Routinization of Sustainable Innovation in Public Sector

(A LEED Analysis)

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Abstract

Innovation can be defined as "*The use of non-trivial change and improvement in a process, product or the system that is novel to the institution developing the change*" (Slaughter1998). And once an innovation is constantly used by an organization on a regular basis, it leads to routinization. Rogers (2003) defines routinization as "*when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity."* We also know from the prior research that the innovation could be segregated as per its technical attributes (process or product Innovation), types of innovation (incremental or radical innovation) or economic attributes (direct or indirect economic innovation).Through this study we are trying to observe whether public sector organizations routinize sustainable innovations that are used in the initial projects, and can a relationship be established between the selected attributes of those innovations including process-product, direct-indirect, radical-incremental innovation that may explain their routinization. The LEED Checklist was used as the baseline for studying routinization in public sector organizations. A group of four public sector organizations namely: Arizona State University, University of Florida, City of Austin and City of Seattle were selected on the basis of the constraints that were identified in the early stages of the study. Upon selecting these organizations the LEED Checklists were analyzed and the routinized credits were segregated. The LEED Checklist we segregated on the basis of the attributes of the innovation. To confirm the accuracy of the sorting process an Inter-Rater Reliability was established with the help of an expert panel. The results determined from the segregation process were made to overlap on the routinized credits from the LEED Checklist and the data retrieved was used for the final analysis. During the process of establishing the final results for this research, we segregated the general credits from the prerequisites to avoid any skewing of the results considering that both types of credits were based on different concepts. The results show that public sector organizations do routinize sustainable innovations that were used in the initial projects, and incremental innovation diffuses faster than the radical innovation; product innovation diffuses faster than process innovation; and direct economic innovation diffuses faster than the indirect economic innovation.

Dedications

I dedicate my life's most important achievement till now to Minal "Thanks for being around always."

I also dedicate this thesis to my family, friends, and my mentors. Thank you all for your constant guidance and support.

Additionally, I dedicate this thesis to all my friends who encouraged me, whenever things seemed impossible.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Introduction

The human population continues to grow and it is estimated by researchers that the population will reach 7 Billion by 2011 (Wikipedia 2008). One of the consequences of rising population is an increase in need of constructing facilities to shelter humans and their possessions for survival, growth, and prosperity, thus resulting in the scarcity of natural resources (Hardin 1968). The effects of these built features on the environment, if taken cumulatively, cannot be denied(Pearce and Vanegas 2002a). It is estimated by the United States Green Building Council (USGBC) that the construction industry globally accounts for 12% use of the potable water, 25% of the wood harvested, 33% of the carbon dioxide emissions, and 40% of the energy use (USGBC 2008). About 38% of the primary energy consumption is related to building operations (USDOE 2001; Scheuer and Keoleian 2002). With these encumbering effects on the ecosystem, sustainability is gaining momentum and will be one of the prime solutions to offset ill-effects of the built environment. Sustainability has been defined as development that can meet the needs of the present generation without limiting the ability of the future generations to meet their own needs (Pearce and Vanegas 2002a, paraphrasing WCED 1987).

USGBC was created in 1993 as a non-profit organization primarily to incorporate the concept of sustainability within the construction industry and to create awareness within the society (Kibert 2002). In 1998, Leadership in Energy and Environmental Design (LEED) 1.0 green building rating system, a pilot program, was released and 12 buildings were certified under this program by the March of 2000. By the year 2006 about 7,600 organizations were members of USGBC (Ahn and Pearce 2007). A similar relation to the field of sustainability can be observed to people who are "Early Adopters" described by Rogers (2003), and the consistent use of sustainable innovations by early adaptors leads to routinization. Rogers (2003) defines routinization as "*when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity*." But in order for an innovation to be routinized, the innovation has to be diffused within the organization. Economic benefits, federal regulations like LEED Certification of public buildings, social awareness, environmental pressure, and changes in technological capability are some of the major reasons that can result in the diffusion of a sustainable innovation, which ultimately results in routinization (Bossink 2004; DuBose et al. 2007 Vanegas & Pearce 2002). LEED has been used as the baseline for this study because it is one of the major measuring tools and common practice to evaluate the sustainability. Also the federal government and some state governments are making LEED certification of buildings mandatory and thereby enhancing the chances for routinization of certain innovations. (Bossink 2004; DuBose et al. 2007, Vanegas& Pearce

2002). In addition, LEED is well established in the construction market in the United States and is widely applied to the public sector buildings. Hence LEED was used as the baseline for this study.

This study shall mostly focus on the public buildings, since the US federal government alone has over 500,000 public facilities in their portfolio (NRC 2004). Also, the federal government has spent approximately $ 40 billion of expenditure on built facilities annually which was about was about 1.5% of total receipts (EOPUS 2008). Also by aiming for the public sector organization there was relative ease to obtain information when needed for this study.

It is imperative to observe how various public organizations have to incorporate technologies that could enhance the capacity of their buildings.
The question to be answered in this research is which of the innovations incorporated by early adopters to develop sustainable buildings get routinized over time, while the public sector organization incorporating these innovations obtains more practical experience for handling such sustainable projects.

1.2 Background

Czepiel (1974), Fichman (1992), Kobel et al. (2003), Roger (2003), Habets et al. (2006), and Atun & Sheridan (2007) defines innovation as "any practice or material artifact perceived to be new to the relevant adopting unit." For the purpose of this study innovation has been defined as "the use of a non-trivial change and improvement in a process, product or system that is novel to the institution developing the change" (Schmookler 1952; Freeman 1997; Slaughter 1998; Slaughter 2000; Sexton & Barrett 2003; Blayse & Manley 2004). Innovations could be further categorized on the basis of technical attributes, economic attributes, and types.

Technical Attributes:

These attributes are related to products or processes for the built system and can be divided into two parts: product innovation and process innovation (Arditi 1997; Cagan et al. 2003; Koebel et al. 2003; Abbott et al. 2006). Product innovations could be defined in the form of product design, material usage and how products are manufactured (Orlikowski 1991; Arditi 1997). As per the definition of product innovation, one example could be the installation of photovoltaic solar panels for the generation of renewable energy for a building. On the other hand, process innovation could be defined as an idea that can change the way things have been done previously and resulting in change in the production, manufacturing and implementation of the material (Orlikowski 1991; Arditi 1997; Cagan et al. 2003; Abbott et al. 2006). Process innovation could also mean a change in behavior on the part of the owner, occupants, or in-house maintenance staff to adapt to different operating conditions than are otherwise preferred or default. An

example of this type of innovation is establishing a rule of No-Smoking within the built facility. By doing so, the owner has to ensure that no one within the built facility smokes and also requires a behavioral change from the occupants of the built facility.

Economic attributes:

Economic attributes at times can be a determining factor for the routinization of innovation, as they affect who will bear the cost for the innovation and who will enjoy the benefits (Pearce 2008). These attributes can be divided into two parts: direct economic innovation and indirect economic innovation. Direct economic innovation may be defined as the innovations that shall affect the economics of the owner directly and to further determine the future of profit and losses that shall directly pertain to the owner (Cagan et al. 2003). The benefits obtained by the incorporation of these innovations are enjoyed by the owner directly. These are measurable savings which might occur on some projects for the owner, but not on all projects or improved productivity, but not typically captured as a facility-related cash flow. One example for direct economic innovation could be the use of geothermal energy for air-conditioning of built space. The initial investment can be high and is usually paid by the owners. However, there are fiscal benefits of including the reduced life cycle cost, energy savings, and reduced extra costs for maintenance of the air-conditioning systems, thus repaying the owner's initial investments through life cycle cost savings.

Indirect economic benefits, on the other hand, can be defined as the benefits that are intangible and the benefits that cannot be easily quantified monetarily (Wolff 2006). One example for the indirect economic innovation could be the use of a brownfield as a site for development. Brownfield are defined by EPA as sites containing real or perceived contamination from activities occurring on or near the site. The example for this would be a site that was earlier used as a gas station. The benefits of using these sites are generally observed predominately not for the owner, but for the society as a whole as it results in the reduction of brownfields within the area. Cagan et al. (2003) have also demonstrated that direct economic innovations at times can be a major determinant for the routinization of a sustainable innovation within public sector organizations.

Types in innovation:

This category divides the innovation into its system components. Slaughter (1998) defines incremental innovation as a "small change based on the existing knowledge." She further divides the term innovation into:

- Radical innovation (a breakthrough in the science and technology that replaces the construction technologies previously practiced with new systems, a result of which previously used materials and processes seem to become obsolete. These innovations require a specialist for their installation)
- Modular innovation (a change in the concept within the component)
- Architectural innovation (a change in link to other component or system)
- System innovation (a multiple, integrated innovation)

The main focus of this study shall be around the two extreme types of innovations: radical and incremental innovations. One example for the radical innovation as per the definition could be the use of green roof because it represents the breakthrough in the roofing technology and at the same time these innovations require a specialist in order for the innovations to be installed. Once they are used on a regular basis, they would make the existing systems obsolete. In contrast, the example for incremental innovation could be use of alternative pavements for non-roof surfaces. It has been demonstrated that the incremental innovation diffuses faster than the radical innovation and is also used more than the latter (Orlikowski 1991; Male and Stocks 1991).

These innovations have been classified on the basis of the effects they have on the individual or the organization.

The main aim of this study is to observe the routinization of multiple innovations across projects of multi-public-project owners and then evaluate the attributes and types of the routinized innovations. Howard and Moore (1998) define diffusion as "the spread of the innovation throughout the social system." Considerable research has also been done on the diffusion as shown in Figure 1 to understand the process of diffusion over a period of time and the effects of variables like advertisement and competition over the process of diffusion of an innovation.

Rogers (2003) also defines organization as "*the system of individuals who work together to achieve common goals through a hierarchy of ranks and divisions of labor*." One major reason that the diffusion of innovation in an organization is different than the diffusion within population of individuals is that the organization is comprised of individuals varying from high level of innovation to low level (Rogers 2003). The different levels of diffusion of innovation among the population of individuals within the organization make the process of diffusion of sustainable innovations difficult. Some of the major reasons for the initiation of diffusion within the organization are mainly due to performance gap, market demands, operating efficiency and cost, and response to technological opportunities that have been found to simulate the innovation (Cagan et al. 2003; Taylor and Levitt 2005).There are various phases within the organization that an innovation has to pass in order to be adopted successfully. Different researchers have

given different names to these stages within the organization. For instance, according to Cagan et al. (2003) there are four stages: Evaluation, Initiation, Implementation and Routinization. On the other hand, Rogers (2003) has associated five stages with the diffusion of innovation in an organization: Agenda setting, Matching, Redefining or Restructuring, Clarifying, and Routinization.

Table 1: The table shows the studies done by various researches regarding the diffusion.

Researcher	Brief summary
(Bulte 2000)	The researcher has demonstrated with the help of a model that the time taken to diffuse an innovation within the society has reduced over the decades. He also states the diffusion is also related to the social structure, geographic location of the diffusion and the economic growth of the area.
(Everdingen et al. 2005)	The researcher generated diffusion model in the early diffusion process with the introduction of the co-variants including social systems, advertisements, economy and time line in which innovation takes place and tried to observe the effects.
(Mahajan and Muller 1979)	The paper is about the diffusion models in the marketing industry. The researcher explains the various subsets for the study of the diffusion models which are early adopters, potential adopters and untapped individuals. Further, the researcher points out the reasons for the shift of individuals from one subset to another, some of which coincide with the reasons which encourage the diffusion of an innovation according to Rogers.
(Fourt & Woodlock 1960)	The researcher generates a diffusion model that depicts the process of diffusion in terms of number of customers that have bought a product over a period of time.

At certain instances, Rogers (2003) has named routinization as institutionalization and according to him, it is defined as the "*when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity*." It also marks the end of the innovation process and from here the innovation is regularly used (Rogers 2003). Not much research has been done in the area of routinization, thus the main study shall be focused on exploring routinization of sustainable innovations within the public sector organizations. Figure 1 also explains the scope of the study for this research.

1.3 Thesis Question

Do public sector organizations routinize sustainable innovations that are used in the initial projects, and can a relationship be established between the selected attributes of those innovations including process-product, direct-indirect, and radical-incremental innovation that may explain their routinization?

1.4 Hypotheses

This part of the chapter deals with the hypotheses that were used to establish the research. We would try to test these hypotheses at the end of the research. Please find the hypotheses mentioned below:

We can start our hypothesis with the basic assumption that if a public sector organization decides to use sustainable innovation over a number of projects, there are high chances that the innovation be routinized. Further we can also hypothesize that:

First, based on the findings of Orlikowski (1991), we hypothesize that there will be fewer radical innovations routinized in comparison to the incremental innovations.

Second, we would also hypothesize that the product based innovations would routinize faster than the process based innovations.

Third, based on the concepts of Wolff (2006) and Cagan et al (2003), we hypothesize that there would be more direct economic innovations routinized than the indirect economic innovation.

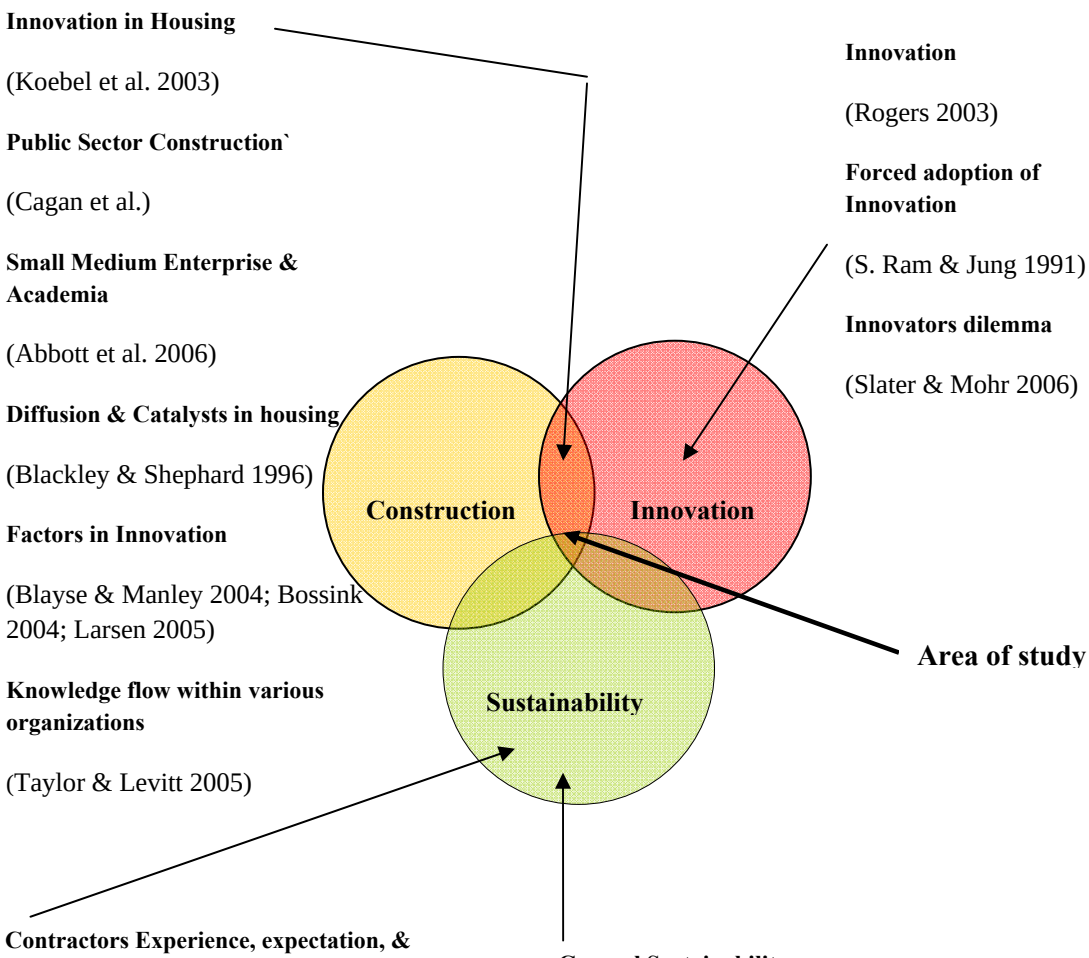

Figure 1: Area of Study.

Chapter 2: Methodology

The chapter establishes the procedural methods to formulate the analysis that could help the researcher to arrive to the appropriate results. The Figure 2 is a process map representing the order of activities across the time line of the research project. The chapter is mainly divided into six categories which are as follows:

1. Defining and establishing constructs.
2. Selection and short listing of samples.
3. Determination of routinization.
4. Segregation of LEED.
5. Combination of routinization of credits with LEED segregation.
6. Results.

(IRR: Inter-rater Reliability)

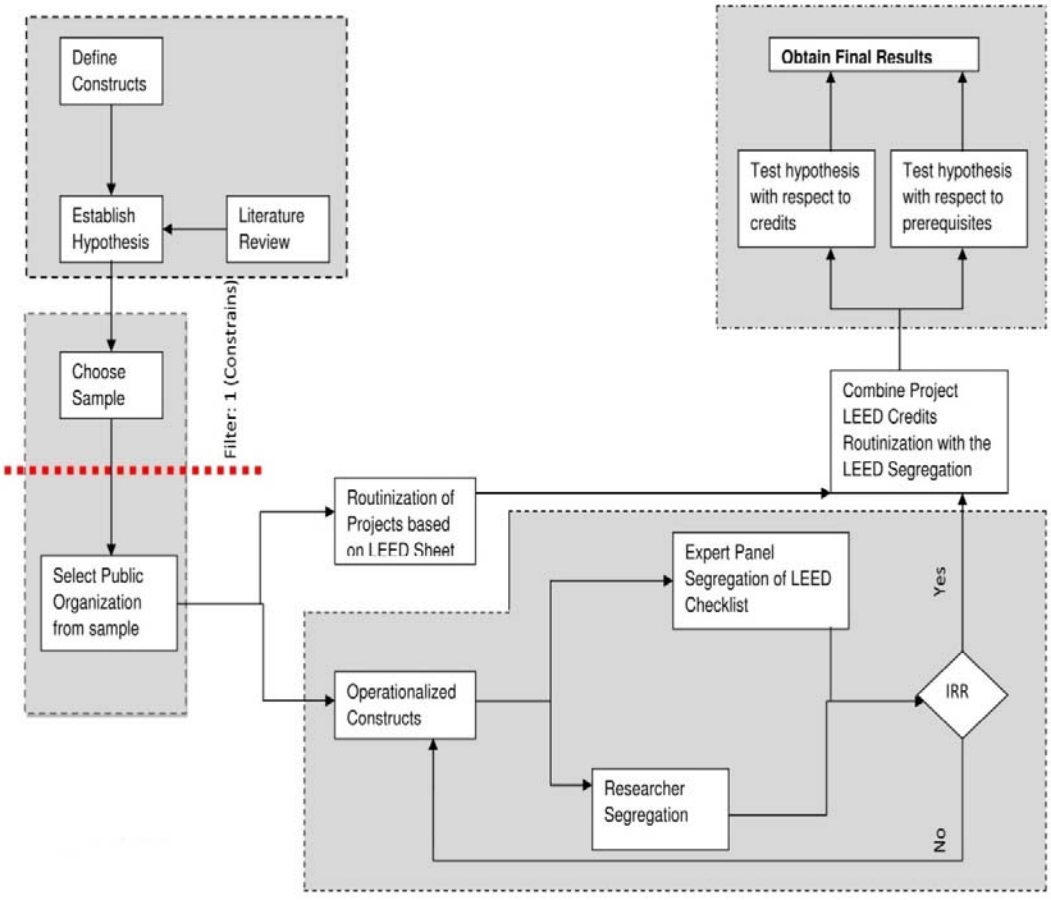

Figure 2: Flow chart for the methodology.

2.1 Defining and establishing constructs

This part of the study is comprised of defining the constructs and then establishing those constructs with the help of literature review. This section formulated the first part of the methodology.

Define constructs:

In this section we define the constructs that formed the base for the research. These constructs were mainly focused on the routinization process which led to the thesis question. This study shall establish the criteria for the specific user base on whose perspective the researcher based the findings; it also suggests the possible stakeholders who would be affected by the sustainable innovations incorporated within the built facility.

Establishing Constructs:

In this section, the literature review is applied to establish the hypotheses for the research. We have observed that routinization of sustainable innovation within the public sector had not been studied until the beginning of this study and so primarily our base hypotheses is; if a public sector organization decides to use sustainable innovation over a number of projects, there are chances that the innovation gets routinized. The other three hypotheses are then defined as mentioned in the previous chapter. After establishing these constructs we tried to find a sample that is suitable as per constraints. The sample shall be discussed in detail in the section below.

2.2 Choosing and short listing of sample

Once the constructs are established and once the hypotheses are defined, our next major step was to find a sample that met our constraints. We divided this process of selection into two steps.

Choosing of sample:

The first stage was to find and review relevant organizations that have executed LEED certified projects. On gathering relevant data on the list of organizations that have worked on LEED certified projects, only public sector organizations are sorted separately as a group for study in the research. They are further filtered as per the criteria that for "*number of projects*" that the organization has handled, the list shall be such that the organization has handled at least four LEED certified projects. All public sector organizations with fewer than four projects were not considered eligible for this study. The group, thus shortlisted, was promoted to the second stage.

Criteria for selection:

The second stage of the selection process was based on the few sets of constraints that were put on the pool of projects handled by each organization as mentioned below:

- Similar geographic location.
- Availability of information in form of LEED Checklists
- Similar climate

The public sector organizations that fulfilled all of the above mentioned criteria were shortlisted for this research study. However, not all the organizations that were finally shortlisted were used for this study. We had intended to limit the scope of study based on a selection of four public sector organizations. For this purpose, we selected the public sector organizations that had experience handling most types of LEED certified construction projects. Thus, we had a set of four organizations which were studied for the routinization of the credits within each organization.

2.3 Determination of routinization

Rogers (2003) defines routinization as follows "*when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity.*" This would also mark the end of the innovation process and from here onwards the innovation would be regularly used (Rogers 2003). In other words, we could also say that the innovation was routinized when the organization started to use the innovation on a consistent basis. The major challenge for the research, during the process of routinization, was the constraint that the innovations were observed within the construction industry. The reason for this is that every project is distinct; and at times it would be difficult for the organization to adopt a particular innovation consistently for all the projects consecutively. The best example that explains this phenomenon is if we consider that an organization has initiated routinization of I*EQ Credit 8.2: (Views for 90% of the spaces)*, after successful routinization for a wide arena of projects. When the next project handled by the organization is either a museum or a theatre, where it happens that as per design guidelines for a theatre it is optimum to restrict use of lighting views as far as possible, then this innovation would not be relevant, meaning the owner would not need to apply or achieve this credit at all and thus the particular innovation for that project won't routinize, meaning while calculating the routinized projects for an organization the typology of the structure was to be a major guiding factor. For this study we tried to keep the limit of 75%, implying that any innovation consistently used on over 75% of the projects within an organization shall be considered as routinized. An observed break through the process of routinization was considered independent along the timeline axis. This shall be elaborately explained in Chapter 3 on Analysis. Thus, it is implied from the above study that an innovation can be discontinued at any point in time if its application is not considered beneficial for the particular project and later the innovation can be readopted for the successive projects. The innovation can be considered as routinized if

75% or more of the projects within a particular organization have incorporated the innovation successfully.

2.4 Segregation of LEED

This part of the chapter deals with the LEED Checklist segregated into innovation based on economic attributes, technical attributes and types of innovation. This was an important segment of the study. This phase of research was categorized into four phases which are as follows:

Operationalization of constructs

- Researcher segregation
- Expert segregation
- Inter-Rater Reliability

Operationalization of constructs:

This part was the first phase in this course that led to the segregation of the LEED Credits. In this case, the researcher operationalized the constructs that set apart the innovations based on economic attributes (direct and indirect economic innovation), technical attributes (product innovation and process innovation) and types of innovation (incremental innovation and radical innovation).

Researcher segregation:

Once the constructs were operationalized, then the researcher segregated the LEED Checklist based on the previous operationalization.

Expert segregation:

Once the constructs were operationalized and the researcher segregated the LEED Checklist, the researcher simultaneously sent these constructs to the expert panel. The panel also started the segregation process based on the constructs provided to them.

Inter-Rater Reliability (IRR):

Once the experts had finished the segregation process individually, they sent their version of the segregated LEED Checklist to the researcher. After obtaining the LEED Checklist from the expert panel, the researcher compared it with his version to evaluate Inter-Rater Reliability. At places where the Inter-Rater Reliability did not match, the experts and researcher iterated and discussed until all parties agreed on a common point, thus achieving complete convergence of segregation. These discussions lead to a few specific changes in the operationalization of constructs. Once 100% convergence was achieved these

results were retained as separate for the next stage where the routinized credits as per the organizations would be matched with these results.

2.5 Combination of routinization of credits with LEED segregation

Once the Inter-Rater Reliability of LEED Checklist was established, based on economic attributes (direct and indirect economic innovation), technical attributes (product innovation and process innovation) and types of innovation (incremental innovation and radical innovation), the results were matched with the credits that were routinized for each of the organization that were in turn shortlisted for this study. In short, this step was a combination of the results derived from the steps 2.3 and 2.4.

2.6 Results

This section formed the last part of the chapter. In this part we analyzed the final results to ascertain if they really supported our hypotheses that we had established in step 2.2. In this step, however, we tried to segregate the routinized prerequisites from the routinized credits. We determined that it was better for this study to research credits and prerequisites separately as they were representing different concepts. The prerequisites are mandatory for the owner to achieve the LEED certification of the project and must be fulfilled irrespective of whether the client wants it or not. On the other hand, the general credits are where the owner was free to decide if he would want to attempt the credits as per his needs. Thus, the results for routinization could not be accurate if we had integrated the prerequisites along with the general credits. Thus the results were segregated into three parts which are:

Test results for credits
Test results for prerequisites
Final results

Test results for credits:

As discussed earlier we had segregated the general credits from the prerequisites and so for this section we would discuss the results for the general credits. All the results from the combinations of routinization of credits with LEED segregation from each organization were added to form a total which were used to test our hypotheses. Once each hypothesis had been established, the next step was to look into each organization to observe if the results that were generated from the grand total shall be maintained or have changed for each of the individual organizations. If so, then we tried to ascertain the reasons for this shift in result.

Test results for prerequisite:

As discussed earlier we had segregated the credits from the prerequisites and so for this section we would discuss the results for the prerequisites. All the results from the combinations of routinization of prerequisites with LEED segregation from each organization were added to from a total which were used to test our hypotheses. Once each hypothesis had been established, the next step was to look into each organization to observe if the results that were generated from the grand total shall be maintained or have changed for each of the individual organizations and if so, then we tried to ascertain the reasons for this shift in result.

Final results:

After we had achieved the results for both the prerequisites and the general credits, we tried to observe if there was a major shift in the overall results as compared to each other. If there was a shift in the results, then we tried to explain these shifts with the help of relevant reasoning.

Chapter 3: Analysis

This chapter shall discuss the methods that we were able to implement from the chapter on methodology in order to achieve results and confirm our hypotheses. In this chapter we shall explain the results on the basis of one part of the sample that has been regularly used to show how we have formulated the final results as an illustration. Detailed information on evaluation of all the samples shall be elaborated on in the appendices. As mentioned in the previous chapter, we have segregated this chapter into five categories. A sixth category consisting of results shall be discussed in the next Chapter four. The five categories are as follows:

1. Defining and establishing constructs.
2. Selection and short listing of sample.
3. Determination of routinization.
4. Segregation of LEED.
5. Combination of routinization of credits with LEED segregation.

3.1 Defining and establishing constructs

This part of the study is comprised of defining the constructs and then establishing those constructs with the help of literature review. This section formulated the first part of the methodology.

Define constructs:

Rogers (2003) defines organization as "*the system of individuals who work together to achieve common goals through a hierarchy of ranks and divisions of labor*." And he further defines routinization as "*when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity*". So we can propose that when an organization starts to use an innovation on regular basis, then we assume the innovation to be routinized. In this case we are considering the public sector organizations as the base line of organization and the study is from the owner's perspective. The stakeholders that we expect to be affected are occupants so we are considering their perspective as well for the purpose of this study. The researcher had also considered including the housekeeping staff as an affected stakeholder, but later this factor was ignored considering the potential for clashes with the perspective of the owner. This decision will be elaborately discussed in the next chapter. The stakeholders not considered within the scope of this study are: architects, consultants, suppliers, general contractor, and subcontractors.

Establishing Constructs:

In this section, with the help of the literature review we were able to establish our hypotheses. With the help of literature review we were able to deduce that research on routinization with respect to the construction industry and sustainability had not been done earlier. We also came up with some hypotheses that had been proven for construction industry but neither in the context of public sector organizations of the Unites States nor in the context of sustainability. These hypotheses became the baseline for this study, and in the last section the researcher tried to evaluate the final results based on these hypotheses. We can start our hypothesis with the basic assumption that if a public sector organization decides to use sustainable innovation over a number of projects, there is a high possibility that the innovation will be routinized. We hypothesize that:

First, based on the findings of Orlikowski (1991), we hypothesize that there will be fewer radical innovations routinized in comparison to the incremental innovations.

Second, we hypothesize that the product based innovations would routinize faster than the process based innovations.

Third, based on the concepts of Wolff (2006) and Cagan et al (2003), we hypothesize that there would be more direct economic innovations routinized than the indirect economic innovations.

3.2 Choosing and short listing of sample

Once we had established our constructs and clearly stated our hypotheses our next major step was to find a sample that met our constraints. We divided this process of selection into two steps:

Choosing a sample

Selection Criteria

Choosing a sample:

This section dealt with an introduction to the selection process for the public sector organizations and the basis of their selection to establish conclusions on the proposed hypotheses for the research as per technical attributes of innovation (process and product innovation), economic attributes (direct and indirect innovation) and types of innovation (incremental and radical innovation).

Initially Table 2 depicts the potential pool of the organizations that had been short listed from the total organizations that have been LEED certified. A minimum criterion of four LEED certified projects for each public organization had been set for the selection of the organizations in Table 2.

Table 2: List of public sector organizations that cleared the first criteria of having more than four LEED Certified Projects

Name of the Organizations that have more than four Projects	Total Number of Projects done till 2008	Number of projects that do not have information in terms of LEED Checklist.
Arizona State University	7	2
University of California	5	1
City of Los Angeles	4	1
The University Of Florida	9	2
Georgia Department of Natural Resources	6	0
City of Chicago	4	1
Chicago Public Library	4	1
City of Austin	7	0
City of Dallas	4	0
University of Vermont	4	1
City of Seattle	8	0
US Navy	4	0
US General Service Admin, GSA	6	0

Selection Criteria:

Once we had the pool of public sector organizations that had an experience of at least four projects, we then applied the following constraints:

- Same geographic location of all projects.
- Same climatic zone of all projects.
- Availability of information, especially in terms of LEED Checklist.

When we are talking about the availability of information in form of LEED Checklist, it is implied that we should be able to get these checklists.

Table 3 shows how the analysis was conducted and the organizations were selected. The literature used to study these projects was in the form of LEED Checklists, reports, and web pages regarding the project and the information about the green features incorporated in the built facilities.

Table 3: Pool of public sector organizations that has more than 4 LEED certified projects

Name of Organization	**Same geographic location**	**Availability of LEED Checklist**	**Same climate.**
Arizona State University	√	√	√
University of California	—	√	√
City of Los Angeles	—	√	—
The University Of Florida	√	√	√
Georgia Department of Natural Resources	—	√	—
City of Chicago	√	√	√
Chicago Public Library	√	√	√
City of Austin	√	√	√
City of Dallas	√	√	√
University of Vermont	√	√	√
City of Seattle	√	√	√
US Navy	—	√	—
US General Service Admin, GSA	—	√	—

In Table 3 we also observe that from the pool of public organizations that we obtained from the previous segment, only eight public sector organizations met all our criteria. Out of these eight organizations, four organizations were selected based on the maximum number of projects handled by each organization. The organizations selected for study were as follows:

1. Arizona State University, Arizona.
2. University of Florida, Florida.
3. City of Austin, Texas.
4. City of Seattle, Washington.

Arizona State University:

This organization is a state university. Only four projects under Arizona State University (ASU) have achieved LEED certification by May 2008. All the projects are located in Tempe, Arizona and satisfied the selection criteria mentioned above. Table 4a explains the location, type, size and cost of each of the projects. The project summary about each of the projects is provided in Appendix II.

Table 4a: Information about each of the projects in Arizona State University

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Interdisciplinary Science & Technology Building 2	Research Facility	66,000	$13.8 million
The Bio-design Institute, Building A	Research Facility	172,000	$72 million
Arizona Bio-design Institute, Phase 2	Research Facility	175,000	$72 million
ASU Fulton Centre	College of liberal arts & science administration.	140,000	NA

(NA: Not Available)

University of Florida:

This organization is a state university within the state of Florida and had seven projects which met the selection criteria and all the projects are located in Gainesville, Florida. Table 4b explains the location, type, size and cost of each of the projects. The project summary about each of the projects is provided in Appendix II.

Table 4b: Information about each of the projects in University of Florida

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Rinker Hall	Multi use building, class rooms, laboratory, offices, & other amenities.	47,300	$6.5 million
McGuire Centre for Lepidoptera and Biodiversity	Museum of natural history	58,000	$8.4 million
Mary Ann Coffrin - Harn Pavilion	Museum of Art	19,240	$5.36 million
Powell Structures Lab	Research laboratories & offices	8,565	$2.6 million
UF & Shands Orthopedics and Sports Medicine Institute	Medical institute & medical Centre	132,663	$26.5 million
Veterinary Medicine Food Animal Facility	College of veterinary medicine	9,997	$2.6 million
Library West Additions & Renovations	Library building	176,700	$24.2 million

(NA: Not Available)

City of Austin:

The local government at the City of Austin, Texas, had seven LEED certified projects that met the selection criteria and all the projects are located in Austin, Texas. Table 4c explains the location, type, size and cost of each of the projects. The detailed information about each of the projects is provided in Appendix II.

Table 4c: Information about each of the projects in City of Austin, Texas

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Combined Transportation Emergency & Communications Centre	Public safety facility	79,776	$29 million
Far Southeast Austin EMS Station # 28	Emergency medical service facility	5, 300	NA
George Washington Carver Museum & Cultural Centre	Museum of art, history, photography, music and politics.	27,000	NA
George Washington Carver Branch Library	Library building	12,000	$0.8 million
Austin City Hall and Public Plaza	Multi use (city council office, council chambers, café, city sore)	118,000	56 million
Circle C EMS and Fire Station	Public Order & Safety	15,000	NA
Austin Resource Centre	Local government building	26,800	$5 million

(NA: Not Available)

City of Seattle:

The local government at the City of Seattle, Washington, had eight LEED certified projects that met the selection criteria and all the projects are located in Seattle, WA. Table 4d explains the location, type, size and cost of each of the projects. The project summary about each of the projects is provided in Appendix II.

Table 4d: Information about each of the projects in City of Seattle, Washington

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Carkeek Park Environmental Learning Centre	Space for environmental education, and for gathering and meeting space	NA	NA
Fisher Pavilion	Urban Oark and exhibition hall	21000	$9.5 million
City of Seattle Justice Centre	Municipal/Government building	288,000	$91.35 million
High Point Community Centre Addition	Community Centre	added 10000 to existing 9600	$3.7 million
Park 90/5 Building C	Office space for police department	182,000	$30 million
Seattle Central Library,	Library building	412,000	$111.9 million
Seattle City Hall	Municipal building	198,000	$72 million
Yesler Community Centre	Community Centre	20,000	NA

(NA: Not Available)

3.3 Determination of routinization.

Rogers (2003) defines routinization as follows "*when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity*." However for this study as explained in the previous chapter 2.3 we have tried to keep the limit of 75%, implying that any innovation that is used by more than 75% of the projects within an organization shall be considered as routinized. If any breaks are observed throughout the process of routinization, they shall be considered independent across the axis of the timeline. It can be implied from above that any innovation can be discontinued at any point of time if it is not beneficial for the particular project, and then reused for the successive projects. The innovation can be considered routinized if 75% or more of the projects within a particular organization incorporate that innovation. The best example for this could be explained from the Table 5 and Figure 3. Table 5 is a matrix representation of LEED Credits for the Sustainable Site category, along with the LEED certified projects executed by Arizona State University (ASU). We observe that *SS Prerequisite 1 and Credits 1, 4.1, 4.2, 6.1, 7.1, and 7.2* were routinized on a regular basis and *Credits 2, 4.4, 5.1, 6.2,* and 8 were routinized for more than 75% of the projects. Both types of credits are hashed in a different manner, but for the purpose of this study and to find the final results considered, all the credits mentioned above are routinized. In Figure 3 we can observe from the graph that any credit that is below the level in which Routinization occurs in an organization is not considered as routinized and is marked with grey color scheme to differentiate in the respective figure. The credits at or above the level in which Routinization occurs are considered routinized and are represented with orange color scheme. This level shall be a representation that 75% of the total projects are executed by an organization incorporating the particular innovation. For this case we are observing four LEED certified projects done by ASU, any three of which make up 75%. So any credit that has been adopted in more than three projects would be considered as routinized. The process of routinization for every organization has been discussed in the Appendix III with the help of matrixes and graphs. Thus, by the end of this stage we would be able to observe for each organization as to which of the credits have been routinized on a consistent basis and which have not been routinized. For our final results we have identified the routinized credits separately. We have also tried to keep the prerequisites distinct from the general credits because for the owner it is mandatory to achieve the prerequisites if he wants his project to be considered for the LEED certification. However, for other credits it is at the convenience of the owner and the main focus of the study to observe the general credits that the owner would achieve routinization on a consistent basis. When we are conducting the final result we would keep the prerequisites and credits separately to test our hypotheses that product innovation diffuses more than process innovation, incremental innovation diffuses more than radical innovation, and that direct economic innovation shall diffuse more than the indirect economic innovation.

ARIZONA STATE UNIVERSITY

Table 5: Routinization in Arizona State University (ASU)

Site Selection

	Interdisciplinary Science & Technology Building 2	The Bio-design Institute, Building A	Arizona Bio-design Institute, Phase 2	ASU Fulton Centre
Year of Certification	7/26/2006	6/19/2007	7/31/2007	7/11/2007
Project Number	# 2707	# 10020369	# 10001306	# 10000932
Points Achieved	10	12	12	8
Name of the Credit.				
Erosion & Sedimentation Control	✓	✓	✓	✓
Site Selection	✓	✓	✓	✓
Urban Redevelopment Density	○	✓	✓	✓
Brownfield Redevelopment	○	○	○	○
Alternative Transportation	✓	✓	✓	✓
Alternative Transportation	✓	✓	✓	✓
Alternative Transportation	○	○	○	✓
Alternative Transportation	✓	✓	✓	○
Reduced Site Disturbance	✓	✓	✓	○
Reduced Site Disturbance	○	✓	✓	○
Storm water Management	✓	✓	✓	✓
Storm water Management	✓	✓	✓	○
Reduce Heat Islands	✓	✓	✓	✓
Reduce Heat Islands	✓	✓	✓	✓
Light Pollution Reduction	✓	✓	✓	○

Platinum		Routinized 100%		
Gold		Routinized up to 75%		
Silver				
Certified				

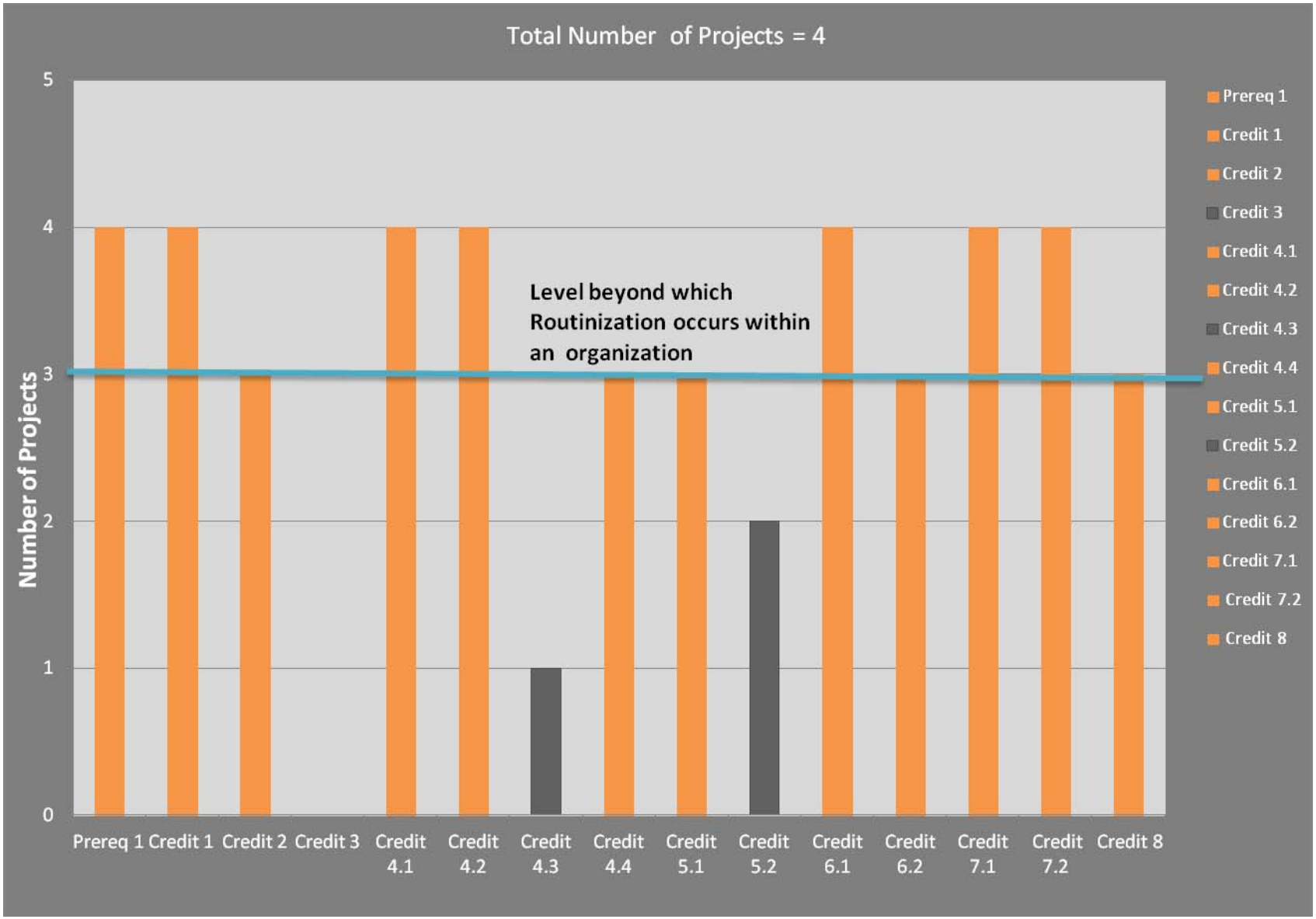

Figure 3: Graph representing routinization of Sustainable Sites LEED Credits within the Arizona State University

3.4 Segregation of LEED Checklist.

This part of the chapter deals with the LEED Checklist segregation into economic attributes, technical attributes, and types of innovation. This was one of the important segments for the study. This phase of research was categorized into four phases which are as follows:

Operationalization of Constructs
Researcher Segregation
Expert Segregation
Inter-Rater Reliability

Operationalization of Constructs:

The following descriptions attempt to describe the criteria for sorting LEED credits according to the three constructs, which are described as technical attributes of innovation, economic attributes of innovation, and types of innovation. At the end of the each section there are notes that attempt to describe in more detail about any clarification, exceptions, or other information that could be considered relevant to the procedure. The sorting of LEED credits, even with the available detailed criteria, would be difficult due to the performance-based nature of many of the credit requirements. In other words, there are multiple ways an owner could meet the credit requirements, some of which are more extreme compared to the others, and most of which are determined to some extent by context. Ideally, we would have sorted based on the actual *strategies and technologies* used on each project, but not enough detailed information was available for all projects to permit this sort. For credits that had multiple compliance paths, professional judgment was used to make a distinction, and these reasons are captured in the annotations in the spreadsheet that represents all the relevant data. Ideally, the researcher would go back and assign a confidence level to each of the classifications in order to identify which ones were “arguable” vs. those that are more certain. In addition we have operationalized the constructs in the later stage of this chapter which has helped us during formalizing of the definitions and sorting the LEED credits.

Technical Attributes of Innovation:

Following are some of the thoughts that were considered before the constructs were finalized:

- Can this credit be implemented by substituting one product, service, or process for another without disrupting the design, selection, or operation of other systems?
- Is a domain specialist or specialty subcontractor required to achieve this credit, either during design, construction, or on an ongoing basis?

Incremental Innovation	**Radical Innovation**
▪ The innovation can be implemented by choosing a different type of the same system, OR ▪ The innovation can be implemented without having to adjust the design of other building systems AND ▪ The innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor.	▪ The innovation requires the use of a completely different type of system that is not currently used on this owner's buildings, OR ▪ The innovation requires the design of other systems to be adjusted to accommodate it, OR ▪ The innovation requires a domain knowledge specialist or specialty subcontractor to install or maintain.

Notes: Most prerequisites are classified as incremental since they are assumed to be achievable on all projects with minimal effort or there are already existing standards that they need to follow e.g. *SS Prerequisite 1: Construction Activity Pollution Prevention,* requires the owner to conform the standards of 2003 EPA (Environmental Protection Agency) Construction General Permit or local erosion or sedimentation control standards and codes. However, again there are certain exceptions like *EA Prerequisite 1: Fundamental Commissioning of the Building Energy System* under the Energy and Atmosphere Category, in which the owner is required to appoint a commissioning agent who is a specialist, and thus the innovation would be a radical innovation.

Type of Innovation:

Following are some of the thoughts that were considered before the constructs were finalized:

- Does achieving this credit require the owner to change expectations or building functionality during the design or change behavior during occupancy?
- Does achieving this credit require the owner to adapt to a different set of operating conditions or functionalities in the facility?

Product Innovation	Process Innovation
▪ The innovation is a purchased technology or service that the owner pays for but doesn't need to change behavior to reap benefits at the end.	▪ The innovation requires behavioral changes or change in expectations on the part of the owner, or occupants, when initially implementing the rating system OR ▪ The innovation requires the owner to adapt to different operating conditions than are otherwise preferred or default.

Notes: All LEED credits require someone to change their behavior or process. In this case, we are focused only on the owner's perspective, so as long as the owner's process or expectations don't change, we have classified the credit as a product innovation. The change in behavior could be defined as the change that the owner and the occupants have to inculcate within themselves in comparison to the existing set of behavior that they would have had otherwise in a contemporary building. For instance, *SS Prerequisite 1: Construction Activity Pollution Prevention* requires contractors to change the way in which they interact with the site. If we were considering the contractor's perspective, we might classify this credit as a process innovation. However, from the perspective of the owner, there is no change in behavior required; therefore, this credit was classified as a product innovation in this analysis.

The researcher and experts had also discussed at length about the inclusion of the maintenance staff perspective along with the owner and occupants, but found out that there were instances where the perspective of the owner and occupant clashed with the maintenance staff's perspective. One of the examples of this clash is *EA Credit 2.1, 2.2, 2.3: On–site Renewable Energy.* If we consider this credit from the owner or occupant's perspective, then this credit is a product innovation because this credit requires the owner to install renewable energy producing equipment that meet the requirements of the credit. However, if we consider this credit from the maintenance staff's perspective then it's a process innovation because the innovation requires behavioral changes or change in expectations on the part of maintenance staff. We also found that in some of the organizations the maintenance responsibility at times was contracted out, rather than having in-house staff. So for the clarity of this study and to avoid the clashes of perspective, we decided to keep the housekeeping out. We considered them as a non-affected stakeholder like an architect but not like the stakeholders that would have been affected by the product or process innovation from the standpoint of the owner or occupants.

Economic Attributes of an Innovation:

Following thoughts were considered at lengths before the constructs were finalized:

- Is there a positive change in owner's cash flow at some point during the innovation's life cycle for most or all projects, regardless of context?

Direct Economic Innovation (i.e., benefits owner's $)	**Indirect Economic Innovation** (i.e., benefits society)
▪ A positive cash flow or measurable savings for the owner will occur at some point during the service life of the innovation for most or all projects, regardless of context.	▪ Positive cash flow or measurable savings *might* occur on some projects for the owner, but not on all projects; context is critical. OR ▪ No positive cash flow.

Notes: In order for an innovation to be classified as a direct economic innovation, Net Present Value (NPV) doesn't need to be positive for an innovation as long as there is at least one instance of positive cash flow likely to occur. In other words, we did not require innovations to be likely to have a service life longer than their payback period in order to classify a LEED credit as being a direct economic innovation. This decision was made due to the uncertainty of market conditions that can significantly affect pricing over long periods of time.

For some LEED credits the innovation used may or may not offer direct economic innovation to an owner depending on the specific attributes of the project. For instance, this determination would have to be made independently for each project for credits associated with site selection such as *SS Credits 1: Site Selection,* and *SS Credit 2: Urban Redevelopment Density*. If a credit was project-specific then direct benefit may have occurred on some but not all projects. It was classified as an indirect economic benefit in recognition that on some projects, the benefits would *only* be societal. A similar logic can be applied to *SS Credit 3: Brownfield Redevelopment,* where the owner is expected to use a Brownfield Site. There are incentives in some and not all states, and since public sector owners don't benefit from tax incentives, this credit offers only indirect economic benefit to the owner. On contrary if we observe *SS Credit 5.1: Site Development- Protect or Restore Habitat,* where the owner is expected to conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity, we can observe it is a direct economic benefit because the process of planting native species can reduce ongoing landscape maintenance costs compared to conventional landscaping. Minimizing site disturbance can also increase

property values due to mature landscape. And since these benefits are measurable savings for the owner that will occur at the various stages of the project, the benefits from the credit causes direct economic innovation.

Following is another set of assumptions that we considered before segregation process began and these assumptions could help our judgment while the segregation of LEED Checklist was in process. These assumptions were mostly aimed towards the realms of knowledge that the owner would have before he started the sustainable projects. The assumptions considered for this study were as follows:

- The owner already has certain experience in the construction of contemporary buildings, but none with green buildings under the LEED rating system. The selected groups of buildings from each of the organization are the first few projects where the owner would interact directly with the technologies and practices identified by the U.S. Green Building Council.

- The owner is well aware of the basic standards set by the EPA (Environmental Protection Agency), ASHRAE (American Society of Heating, Refrigeration, and Air-Conditioning Engineers), and local municipal codes for contemporary buildings.

- The owner would not self-perform the construction process. He would hire general contractors to carry out the task, but for this study we assume that the outcome would be equivalent to the owner installing it himself.

- There are certain credits in the LEED Checklist where, if the owner decides to pursue the credit during the conceptual stage, he has nothing to do but pay for any cost associated with it. Some of the credits that could be identified in this category are EA *Credit 7: Green Power* and *SS Credit 5.1: Reduced Site Disturbance- Protect or Restore Open Space*. The general contractor or the provider of the services could see these credits as process innovation, but from the owner's perspective, which is the main aim of this study, the innovation is a product innovation. We have used the term "*Buy Me Credit*" from the owner's perspective. So whenever an owner decides to pursue a credit and has nothing to do, except deciding in the conceptual stage of the project about the inclusion of the credit and then paying all the expenses related to achieving the credit, we will classify that credit as a product innovation and denote it as a *Buy Me Credit.*

- There are certain credits in the LEED Checklist (for example the credit *EA 1: Optimizing Energy Performance*) which have many ways to achieve the credit involving building systems. Establishing a basis for whether the credit is achieved requires the construction of a model, which is of sufficient complexity to require the use of a specialist. When an owner decides to employ a specialist to

generate a respective model, then we will classify the innovation from the owner's perspective as a process innovation because it may change the expectation of the owner or functional allocation of the spaces within the facility, especially during the design and construction phase. The second way to achieve this credit is by directly installing certain products that help in achieving such credits. So types of credits where there is more than one way to achieve creditor requires installation of products on the basis of model simulation were classified under a third *contextual innovation category.*

Researcher segregation:

Once all the constructs and assumptions were established the researcher began the segregation of the LEED checklist. The segregation of the LEED Checklist was on the basis of whether the credit or prerequisite was process innovation or product innovation or contextual innovation, whether it was incremental or radical innovation, and whether it was direct economic or indirect economic innovation based from an owner's or occupants' perspective. The obtained results we classified in the form of a table and kept aside to be compared with the results obtained from that of the experts.

Expert segregation:

Once the constructs were operationalized and the researcher was segregating the LEED Checklist, the researcher simultaneously sent these constructs, along with the assumptions, to the expert panel and they also started the segregation based on the information provided to them. They also segregated the LEED Checklist on the basis of whether the credit or prerequisite was process, product, or contextual innovation, and whether it was incremental or radical innovation or whether it was direct economic or indirect economic innovation based from an owner's or occupants perspective. The experts were individuals who were LEED accredited professionals and had certain amount of experience with public organizations and the concepts of sustainability. For this study we were able to generate a response rate of 66%.

Inter-Rater Reliability (IRR):

Inter-Rater Reliability formed a pivotal part of the study as it became clear that the LEED checklist could have been mostly segregated in the same way by other experts as we had been able to do so. Once the segregation of the LEED checklist was obtained from the experts, the results were compared with that of the researcher. The response rate for this part of the survey on an average was found to be 66%. The experts did provide a sort and at times altered the constructs by increments. The initial Inter-Rater Reliability was 85% between the sort done by the experts and the researcher. At places where the Inter-Rater Reliability did not match, the experts and researchers iterated and discussed until convergence was achieved. Below is an example discussing the iterations and the discussions between the researcher and the expert regarding the segregation for the *SS Credit 3: Brownfield Redevelopment?*

Researcher:

"In this category I had thought that Brownfield redevelopment was a product innovation, but then found that you have assigned it as a process innovation. I feel that it is a product innovation because it is entirely up to the owner to purchase whatever site he wants and when he decides to purchase this kind of site; the site helps him achieve this credit. I also feel the remediation process would be carried out by the specialty contractor who could be in any kind of contractual relationship with either the owner or the General Contractor. The owner would not actually oversee the process, as it would be so with respect to the General Contractor. He just accepts the proposals. Finally after discussion on over the same I quoted it is a product innovation.

In the same category I also thought that this innovation generated direct economic benefits to the owners as there are certain states that offer tax incentives for the development of the Brownfield. And since there are certain calculative returns by using this site, I categorized it into direct economic innovation. Please let me know as to what you think about the same.

Expert:

"I can agree with the classification as a product innovation since the ongoing activities are likely to be contracted out. However, since there are only Brownfield incentives in some and not all states, and since public sector owners don't benefit from tax incentives, I stand by my original classification of indirect economic innovation."

Once 100% of the Inter-Rater Reliability was achieved, the results were once again plotted in a matrix format against the credits. Table 6 shows an example of segregation after the Inter-Rater Reliability (IRR) was established. Appendix IV has detailed explanation for each of the segregation that was done. Once all the segregations were done, the study was ready for the next stage where the segregated LEED checklist would be combined with the routinized credits that were obtained from each organization.

3.5 Combination of routinization of credits with LEED segregation.

Once the Inter-Rater Reliability of LEED checklist was established, based on economic attributes (direct and indirect economic innovation), technical attributes (product innovation and process innovation) and types of innovation (incremental innovation and radical innovation), the results were matched with the credits that were routinized for each of the organizations that were shortlisted for this study. In short form this step was the combination of the results derived from the steps 2.3 and 2.4. Apart of it can be observed in Table 7. Table 7 is a matrix representation of LEED Credits for the Sustainable Site category, along with the type of innovation, technical attributes, and economic attributes for the Arizona State University. Appendix IV has detailed matrix combination of routinization of credits with LEED segregation.

The check mark in each box confirms the attribute of the innovation. The hashes represent the credits that have been routinized. Also, at the end of the table is the total amount of checks, and this pattern is the same for each of the category under every organization. Once we had completed the Combination of routinization of credits with LEED segregation, the research was ready to conclude the final results and test our hypotheses.

Table 6: LEED Checklist segregation based on economic attributes, technical attributes and types of innovation after IRR of 100% was achieved.

	Site Selection									
Credit no.	**Name of the Credit.**	**Incremental Innovation**	**Radical Innovation**		**Product Innovation**	**Conte-xtual**	**Process Innovation**		**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq. 1	Erosion & Sedimentation Control	✓			✓				✓	
Credit 1	Site Selection	✓					✓			✓
Credit 2	Urban Redevelopment Density	✓					✓			✓
Credit 3	Brownfield Redevelopment		✓		✓					✓
Credit 4.1	Alternative Transportation	✓			✓					✓
Credit 4.2	Alternative Transportation	✓			✓					✓
Credit 4.3	Alternative Transportation		✓		✓					✓
Credit 4.4	Alternative Transportation	✓					✓		✓	
Credit 5.1	Reduced Site Disturbance	✓			✓				✓	
Credit 5.2	Reduced Site Disturbance	✓			✓					✓
Credit 6.1	Storm water Management		✓		✓					✓
Credit 6.2	Storm water Management		✓		✓					✓
Credit 7.1	Reduce Heat Islands	✓			✓				✓	
Credit 7.2	Reduce Heat Islands		✓		✓				✓	
Credit 8	Light Pollution Reduction		✓				✓		✓	

Table 7: Segregated LEED Checklist combined with the LEED check sheet of Arizona State University for the sustainable site section.

Credit no.	Name of the Credit.	Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
Prereq. 1	Erosion & Sedimentation Control	✓		✓			✓	
Credit 1	Site Selection	✓				✓		✓
Credit 2	Urban Redevelopment Density	✓				✓		✓
Credit 3	Brownfield Redevelopment		✓	✓				✓
Credit 4.1	Alternative Transportation	✓		✓				✓
Credit 4.2	Alternative Transportation	✓		✓				✓
Credit 4.3	Alternative Transportation		✓	✓				✓
Credit 4.4	Alternative Transportation	✓				✓	✓	
Credit 5.1	Reduced Site Disturbance	✓		✓			✓	
Credit 5.2	Reduced Site Disturbance	✓		✓				✓
Credit 6.1	Storm water Management		✓	✓				✓
Credit 6.2	Storm water Management		✓	✓				✓
Credit 7.1	Reduce Heat Islands	✓		✓			✓	
Credit 7.2	Reduce Heat Islands		✓	✓			✓	
Credit 8	Light Pollution Reduction		✓			✓	✓	
	Total routinized Credits	7	5	8	0	4	5	7
	Total routinized Perquisites	1	0	1	0	0	1	0

Chapter 4: Results

This chapter deals with the final results that established our hypotheses that we had mentioned in the methodology of this study. We stated the hypothesis with the basic assumption that if a public sector organization decided to use a sustainable innovation over a number of projects, there are high chances that the innovation would be routinized. Thus we can further base our hypotheses as follows:

First, based on the findings of Taylor & Levitt (2005) and Slater & Mohr (2006), we had hypothesized that there were fewer radical innovations routinized in comparison to the incremental innovations.

Second, we would also hypothesize that the product based innovations would routinize more than the process based innovations.

Third, based on the concepts of Wolff (2006) and Cagan et al (2003), we hypothesized that there would be more direct economic innovations routinized than the indirect economic innovations.

In order to test the hypotheses we completed the superimposing of routinized credits with LEED segregation as discussed in the previous chapter. Now the data is ready to be analyzed to derive the final results that could test the hypotheses. Before we could begin this process, the researcher segregated the routinized innovations into general credits and prerequisites. We analyzed that it was better for this study to research both the components separately as both were representing different concepts.

The prerequisites were mandatory for the owner in order to achieve the LEED certification of the project and the owner had to fulfill all the requirements irrespective of whether he would wanted those or not. However, the general credits were the ones where the owner was free to decide if he even wanted to attempt the credits, as per his needs. Hence, if the researcher had integrated the prerequisites with the general credits to derive the final results, there are chances that the results achieved would not be accurate. For the purpose of this reason the chapter has been divided into three major parts which are as follows:

Test results for credits

Test results for prerequisites

Final results

4.1 Test results for general credits

Once we had the superimposed routinized credits with LEED segregation as discussed in the previous chapter, we thus had the data from which we could obtain the results. As seen in Tables8a, 8b, 8c, and 8d, we have the data from the Arizona State University, University of Florida, City of Austin, and City of

Seattle respectively. Within each table there are six categories. On one axis are the types or attributes of innovation while on the other axis of the table are the categories of the LEED checklist. Each cell within the table has certain numbers corresponding to it. The numbers depict the amount of attribute or type of innovations that were routinized. The five categories in each table are "*Sustainable Sites, Water Efficiency, Energy and Atmosphere, Material and Resource, and Indoor Air Quality.* The sixth category in the table is "*total*" which sums up the attributes or types of the routinized innovations for all the categories above. Also, all the four organizations have identical tables with totals. Table 8e is the sum of the totals from Tables 8a, 8b, 8c, and 8d (i.e. sum of all the attributes or types of innovations for all the organizations). Thus, Table 8e shows us the final results for the general credits, and we are clearly able to establish that our entire hypothesis have been successful. Now this study shall discuss each attribute of the innovation in detail.

Incremental Innovation and Radical Innovation

Figure 4 establishes our hypothesis that incremental innovation is routinized more than the radical innovation. Out of 90 routinized credits for all the organizations, we found that 70 credits, i.e. 78% of the total credits, were incremental innovations.

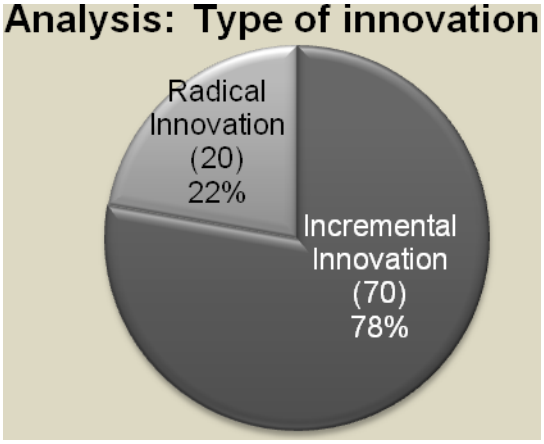

Figure 4: Comparative analyses between radical and incremental innovations for the routinized credits.

		Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
ARIZONA STATE UNIVERSITY	Site Selection	7	5	8	0	4	5	7
	Water Efficiency	3	0	3	0	0	3	0
	Energy & Atmosphere	1	2	1	2	0	2	1
	Material & Resource	4	0	4	0	0	0	4
	Indoor Environmental Quality	6	1	6	0	1	7	0
	Total Routinized Credits for the organization.	**21**	**8**	**22**	**2**	**5**	**17**	**12**

Table 8a & 8b: Total number of routinized credits from each category for the Arizona State University & University Of Florida respectively.

		Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
UNIVERSITY OF FLORIDA	Site Selection	5	2	5	0	2	1	6
	Water Efficiency	0	0	0	0	0	0	0
	Energy & Atmosphere	0	3	0	3	0	3	0
	Material & Resource	4	0	4	0	0	0	4
	Indoor Environmental Quality	5	0	5	0	0	5	0
	Total Routinized Credits for the organization.	**14**	**5**	**14**	**3**	**2**	**9**	**10**

		Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
CITY OF AUSTIN	Site Selection	5	2	5	0	2	2	5
	Water Efficiency	1	0	1	0	0	1	0
	Energy & Atmosphere	2	1	2	0	1	1	2
	Material & Resource	5	0	5	0	0	0	5
	Indoor Environmental Quality	5	1	5	0	1	6	0
	Total Routinized Credits for the organization.	**18**	**4**	**18**	**0**	**4**	**10**	**12**

Table 8c & 8d: Total number of routinized credits from each category for the city of Austin & City of Seattle respectively.

		Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
CITY OF SEATTLE	Site Selection	4	0	3	0	1	1	3
	Water Efficiency	1	0	1	0	0	1	0
	Energy & Atmosphere	1	3	1	2	1	3	1
	Material & Resource	4	0	4	0	0	0	4
	Indoor Environmental Quality	7	0	6	0	1	7	0
	Total Routinized Credits for the organization.	**17**	**3**	**15**	**2**	**3**	**12**	**8**

Table 8e: Final Results for the routinized general credits.

	Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
Total Routinized Credits considering all the organization	**70**	**20**	**69**	**7**	**14**	**48**	**42**

The remaining 22% of innovations were classified as radical innovations. Recall that incremental innovations generally offer incremental additions to the existing set of knowledge and the components that are affected do not require a specialist. Also, incremental innovations are easier to implement without having to adjust the design of other building systems, and due to this reason, the upsurge in diffusion of this innovation is plausible.

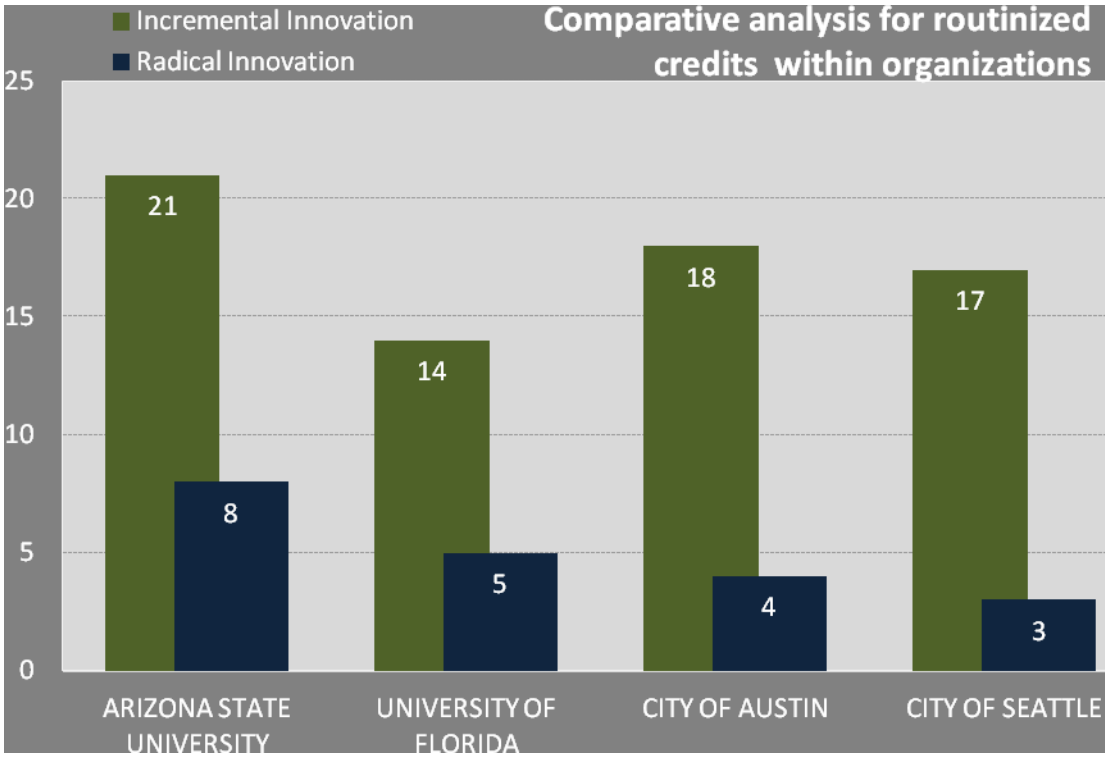

Figure 5: Comparative analyses among incremental innovation and radical innovation among routinized credits across the selected set of public sector organizations.

In contrast, the radical innovations are new findings in the industry and would require the owner to change the design of the systems that are affected. At the same time, the radical innovations would also require the specialist to be a part of the construction process so that the explicit knowledge that the specialist possesses could be converted into implicit knowledge and then conveyed to all the stakeholders of the project. Figure 5 also shows how incremental innovations have been uniformly accepted across the selected set of public sector organizations. This again supports our hypothesis and final result that the incremental innovations routinize more readily than radical innovations.

Product Innovation and Process Innovation

Figure 6 establishes our hypothesis that product innovations are routinized more than the process innovations. Out of the 90 routinized credits across all four owners, 69 credits, i.e., 77% of total credits, were product innovations and 14 credits, i.e., 15% of the total credits, were process innovations. In this category, we also found that there were 8% of the total credits were contextual innovations. The contextual credits were those innovations which possessed both the qualities of process innovation and product innovation depending on the specific nature of the projects in which they were applied. Even if we look into the detailed results from Figure 7 that is spread across the selected set of the public organizations, it is very much evident that the product innovation is routinized consistently as compared to process innovation.

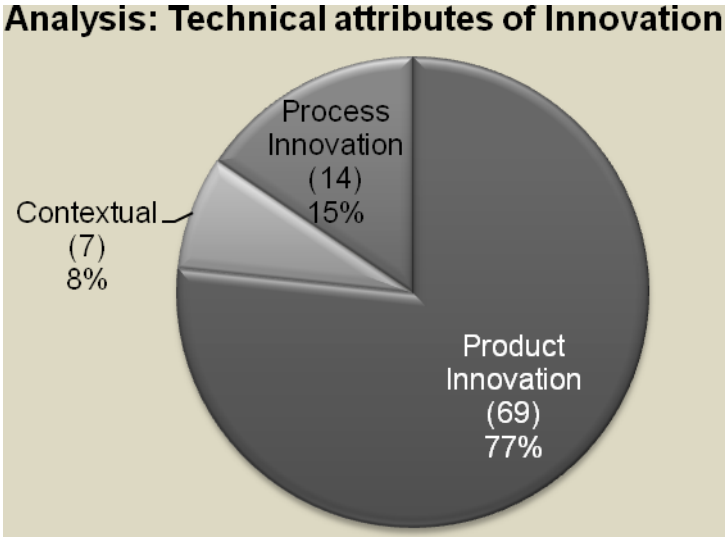

Figure 6: Comparative analyses among product innovation, contextual innovation and process innovation among routinized credits for public sector organizations.

The fact that can be ascertained by such a result could be explained as it is easier for an owner to routinize a product innovation as an owner can achieve the credit by just having them installed. However, process innovations generally require a behavioral change on the part of both the owner and the occupants and are generally observed to be difficult to routinize unless enforced by the owner or the law. One of the important points to be noted is that the "*Buy me Credits*" were also categorized as product innovation as the study is mainly from the owner's perspective. Hence, expected the product innovation routinizes more than the process innovation.

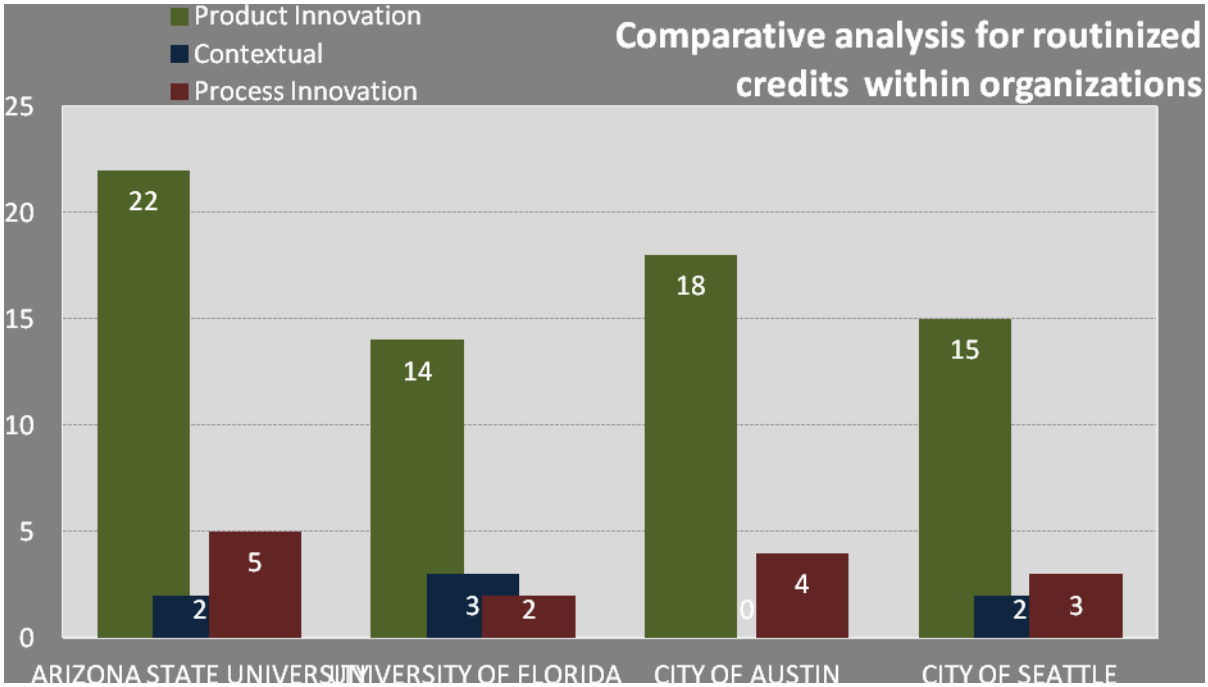

Figure 7: Comparative analyses among product innovation, contextual innovation and process innovation among routinized credits across the selected set of public sector organizations.

Direct Economic Innovation and Indirect Economic innovation:

Figure 8 establishes our hypotheses that direct economic innovations are routinized more than the indirect economic innovations. Out of the 90 credits routinized across all four public organizations, 48 credits, i.e., 53% of total credits, were direct economic innovations and 42 credits, i.e., 47% of the total credits, were indirect economic innovations. Although our hypothesis stands validated for this case, the difference between the two innovations is very marginal. Even though direct economic innovation would cause quantifiable economic benefits for the owner, it will occur at some point during the service life of the innovation for most or all projects, regardless of context. These benefits are irrespective of whether there

is a positive cash flow or negative cash flow. However, the indirect economic innovations are unquantifiable benefits or don't benefit owner at all.

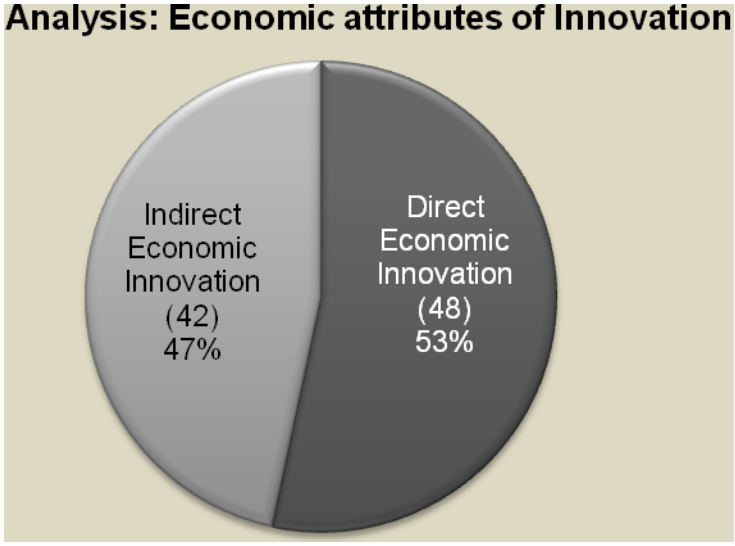

Figure 8: Comparative analyses among direct economic innovation and indirect economic innovation among routinized credits.

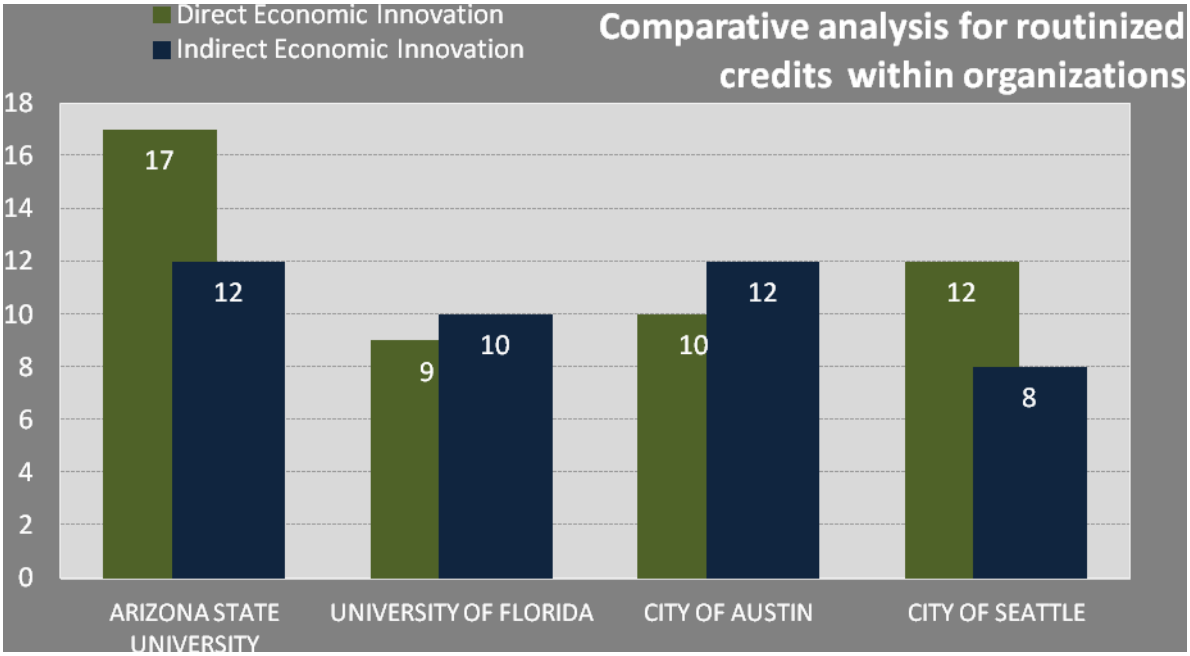

Figure 9: Comparative analyses among direct economic innovation and indirect economic innovation among routinized credits across the selected set of public sector organizations.

In Figure 9, we observe that direct economic innovations are routinized on an overall basis, but at the University of Florida and City of Austin, indirect economic innovations routinized more than direct economic innovations. These discrepancies may be explained by the following factors:

- Small sample size:

  Since we used a sample of four organizations out of eight organizations, there are chances that the results could have been skewed. We had tried to get the maximum number of projects by selecting the organizations that had the most number of projects. But even after that, we still feel that the sample was small. There are also chances that we chose organizations that had performance based interest than of the Return on Investment (ROI) as stated by Tafun Cagan (2003). So for future research we would like to recommend that a much bigger sample be taken so that such results could be avoided. Also being a small sample the effect of regional requirements affected the final results. This could be explained as all the Water Efficiency (WE) and Indoor Environment Quality (IEQ) credits were direct economic and that mostly Florida and Texas lost on the WE credit. Again Material and Resources (MR) Credit is irrespective of region and most of the credits achieved are indirect economic innovations and easy to achieve and have been achieved by most of the states. This probably explains the change in the graph's pattern for various organizations.

- Operationalization didn't capture the Constructs:

  Another possibility that could explain such result is that we actually didn't calculate the Net Present value (NPV) and the Return on Investments (ROI) for the investments made by the owner. By not doing so we expect that the results could have been skewed. So for the purpose of future research we would recommend such methods be employed for figuring out the direct economic innovation for the owner.

- No relationship between Economic Innovations and Routinization:

  A third possibility is that there is no relationship between the economic benefit and the routinization of the innovation. However, given the two other possible explanations, we recommend that future research be undertaken to further test our hypothesis for this variable.

Final overall results for the General Credits:

Thus from Figure 10, we are able to conclude distinctly that incremental innovation gets routinized more than the radical innovation; product innovation gets routinized more than process innovation and direct economic innovation gets routinized more than indirect economic innovation. Thus our first three hypotheses are established. And from this figure we can also conclude that if a public sector organization decides to use sustainable innovations over a number of projects, there are high chances that the innovation would be routinized.

Hence, at the end of this first part of our chapter we are able to ascertain that our entire hypotheses that we mentioned earlier stood true for the general credit.

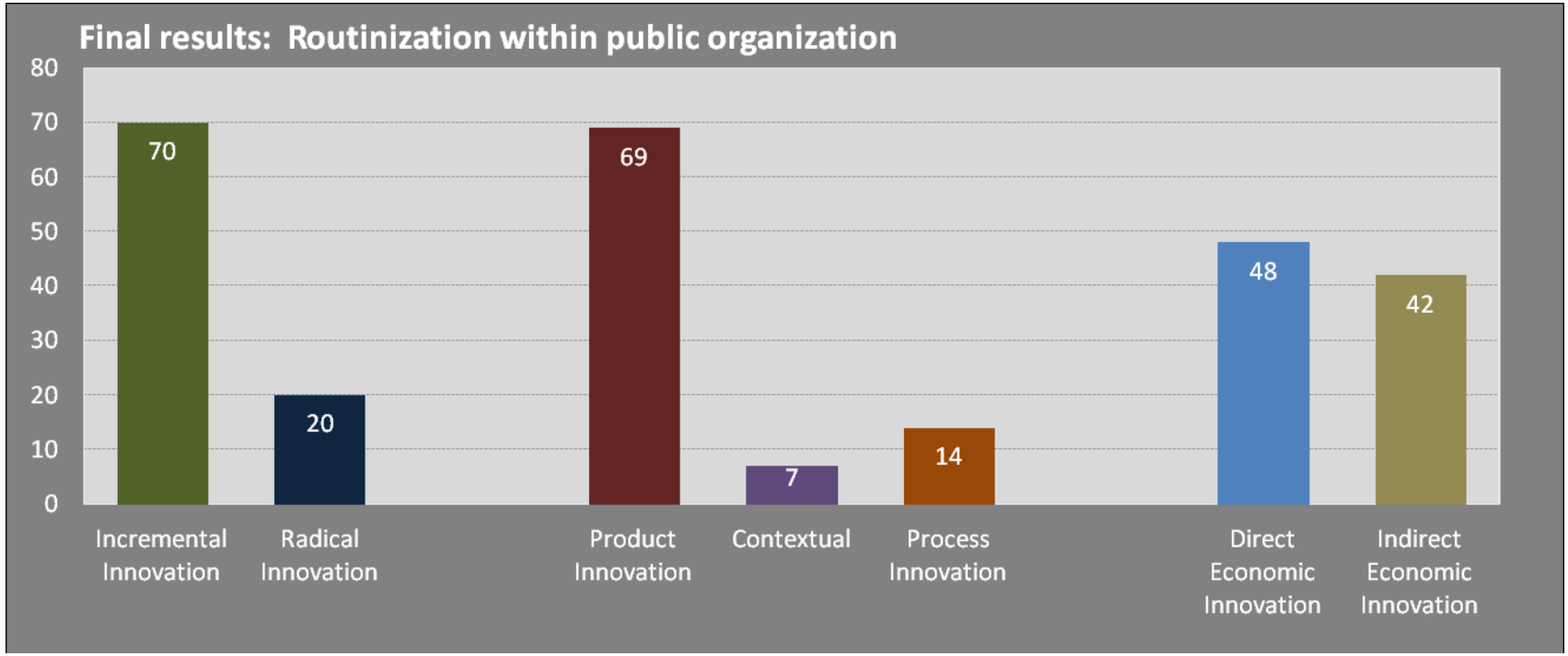

Figure 10: Final comparative analyses for all the innovations among general credits across the selected set of public sector organizations

4.2 Final Results for Prerequisites

After we superimposed routinized credits with LEED segregation as discussed in the previous chapter, we have the data from which we can obtain the results. As observed from Table 9a, 9b, 9c, and 9d we have the data from the Arizona State University, University of Florida, City of Austin, and City of Seattle respectively. Within each table there are each six categories. On one axis are the types or attributes of innovation and on the on the other axis of the table are the categories of the LEED checklist. Each cell within the table has certain numbers corresponding to it. These numbers depict the attribute or type of innovations that were routinized. The five categories in each table are the "*Sustainable Sites, Water Efficiency, Energy and Atmosphere, Material and Resource, and Indoor Environmental Quality*". And the sixth category in the table is "*total*" which sums up the attributes or types of the routinized innovations for all the categories above, for each organization. Also, all the four organizations have the identical tables having the totals. Table 9e is the sum of the totals of Tables 9a, 9b, 9c, and 9d (i.e. sum of all the attributes or types of innovations for all the organizations). Table 9e clearly shows that in the prerequisites, incremental innovation diffuses more than radical innovation, product innovation diffuses more than both process innovation and contextual innovation, and direct economic innovation diffuses more than the indirect economic innovation. We are also able to state that if a public sector organization decides to use sustainable innovations over a number of projects, there are high chances that the innovation be routinized. The sections in the later part of the chapter discuss each of the results in detail and show the results in detail for each of the innovation.

		Incremental Innovation	Radical Innovation		Product Innovation	Contextual	Process Innovation		Direct Economic Innovation	Indirect Economic Innovation
ARIZONA STATE UNIVERSITY	Site Selection	1	0		1	0	0		1	0
	Water Efficiency	0	0		0	0	0		0	0
	Energy & Atmosphere	2	1		1	1	1		2	1
	Material & Resource	1	0		1	0	0		1	0
	Indoor Environmental Quality	2	0		1	0	1		2	0
	Total Routinized prerequisite for the organization.	**6**	**1**		**4**	**1**	**2**		**6**	**1**

Table 9a & 9b: Total number of routinized prerequisites from each category for the Arizona State University & University Of Florida respectively.

UNIVERSITY OF FLORIDA	Site Selection	1	0		1	0	0		1	0
	Water Efficiency	0	0		0	0	0		0	0
	Energy & Atmosphere	2	1		1	1	1		2	1
	Material & Resource	1	0		1	0	0		1	0
	Indoor Environmental Quality	2	0		1	0	1		2	0
	Total Routinized prerequisite for the organization.	**6**	**1**		**4**	**1**	**2**		**6**	**1**

CITY OF AUSTIN		Incremental Innovation	Radical Innovation		Product Innovation	Contextual	Process Innovation		Direct Economic Innovation	Indirect Economic Innovation
	Site Selection	1	0		1	0	0		1	0
	Water Efficiency	0	0		0	0	0		0	0
	Energy & Atmosphere	2	1		1	1	1		2	1
	Material & Resource	1	0		1	0	0		1	0
	Indoor Environmental Quality	2	0		1	0	1		2	0
	Total Routinized credits for the organization.	**6**	**1**		**4**	**1**	**2**		**6**	**1**

Table 9c & 9d: Total number of routinized prerequisites from each category for the City of Austin & City of Seattle respectively.

CITY OF SEATTLE										
	Site Selection	1	0		1	0	0		1	0
	Water Efficiency	0	0		0	0	0		0	0
	Energy & Atmosphere	2	1		1	1	1		2	1
	Material & Resource	1	0		1	0	0		1	0
	Indoor Environmental Quality	2	0		1	0	1		2	0
	Total Routinized credits for the organization.	**6**	**1**		**4**	**1**	**2**		**6**	**1**

	Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
Total Routinized credits for the organization.	24	4	16	4	8	24	4

Table 9e: Final Results for the routinized general credits.

Incremental Innovation and Radical Innovation:

Figure11 establishes our hypothesis that incremental innovations are routinized more than the radical innovations. Out of 28 prerequisites for all the organizations we found that 24 prerequisites, i.e., 86% of the total prerequisites, were incremental innovations. The rest of the 14% of the prerequisites were radical innovations. The fact that could be ascertained from the results generated above is that incremental innovations generally offer incremental additions to the existing set of knowledge and the components that are affected do not require a specialist. Also, incremental innovations could be implemented without having to adjust the design of other building systems. However, in contrast the radical innovations are new findings in the industry and would require the owner to change the design of other systems that are affected. At the same time, the radical innovations would also require the specialist to be a part of the construction process so that the explicit knowledge that the specialist possesses could be converted into implicit knowledge and then conveyed to all the stakeholders of the project. Also, Figure 12 also shows how incremental innovations have been uniformly accepted over the selected set of public sector organizations and this figure again supports our hypothesis and final result that the incremental innovations routinize more than radical innovations.

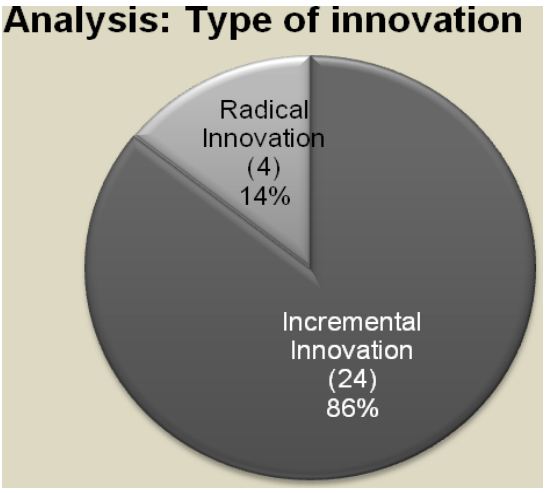

Figure 11: Comparative analyses among incremental innovation and radical innovation among prerequisites across the selected set of public sector organizations.

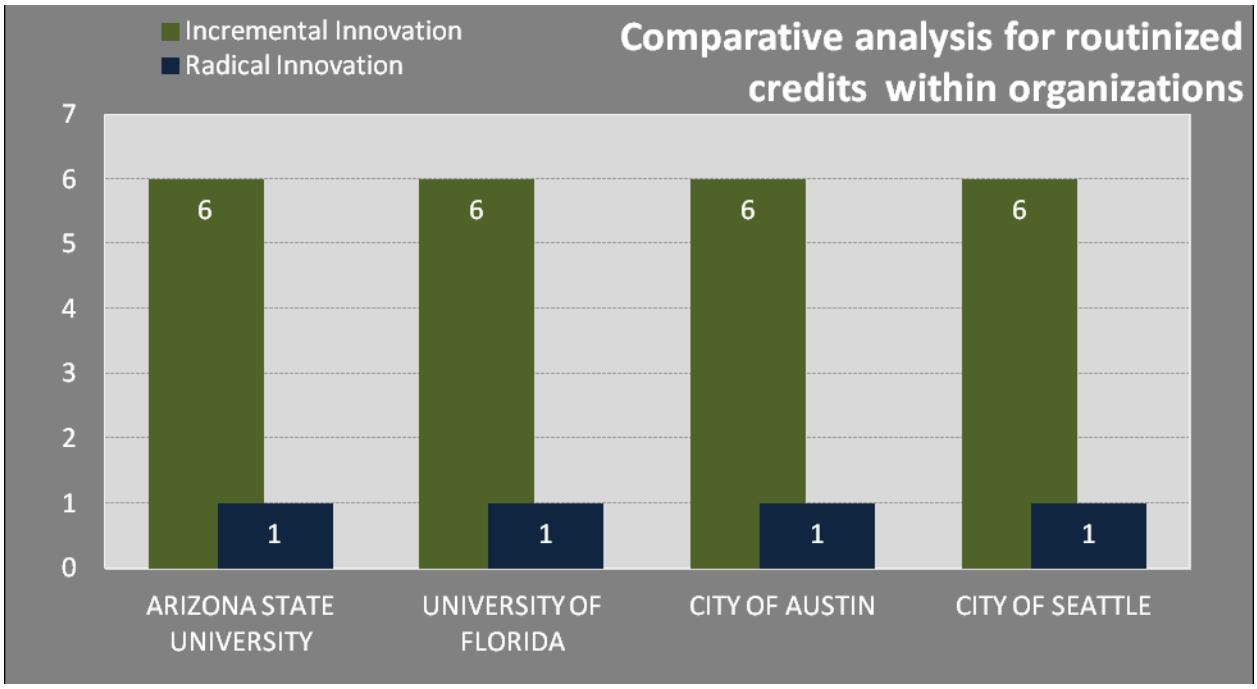

Figure 12: Comparative analyses among incremental innovation and radical innovation among the prerequisites across the selected set of public sector organizations.

Product Innovation and Process innovation:

Figure 13 establishes our hypothesis that product innovations are routinized more than the process innovations. Out of the 28 prerequisites, 16 credits, i.e., 57% of total credits were product innovations and 8 prerequisites, i.e., 29% of the total credits, were process innovations. In this category, we also found that 29% of the total credits were contextual innovations. The contextual credits were those innovations which possessed both the qualities of process innovation and product innovation. Even if we look into the detailed results from Figure 14 that are spread across the selected set of the public organizations, it is very much evident that the product innovations are routinized consistently more than process innovations. The fact that could be ascertained based on such a result could be explained as it is easier for an owner to routinize product innovation as an owner can achieve the credit by just installing the necessary equipment. However, the process innovation generally requires a behavioral change on the part of both the owner and the occupants and it is generally observed to be difficult to diffuse unless enforced by the owner or the law. Hence, we feel the product innovation routinizes more than the process innovation.

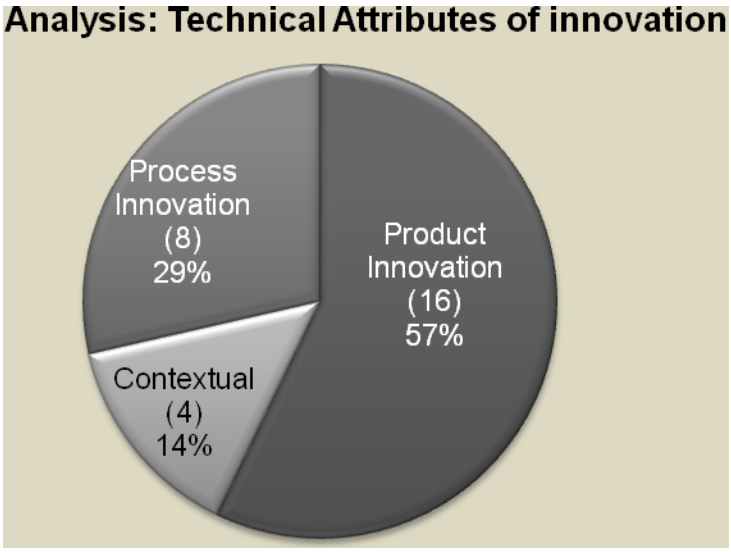

Figure 13: Comparative analyses among product innovation, contextual innovation and process innovation among prerequisites across the selected set of public sector organizations.

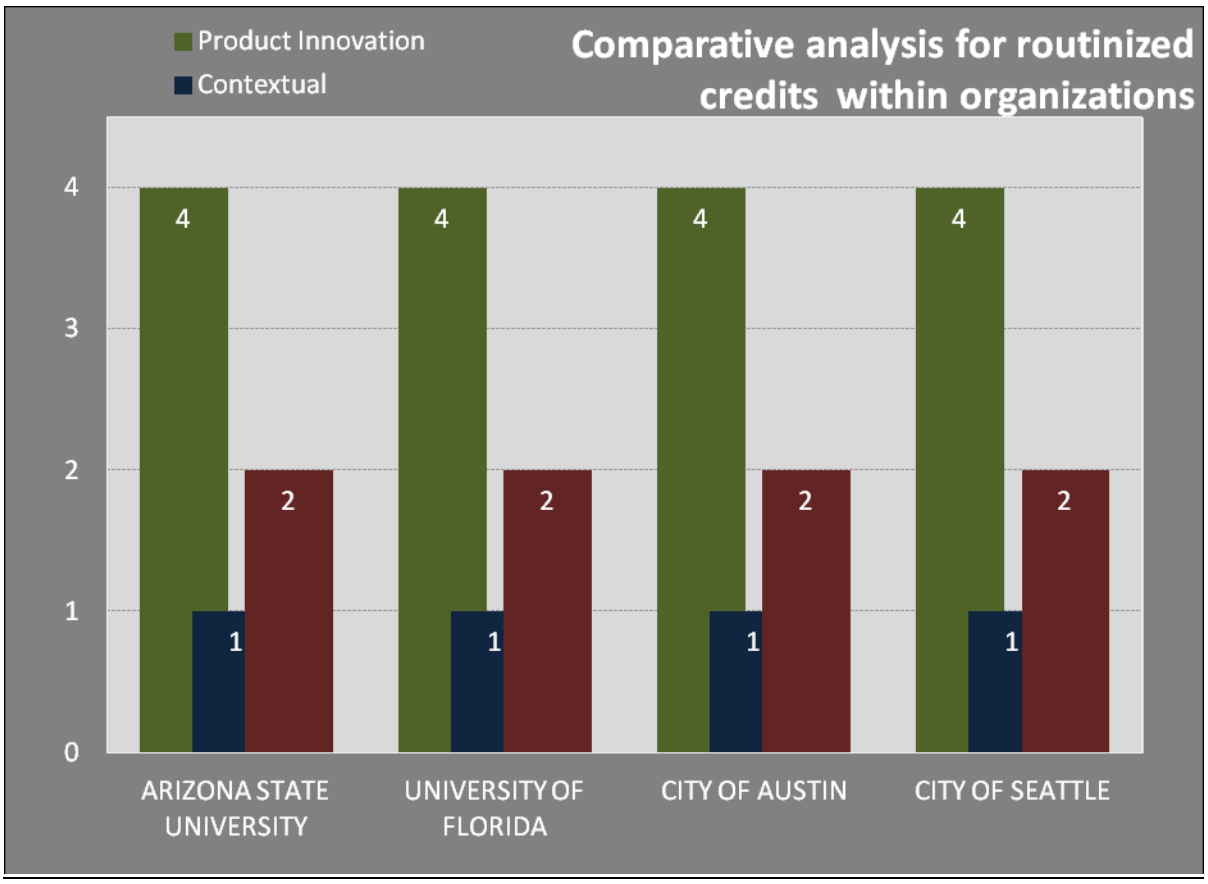

Figure 14: Comparative analyses among product innovation, contextual and process innovation among the prerequisites across the selected set of public sector organizations.

Figure 14 also shows how product innovation has been uniformly accepted over the selected set of public sector organizations, and this figure again supports our hypotheses and final result that the product innovation routinizes more than process innovation.

Direct Economic Innovation and Indirect Economic Innovation:

Figure 15 supports our hypothesis that direct economic innovations are routinized more than the indirect economic innovations. Out of the 28credits routinized from all the four organizations, 24 credits i.e., 86% of total credits, were direct economic innovations and 4 credits, i.e., 14% of the total credits, were indirect economic innovations. In this case too, our hypothesis stands validated. The reasons could be ascertained based on the results that the direct economic innovations would cause quantifiable economic benefits for the owner and they will occur at some point during the service life of the innovation for most or all projects, regardless of context. These benefits are irrespective of whether there is a positive or negative cash flow. However, the indirect economic innovations offer unquantifiable benefits or don't benefit the owner at all.

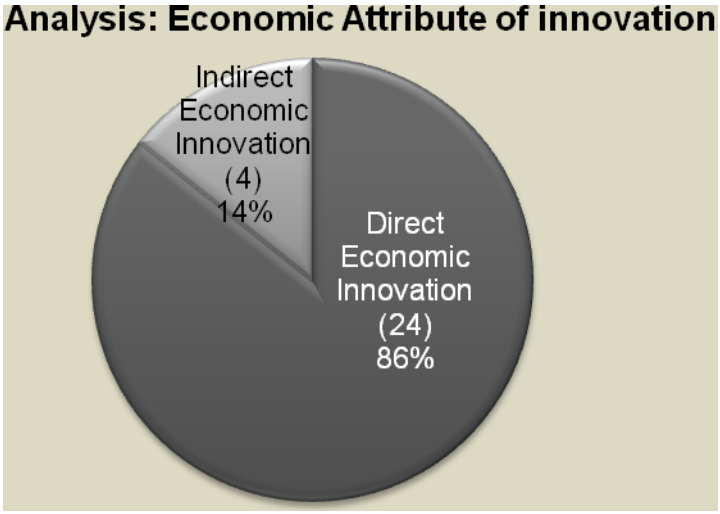

Figure 15: Comparative analyses among direct economic innovation and indirect economic innovation among prerequisites across the selected set of public sector organizations.

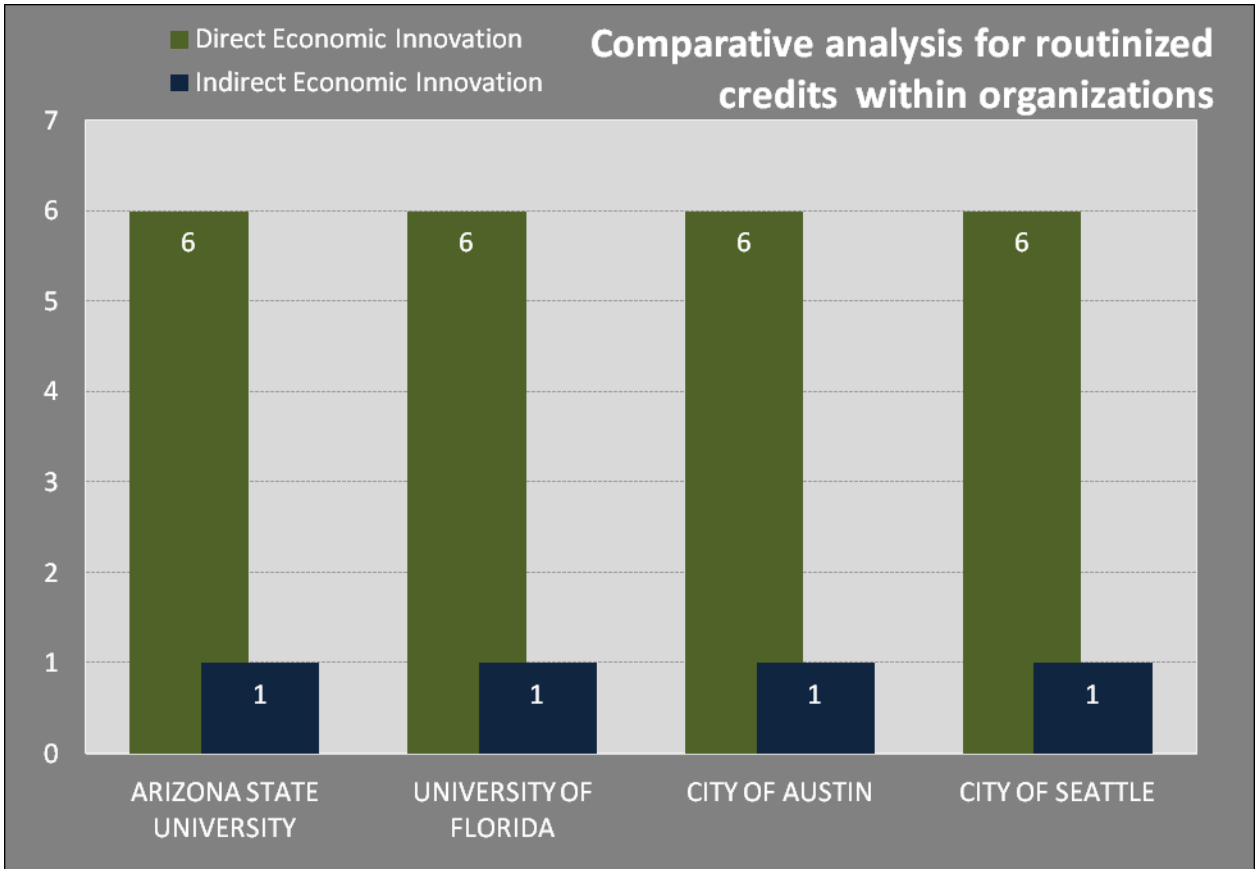

Figure 16: Comparative analyses among direct economic innovation and indirect economic innovation among prerequisites.

Final overall results for the Prerequisites:

Thus from Figure 17, we are able to conclude distinctly that incremental innovation gets routinized more than the radical innovation; product innovation gets routinized more than process innovation, and direct economic innovation gets routinized more than indirect economic innovation. Thus, our first three hypotheses are supported. And from this figure we can also conclude that if a public sector organization decides to use sustainable innovations over a number of projects, there are high chances that the innovation would be routinized. This is to be expected given the selection criteria for this research, since LEED certified projects by definition must achieve all prerequisites. However, the findings here support the hypotheses from the standpoint of the technical committees at the USGBC who decide which credits are mandatory vs. optional, yet another perspective that could be further explored in future research.

Hence, at the end of this chapter we are able to ascertain that our entire hypotheses mentioned earlier also stood true for the prerequisites.

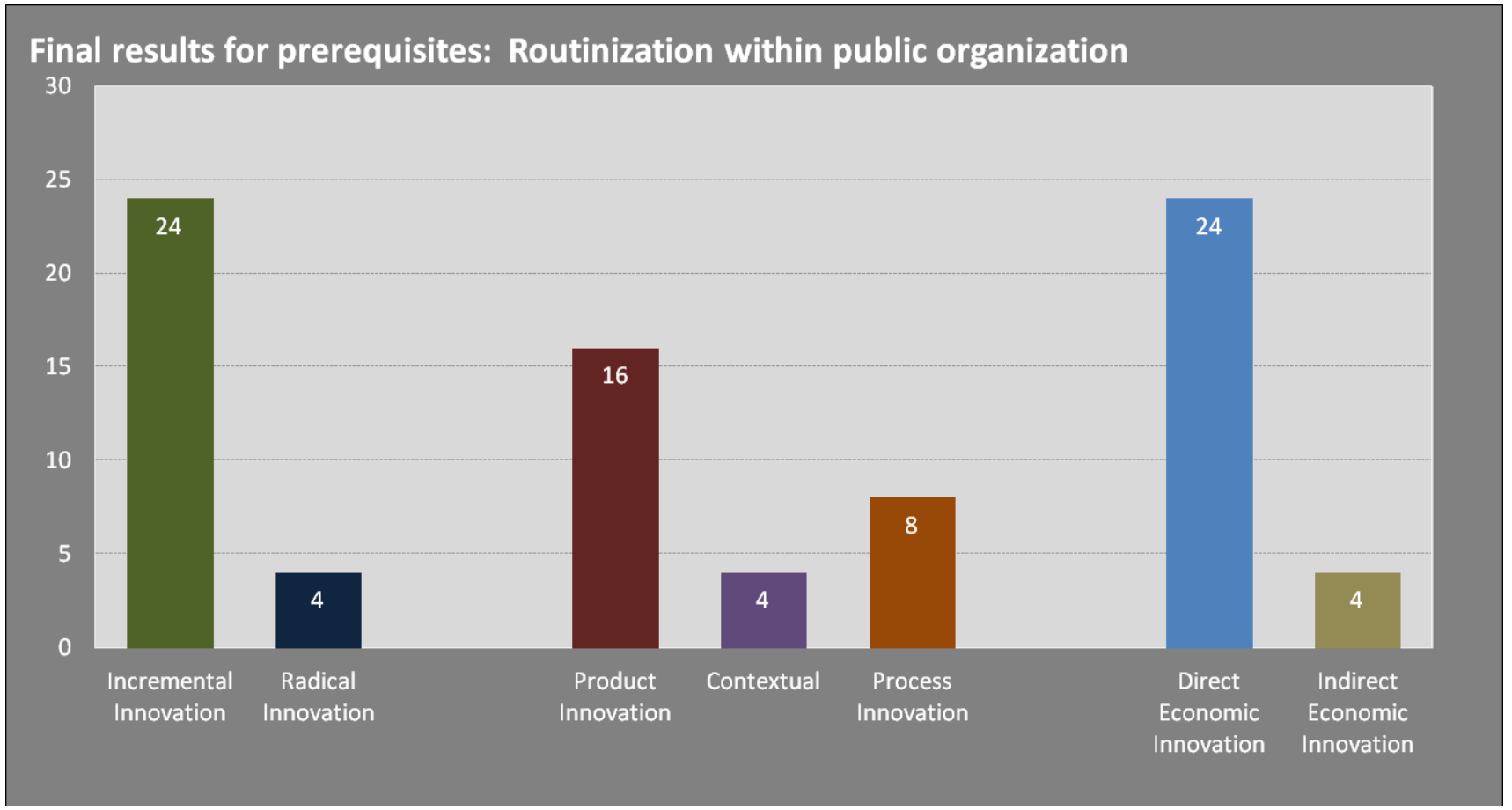

Figure 17: Final comparative analyses for all the innovations among routinized prerequisites across the selected set of public sector organization

4.3 Final results

If we observe both the results for the prerequisites and the general credits closely we can observe the logic as to why we separated credits and hypothesis for the final result analysis. The percentage of all the innovations changes drastically, especially for the direct economic benefits and indirect economic benefits. If we observe Figure 8 and Figure 15, we would observe that the routinization of direct economic innovation increases from 53% to 86%. Along similar lines if we also observed the type of innovation from Figure 6 and Figure 13, we would observe that the product innovation had decreased from 77% to 57% and the process innovation had increased from 15% to 29%.

Thus, had the researcher not kept the prerequisites and credits together, the results would have been skewed and we might have concluded some of the results differently. Hence, our assumption in the beginning of analyzing the results to keep the two components separately was proven correct.

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Chapter 5: Future Research and Benefits

All research paves a path to future research keeping the former research as a baseline. So is the case with this research. The findings of this research are not only going to benefit society, but also pave the path for future research to be conducted so that the realms of the knowledge could be increased. The first part of this chapter deals with the prospects of future research and the second part of this chapter deals with the impacts of the research on society.

5.1 Benefits of this research

Every research contributes to the society and so does this research too. This part of the chapter deals with the benefits that this research would have on the society and they are as follows:

- This study will enable the academia and the construction professionals to evaluate which technologies are routinized by public sector organizations and which are lost during the process of routinization.
- It would also help manufacturers to understand which techniques or products the organizations looks forward to applying on a consistent basis and thus help them to improve their products to better fit the public organizations.
- This study also aims towards helping other organizations and owners that shall be handling a sustainable project for the first time to understand the sustainable innovative techniques that are consistently being adopted by similar organizations, and which might be successful for their projects. Thus, it can set a benchmark within the industry.
- This study would also help the general contractors, and architects to understand as to which credits would cause direct and indirect economic benefits to the owner.
- This research would also benefit the owners who are doing the sustainable projects for the first time as it would let them know for which credits they have to change their behavior versus which credits they can simply “buy”. They can also know whether the credit offers them incremental or radical innovation. Lastly it would also help the owner know as to which innovation offers them direct economic benefits.

5.2 Future Research:

This part of the chapter deals with the future research options that could be derived from this study. This study has paved the path for some of the researches that could be carried out by other researchers in the course of time. The possibilities are as follows:

- There can be a research on the relative ease for the owner to achieve credits. There are some credits where the owner buys a product and then forgets it, whereas others require O&M and some are associated with the processes and require a change in process. A future research can be generated to analyze this part of human interface with these credits.
- While analyzing the LEED Checklist, there was a big concern if the prerequisites should be considered as routinized because without these prerequisites the owner would not have been able to qualify. For this research we also found that product innovation and process innovation could also be divided into two parts within an organization:
  1. Proactive routinization
  2. Reactive routinization

  So we could also dwell into the fact as to how much do the reactive routinization prevents the proactive routinization to occur, especially when the reactive innovation is not considered as an established law to be routinized. Further, does it mean that we should cancel prerequisites and just have a minimum number of credits that an organization needs to achieve to be certified? It is assumed down the line, the main concept of the USGBC is to enhance the concept of sustainability and reduce the harmful effects of chemicals that we introduce into our daily activities.
- This leads to another question that "*do prerequisites benefit the society or just discourage some of the people who would have their buildings certified*" otherwise under LEED but could not as they missed achieving the minimum requirement for the prerequisite? So does that also mean that is it the time for USGBC to eliminate prerequisite from the LEED Checklists or at the least not include more such prerequisite in the newer versions of LEED?
- A future research can also be conducted to find if a relation really exists between the economic benefits and the routinization.
- This study was aimed from the perspective of the owner mainly on the LEED Version 2.2 but another study could also be conducted from the perspective of general contractors, and architects. These perspective studies could be overlapped with this study and where each study could be observed and compared to deduce the commonalities. We could further analyze if the commonalities have effect on the routinization of sustainable innovations within the public sector organizations.

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Appendix I

Project Summaries:

This section of the appendix deals with the project summaries of the LEED certified projects executed by the public sector organizations and that have been covered in this research. Table 10a, 10b, 10c and 10 d represents the list of the organizations with the projects.

Table 10a: Arizona State University

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Interdisciplinary Science & Technology Building 2	Research Facility	66,000	$13.8 million
The Bio-design Institute, Building A	Research Facility	172,000	$72 million
Arizona Bio-design Institute, Phase 2	Research Facility	175,000	$72 million
ASU Fulton Centre	College of liberal arts & science administration.	140,000	NA

(NA: Not Available)

Table 10b: University of Florida

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Rinker Hall	Multi use building, class rooms, laboratory, offices, & other amenities.	47,300	$6.5 million
McGuire Centre for Lepidoptera and Biodiversity	Museum of natural history	58,000	$8.4 million
Mary Ann Coffrin - Harn Pavilion	Museum of Art	19,240	$5.36 million
Powell Structures Lab	Research laboratories & offices	8,565	$2.6 million
UF & Shands Orthopedics and Sports Medicine Institute	Medical institute & medical Centre	132,663	$26.5 million
Veterinary Medicine Food Animal Facility	College of veterinary medicine	9,975	$2.6 million
Library West Additions & Renovations	Library building	176,700	$24.2 million

(NA: Not Available)

Table 10c: City of Austin

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Combined Transportation Emergency & Communications Centre	Public safety facility	79,776	$29 million
Far Southeast Austin EMS Station # 28	Emergency medical service facility	5, 300	NA
George Washington Carver Museum & Cultural Centre	Museum of art, history, photography, music and politics.	27,000	NA
George Washington Carver Branch Library	Library building	12,000	$0.8 million
Austin City Hall and Public Plaza	Multi use (city council office, council chambers, café, city sore and mayor)	118,000	56 million
Circle C EMS and Fire Station	Public Order & Safety	15,000	NA
Austin Resource Centre	Local government building	26,800	$5 million

(NA: Not Available)

Table 10d: City of Seattle

Name of the Project	**Type of Project**	**Size of Project** (Sq. Ft)	**Cost of Project** (USD)
Carkeek Park Environmental Learning Centre	Space for environmental education, and for gathering and meeting space	NA	NA
Fisher Pavilion	Urban Oark and exhibition hall	21000	$9.5 million
City of Seattle Justice Centre	Municipal/Government building	288,000	$91.35 million
High Point Community Centre Addition	Community Centre	added 10000 to existing 9600	$3.7 million
Park 90/5 Building C	Office space for police department	182,000	$30 million
Seattle Central Library,	Library building	412,000	$111.9 million
Seattle City Hall	Municipal building	198,000	$72 million
Yesler Community Centre	Community Centre	20,000	NA

(NA: Not Available)

Appendix II

Routinization of Projects:

This section of the appendix deals with routinization of the credits. Generally an innovation is considered as routinized when the innovation is used on a consistent basis. However for this study we have tried to keep the limit of 75%, implying that any innovation that is used by more than 75%of the projects within an organization shall be considered as routinized. If any breaks are observed throughout the process of routinization, they shall be considered independent across the axis of the timeline. It can be implied from above that any innovation can be discontinued at any point of time if it is not beneficial for the particular project and then reused for the successive projects. The innovation can be considered routinized if 75% or more than 75% of the projects within a particular organization incorporate that innovation. In the tables below we have hatched 100% routinized innovations in an angular manner and the innovations routinized at or more than 75% of the times used as vertical. There are tables for every category and for every organization. By going through this organization we would be able to find out the most routinized credits within each category of each organization. Once we have this data, it would be kept separately until the step four where the routinized credits are superimposed on the segregated LEED Checklist.

Table 11a: Site Selection for Arizona State University

	Name of the University Facility	Interdisciplinary Science & Technology Building 2	The Bio design Institute, Building A	Arizona Biodesign Institute, Phase 2	ASU Fulton Centre
	Year of Certification	7/26/2006	6/19/2007	7/31/2007	7/11/2007
	Points Achieved	10	12	12	8
Credit No	**Name of the Credit.**				
Prereq 1	Erosion & Sedimentation Control	✓	✓	✓	✓
Credit 1	Site Selection	✓	✓	✓	✓
Credit 2	Urban Redevelopment Density	○	✓	✓	✓
Credit 3	Brownfield Redevelopment	○	○	○	○
Credit 4.1	Alternative Transportation	✓	✓	✓	✓
Credit 4.2	Alternative Transportation	✓	✓	✓	✓
Credit 4.3	Alternative Transportation	○	○	○	✓
Credit 4.4	Alternative Transportation	✓	✓	✓	○
Credit 5.1	Reduced Site Disturbance	✓	✓	✓	○
Credit 5.2	Reduced Site Disturbance	○	✓	✓	○
Credit 6.1	Storm water Management	✓	✓	✓	✓
Credit 6.2	Storm water Management	✓	✓	✓	○
Credit 7.1	Reduce Heat Islands	✓	✓	✓	✓
Credit 7.2	Reduce Heat Islands	✓	✓	✓	✓
Credit 8	Light Pollution Reduction	✓	✓	✓	○

Platinum		Routinized 100%	
Gold		Routinized 75%	
Silver			
Certified			

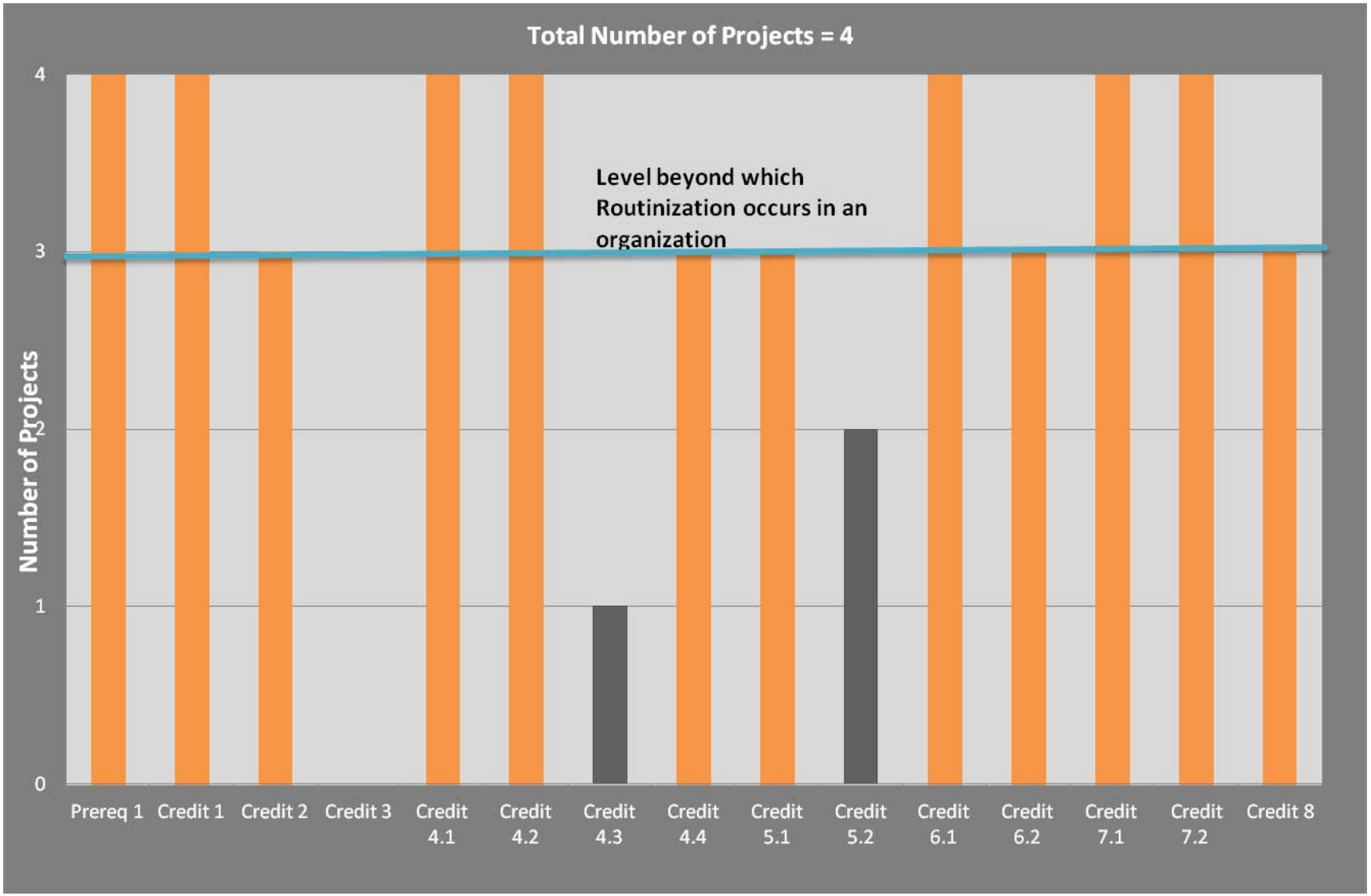

Figure 18a: Site Selection for Arizona State University

Table 11b: Water Efficiency for Arizona State University

	Name of the University Facility	Interdisciplinary Science & Technology Building 2	The Biodesign Institute, Building A	Arizona Biodesign Institute, Phase 2	ASU Fulton Centre
	Year of Certification	7/26/2006	6/19/2007	7/31/2007	7/11/2007
	Points Achieved	3	4	4	3
Credit No	**Name of the Credit**				
Credit 1.1	Water efficient landscaping, Reduce By 50%	✓	✓	✓	✓
Credit 1.2	Water efficient landscaping, No Portable Use or Irrigation	○	✓	✓	○
Credit 2	Innovative wastewater technologies	○	○	○	○
Credit 3.1	Water Use Reduction, 20% Reduction	✓	✓	✓	✓
Credit 3.2	Water Use Reduction, 30% Reduction	✓	✓	✓	✓

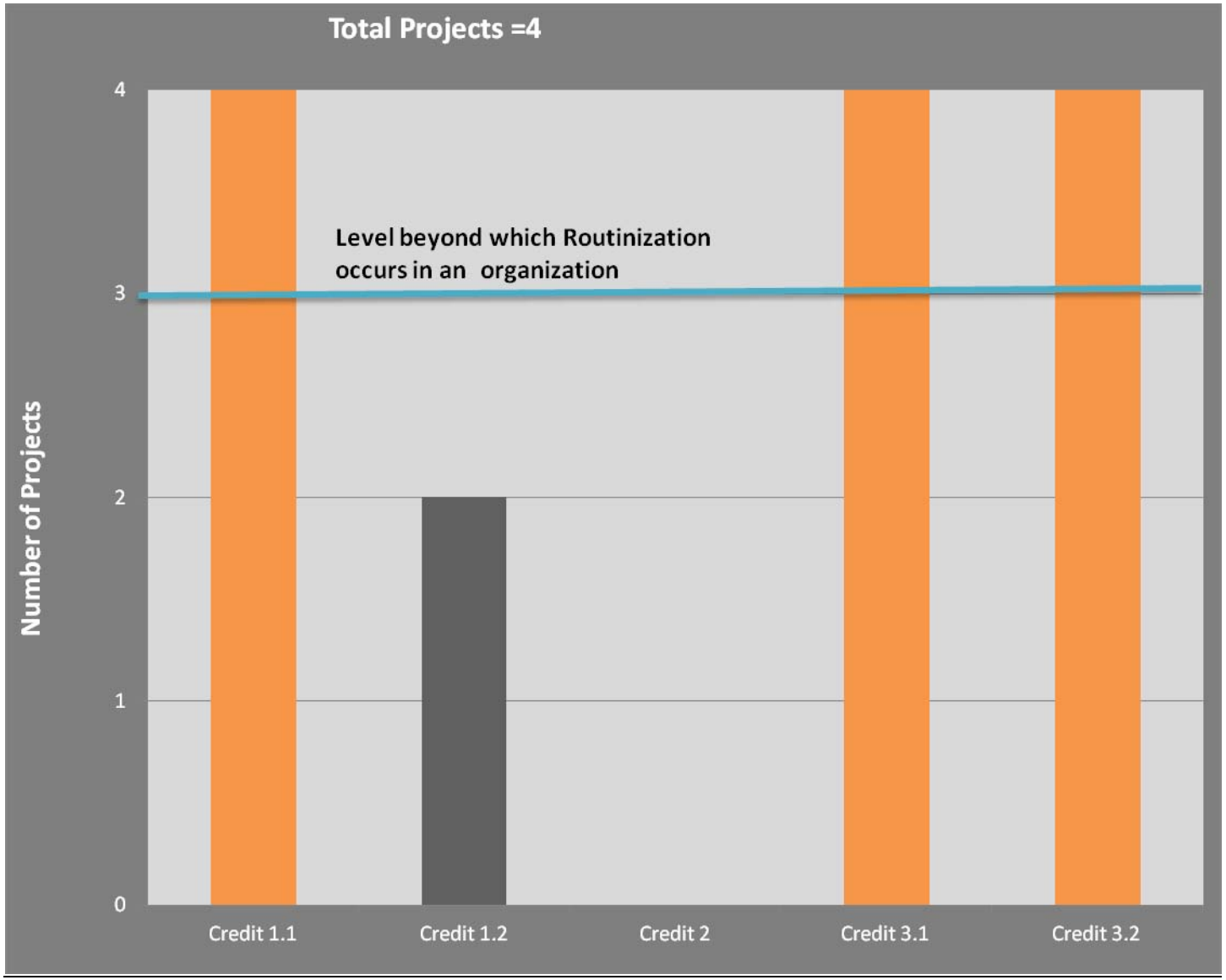

Figure 18b: Water efficiency for Arizona State University

Table 11c: Energy & Atmosphere for Arizona State University

	Name of the University Facility	Interdisciplinary Science & Technology Building 2	The Biodesign Institute, Building A	Arizona Biodesign Institute, Phase 2	ASU Fulton Centre
	Year of Certification	7/26/2006	6/19/2007	7/31/2007	7/11/2007
	Points Achieved	5	6	15	3
Credit No	**Name of the Credit**				
Prereq 1	Fundamental Building Systems Commissioning	✓	✓	✓	✓
Prereq 2	Minimum energy performance	✓	✓	✓	✓
Prereq 3	CFC Reduction in HVAC&R Equipment	✓	✓	✓	✓
Credit 1.1	Optimize Energy Performance	✓	✓	✓	✓
Credit 1.2	Optimize Energy Performance	✓	✓	✓	○
Credit 1.3	Optimize Energy Performance	○	○	✓	○
Credit 1.4	Optimize Energy Performance	○	○	✓	○
Credit 1.5	Optimize Energy Performance	○	○	✓	○
Credit 2.1	Renewable Energy, 5%	○	○	✓	○
Credit 2.2	Renewable Energy, 10%	○	○	✓	○
Credit 2.3	Renewable Energy, 15%	○	○	○	○
Credit 3	Additional commissioning	✓	○	✓	○
Credit 4	Ozone depletion	✓	✓	✓	✓
Credit 5	Measurement & Verification	○	○	○	○
Credit 6	Green Power	○	✓	✓	○

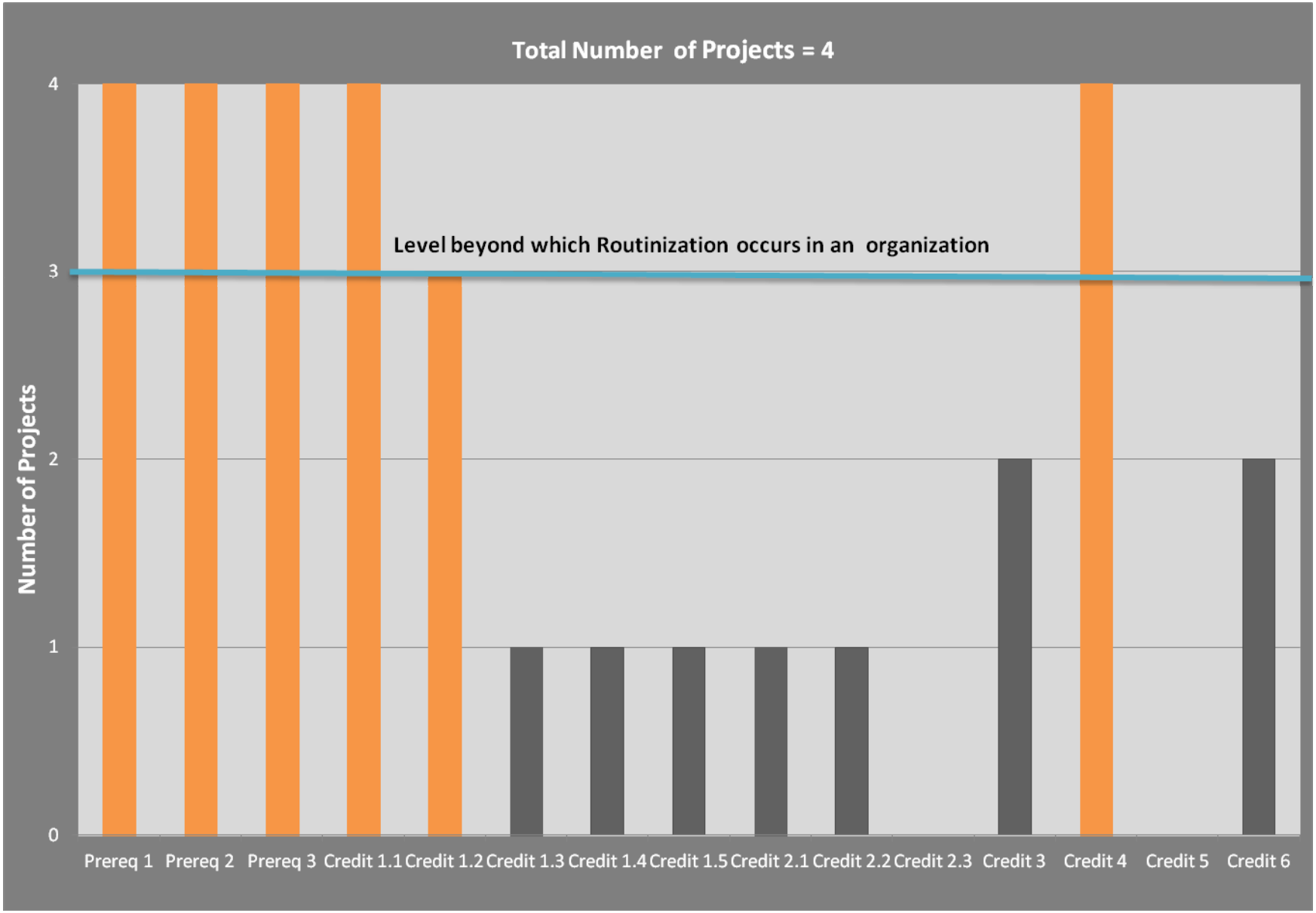

Figure 18c: Energy & Atmosphere for Arizona State University

Table 11d: Material & Resource for Arizona State University

	Name of the University Facility	Interdisciplinary Science & Technology Building 2	The Biodesign Institute, Building A	Arizona Biodesign Institute, Phase 2	ASU Fulton Centre
	Year of Certification	7/26/2006	6/19/2007	7/31/2007	7/11/2007
	Points Achieved	5	3	5	4
Credit No	**Name of the Credit**				
Prereq1	Storage and collection of recyclables	✓	✓	✓	✓
Credit 1.1	Building Reuse	O	O	O	O
Credit 1.2	Building Reuse	O	O	O	O
Credit 1.3	Building Reuse	O	O	O	O
Credit 2.1	Construction waste management	✓	O	✓	O
Credit 2.2	Construction waste management	✓	O	O	O
Credit 3.1.	Materials reuse	O	O	O	O
Credit 3.1.	Materials reuse	O	O	O	O
Credit 4.1	Recycled Content	✓	✓	✓	✓
Credit 4.2	Recycled Content	✓	O	✓	✓
Credit 5.1	Regional Materials	✓	✓	✓	✓
Credit 5.2	Regional Materials	O	✓	✓	✓
Credit 6	Rapidly Renewable Materials	O	O	O	O
Credit 7	Certified Wood	O	O	O	O

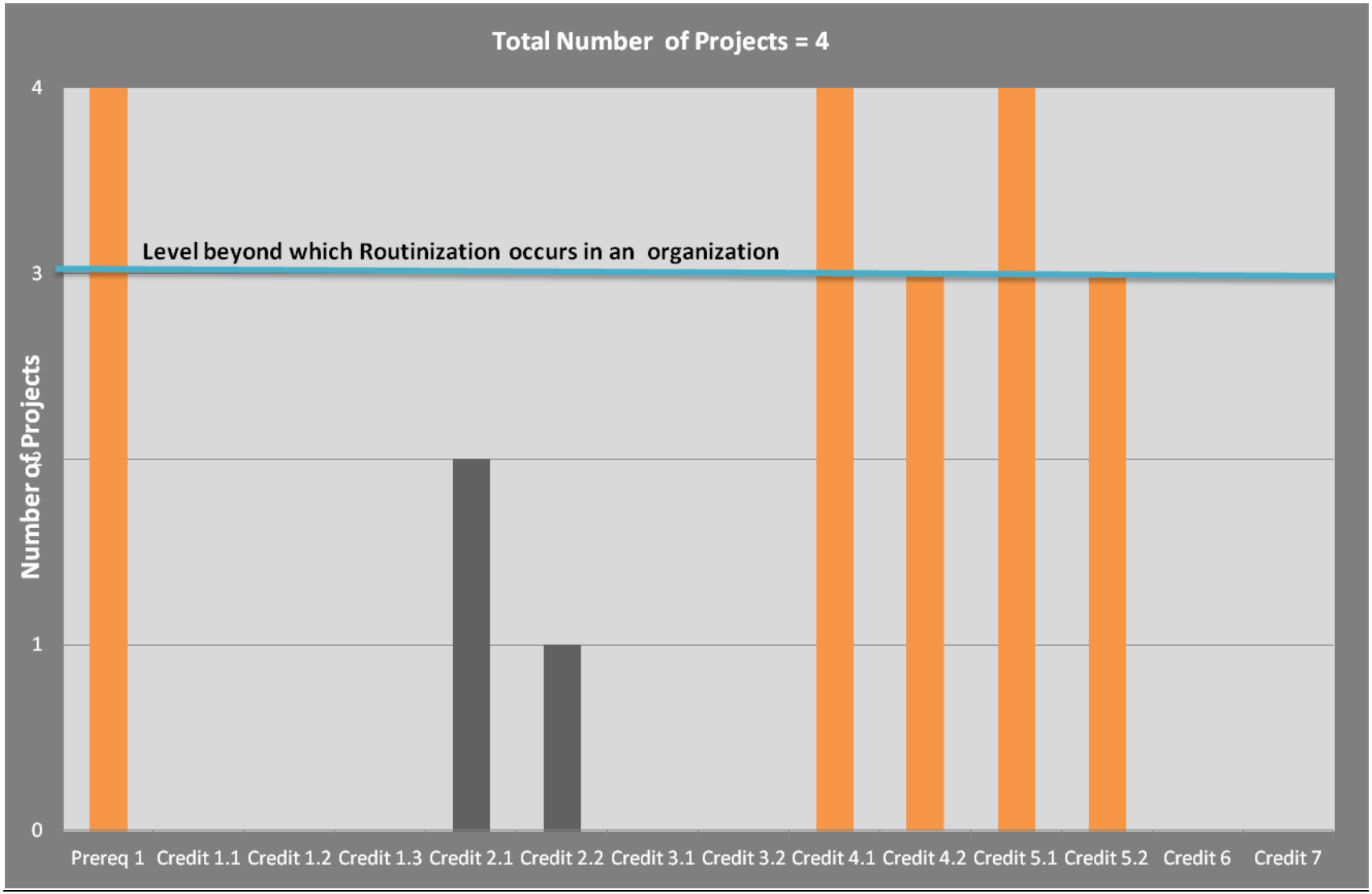

Figure 18d: Material & Resource for Arizona State University

Table 11e: Indoor Air Quality for Arizona State University

	Name of the University Facility	Interdisciplinary Science & Technology Building 2	The Biodesign Institute, Building A	Arizona Biodesign Institute, Phase 2	ASU Fulton Centre
	Year of Certification	7/26/2006	6/19/2007	7/31/2007	7/11/2007
	Points Achieved	8	10	11	5
Credit No	**Name of the Credit**				
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓	✓	✓	✓
Prereq 2	Environmental Tobacco Smoke Control	✓	✓	✓	✓
Credit 1	Outdoor air delivery monitoring	○	✓	✓	○
Credit 2	Increased ventilation	○	✓	✓	○
Credit 3.1	Construction IAQ management plan	✓	✓	✓	○
Credit 3.2	Construction IAQ management plan	✓	○	✓	○
Credit 4.1	Low –Emitting Materials	✓	✓	✓	○
Credit 4.2	Low –Emitting Materials	✓	○	○	○
Credit 4.3	Low –Emitting Materials	✓	✓	✓	✓
Credit 4.4	Low –Emitting Materials	○	○	○	✓
Credit 5	Indoor chemical and pollution source control	○	✓	✓	✓
Credit 6.1	Controllability of systems	○	✓	✓	○
Credit 6.2	Controllability of systems	○	○	○	○
Credit 7.1	Thermal Comfort	✓	✓	✓	✓
Credit 7.2	Thermal Comfort	✓	✓	✓	✓
Credit 8.1	Day lighting & Views	○	○	○	○
Credit 8.2	Day lighting & Views	✓	✓	✓	○

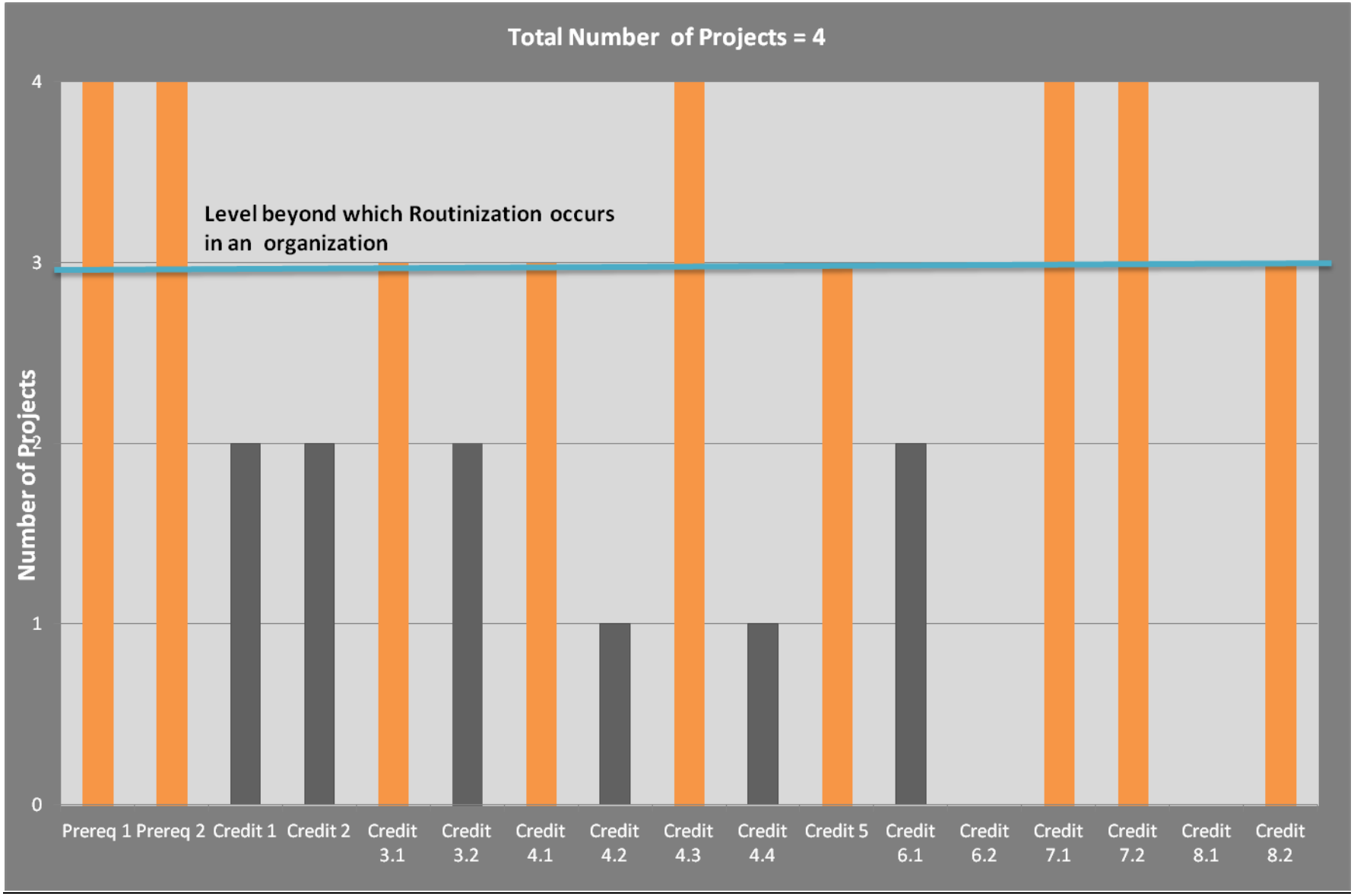

Figure 18e: Indoor Air Quality for Arizona State University

Table 12a: Site Selection for University of Florida

	Name of the University Facility	Rinker Hall	McGuire Center for Lepidoptera and Biodiversity	Mary Ann Coffrin-Harn Pavilion	Powell Structures Lab	UF & Shands Orthopedics and Sports Medicine Institute	Veterinary Medicine Food Animal Facility	Library West Additions & Renovations
	Year of Certification	5/7/2004	7/1/2005	9/28/2006	10/1/2006	11/28/2006	6/4/2007	7/2/2007
	Points Achieved	9	7	8	8	8	9	8
Credit No	**Name of the Credit**							
Prereq 1	Erosion & Sedimentation Control	✓	✓	✓	✓	✓	✓	✓
Credit 1	Site Selection	✓	✓	✓	✓	✓	✓	✓
Credit 2	Urban Redevelopment Density	○	○	○	○	○	○	✓
Credit 3	Brownfield Redevelopment	○	○	○	○	○	✓	○
Credit 4.1	Alternative Transportation	✓	✓	✓	○	✓	✓	✓
Credit 4.2	Alternative Transportation	✓	✓	✓	○	✓	✓	○
Credit 4.3	Alternative Transportation	○	○	○	✓	○	○	✓
Credit 4.4	Alternative Transportation	✓	✓	✓	✓	✓	✓	✓
Credit 5.1	Reduced Site Disturbance	○	○	✓	○	○	○	✓
Credit 5.2	Reduced Site Disturbance	✓	✓	✓	✓	✓	✓	✓
Credit 6.1	Storm water Management	✓	✓	✓	✓	✓	✓	○
Credit 6.2	Storm water Management	○	✓	✓	✓	✓	✓	○
Credit 7.1	Reduce Heat Islands	✓	○	○	○	✓	○	✓
Credit 7.2	Reduce Heat Islands	✓	○	○	✓	○	○	○
Credit 8	Light Pollution Reduction	✓	○	○	✓	○	✓	○

Platinum		Routinized 100%	
Gold		Routinized 75%	
Silver			
Certified			

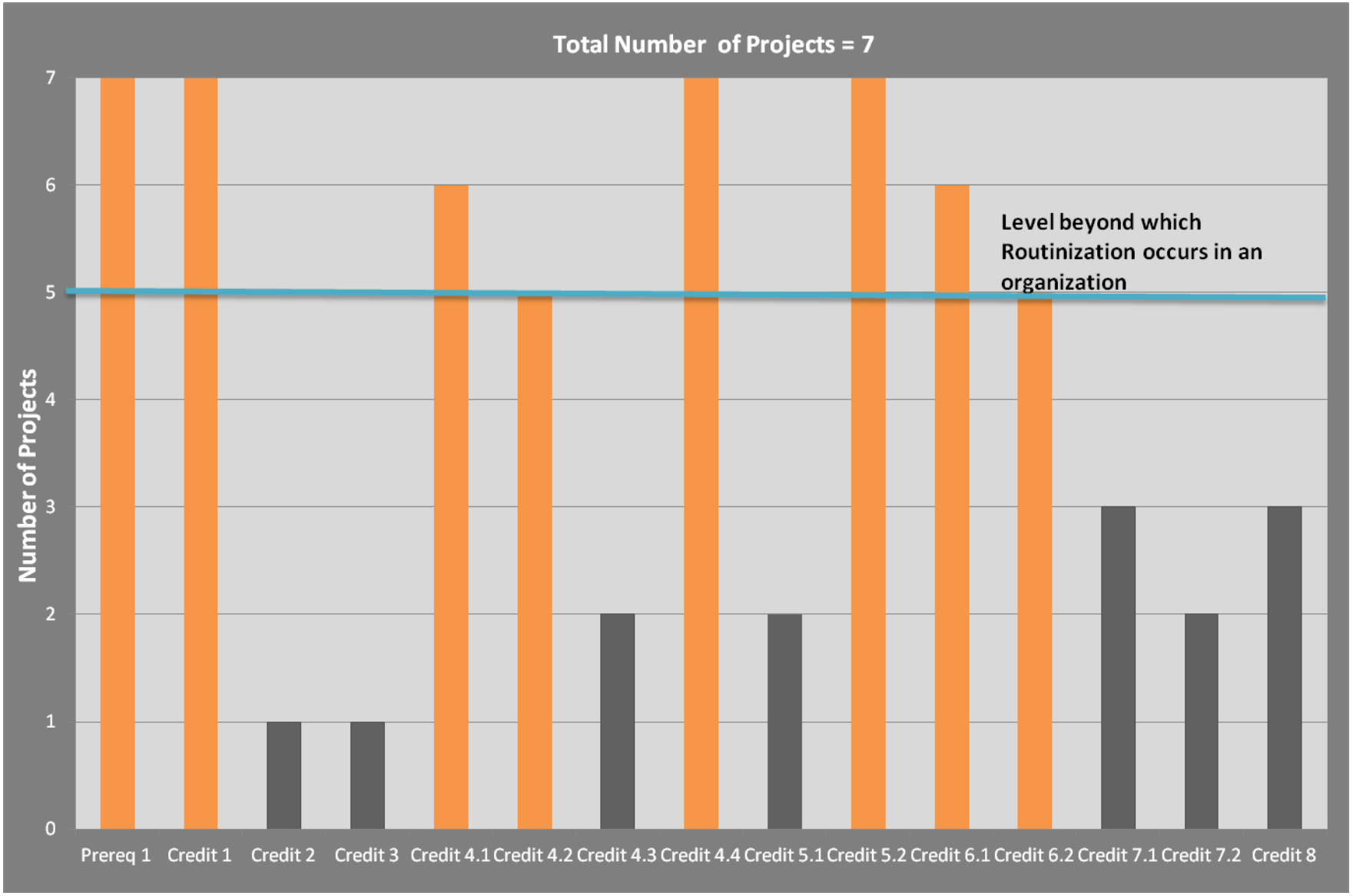

Figure 19a: Site Selection for University of Florida

Table 12b: Water Efficiency for University of Florida

	Name of the University Facility	Rinker Hall	McGuire Center for Lepidoptera & Biodiversity	Mary Ann Coffrin-Harn Pavilion	Powell Structures Lab	UF & Shands Orthopedics & Sports Medicine Institute	Veterinary Medicine Food Animal Facility	Library West Additions & Renovations
	Year of Certification	7-May-04	1-Jul-05	9/28/2006	10/1/2006	11/28/2006	6/4/2007	7/2/2007
	Points Achieved	4	2	2	0	1/3/1900	0	4
Credit No	**Name of the Credit**							
Credit 1.1	Water efficient landscaping	✓	✓	○	○	✓	○	✓
Credit 1.2	Water efficient landscaping	✓	✓	○	○	○	○	✓
Credit 2	Innovative wastewater technologies	○	○	○	○	○	○	○
Credit 3.1	Water Use Reduction	✓	○	✓	○	✓	○	✓
Credit 3.2	Water Use Reduction	✓	○	✓	○	✓	○	✓

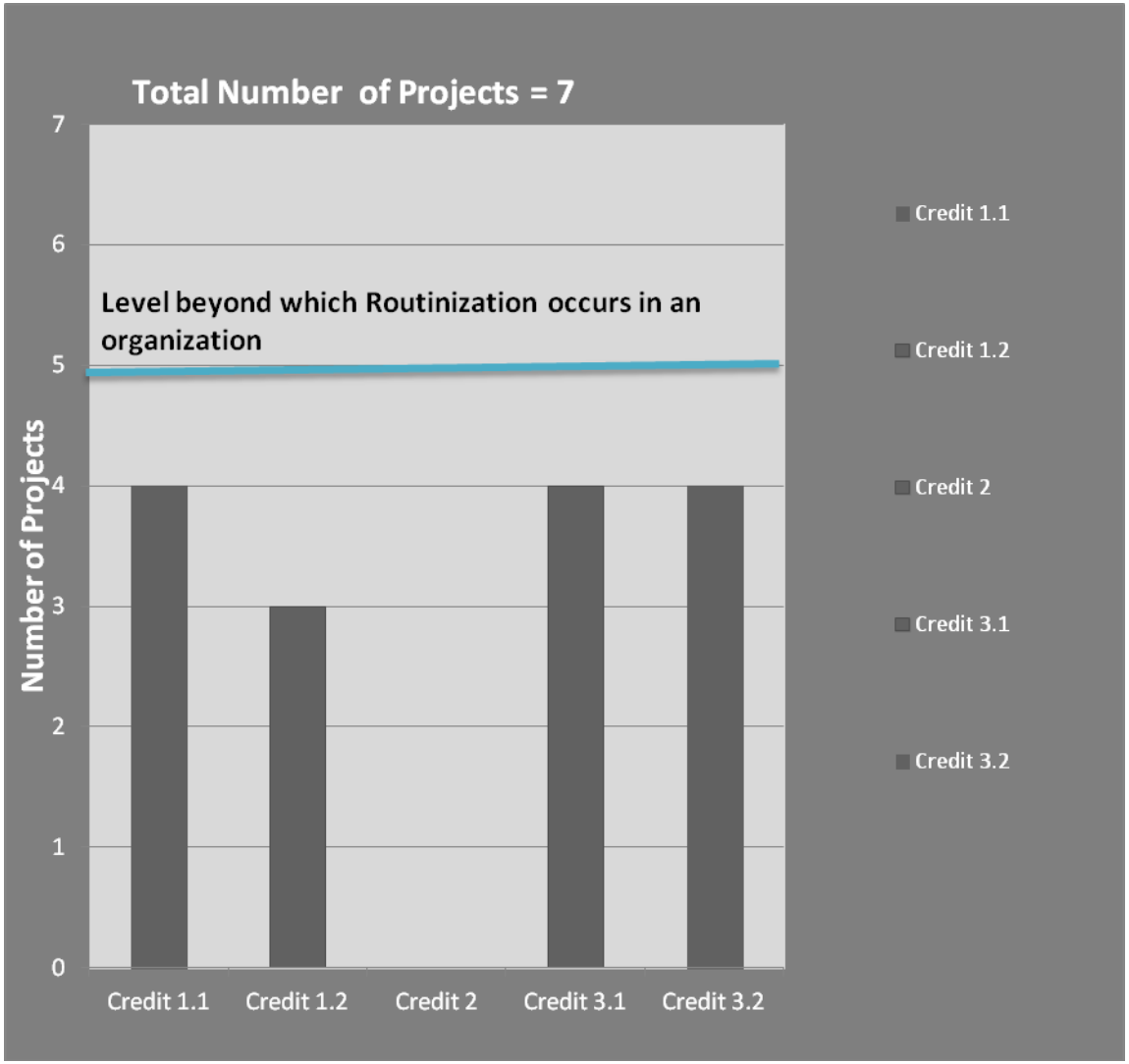

Figure 19b: Water Efficiency for University of Florida

Table 12c: Energy & Atmosphere for University of Florida

	Name of the University Facility	Rinker Hall	McGuire Center for Lepidoptera & Biodiversity	Mary Ann Coffrin-Harn Pavilion	Powell Structures Lab	UF & Shands Orthopedics & Sports Medicine Institute	Veterinary Medicine Food Animal Facility	Library West Additions & Renovations
	Year of Certification	5/7/2004	7/1/2005	9/28/2006	10/1/2006	11/28/2006	6/4/2007	7/2/2007
	Points Achieved	9	3	5	5	2	5	6
Credit No	**Name of the Credit**							
Prereq 1	Fundamental Building Systems Commissioning	✓	✓	✓	✓	✓	✓	✓
Prereq 2	Minimum energy performance	✓	✓	✓	✓	✓	✓	✓
Prereq 3	CFC Reduction in HVAC&R Equipment	✓	✓	✓	✓	✓	✓	✓
Credit 1.1	Optimize Energy Performance	✓	✓	✓	✓	○	✓	✓
Credit 1.2	Optimize Energy Performance	✓	✓	✓	✓	○	✓	✓
Credit 1.3	Optimize Energy Performance	✓	○	✓	○	○	○	✓
Credit 1.4	Optimize Energy Performance	✓	○	○	○	○	○	○
Credit 1.5	Optimize Energy Performance	✓	○	○	○	○	○	○
Credit 2.1	Renewable Energy, 5%	○	○	○	○	○	○	○
Credit 2.2	Renewable Energy, 10%	○	○	○	○	○	○	○
Credit 2.3	Renewable Energy, 15%	○	○	○	○	○	○	○
Credit 3	Additional commissioning	○	○	○	○	✓	✓	✓
Credit 4	Ozone depletion	○	○	○	✓	✓	✓	✓
Credit 5	Measurement & Verification	○	○	○	○	○	○	✓
Credit 6	Green Power	○	○	○	✓	○	✓	○

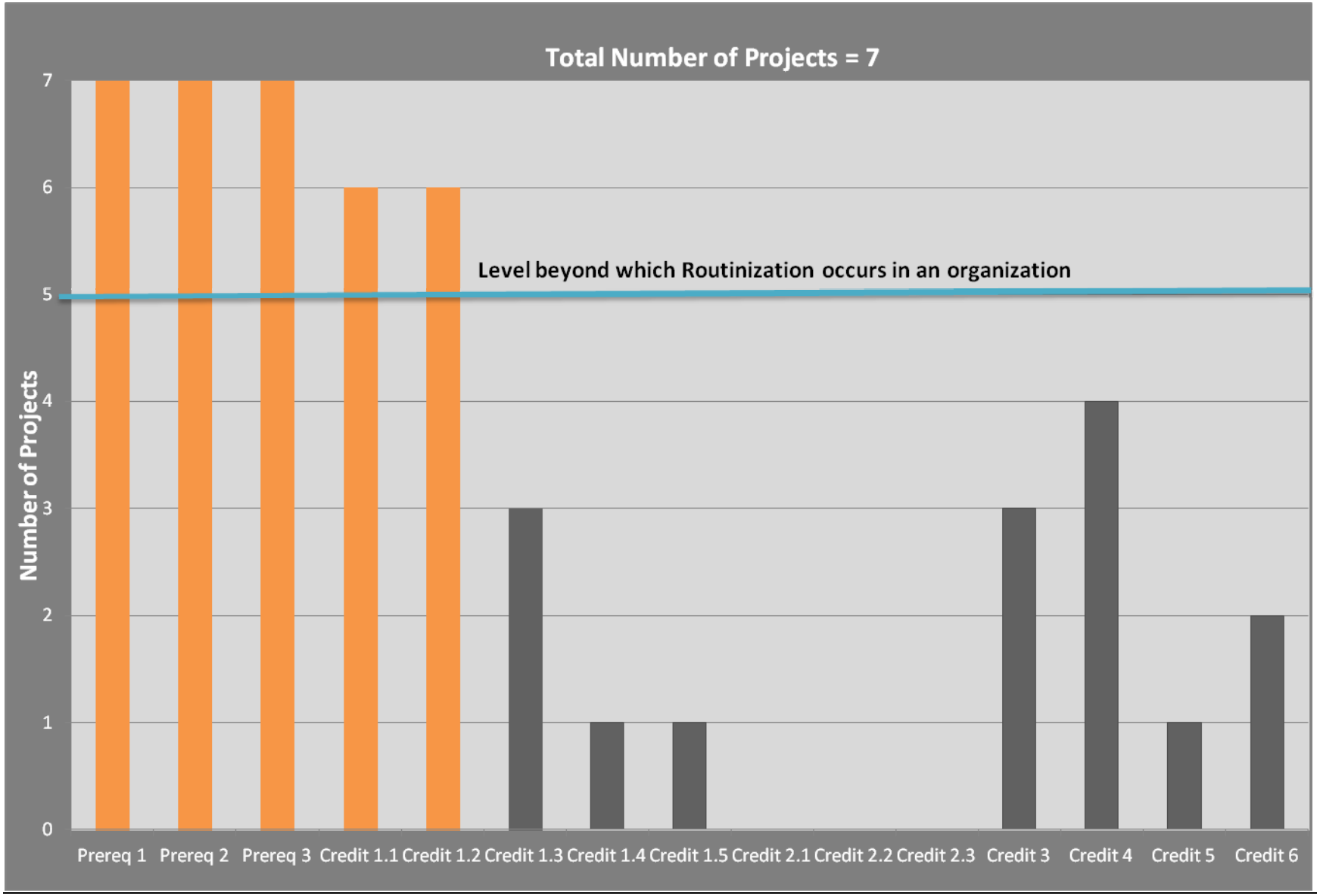

Figure 19c: Energy & Atmosphere for University of Florida

Table 12d: Material & Resource for University of Florida

	Name of the University Facility	Rinker Hall	McGuire Center for Lepidoptera & Biodiversity	Mary Ann Coffrin-Harn Pavilion	Powell Structures Lab	UF & Shands Orthopedics & Sports Medicine Institute	Veterinary Medicine Food Animal Facility	Library West Additions & Renovations
	Year of Certification	5/7/2004	7/1/2005	9/28/2006	10/1/2006	11/28/2006	6/4/2007	7/2/2007
	Points Achieved	6	4	6	6	3	4	7
Credit No	**Name of the Credit**							
Prereq1	Storage and collection of recyclables	✓	✓	✓	✓	✓	✓	✓
Credit 1.1	Building Reuse	○	○	○	○	○	○	✓
Credit 1.2	Building Reuse	○	○	○	○	○	○	○
Credit 1.3	Building Reuse	○	○	○	○	○	○	○
Credit 2.1	Construction waste management	✓	✓	✓	✓	✓	✓	✓
Credit 2.2	Construction waste management	✓	○	✓	✓	○	○	✓
Credit 3.1.	Materials reuse	○	○	○	○	○	○	○
Credit 3.1.	Materials reuse	○	○	○	○	○	○	○
Credit 4.1	Recycled Content	✓	✓	✓	✓	○	✓	✓
Credit 4.2	Recycled Content	✓	○	✓	✓	○	○	✓
Credit 5.1	Regional Materials	✓	✓	✓	✓	✓	✓	✓
Credit 5.2	Regional Materials	○	✓	✓	✓	✓	✓	✓
Credit 6	Rapidly Renewable Materials	○	○	○	○	○	○	○
Credit 7	Certified Wood	✓	○	○	○	○	○	○

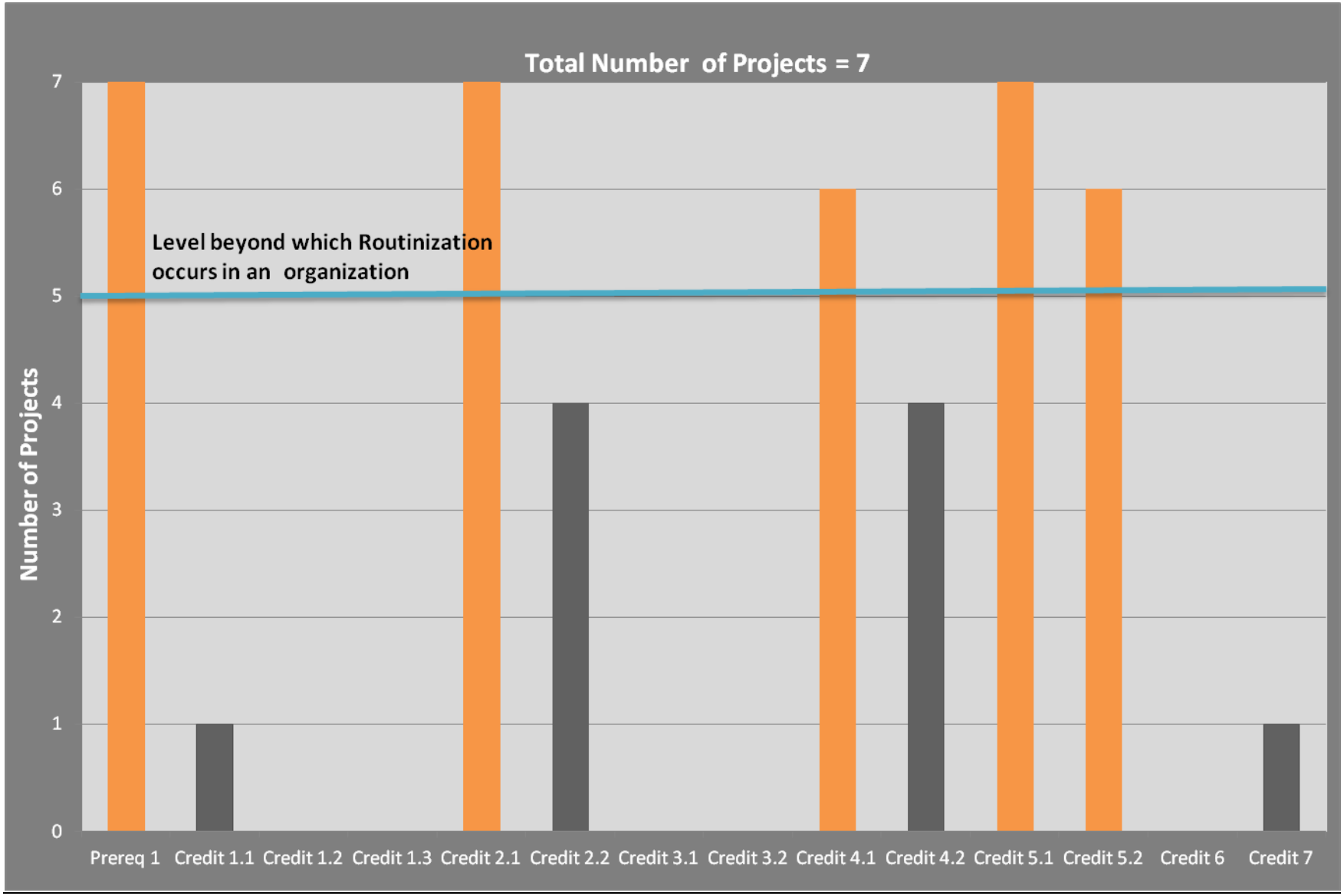

Figure 19d: Material & Resource for University of Florida

Table 12e: Indoor Air Quality for University of Florida

	Name of the University Facility	Rinker Hall	McGuire Center for Lepidoptera & Biodiversity	Mary Ann Coffrin-Harn Pavilion	Powell Structures Lab	UF & Shands Orthopedics & Sports Medicine Institute	Veterinary Medicine Food Animal Facility	Library West Additions & Renovations
	Year of Certification	5/7/2004	7/1/2005	9/28/2006	10/1/2006	11/28/2006	6/4/2007	7/2/2007
	Project No	# 0135	# 0862	10001284	#2906	# 1146	10002606	10001224
	Points Achieved	8	9	6	6	7	7	13
Credit No	**Name of the Credit**							
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓	✓	✓	✓	✓	✓	✓
Prereq 2	Environmental Tobacco Smoke Control	✓	✓	✓	✓	✓	✓	✓
Credit 1	Outdoor air delivery monitoring	○	✓	○	○	○	○	✓
Credit 2	Increased ventilation	○	○	○	○	○	○	✓
Credit 3.1	Construction IAQ management plan,	✓	✓	✓	○	○	✓	✓
Credit 3.2	Construction IAQ management plan,	○	○	○	✓	○	✓	✓
Credit 4.1	Low –Emitting Materials	✓	○	✓	✓	✓	○	✓
Credit 4.2	Low –Emitting Materials	✓	✓	✓	✓	✓	✓	✓
Credit 4.3	Low –Emitting Materials	✓	✓	✓	○	✓	✓	✓
Credit 4.4	Low –Emitting Materials	○	✓	✓	○	✓	✓	✓
Credit 5	Indoor chemical and pollution source control	○	✓	✓	○	✓	✓	○
Credit 6.1	Controllability of systems	✓	○	○	○	○	○	✓
Credit 6.2	Controllability of systems	○	○	○	○	○	○	✓
Credit 7.1	Thermal Comfort	✓	✓	○	✓	✓	✓	✓
Credit 7.2	Thermal Comfort	○	✓	○	○	✓	○	✓
Credit 8.1	Day lighting & Views	✓	✓	○	✓	○	○	○
Credit 8.2	Day lighting & Views	✓	○	○	✓	○	○	✓

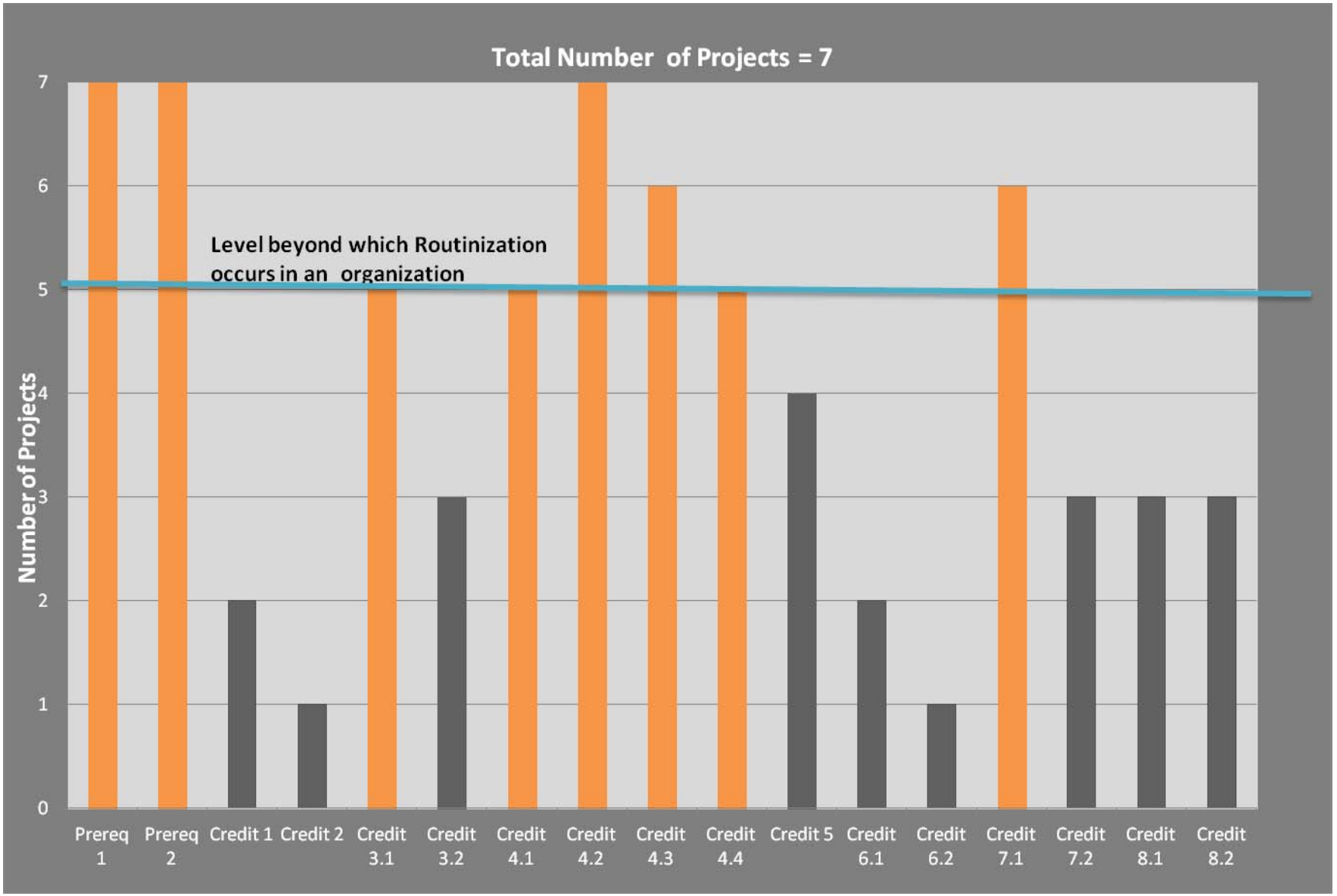

Figure 19e: Indoor Air Quality for University of Florida

Table 13a: Site Selection for City of Austin, Texas

	Name of the University Facility	Combined Transportation Emergency & Communications Centre	Far Southeast Austin EMS Station # 28	George Washington Carver Museum & Cultural Centre	George Washington Carver Branch Library	Austin City Hall & Public Plaza	Circle C EMS & Fire Station	Austin Resource Centre for the Homeless
	Year of Certification	3/17/2004	7/13/2005	15/06/2006	6/15/2006	8/14/2006	9/15/2006	22/02/2008
	Points Achieved	8	9	9	9	5	8	11
Credit No	**Name of the Credit**							
Prereq 1	Erosion & Sedimentation Control	✓	✓	✓	✓	✓	✓	✓
Credit 1	Site Selection	✓	✓	✓	✓	✓	✓	✓
Credit 2	Urban Redevelopment Density	○	○	○	○	✓	○	✓
Credit 3	Brownfield Redevelopment	✓	○	○	○	○	○	✓
Credit 4.1	Alternative Transportation	○	✓	✓	✓	✓	○	✓
Credit 4.2	Alternative Transportation	✓	✓	✓	✓	✓	✓	✓
Credit 4.3	Alternative Transportation	✓	✓	✓	✓	○	○	✓
Credit 4.4	Alternative Transportation	○	✓	✓	✓	○	✓	✓
Credit 5.1	Reduced Site Disturbance	✓	○	○	○	○	✓	○
Credit 5.2	Reduced Site Disturbance	✓	○	✓	✓	○	✓	○
Credit 6.1	Storm water Management	○	✓	✓	✓	○	✓	✓
Credit 6.2	Storm water Management	○	✓	○	○	○	✓	○
Credit 7.1	Reduce Heat Islands	✓	✓	✓	✓	✓	✓	✓
Credit 7.2	Reduce Heat Islands	✓	○	○	○	○	○	✓
Credit 8	Light Pollution Reduction	○	✓	✓	✓	○	○	✓

Platinum		Routinized 100%	
Gold		Routinized 75%	
Silver			
Certified			

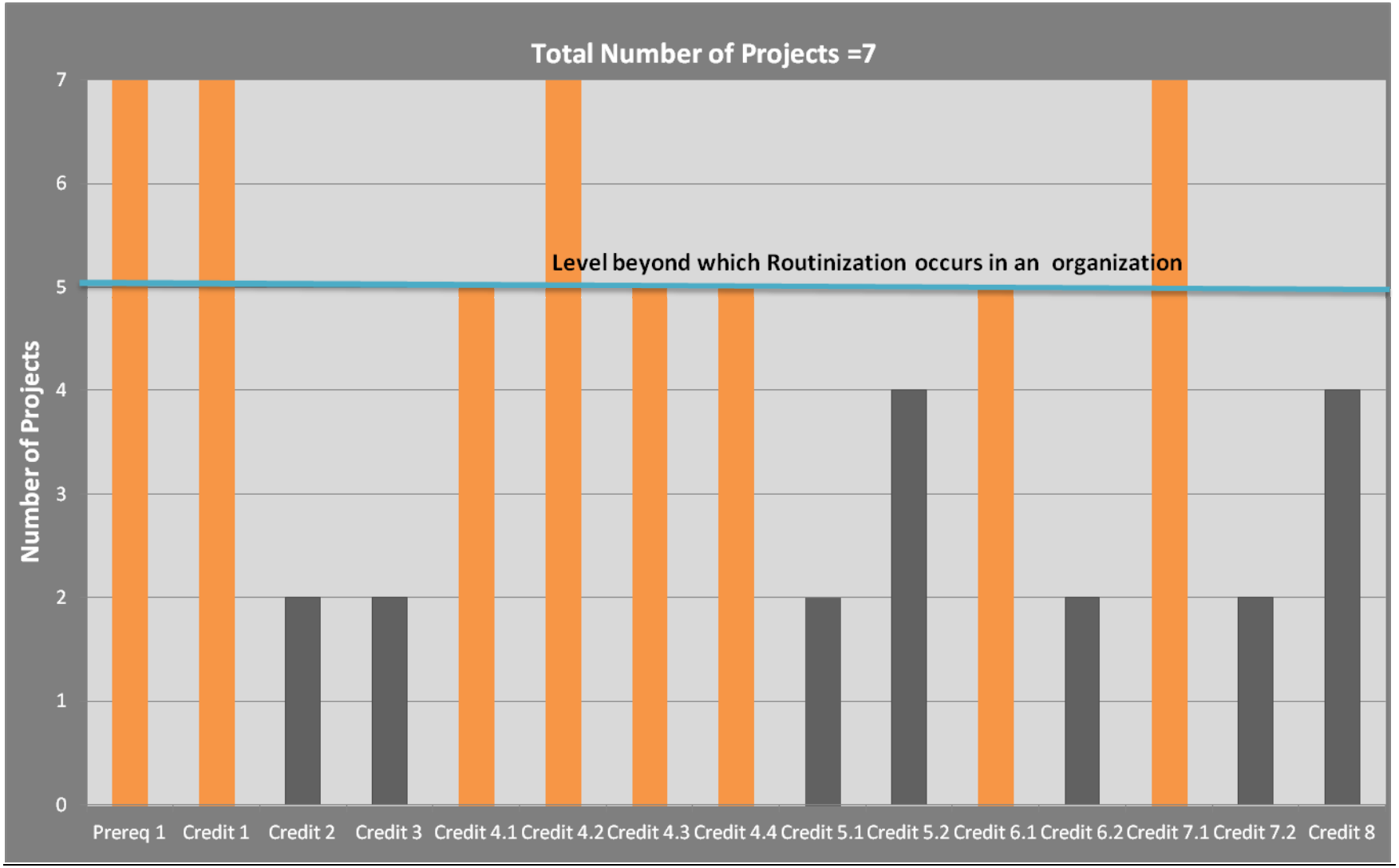

Figure 20a: Site Selection for City of Austin, Texas

Table 13b: Water Efficiency for City of Austin, Texas

	Name of the University Facility	Combined Transportation Emergency & Communications Centre	Far Southeast Austin EMS Station # 28	George Washington Carver Museum & Cultural Centre	George Washington Carver Branch Library	Austin City Hall & Public Plaza	Circle C EMS & Fire Station	Austin Resource Centre for the Homeless
	Year of Certification	3/17/2004	7/13/2005	15-Jun-06	6/15/2006	8/14/2006	9/15/2006	22/02/2008
	points Achieved	2	4	2	2	2	2	4
Credit No	**Name of the Credit**							
Credit 1.1	Water efficient landscaping, Reduce By 50%	✓	✓	○	○	✓	✓	✓
Credit 1.2	Water efficient landscaping, No Portable Use or Irrigation	✓	✓	○	○	✓	✓	○
Credit 2	Innovative wastewater technologies	○	○	○	○	○	○	✓
Credit 3.1	Water Use Reduction, 20% Reduction	○	✓	✓	✓	○	○	✓
Credit 3.2	Water Use Reduction, 30% Reduction	○	✓	✓	✓	○	○	✓

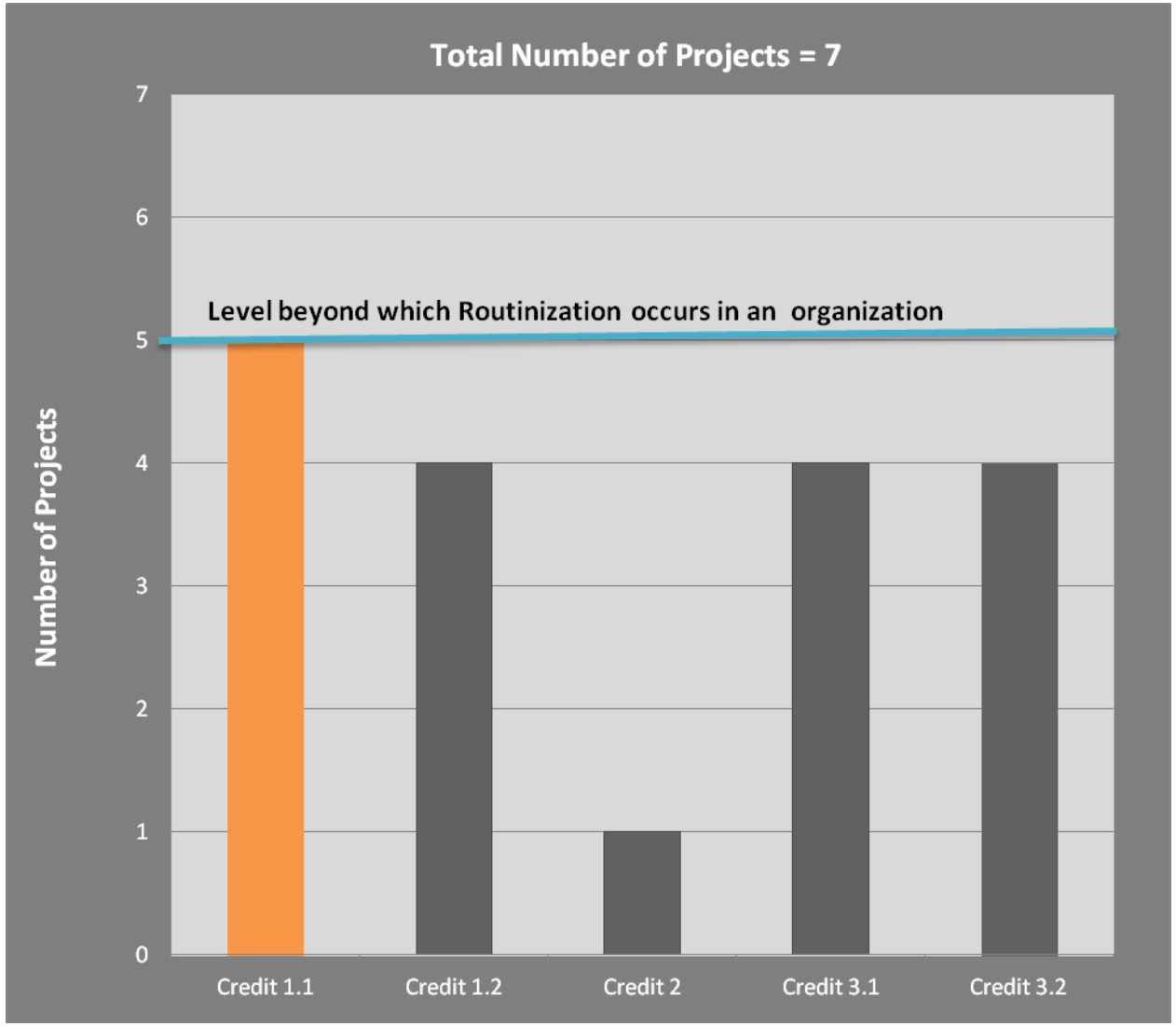

Figure 20b: Water Efficiency for City of Austin, Texas

Table 13c: Energy & Atmosphere for City of Austin, Texas

	Name of the University Facility	Combined Transportation Emergency & Communications Centre	Far Southeast Austin EMS Station # 28	George Washington Carver Museum & Cultural Centre	George Washington Carver Branch Library	Austin City Hall & Public Plaza	Circle C EMS & Fire Station	Austin Resource Centre for the Homeless
	Year of Certification	3/17/2004	7/13/2005	6/15/2006	6/15/2006	8/14/2006	9/15/2006	2/22/2008
	Points Achieved	5	7	2	2	13	9	2
Credit No	**Name of the Credit**							
Prereq 1	Fundamental Building Systems Commissioning	✓	✓	✓	✓	✓	✓	✓
Prereq 2	Minimum energy performance	✓	✓	✓	✓	✓	✓	✓
Prereq 3	CFC Reduction in HVAC&R Equipment	✓	✓	✓	✓	✓	✓	✓
Credit 1.1	Optimize Energy Performance,	✓	✓	○	○	✓	✓	○
Credit 1.2	Optimize Energy Performance	✓	✓	○	○	✓	✓	○
Credit 1.3	Optimize Energy Performance	○	✓	○	○	✓	✓	○
Credit 1.4	Optimize Energy Performance	○	○	○	○	✓	○	○
Credit 1.5	Optimize Energy Performance	○	○	○	○	✓	○	○
Credit 2.1	Renewable Energy, 5%	○	○	○	○	○	○	○
Credit 2.2	Renewable Energy, 10%	○	○	○	○	○	○	○
Credit 2.3	Renewable Energy, 15%	○	○	○	○	○	○	○
Credit 3	Additional commissioning	✓	○	✓	✓	✓	✓	○
Credit 4	Ozone depletion	✓	✓	○	○	✓	✓	✓
Credit 5	Measurement & Verification	○	○	○	○	✓	○	○
Credit 6	Green Power	○	○	✓	✓	✓	✓	✓

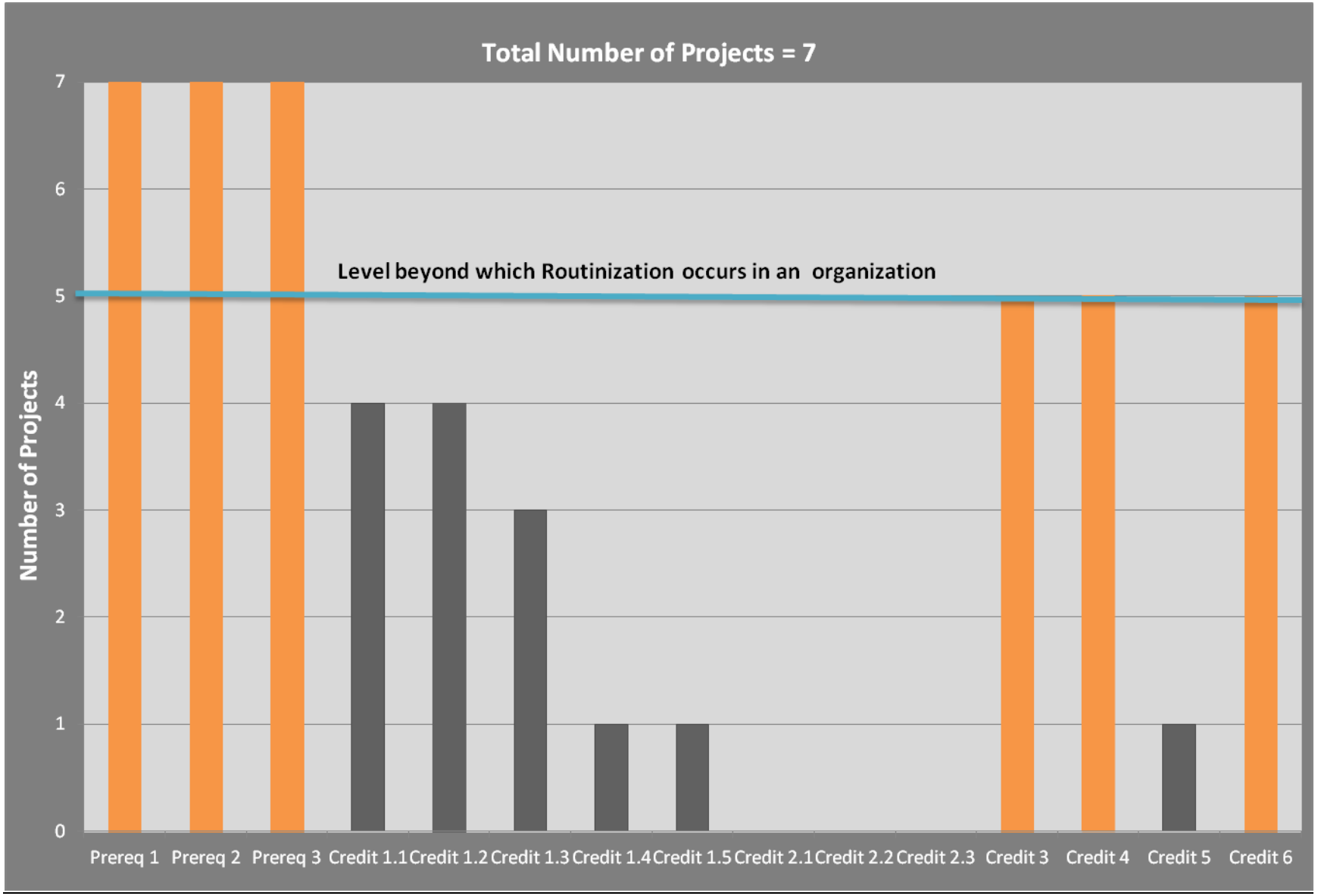

Figure 20c: Energy & Atmosphere for City of Austin, Texas

Table 13d: Material & Resource for City of Austin, Texas

	Name of the University Facility	Combined Transportation Emergency & Communications Centre	Far Southeast Austin EMS Station # 28	George Washington Carver Museum & Cultural Centre	George Washington Carver Branch Library	Austin City Hall & Public Plaza	Circle C EMS & Fire Station	Austin Resource Centre for the Homeless
	Year of Certification	3/17/2004	7/13/2005	6/15/2006	6/15/2006	8/14/2006	9/15/2006	2/22/2008
	Points Achieved	5	4	5	7	6	6	6
Credit No	**Name of the Credit**							
Prereq1	Storage and collection of recyclables	✓	✓	✓	✓	✓	✓	✓
Credit 1.1	Building Reuse	O	O	O	✓	O	O	O
Credit 1.2	Building Reuse	O	O	O	O	O	O	O
Credit 1.3	Building Reuse	O	O	O	O	O	O	O
Credit 2.1	Construction waste management	O	O	✓	✓	✓	✓	✓
Credit 2.2	Construction waste management	O	O	O	✓	✓	O	✓
Credit 3.1.	Materials reuse	O	O	O	O	O	O	O
Credit 3.1.	Materials reuse	O	O	O	O	O	O	O
Credit 4.1	Recycled Content	✓	✓	✓	✓	✓	✓	✓
Credit 4.2	Recycled Content	✓	✓	✓	✓	✓	✓	✓
Credit 5.1	Regional Materials	✓	✓	✓	✓	✓	✓	✓
Credit 5.2	Regional Materials	✓	✓	✓	✓	✓	✓	✓
Credit 6	Rapidly Renewable Materials	O	O	O	O	O	O	O
Credit 7	Certified Wood	✓	O	O	O	O	✓	O

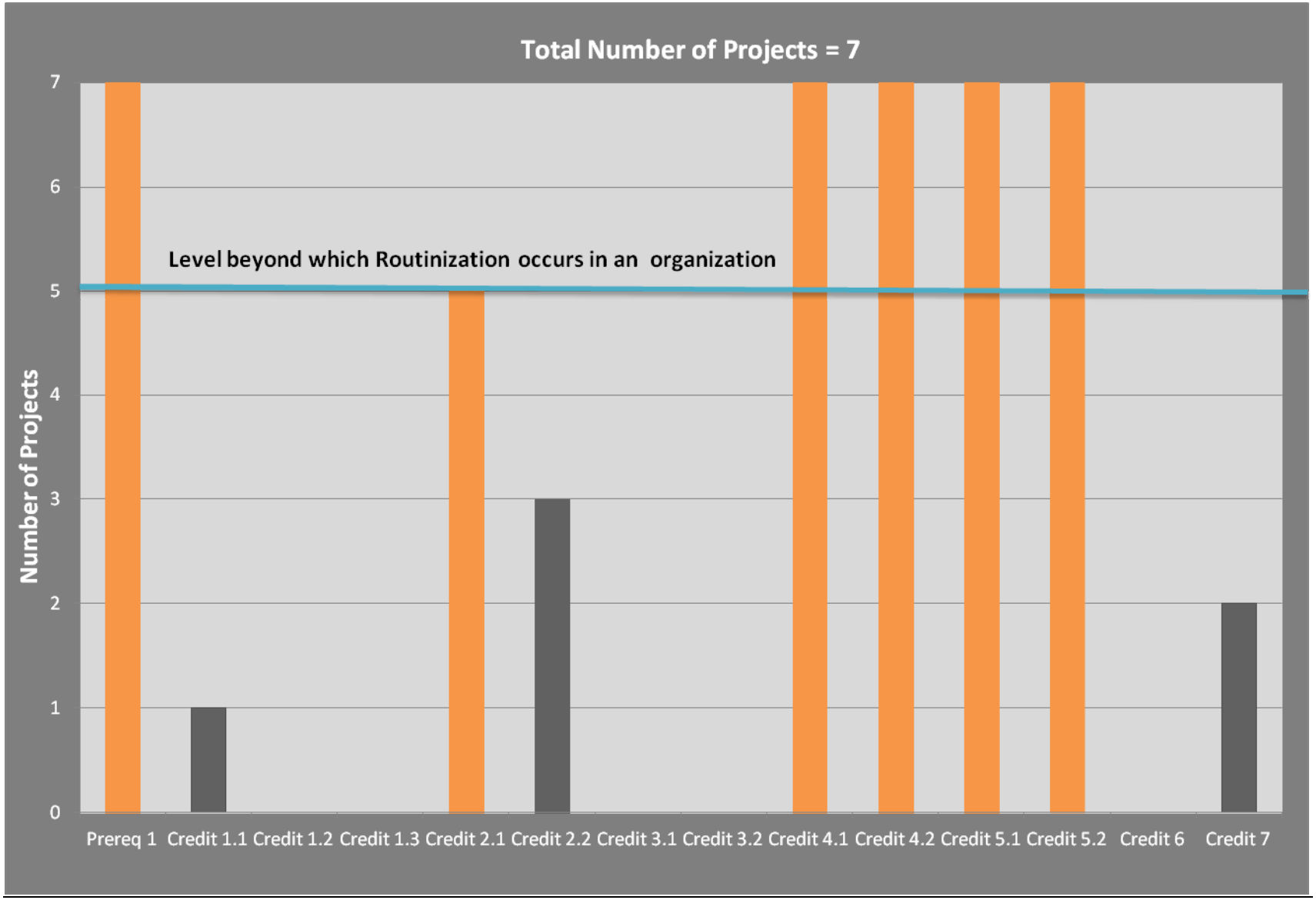

Figure 20d: Material & Resource for City of Austin, Texas

Table 13e: Indoor Air Quality for City of Austin, Texas

	Name of the University Facility	Combined Transportation Emergency & Communications Centre	Far Southeast Austin EMS Station # 28	George Washington Carver Museum & Cultural Centre	George Washington Carver Branch Library	Austin City Hall & Public Plaza	Circle C EMS & Fire Station	Austin Resource Centre for the Homeless
	Year of Certification	3/17/2004	7/13/2005	6/15/2006	6/15/2006	8/14/2006	9/15/2006	2/22/2008
	Points Achieved	9	12	9	7	9	8	6
Credit No	**Name of the Credit**							
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓	✓	✓	✓	✓	✓	✓
Prereq 2	Environmental Tobacco Smoke Control	✓	✓	✓	✓	✓	✓	✓
Credit 1	Outdoor air delivery monitoring	✓	✓	○	○	○	○	○
Credit 2	Increased ventilation	○	○	○	○	○	○	○
Credit 3.1	Construction IAQ management plan	✓	○	○	○	✓	○	○
Credit 3.2	Construction IAQ management plan	✓	○	✓	✓	✓	○	○
Credit 4.1	Low –Emitting Materials	✓	✓	○	○	✓	✓	○
Credit 4.2	Low –Emitting Materials	○	✓	✓	✓	✓	✓	✓
Credit 4.3	Low –Emitting Materials	✓	✓	✓	✓	✓	✓	✓
Credit 4.4	Low –Emitting Materials	✓	✓	✓	✓	✓	○	○
Credit 5	Indoor chemical and pollution source control	○	✓	✓	✓	✓	✓	✓
Credit 6.1	Controllability of systems	○	✓	○	○	○	✓	○
Credit 6.2	Controllability of systems	✓	✓	○	○	○	○	○
Credit 7.1	Thermal Comfort	✓	✓	✓	✓	✓	✓	✓
Credit 7.2	Thermal Comfort	✓	✓	✓	✓	✓	○	○
Credit 8.1	Day lighting & Views	○	✓	✓	○	○	✓	✓
Credit 8.2	Day lighting & Views	○	✓	✓	○	○	✓	✓

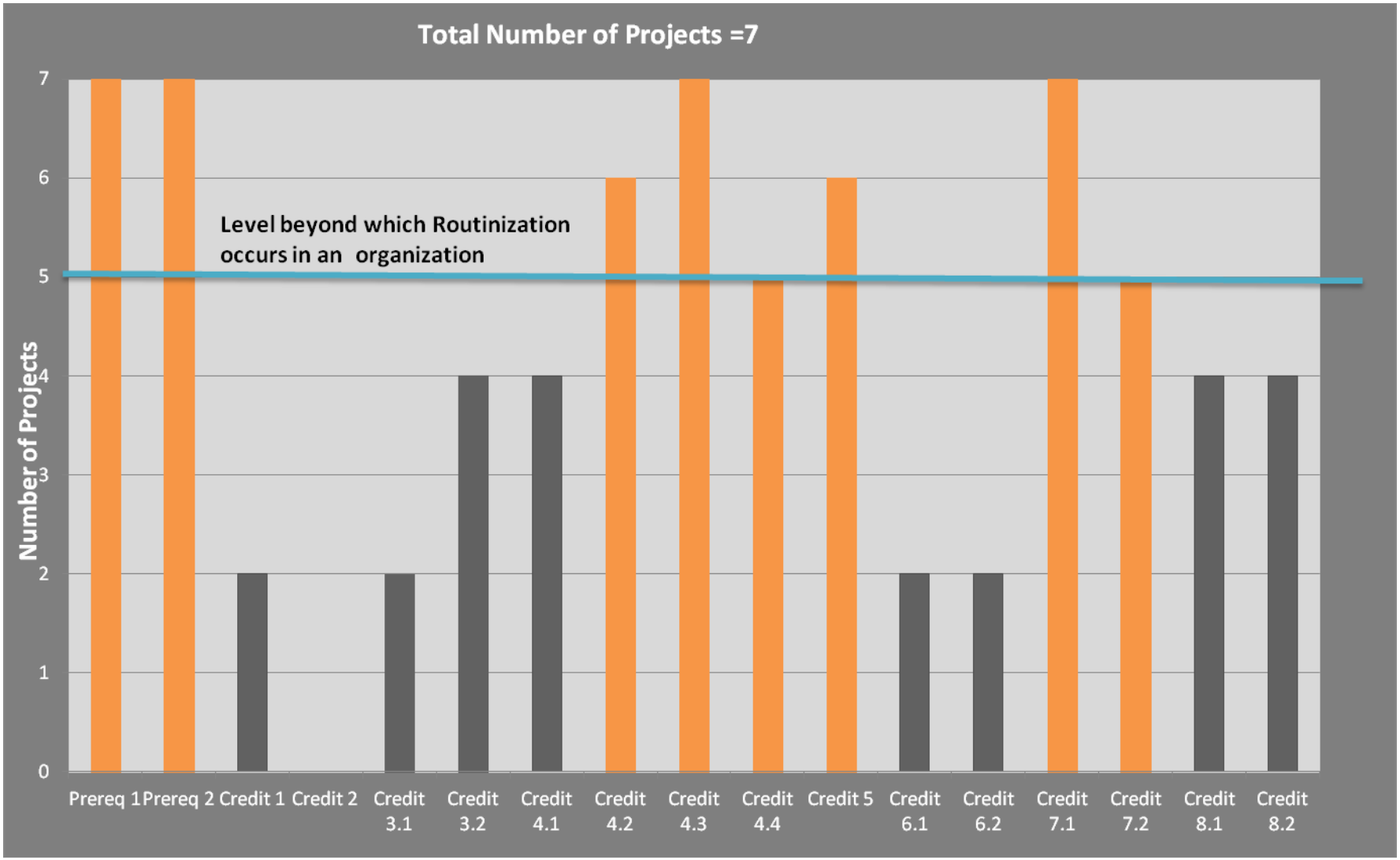

Figure 20e: Indoor Air Quality for City of Austin, Texas

Table 14a: Site Selection for City of Seattle, Washington.

	Name of the University Facility	Carkeek Park Environmental Learning Center	Fisher Pavilion	City of Seattle Justice Center,	High Point Community Center Addition	Park 90/5 Building C	Seattle Central Library,	Seattle City Hall	Yesler Community Center
	Year of Certification	11/3/2003	4/28/2004	8/12/2004	9/22/2004	10/25/2004	11/22/2004	9/26/2005	8/22/2006
	Points Achieved	**2**	**5**	**9**	**9**	**7**	**7**	**8**	**11**
Credit No	**Name of the Credit**								
Prereq 1	Erosion & Sedimentation Control	✓	✓	✓	✓	✓	✓	✓	✓
Credit 1	Site Selection	✓	✓	✓	✓	✓	✓	✓	✓
Credit 2	Urban Redevelopment Density	○	○	✓	○	○	✓	✓	✓
Credit 3	Brownfield Redevelopment	○	○	○	○	○	○	○	✓
Credit 4.1	Alternative Transportation	○	✓	✓	✓	✓	✓	✓	✓
Credit 4.2	Alternative Transportation	○	✓	✓	✓	✓	✓	✓	✓
Credit 4.3	Alternative Transportation	○	○	✓	○	○	○	✓	✓
Credit 4.4	Alternative Transportation	✓	○	✓	✓	✓	○	○	✓
Credit 5.1	Reduced Site Disturbance	✓	○	○	✓	○	○	○	○
Credit 5.2	Reduced Site Disturbance	✓	✓	○	✓	○	○	○	✓
Credit 6.1	Storm water Management	✓	○	○	✓	○	○	✓	○
Credit 6.2	Storm water Management	✓	○	✓	✓	○	○	✓	○
Credit 7.1	Reduce Heat Islands	✓	✓	✓	○	✓	✓	✓	✓
Credit 7.2	Reduce Heat Islands	✓	○	✓	○	✓	✓	○	✓
Credit 8	Light Pollution Reduction	○	○	○	✓	✓	✓	○	✓

Platinum		Routinized 100%	
Gold		Routinized 75%	
Silver			
Certified			

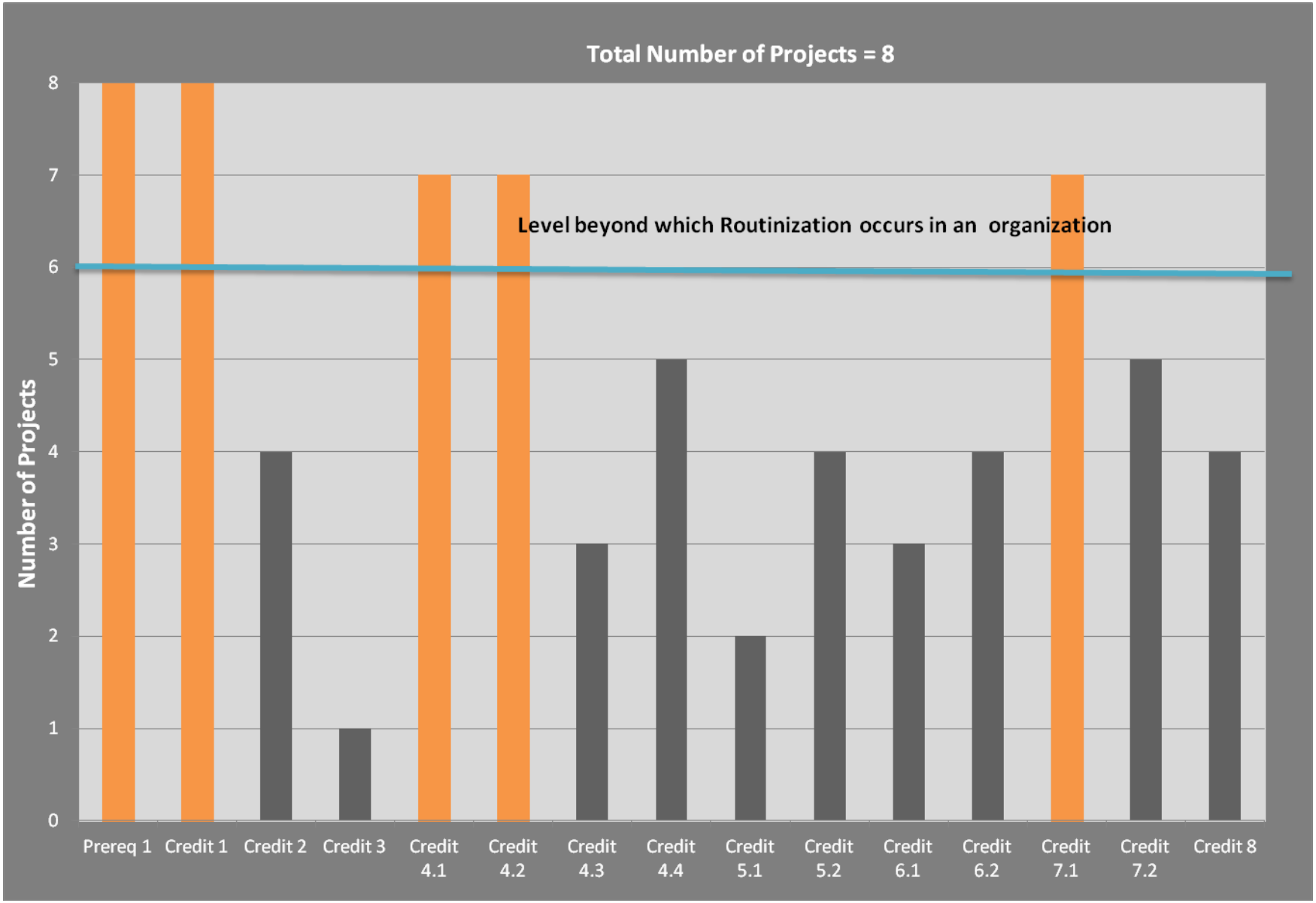

Figure 21a: Site Selection for City of Seattle, Washington.

Table 14b: Water Efficiency for City of Seattle, Washington.

	Name of the University Facility	Carkeek Park Environmental Learning Center	Fisher Pavilion	City of Seattle Justice Center,	High Point Community Center Addition	Park 90/5 Building C	Seattle Central Library,	Seattle City Hall	Yesler Community Center
	Year of Certification	11/3/2003	4/28/2004	8/12/2004	9/22/2004	10/25/2004	11/22/2004	9/26/2005	8/22/2006
Credit No	**Name of the Credit**								
Credit 1.1	Water efficient landscaping	✓	✓	✓	✓	✓	✓	✓	✓
Credit 1.2	Water efficient landscaping	○	○	✓	✓	✓	✓	✓	○
Credit 2	Innovative wastewater technologies	○	○	○	○	✓	○	✓	○
Credit 3.1	Water Use Reduction	✓	○	○	○	✓	✓	✓	✓
Credit 3.2	Water Use Reduction	○	○	○	○	✓	○	✓	✓

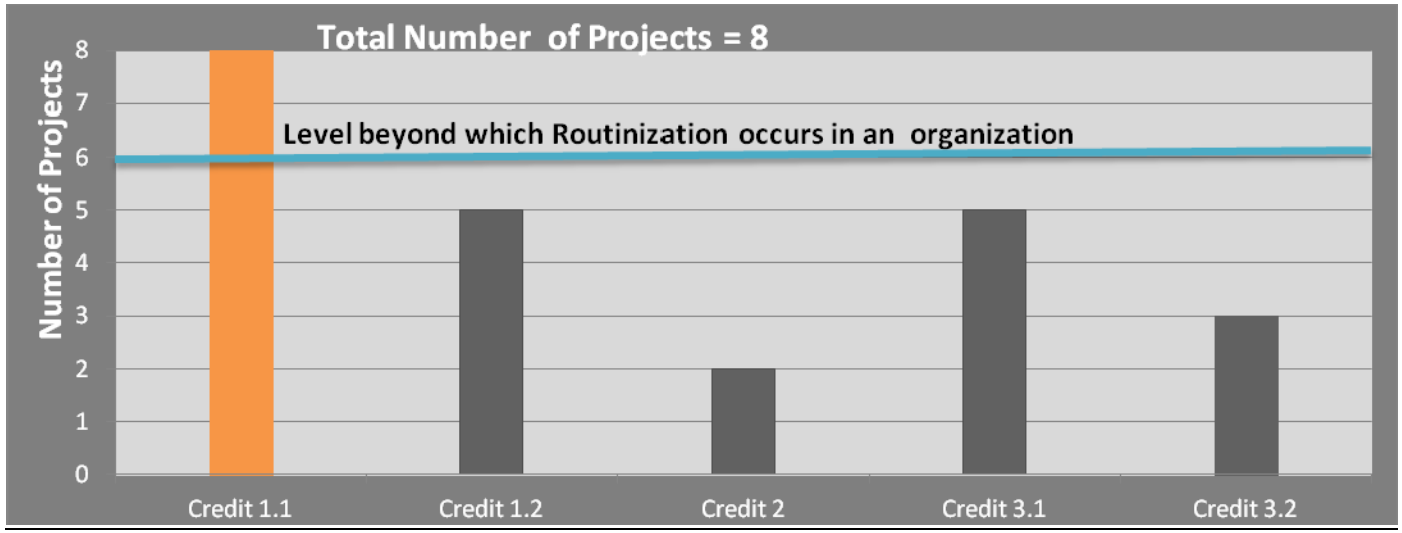

Figure 21b: Water Efficiency for City of Seattle, Washington.

Table 14c: Energy & Atmosphere for City of Seattle, Washington.

	Name of the University Facility	Carkeek Park Environmental Learning Center	Fisher Pavilion	City of Seattle Justice Center,	High Point Community Center Addition	Park 90/5 Building C	Seattle Central Library,	Seattle City Hall	Yesler Community Center
	Year of Certification	11/3/2003	4/28/2004	8/12/2004	9/22/2004	10/25/2004	11/22/2004	9/26/2005	8/22/2006
	Points Achieved	**13**	**2**	**7**	**5**	**9**	**9**	6	8
Credit No	**Name of the Credit**								
Prereq 1	Fundamental Building Systems Commissioning	✓	✓	✓	✓	✓	✓	✓	✓
Prereq 2	Minimum energy performance	✓	✓	✓	✓	✓	✓	✓	✓
Prereq 3	CFC Reduction in HVAC&R Equipment	✓	✓	✓	✓	✓	✓	✓	✓
Credit 1.1	Optimize Energy Performance	✓	○	✓	✓	✓	✓	✓	✓
Credit 1.2	Optimize Energy Performance	✓	○	✓	✓	✓	✓	✓	✓
Credit 1.3	Optimize Energy Performance	✓	○	✓	○	✓	✓	○	✓
Credit 1.4	Optimize Energy Performance	✓	○	○	○	○	○	○	○
Credit 1.5	Optimize Energy Performance	○	○	○	○	○	○	○	○
Credit 2.1	Renewable Energy, 5%	✓	○	○	○	○	○	○	○
Credit 2.2	Renewable Energy, 10%	✓	○	○	○	○	○	○	○
Credit 2.3	Renewable Energy, 15%	✓	○	○	○	○	○	○	○
Credit 3	Additional commissioning	✓	✓	✓	○	✓	✓	✓	○
Credit 4	Ozone depletion	○	✓	○	✓	✓	✓	○	✓
Credit 5	Measurement & Verification	○	○	✓	✓	✓	✓	✓	○
Credit 6	Green Power	✓	○	○	○	○	○	○	✓

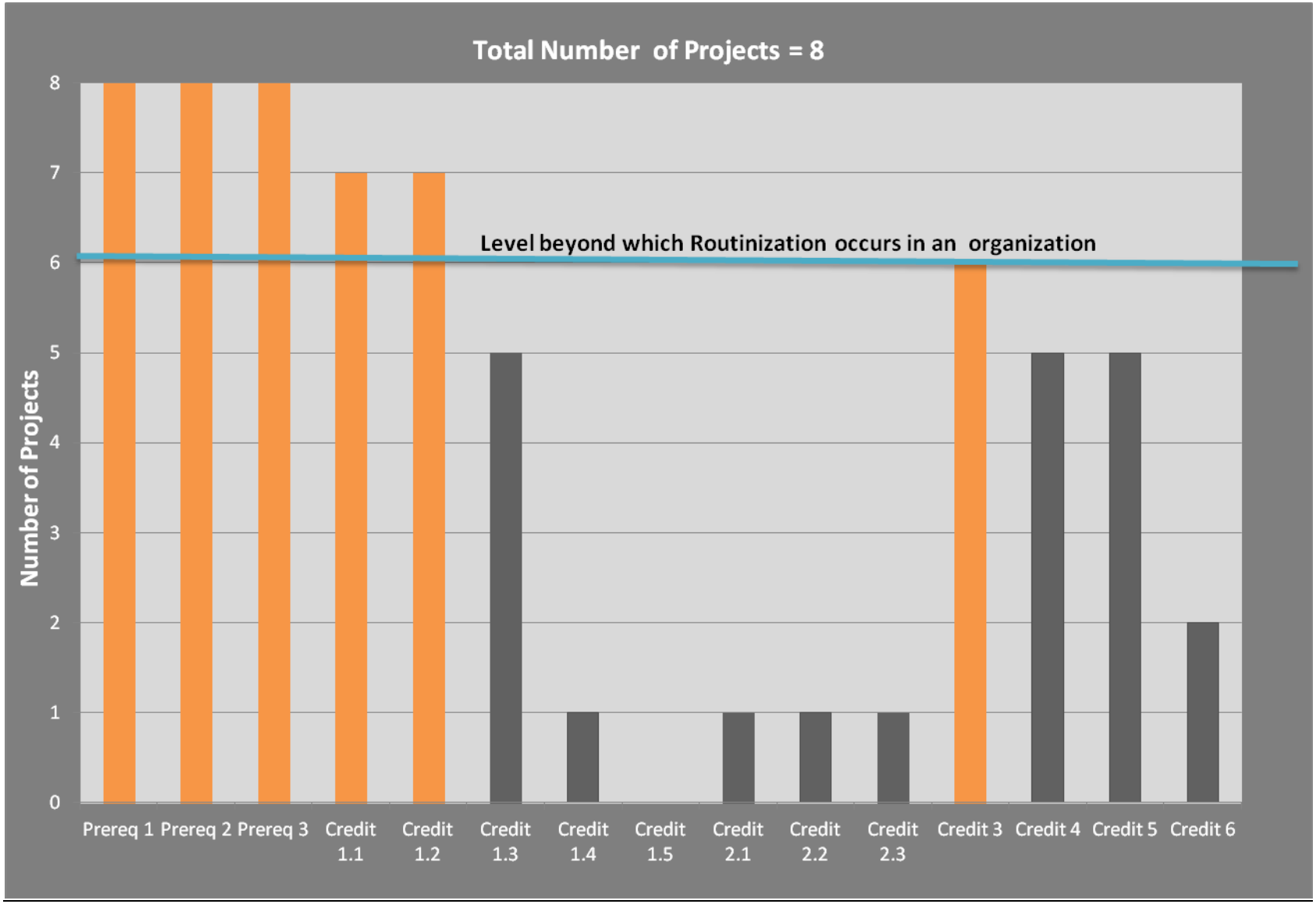

Figure 21c: Energy & Atmosphere for City of Seattle, Washington.

Table 14d: Material & Resources for City of Seattle, Washington.

	Name of the University Facility	Carkeek Park Environmental Learning Center	Fisher Pavilion	City of Seattle Justice Center,	High Point Community Center Addition	Park 90/5 Building C	Seattle Central Library,	Seattle City Hall	Yesler Community Center
	Year of Certification	11/3/2003	4/28/2004	8/12/2004	9/22/2004	10/25/2004	11/22/2004	9/26/2005	8/22/2006
	Points Achieved	4	6	4	2	11	6	**5**	**6**
Credit No	**Name of the Credit**								
Prereq1	Storage and collection of recyclables	✓	✓	✓	✓	✓	✓	✓	✓
Credit 1.1	Building Reuse	○	○	○	○	✓	○	○	○
Credit 1.2	Building Reuse	○	○	○	○	✓	○	○	○
Credit 1.3	Building Reuse	○	○	○	○	○	○	○	○
Credit 2.1	Construction waste management	✓	✓	✓	✓	✓	✓	✓	✓
Credit 2.2	Construction waste management	✓	✓	✓	✓	✓	✓	✓	✓
Credit 3.1.	Materials reuse	○	○	○	○	✓	○	○	○
Credit 3.1.	Materials reuse	○	○	○	○	✓	○	○	○
Credit 4.1	Recycled Content	○	✓	✓	○	✓	✓	✓	✓
Credit 4.2	Recycled Content	○	✓	○	○	✓	✓	✓	✓
Credit 5.1	Regional Materials	✓	✓	✓	○	✓	✓	✓	✓
Credit 5.2	Regional Materials	✓	✓	○	○	✓	✓	○	✓
Credit 6	Rapidly Renewable Materials	○	○	○	○	○	○	○	○
Credit 7	Certified Wood	○	○	○	○	✓	○	○	○

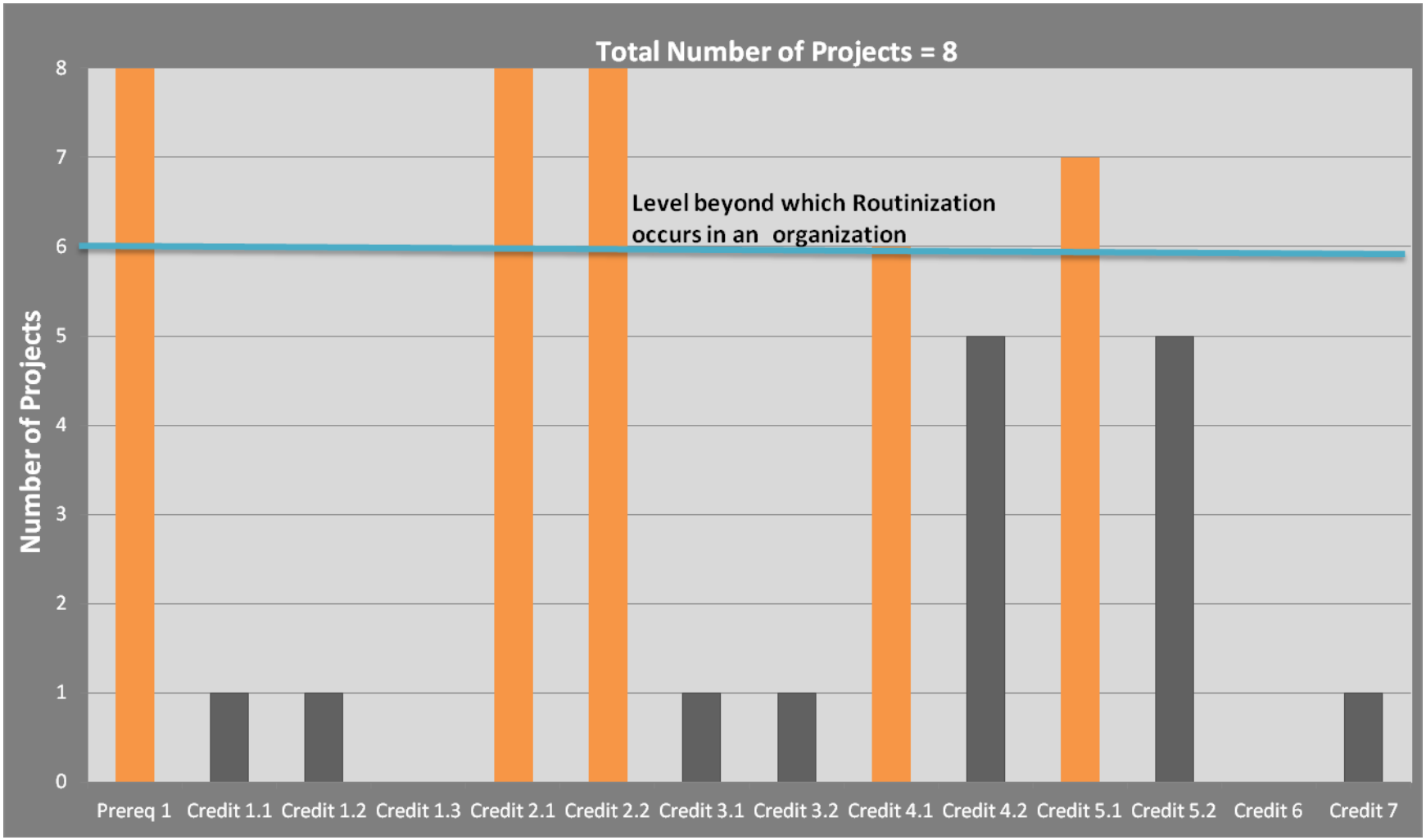

Figure 21d: Material & Resources for City of Seattle, Washington.

Table 14e: Indoor Environmental Quality for City of Seattle, Washington.

	Name of the University Facility	Carkeek Park Environmental Learning Center	Fisher Pavilion	City of Seattle Justice Center,	High Point Community Center Addition	Park 90/5 Building C	Seattle Central Library,	Seattle City Hall	Yesler Community Center
	Year of Certification	11/3/2003	4/28/2004	8/12/2004	9/22/2004	10/25/2004	11/22/2004	9/26/2005	8/22/2006
	Project No	# 0097	# 0194	# 0017	# 0550	# 0034	# 0007	# 0043	# 10000560
Credit No	**Points Achieved**	**11**	**10**	**8**	**7**	**8**	**5**	13	11
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓	✓	✓	✓	✓	✓	✓	✓
Prereq 2	Environmental Tobacco Smoke Control	✓	✓	✓	✓	✓	✓	✓	✓
Credit 1	Outdoor air delivery monitoring	✓	✓	✓	○	○	○	✓	○
Credit 2	Increased ventilation	○	○	○	○	○	○	✓	✓
Credit 3.1	Construction IAQ management plan	✓	✓	✓	✓	✓	✓	✓	✓
Credit 3.2	Construction IAQ management plan	✓	✓	✓	✓	○	✓	✓	✓
Credit 4.1	Low –Emitting Materials	✓	✓	✓	○	✓	○	✓	✓
Credit 4.2	Low –Emitting Materials	✓	✓	✓	○	✓	○	✓	✓
Credit 4.3	Low –Emitting Materials	✓	✓	✓	✓	✓	✓	✓	✓
Credit 4.4	Low –Emitting Materials	✓	○	○	✓	✓	○	✓	✓
Credit 5	Indoor chemical and pollution source control	○	✓	✓	✓	✓	○	○	✓
Credit 6.1	Controllability of systems	✓	○	○	○	○	○	○	✓
Credit 6.2	Controllability of systems	○	○	○	○	○	○	✓	✓
Credit 7.1	Thermal Comfort	✓	✓	○	✓	✓	✓	✓	✓
Credit 7.2	Thermal Comfort	○	✓	✓	○	✓	○	○	○
Credit 8.1	Day lighting & Views	✓	○	○	○	○	○	○	✓
Credit 8.2	Day lighting & Views	✓	✓	○	✓	○	✓	○	✓

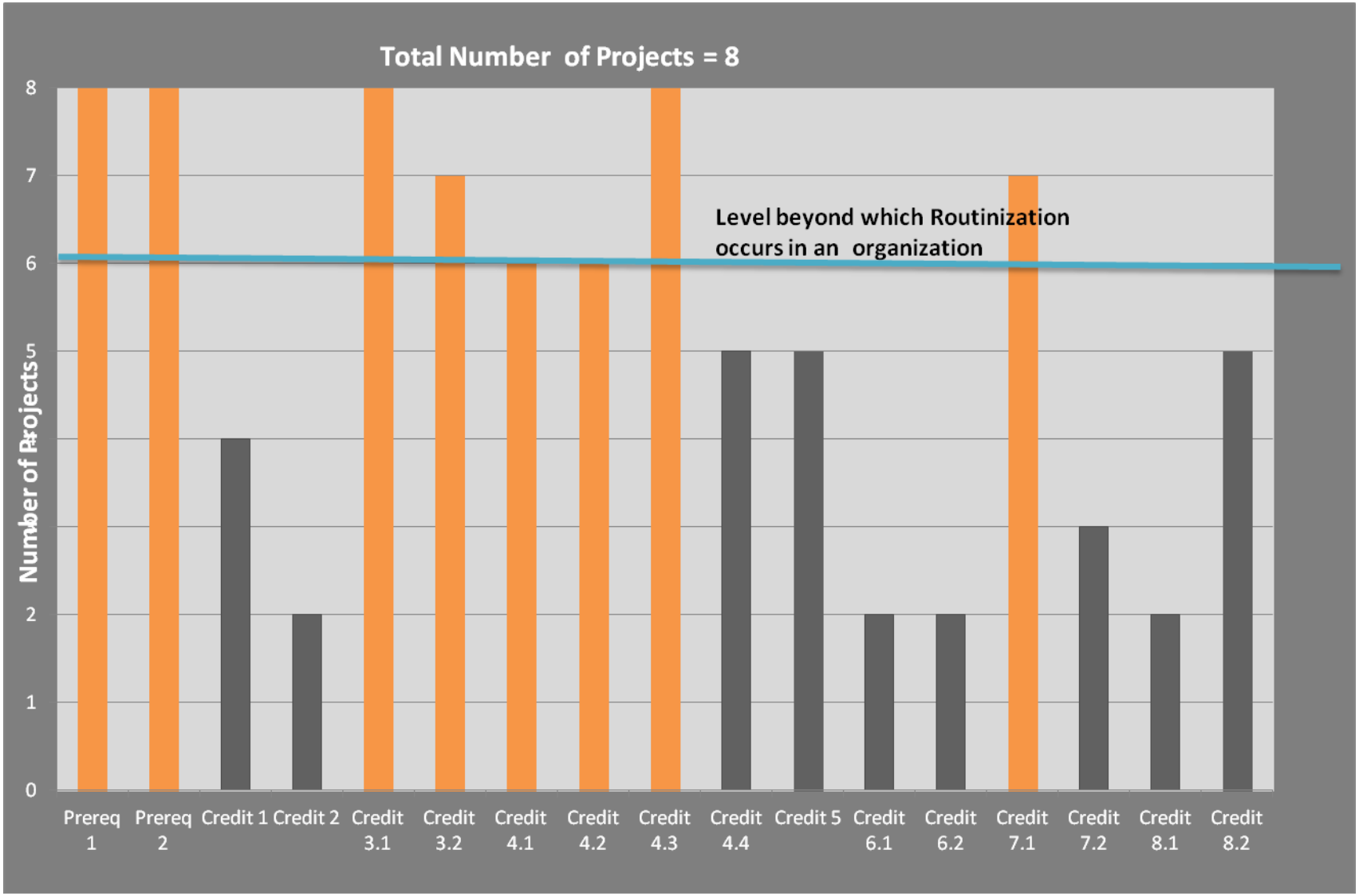

Figure 21e: Indoor Environmental Quality for City of Seattle, Washington.

Appendix III

Segregation of LEED Checklist:

This appendix revolves around the segregation of the LEED checklist based on the attributes of the innovation discussed earlier. As mentioned earlier in the methodology, this appendix is the end result of the following steps which were done in tandem both by the researcher and the expert panel. The steps that led to the segregation of the LEED checklist are as following:

1. Establish Constructs.
2. Researcher Segregation.
3. Expert Segregation.
4. Inter-Rater Reliability.

Once the Inter-Rater Reliability of 100% was achieved, the segregated LEED checklist became the final outcome of this step.

Table 15a: Segregation of LEED Checklist for *Sustainable Sites*

	Site Selection									
Credit No.	**Name of the Credit.**	**Incremental Innovation**	**Radical Innovation**		**Product Innovation**	**Contextual**	**Process Innovation**		**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Erosion & Sedimentation Control	✓			✓				✓	
Credit 1	Site Selection	✓					✓			✓
Credit 2	Urban Redevelopment Density	✓					✓			✓
Credit 3	Brownfield Redevelopment		✓		✓					✓
Credit 4.1	Alternative Transportation	✓			✓					✓
Credit 4.2	Alternative Transportation	✓			✓					✓
Credit 4.3	Alternative Transportation		✓		✓					✓
Credit 4.4	Alternative Transportation	✓					✓		✓	
Credit 5.1	Reduced Site Disturbance	✓			✓				✓	
Credit 5.2	Reduced Site Disturbance	✓			✓					✓
Credit 6.1	Storm water Management		✓		✓					✓
Credit 6.2	Storm water Management		✓		✓					✓
Credit 7.1	Reduce Heat Islands	✓			✓				✓	
Credit 7.2	Reduce Heat Islands		✓		✓				✓	
Credit 8	Light Pollution Reduction		✓				✓		✓	

Table 15b: Segregation of LEED Checklist for *Water Efficiency*

	Water Efficiency									
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**		**Product Innovation**	**Contextual**	**Process Innovation**		**Direct Economic Innovation**	**Indirect Economic Innovation**
Credit 1.1	Water efficient landscaping	✓			✓				✓	
Credit 1.2	Water efficient landscaping		✓				✓		✓	
Credit 2	Innovative wastewater technologies		✓				✓		✓	
Credit 3.1	Water Use Reduction	✓			✓				✓	
Credit 3.2	Water Use Reduction	✓			✓				✓	

Table 15c: Segregation of LEED Checklist for *Energy & Atmosphere*

	Energy & Atmosphere									
Credit no.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**		**Product Innovation**	**Contextual**	**Process Innovation**		**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Fundamental Building Systems Commissioning		✓				✓		✓	
Prereq 2	Minimum energy performance	✓				✓			✓	
Prereq 3	CFC Reduction in HVAC&R Equipment	✓			✓					✓
Credit 1.1	Optimize Energy Performance		✓			✓			✓	
Credit 1.2	Optimize Energy Performance		✓			✓			✓	
Credit 1.3	Optimize Energy Performa		✓			✓			✓	
Credit 1.4	Optimize Energy Performance		✓			✓			✓	
Credit 1.5	Optimize Energy Performance		✓			✓			✓	
Credit 2.1	Renewable Energy		✓		✓				✓	
Credit 2.2	Renewable Energy		✓		✓				✓	
Credit 2.3	Renewable Energy		✓		✓				✓	
Credit 3	Additional commissioning		✓				✓		✓	
Credit 4	Ozone depletion	✓			✓					✓
Credit 5	Measurement & Verification		✓				✓		✓	
Credit 6	Green Power	✓			✓					✓

Table 15d: Segregation of LEED Checklist for *Material & Resources*

	Material & Resource									
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**		**Product Innovation**	**Contextual**	**Process Innovation**		**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq1	Storage and collection of recyclables.	✓			✓				✓	
Credit 1.1	Building Reuse	✓			✓				✓	
Credit 1.2	Building Reuse	✓			✓				✓	
Credit 1.3	Building Reuse	✓			✓				✓	
Credit 2.1	Construction waste management	✓			✓					✓
Credit 2.2	Construction waste management	✓			✓					✓
Credit 3.1	Materials reuse		✓		✓					✓
Credit 3.2	Materials reuse		✓		✓					✓
Credit 4.1	Recycled Content	✓			✓					✓
Credit 4.2	Recycled Content	✓			✓					✓
Credit 5.1	Regional Materials	✓			✓					✓
Credit 5.2	Regional Materials	✓			✓					✓
Credit 6	Rapidly Renewable Materials	✓			✓					✓
Credit 7	Certified Wood	✓			✓					✓

Table 15e: Segregation of LEED Checklist for Indoor *Environmental Quality*

	Indoor Environmental Quality									
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**		**Product Innovation**	**Contextual**	**Process Innovation**		**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓			✓				✓	
Prereq 2	Environmental Tobacco Smoke Control	✓					✓		✓	
Credit 1	Outdoor air delivery monitoring		✓				✓		✓	
Credit 2	Increased ventilation	✓			✓				✓	
Credit 3.1	Construction IAQ management plan	✓			✓				✓	
Credit 3.2	Construction IAQ management plan	✓					✓		✓	
Credit 4.1	Low –Emitting Materials	✓			✓				✓	
Credit 4.2	Low –Emitting Materials	✓			✓				✓	
Credit 4.3	Low –Emitting Materials	✓			✓				✓	
Credit 4.4	Low –Emitting Materials	✓			✓				✓	
Credit 5	Indoor chemical and pollution source control	✓			✓				✓	
Credit 6.1	Controllability of systems	✓					✓		✓	
Credit 6.2	Controllability of systems	✓					✓		✓	
Credit 7.1	Thermal Comfort	✓			✓				✓	
Credit 7.2	Thermal Comfort		✓				✓		✓	
Credit 8.1	Day lighting & Views		✓		✓				✓	
Credit 8.2	Day lighting & Views	✓			✓				✓	

Sustainable Sites

The main aim of this category is to reduce the effects of human development on the environment and the biosphere. Human development always has an impact but with sensible redevelopment and effective use of technologies, the effects caused by the development can be reduced to the minimal. The USGBC also stresses on features like development of Brownfield, reduction in hard and impervious surfaces, urban development, and use of mass transportation by the occupants. This category has mainly one prerequisite and eight credits which are as follows:

1. Construction Activity Pollution Prevention
2. Site Selection
3. Development Density and Community Connectivity
4. Brownfield Redevelopment
5. Alternative Transportation
6. Site Development- Protect or Restore Habitat
7. Storm water Management- Quantity Control
8. Heat Island Effect
9. Light Pollution Reduction

SS Prerequisiste1 (Construction Activity Pollution Prevention):

Intent:

The main intent of this credit is to reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation.

Requirement:

- Create and implement an Erosion and Sedimentation Control (ESC) Plan for all construction activities that are associated with the project; and it shall conform to the sedimentation and erosion requirements of the 2003 EPA Construction General Permit or local sedimentation control standards and codes, whichever is stringent.

Type of Innovation:

Product or Process:

This credit is a product innovation because the owner has to pay for the products that reduce soil erosion and dust generation. Also the owner achieves this credit by using the innovation in the form of products. Hence, the owner achieves this innovation within the facility by installing these products and so the credit is a product innovation.

Direct or Indirect Economic Innovation:

The benefits from this are direct economic benefits to the owner. This credit mainly aims at reducing soil erosion, water sedimentation and dust generated from the site which in the long run reduces the chances of infertile soil and further enhances the aquatic life in the vicinity. This credit results in the owner saving money on the purchase of the fertile soil as the soil does not erode into the streams during the construction season. Hence this innovation is a direct economic benefit to the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as the owner has to abide either to erosion and sedimentation requirements of the 2003 EPA Construction General Permit or local sedimentation control standards and codes, whichever is stringent. So this innovation actually builds up on the existing knowledge as we have assumed that the owner is familiar with the local codes set by the EPA, ASRAE and local municipal codes for contemporary buildings.

SS Credit 1 (Site Selection):

Intent:

The main intent of this credit is to avoid the development of the inappropriate sites and reduce the environmental impacts from the location of building on a site.

Requirement:

The main requirement for this credit is to ensure that the owner does not develop building, roads or parking or any part of the site that meets the following criterion:

- Prime farmland as defined by the United Stated Department of Agriculture.
- Previously undeveloped land whose elevation is lower than five feet above the elevation of the 100 year flood as defined by FEMA (Federal Emergency Management Agency).
- Land that is specifically identified as habitat for any species on Federal or State endangered lists.
- Land within 100 feet of any wetland as defined by United States Codes of Federal Regulation, or within setback distance of the wetlands, prescribed in the state or local regulation, whichever is stringent.
- Previously undeveloped land that is within 50 feet of the water-body, defined as sea, streams, tributaries, lakes which support or could support fish, recreation, industrial use, consistent with the terminology of the Clean Water Act.
- Land which prior to the acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation because the owner along with the architect and other stakeholders has to select a site that meets the requirements of this credit. This innovation requires the owner to adapt to different operating conditions that are otherwise preferred or are default. Hence this credit is a process innovation.

Direct or Indirect Economic Innovation:

The benefits from this are indirect economic benefits to the owner because the benefits are intangible, difficult to quantify, also benefits do not involve actual changes to owner cash flows during building operation. The society is benefitted by having the habitat for endangered species, prime farm land, public parks and land near water bodies protected. Also, the owner would have to pay a higher first cost for the site selection and the survey process. At the same time, if the owner prescribes to the requirements of the

credit then he reduces considerable risks that are generated from landslides, floods, soil erosion and sinkholes. However, these costs cannot be quantified, so this credit is categorized as an indirect economic innovation to the owner

Radical Innovation or Incremental Innovation:

The credit is an incremental innovation as the owner has to select the site on the basis of the existing set standards. Also, the credit can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Hence, this innovation is an incremental innovation.

SS Credit 2 (Develop Density and Community Connectivity):

Intent:

The main intent of this credit is to channel the development to urban areas with existing infrastructure, project Greenfields and preserve natural resources.

Requirement:

OPTION 1- Development Density

- Construct or renovate a building on a previously developed site and in a community with a minimum density of 60,000 square feet per acre net.

OPTION 2- Community Connectivity

- Construct or renovate a building on a previously developed site and within .5 mile of a residential or neighborhood with an average density of 10 units per acre net and within .5 mile of at least 10 Basic Services and with a pedestrian access between the building and the services.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation because this credit can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Also this credit can result in the behavioral change to the owner during the operation and maintenance of the facility. Thus, this credit can be categorized into process innovation.

Direct or Indirect Economic Innovation:

The credit has an indirect economic benefit to the owner because the benefits are intangible, difficult to quantify and also benefits do not involve actual changes to owner cash flows during building operations.

Also, the owner might have to spend higher initially as this credit identifies sites that are in the high density; these sites are generally sold at a higher price in comparison to the sites of the same area but in the outskirts of an urban context.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as this credit can be achieved without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Hence, this innovation is an incremental innovation.

SS Credit 3 (Brownfield Redevelopment):

Intent:

The main intent of this credit is to rehabilitate the damaged sites where development is complicated by environmental contamination, reducing pressure on undeveloped land.

Requirement:

Develop on a site documented as contaminated or defined as a Brownfield by a local, state or federal state agency.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because it is entirely up to the owner to purchase whatever site he wants and when he decides to purchase this kind of site; the site helps him achieve this credit. Also the remediation process would be carried out by the specialty contractor who can be in any kind of contractual relationship with either the owner or the General Contractor. The general contractor would oversee the process and the owner would not actually oversee the process. Hence, this credit is a product innovation.

Direct or Indirect Economic Innovation:

The credit offers indirect economic benefits to the owner since the brownfield incentives are in some and not all states, and since public sector owner do not benefit from tax incentives. Thus this credit offers indirect economic benefit to the owner.

Radical Innovation or Incremental Innovation:

This credit is a radical innovation because it requires the use of a completely different type of system that is not currently used on the owner's buildings, and it also requires a domain knowledge specialist or specialty subcontractor to make the site habitable and usable as per the standards.

SS Credit4.1 (Alternative Transportation- Public Transport Access):

Intent:

The main intent of this credit is to reduce the pollution and land development impacts from automobile use.

Requirement:

Locate project within half mile of an existing – or planned and funded-commuter rail, light rail or subway station.

OR

Locate project within quarter mile of one or more stops for two or more public or campus bus lines usable by building occupants.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because the owner uses the facilities that are near the site as the products and also the owner provides the opportunity and allows occupants the ability to choose between mass transportation and private transportation.

Direct or Indirect Economic Innovation:

The benefit from this credit is indirect economic benefit to the owner because the benefits are intangible, difficult to quantify and do not involve actual changes to owner cash flows during building operation. Also, the owner might have to invest initially as this credit identifies sites that are in high density and these sites are generally sold at a higher price. The society would be benefitted by this credit as owner gives the choice of choosing mass transportation to the occupants. By doing so, there is a reduction in the overall dependency of the society on petroleum, and also, the pollution produced by such individual vehicles is reduced.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as this credit can be achieved without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Hence this innovation is an incremental innovation.

SS Credit 4.2 (Alternative Transportation - Bicycle storage and changing rooms):

Intent:

The main intent of this credit is to reduce the pollution and land development impacts from automobile use.

Requirement:

For commercial or institutional buildings, provide secure bicycle racks and storage for 5% or more of all the building users. Also provide shower and changing facilities in the building or within 200 yards of a building entrance.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation, because it requires the bicycle storage and the changing rooms to be installed as per the specifications mentioned in the credit, in order to achieve the credit. Hence this credit is a product innovation.

Direct or Indirect Economic Innovation:

The benefit from this credit is indirect economic benefit to the owner because the benefits are intangible, difficult to quantify and do not involve actual changes to owner cash flows during building operation.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as this credit can be achieved without the assistance of a domain knowledge specialist or specialty subcontractor. Hence, this innovation is an incremental innovation.

SS Credit 4.3 (Alternative Transportation- Low Emission & Fuel-Efficient Vehicles):

Intent:

The main intent of this credit is to reduce the pollution and land development impacts from the automobile use.

Requirement:

OPTION 1

- Provide low–emitting and fuel-efficient vehicles for 3% of full time equivalent (FTE) occupants and also provide preferred parking for these vehicles.

OPTION 2

- Provide preferred parking for the low-emitting and fuel-efficient vehicles for 5%of the total vehicle parking capacity of the site.

OPTION 3

- Install alternative fuel-efficient refueling station for 3% of the local total vehicle parking capacity of the site.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because it requires the owner either of the three options; (1) Provide low -emitting and fuel efficient vehicles (2) provide preferred parking for the low-emitting and fuel-efficient vehicles, and (3) install alternative fuel-efficient refueling station. So, by providing any of these facilities within the structure the owner is able to achieve this credit and thus this credit is a product innovation.

Direct or Indirect Economic Innovation:

The benefits from this credit are indirect economic benefits to the owner as benefits of providing tax incentives for such measure are there in some but not in all the states, and since public sector owners don't benefit from tax incentives. Thus this credit offers indirect economic benefit to the owner. However, the society would be benefitted as it would give incentives for the employees of the built facility to buy fuel efficient vehicles and further reduce the pollution, implying cleaner air for the society.

Radical or Incremental Innovation

It is a radical innovation because this credit requires the employment of a specialist for three of the options within the requirements. Thus this innovation is a radical innovation.

SS Credit 4.4 (Alternative Transportation- Parking Capacity):

Intent:

The main intent of this credit is to reduce the pollution and land development impacts from the automobile use.

Requirement:

OPTION 1- Non-Residential

- Size parking capacity to not exceed minimum local zoning requirements, and provide preferred parking for carpools and vanpools for 5% of the total provided parking spots.

OPTION 2- Non-Residential

- For projects that provide parking less than 5% of FTE building occupants provide preferred parking for carpools or vanpools, marked as such, 5% of total provided parking spaces.

OPTION 3- Residential

- Size parking not to exceed minimum local zoning requirements and provide infrastructure and support program to facilitate shared vehicle usage such as carpool drop-off areas, designated parking spots for vanpools, ride-boards and shuttle service to mass transit stations.

OPTION 4- All

- Provide no new parking.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation because this credit may force people to change their commuting habits due to lack of parking, unlike the bicycling and transit credits which offer an opportunity to change rather than forcing them. Hence, this credit is a process innovation.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefits to the owner because this credit reduces the need to construct and maintain extra parking. The design of bare minimum parking would result in lower investment by the owner on the construction of parking lot. The society would be benefitted with having fewer cars in the area, resulting in less pollution. Thus, this credit offers direct economic benefit to the owner

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation, because this credit can be achieved without the assistance of a domain knowledge specialist or specialty subcontractor. Hence this innovation is an incremental innovation.

SS Credit 5.1 (Site Development- Restore and Protect):

Intent:

The main intent of this credit is to conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirement:

On greenfield sites, limit all the site disturbance to 40 feet beyond the building perimeter; 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter;15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond construction areas with permeable surfaces.

OR

On previously developed or graded sites restore or protect 50% of the site area (excluding the building footprint) with native or adapted vegetation.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation in both the options. If the owner and the stake holders prefer the option 1, where the construction process has to be restricted within a certain perimeter, then this credit becomes a "*buy me*" credit for the owner because the owner decides to pursue a credit. The owner has nothing to do except deciding in the conceptual stage of the project about the inclusion of the credit and then paying all the expenses related to achieving the credit. Now in case the owner decides to go with the option 2, where he has to restore and protect a minimum of 50% of the site area with native or adapted vegetation, then the credit again is a product innovation because he has to 50% of the site area with the native species. Hence, this credit is a product innovation in both the cases.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefit to the owner because the process of planting native species can reduce ongoing landscape maintenance costs. Minimizing site disturbance can also increase property values due to mature landscape. And since these savings are measurable for the owner that will occur at the various stages of the project, so the credit offers direct economic benefits.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation, because this credit can be achieved without the assistance of a domain knowledge specialist or specialty subcontractor. Hence this innovation is an incremental innovation.

SS Credit 5.2 (Site Development- Maximize Open Space):

Intent:

The main intent of this credit is to provide a high ratio of open space to development footprint to promote biodiversity.

Requirement:

OPTION 1

- Reduce the development footprint or provide vegetated open space within the project boundary to exceed the local zoning's open space requirement for the site by 25%.

OR

OPTION 2

- For areas with no zoning requirement, provide vegetated or open space adjacent to the building that is equivalent to the building footprint.

OR

OPTION3

- Where a zoning ordinance exists, but there is no requirement for open space, provide vegetated open space equivalent to 20% of the project site area.

ALL OPTIONS

- For projects located in urban area and that earn SS Credit 2, vegetated roof area can contribute to credit compliance.
- For projects located in urban area and that earn SS Credit 2, pedestrian oriented hardscape can contribute to the credit compliance. For such a project, a minimum of 25% of the open space counted must be vegetated.
- Wetlands and naturally designed ponds may count as open space if they have a side slope gradient average of 1:4 or less and is vegetated.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because this credit can be achieved only when a certain amount of green space or open space is left on the site. Thus, this credit is a product innovation

Direct or Indirect Economic Innovation:

The benefits for this credit are indirect economic benefits to the owner because the benefits are intangible, difficult to quantify and do not involve actual changes to owner cash flows during building operation.

Radical Innovation or Incremental Innovation:

It is an incremental innovation because this credit can be achieved without the assistance of a domain knowledge specialist or specialty subcontractor. Hence, this credit is an incremental innovation.

SS 6.1 (Storm water Design- Quantity Control):

Intent:

The main intent of this credit is to limit the disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, and managing on-site runoff.

Requirement:

OPTION 1- Existing imperviousness is less than or equal to 50%

- Implement a storm water management plan that prevents the post development peak discharge rate and quantity from exceeding the pre development discharge rate and quantity for one-and two-year, 24 hours design storms

OR

- Implement a storm water management plan that protects receiving stream channels from excessive erosion by implementing a stream channel protection strategy and quantity control strategies.

OR OPTION 2- Existing imperviousness is greater than 50%

- Implement a storm water management plan that results in 25% decrease in the volume of storm water runoff from the two year, 24 hour design storm.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because by installing various products like a green roof, pervious hard scape, and bio-swales the owner can achieve this credit. Hence, this credit is a product innovation.

Direct or Indirect Economic Innovation:

The benefits achieved by this credit are indirect economic benefits for the owner because the benefits are intangible, difficult to quantify and do not involve actual changes to owner cash flows during building operation.

Radical Innovation or Incremental Innovation:

This credit is a radical innovation because some of the methods mentioned to achieve this credit were achieved by installing a green roof, bio-swales, retention ponds, pervious materials, and clustering development where most of which required a specialist. In addition to above, if the owner decides to implement this credit then the rainwater drains that connect the site rainwater to the municipal drains would become obsolete as most of the sites would take care of the rainwater themselves that is generated from the site.

SS 6.2 (Storm Water Design- Quality Control):

Intent:

The main intent of this credit is to reduce or eliminate water pollution by reducing the impervious cover, increasing on-soil infiltration, eliminating source of contaminants, and removing pollutants from storm water runoff.

Requirement:

Implement a storm water management plan that reduces storm water cover, promotes infiltration and captures and treats the storm water runoff from 90% of the average annual rainfall using Best Management Practices (BMP).

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because by installing various products like a green roof, pervious hard scape, and bio-swales the owner can achieve this credit. Hence, this credit is a product innovation.

Direct or Indirect Economic Innovation:

The benefits achieved by this credit are indirect economic benefits for the owner because the benefits are intangible, difficult to quantify and also benefits do not involve actual changes to owner cash flows during building operation.

Radical Innovation or Incremental Innovation:

This credit is a radical innovation because some of the methods mentioned to achieve this credit were achieved by installing a green roof, bio-swales, retention ponds, pervious materials, and clustering development where most of which required a specialist. In addition to above, if the owner decides to implement this credit then the rainwater drains that connect the site rainwater to the municipal drains would become obsolete as most of the sites would take care of the rainwater themselves that is generated from the site.

SS 7.1 (Heat Island Effect- Non-Roof):

Intent:

The main intent of this credit is to reduce the heat island effect to minimize the impact on microclimate and human and wildlife habitat.

Requirement:

OPTION 1

- Provide any combination of the following strategies for 50% of the site hardscape:
    1. Shade within 5 years of occupancy
    2. Paving materials with a Solar Reflective Index (SRI) of at least 29.

3. Open grid paving system

OPTION 2

- Place a minimum of 50% of parking spaces under cover (underground parking, under deck parking, under roof). Any roof used to shade or cover parking must have a SRI of at least 29.

Type of Innovation:

Product, Process or Both:

This credit product innovation because by installing trees and certain materials like open grid pavers, pavers with a SRI higher than 29, the owner can achieve this credit. Thus, this credit is a product innovation.

Direct or Indirect Economic Innovation:

The benefits from the credit directly benefit the owner because it results in reduced heat island effect which in turn reduces the energy consumption within the facility. The owner might have to initially invest higher in comparison to the contemporary buildings to meet the requirements of the credit, but these elements have a payback period within which the owner can achieve the Return on Investment (ROI). And since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it is an increment of the existing technologies and does not require any specialist to be brought into the construction stream. Hence this credit is an incremental innovation.

SS 7.2 (Heat Island Effect- Roof):

Intent:

The main intent of this credit is to reduce the heat island effect to minimize the impact on microclimate and human and wildlife habitat.

Requirement:

OPTION- 1

- Use of roofing material having a SRI equal to or greater than (Low-Sloped Roof-78; Steep-Sloped Roof-29) for a minimum of 75% of the roof area.

OR OPTION- 2

- Install vegetated roof for at least 50% of the roof area.

OR OPTION- 3

- Install high albedo and vegetated roof surface in combination.

Type of Innovation:

Product, Process or Both:

The innovation a product innovation because this credit can be achieved by installing certain products like a vegetated roof, coated concrete, etc.

Direct or Indirect Economic Innovation:

The benefits from the credit directly benefit the owner as it results in reduced heat island effect which in turn reduces the energy consumption within the facility. The owner is also able to reduce the storm water run-off thereby also conserving water. However the initial cost to meet the requirements of the credit might be higher. But these elements have a payback period within which the owner can achieve the Return on Investment (ROI). And since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner.

Radical Innovation or Incremental Innovation:

This credit is a radical innovation because this credit requires the use of a completely different type of system that is not currently used on this owner's buildings, and also the innovation requires the design of other systems to be adjusted to accommodate it. In addition to above, this credit also requires a domain knowledge specialist or specialty subcontractor to install or maintain. Hence this credit is a radical innovation.

SS Credit 8 (Light pollution Reduction):

Intent:

The main aim of this credit is to minimize the light trespass from the building and site, reduce sky glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce developmental impact on nocturnal environments.

Requirement:

FOR INTERIOR LIGHTING

The angle of maximum candela for each luminaire as located in the building shall intersect opaque building interior surfaces and not exit through the windows.

OR

All non-emergency interior lighting shall be automatically controlled to turn off during non-business hours. Provide manual override capability for afterhours use.

AND FOR EXTERIOR LIGHTING

Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% of building facades and landscape features as defined in ASHRAE standard 90.1-2004, exterior lighting section, without amendments.

Type of Innovation:

Product, Process or Both:

This credit is process innovation for the owner because this credit requires compensatory behavior on the part of users to adjust to lower lighting conditions. Also the expectations of the owner in terms of the interior layout can be changed in this credit. Thus this credit requires the owner to adapt to different operating conditions that would be otherwise preferred and also requires certain behavioral changes on the part of the occupants.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefit as the owner would save money on his energy bills over the lifetime of the project. At the same time it is very complex and would require the owner to spend some money upfront in hiring a lighting consultant and installing fixtures that are expensive than the commonly used.

Radical Innovation or Incremental Innovation:

The innovation is radical innovation as proving this credit requires a light model by a lighting analyst, which is specialized domain knowledge. This credit also changes how we perceive to light our buildings. Thus, this credit is a radical innovation.

Water Efficiency

The main aim of this category is to simultaneously reduce the consumption of water and increase the rain water infiltration to enhance the reducing ground water table (USGBC 2008). This category also aims to enhance innovative ways in which the rain water and to reduce reduced. This category has mainly three credits which are as follows:

1. Water efficient landscaping.
2. Innovative waste water technologies.
3. Water use reduction.

WE 1.1 Water efficient Landscaping: Reduce by 50%

Intent:

The main intent of this credit is to limit or eliminate the use of the portable water, or other natural surface or subsurface water resource available on or near the project, for landscaping irrigation.

Requirement:

Reduce portable consumption for irrigation by 50% from a calculated mid-summer baseline case. Reductions shall be attributed to any contribution of the following items:

- Plant species factor.
- Irrigation efficiency
- Use of captured rain water.
- Use of recycled waste water.
- Use of water treated and conveyed by a public agency specifically for non-portal use.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation for the owner because the credit requires the owner to install equipment like a drip system, moisture sensors, and rain water collection systems. Additionally the credit requires the owner to install native species that consume less water

Direct or Indirect Economic Innovation:

This credit is a direct economic benefit to the owner as he would save money on his water bills over the lifetime of the project, and since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it is just an increment of the existing technologies and does not require any specialist to be brought into the construction stream.

WE 1.2 Water efficient Landscaping: No portable water use or no irrigation.

Intent:

The main intent of this credit is to limit or eliminate the use of the portable water, or other natural surface or subsurface water resource available on or near the project, for landscaping irrigation.

Requirement:

- Achieve Credit 1.1

  AND:

- Use only captured rainwater, recycled wastewater, recycled grey water, or water treated and conveyed by a public agency specifically for non-portable uses of irrigation,

OR

- Install landscaping that does not require permanent irrigation system.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation for the owner because unlike the previous credit, eliminating irrigation entirely can change landscaping practices during the operations and maintenance. Incorporating non-portable water sources will also introduce new kinds of maintenance for the innovative systems.

Direct or Indirect Economic Innovation:

This credit is direct economic benefit to the owner as he would save money on his water bills over the lifetime of the project, and since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner.

Radical Innovation or Incremental Innovation:

This credit is a radical innovation because displacing portable with non-portable water requires the introduction of new systems such as rainwater harvesting or grey water, and all of which require specialized design or a specialist. Xeriscaping will introduce the need for domain specialists in many climates.

WE 2 (Innovative Waste water technologies):

Intent:

The main intent of this credit is to reduce generation of waste water and portable water demand, while increasing the local aquifer recharge.

Requirements:

The council has provided two options for this credit to be achieved, which is as follows:

Option 1:

Reduce the water use for the building sewage conveyance by 50% through the use of water conserving fixture (water closet, urinals) or non-portable water (captured rain water, recycled grey water and on –site municipally treated wastewater).

Option 2:

Treat 50% of wastewater on the site to tertiary standards. The treated water must be infiltrated or used on site.

The tertiary standard is achieved when the water is cleaned to a level where it could be reused. It is in this process that the physical, chemical and biological contaminants are removed through various processes and water treated is through the chemical, biological and physical process. Once the water is treated to the tertiary standard, it can be discharged into wet lands, lakes, streams or can also be used to irrigate.

Type of Innovation:

Product Innovation or Process Innovation:

This credit is a process innovation, as all the technologies required to achieve this credit require alternative maintenance practices and user education in order to be successful. This credit also leads to change in behavior inside the building to perform things and thus leads to process innovation.

Direct or Indirect Economic Innovation:

This credit offers direct economic innovation to the owner. The owner would save money on his water bills over the lifetime of the project and since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner. But at the same time, in order to achieve this credit the owner would have to a make huge upfront investment and pay a certain amount of maintenance for the facility.

Radical Innovation or Incremental Innovation:

This credit is a radical innovation as the technologies required to achieve this credit require specialized domain knowledge to design, install, and maintain. This innovation can also result in making some of the existing services obsolete.

WE 3.1 (Water use reduction: 20%)

Intent:

The main intent of this credit is to maximize the water efficiency within the buildings to reduce the burden on the municipal water supply and waste water system.

Requirements:

Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures: water closet, urinals, lavatory faucets, showers and kitchen sinks

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the owner can achieve it by using products like water efficient fixtures which ultimately lead to water use reduction.

Direct or Indirect Economic Innovation:

This credit offers direct economic innovation to the owner as he saves with low water bills and reduced operating costs. And since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner. But at the same time, in order to achieve this credit the owner would have to make huge upfront investment to install these fixtures. These fixtures can at times delay a project as they have a lead time to be delivered to the site. So the decision for the products has to be reached in the initial phase of the project in order for the timely completion of the project.

Radical Innovation or Incremental Innovation:

This innovation is incremental innovation as it is an increment of the existing technologies and does not require any specialist to be brought into the construction stream.

WE 3.2 (Water use reduction: 30%)

Intent:

The main intent of this credit is to maximize the water efficiency within the buildings to reduce the burden on the municipal water supply and waste water system

Requirements:

Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures: water closet, urinals, lavatory faucets, showers and kitchen sinks

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the owner can achieve it by using products like water efficient fixtures which ultimately lead to water use reduction.

Direct or Indirect Economic Innovation:

This credit offers direct economic innovation to the owner as he saves with low water bills and reduced operating costs. And since there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner. But at the same time, in order to achieve this credit the owner would have to make huge upfront investment to install these fixtures. These fixtures can at times delay a project as they have a lead time to be delivered to the site. So the decision for the products has to be reached in the initial phase of the project in order for the timely completion of the project.

Radical Innovation or Incremental Innovation:

This innovation is incremental innovation as it is an increment of the existing technologies and does not require any specialist to be brought into the construction stream.

Energy and Atmosphere

The main aim of this category is to reduce the consumption of energy and at the same time use more benign forms to produce the energy (USGBC 2008). This category has mainly three prerequisites and six credits which are as follows:

1. Fundamental commissioning of the building energy systems (Prerequisite).
2. Minimum energy performance (Prerequisite).
3. Fundamental refrigerant management (Prerequisite).
4. Optimize energy performance.
5. On-site renewable energy.
6. Enhanced commissioning.
7. Enhanced refrigerant management.
8. Measurement & verification.
9. Green power.

EA Prerequisite 1 (Fundamental commissioning of the building energy systems):

Intent:

The main aim of the building is to verify that the building's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design and construction documents.

Requirement:

This credit is a pre-requisite and has to be achieved. The following activities shall be completed by the commissioning team:

- Designate an individual as a Commissioning agent (CxA) to lead, review and oversee the completion of the commission process activities.
- The CxA shall have documented commissioning agent experience in at least two building projects.
- The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firm providing these services.
- The CxA shall report the findings, results and recommendations directly to the owner.
- For the projects smaller than the 50,000 sq. ft., the CxA may include qualified persons in the design and construction team who have the required experience.
- The owner shall document the Owner's Project Requirement (OPR). The team shall develop the Basis of Design (BOD). The CxA shall review these documents for the clarity and completeness. The owner and the design team shall be responsible for updates to their responsible documents.
- Develop and incorporate commissioning requirements into the construction documents.
- Develop and implement a commissioning plan. Verify the installation and performance of the systems to be commissioned.
- Complete a summary commissioning report.

Type of Innovation:

Product, Process or Both:

The innovation is a process innovation for the owner for many reasons (1) it requires the CxA to report all findings and recommendations directly to the owner, and the owner has special roles in documenting the basis of design during the whole design and construction process; (2) the expectation of the owner (3) functional allocation of the spaces within the facility especially during the design and construction phase; the owner behavior changes during the operations phase of the project. Thus, employing a commissioning agent for this pre-requisite is process innovation as it changes ways the things have been done.

Direct or Indirect Economic Innovation:

This credit has direct economic benefit to the owner as most items in this category result in a reduced use of energy from the grid, thus reducing power bills. It is estimated that energy efficiency up to 10% can be achieved. Researchers at Lawrence Berkeley National Lab fund out the payback period for employing a commissioning agent is about 4.8 years (USGBC 2008) from the energy savings alone. If the owner extends the commission process to plumbing and HVAC, it can enhance the air quality and increase the productivity of the organization and thereby reduce the payback period considerably. Thus, there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation.

Radical Innovation or Incremental Innovation:

This innovation is radical innovation as this credit requires CxA to check the building systems during the installation and then during the system performance testing. The CxA is a specialist with an experience of at least two projects. Thus, the credit requires a domain knowledge specialist who requires the design of other systems to be adjusted to accommodate it.

EA Prerequisite 2 (Minimum Energy Performance):

Intent:

The main intent of this credit is to establish a minimum level of energy efficiency for the proposed building and systems.

Requirements:

Design the building project to comply with the both:

- The mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/ Illuminating Engineering Society of North America (IESNA) Standard 90.1-2004; AND
- The perspective requirements (Sections 5.5, 6.5, 7.5, and 9.5) or performance requirements (Section 11) of ASHREA/IESNA Section 90.1-2004.

Type of Innovation:

Product, Process or Both:

The credit is contextual as there are scenarios where the credit can be product innovation and there are scenarios when it can be process innovation Or the credit can be process innovation if it results in the change in expectation for the owner and at time also in the functional allocation of the spaces within the facility especially during the design and construction phase this credit can be product innovation if the

owner achieves this credit by installing these products within the facility as per the requirements of the credit.

Direct or Indirect Economic Innovation:

This credit has direct economic benefit to the owner through overall energy savings for the owner over the lifespan of the project. Since, there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic benefits to the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as the owner is required to comply both with the mandatory provisions of ASHRAE (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) or Illuminating Engineering Society of North America (IESNA) Standard 90.1-2004; and the perspective requirements (Sections 5.5, 6.5, 7.5, and 9.5) or performance requirements (Section 11) of ASHREA/IESNA Section 90.1-2004. Thus this credit is just an increment of the existing technologies and does not require any specialist to be brought into the construction stream.

EA Prerequisite 3 (Fundamental Refrigerant Management):

Intent:

Reduce ozone depletion.

Requirements:

Zero use of CFC based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase out conversion prior to project completion. Phase out plans extending beyond the completion date would be considered on their merits. Small HVAC units (defined as containing less than 0.5 lbs. of refrigerant), and other equipment such as standard refrigerator, small water cooler, and any other cooling equipment that contains less than 0.5 lbs. of refrigerant, are not considered part of the "base building" system and are not subjected to the requirements of the credit.

Type of Innovation:

Product, Process or Both:

The innovation is a Product Innovation because it requires the owner to purchase HVAC&R systems that do not use Chloro Flouro Carbons as the refrigerants. With such a purchase the owner is able to achieve the credit. During the renovation, the owner has to make sure that the refrigerant is CFC free and if it is not then he must retrofit it.

Direct or Indirect Economic Innovation:

This prerequisite has indirect economic benefits to the owner as the benefits do not involve actual changes to owner cash flows during building operation, and are intangible, and difficult to quantify. The benefit obtained from the prerequisite is more to society than to the owner as it reduces the chances of having ozone depletion. It also reduces the chances of skin cancer, cataract and weaker immune system within the members of society.

Radical Innovation or Incremental Innovation:

This innovation is an incremental innovation as the government banned the production of CFC as early as 1995 and had substitutions in the market. It is just an increment of the existing technologies and does not require any specialist to be brought into the construction stream.

EA Credit 1 (Optimize Energy Performance):

Intent:

The main intent of the credit is to achieve the levels of energy performance above the baseline in the prerequisite to reduce environmental and economic impacts associated with excessive energy use.

Requirements:

Select one of the three compliance path options described below. However, buildings registered after 26th June 2008 is required to achieve at least two out of the points mentioned below to earn this credit.

1. Whole building energy simulation.
2. Prescriptive compliance path (Buildings must be less than 20,000 sq. ft.).
3. Prescriptive compliance path (Buildings must be less than 100,000 sq. ft.).
4. Prescriptive compliance path (projects registered after 26th July 2007 may not use this option).

Type of Innovation:

Product, Process or Both:

The credit is contextual as there are scenarios where the credit can be product innovation and there are scenarios when it can be process innovation or this credit can be process innovation as it results in the change in expectation for the owner and at time also in the functional allocation of the spaces within the facility especially during the design and construction phase This credit is a product innovation if the owner achieves this credit by installing these products within the facility as per the requirements of the credit.

Direct or Indirect Economic Innovation:

This credit has direct economic benefit to the owner resulting in an overall energy savings for the owner over the lifespan of the project. Since, there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, this credit results in direct economic innovation to the owner.

Radical Innovation or Incremental Innovation:

This credit is classified as radical innovation because an energy model is required for compliance, and this model requires a domain knowledge specialist.

EA Credit 2 (On-site Renewable Energy):

Intent:

The main intent of this credit is to recognize and encourage the increasing levels of on-site renewable energy supply to reduce environmental and economic impacts associated with fossil fuel energy use.

Requirement:

Use on-site renewable energy cost to offset building energy cost. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building annual energy cost. Use the building energy cost calculated in EA Credit 1 or Department of Energy (DOE) Commercial Building Energy Consumption Survey (CBECS) database to determine the estimated energy use.

Type of Innovation:

Product, Process or Both:

This credit is a Product innovation because it would the various stakeholders to purchase innovative products like Photo Voltaic Panels, Wind mills, etc. that is necessary to achieve this credit. With such a purchase the owner is able to achieve the credit.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct and the owner can achieve cost savings by generating energy for the project. Initially, the owner might have to make larger investment upfront to achieve the credit, but eventually he can earn back his investment. Some of the states also buy back the excessive electricity produced by the organization. Rebates are also available for the installation of such technologies. The generation of the energy on the site reduces the reliability on the local power grid.

Radical Innovation or Incremental Innovation:

This credit is a Radical innovation because it requires a specialist having experience with installation and maintenance of the equipment related to above mentioned technologies. Thus this credit requires a

domain knowledge specialist. Simultaneously, due to the adaption of such technologies; the design of the related systems would also need to be adjusted.

EA Credit 3 (Enhanced Commissioning):

Intent:

The main intent if this credit is to begin the commission process early during the design process and execute the additional activities after systems performance verification is completed.

Requirement:

To have a contract in place to implement the following commission activities in addition to the requirements of EA Prerequisite 1:

1. Prior to the start of the construction phase, designate an independent commission agent (CxA) to lead, review, and oversee the commission process. Task 2, 3 and 6 should at least be done by the CxA, and Task 4 & 5 should be done by other team members.
2. The CxA shall conduct, at a minimum, one commissioning design review of the Owner's Project Requirement (OPR), Basis of Design (BOD), and design documentation prior to mid-construction document phase and back check the review comments in the subsequent design commission.
3. The CxA shall review contractor submittal applicable to systems being commissioned for compliance with the OPR and BOD. The review shall be concurrent with the A/E review and submitted to the design team and the owner.
4. Develop a manual that provides future staff the information needed to understand and optimally operate the commissioned systems.
5. Verify that the requirements for training operating personnel and building occupants are complete.
6. Assure the involvement by the CxA in reviewing building operation within 10 months after subsequent completion with the O&M staff and occupants. Include a plan for resolution of outstanding commissioning-related issues.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation for the owner as it requires the CxA to report all findings and recommendations directly to the owner, and the owner has special roles in documenting the basis of design during the whole design and construction process. Also the owner has to make sure that a manual is made and all topics are covered. After the project is complete the owner and the users of the building would be involved with the CxA to observe if the facility is operating to the desired standards. This credit

can also change the expectation of the owner, or functional allocation of the spaces within the facility especially during the design and construction phase, also the owner behavior can change during the operations phase of the project.

Direct or Indirect Economic Innovation:

This credit has direct economic benefit to the owner as most items in this category result in a reduced use of energy from the grid, thus reducing power bills. It is estimated that the energy efficiency up to 10% can be achieved (USGBC 2008). If the owner extends the commission process to plumbing and HVAC, it can enhance the air quality and increase the productivity of the organization and thereby reduce the payback period considerably. Also having a CxA from the very start of the project reduces the chances of change orders as he constantly reviews the process. Thus there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation, resulting in direct economic benefit to the owner.

Radical Innovation or Incremental Innovation:

This credit is radical innovation as it requires CxA to check the building systems during the installation and then perform the system performance testing. The CxA is a specialist with an experience of at least two projects. Thus the credit requires a domain knowledge specialist also the design of other systems to be adjusted to accommodate it.

EA Credit 4 (Enhanced Refrigerant Management):

Intent:

Reduce ozone depletion and support with the early compliance with the Montreal Protocol while minimizing direct contributions to the global warming.

Requirements:

1. Do not use refrigerants.
2. Select refrigerants that minimize or eliminate the emission of compounds that contribute to the ozone depletion and global warming. Also do not install fire suppression systems that contain ozone suppression substances.

Type of Innovation:

Product, Process or Both:

The credit is a Product Innovation as it requires the owner to either not use the refrigerants, or to use refrigerants that have low emissions of Ozone Depleting Substances. By installing the materials as per the above mentioned requirements of the credit the owner is able to achieve this credit.

Direct or Indirect Economic Innovation:

This credit has indirect economic benefits to the owner as the benefits do not involve actual changes to owner cash flows during building operation, and the benefits are intangible and difficult to quantify. The benefit obtained from the credit is more to society than to the owner as it reduces ozone depletion. It also reduces the chances of skin cancers, cataracts and weaker immune systems within the members of society.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as the government banned the production of CFC as early as 1995 and had substitutions in the market. Also no breakthrough has been achieved for the refrigerants except the HFC which are much less harmful than the CFC but not completely harmless to the ozone. The major drawback of HFC is that they are not efficient.

EA Credit 5 (Measurement and Verification):

Intent:

Provide accountability of the building energy consumption over time.

Requirement:

- Develop and implement a Measurement & Verification (M&V) Plan consistent with Option D (Calibrated Simulation-Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the International Performance Measurement & Verification Protocol (IPMVP) Volume III.
- The M&V shall cover a period of not less than one year of post-construction occupancy.

Type of Innovation:

Product, Process or Both:

The innovation is a Process Innovation for the owner as it requires the owner to develop a measurement and verification plan with the agency to test the systems operation within the facility post-construction. The owner would also need to install various components that would track the performance of the

equipment by comparing the predicted performance to the actual performance. Thus it changes the owner behavior in terms of how he handles post-occupancy.

Direct or Indirect Economic Innovation:

This credit results in direct economic benefits to the owner, because of energy efficient systems which result in low electricity bills. Thus there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. But at the same time, it also requires a certain amount of initial investment form the owner. It gives the owner a chance to observe the systems to determine if they are performing to the desired levels on a consistent basis. But at the same time it comes with a first cost and the first cost is at times directly dependent on the complexity of the systems.

Radical Innovation or Incremental Innovation:

The credit is a Radical Innovation from the owner's point of view as the measurement & verification requires the specialist to maintain and keep vigil of the data that affects ongoing owner processes.

EA Credit 6 (Green Power):

Intent:

The main intent of this credit is to encourage the development and use of grid source, renewable energy technologies on a net zero pollution basis.

Requirement:

Option1:

Provide at least 35% of the building's energy from the renewable sources by engaging in a renewable energy contract for at least two years.

Option 2:

If Green power is not available through the local utilities, then he has to purchase a tradable Renewable Certificate equal to 35% of the predicted annual consumption for a period of at least 2 years.

Type of Innovation:

Product, Process or Both:

This credit is product innovation for both the options. If the owner and the stake holders prefer the option 1, then this credit becomes a "*buy me*" credit for the owner because the owner decides to pursue a credit in which he is only responsible for deciding about the inclusion of the credit and then paying all the expenses related to achieving the credit innovation; all the manual labor is done by the supplier. In case the owner decides to go with option 2, where the green power is not available through the local utilities, then he has to purchase a tradable Renewable Certificate equal to 35% of the predicted annual

consumption for a period of over 2 years. In this case the credit becomes a "*buy me*" credit. It is buy me credit because the owner has nothing to do, except decide in the conceptual stage of the project about whether to include the credit. Afterwards owners pays all the expenses related to achieving the innovation. Hence this credit is a product innovation in both cases.

Direct or Indirect Economic Innovation:

This credit offers indirect economic benefits to the owner as there are no quantifiable economic incentives or benefits for the investments made. In most cases, the cost of green energy is higher than the conventional energy (USGBC 2008). But at the same time it is also expected that in the future the cost of green power would be competitive in comparison to conventional power. The general society as a whole benefits from this credit, as the amount of resources consumed and pollution to produce a unit of energy is reduced considerably.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as the technology to produce energy was available in the industry, but the only issue was that it was not cost effective. Also, this credit can be fulfilled by choosing a different type of the same system and can be implemented without having to adjust the design of other building systems. Thus, this credit is a radical innovation.

Material and Resource

The main aim of this category is to reduce the consumption of material that is produced from a virgin source, and at the same time, also reduce the waste produced from a building and construction site into the landfill. The USGBC also stresses the reuse and recycling of materials to reduce the waste in landfills and also the need for materials (USGBC 2008). This category has mainly one prerequisite and seven credits which are as follows:

1. Storage and Collection of Recyclables
2. Building Reuse
3. Construction Waste Management
4. Materials Reuse
5. Recycled Content
6. Regional Materials
7. Rapidly Renewable Materials
8. Certified Wood

MR Prerequisite 1 (Fundamental commissioning of the building energy systems):

Intent:

The main intent of this credit is to facilitate the reduction of the waste generated by the building occupants that is hauled to and disposed of in the landfills.

Requirement:

Provide an easily accessible area that serves the entire building and is dedicated to the collection and storage of non-hazardous materials for recycling, including at least paper, plastic, corrugated cardboard, metal and glass.

Type of Innovation:

Product, Process or Both:

This prerequisite is a product innovation because it requires the owner to purchase the recycling bins as per the requirements of the credit to achieve this prerequisite.

Direct or Indirect Economic Innovation:

The benefits of this prerequisite to the owner are that the owner is able to generate a positive cash flow or measurable savings (like the savings on the tipping fees) hence this prerequisite is a direct economic innovation. However, there are some initial costs associated with this prerequisite, like installation of the recycling bins and their use of the floor space, but overall it gives the owner a direct economic benefit. This prerequisite benefits the society, because less landfill space is taken up and most of the post-consumer material is recycled.

Radical Innovation or Incremental Innovation:

This prerequisite is an incremental innovation as it is a small change on existing knowledge, and the prerequisite can be achieved by implementing it without having to adjust the design of other building systems. Thus, this credit is an incremental innovation.

MR Credit 1.1 (Building Reuse: Maintain 75% of existing Walls, Floors & Roofs):

Intent:

The main aim of this credit is to extend the life cycle of existing building stock, conserve resources, retain cultural resources, and reduce waste and environmental impacts of new buildings as they relate to material manufacture and transport.

Requirements:

Maintain at least 75% (Based on surface area) of existing building structure (including structural floor and roof decking) and envelope. Hazardous materials that are remediated as a part of the project scope shall be excluded from the calculation of the percentage maintained. If the project includes addition to the existing building, this credit is not applicable if the floor area of the addition is more than twice the square footage of the existing building.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the building materials are taken out from the existing structure and with the due consent of the owner, placed in the proposed building. So with the help of the building materials, the owner achieves the credit. In addition, this credit is also about a concept where the elements from the existing building go to the proposed building if they are not hazardous, instead of the landfills. Thus, this innovation is a product innovation.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefits be the owner is able to generate a positive cash flow or measurable savings. The owner does not have to pay for the demolition of the existing facility and he also saves on the transportation of these elements to the landfill. In addition, he will also save on the cost of purchasing and transporting the new material. Lot of savings are also incurred in masonry, site work, carpentry, and concrete if existing material is reused in the proposed facility rather than installing a new material. With these benefits, the owner would only have to make adjustments in the field of aesthetics, as some of reused elements might not match the aesthetical aspirations of the owner or other participants of the project.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it can be fulfilled without having to adjust the design of other building systems, without the assistance of a domain knowledge specialist or specialty subcontractor. Also, this credit does not represent a breakthrough in science and technology used in the particular time frame.

MR Credit 1.2 (Building Reuse: Maintain 90% of existing Walls, Floors & Roofs):

Intent:

The main aim of this credit is to extend the life cycle of existing building stock, conserve resources, retain cultural resources, and reduce waste and environmental impacts of new buildings as they relate to material manufacture and transport.

Requirements:

Maintain at least 90% (Based on surface area) of existing building structure (including structural floor and roof decking) and envelope. Hazardous materials that are remediated as a part of the project scope shall be excluded from the calculation of the percentage maintained. If the project includes addition to the existing building, this credit is not applicable if the floor area of the addition is more than twice the square footage of the existing building.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the building materials are taken out from the existing structure and with the due consent of the owner, placed in the proposed building. So with the help of the building materials, the owner achieves the credit. In addition, this credit is also about a concept where the elements from the existing building go to the proposed building if they are not hazardous, instead of the landfills. Thus, this innovation is a product innovation.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefits be the owner is able to generate a positive cash flow or measurable savings. The owner does not have to pay for the demolition of the existing facility and he also saves on the transportation of these elements to the landfill. In addition, he will also save on the cost of purchasing and transporting the new material. Lot of savings are also incurred in masonry, site work, carpentry, and concrete if existing material is reused in the proposed facility rather than installing a new material. With these benefits, the owner would only have to make adjustments in the field of aesthetics, as some of reused elements might not match the aesthetical aspirations of the owner or other participants of the project.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it can be fulfilled without having to adjust the design of other building systems, without the assistance of a domain knowledge specialist or specialty subcontractor.

Also, this credit does not represent a breakthrough in science and technology used in the particular time frame.

Credit 1.3 (Building Reuse: Maintain 50% of Interior Non-structural elements):

Intent:

The main aim of this credit is to extend the life cycle of existing building stock, conserve resources, retain cultural resources, and reduce waste and environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirements:

Use existing interior non-structural elements (interior walls, doors, floor coverings and ceilings systems) in at least 50% of the completed building (including additions). If the project includes addition to the existing building, this credit is not applicable if the floor area of the addition is more than twice the square footage of the existing building.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the building materials are taken out from the existing structure and with the due consent of the owner, placed in the proposed building. So with the help of the building materials, the owner achieves the credit. In addition, this credit is also about a concept where the elements from the existing building go to the proposed building if they are not hazardous, instead of the landfills. Thus, this innovation is a product innovation.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefits be the owner is able to generate a positive cash flow or measurable savings. The owner does not have to pay for the demolition of the existing facility and he also saves on the transportation of these elements to the landfill. In addition, he will also save on the cost of purchasing and transporting the new material. Lot of savings are also incurred in masonry, site work, carpentry, and concrete if existing material is reused in the proposed facility rather than installing a new material. With these benefits, the owner would only have to make adjustments in the field of aesthetics, as some of reused elements might not match the aesthetical aspirations of the owner or other participants of the project.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it can be fulfilled without having to adjust the design of other building systems, without the assistance of a domain knowledge specialist or specialty subcontractor. Also, this credit does not represent a breakthrough in science and technology used in the particular time frame.

MR Credit 2.1 (Construction Waste Management: Divert 50% from Disposal):

Intent:

Divert construction & demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites.

Requirement:

Recycle or salvage at least 50% of non-hazardous construction and demolition. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on site or comingled. Excavated site and land clearing debris does not contribute to this credit. Calculations must be done by weight or volume, but they must be consistent throughout.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because the owner can get this credit if he decides to salvage or recycle more than 50% of non-hazardous construction and demolition material, as calculated for the MR Credit 2.1. This credit becomes a "*buy me*" credit for the owner because the owner decides to pursue a credit and do nothing, except decide in the conceptual stage of the project about the inclusion of the credit he would be paying all the expenses related to achieving this credit. All the work is done by the general contractor as he will be keeping a track of amount of material that is recycled or salvaged to the site or donated to the charitable organizations like Habitat for Humanity.

Direct or Indirect Economic Innovation:

This credit has indirect economic benefits to the owner because Construction waste management can result in cost savings to the contractor (and thus indirect savings to the owner), but has no direct benefit for the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation it is a small change on the existing knowledge and is generally added to the process. Also the innovation can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist.

MR Credit 2.2 (Construction Waste Management: Divert 75% from Disposal):

Intent:

Divert construction & demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites.

Requirement:

Recycle or salvage at least 75% of non-hazardous construction and demolition. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on site or comingled. Excavated site and land clearing debris does not contribute to this credit. Calculations must be done by weight or volume, but they must be consistent throughout.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because the owner can get this credit if he decides to salvage or recycle more than 75% of non-hazardous construction and demolition material, as calculated for the MR Credit 2.1. This credit becomes a "*buy me*" credit for the owner because the owner decides to pursue a credit and do nothing, except decide in the conceptual stage of the project about the inclusion of the credit he would be paying all the expenses related to achieving this credit. All the work is done by the general contractor as he will be keeping a track of amount of material that is recycled or salvaged to the site or donated to the charitable organizations like Habitat for Humanity.

Direct or Indirect Economic Innovation:

This credit has indirect economic benefits to the owner because Construction waste management can result in cost savings to the contractor (and thus indirect savings to the owner), but has no direct benefit for the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it is a small change on the existing knowledge and is generally added to the process. Also the innovation can be implemented without having to adjust the design of other building systems, and can be implemented without the assistance of a domain knowledge specialist.

MR Credit 3.1 (Material Reuse: 5%):

Intent:

The main intent of this credit is to reuse building and products in order to reduce the demand for the virgin material and to reduce the waste, thereby reducing the impacts with the extraction and processing of virgin resources.

Requirement:

Use salvaged, refurbished or reused materials, such that the sum of these materials constitutes at least 5%, based on cost, of the total value on project. Mechanical, Electrical, plumbing and specialty equipment shall not be included in the calculations. Only include material permanently included in the project.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the owner uses the mentioned materials into the projects in the prescribed manner in order to achieve that credit.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that *might* occur over the lifetime of the project. We can also add to the above mentioned fact by saying that the salvaged materials do sell at a higher cost than the new material because it involves labor in recovering it and then further remolding it as per the decided requirement. But, it has also been found out that the salvaged materials are of higher quality than most of the material found. At the same time, the use of salvaged material can also lead to compromise to the aesthetics of the project. So with higher costs associated for the owner to buy the salvaged material and a certain risk on the part of aesthetics, the benefits to the owner are more of indirect than direct.

Radical Innovation or Incremental Innovation:

This credit is radical innovation because it is a quite often extensive recovery process and has to be undertaken to reuse materials from the same site, requiring specialty contractors. Newer systems often change as well to accommodate these materials.

MR Credit 3.2 (Material Reuse: 10%):

Intent:

The main intent of this credit is to reuse building and products in order to reduce the demand for the virgin material and to reduce the waste, thereby reducing the impacts with the extraction and processing of virgin resources.

Requirement:

Use salvaged, refurbished or reused materials, such that the sum of these materials constitutes at least 5%, based on cost, of the total value on project. Mechanical, Electrical, plumbing and specialty equipment shall not be included in the calculations. Only include material permanently included in the project.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the owner uses the mentioned materials into the projects in the prescribed manner, in order to achieve that credit.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project. We can also add to the above mentioned fact by saying that the salvaged materials do sell at a higher cost than the new material because it involves labor in recovering it and then further remolding it as per the decided requirement. But, it has also been found out that the salvaged materials are of higher quality than most of the material found. At the same time, the use of salvaged material can also lead to compromise to the aesthetics of the project. So with higher costs associated for the owner to buy the salvaged material and a certain risk on the part of aesthetics, the benefits to the owner are more of indirect than direct.

Radical Innovation or Incremental Innovation:

This credit is radical innovation because it is a quite often extensive recovery process and has to be undertaken to reuse materials from the same site, requiring specialty contractors. Newer systems often change as well to accommodate these materials. Hence this innovation is a radical innovation.

MR Credit 4.1 (Recycled Content: 10%):

Intent:

The main intent of this credit is to increase the demand for the building products that incorporate the recycled content materials, thereby resulting impacts resulting from extraction and processing of virgin materials.

Requirement:

Use materials with recycled content such that the sum of post-consumer recycled content plus one half of the pre-consumer content constitutes at least 10% of the total value of the materials on the project. The recycled content value of the material shall be determined by weight.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because it requires the owner to buy these materials according to the requirements of the credit.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation because it can be achieved by implementing innovations that are fulfilled without having to adjust the design of other building systems, and also without the assistance of a domain knowledge specialist or specialty subcontractor. Thus this innovation is an incremental innovation.

MR Credit 4.2 (Recycled Content: 20%):

Intent:

The main intent of this credit is to increase the demand for the building products that incorporate the recycled content materials, thereby resulting impacts resulting from extraction and processing of virgin materials.

Requirement:

Use materials with recycled content such that the sum of post-consumer recycled content plus one half of the pre-consumer content constitutes at least 20% of the total value of the materials on the project. The recycled content value of the material shall be determined by weight.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because it requires the owner to buy these materials according to the requirements of the credit.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation because it can be achieved by implementing innovations that are fulfilled without having to adjust the design of other building systems, and also without the assistance of a domain knowledge specialist or specialty subcontractor. Thus this innovation is an incremental innovation.

MR Credit 5.1 (Regional Materials: 10% Extracted, Processed & Manufactured Regionally):

Intent:

The main intent of this credit is to increase the demand for the building materials and products that are regionally manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts caused from transportation.

Requirements:

The credit requires building materials, products that have been harvested, extracted or recovered and as well as manufactured within 500 miles of the project site for a minimum of 10% of the total material value. Mechanical, electrical, plumbing and specialty equipment shall not be included in this calculation.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because it requires the owner to buy these materials according to the requirements of the credit. Also the amount of materials purchased for the project depends on the location of the project.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project. This credit also enhances the local economy and the area around site.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation because it can be achieved by implementing innovations that are fulfilled without having to adjust the design of other building systems, and also without the assistance of a domain knowledge specialist or specialty subcontractor. Thus this innovation is an incremental innovation.

MR Credit 5.2 (Regional Materials: 20% Extracted, Processed & Manufactured Regionally):

Intent:

The main intent of this credit is to increase the demand for the building materials and products that are regionally manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts caused from transportation.

Requirements:

The credit requires building materials, products that have been harvested, extracted or recovered and as well as manufactured within 500 miles of the project site for a minimum of 20% of the total material value. Mechanical, electrical, plumbing and specialty equipment shall not be included in this calculation.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because it requires the owner to buy these materials according to the requirements of the credit. Also the amount of materials purchased for the project depends on the location of the project.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project. This credit also enhances the local economy and the area around site.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation because it can be achieved by implementing innovations that are fulfilled without having to adjust the design of other building systems, and also without the assistance of a domain knowledge specialist or specialty subcontractor. Thus this innovation is an incremental innovation.

MR Credit 6 (Rapidly Renewable Materials):

Intent:

Reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable material.

Requirements:

Use rapidly renewable materials and products (made from plants that are harvested within a ten year cycle or shorter) for 2.5% of the total value of all building materials, products used in the project, based on the cost.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because it requires the owner to buy these materials that are rapidly renewable and these materials may vary as per the geography of the project.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project. Also, the cost of the material right now is more than the conventional material and the owner is expected to pay more for these materials. At

the same time it is also expected that Rapidly Renewable Materials would become more cost competitive with the increase in demand. With the owner using rapidly renewable materials, the habitat of endangered species is protected. Through this credit the owner also tries to ease the pressure of demand on the forests and reduces the process of deforestation to a certain extent, thus, the benefits of this credit are Indirect Economic Innovation for the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation because this can be achieved by implementing innovations that are fulfilled without having to adjust the design of other building systems, and also without the assistance of a domain knowledge specialist or specialty subcontractor. This credit adds up the existing knowledge and propagates the use of rapidly renewable materials, as it is beneficial for the planet and the human race.

MR Credit 7 (Rapidly Renewable Materials):

Intent:

The main intent of this credit is to encourage environmentally responsible forest management.

Requirement:

Use minimum of 50% of wood-based materials and products, which are certified in accordance with the Forest Stewardship Council's (FSC) principles and criteria's for wooden building component. These components include, but are not limited to, structural framing and general dimensional framing, sub-flooring, wood doors and finishes. Include materials permanently installed on the project (e.g., formwork, bracing, sidewalk, scaffolding, side protection and guard rails) may be included in the calculation at the project team's discretion.

Type of Innovation:

Product, Process or Both:

This credit is product innovation because it requires the owner to buy wood or wood products that are FSC certified.

Direct or Indirect Economic Innovation:

The benefits to the owners are indirect economic benefits because there is no positive cash flow or measurable savings that might occur over the lifetime of the project. Also the cost of the certified wood is more than the conventional wood and the owner is expected to pay more for it. At the same time it is also

expected that with the increase of the demand the rapidly renewable material would become more cost competitive. However, with the owners using FSC certified wood, the society will benefit more. With more and more people opting for the certified wood, the responsible forest practices can be cultivated within the society leading to preservation of the health and integrity of the forest ecosystem. Also FSC-certified forests include sustainable forest harvesting, preserving wildlife biodiversity, maintaining soil and water quality and minimizing the effects of the harmful chemicals. Thus this credit is Indirect Economic Benefits to the owner.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation because it can be achieved by implementing innovations that are fulfilled without having to adjust the design of other building systems, and also without the assistance of a domain knowledge specialist or specialty subcontractor. This credit propagates the use of woods that are FSC-certified. From an owner's perspective, instead of the buying conventional woods the owner uses FSC-certified wood, thus keeping its ecological advantages in mind.

Indoor Environmental Quality

This credit deals with enhancing the indoor air quality within the building. It is estimated that on average Americans, spend about 90% of their time indoors. Also, the US Environmental Protection Agency (EPA) states that the levels of pollutants within a building many run from two to five times higher than the outdoors. So it is important that the standards of indoor air be improved. The Rocky Mountain Institute cites that with improved IEQ, the workers' productivity is increased by 16%. This category has mainly two prerequisite and eight credits which are as follows:

1. Minimum Indoor Air Quality (IAQ) Performance (Prerequisite 1)
2. Environmental Tobacco Smoke Control (Prerequisite 2)
3. Outdoor air delivery monitoring (Credit 1)
4. Increased Ventilation (Credit 2)
5. Construction IAQ management plan, During Construction (Credit 3.1)
6. Construction IAQ management plan, Before Occupancy (Credit 3.2)
7. Low –Emitting Materials, Adhesive & Sealant (Credit 4.1)
8. Low –Emitting Materials, Paints & Coatings (Credit 4.2)
9. Low –Emitting Materials, Carpet System (Credit 4.3)
10. Low –Emitting Materials, Compost wood & Agrifiber (Credit 4.4)
11. Indoor chemical and pollution source control (Credit 5)
12. Controllability of systems, Lighting (Credit 6.1)
13. Controllability of systems – Thermal Comfort (Credit 6.2)
14. Thermal Comfort, Design (Credit 7.1)
15. Thermal Comfort, Verification (Credit 7.2)
16. Day lighting & Views, Daylight 75% of the spaces (Credit 8.1)
17. Day lighting & Views, Views for 90% of the spaces (Credit 8.2)

EQ Prerequisite 1 (Minimum IAQ Performance)

Intent:

The main intent of this credit is to establish indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

Requirements:

Meet the minimum requirements of Section4 through 7of ASHRAE 6.1-2004, Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure or the applicable code, whichever is stringent.

Type of Innovation:

Product, Process or Both:

This prerequisite is a product innovation because the owner and other stake holders have to install one or more of the following strategies: passive ventilation (naturally ventilated), active ventilation (mechanically ventilated), or mixed mode ventilation (both). Thus either of the strategy would be optimum for the project.

Direct or Indirect Economic Innovation:

The benefits from this prerequisite are direct economic benefits to the owner because there will be a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. The enhanced indoor air quality leads to better efficiency of the workers for the organization. Also the implementation of this credit reduces the liabilities regarding the indoor air quality for the owner, occupants and building operators. Adding the required features to the building properties does not come with an added cost, and so this credit is a direct economic benefit to the owner.

Radical Innovation or Incremental Innovation:

This prerequisite is an incremental innovation because this credit is based on Section4 through 7of ASHRAE 6.1-2004. Also this credit can be achieved by implementing the innovation without having to adjust the design of other building systems, and can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor.

EQ Prerequisite 2 (Environmental Tobacco Smoke (ETS) Control)

Intent:

The main intent of this credit is to minimize the exposure of the building occupants, indoor surfaces and ventilation systems to environmental tobacco smoke (ETS).

Requirement:

Option 1:

- Prohibit smoking in the building.
- Locate any exterior designated smoking areas at least 25 feet away from the entries, outdoor air intakes and operable windows.

Option 2:

- Prohibit smoking in the building except in designated smoking areas.
- Locate any exterior designated smoking areas at least 25 feet away from the entries, outdoor air intakes and operable windows.
- Locate any smoking rooms to effectively contain, capture and remove the ETS from the building. At a minimum, the smoking room must be directly exhausted to the outdoors with no recirculation of ETS-containing air back to the non-smoking area of the building. With the doors to the smoking doors closed, operate sufficient to create a negative pressure with respect to the adjacent spaces of at least at an average of 5 Pa and minimum of 1 Pa.
- Performance of the smoking room differential air pressures shall be verified by conducting 15 minutes of measurement, with a minimum of one measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with doors to smoking rooms closed. The testing will be conducted with each space configured for the worst case condition of transport air from the smoking rooms to the adjacent space with smoking room's doors closed.

Option 3:

- Prohibit smoking in the building.
- Locate any exterior designated smoking areas at least 25 feet away from the entries, outdoor air intakes and operable windows.
- Minimize the uncontrolled pathways for ETS transfer between individual residential units by sealing penetration in the walls, sealing and floors in the residential units.
- All the doors in the residential units leading from common hallways shall be weather stripped to minimize the air leakage into the hallway. If the common hallways are pressurized with respect to the residential units then the doors in the residential units leading to the common hallway need not be weather stripped, provided positive pressure difference is observed.

Type of Innovation:

Product, Process or Both:

The prerequisite is a process innovation because it requires behavioral changes on the part of the owner, or occupants that have to adapt to different operating conditions than are otherwise preferred or default. This can be explained by the fact that when the owner decides to implement the policy of no-smoking he would have to go through all the requirements and ensure that the occupants do follow it. The owner might also have to train all the occupants about the importance of smoking in the designated areas or out of the building.

Direct or Indirect Economic Innovation:

The benefits from this prerequisite are direct economic benefits to the owner because there will be a positive cash flow or measurable savings for the owner will occur at some point during the service life of the innovation. This is because, the occupants of the buildings would have lesser chances of diagnosed with lung cancer, reduced liability for the owner and increased productivity of the employees working within the building.

Radical Innovation or Incremental Innovation:

The prerequisite is an Incremental Innovation as it can be implemented without having to adjust the design of other building systems, and without the assistance of a domain knowledge specialist or a specialty subcontractor. Also it was known previously that the effects of smoking are harmful for not only the people smoking actively but also passively. Hence by following this credit we would be building on the exiting knowledge and so it is an incremental innovation.

EQ Credit 1 (Outdoor Air Delivery Monitoring):

Intent:

The main intent of this credit is to provide capacity for ventilation system monitoring to help sustain occupant comfort and wellbeing.

Requirements:

Install permanent monitoring system that provide feedback on ventilation system performance to ensure that the ventilation system maintain design minimum ventilation requirements. Configure all monitoring equipment to generate an alarm when the conditions vary by 10% or more from the set point via building automation system to the building operator.

For mechanically ventilated spaces:

- Monitor carbon dioxide concentration within all densely occupied spaces and the CO_2 monitoring locations shall be located between 3 to 6 feet above the floor.
- For each mechanical ventilation system serving non-densely occupied spaces, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 15%.

For naturally ventilated spaces:

- Monitor carbon dioxide concentration within all densely occupied spaces and the CO_2 monitoring locations shall be located between 3 to 6 feet above the floor. One CO_2 may be used to represent multiple spaces if the natural ventilation uses passive stack or other means to induce air flow through those spaces equally and simultaneously without intervention by building occupants.

Type of Innovation:

Product, Process or Both:

This credit is process innovation because this credit requires behavioral changes on the part of the owner, or occupants, in order that the requirements of the credit are met.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct economic benefits to the owner because there will be a positive cash flow or measurable savings for the owner will incur at some point during the service life of the innovation. It will be because of enhanced productivity and reduced absenteeism by the employees. However, an initial cost would have to be incurred by the owner to get the things in line and would also mean a consistent expenditure on the operations and maintenance of the equipment.

Radical Innovation or Incremental Innovation:

This credit is a Radical Innovation as the credit requires the use of a completely different type of system that is not currently used in the owner's buildings. Also the credit requires a domain knowledge specialist or specialty subcontractor to install or maintain.

EQ Credit 2 (Increased Ventilation):

Intent:

The main intent of this credit is to provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being and productivity.

Requirements:

For Mechanically Ventilated spaces:

- Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30%above the minimum rates requires by ASHRAE standard 62.1-2004.

For Naturally Ventilated spaces:

- Design natural ventilation system for occupied spaces to meet the recommendations set forth in the Carbon Trust Good Practices Guide 237 (1998).

And

- Use diagrams and calculations to show the design of the natural ventilation system meets the recommendation set forth in CIBSE application manual.

Or

- Use macroscopic, multi-zone, analytic model to predict room by room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by ASRAE 62.1-2004 Chapter 6 for at least 90% of the occupied space.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because owner can achieve credit by installing required equipment, like mechanical systems or natural windows as per the specification of the credit. The owner pays for the equipment but does not need to change his behavior to reap the benefits. So this credit is Product Innovation.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. This credit leads to better Indoor environmental quality after the occupancy ultimately leading to higher efficiency from the employees, after the occupancy of the building. But at the same time, this credit requires the owner to make lot of decision that can take a large amount of time, money and efforts from his part.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as it can be implemented by choosing a different type of the system, or the innovation can be implemented without having to adjust the design of other building

systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor

EQ Credit 3.1 (Construction Management Pan- During Construction):

Intent:

The main intent of this credit is to reduce the indoor air quality (IAQ) problems resulting from the construction/renovation process in order to help sustain the comfort and wellbeing of the construction workers and occupants.

Requirement:

Develop and implement IAQ management plan for the construction and pre-occupancy phases of the building as follows:

- During construction meet or exceed the recommended control measures of the sheet metal and Air Conditioners Contractors National (SMACNA) IAQ guidelines for occupied buildings for occupied buildings under construction.
- Protect stored on-site or installed absorptive materials from moisture damage.
- If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return grill. Replace all filtration media prior to occupancy.

Type of Innovation:

Product, Process or Both:

This innovation is product innovation. We have termed this credit previously as a "*buy me*" credit for the owner because the owner decides to pursue a credit and then he has nothing to do, except deciding in the conceptual stage of the project about the inclusion of the credit and then paying all the expenses related to achieving the credit innovation. All the work is done by the general contractor.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. The benefits from this innovation leads to better Indoor Air quality during the construction and after the occupancy, ultimately leading to higher efficiency from the construction workers, during the construction process and then from the employees, after the occupancy of the building. But at the same time, it requires proper coordination of activities between the sub-contractor and general contractor so that the activities are executed as per the schedule and none of the absorptive material lay around the work area. In addition, the

general contractor has to make sure that porous materials are stored in the clean areas and some of the spaces used effectively so that the contaminated air does not affect the materials.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation it can be implemented without having to adjust the design of other building systems, and using the assistance of a domain knowledge specialist or specialty subcontractor.

EQ Credit 3.2 (Construction Management Pan- Before Occupancy):

Intent:

The main intent of this credit is to reduce the indoor air quality (IAQ) problems resulting from the construction/renovation process in order to help sustain the comfort and wellbeing of the construction workers and occupants.

Requirement:

Develop and implement IAQ management plan for pre-occupancy phase as follows:

OPTION 1: FLUSH-OUT.

- After the construction ends, prior to occupancy and with all the interior finishes installed, perform a building flush-out by supplying a total volume of air at 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60^0 F and relative humidity not higher than 60%.

OR

- If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of minimum of 3,500 cu. ft. of outdoor air per sq. ft. of the floor area to the space. Once a space is occupied, it shall be ventilated at the minimum rate of 0.30cfm/sq. ft. of outside air or design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During the each day of the flush-out period, ventilation shall begin 3 hours prior to the occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft. / sq. ft. of outside air has been delivered in the space.

OR

OPTION 2- AIR QUALITY TESATING.

- Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the United States Environment Protection Agency (EPA) Compendium of Methods for the determination of Air Pollutants in Indoor Air and as additionally detailed in this Reference Guide.
- Demonstrate that the contaminated listed below are not exceeded:

  Formaldehyde: 50 parts per billion.

  Particulates: 50 micrograms per cubic meter.

  Total Volatile compounds: 500 micrograms per cubic meter.

  4-Phenylcyclohexane: 6.5 micrograms per cubic meter.

  Carbon Monoxide: 9 parts per million and no greater than 2 parts per million above outdoor levels.
- For each sampling point where the maximum concentration limits are exceeded conduct additional flush-out with outside air and retest the specific parameters exceeded to indicate the requirements are achieved. Repeat the procedure until all the requirements have been met. When testing the non-complying building areas, take samples from the same location as in the first test.
- The air sample test shall be conducted as follows:
  1. All measurements shall be conducted prior to the occupancy, but during the normal occupied hours and with the building ventilation systems starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
  2. The building shall have all interior finished installed, included, but not limited to millwork, doors, paints, carpet and acoustical tiles. Non-fixed furnishing such as workstation and partitions are encouraged, but not required, to be in place for testing.
  3. The number of sampling shall vary depending on the size of the building and the number of the ventilation systems. For each part of the building served by separated ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft., or for each contiguous floor, whichever is larger, and include areas with the least ventilation and greatest presumed strength.
  4. Air samples shall be collected between 3 feet and 6 feet from floor to represent the breathing zone of occupants, and over a minimum of 4 hour period.

<u>Type of Innovation:</u>

Product, Process or Both:

This credit is a process innovation because it requires behavioral changes on the part of the owner, and occupants. It also requires the owner to change the approach for occupying the building once it is completed. Once all the building work is completed, including the punch list, the general contractor, owner and all the stake-holders discuss and decide which innovation, flush-out or air qualifying testing should be pursued. Once, a decision has been taken taking all the factors into account, and then it is conveyed to the person responsible for this credit.

Direct or Indirect Economic Innovation:

The benefits from this innovation are direct to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. It also leads to better Indoor Air quality after the occupancy ultimately leading to higher efficiency from the employees. But at the same time, it can delay the date for the initial occupancy. It can also extend the schedule of the project, as it expects that the building inside be cleaned regularly and work done in a pre-decided fashion.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as the innovation can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor.

EQ Credit 4.1 (Low Emitting Materials- Adhesives and Sealants):

Intent:

The main intent of this credit is to reduce the indoor air contaminants that are odorous, irritating and/or harmful to the comfort and wellbeing of the installers and occupants.

Requirements:

- Adhesive, Sealant & Sealant Primer: South Coast Air Quality Management District Rule #1168. VOC limits listed in the figure on page 339 of the LEED New Construction Manual Version 2.2 and they correspond to an effective July 1st 2005and an amendment of January 7th 2005.
- Aerosol Adhesives: Green Seal Standard for commercial adhesives GS 36 requirements in effect on October 19, 2000.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the innovation is a purchased technology or service that the owner pays for but doesn't need to change behavior.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct to the owner as there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. This credit also leads to better Indoor Air quality after the occupancy ultimately leading to higher efficiency from the employees. But at the same time, it requires the owner and the general contractor to make sure that the desired sealant is applied.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as the innovation can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor.

EQ Credit 4.2 (Low Emitting Materials- Paints and Coating):

Intent:

The main intent of this credit is to reduce the indoor air contaminants that are odorous, irritating and/or harmful to the comfort and wellbeing of the installers and occupants.

Requirements:

- Architectural paints, coatings and primers applied to the interior walls and ceilings: Do not exceed the VOC content limits established by the Green seal standard GS 11. Primers must meet the VOC limit for non-flat paint (Flat 50g/L ; Non-flat 150g/L)
- Anti-corrosive paints applied to interior ferrous metal substrates: Do not exceed the VOC limit of 250g/L established in the Green seal standard GS-03.
- Clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements. Do not exceed the VOC limits established in South Coast Air Quality Management District.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the innovation is a purchased technology or service that the owner pays for but doesn't need to change behavior.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct to the owner as there is a positive cash flow or measurable savings for the owner will occur at some point during the service life of the innovation. This credit also leads to better Indoor Air quality after the occupancy ultimately leading to higher efficiency from the employees, after the occupancy of the building. But at the same time, it requires the owner and the general contractor to make sure that the desired paints and coating are applied.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as the innovation can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Thus this credit offers an incremental innovation to the owner.

EQ Credit 4.3 (Low Emitting Materials- Carpet System):

Intent:

The main intent of this credit is to reduce the indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of the installers and occupants.

Requirements:

- All carpets installed in the building shall meet the testing and product requirement of the carpet and Rug Institute's green label plus program
- All carpet cushion installed in the building interior shall meet the requirements of the Carpet Rug Institute Green Label Program.
- All carpet adhesives shall meet the requirements of EQ 4.1, VOC limit of 50g/L.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the innovation is a purchased technology or service that the owner pays for but doesn't need to change behavior.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct to the owner as there is a positive cash flow or measurable savings for the owner will occur at some point during the service life of the innovation. This credit also leads to better Indoor Air quality after the occupancy ultimately leading to higher efficiency from the employees, after the occupancy of the building. But at the same time, it requires the owner and the general contractor to make sure that the desired carpets are applied.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as the innovation can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Thus this credit offers an incremental innovation to the owner.

EQ Credit 4.4 (Low Emitting Materials- Agrifiber, wood boards):

Intent:

The main intent of this credit is to reduce the indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of the installers and occupants.

Requirements:

- Composite wood and Agrifiber products used on the interior of the building shall contain no added urea formaldehyde resins.
- Laminating adhesives used to fabricate on-site and shop applied composite wood and Agrifiber assemblies shall contain no added urea formaldehyde resins.
- Composite wood and Agrifiber products are defined as: particleboard, medium density fiber board (MDF), plywood, wheat board, strawboard, panel substrates and door cores. Furniture and equipment are not considered base building element and are not included.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation as the innovation is a purchased technology or services that the owner pays for but doesn't need to change behavior.

Direct or Indirect Economic Innovation:

The benefits from this credit are direct to the owner as there is a positive cash flow or measurable savings for the owner will occur at some point during the service life of the innovation. This credit also leads to

better Indoor Air quality after the occupancy ultimately leading to higher efficiency from the employees, after the occupancy of the building. But at the same time, it requires the owner and the general contractor to make sure that the desired wall board's Agrifiber is applied.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as the innovation can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor. Thus, this credit offers an incremental innovation to the owner.

EQ Credit 5 (Indoor Chemical & Pollution Source Control):

Intent:

The main intent of this credit is to minimize the exposure of the building occupants to potentially hazardous particulates and chemical pollutants.

Requirements:

- Employ, permanent entryway system at least six feet in the primary direction of travel to capture the dirt and particulates from entering the building at entryways that are daily connected to the outdoors and that serve as regular entry points for building users. Acceptable entryway systems include permanently installed gates, grilles or sorted systems that allow for cleaning of the underneath. Roll-out mats are only acceptable when maintained on a weekly basis by a contracted service organization.
- When hazardous chemicals or gas are used or present within the building, exhaust each space sufficiently to create negative pressure. For each of those spaces provide hard lit ceiling, self-closing doors or a deck to deck partition. The exhaust rate should be at least 0.50 cfm/sq. ft., with no air re-circulation.
- In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media prior to occupancy that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation it is a purchased technology or service that the owner pays for but doesn't need to change behavior. Once the owner has placed the equipment as per the requirement of the

credit, it becomes easier to achieve. So this innovation does not require a behavioral change neither from the owner nor from the occupants. Hence this credit is a product innovation from the owner's perspective.

Direct or Indirect Economic Innovation:

The benefits from this innovation are direct to the owner as there is a positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. This credit also leads to better Indoor Air quality after the occupancy, ultimately leading to higher efficiency from the employees, after the occupancy of the building. But these benefits come at a very high price. The owner has to make an initial investment such as additional sinks, drains, room separation and separate housekeeping areas. In addition a separate ventilation system may also be required at times and this ventilation system may depend on the type of climate. For example, moderate climatic zones, an exhaust fan could work, but in extreme climate, it would require a separate HVAC system.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as it can be implemented without having to adjust the design of other building systems, and the innovation can be implemented without the assistance of a domain knowledge specialist or specialty subcontractor.

EQ Credit 6.1 (Controllability of Systems- Lighting):

Intent:

The main intent of this credit is to provide a high level of lighting systems controlled by individual occupants or by specific groups in multi-occupant spaces (i.e. Classroom or conference areas) to promote the productivity, comfort and well-being of building occupants.

Requirement:

Provide individual lighting controls for 90% of the building occupants to enable adjustments to suit individual task needs and preferences.

AND

Provide lighting system controllability for all shared multi-occupant spaces to enable lighting adjustments that meet group needs and preferences.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation because the credit requires behavioral changes on the part of the owner, occupants and also the credit requires the owner to adapt to different operating conditions than are

otherwise preferred. Also, it requires the owner, architect and interior designers to plan the workstation and spaces as per the requirements of the credit.

Direct or Indirect Economic Innovation:

The benefits from this innovation are direct to the owner as there is a positive cash flow or measurable savings for the owner will occur at some point during the service life of the innovation. It also leads to better Indoor Environmental Quality, after leading to higher efficiency from the employees, after the occupancy of the building. Also the heat consumption within the building can be reduced especially if the site is located in the colder zones of the planet. In addition to above if appropriately lighted the overall energy cost of the building through the life time of the building can also be reduced

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation that can be implemented without having to adjust the design of other building systems, and using the assistance of a domain knowledge specialist or specialty subcontractor. Thus this credit offers an incremental innovation to the owner.

EQ Credit 6.2 (Controllability of Systems- Thermal Comfort):

Intent:

The main intent of this credit is to provide a high level of thermal comfort system control by individual occupants or by specific groups in multi occupied spaces (classes or conferences) to promote the productivity, comfort and well-being of the occupants.

Requirements:

- Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustment to suit individual task needs and preferences. Operable windows can be used in lieu of comfort controls for occupants of areas that are 20 feet inside of and 10 feet to either side of the operable part of the window. The area of the operable window should meet the requirements of ASHRAE 62.1-2004.
- Provide comfort system controls for all shared multi-occupant spaces to enable adjustments to suit group's needs and preferences.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation because the credit requires behavioral changes on the part of the owner, occupants and also the credit requires the owner to adapt to different operating conditions that are otherwise preferred.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as all the requirements are built from the existing set of the knowledge that we have. This credit builds on enhancing the Indoor Air Quality for the users and provide more controls to the users so that the environment within the facility suites the needs of most of the individuals.

EQ Credit 7.1 (Thermal Comfort - Design):

Intent:

The main intent of this credit is to provide a thermal environment that supports the productivity and well-being of the building occupants.

Requirements:

Design HVAC systems and building envelope to meet the requirements of ASHRAE Standards 55-2004.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because it requires to install equipment that can be: (Passive Ventilation (naturally ventilated), Active Ventilation (mechanically ventilated) or Mixed Mode Ventilation (both)) to achieve this credit. Once the owner has placed the equipment as per the requirement of the credit, the credit becomes achievable.

All the methodologies have their own trade-offs and the owner has to select the one that suites and represents his needs the most. Once all the decisions have been taken by the owner, then he purchases the required elements to achieve the credit.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. The enhanced Indoor Air Quality leads to better efficiency of the workers for the organization. Also the implementation of this credit reduces the liabilities regarding the Indoor Air Quality for the owner, occupants and building operators.

Radical Innovation or Incremental Innovation:

This credit is an incremental innovation as all the requirements are built from the existing set of the knowledge that we have. This credit builds on enhancing the Indoor Air Quality for the users and providing more controls to the users so that the environment within the facility suites the needs of most of the individuals.

EQ Credit 7.2 (Thermal Comfort - Verification):

Intent:

The main intent of this credit is to provide assessment of the building thermal comfort overtime.

Requirements:

- Agree to implement a thermal comfort survey of the building occupants within a period of 6 to 18 months. This survey shall collect anonymous responses about the thermal comfort in the building. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of the occupants are dissatisfied with the thermal comfort in the building.

Type of Innovation:

Product, Process or Both:

This credit is a process innovation because the credit requires behavioral changes on the part of the owner, and occupants. Initially, during the design phase, owner and the HVAC consultants identify the appropriate thermal comfort level criteria. After the 6 to 18 months occupancy, the credit further requires the owner and the occupants of the building to participate in a survey that asks about the thermal comfort levels. If less than 20% are dissatisfied with the thermal comfort level, then the building is operating fine. However if more than 20% of the people are not happy with the thermal comfort level within the facility, necessary remedial actions would be required. So this credit requires the constant monitoring on the part of the owner in order to be achieved.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. The major benefit with this credit is that the occupants of the facility are happy thermal comfort level within the facility thereby enhancing the efficiency of the work force. It also reduces absenteeism and thereby generating higher profits to the organization. However, by pursuing this credit, the owner might have to incur slightly a higher expenditure during the operations and maintenance part of the project.

Radical Innovation or Incremental Innovation:

This credit leads to radical innovation as the credit requires the use of a completely different type of system that is not currently used on the owner's buildings. Also the credit requires a domain knowledge specialist or specialty subcontractor to install or maintain

EQ Credit 8.1 (Daylight and Views – Daylight 75% of space):

Intent:

The main intent of this credit is to provide for the building occupants a connection between the interior spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Requirement:

OPTION 1:

- Achieve a minimum glazing factor of 2% in a minimum of 75% of all regularly occupied areas.

OR OPTION 2:

- Demonstrate through computer simulation that a minimum daylight illumination level of 25 foot-candles has been achieved in a minimum of 75% of all regularly occupied areas. Modeling must demonstrate 25 horizontal foot-candles under clear sky conditions.

OR OPTION 3:

- Demonstrate through records of indoor light measurements, that a minimum daylight level of 25 foot-candles has been achieved in at least 75% of regularly occupied areas. The measurements must be taken on a 10 foot grid for all occupied spaces and must be recorded on the building floor plans.

- In all cases, only the square footage associated with the portions of rooms meeting the minimum illumination requirements can be applied towards the 75% of total area calculations.
  In all cases, provide daylight reduction or glare reduction devices to avoid high contrast situation that could impede visual tasks. Exception for the areas where the tasks would be hindered by the use of daylight will be considered on the merits.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because in order to achieve this credit the owner has to install equipment within the facility that facilitates the requirements of the credit. Once the owner understands the need, then the areas are segregated on the basis of occupied space, common space and non-occupied spaces. After doing so the necessary day lighting mechanisms are designed for the building. During this designing period the owner and the design team have to make sure that all the day lighting elements do not conflict the requirements of the owner and compliment the building aesthetically. There can be times when the requirements or the spaces are shuffled in order to achieve higher efficiency. But once this phase is over and the material purchased and installed, the credit is achieved.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. It is estimated that with proper day lighting of a building, the energy consumption is reduced to 50% in comparison to a contemporary building. However, at the same time this credit also requires the owner to make an initial investment for purchasing all the required equipment for achieving this credit.

Radical Innovation or Incremental Innovation:

This credit leads to radical innovation as it requires the design of other systems to be adjusted to accommodate it, and at the same time the credit requires a domain knowledge specialist or specialty subcontractor to install the system.

EQ Credit 8.2 (Daylight and Views – Daylight 90% of space):

Intent:

The main intent of this credit is to provide for the building occupants a connection between the interior spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Requirement:

Achieve direct line of sight to the outdoor environment via vision glazing between 2'6" and 7'6" above floor finish for building occupancy in 90% of all regularly occupied areas. Determine the area with the direct line of sight by totaling occupied square footage that meets the following criteria:

- In planar view, the area is within sight lines drawn from perimeter vision glazing.
- In section view, a direct sight line can be drawn from the area to perimeter vision glazing.

Lines of sight can be drawn through the interior glazing. For private offices, the entire square footage of the office can be counted if 75% or more area has direct line of sight to perimeter vision glazing.

Type of Innovation:

Product, Process or Both:

This credit is a product innovation because in order to achieve this credit the owner has to install equipment within the facility that facilitates the requirements of the credit. Once the owner understands the need, then the areas are segregated on the basis of occupied space, common space and non-occupied spaces. After doing so the necessary day lighting mechanisms are designed for the building. During this designing period the owner and the design team have to make sure that all the day lighting elements do not conflict the requirements of the owner and compliment the building aesthetically. There can be times when the requirements or the spaces are shuffled in order to achieve higher efficiency. But once this phase is over and the material purchased and installed, the credit is achieved.

Direct or Indirect Economic Innovation:

This credit causes direct economic innovation to the owner as there is positive cash flow or measurable savings for the owner that will occur at some point during the service life of the innovation. It is estimated that with proper day lighting of a building, the energy consumption is reduced to 50% in comparison to a contemporary building. However, at the same time this credit also requires the owner to make an initial investment for purchasing all the required equipment for achieving this credit.

Radical Innovation or Incremental Innovation:

This credit leads to incremental innovation as all the requirements are built from the existing set of the knowledge that we have. This credit builds on enhancing the Indoor Air Quality for the users and

providing more controls to the users so that the environment within the facility suites the needs of most of the individuals.

Appendix IV

Combination of LEED with Routinization:

The main aim of this Appendix is to observe the combination of LEED segregation and the routinized credits. Once the segregation of the LEED checklist was established from the Inter-Rater Reliability, based on economical attributes (direct and indirect economic innovation), technical attributes (product innovation and process innovation) and types of innovation (incremental innovation and radical innovation), the results were matched with the credits that were routinized for each of the organizations that were shortlisted for this study. In short form this step was the combination of the results obtained from Appendix II and Appendix III. And so for this Appendix, a new table was created that had the components of the above mentioned appendixes. From this table we were able to identify routinized credits on one hand and the attributes of each credit in context of the innovation on the other hand. From this step we were able to come close to the results and observe the results in a very superficial manner. The detailed analysis of the results was observed in the results section.

Table 16a: Combination of LEED with Routinization for Sustainable Sites for Arizona State University.

	Site Selection							
Credit No.	**Name of the Credit.**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Erosion & Sedimentation Control	✓		✓			✓	
Credit 1	Site Selection	✓				✓		✓
Credit 2	Urban Redevelopment Density	✓				✓		✓
Credit 3	Brownfield Redevelopment		✓	✓				✓
Credit 4.1	Alternative Transportation	✓		✓				✓
Credit 4.2	Alternative Transportation	✓		✓				✓
Credit 4.3	Alternative Transportation		✓	✓				✓
Credit 4.4	Alternative Transportation	✓				✓	✓	
Credit 5.1	Reduced Site Disturbance	✓		✓			✓	
Credit 5.2	Reduced Site Disturbance	✓		✓				✓
Credit 6.1	Storm water Management		✓	✓				✓
Credit 6.2	Storm water Management		✓	✓				✓
Credit 7.1	Reduce Heat Islands	✓		✓			✓	
Credit 7.2	Reduce Heat Islands		✓	✓			✓	
Credit 8	Light Pollution Reduction		✓			✓	✓	
	Total routinized Credits	7	5	8	0	4	5	7
	Total routinized Prerequisites	1	0	1	0	0	1	0

Table 16b: Combination of LEED with Routinization for Water Efficiency for Arizona State University

	Water Efficiency							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Credit 1.1	Water efficient landscaping	✓		✓			✓	
Credit 1.2	Water efficient landscaping		✓			✓	✓	
Credit 2	Innovative wastewater technologies		✓			✓	✓	
Credit 3.1	Water Use Reduction	✓		✓			✓	
Credit 3.2	Water Use Reduction	✓		✓			✓	
	Total routinized credits	3	0	3	0	0	3	0
	Total routinized Prerequisites	0	0	0	0	0	0	0

Table 16c: Combination of LEED with Routinization for Energy & Atmosphere for Arizona State University

	Energy & Atmosphere								
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Fundamental Building Systems Commissioning		✓			✓	✓	
Prereq 2	Minimum energy performance	✓			✓		✓	
Prereq 3	CFC Reduction in HVAC&R Equipment	✓		✓				✓
Credit 1.1	Optimize Energy Performance		✓		✓		✓	
Credit 1.2	Optimize Energy Performance		✓		✓		✓	
Credit 1.3	Optimize Energy Performance		✓		✓		✓	
Credit 1.4	Optimize Energy Performance		✓		✓		✓	
Credit 1.5	Optimize Energy Performance		✓		✓		✓	
Credit 2.1	Renewable Energy		✓	✓			✓	
Credit 2.2	Renewable Energy		✓	✓			✓	
Credit 2.3	Renewable Energy		✓	✓			✓	
Credit 3	Additional commissioning		✓			✓	✓	
Credit 4	Ozone depletion	✓		✓				✓
Credit 5	Measurement & Verification		✓			✓	✓	
Credit 6	Green Power	✓		✓				✓
	Total routinized Credits	1	2	1	2	0	2	1
	Total routinized Prerequisites	2	1	1	1	1	2	1

Table 16d: Combination of LEED with Routinization for Material & Resources for Arizona State University

	Material & Resource							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Storage and collection of recyclables	✓		✓			✓	
Credit 1.1	Building Reuse	✓		✓			✓	
Credit 1.2	Building Reuse	✓		✓			✓	
Credit 1.3	Building Reuse	✓		✓			✓	
Credit 2.1	Construction waste management	✓		✓				✓
Credit 2.2	Construction waste management	✓		✓				✓
Credit 3.1	Materials reuse		✓	✓				✓
Credit 3.2	Materials reuse		✓	✓				✓
Credit 4.1	Recycled Content	✓		✓				✓
Credit 4.2	Recycled Content	✓		✓				✓
Credit 5.1	Regional Materials	✓		✓				✓
Credit 5.2	Regional Materials	✓		✓				✓
Credit 6	Rapidly Renewable Materials	✓		✓				✓
Credit 7	Certified Wood	✓		✓				✓
	Total routinized Credits	4	0	4	0	0	0	4
	Total routinized Prerequisites	1	0	1	0	0	1	0

Table 16e: Combination of LEED with Routinization for Indoor Environmental Quality for Arizona State University

	Indoor Environmental Quality								
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓		✓			✓	
Prereq 2	Environmental Tobacco Smoke Control	✓				✓	✓	
Credit 1	Outdoor air delivery monitoring		✓			✓	✓	
Credit 2	Increased ventilation	✓		✓			✓	
Credit 3.1	Construction IAQ management plan	✓		✓			✓	
Credit 3.2	Construction IAQ management plan	✓				✓	✓	
Credit 4.1	Low –Emitting Materials	✓		✓			✓	
Credit 4.2	Low –Emitting Materials	✓		✓			✓	
Credit 4.3	Low –Emitting Materials	✓		✓			✓	
Credit 4.4	Low –Emitting Materials	✓		✓			✓	
Credit 5	Indoor chemical and pollution source control	✓		✓			✓	
Credit 6.1	Controllability of systems	✓				✓	✓	
Credit 6.2	Controllability of systems	✓				✓	✓	
Credit 7.1	Thermal Comfort	✓		✓			✓	
Credit 7.2	Thermal Comfort		✓			✓	✓	
Credit 8.1	Day lighting & Views		✓	✓			✓	
Credit 8.2	Day lighting & Views	✓		✓			✓	
	Total routinized Credits	6	1	6	0	1	7	0
	Total routinized Prerequisites	2	0	1	0	1	2	0

Table 17a: Combination of LEED with Routinization for Sustainable Sites for University of Florida

Site Selection

Credit No.	Name of the Credit.	Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
Prereq 1	Erosion & Sedimentation Control	✓		✓			✓	
Credit 1	Site Selection	✓				✓		✓
Credit 2	Urban Redevelopment Density	✓				✓		✓
Credit 3	Brownfield Redevelopment		✓	✓				✓
Credit 4.1	Alternative Transportation	✓		✓				✓
Credit 4.2	Alternative Transportation	✓		✓				✓
Credit 4.3	Alternative Transportation		✓	✓				✓
Credit 4.4	Alternative Transportation	✓				✓	✓	
Credit 5.1	Reduced Site Disturbance	✓		✓			✓	
Credit 5.2	Reduced Site Disturbance	✓		✓				✓
Credit 6.1	Storm water Management		✓	✓				✓
Credit 6.2	Storm water Management		✓	✓				✓
Credit 7.1	Reduce Heat Islands	✓		✓			✓	
Credit 7.2	Reduce Heat Islands		✓	✓			✓	
Credit 8	Light Pollution Reduction		✓			✓	✓	
	Total routinized Credits	5	2	5	0	2	1	6
	Total routinized Prerequisites	1	0	1	0	0	1	0

Table 17b: Combination of LEED with Routinization for Water Efficiency for University of Florida,

	Water Efficiency							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Credit 1.1	Water efficient landscaping	✓		✓			✓	
Credit 1.2	Water efficient landscaping		✓			✓	✓	
Credit 2	Innovative wastewater technologies		✓			✓	✓	
Credit 3.1	Water Use Reduction	✓		✓			✓	
Credit 3.2	Water Use Reduction	✓		✓			✓	
	Total routinized Credits	0	0	0	0	0	0	0
	Total routinized Prerequisites	0	0	0	0	0	0	0

Table 17c: Combination of LEED with Routinization for Energy & Atmosphere for University of Florida

	Energy & Atmosphere							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Fundamental Building Systems Commissioning		✓			✓	✓	
Prereq 2	Minimum energy performance	✓			✓		✓	
Prereq 3	CFC Reduction in HVAC&R Equipment	✓		✓				✓
Credit 1.1	Optimize Energy Performance		✓		✓		✓	
Credit 1.2	Optimize Energy Performance		✓		✓		✓	
Credit 1.3	Optimize Energy Performance		✓		✓		✓	
Credit 1.4	Optimize Energy Performance		✓		✓		✓	
Credit 1.5	Optimize Energy Performance		✓		✓		✓	
Credit 2.1	Renewable Energy		✓	✓			✓	
Credit 2.2	Renewable Energy		✓	✓			✓	
Credit 2.3	Renewable Energy		✓	✓			✓	
Credit 3	Additional commissioning		✓			✓	✓	
Credit 4	Ozone depletion	✓		✓				✓
Credit 5	Measurement & Verification		✓			✓	✓	
Credit 6	Green Power	✓		✓				✓
	Total routinized Credits	0	3	0	3	0	3	0
	Total routinized Prerequisites	2	1	1	1	1	2	1

Table 17d: Combination of LEED with Routinization for Material & Resource for University of Florida

	Material & Resource							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Storage and collection of recyclables	✓		✓			✓	
Credit 1.1	Building Reuse	✓		✓			✓	
Credit 1.2	Building Reuse	✓		✓			✓	
Credit 1.3	Building Reuse	✓		✓			✓	
Credit 2.1	Construction waste management	✓		✓				✓
Credit 2.2	Construction waste management	✓		✓				✓
Credit 3.1	Materials reuse		✓	✓				✓
Credit 3.2	Materials reuse		✓	✓				✓
Credit 4.1	Recycled Content	✓		✓				✓
Credit 4.2	Recycled Content	✓		✓				✓
Credit 5.1	Regional Materials	✓		✓				✓
Credit 5.2	Regional Materials	✓		✓				✓
Credit 6	Rapidly Renewable Materials	✓		✓				✓
Credit 7	Certified Wood	✓		✓				✓
	Total routinized Credits	4	0	4	0	0	0	4
	Total routinized Prerequisites	1	0	1	0	0	1	0

Table 17e: Combination of LEED with Routinization for Indoor Environmental Quality for University of Florida

	Indoor Environmental Quality							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓		✓			✓	
Prereq 2	Environmental Tobacco Smoke Control	✓				✓	✓	
Credit 1	Outdoor air delivery monitoring		✓			✓	✓	
Credit 2	Increased ventilation	✓		✓			✓	
Credit 3.1	Construction IAQ management plan	✓		✓			✓	
Credit 3.2	Construction IAQ management plan	✓				✓	✓	
Credit 4.1	Low –Emitting Materials	✓		✓			✓	
Credit 4.2	Low –Emitting Materials	✓		✓			✓	
Credit 4.3	Low –Emitting Materials	✓		✓			✓	
Credit 4.4	Low –Emitting Materials	✓		✓			✓	
Credit 5	Indoor chemical and pollution source control	✓		✓			✓	
Credit 6.1	Controllability of systems	✓				✓	✓	
Credit 6.2	Controllability of systems	✓				✓	✓	
Credit 7.1	Thermal Comfort	✓		✓			✓	
Credit 7.2	Thermal Comfort		✓			✓	✓	
Credit 8.1	Day lighting & Views		✓	✓			✓	
Credit 8.2	Day lighting & Views	✓		✓			✓	□
	Total routinized Credits	5	0	5	0	0	5	0

Total routinized Prerequisites	2	0	1	0	1	2	0

Table 18a: Combination of LEED with Routinization for Sustainable Sites for City of Austin

Site Selection

Credit No.	Name of the Credit.	Incremental Innovation	Radical Innovation	Product Innovation	Contextual	Process Innovation	Direct Economic Innovation	Indirect Economic Innovation
Prereq 1	Erosion & Sedimentation Control	✓		✓			✓	
Credit 1	Site Selection	✓				✓		✓
Credit 2	Urban Redevelopment Density	✓				✓		✓
Credit 3	Brownfield Redevelopment		✓	✓				✓
Credit 4.1	Alternative Transportation	✓		✓				✓
Credit 4.2	Alternative Transportation	✓		✓				✓
Credit 4.3	Alternative Transportation		✓	✓				✓
Credit 4.4	Alternative Transportation	✓				✓	✓	
Credit 5.1	Reduced Site Disturbance	✓		✓			✓	
Credit 5.2	Reduced Site Disturbance	✓		✓				✓
Credit 6.1	Storm water Management		✓	✓				✓
Credit 6.2	Storm water Management		✓	✓				✓
Credit 7.1	Reduce Heat Islands	✓		✓			✓	
Credit 7.2	Reduce Heat Islands		✓	✓			✓	
Credit 8	Light Pollution Reduction		✓			✓	✓	
	Total routinized Credits	5	2	5		2	2	5
	Total routinized Prerequisites	1	0	1		0	1	0

Table 18b: Combination of LEED with Routinization for Water Efficiency for City of Austin

	Water Efficiency							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Credit 1.1	Water efficient landscaping	✓		✓			✓	
Credit 1.2	Water efficient landscaping		✓			✓	✓	
Credit 2	Innovative wastewater technologies		✓			✓	✓	
Credit 3.1	Water Use Reduction	✓		✓			✓	
Credit 3.2	Water Use Reduction	✓		✓			✓	
	Total routinized Credits	1	0	1	0	0	1	0
	Total routinized Prerequisites	0	0	0	0	0	0	0

Table18c: Combination of LEED with Routinization for Energy & Atmosphere for City of Austin

	Energy & Atmosphere							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Fundamental Building Systems Commissioning		✓			✓	✓	
Prereq 2	Minimum energy performance	✓			✓		✓	
Prereq 3	CFC Reduction in HVAC&R Equipment	✓		✓				✓
Credit 1.1	Optimize Energy Performance		✓		✓		✓	
Credit 1.2	Optimize Energy Performance		✓		✓		✓	
Credit 1.3	Optimize Energy Performance		✓		✓		✓	
Credit 1.4	Optimize Energy Performance		✓		✓		✓	
Credit 1.5	Optimize Energy Performance		✓		✓		✓	
Credit 2.1	Renewable Energy		✓	✓			✓	
Credit 2.2	Renewable Energy		✓	✓			✓	
Credit 2.3	Renewable Energy		✓	✓			✓	
Credit 3	Additional commissioning		✓			✓	✓	
Credit 4	Ozone depletion	✓		✓				✓
Credit 5	Measurement & Verification		✓			✓	✓	
Credit 6	Green Power	✓		✓				✓
	Total routinized Credits	2	1	2	0	1	1	2
	Total routinized Prereq.	2	1	1	1	1	2	1

Table 18d: Combination of LEED with Routinization for Material & Resource for City of Austin

	Material & Resource							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Storage and collection of recyclables	✓		✓			✓	
Credit 1.1	Building Reuse	✓		✓			✓	
Credit 1.2	Building Reuse	✓		✓			✓	
Credit 1.3	Building Reuse	✓		✓			✓	
Credit 2.1	Construction waste management	✓		✓				✓
Credit 2.2	Construction waste management	✓		✓				✓
Credit 3.1	Materials reuse		✓	✓				✓
Credit 3.2	Materials reuse		✓	✓				✓
Credit 4.1	Recycled Content	✓		✓				✓
Credit 4.2	Recycled Content	✓		✓				✓
Credit 5.1	Regional Materials	✓		✓				✓
Credit 5.2	Regional Materials	✓		✓				✓
Credit 6	Rapidly Renewable Materials	✓		✓				✓
Credit 7	Certified Wood	✓		✓				✓
	Total routinized Credits	5	0	5		0	0	5
	Total routinized Prerequisites	1	0	1		0	1	0

Table 18e: Combination of LEED with Routinization for Indoor Environmental Quality for City of Austin

	Indoor Environmental Quality							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓		✓			✓	
Prereq 2	Environmental Tobacco Smoke Control	✓				✓	✓	
Credit 1	Outdoor air delivery monitoring		✓			✓	✓	
Credit 2	Increased ventilation	✓		✓			✓	
Credit 3.1	Construction IAQ management plan	✓		✓			✓	
Credit 3.2	Construction IAQ management plan	✓				✓	✓	
Credit 4.1	Low –Emitting Materials	✓		✓			✓	
Credit 4.2	Low –Emitting Materials	✓		✓			✓	
Credit 4.3	Low –Emitting Materials	✓		✓			✓	
Credit 4.4	Low –Emitting Materials	✓		✓			✓	
Credit 5	Indoor chemical and pollution source control	✓		✓			✓	
Credit 6.1	Controllability of systems	✓				✓	✓	
Credit 6.2	Controllability of systems	✓				✓	✓	
Credit 7.1	Thermal Comfort	✓		✓			✓	
Credit 7.2	Thermal Comfort		✓			✓	✓	
Credit 8.1	Day lighting & Views		✓	✓			✓	
Credit 8.2	Day lighting & Views	✓		✓			✓	
	Total routinized Credits	5	1	5		1	6	0
	Total routinized Prerequisites	2	0	1		1	2	0

Table19a: Combination of LEED with Routinization for Sustainable Sites for City of Seattle

	Site Selection							
Credit No.	**Name of the Credit.**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Erosion & Sedimentation Control	✓		✓			✓	
Credit 1	Site Selection	✓				✓		✓
Credit 2	Urban Redevelopment Density	✓				✓		✓
Credit 3	Brownfield Redevelopment		✓	✓				✓
Credit 4.1	Alternative Transportation	✓		✓				✓
Credit 4.2	Alternative Transportation	✓		✓				✓
Credit 4.3	Alternative Transportation		✓	✓				✓
Credit 4.4	Alternative Transportation	✓				✓	✓	
Credit 5.1	Reduced Site Disturbance	✓		✓			✓	
Credit 5.2	Reduced Site Disturbance	✓		✓				✓
Credit 6.1	Storm water Management		✓	✓				✓
Credit 6.2	Storm water Management		✓	✓				✓
Credit 7.1	Reduce Heat Islands	✓		✓			✓	
Credit 7.2	Reduce Heat Islands		✓	✓			✓	
Credit 8	Light Pollution Reduction		✓			✓	✓	
	Total routinized Credits	4	0	3	0	1	1	3
	Total routinized Prerequisites	1	0	1	0	0	1	0

Table 19b: Combination of LEED with Routinization for Water Efficiency for City of Seattle

	Water Efficiency							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Credit 1.1	Water efficient landscaping	✓		✓			✓	
Credit 1.2	Water efficient landscaping		✓			✓	✓	
Credit 2	Innovative wastewater technologies		✓			✓	✓	
Credit 3.1	Water Use Reduction	✓		✓			✓	
Credit 3.2	Water Use Reduction	✓		✓			✓	
	Total routinized Credits	1	0	1	0	0	1	0
	Total routinized Prerequisites	0	0	0	0	0	0	0

Table 19c: Combination of LEED with Routinization for Energy & Atmosphere for City of Seattle

	Energy & Atmosphere							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Fundamental Building Systems Commissioning		✓			✓	✓	
Prereq 2	Minimum energy performance	✓			✓		✓	
Prereq 3	CFC Reduction in HVAC&R Equipment	✓		✓				✓
Credit 1.1	Optimize Energy Performance		✓		✓		✓	
Credit 1.2	Optimize Energy Performance		✓		✓		✓	
Credit 1.3	Optimize Energy Performance		✓		✓		✓	
Credit 1.4	Optimize Energy Performance		✓		✓		✓	
Credit 1.5	Optimize Energy Performance		✓		✓		✓	
Credit 2.1	Renewable Energy		✓	✓			✓	
Credit 2.2	Renewable Energy		✓	✓			✓	
Credit 2.3	Renewable Energy		✓	✓			✓	
Credit 3	Additional commissioning		✓			✓	✓	
Credit 4	Ozone depletion	✓		✓				✓
Credit 5	Measurement & Verification		✓			✓	✓	
Credit 6	Green Power	✓		✓				✓
	Total routinized Credits	1	3	1	2	1	3	1
	Total routinized Prerequisites	2	1	1	1	1	2	1

Table 19d: Combination of LEED with Routinization for Material & Resource for City of Seattle

	Material & Resource							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Storage and collection of recyclables	✓		✓			✓	
Credit 1.1	Building Reuse	✓		✓			✓	
Credit 1.2	Building Reuse	✓		✓			✓	
Credit 1.3	Building Reuse	✓		✓			✓	
Credit 2.1	Construction waste management	✓		✓				✓
Credit 2.2	Construction waste management	✓		✓				✓
Credit 3.1	Materials reuse		✓	✓				✓
Credit 3.2	Materials reuse		✓	✓				✓
Credit 4.1	Recycled Content	✓		✓				✓
Credit 4.2	Recycled Content	✓		✓				✓
Credit 5.1	Regional Materials	✓		✓				✓
Credit 5.2	Regional Materials	✓		✓				✓
Credit 6	Rapidly Renewable Materials	✓		✓				✓
Credit 7	Certified Wood	✓		✓				✓
	Total routinized Credits	4	0	4	0	0	0	4
	Total routinized Prerequisites	1	0	1	0	0	1	0

Table 19e: Combination of LEED with Routinization for Indoor Environment Quality for City of Seattle

	Indoor Environmental Quality							
Credit No.	**Name of the Credit**	**Incremental Innovation**	**Radical Innovation**	**Product Innovation**	**Contextual**	**Process Innovation**	**Direct Economic Innovation**	**Indirect Economic Innovation**
Prereq 1	Minimum Indoor Air Quality (IAQ) Performance	✓		✓			✓	
Prereq 2	Environmental Tobacco Smoke Control	✓				✓	✓	
Credit 1	Outdoor air delivery monitoring		✓			✓	✓	
Credit 2	Increased ventilation	✓		✓			✓	
Credit 3.1	Construction IAQ management plan	✓		✓			✓	
Credit 3.2	Construction IAQ management plan	✓				✓	✓	
Credit 4.1	Low –Emitting Materials	✓		✓			✓	
Credit 4.2	Low –Emitting Materials	✓		✓			✓	
Credit 4.3	Low –Emitting Materials	✓		✓			✓	
Credit 4.4	Low –Emitting Materials	✓		✓			✓	
Credit 5	Indoor chemical and pollution source control	✓		✓			✓	
Credit 6.1	Controllability of systems	✓				✓	✓	
Credit 6.2	Controllability of systems	✓				✓	✓	
Credit 7.1	Thermal Comfort	✓		✓			✓	
Credit 7.2	Thermal Comfort		✓			✓	✓	
Credit 8.1	Day lighting & Views		✓	✓			✓	
Credit 8.2	Day lighting & Views	✓		✓			✓	
	Total routinized credits	7	0	6	0	1	7	0
	Total routinized Prerequisites	2	0	1	0	1	2	0