GreenGrey

by T.A. Group s.a.r.l

GREEN BROCHURE

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I. T.A. GROUP - SUSTAINABLE CONSTRUCTION/ GREEN

Tomorrow's habitat will comply with all dimensions of comfort. Everyone wants to enjoy a sense of well-being in their home, to feel safe, protected from the negative aspects of the outside world, comfortable and healthy. T.A. Group provides solutions that make buildings more efficient in terms of their energy consumption, and which help contribute to saving the planet. Most of its solutions are already helping and will help even more in building a sustainable future through leading both the green building design and the sustainable building design.

Not Every Green Building Is Considered Sustainable!

Many like to use the words "green" and "sustainable" interchangeably when it comes to the dialog on eco-friendly building design. However, there are several differences between them to note.

Green building is not necessarily the same as sustainable design. Sustainable design refers to the design and construction of buildings in a way that meets the needs of today for housing, working environments and infrastructure without compromising the ability of future generations to meet their own needs in times to come. It incorporates elements of economic efficiency, environmental performance and social responsibility – and contributes to the greatest extent when architectural quality, technical innovation and transferability are included.

However, with green building, the focus is often limited to environmental impacts. A "**green**" building is not always considered "**sustainable**". A building is green when it helps to minimize its environmental footprint by including the use of renewable energy sources such as wind, water, or solar.
A **green building** also involves creating a healthy indoor environment for example with natural ventilation systems and construction materials that minimize the use of volatile organic compounds (VOCs) in the building.

Indeed, true sustainable design considers the economic and social aspects of the design in addition to the environmental impacts and looks to balance this "triple bottom line." Sustainable building design is a holistic look at the entire building process.

I.T.A. GROUP - SUSTAINABLE CONSTRUCTION/ GREEN DESIGN

Green Building

Green building is firmly established in the commercial new construction market, and demand for green building materials continues to grow. As of April 2014, the U.S. Green Building Council (USGBC®) has certified 3 billion square feet of building space throughout the world. Numerous federal government agencies and state governments have enacted green building initiatives. In many cases, these initiatives move beyond voluntary measures to actual LEED®certification requirements for public and in some cases, private, new construction.

Green Grey

GreenGrey is the green label of T.A. Group S.A.R.L., a trade mark registered by the Lebanese Ministry of Economic and Commerce. **GreenGrey** will identify each and every product, system, service, application or design that may help reducing environmental impacts preserving the right of the future generations in meeting their needs within an appropriate and natural environment.

In other words, **GreenGrey** reflects the Green Identity of T.A. Group.

This report introduces the prerequisites and credits listed in LEED v4 BD+C, the newest version of the Leadership in Energy and Environmental Design for New Construction and Major Renovation, and examines their connection with T.A. Group products and solutions.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

1. ABOUT LEED

LEED® for New Construction is a tool for assessing the energy and environmental impact of buildings that was developed by the U.S. Green Building Council (USGBC®). LEED® stands for Leadership in Energy and Environmental Design, and USGBC has developed several rating systems for the different types of construction in the building industry, including new construction, existing buildings, schools, etc. The LEED rating systems are voluntary rating systems that provide a third-party certification to define what constitutes a "green" building.

LEED, or Leadership in Energy and Environmental Design, is changing the way we think about how buildings and communities are planned, constructed, maintained and operated. Leaders around the world have made LEED the most widely used third-party verification for green buildings, with around 1.85 million square feet being certified daily.

LEED works for all buildings—from homes to corporate headquarters—at all phases of development. Projects pursuing LEED certification earn points across several areas that address sustainability issues. Based on the number of points achieved, a project then receives one of four LEED rating levels: Certified, Silver, Gold and Platinum.

LEED-certified buildings are resource efficient. They use less water and energy and reduce greenhouse gas emissions. As an added bonus, they save money.

LEED was developed to address all buildings everywhere, regardless of where they are in their life cycle. From hospitals to data centers, from historical buildings to those still in the design phase, there is a LEED for every building depending on the project type. Project types are classified as below:

- ✓ Building Design and Construction
- ✓ Interior Design and Construction
- ✓ Building Operation and Maintenance
- ✓ Neighborhood Development
- ✓ Home

This reference guide illustrated below is the "LEED for Building Design and Construction BD+C" guide. It applies to buildings that are being newly constructed or going through a major renovation; includes New Construction, Core & Shell, Schools, Retail, Hospitality, Data Centers, Warehouses & Distribution Centers, and Healthcare.

This reference guide is designed to elaborate upon and work in conjunction with the rating system. It serves as a roadmap, describing the steps for meeting and documenting credit requirements and offering advice on best practices.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

2. LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE

➢ LOCATION & TRANSPORTATION

The LEED Location and Transportation category of credits is based on where the project is located, its connectibility to public transportation, and making accommodations for those using alternative transportation modes.

✓ LEED for Neighborhood Development Location

This credit is worth **3-16 points**. If the project site is located within a development area that has qualified for LEED for Neighborhood Development, the project is awarded points based on the certification level that the neighborhood achieved. Qualifications for LEED for Neighborhood Development include community connectivity, appropriateness of the development site, and whether the development encourages physical activity.

LEED for Neighborhood Development recognizes development projects that successfully protect and enhance the overall health, natural environment and quality of life in our communities. The rating system encourages smart growth and New Urbanist best practices by promoting the location and design of neighborhoods that reduce vehicle miles traveled (VMT) and creating developments where jobs and services are accessible by foot or public transit. It also promotes an array of green building and green infrastructure practices, particularly more efficient energy and water use—especially important in urban areas where infrastructure is often overtaxed.
If the project qualifies for this credit, it is not eligible to receive any other credits from the Location and Transportation category.

✓ Sensitive Land Protection

This credit is worth **1-2 points.** To earn this credit, the project must be located in a previously developed site (**worth one point**), and/or not be located in one of several sensitive sites: farmland, natural habitat, floodplains, and near water bodies or wetlands (**worth an additional point**).

"Minor improvements" are allowed near water bodies and wetlands if they help visitors to appreciate the bodies. "Minor improvements" include bicycle and walking paths, restoration/maintenance of native natural communities or hydrology, small single-story structures, removal of hazardous or diseased trees, and brownfield remediation.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

✓ High-Priority Site

This credit is worth **1-2 points**. **One point** is given for locating the project within an infill or previously developed site in a historic district, or for locating in one of several priority zoning locations, which have been determined by local or national jurisdictions. These include EPA certification as a Nation Priority Site and Department of the Treasury certification as a low-income area. **Two credits** are available for developing on a brownfield, or contaminated site.

✓ Surrounding Density and Diverse Uses

This credit is worth **1-5 points.** Projects receive **2-3 points** for locating in an area with specific densities of occupation within a 1/4 mile radius. The LEED Reference Guide provides a table detailing what these densities are.

In addition, projects can receive **1-2 points** for locating near several publicly available diverse uses. The uses, such as restaurants, grocery shopping, beauty parlors, gyms, etc., are measured within a 1/2 mile radius of the project front entrance, and only one location of each use type counts (only one restaurant qualifies, even if there are five within the boundary). If a project is near 4-7 distinct uses, it receives one point, and if there are eight or more, it receives two points.

✓ Access to Quality Transport

This credit is worth **1-5 points**. Projects earn credits based on the number of public and private transportation routes and stops that are located within a 1/2 mile of the project's front entrance. The accepted transportation modes include buses, light rail, ferries, and rideshare programs. Both current transportation stops and routes and those that are planned with a short time are included.

✓ Bicycle Facilities

This credit is worth **1 point**. Projects can earn this credit by locating near a bicycle network and providing secure bicycle parking and showering facilities. The bicycle network must connect to at least 10 distinct uses, as defined in the Density and Uses credit, an employment center (for projects that are 50% or more residential), or rapid transit.

The project must provide both long and short-term bicycle parking and showering facilities on-site. The number of parking spaces and showers is based on a percentage of the expected occupancy of the project.

✓ Reduced Parking Footprint

This credit is worth **1 point**. Projects must not exceed the local requirements for the number of parking spaces, and must achieve a reduction in the number of spaces that is 20-40% lower than the base ratio provided by the Parking Consultants Council, depending on the development density and transit availability of the local area.

Projects must also provide priority parking for carpools. Preferred parking is not required if no off-street parking is provided.

✓ Green Vehicles

This credit is worth **1 point**. In order to earn this credit, projects must designate 5% of the parking spaces for alternative fuel and hybrid vehicles. These spaces should be priority spaces and evenly distributed between short and long-term spaces. An additional 2% of the spaces should have vehicle charging services for electric vehicles or other alternative fuel forms (liquid, gas, or battery).

➢ SUSTAINABLE SITES

LEED Sustainable Sites credits deal with protecting natural habitat, keeping open spaces, dealing with rainwater, and heat island and light pollution reduction.

✓ Construction Activity Pollution Prevention

This measure is **required** for LEED certification. It involves executing specific measures designed to limit the effect of construction activities on the surrounding environment, by containing soil erosion, sedimentation of water ways, and airborne dust. A plan must be developed that meets the requirements of the EPA 2012 Construction General Permit or local requirements, whichever is more stringent. This plan must be in effect throughout the project, with photo and inspection evidence to show that the plan was maintained.

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✓ Site Assessment

This credit is worth **1 point**. In order to earn this credit, project teams must perform and document a site assessment of the project location, including the following topics: topography, hydrology, climate, vegetation, soils, human use, and human health effects. The assessment should discuss how the topics above influence the design, as well as any of the topics that were not addressed in the design.

✓ Protect or Restore Habitat

This credit is worth **1-2 points**. The project must preserve and protect at least 40% of the Greenfield (undeveloped) area on the project site, if such an area exists. In addition, the project must restore 30% of the site to natural habitat using native and adapted plant species (worth **2 credits**), or provide financial support to an organization accredited by the Land Trust Alliance (worth **1 credit**). The habitat restoration should include both soil and vegetation, and vegetated roofs can be counted in certain circumstances.

✓ Open Space

This credit is worth **1 point**. The project must provide open space equal to 30% of the total site area. At least 25% of that open space must be vegetated or have overhead vegetation. Turf grass areas do not count as vegetated areas. Open spaces must be designed for one or more of the following uses: social gathering, gardening, physical activity, or natural habitat that includes elements for human interaction. Vegetated roofs can be counted in certain circumstances.

✓ Rainwater Management

This credit is worth **1-3 points**. This credit asks the project team to design a rainwater management system that handles the water falling on the site in a way that is similar to the native state of the site. Depending on how much water the system is capable of handling, 1-3 points are possible. The capacity of the system is measured by what percentage of local or regional rain events could be handled by the system. If the system can handle 95% of the events, then it can earn 2 points, and 3 points for handling 98%. Or, as an alternate way of calculating the credit, if the system can handle 100% of the increase in runoff that occurs as the result of the development of the site from its natural state, then the project can earn 3 points.

✓ Heat Island Reduction

This credit is worth **1-2 points**. Heat islands occur in areas where hardscape surfaces (such as parking lots and sidewalks) hold heat and reflect it back, raising the temperature of the surrounding environment. This change in temperature can affect weather patterns in the local area. To avoid this, projects receive credit for using roofing materials with a high solar reflectance, reducing the amount of hard surfaces, shading project areas with trees and other foliage, placing parking lots under cover, and using open paver systems.

✓ Light Pollution Reduction

This credit is worth **1 point**. Projects must reduce the amount of up-lighting used for exterior lighting, avoid pollution of light into adjoining sites, and control light levels outside the building to meet certain standards. This requires a photometric plan, which shows the level of light in all areas of the site. The design team must take measurements to confirm that the built condition meets the requirements for this credit.

➢ Water Efficiency

Fresh, drinkable water is a precious commodity that is only available in a limited supply. Therefore, prudent use and treatment of waste water are very important as we look to expand our built environment and shrink natural treatment areas. Credits under this category have to do with limiting water use, both inside buildings and outside in landscaping.

✓ Outdoor Water Use Reduction

This is a **required** measure and must be completed to qualify for LEED certification. Reduce outdoor water use by providing landscaping that requires little or no irrigation. The use of native and drought-resistant plant species is encouraged.

The project must use no irrigation (after a two-year establishment period, where temporary irrigation systems are acceptable) or use 30% less than a baseline model. Plant species and the use of drip irrigation systems and moisture sensors are used as strategies to meet this goal.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

✓ Indoor Water Use Reduction

This is a **required** measure. Provide fixtures and fittings that will reduce indoor water use by 20% over a baseline case. Water use for fixtures is determined by tables provided in the Reference Guide. All plumbing fixtures should be Water Sense labeled or similar. Calculations should include appliance and process water use.

✓ Building-Level Water Metering

This is a **required** measure. Provide a water meter to measure water use on a monthly and annual basis, either automatically or manually, and provide such information to the US Green Building Council for a period of five years after the building is occupied or certified, whichever comes first.

✓ Outdoor Water Use Reduction

This credit is worth **1-2 points**. Provide no irrigation system (after a two-year establishment period) for 2 points, or reduce the amount of water needed for irrigation by 50% or more over the baseline calculation. Strategies include plant selection, irrigation delivery system, and alternative water sources.

✓ Indoor Water Use Reduction

This credit is worth **1-6 points**. Reduce the amount of water needed for indoor fixtures and fittings, similar to the prerequisite above. For each 5% increase in efficiency, from 25% to 50%, a point is awarded. 1 point for 25% efficiency, 2 for 30%, etc. The use of water saving fixtures, such as dual-flush toilets, low-flow urinals, and sensored faucets, are key to earning these credits.

✓ Cooling Tower Water Use

This credit is worth **1-2 points**. This credit has to do with the treatment of the makeup water for cooling towers or condensers. Projects with this equipment must perform a water quality test and determine how many cycles the water can go through before exceeding limits for compounds such as calcium carbonate, silicon dioxide, and total alkalinity as per the Reference Guide. Then, the equipment must be set to not exceed the number of cycles calculated (up to 10), and the project earns 1 point. If the water can go through over 10 cycles or if it achieves the first credit and uses a minimum of 20% of recycled nonpotable water, another point can be earned.

✓ Water Metering

This credit is worth **1 point**. Provide water sub-metering for additional systems in addition to the main building meter. At least two of the following systems must be monitored to earn 1 point: irrigation, indoor plumbing fixtures and fittings, domestic hot water, boilers, reclaimed water, and other process water.

➢ Energy and Atmosphere

Improving energy efficiency is one of the easiest ways to save money and improve the sustainability of a building. Therefore almost a third of the points available in LEED are found in this category. Projects can earn these points by making the building more efficient that a code baseline building of similar size and shape, commissioning the building systems, and adding renewable power sources to the project.

✓ Fundamental Commissioning and Verification

This is a **required** measure and must be completed to qualify for LEED certification. Commissioning involves testing the equipment to verify that it is performing according to the design intent. The commissioning agent, or person performing the testing, can be a member of the project team, but should not be directly involved in the building design. Systems that need to be commissioned include: HVAC, electrical, plumbing, and renewable energy. Exterior enclosures are also reviewed by the commissioning agent.

Fundamental commissioning includes: design review, development and inclusion of a commissioning plan into the construction documents, developing checklists and testing procedures, testing of the systems, maintenance of a trouble log, and reporting all findings to the building owner.

In addition, the project must develop an operations and maintenance plan designed to keep the building operating efficiently. The plan should include: set points and schedules for the building system controls, a systems narrative, preventative maintenance plan, and an ongoing commissioning plan.

✓ Water Metering

This credit is worth **1 point**. Provide water sub-metering for additional systems in addition to the main building meter. At least two of the following systems must be monitored to earn 1 point: irrigation, indoor plumbing fixtures and fittings, domestic hot water, boilers, reclaimed water, and other process water.

✓ Minimum Energy Performance

This is a **required** measure and must be completed to qualify for LEED certification. There are three options to meet this prerequisite. The first involves providing a whole building energy simulation showing that the design will save at least 5% of the total energy use as compared to a code building of similar size and shape. Projects must meet this requirement without including renewable energy sources.

The second option is to comply with the mandatory and prescriptive measures included in **ASHRAE Standard 90.1-2010**. The standard provides requirements for HVAC and service water heating requirements, including equipment efficiency, economizers, ventilation, and ducts and dampers.

Projects less than 100,000 square feet can earn this prerequisite by following the prescriptions of ASHRAE Standard 90.1-2010 Sections 1-3, which provide strategies and requirements for certain building systems.

✓ Building-Level Energy Metering

This is a **required** measure and must be completed to qualify for LEED certification. Projects must include whole building-level meters or sub-meters that can be aggregated to provide whole building use quantities for all energy consumption (natural gas, electricity, biomass, steam, propane, etc.). The project must also agree to provide this data on a monthly basis to the US Green Building Council for a five-year period.

✓ Fundamental Refrigerant Management

This is a **required** measure and must be completed to qualify for LEED certification. Projects should not use chlorofluorocarbon (CFC)-based refrigerants in new heating, ventilating, air-conditioning, and refrigeration systems. If systems or equipment are re-used, a phase-out plan must be provided.

✓ Enhanced Commissioning

This credit is worth **2-6 points**. Enhanced commissioning is performed in addition to the fundamental prerequisite above. In order to receive this credit, the commissioning agent must be an independent contractor not already on the project team. To earn 3 points, the commissioning process must include, in additional to the fundamental tasks: submittal review, verification that maintenance documentation and training is included in the construction documents, verification of training effectiveness and seasonal testing, reviewing operations 10 months after occupancy, and providing an ongoing commissioning plan.

An additional point can be earned by developing a plan to continually monitor data points to assess the performance of the energy and water use systems. An additional 2 points can be earned by commissioning the building envelope for energy, water, indoor environmental quality, and durability. The review should include: submittal review, inclusion of maintenance manuals and training in the construction documents, verification of training and seasonal testing, reviewing operations 10 months after occupancy, and providing an ongoing commissioning plan.

✓ Optimize Energy Performance

This credit is worth **1-18 points**. Using whole-building energy modeling or prescriptive paths as described in the **ASHRAE 50% Advanced Energy Design Guide** for the type of building being used, provide energy efficiency measures to save from 6-50% over a code building. Projects can earn up to 18 points if they use the energy modeling path, and up to 6 points for using the Energy Design Guide.

✓ Advanced Energy Metering

This credit is worth **1 point**. Energy sources that are used by the whole building or provide more than 10% of the annual energy consumed by the entire building must be subject to advanced metering. The advanced metering must include hourly use, energy consumption and demand, be collected on a local data server, and be remotely accessible.

✓ Demand Response

This credit is worth **1-2 points**. Local utilities may provide the ability for a project to enroll in a demand response plan. These plans broadcast the pricing of energy based on current demand, allowing projects to schedule their peak loads when the utility is cheapest. Projects must participate in an existing demand response plan for a period of one year if it is available (worth 2 points) or provide the infrastructure to take advantage of one when it becomes available (worth 1 point).

✓ Renewable Energy Production

This credit is worth **1-3 points**. Provide from 1-10% of the building's annual energy consumption from renewable energy sources. Using solar gardens or community renewable projects is allowed if the project owns the system or has leased it for over 10 years and it is in the same local utility area as the project.

✓ Enhanced Refrigerant Management

This credit is worth **1 point**. Projects should either not use refrigerants, or only use those that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50. A weighted calculation can be used to determine if the project meets the requirement when certain refrigerants may be over the limit.

✓ Green Power and Carbon Offsets

This credit is worth **1-2 points**. The project must enter into a contract to purchase Green-e certified green power or RECs (renewable energy certificates). The programs must have come online since January 1, 2005 and the contract must be for at least five years. One point is awarded for purchasing 50% of the building's annual energy use from these sources, two points for 100%.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

➢ Materials and Resources

What materials are used, where they come from, how they are made, and how they are disposed of are instrumental in determining how green a project is. Using more green materials, including renewable materials, recycled materials, and natural materials, is good for the building occupants and the environment. LEED v4 shifts the focus a bit, providing credits for using materials that have published **life cycle assessments** and **environmental product declarations**.

✓ Storage and Collection of Recyclables

This is a **required** measure and must be completed to qualify for LEED certification. Projects must provide space to allow for storage and collection of recyclables. Materials collected must at least include paper, cardboard, glass, plastic, and metals. The project must also make arrangements for the storage and collection of two of the following: batteries, mercury-containing lamps, and electronic waste.

✓ Construction and Demolition Waste Management Planning

This is a **required** measure and must be completed to qualify for LEED certification. The project must develop a waste management plan for use during demolition and construction, and report on actual diversion rates for all debris leaving the site. At least five materials must be targeted for recycling or reuse.

✓ Building Life-Cycle Impact Reduction

This credit is worth **2-5 points**. There are four options to achieve points: (1) Reuse a building listed on a local or national historical register, following requirements of the appropriate program for rehabilitation – **5 points**; (2) Renovate an abandoned or blighted building, maintaining at least 50% of the existing structure and interior elements – **5 points**; (3) Re-use or salvage, from on the project site or off-project, building materials to equal 25-75% of the surface area of the project – 25% for 2 points, 50% for 3 points, 75% for **4 points**; (4) Provide a life cycle assessment of the structure and enclosure, showing a minimum of 10% reduction in at least three of six impact categories, including global warming potential, ozone depletion, and depletion of non-renewable energy sources – **3 points**.

✓ Building Product Disclosure and Optimization – Environmental Product Declarations

This credit is worth **1-2 points**. Use at least 20 permanently installed building materials, from at least 5 different manufacturers, that have had an environmental product declaration published – 1 point. Use products certified as providing a reduction in environmental impact for at least 50% of the permanently installed materials. Products sourced within 100 miles of the project site count at 200% of their cost – 1 point.

✓ Building Product Disclosure and Optimization – Sourcing of Raw Materials

This credit is worth **1-2 points**. Use at least 20 permanently installed building materials, from at least 5 different manufacturers, that have publicly released a report showing their extraction locations, methods, and a commitment to sustainable extraction practices – **1 point**. Use materials, for at least 25% of the total material cost, that are: bio-based products, **FSC certified lumber**, salvaged or reused, have recycled content, or have a producer responsibility program. Products sourced within 100 miles of the project site count at 200% of their cost – **1 point**.

This credit is worth **1-2 points**. The project must enter into a contract to purchase Green-e certified green power or RECs (renewable energy certificates). The programs must have come online since January 1, 2005 and the contract must be for at least five years. One point is awarded for purchasing 50% of the building's annual energy use from these sources, two points for 100%.

✓ Building Product Disclosure and Optimization – Material Ingredients

This credit is worth **1-2 points**. Use at least 20 permanently installed building materials, from at least 5 different manufacturers, that have published reports showing the chemical content of the material. The reports must be in the form of a manufacturer's inventory, health product declaration, or **Cradle 2 Cradle** certification – 1 point. Use materials that have published reports through one of the following programs, for at least 25% of the cost of the permanently installed materials: GreenScreen v1.2 Benchmark, Cradle 2 Cradle certified, or REACH Optimization – 1 point. Use materials that have published reports documenting their safety and health practices throughout the supply chain, for at least 25% of the cost of the permanently installed materials – 1 point.

✓ Construction and Demolition Waste Management

This credit is worth **1-2 points**. Using the waste management plan developed in the prerequisite, points are awarded for meeting targets for the amount of material diverted from the landfill and that is recycled or reused. 1 point is awarded for diverting 50% of the waste in at least three waste streams (types). 2 points are awarded for diverting 75% of the waste in at least four waste streams. Or a project cannot create more than 2.5 pounds of construction waste per square foot of the building's floor area for 2 points.

➢ Indoor Environmental Quality

The quality of the air on the inside of a building is important to all the occupants, as it can contribute to illness and lack of productivity. Increasing the amount of fresh air and using building materials and products without harmful chemicals can improve the air quality. Also important is the connection between the occupants and the world outside. Having access to views of the outside and providing natural lighting are important to occupant well-being.

✓ Minimum Indoor Air Quality Performance

This is a **required** measure and must be performed in order for a project to be LEED certified. Provide the required amount of outdoor air ventilation as per ASHRAE Standard 62.1-2010 or local requirement, whichever is more stringent. Monitor actual outdoor air intake, signaling an alarm when it is +/- 15% of the required minimum.

✓ Environmental Tobacco Smoke Control

This is a **required** measure and must be performed in order for a project to be LEED certified. Prohibit smoking inside the building. Prohibit smoking outside within 25 feet of entrances and exits, air intakes, and operable windows. Residential projects may allow smoking outside in designated areas, and individual units must be weather-stripped and sealed to prevent smoke from transferring between units or into common areas.

✓ Enhanced Indoor Air Quality Strategies

This credit is worth **1-2 points**. Install permanent entryway systems (mats, grilles, grates) that capture dirt and particulates and keep them from entering the building. Prevent interior cross-contamination by providing separate air exhaust systems for areas in which potentially harmful chemicals are used (such as a janitor's closet or copy room). Air exhaust system must create a negative pressure area (create suction effect). Outdoor air entry points shall have a filter with a MERV (minimum efficiency reporting value) rating of 13 or higher (measure of the size of particulates that are filtered). Replace all filters after construction and before occupancy.

✓ Low-Emitting Materials

This credit is worth **1-3 points**. Use materials with **low VOC** (volatile organic compounds) content. There are different requirements for interior and exterior products and for different categories of products. Product categories covered under this credit include: interior paints and coatings, adhesives, **flooring**, **composite wood products**, ceilings/**walls**/**insulation**, and **furniture**. Depending on the number of categories in which the VOC content is maintained below the threshold, 1-3 points are awarded. If not all products used on a project meet the requirement, a budget method may be used to show that overall VOC exposure is less than required.

✓ Construction Indoor Air Quality Management Plan

This credit is worth **1 point**. Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases. The plan must address the following: follow all recommendations from the Sheet Metal and Air Conditioning National Contractors Association's (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition, 2007; protect absorptive materials that are installed or stored on-site from moisture; if possible, do not use permanently installed HVAC equipment prior to occupancy, or if used during construction, provide filters with a MERV rating of at least 8 and change all filters prior to occupancy; and prohibit smoking inside the building and within 25 feet of entrances during construction.

✓ Indoor Air Quality Assessment

This credit is worth **1-2 points**. After construction has been completed and the building has been completely cleaned, follow one of the two following procedures to perform a building flush-out: (1) Change all filtration media and perform a whole building flush-out using at least 14,000 cubic feet of outside air per gross square foot of floor area, keeping the temperature between 60-80 F and the relative humidity no higher than 60%; (2) If occupancy is desired before flush-out, furniture may be moved in after 3,500 cubic feet of outside air has been delivered for each gross square foot of floor area, keeping it between 60-80 F and the relative humidity under 60%; once occupied, flush-out must continue at 0.3 cubic foot per minute of outside air for each gross square foot of floor area, until at least 14,000 cubic feet of outside area have been circulated for each square foot of floor space. These flush-out options are each worth 1 point.

Two points can be earned by having an independent testing company test air samples for chemicals and VOCs just prior to occupancy. If any levels are above the required thresholds, take immediate steps to correct them, and have the air retested. Continue until all levels are in the acceptable ranges.

✓ Thermal Comfort

This credit is worth **1 point**. Design the HVAC system to meet the requirements for thermal comfort as determined by ASHRAE Standard 55-2010, ISO 7730:2010, CEN Standard EN 15251:2007, or local standards. In addition, provide **thermal controls** for at least 50% of the individual occupant spaces and group controls for shared multi-occupant spaces.

✓ Interior Lighting

This credit is worth **1-2 points**. Provide lighting controls to at least 90% of the individual occupant spaces and multizone controls for multi-occupant spaces. Lighting controls must allow users to set at least three different lighting levels (on, off, midlevel). This is worth 1 point.

Provide light fixtures and placement to meet at least four of the light quality measures, including the use of lamps with a CRI (color rendering index) of at least 80, use of lamps with an expected life of 24,000 hours or more, choosing reflective fabrics/surfaces for furniture, and choosing reflective surfaces for walls and ceilings. This is worth 1 point.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

✓ Daylight

This credit is worth **1-3 points**. Provide proof through computer modeling that regularly occupied individual occupant spaces are provided with natural day lighting that meets the following conditions: **spatial daylight autonomy** of 55-90%, **annual sunlight exposure** of no more than 10%, or that illuminance levels will be from 300-3,000 lux at 9 am and 3 pm on a clear day at the equinox. Credits are awarded based on what modeling process is used and the percentage of the floor space that meets the requirements.

✓ Quality Views

This credit is worth **1 point**. Provide a line of sight to the outdoors for at least 75% of regularly occupied occupant spaces. Views must meet requirements for multiple lines of sight, the subject of the view, the quality of the view, and whether the view is unobstructed. Interior atria can be used to meet up to 30% of view requirement.

✓ Acoustic Performance

This credit is worth **1 point**. Meet requirements for HVAC background noise, sound isolation, reverberation time, and sound reinforcing and masking. Required levels vary according to the type of project and specific room type requirements.

➢ Innovation

✓ Innovation Credits

This credit is worth **1-5 points**. Projects can earn additional credits for innovations in green building. There are three ways to earn credits in this section: (1) Achieve significant, measurable environmental performance using a strategy not included in the LEED rating system; (2) Achieve a pilot credit not currently included in an existing rating system from USGBC's Pilot Credit Library; or (3) Achieve exemplary performance of an existing LEED prerequisite or credit as per the Reference Guide (usually defined as double the existing threshold or at the next incremental percentage threshold).

✓ LEED Accredited Professional (LEED AP)

This credit is worth **1 point**. At least one principal member of the project team must be a LEED Accredited Professional with a specialty appropriate for the type of project.

➢ Regional Priority Credits

This credit is worth **1-4 points**. Regional Priority credits are existing prerequisites or credits in the rating system that have been selected by USGBC Chapters and Regions as especially important in their area. The USGBC web site has **a listing of the priority credits for each region** of the United States. Projects can earn additional points for achieving these credits on their project. Up to four additional points can be awarded.

For example, one of the RP credits for the Northwest is Rainwater Management. A project that achieves three points on this credit will get an additional point in the Regional Priority category. So, a project in the Northwest could earn 4 points for meeting the requirements for 3 points, with no additional work or documentation required. If the project only earned 2 points under Rainwater Management, however, it would not receive the additional RP point, as 3 points are required per the priority credit database.

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

3. LEED V4 FOR BD+C: NEW CONSTRUCTION & MAJOR RENOVATION CHECKLIST

LEED v4 for BD+C: New Construction and Major Renovation

Project Checklist

Project Name
Date

Y	?	N			
			Credi 1	Integrative Process	1
			Location and Transportation	**Possible Points:**	**16**
			Credit 1	LEED for Neighborhood Development Location	16
			Credit 2	Sensitive Land Protection	1
			Credit 3	High Priority Site	2
			Credit 4	Surrounding Density and Diverse Uses	5
			Credit 5	Access to Quality Transit	5
			Credit 6	Bicycle Facilities	1
			Credit 7	Reduced Parking Footprint	1
			Credit 8	Green Vehicles	1
			Sustainable Sites	**Possible Points:**	**10**
Y			Prereq 1	Construction Activity Pollution Prevention	Required
			Credit 1	Site Assessment	1
			Credit 2	Site Development--Protect or Restore Habitat	2
			Credit 3	Open Space	1
			Credit 4	Rainwater Management	3
			Credit 5	Heat Island Reduction	2
			Credit 6	Light Pollution Reduction	1
			Water Efficiency	**Possible Points:**	**11**
Y			Prereq 1	Outdoor Water Use Reduction	Required
Y			Prereq 2	Indoor Water Use Reduction	Required
Y			Prereq 3	Building-Level Water Metering	Required
			Credit 1	Outdoor Water Use Reduction	2
			Credit 2	Indoor Water Use Reduction	6
			Credit 3	Cooling Tower Water Use	2
			Credit 4	Water Metering	1
			Energy and Atmosphere	**Possible Points:**	**33**
Y			Prereq 1	Fundamental Commissioning and Verification	Required
Y			Prereq 2	Minimum Energy Performance	Required
Y			Prereq 3	Building-Level Energy Metering	Required
Y			Prereq 4	Fundamental Refrigerant Management	Required
			Credit 1	Enhanced Commissioning	6
			Credit 2	Optimize Energy Performance	18
			Credit 3	Advanced Energy Metering	1
			Credit 4	Demand Response	2
			Credit 5	Renewable Energy Production	3
			Credit 6	Enhanced Refrigerant Management	1
			Credit 7	Green Power and Carbon Offsets	2

II.LEED FOR BUILDING DESIGN & CONSTRUCTION GUIDE & RATING SYSTEM CHECKLIST (V4)

			Materials and Resources	Possible Points:	13
Y			Prereq 1	Storage and Collection of Recyclables	Required
Y			Prereq 2	Construction and Demolition Waste Management Planning	Required
			Credit 1	Building Life-Cycle Impact Reduction	5
			Credit 2	Building Product Disclosure and Optimization - Environmental Product Declarations	2
			Credit 3	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
			Credit 4	Building Product Disclosure and Optimization - Material Ingredients	2
			Credit 5	Construction and Demolition Waste Management	2

			Indoor Environmental Quality	Possible Points:	16
Y			Prereq 1	Minimum Indoor Air Quality Performance	Required
Y			Prereq 2	Environmental Tobacco Smoke Control	Required
			Credit 1	Enhanced Indoor Air Quality Strategies	2
			Credit 2	Low-Emitting Materials	3
			Credit 3	Construction Indoor Air Quality Management Plan	1
			Credit 4	Indoor Air Quality Assessment	2
			Credit 5	Thermal Comfort	1
			Credit 6	Interior Lighting	2
			Credit 7	Daylight	3
			Credit 8	Quality Views	1
			Credit 9	Acoustic Performance	1

			Innovation	Possible Points:	6
			Credit 1	Innovation	5
			Credit 2	LEED Accredited Professional	1

			Regional Priority	Possible Points:	4
			Credit 1	Regional Priority: Specific Credit	1
			Credit 2	Regional Priority: Specific Credit	1
			Credit 3	Regional Priority: Specific Credit	1
			Credit 4	Regional Priority: Specific Credit	1

			Total	Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

The LEED® (Leadership in Energy and Environmental Design) Green Building Rating System is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. Below is how T.A. Group products can be used as a part of an overall strategy to earn points in several categories.

1. KRYTON – SUSTAINABILITY & LEED

1.1. ENVIRONMENTAL BENEFITS

How Krystol Products differ from other concrete waterproofing options?
Reducing site disturbance and waste, containing no volatile organic compounds (VOCs), and being safe for use with potable water are just a few of the ways that Kryton's Krystol line of concrete waterproofing products can help your project leave a lighter footprint.
Have a look at facts below, to explore the environmental benefits of Krystol Technology.

1.2. HOW DOES KRYSTOL TECHNOLOGY WORK?

When added or applied to concrete, Krystol chemicals create a reaction that causes long, narrow crystals to form, filling the pores, capillaries and hairline cracks of the concrete mass. As long as moisture remains present, crystals continue to grow throughout the concrete, reaching lengths of many inches over time.

Once the concrete has cured, the crystalline chemicals sit dormant until another dose of water (such as through a new crack) causes the chemical reaction to begin again. The ability to reactivate in the presence of water gives Krystol-treated concrete the ability to "self-seal". When cracks form due to curing shrinkage, settling, seismic activity, etc., water entering through them causes new crystals to form and grow, blocking and filling the cracks.

The most unique and effective feature is its ability to self-seal cracks, this can help to dramatically reduce the long-term maintenance and repair costs of a concrete structure.
How does this help reduce the environmental impact of your project?

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ **Short Term Benefits:**

- **Reduces site disturbance:**

  Less excavation is required because Krystol Internal Membrane (KIM) waterproofing admixture is added directly to the concrete mix. No need to excavate to accommodate space for workers applying physical membranes.

- **Reduces waste on the job-site:**

  Krystol Internal Membrane comes is available in custom sized pulp able bags, which are added directly to the ready-mix truck.

- **Contains no Volatile Organic Compounds (VOCs):**

  Krystol contains no volatile organic compounds, and does not affect air quality.

✓ **Long Term Benefits:**

- **Safe to use with potable water:**

  Kryton's Krystol Concrete Waterproofing Products are certified all over the world by various agencies as safe for use with portable water and by NSF to NSF/ANSI Standard 61 Drinking Water Components – Health Effects.

- **Creates a Recyclable Concrete:**

  While membrane coated concrete goes straight to the landfill, KIM concrete can be recycled post demolition, eliminating waste.

- **Permanent solution:**

  Krystol Technology will last the life of the concrete, growing stronger over time. KIM and other Krystol concrete waterproofing products contribute to the overall durability and life expectancy of a building by stopping corrosion, increasing freeze/thaw durability, and protecting against chemical attack, carbonation and other detrimental effects.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

1.3. KRYTON PRODUCTS CAN HELP BUILDINGS EARN VALUABLE LEED POINTS

Kryton products can contribute to achieving valuable LEED points for your building. **LEED (Leadership in Energy and Environmental Design) certification** measures a building's impact on the environment. It is one of the most widely used project rating systems for new construction and major renovation. The program is regulated by the **US Green Building Council.**

Here are just a few ways Kryton products can help:

✓ **Sustainable Sites**

- **SS Credit 2 - Site Development: Protect or Restore Habitat (2 Points)**

  Kryton can help reduce site disturbance. Less excavation is required because Krystol Internal Membrane (KIM) waterproofing admixture is added directly to the concrete mix. No need to excavate to accommodate space for workers applying physical membranes.

- **SS Credit 5 - Heat Island Effect: Roof (1 Points)**

  Kryton can waterproof roofing, adding to a building's green roof.

✓ **Materials & Resources**

- **MR Credit 5 - Construction and Demolition Waste Management (1 Point)**

  While membrane coated concrete goes straight to the landfill, KIM concrete can be recycled post demolition, eliminating waste.

✓ **Indoor Environmental Quality**

- **EQ Credit 2: Low-Emitting Materials: Paints & Coatings (1 Point)**

  Krystol contains no volatile organic compounds, and does not affect air quality.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ **Innovation and Design Process**

- **ID Credit 1 - Innovation in Design (1 Point)**

  KIM and Krystol concrete waterproofing products contribute to the overall durability and life expectancy of a building by stopping corrosion, increasing freeze/thaw durability, and protecting against chemical attack, carbonation and other detrimental effects.

2. FORTA-FERRO FIBER REINFORCED PERVIOUS: CONTRIBUTING TO LEED

2.1. OVERVIEW

Pervious concrete has been used in many countries for many years, and is now becoming more than just an oddity in the United States. The impetus behind this surge in application is a growing need to take full advantage of shrinking building sites, and to accommodate storm-water runoff in the process. Inherent to the air-void nature of pervious, or porous concrete, is the potential for a lack of durability and toughness, which often impacts application choices and project volume. Experts in the art of pervious materials and practice have long sought out ways to improve the material's durability, and to add to the long-term comfort level of owners that choose it and architects that specify it. Synthetic fibers have been tested and used for many years to add an element of crack control, however these fibers have been somewhat limited by shape and dosage, and have not offered a contribution level that could be considered as significant to this long-term durability goal. The advent of second-generation macro-synthetic fibers has opened a door of opportunity for this application, one that continues to morph and change with new project experience and laboratory study.

2.2. PERVIOUS DEFINITION, HISTORY & DEFICIENCIES

By definition, the word 'pervious' means permeable, describing a material that has pores or openings that allow liquid to pass through. Therefore, pervious concrete is that which is designed to allow water – primarily storm water – to pass through its cross-section, and proceed into a drainage bed of some type and then distributed as site conditions allow. Pervious concrete has been described as a material which is first and foremost designed as a storm water dispersal system that is cleverly disguised as concrete sidewalks, driveways, and parking lots.

The void structure that is necessary to allow for the water movement, is achieved by removing the sand/cement/water paste fraction found in conventional concrete, which essentially results in cement-paste covered aggregates stacked against each other to provide a wearable surface with anywhere from 15% to 30% void space. Since much of conventional concrete's strength comes from that paste fraction that holds the coarse aggregates firmly in place (hardened paste is stronger than air), the constant challenge of pervious concrete designers becomes creating a durable balance between permeability and strength.

Pervious concrete has been utilized in the world scene for over 200 years. In some cases, the construction intent was not permeability focused, but rather stimulated by a simple shortage of concrete building materials during wartime, creating an inadvertent pervious material. Countries like China have pursued the porosity-values of pervious concrete, and have continued to improve and use the technology in millions of cubic yards of in-place applications. Many countries in Europe have expanded the use of pervious in applications that include actual high-traffic roadways and pavements, recognizing the advantages of reduced pavement noise as well as less surface water as contributions to improved driver-friendliness and road safety. Pervious concrete has been used in the United States for approximately 30 years, though has been primarily restricted to low-trafficked applications, such as sidewalks, driveways, curb-and-gutters, and parking lots. The removal of storm-water has become increasingly important in the U.S. to business property owners, to allow them the latitude of using more available space for commercial enterprise and less area for collection ponds and other treatment methods. The use of pervious concrete for parking lots offers a dual-purpose solution to both storm-water and parking requirements, and offers owners a cost-effective way to optimize their retail space use. However, the challenges have been to specify and place a pervious concrete mix that will not only maintain a porous nature, but remain durable enough to stand the test of time with minimal maintenance and repair. Optimization of aggregates, mixes, and practice has helped extend considerably the expected life of pervious pavements, however the desire for additional toughness and durability in these applications continues to be a priority.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

2.3. FIBER REINFORCEMENT – HISTORY & BACKGROUND

FORTA Corporation introduced micro-synthetic fibers to the U.S. market in 1978, which were designed to reduce plastic shrinkage and offer an element of shrinkage/temperature crack control. These products generally took the form of very fine single-filament polypropylene and nylon fibers, called multi- or mono-filament fibers, normally used at a dosage of 1.0 lb./cu yd, or deformed net-shaped polypropylene fibers, called fibrillated, typically used at 1.5 lbs. to 3.0 lbs./cu yd.

Though it was generally acknowledged that higher dosages would lead to considerably higher levels of shrinkage crack reduction, these fine-filament fibers created mixing and placement challenges at these increased dosages due to their high surface-area characteristic. After almost a decade of trials and research, FORTA® introduced the first of its kind macro-synthetic fiber in 1999 to solve the user-friendly issues at higher dosages. This ability to add considerably to the fiber volume percentage has allowed for a much higher replacement level of conventional temperature-steel reinforcement in slabs on ground, along with advances in extending joint-spacing practices which have resulted in considerable cost savings and premium floor systems for specifiers and owners for over 10 years.

2.4. PERVIOUS CONCRETE & FIBERS

As pervious concrete applications began to hit the U.S. construction scene, micro synthetic fibers were quickly considered for their potential to add value to this unique concrete material. As with conventional concrete, micro-synthetic fiber dosages for pervious were typically in the same range – 1.0 lb./cu yd for short monofilament fibers and 1.5 lbs./cu yd for fibrillated fibers. The intent for this low-volume fiber usage was primarily to preserve the pervious void-structure stability in the plastic state, and secondarily to add at least a chance for improved crack-control in the hardened state, though low dosages of micro fibers could not be expected to contribute to long-term durability to any major degree based on their history in conventional concrete. The advent of second-generation macro-synthetic fibers offered the potential for higher possible dosages, and therefore the hope for resulting increases to toughness and durability. Perhaps the larger question was the capacity of macro-synthetic fibers at high dosages to be user-friendly on real-world pervious projects, and be compatible with the unique air-void mixes involved.

Thomas Concrete Pervious Pavement Pad reinforced with FORTA® Green-Net® recycled fibrillated, 1 ½" long @ 1.5 lbs./cu. yd - March 2009

2.5. PERVIOUS CONCRETE & LEED

When used in building site design, pervious concrete can aid in the process of qualifying for LEED Green Building Rating System credits. Pervious concrete can contribute to many LEED categories including sustainable sites, water efficiency, and material and resources.
Specific credits where pervious concrete can aid the designer include:

✓ Sustainable Sites

- **Credit 4 - Rainwater Management (1-3 Points)**

  The intent of this credit is to limit pollution of natural water flows by managing rainwater runoff, enhancing onsite infiltration and eliminating contaminants.

- **Credit 5 - Heat Island Reduction (1-2 points)**

  The intent of this credit is to reduce the heat islands to minimize impact on microclimate and living organisms' habitat. Pervious concrete acts to reduce the heat island effect of concrete by absorbing less heat from solar radiation than darker pavements. The relatively open pore structure and the light color of pervious concrete store less heat, thereby reducing the heat reflected back into the environment and helping to lower heat island effects in urban areas. The heat island effect can be further minimized by the addition of trees planted in parking lots. The trees offer shade and produce a cooling effect for the paving. Pervious concrete pavement is ideal for protecting trees in a paved environment (many plants have difficulty growing in areas covered by impervious pavements, sidewalks and landscaping because air and water have difficulty getting to the roots). Pervious concrete pavements or sidewalks allow adjacent trees to receive more air and water and still permit full use of the pavement pervious concrete.

  Pervious concrete has not been explicitly approved for use in **SS credit 5** for its high albedo properties; however, the pervious concrete design may be submitted for interpretation. If the concrete producer has reflectance of test results for the pervious concrete mix used on the project, he may choose to submit a letter to the contractor (and architect) indicating the results of the tests, increasing the chance that the **SS credit 5** will be awarded.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ Water Efficiency

- **Credit 1 - Outdoor Water Use Reduction (1-2 Points)**

  The intent of this credit is to limit or eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation. To earn this credit, potable water for irrigation must be reduced by 50% when compared to a mid-summer baseline case. The gravel sub-base under pervious concrete can be used to store storm water for irrigation, helping to satisfy this credit.

  If no irrigation is required for a project, two points may be earned.

✓ Material and Resources

- **Credit 3 - Building Product Disclosure and Optimization – Sourcing of Raw Materials (1-2 Points)**

  The impact of this credit is to use recycled materials and products certified as providing reduction in the environmental impact.

  Almost all ready mixed concrete contains recycled materials in the form of supplementary cementitious materials (SCM) such as fly ash, slag or silica fume. The use of SCMs or recycled aggregate in pervious concrete or base material contributes to recycled content needed for this credit. SCMs are considered pre-consumer recycled material and recycled aggregate from a demolished project is considered post-consumer recycled material. In addition, the majority of materials in pervious concrete, and most ready mixed concrete, are considered regional materials. Projects with large amounts of concrete can meet the required 10% or 20% regional materials to meet this credit.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

2.6. PROJECT REFERENCE: LEED SILVER-LEVEL PROJECT

Owner: Erie Art Museum, Erie, PA

Pervious concrete supplier: Baycrete Ready-Mix, Erie, PA

Contractor: Maya Brothers Inc., Erie, PA

Engineer: Civil and Environmental Consultants, Pittsburgh, PA

Fiber: FORTA® Green-Net® recycled fibrillated, 1 ½" long @ 1.5 lbs./cu.yd.

Erie Art Museum Pervious Parking and Delivery Pad reinforced with FORTA® Green-Net® recycled fibrillated, 1 ½" long @ 1.5 lbs./cu.yd - July 2010

The July 2010 Erie Art Museum $9 million expansion and renovation project in Erie, PA, involved a variety of interior ground and polished fiber-reinforced floors, as well as 1,300 sq. ft. of exterior pervious parking and delivery areas.

As part of the LEED silver-level project, the eco-friendly pervious parking lot area was further enhanced with the recycled FORTA® Green-Net® fibrillated fiber.

The use of pervious pavement allowed for manageable storm-water runoff on this slope-challenged project layout, and allowed for a more efficient percentage of interior vs. exterior lot usage. The Green-Net® fiber length was 1 ½", with a dosage of 1.5 lbs. /cu. yd. to add additional pervious concrete toughness under loading and abrasive turning-radius delivery areas.

Though the fiber length and dosage were greater than conventional fiber usage in pervious applications, placement contractor Maya Brothers Inc. experienced no difficulties in mixing, placing, or finishing the three dimensional fiber reinforcement.

Combined with the sustainable use of polished concrete floors within the museum showroom areas, the Erie Art Museum project was the recipient of the 2010 World of Concrete Green Site Award for Institutional applications.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

3. LATERLITE LIGHT WEIGHT EXPANDED CLAY AGGREGATE: SUSTAINABILITY & LEED

3.1. OVERVIEW

Having always been committed to the research and development of light and insulating solutions for construction, Laterlite founded the criteria for sustainable growth on three fundamental pillars: respecting the environment in addition to respecting the social and economic aspects.
The performances of both acoustic insulation of the constructions and air quality in the homes are primary concerns for the health and comfort of the users who, in Europe, spend around 90% of their time within edifices. The importance of sustainable growth is proved by the numbers: over 50% of naturally extracted materials are processed into construction materials and in the European Community more than 40% of energy is consumed by buildings. An approach oriented to the life cycle of the building is hence extremely important, based on an analysis of all the constituent parts of the process: from the production and transportation of construction materials to overall energy efficiency, and from the maintenance over time of the performances and characteristics of products to the final phase of demolition and disposal. Laterlite supports the construction industry with the contribution of an aggregate that is insulating, lightweight, reusable and versatile for numerous applications: the expanded clay LECA. The production of LECA occurs through the employment of best available technologies, supported by continuous research and improvement of energy efficiency.

In recent years, Laterlite invested in the realization of a project at a very high rate of technological innovation, first in Europe, to cook and expand the clay of Sicily using electricity produced from the sun (thanks to a 1 MW photovoltaic plant) and heat from the combustion of biomass: wheat straw (or chaff) being introduced as new fuel with an investment of over 2 million Euros as of summer 2014 in the process of firing clay, that is the gap resulting from threshing wheat grown by the Consortium of local bakers. It has been implemented a plant able to grind up to 3 tons/hour of straw (or chaff) obtaining a granulometric fineness of less than 1 mm; the use of biomass will allow to save 100% of the coal coming from Russia and, consequently, will prevent the emission into the atmosphere of 10,000 tons of CO2 per 100,000 m3 of expanded clay produced. An unprecedented chain project that combines the world of agriculture to that of industry, paying great attention to the local ecosystem and the use of land resources by ideally combining two primary elements for the existence and welfare of man: the house and the bread... Everything in utmost respect for nature and in harmony with the environment... From the Earth, the Sun and the Straw (or Chaff) of Sicilia is born the Expanded Clay LECA the most sustainable in Europe...

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

3.2. LEED® CREDITS TO WHICH LATERLITE LIGHTWEIGHT EXPANDED CLAY AGGREGATES CAN HELP

Specific prerequisites and credits where **Laterlite Lightweight Expanded Clay Aggregates** can help earning LEED points are (based on **LEED BD+C v4 rating system**):

✓ Sustainable Sites

- **Credit 4 - Rainwater Management (1-3 Points)**

  The intent of this credit is to reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

  Laterlite lightweight aggregates can be used as part of the landscaping design to reduce the amount of storm water runoff. Because of their porosity, the aggregate particles can absorb a significant portion of the "first flush" of storm water. They enhances the soil's ability to drain and filter.

  In addition, Laterlite lightweight aggregates can be used to construct rain gardens, bio-retention areas, and bios wales to treat the site's storm water. It provides an excellent environment for beneficial microbial action to remove contaminants from the storm water.

- **Credit 5 - Heat Island Reduction (1-2 Points)**

  The intent of this credit is to reduce heat islands to minimize impacts on microclimates and human and wildlife habitats.

  Laterlite lightweight aggregates can be used in structural soil for tree planting in and around paved areas. Structural soil provides a strong, stable subgrade for paving, while maintaining a superior growing medium for tree roots. The open grading of structural soil made with Laterlite lightweight aggregates provides spaces for root growth to prevent heaving of the pavement often associated with trees growing adjacent to sidewalks, parking areas and streets. Laterlite lightweight aggregates is the key ingredient of a superior, lightweight growing medium for both intensive and extensive green roofs.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ Water Efficiency

- **Credit 1 - Outdoor Water Use Reduction**

  The intent of this credit is to reduce outdoor water consumption.
  Two distinct options are proposed for attaining this credit.
  Option 1: No irrigation required (1-2 Points)
  Option 2: Reduced irrigation (1-2 Points)

  Because of the granular nature of Laterlite Expanded Clay Aggregates which consists of a dense network of intergranular voids with high drainage capacity, it can be used to create lightweight drainage layers of high strength. The porosity and absorption of Laterlite lightweight aggregates help manage water use, while reducing compaction, increasing soil porosity, and maintaining soil temperature.

✓ Energy and Atmosphere

- **Prerequisite 2 - Minimum Energy Performance**

  The intent of this prerequisite is to reduce the environmental and economic harms of excessive energy used by achieving a minimum level of energy efficiency for the building and its systems.
  Three distinct options are proposed for attaining this prerequisite.
  Option 1: Whole building energy simulation
  Option 2: Prescriptive compliance: ASHRAE 50% Advanced Energy Design Guide
  Option 3: Prescriptive Compliance: Advanced BuildingsTM, Core PerformanceTM Guide

  The thermal efficiency of lightweight concrete and masonry building components manufactured with Laterlite lightweight aggregates can maximize the energy performance of the building.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ Water Efficiency

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  Because of the granular nature of Laterlite Expanded Clay Aggregates which consists of a dense network of intergranular voids with high drainage capacity, it can be used to create lightweight drainage layers of high strength. The porosity and absorption of Laterlite lightweight aggregates help manage water use, while reducing compaction, increasing soil porosity, and maintaining soil temperature.

✓ Energy and Atmosphere

- **Prerequisite 2 - Minimum Energy Performance**

  The intent of this prerequisite is to reduce the environmental and economic harms of excessive energy used by achieving a minimum level of energy efficiency for the building and its systems.
  Three distinct options are proposed for attaining this prerequisite.
  Option 1: Whole building energy simulation
  Option 2: Prescriptive compliance: ASHRAE 50% Advanced Energy Design Guide
  Option 3: Prescriptive Compliance: Advanced BuildingsTM, Core PerformanceTM Guide

  The thermal efficiency of lightweight concrete and masonry building components manufactured with Laterlite lightweight aggregates can maximize the energy performance of the building.

- **Credit 2 - Optimize Energy Performance**

  The intent of this credit is to achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic harms associated with excessive energy use.

  Three distinct options are proposed for attaining this credit.
  Option 1: Whole building energy simulation **(1-18 Points)**
  Option 2: Prescriptive compliance (ASHRAE Advanced Energy Design Guide) **(1-6 Points)**
  Lightweight concrete masonry and structural lightweight concrete provide more thermal resistance than ordinary concrete and masonry, while maintaining the benefits of thermal mass. Concrete and masonry building components made with Laterlite lightweight aggregates optimize the combination of R-Values, thermal mass, and low thermal bridging to contribute significant energy cost savings compared with minimum compliance with ASHRAE 90.1 – 2004. When combined with other energy saving systems, lightweight concrete and masonry can contribute toward earning multiple points in this Credit category.

✓ Materials and Resources

- **Prerequisite 2 - Construction and Demolition Waste Water Management**

  The intent of this prerequisite is to reduce construction and demolition waste disposed in landfills and incineration facilities by recovering, reusing, and recycling materials.

- **Credit 1 - Building Life-cycle impact Reduction**

  The intent of this credit is to encourage adaptive reuse and optimize the environmental performance of products and materials.
  Four options are proposed for attaining this credit.
  Option 1: Historic building reuse (1-5 Points)
  Option 2: Renovation of abandoned or blighted building **(1-5 Points)**
  Option 3: Building and material reuse (2–4 Points)
  Option 4: Whole-building life-cycle assessment (1-3 Points)
  Lightweight concrete and structural lightweight concrete made with Laterlite Expanded Clay Aggregates have been utilized in the reuse of countless buildings. By utilizing lightweight concrete building components, existing buildings can often be renovated for a change in use while using original structural components and shell.

- **Credit 3 - Building Product Disclosure and Optimization – Sourcing of Raw Materials**

  The intent of this credit is to encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.

  Two distinct options are proposed for attaining this credit.
  Option 1: Raw material source and extraction reporting **(1 Point)**
  AND
  Option 2: Leadership extraction practices **(1 Point)**

  The natural raw materials used in Laterlite Expanded Clay, its manufacturing process that respects the environment, and the total absence of harmful emissions (even in the presence of fire), make it ideal for sustainable construction as certified by ANAB-ICEA, the Italian Accreditation Institute. The use of concrete products containing Laterlite Expanded Clay contributes to the total recycled content of the project.

  Furthermore, the reduced weight of Laterlite Expanded Clay allows more products to be delivered per truckload, further reducing the environmental impacts resulting from transportation.

- **Credit 5 - Construction and Demolition Waste Management**

  The intent of this prerequisite is to reduce construction and demolition waste disposed in landfills and incineration facilities by recovering, reusing, and recycling materials.

  Two distinct options are proposed for attaining this credit.
  Option 1: Diversion **(1-2 Points)**
  Option 2: Reduction of total waste material **(2 Points)**

  Building components that have been manufactured using Laterlite Expanded Clay can be crushed after demolition and into usable construction aggregates.

✓ **Indoor Environmental Quality**

- **Credit 5 - Thermal Comfort**

  The intent of this credit is to promote occupants' productivity, comfort, and well-being by providing quality thermal comfort.
  Two distinct options are proposed for attaining this credit.
  Option 1. ASHRAE Standard 55-2010 **(1 Point)**
  Option 2. ISO and CEN Standards (1 Point)

  Laterlite Expanded Clay is thermally efficient building material that enhances the stable indoor environment. Its low thermal conductivity **(lambda (λ) 0.09 W/mK)**, reduces sudden temperature changes in the substrate and increases the thermal resistance.

4. FOAMGLAS® INSULATION: SUSTAINABLE DESIGN & LEED® V4

4.1. FOAMGLAS® INSULATION & SUSTAINABLE DESIGN

FOAMGLAS® cellular glass insulation contributes to sustainable design. Sustainable design is becoming increasingly more important, and demand for sustainable products with low environmental impact continues to grow.

FOAMGLAS® cellular glass insulation offers a unique combination of characteristics not often found in a construction material - it is made from abundant raw materials, and many manufacturing facilities include recycled content. It has highly desirable physical properties, as well as proven sustainable performance. FOAMGLAS® insulation is 100% glass, manufactured from sand, limestone, and other abundantly available materials.

FOAMGLAS® insulation is free of HCFCs, and is non-combustible and dimensionally stable.

FOAMGLAS® insulation has high compressive strength and retains its thermal performance properties. It is resistant to moisture, in both liquid and vapor form, and corrosion, and the product has proven its durability in the field.

FOAMGLAS® insulation is used in a wide variety of applications, including piping and vessel insulation, as well as wall, floor, and roof insulation. It is used in the industrial and commercial building construction.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

4.2. FOAMGLAS® INSULATION & ACCESSORY ADHESIVE & SEALANT PRODUCTS

FOAMGLAS® cellular glass insulation is characterized by high compressive strength, resistance to moisture, and resistance to fire. While some other rigid insulating materials such as polyisocyanurate or polystyrene may have a higher initial insulating value, the thermal properties of FOAMGLAS® cellular glass insulation have demonstrated a longer useful life, even when exposed to moisture. Other common building insulations can rapidly lose their insulating properties when subject to moisture or settling. Furthermore, FOAMGLAS® cellular glass insulation has no RED LISTED2 components and is safe for workers to install in accordance with Pittsburgh Corning's guide specifications.

4.3. FOAMGLAS® INSULATION & LEED

The LEED® (Leadership in Energy and Environmental Design) Green Building Rating System is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. While the use of no single construction material can earn points in the LEED® Green Building Rating System, FOAMGLAS® insulation can be used as part of an overall strategy to earn points in several categories.

LEED® V4 CREDITS AND FOAMGLAS® INSULATION AND ACCESSORY PRODUCTS

FOAMGLAS® cellular glass insulation, PC® RTV 450 Silicone Adhesive, PC®99 Adhesive, PITTSEAL® 444N, and PITTSEAL® CW Sealant can contribute toward earning LEED® points on a project in several credit categories as described below.

✓ **Sustainable Sites**

- **Credit 4 – Rainwater Management (1-3 Points)**
- **Credit 5 – Heat Island Reduction (1-2 Points)**

  FOAMGLAS® cellular glass insulation can be part of a vegetated roof design which is one sustainable strategy that can be used to earn both of these Sustainable Sites credits.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ Energy & Atmosphere

- **Prerequisite 2 – Minimum Energy Performance**
- **Credit 2 - Optimize Energy Performance (1-18 Points)**

FOAMGLAS® cellular glass insulation can be used as part of strategies to help achieve the required energy performance and to further reduce the amount of energy consumed by the building.

✓ Materials & Resources

Regional materials is no longer a stand-alone credit in LEED v4 but has been incorporated as weighting multiplier in MR credits 2, 3 and 4. Products that meet the criteria specified in these credits that are sourced (extracted, manufactured, and purchased) within 100 miles (160 km) of the project site are valued at 200% of their base contributing cost. Note that this provision does not apply to all options within these credits.

- **Credit 2 - Building Product Disclosure and Optimization - Environmental Product Declarations (EPD) (1-2 Points)**

An EPD is available for FOAMGLAS® manufactured in the European Union at **www.pe-international.com/uploads/_media/IBU_Declaration_Foamglas.pdf**. Due to differences in raw materials and manufacturing process, an EPD for FOAMGLAS® manufactured in North America is not currently available.

- **Credit 3 - Building Product Disclosure and Optimization - Sourcing of Raw Materials**

Option 1: Raw material source and extraction reporting **(1 Point)**
This option requires a third-party verified report prepared in accordance with the GRI Framework. Though FOAMGLAS® insulation does not currently meet this requirement, a sustainability report, Our Journey. From Environmental Responsibility to Long Term Sustainability, is available on their website. The intention is for future reports to be done in compliance with the GRI Framework.

Option 2: Leadership extraction practices **(1 Point)**
FOAMGLAS® insulation produced in the European Union contains at least 30% post-consumer recycled glass from windshields.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ Energy & Atmosphere

- **Prerequisite 2 – Minimum Energy Performance**
- **Credit 2 - Optimize Energy Performance (1-18 Points)**

FOAMGLAS® cellular glass insulation can be used as part of strategies to help achieve the required energy performance and to further reduce the amount of energy consumed by the building.

- **Credit 4 - Building Product Disclosure and Optimization - Material Ingredients**

Option 1: Material ingredient reporting **(1 Point)**

FOAMGLAS® insulation has prepared chemical inventory of the product to at least 0.1% (1000 ppm) using Chemical Abstracts Service Registry Numbers (CASRN) which can be obtained upon request.

Option 2: Material ingredient optimization **(1 Point)**

Though FOAMGLAS® insulation is not yet certified compliant with GreenScreen v1.2 Benchmark plans are underway to pursue this certification.

FOAMGLAS® cellular glass insulation is also manufactured without the use of HCFC's and is often used as part of HVAC&R systems that do not use HCFC's.

- **Credit 5 – Construction and Demolition Waste Management**

Option 1: Diversion **(1-2 Points)**

FOAMGLAS® cellular glass insulation scrap construction waste can be recycled.

✓ Indoor Environmental Quality

- **Credit 2 – Low-Emitting Materials (1-3 Points)**

Though insulation is not considered in this section, FOAMGLAS® cellular glass insulation would also eliminate another potential source of VOC's in a building. PC® RTV 450 Silicone Adhesive, PC®99 Adhesive, PITTSEAL® 444N, and PITTSEAL® CW Sealant are low VOC products that meet the requirements of this credit.

4.4. OTHER GREEN RATING PROGRAMS

FOAMGLAS® cellular glass insulation has been named a certified Living Building Challenge RED LIST FREE product. This certification is part of the ingredient transparency program administered by the International Living Future Institute's Living Building Challenge. The Living Building Challenge's Declare program requires participating manufacturers to provide a material ingredients list, fostering transparency in the marketplace. Products that have been declared "Red List Free" are eligible for use on Living Building Challenge projects. The Red List is composed of 14 materials and chemicals, all of which have been deemed "worst in class" for their effects on human health and the environment. FOAMGLAS® cellular glass insulation does not contain CFCs, HCFCs or any other hazardous materials or compounds. The RED LIST FREE labels for FOAMGLAS® products can be found in the International Living Future Institute's database: FGL-0001 / FGLz-0002.
FOAMGLAS® cellular glass insulation is GreenSpec® Listed, and was named a Top 10 Green Building Product by Building Green, Inc. in 2010.

5. THE LEED® ASSESSMENT SYSTEM: MAPPING OF ISOLGOMMA PRODUCTS

5.1. HOW DOES ISOLGOMMA CONTRIBUTE TOWARDS ECO-SUSTAINABILITY

The materials used in construction are increasingly required to fulfil eco-sustainable requirements in order to minimize the environmental impact.
Isolgomma has always been at the forefront in the use of regenerated and recycled materials selected through rigorous processes: indeed, our raw materials are made up of recycled materials for at least 92%. These materials guarantee solutions with limited environmental impact and promote sustainable development, while preserving the natural environment and the quality of life.
Isolgomma implements environmental management systems as set forth in the UNI EN ISO 14001 standard, in addition to safety systems as set forth in the OHSAS 18001 standard.
Isolgomma environmental policy does not only target the product, but involves the entire production process through a detailed LCA **(Life Cycle Assessment).**
LCA is a method used for assessing the potential environmental impact of a product from its creation to the end of its service life.
Careful attention to raw material procurement, processing, limitation of emissions in the environment, packaging, distribution, and the use and disposal of reject material are all designed to limit the use of resources and pollutants.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

5.2. LEED® CREDITS TO WHICH ISOLGOMMA PRODUCTS CAN HELP

Isolgomma provides – for each product range – the relevant degree of contribution to LEED® credits in its status of ordinary partner of **GBC Italia**. Indeed, the company has always been attentive to the construction sector's impact on the surrounding environment, and to the serious repercussions its buildings can have on the well-being of the people inhabiting them.

Specific prerequisites and credits where Isolgomma products can help earning LEED points are (based on **LEED BD+C v4**):

✓ **Energy and Atmosphere**

- **Prerequisite 2: Minimum Energy Performance**

  The intent of this prerequisite is to reduce the environmental and economic harms of excessive energy used by achieving a minimum level of energy efficiency for the building and its systems.
  Three distinct options are proposed for attaining this prerequisite.
  Option 1: Whole building energy simulation
  Option 2: Prescriptive compliance: ASHRAE 50% Advanced Energy Design Guide
  Option 3: Prescriptive Compliance: Advanced BuildingsTM, Core PerformanceTM Guide

  Products of the Upgrei, Fybro, Sylencer, Biwall, Trywall and Rewall ranges have thermal insulation characteristics and fulfil the requirements of the UNI EN 12667 reference standard, which specifies the testing principles and procedures for determining thermal resistance on samples having a thermal resistance not inferior to 0.5 m2 K/W.

- **Credit 2: Optimize Energy Performance**

  The intent of this credit is to achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic harms associated with excessive energy use.
  Three distinct options are proposed for attaining this credit.
  Option 1: Whole building energy simulation **(1-18 Points)**
  Option 2: Prescriptive compliance (ASHRAE Advanced Energy Design Guide) **(1-6 Points)**
  Products of the Upgrei, Fybro, Sylencer, Biwall, Trywall and Rewall lines have thermal insulation characteristics and fulfil the requirements of the UNI EN 12667 reference standard, which specifies the testing principles and procedures for determining the thermal resistance on samples having a thermal resistance not inferior to 0.5 m2 K/W.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ Material and Resources

- **Prerequisite 2: Construction and Demolition Waste water Management**

  The intent of this prerequisite is to reduce construction and demolition waste disposed in landfills and incineration facilities by recovering, reusing, and recycling materials.

- **Credit 5: Construction and Demolition Waste Management**

  The intent of this prerequisite is to reduce construction and demolition waste disposed in landfills and incineration facilities by recovering, reusing, and recycling materials.
  Two distinct options are proposed for attaining this credit.
  Option 1: Diversion **(1-2 Points)**
  Option 2: Reduction of total waste material **(2 Points)**

  For its packaging materials, ISOLGOMMA uses recyclable cardboard and PET. Isolgomma has drawn up a self-declaration, on headed paper, specifying that all materials it uses for packaging are recyclable, in order to help the construction company to fulfil the credit requirements.

- **Credit 3: Building Product Disclosure and Optimization – Sourcing of Raw Materials**

  The intent of this credit is to encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.
  Two distinct options are proposed for attaining this credit.
  Option 1: Raw material source and extraction reporting **(1 Point)**
  Option 2: Leadership extraction practices **(1 Point)**

  The product ranges comprising raw materials with recycled content, which therefore contribute to fulfilling the credit requirements, are Roll, Grei, Upgrei, Syl/Sylpro, Sylcer, Sylwood, Mustwall, Fybro, Stywall, Stabe, Sylencer, Biwall, Trywall and Rewall.

✓ **Indoor Environmental Quality**

- **Credit 9: Acoustic Performance**

The intent of this credit is to provide classrooms that facilitate teacher-to-student and student-to-student communication through effective acoustic design.
Two distinct options are proposed for attaining this credit.
Option 1: For each room, confirm that the total surface area of acoustic wall panels, ceiling finishes, and other sound-absorbent finishes equals or exceeds the total ceiling area of the room (excluding lights, diffusers, and grilles). Materials must have an NRC of 0.70 or higher to be included in the calculation. **(1 Point)**
Option 2: Confirm through calculations described in ANSI Standard S12.60-2010 that rooms are designed to meet reverberation time requirements as specified in that standard. **(1 Point)**

The products of the Roll, Grei, Upgrei, Syl/Sylpro, Sylcer, Slywood, Mustwall, Fybro, Megamat, Stywall, Stabe, Sylencer, Biwall, Trywall and Rewall lines, thanks to their high acoustic insulation values – favour sound absorption and mitigate the propagation of sound waves, thereby contributing to fulfilling the credit requirements.

6. SAINT-GOBAIN: THE REFERENCE OF SUSTAINABLE HABITAT

6.1. SAINT-GOBAIN: SUSTAINABLE HABITAT IS WITHIN REACH

✓ **Housing from 1665 to 2065**

For 350 years Saint-Gobain has anticipated the future. Today, its sustainable habitat strategy is responding to the challenges of energy transition and environmental conservation. As a global leader in housing, Saint-Gobain mobilizes the expertise of its companies to offer a range of solutions for buildings that are more energy-efficient but also more comfortable for daily living. To meet the needs of sustainable construction, Saint-Gobain offers materials and solutions, and promotes its vision of housing through its efforts to influence sustainable construction and educate its customers.

Since 1665, the technologies developed by the Group and its subsidiaries have facilitated over three centuries of technical progress and architectural revolution.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

At the end of the 18th century, the mirrors of the Manufacture royal decorated and brought light to the interiors of buildings now divided into separate apartments.

At the end of the 19th century, Pont-à-Mousson pipes supplied water and gas to homes. In the same period, merchants such as Brossette, Jewson and Dahl helped with the introduction and spread of new materials used in construction (metals, cement, and the first industrial mortars)

During the inter-war period, avant-garde architects started to use glass more widely, making it a building material in its own right. Its use became increasingly diversified into mirrors, glazing, bricks and slabs, insulators for electricity, decorative glass and furniture made of tempered glass.

Following the Second World War, Saint-Gobain standardized its materials to address the needs of the era of reconstruction that followed the war. Prefabrication allowed for faster and more economical building. New materials appeared, such as plastics, glass wool and plasterboard.

In the 1970s, after the oil crises, there was a greater focus on reducing the energy consumed in housing: ISOVER glass wool became increasingly widely used for thermal and acoustic insulation.

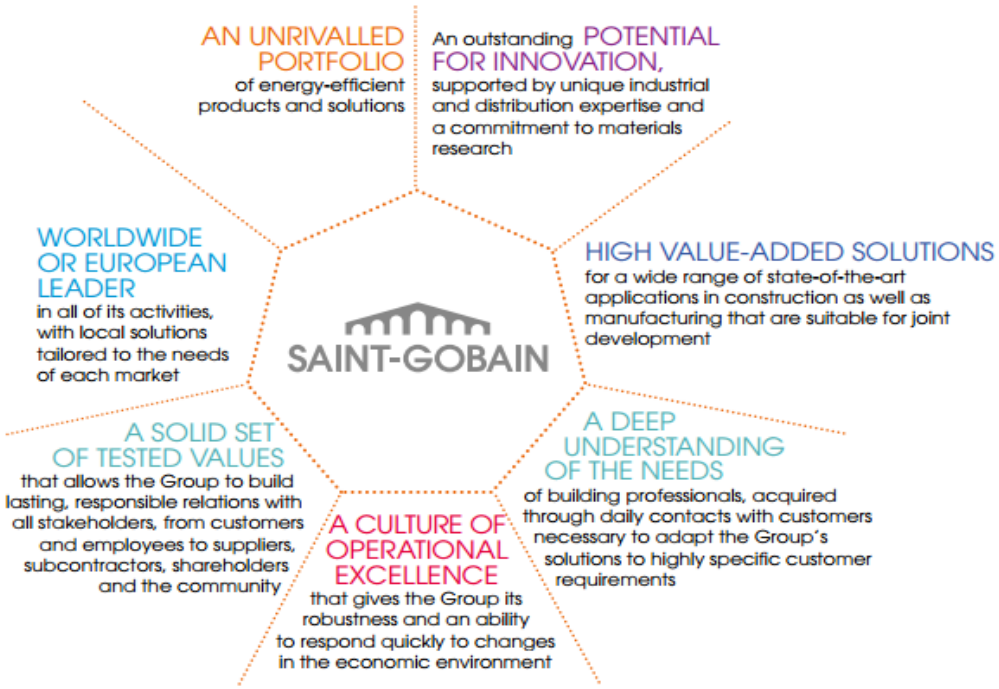
In a number of countries, new buildings will soon have to be positive-energy, which means they will have to generate more energy than they consume. Saint-Gobain has already factored this requirement in by combining all its products in its “Multi-Comfort” projects, which are both attractive and environmentally friendly and ensure the comfort of their occupants.

In 2065, Saint-Gobain imagines a connected habitat that will operate autonomously and recognize its occupants. Weber mortars will change color depending on the weather. SageGlass® variable-tint active glass will adapt to natural lighting and display information. Mobile partitions will reconfigure rooms and broadcast music, among other developments.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ The Reference for Sustainable Habitat

Saint-Gobain has made the strategic decision to become the reference in sustainable habitat, in both the residential construction market and the non-residential and office construction markets. Saint-Gobain is also positioned in fast-growing industrial markets and certain consumer markets. Its goal? To improve our habitat and daily life.



✓ Comfort: An Ongoing Concern

A "Multi-Comfort" building meets the requirements of energy saving, but is especially adapted to the users occupying it: energy efficiency, air quality, lighting and sound control, etc. These have long been concerns of Saint-Gobain, which means it pays close attention to comfort when implementing its products.

✓ **Sustainable Habitat for All**

Saint-Gobain is committed to a sustainable habitat for all, whether by developing solutions or partnerships to make housing accessible to the greatest number of people, or through the Saint-Gobain Initiatives Foundation.

Renovation is essential for combating energy shortages. Saint-Gobain offers affordable solutions and training for professionals in all measures that reduce energy consumption in housing: insulation, replacing windows, etc.

Living space modularity and affordability contribute moreover to "Multi-Comfort:" to address the challenges faced by senior citizens and to make housing more affordable for all generations, Saint-Gobain is developing customized products. The Group's solutions enable housing to be built that adapts to its occupants' life cycles (lifestyles, mobility) for greater comfort. Comfort becomes multi-generational. Although reinforced partitions foster the construction of access ramps, they can also support heavy furniture. While an Italian-style shower facilitates movement, it also guarantees more efficient cleaning, etc.

6.2. SAINT-GOBAIN: BITUVER BRAND – THE COOL ROOF SOLUTIONS

✓ **What is the problem?**

- Who has never burnt their fingers touching a dark surface in summer?
- Who has never noticed the different sensation of heat in a dark car compared to a white one?
- Who has never noticed the high temperature that asphalt can reach during a hot day, and its negative effects in the evening?

The same thing happens on our roofs: a flat roof with a traditional black bituminous membrane easily reaches 80° C on a balmy sunny summer day. Other types of traditional surfaces are equally dark and behave no differently. This causes two types of problems.

✓ **The Collective Problem: The Heat Island**

This is the phenomenon of the temperature increase in urban areas compared to rural areas measured between 1° and 6° C. This creates a vicious circle of air conditioning and heating of the surrounding environment which increases the risk of a black-out, raises consumption and atmospheric pollution.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

✓ The Individual Problem: Energy Consumption

Black roofs reflect only a very small part of the heat received from the sun and, therefore, transmit it to the internal environment underneath, with high air conditioning costs and poor dwelling comfort.

The greater the incidence of roof cover compared to the total surface cover, the greater the impact of this phenomenon. The importance of this problem is obvious for the roofing of shopping malls, supermarkets, hypermarkets and also residential buildings.

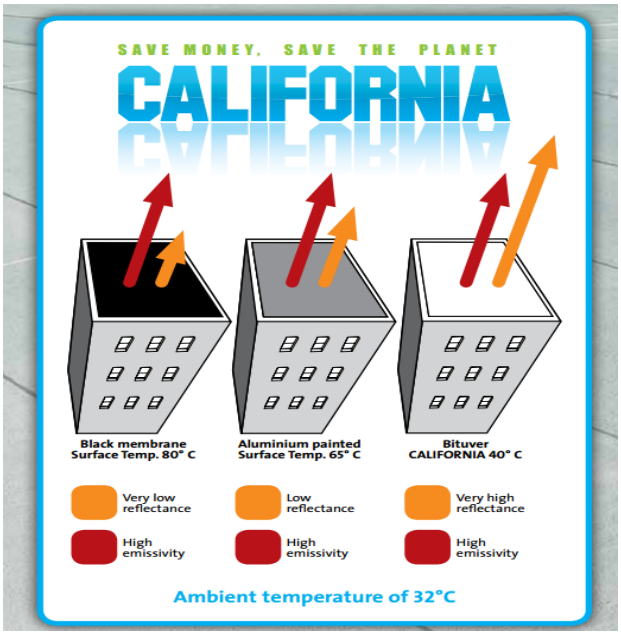
✓ The Solution

California is one of the first places in the world to discover the importance of high emissivity reflecting surfaces, especially for roofs. The concept, called “COOL ROOF, was from the outset considered an important environmental tool, both as an answer to the “HEAT ISLAND” effect and as a vehicle for saving energy. Starting from 1st January 2010, the California Energy Commission updated the energy efficiency standards of all the buildings in the American state, both residential and non-residential. Previously, a residential “COOL ROOF” was an optional measure of energy efficiency. Now, in most cases, roof products must be certified as such.

“Cool Roof” are surfaces of:

- High reflectance and, thus, low absorption of solar radiation
- High thermal emissivity

I.e. High SRI (Solar Reflectance Index)



III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

6.3. CALIFORNIA RANGE OF PRODUCTS

✓ Megaver California

Membrane made with special bitumen modified with new generation elastomeric polymers (BPE), with cold flexibility of -25°C. The reinforcement is made of polyester non-woven fabric strengthened with fiberglass. The membrane, fire resistance “Broof (t2)”, is coated with a sheet of embossed aluminum, pre-painted with PVDF paint, white reflecting and subjected to treatment with high technology aimed at improving its adhesion and life. MEGAVER CALIFORNIA guarantees a sharp reduction in the surface temperature and indirect light from the roof, thanks to the very high reflectance and thermal emissivity that last over time. This characteristic gives important benefits, both for people living in the structure and for the surrounding environment. MEGAVER CALIFORNIA membranes are particularly recommended as a finishing layer in roofs of high aesthetic value where it is necessary to reduce maintenance operations to a minimum.

✓ California P

High performance mono-component paint, designed to cover walkable concrete, cement fiber, wooden, metal surfaces and, in particular, bitumen-polymer membranes, because, by covering and protecting them from UV rays, it prolongs their life. The main benefit, compared to traditional protective paints, is the high reflectance and high emissivity, obtained thanks to the particular composition of the ceramic paint. This characteristic offers important benefits for summer living comfort and energy saving in buildings. It is a watery dispersion based on special modified copolymers, inert fillers, coloring pigments, suspensive materials, thickeners and various additives.

✓ Save the Planet

The Bituver California range of products is a sustainable answer to global warming, as the products reduce the need for air conditioning with ensuing lower consumption of electricity and also reduce the temperature of the surrounding external air thanks to the mitigation of the heat island effect. Moreover, there is also the beneficial effect on Planet Earth’s energy balance.

The albedo is the portion of solar radiation reflected into space by the Earth’s surface. This is estimated at 9%.

The aim of the “Albedo Control” project is to increase that amount. Even a slight improvement of that value is capable of significantly reducing the Earth’s temperature. Researchers recognized at a world level affirm that, by adopting “cool roofs” on a vast scale, it is possible to reduce the average global temperature, thus contributing to compensating for the increase in temperature caused by the increase of greenhouse gases in the atmosphere.

III.MAPPING OF T.A. GROUP PRODUCTS ON LEED V4 – BD+C RATING SYSTEM

6.4. CALIFORNIA P & LEED V4 RATING SYSTEM

In California and in other USA States, “cool roofs” are a subject of studies from long time. An energy consumption monitoring executed in different areas of United States has shown significant energy savings thanks to less demand on air conditioning both in insulated and not insulated buildings. The energy saving reaches up to 70% of air conditioning costs ascribable to a waterproof flat roof. Certainly, total saving is linked to the weight of the surface of roof on the total surface of the building and, more precisely, linked to the incidence of consumption ascribable to the roof on the total energy consumption of the building. In a building where the roof weights approx. 40%, the energy saving is estimated to be about 30%.

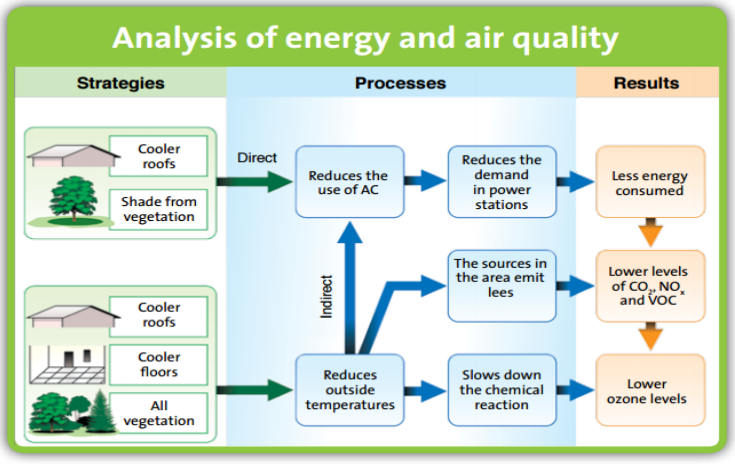
Many other American states and Canada are increasingly sharing the interest in “cool roofs” and authorities have now been officially set up to assess the performances of the roofs. The regulatory provisions supporting cool roofs now include: the ASHRAE 90.1 and 90.2 standards, various state energy efficiency regulations in the USA, the International Energy Conservation Code, the Cool Roof Rating Council in the USA and the EU, the Energy Code for offices in India and other continually increasing initiatives. The Green Building Council also acknowledges the impact of cold roofs.
California P contributes to satisfy the following credits according to LEED v4 rating system:

- **Sustainable Sites SS Credit 5 “Heat Island Reduction - Roofs” (1-2 Points)**

  California P help reducing the heat island effect and consequently the temperature of the surrounding area.

- **Indoor Environmental Quality IEQ Credit 2 Low Emitting Materials (1-3 Points)**

  California P help reducing the surrounding area and the energy consumed, thus lowering the levels of CO2 and Volatile Organic Compounds (VOC).



- **Indoor Environmental Quality IEQ Credit 5 Thermal Comfort (1 Point)**

  California P Improves performance of thermal insulation thus help ensuring the thermal comfort.

IV.SUMMARY OF LEED® CREDITS FOR T.A. GROUP PRODUCTS

1. SUMMARIZED LIST OF POSSIBLE CREDITS EARNED PER EACH BRAND

✓ KRYTON

- **SUSTAINABLE SITES**
  - Credit 2 - Site Development: Protect or Restore Habitat **(2 Points)**
  - Credit 5 - Heat Island Reduction: Roof **(1 Points)**

- **MATERIALS & RESOURCES**
  - Credit 5 - Construction and Demolition Waste Management **(1 Points)**

- **INDOOR ENVIRONMENTAL QUALITY**
  - Credit 2 - Low-Emitting Materials: Paints & Coatings **(1 Point)**

- **INNOVATION AND DESIGN PROCESS**
  - Credit 1 - Innovation in Design **(1 Point)**

✓ FORTA-FERRO PERVIOUS CONCRETE

- **SUSTAINABLE SITES**
  - Credit 4: Rainwater Management **(1-3 Points)**
  - Credit 5: Heat Island Reduction **(1-2 Points)**

- **WATER EFFICIENCY**
  - Credit 1: Outdoor Water Use Reduction **(1-2 Points)**

- **MATERIAL AND RESOURCES**
  - Credit 3: Building Product Disclosure and Optimization – Sourcing of Raw Materials **(1-2 Points)**

IV.SUMMARY OF LEED® CREDITS FOR T.A. GROUP PRODUCTS

✓ LATERLITE

SUSTAINABLE SITES

- Credit 4 - Rainwater Management **(1-3 Points)**
- Credit 5 - Heat Island Reduction **(1-2 Points)**

WATER EFFICIENCY

- Credit 1 - Outdoor Water Use Reduction
  - Option 1: No irrigation required **(1-2 Points)**
  - Option 2: Reduced irrigation **(1-2 Points)**

ENERGY AND ATMOSPHERE

- Prerequisite 2 - Minimum Energy Performance
- Credit 2 - Optimize Energy Performance
  - Option 1: Whole building energy simulation **(1-18 Points)**
  - Option 2: Prescriptive compliance (ASHRAE Advanced Energy Design Guide) **(1-6 Points)**

MATERIALS AND RESOURCES

- Prerequisite 2 - Construction and Demolition Waste Water Management
- Credit 1 - Building Life-cycle impact Reduction
  - Option 1: Historic building reuse (1-5 Points)
  - Option 2: Renovation of abandoned or blighted building (1-5 Points)
  - Option 3: Building and material reuse (2–4 Points)
  - Option 4: Whole-building life-cycle assessment (1-3 Points)
- Credit 3 - Building Product Disclosure and Optimization – Sourcing of Raw Materials
  - Option 1: Raw material source and extraction reporting **(1 Point)**
  - Option 2: Leadership extraction practices **(1 Point)**
- Credit 5 - Construction and Demolition Waste Management
  - Option 1: Diversion **(1-2 Points)**
  - Option 2: Reduction of total waste material **(2 Points)**

INDOOR ENVIRONMENTAL QUALITY

- Credit 5 - Thermal Comfort
  - Option 1. ASHRAE Standard 55-2010 **(1 Point)**
  - Option 2. ISO and CEN Standards **(1 Point)**

IV.SUMMARY OF LEED® CREDITS FOR T.A. GROUP PRODUCTS

✓ FOAMGLAS®

▪ SUSTAINABLE SITES

- Credit 4 – Rainwater Management **(1-3 Points)**
- Credit 5 – Heat Island Reduction **(1-2 Points)**

▪ ENERGY AND ATMOSPHERE

- Prerequisite 2 – Minimum Energy Performance
- Credit 2 - Optimize Energy Performance **(1-18 Points)**

▪ MATERIALS AND RESOURCES

- Credit 2 - Building Product Disclosure and Optimization- Environmental Product Declarations (EPD) **(1-2 Points)**

- Credit 3 - Building Product Disclosure and Optimization - Sourcing of Raw Materials
  - Option 2: Leadership extraction practices (European Union plants) **(1 Point)**

- Credit 4 - Building Product Disclosure and Optimization - Material Ingredients
  - Option 1: Material ingredient reporting - subject to publication of CASRN **(1 Point)**
  - Option 2: Material ingredient optimization - subject to successful completion of Green Screen Benchmark 1.2 **(1 Point)**

- Credit 5 – Construction and Demolition Waste Management
  When the project site is within 100 miles of the manufacturing location, FOAMGLAS® insulation may also qualify as a regional material as part of MR credits 2, 3 and 4. **(1-2 Points)**

▪ INDOOR ENVIRONMENTAL QUALITY

- Credit 2 – low-emitting materials **(1-3 Points)**
  PC® RTV 450 Silicone Adhesive, PC®99 Adhesive, PITTSEAL® 444N, and PITTSEAL® CW Sealant can contribute toward LEED® v4 Credit on IEQ Credit 2, Low-Emitting Materials.

IV.SUMMARY OF LEED® CREDITS FOR T.A. GROUP PRODUCTS

✓ ISOLGOMMA

- **ENERGY AND ATMOSPHERE**

  - Prerequisite 2 - Minimum Energy Performance
  - Credit 2 - Optimize Energy Performance
    - Option 1: Whole building energy simulation **(1-18 Points)**
    - Option 2: Prescriptive compliance (ASHRAE Advanced Energy Design Guide) **(1-6 Points)**

- **MATERIAL AND RESOURCES**

  - Prerequisite 2 - Construction and Demolition Waste water Management
  - Credit 5 - Construction and Demolition Waste Management
    - Option 1: Diversion **(1-2 Points)**
    - Option 2: Reduction of total waste material **(2 Points)**
  - Credit 3 - Building Product Disclosure and Optimization – Sourcing of Raw Materials
    - Option 1: Raw material source and extraction reporting **(1 Point)**
    - Option 2: Leadership extraction practices **(1 Point)**

- **INDOOR ENVIRONMENTAL QUALITY**

  - Credit 9 - Acoustic Performance
    - Option 1: For each room, confirm that the total surface area of acoustic wall panels, ceiling finishes, and other sound-absorbent finishes equals or exceeds the total ceiling area of the room (excluding lights, diffusers, and grilles). Materials must have an NRC of 0.70 or higher to be included in the calculation. **(1 Point)**
    - Option 2: Confirm through calculations described in ANSI Standard S12.60-2010 that rooms are designed to meet reverberation time requirements as specified in that standard. **(1 Point)**

IV.SUMMARY OF LEED® CREDITS FOR T.A. GROUP PRODUCTS

✓ **SAINT-GOBAIN CALIFORNIA RANGE OF PRODUCTS**

- **SUSTAINABLE SITES**
  - Credit 5 - Heat Island Reduction - Roofs **(1-2 Points)**
- **INDOOR ENVIRONMENTAL QUALITY**
  - Credit 2 - Low Emitting Materials **(1-3 Points)**
  - Credit 5 - Thermal Comfort **(1 Points)**

2. SUMMARIZED LIST OF POSSIBLE CREDITS EARNED WHEN USING T.A. GROUP PRODUCTS

- **SUSTAINABLE SITES**
  - Credit 2 – Site Development: Protect and Restore Habitat **(1-2 Points)**
  - Credit 4 - Rainwater Management **(1-3 Points)**
  - Credit 5 - Heat Island Reduction **(1-2 Points)**
- **WATER EFFICIENCY**
  - Credit 1 - Outdoor Water Use Reduction **(1-2 Points)**
- **ENERGY AND ATMOSPHERE**
  - Prerequisite 2 - Minimum Energy Performance
  - Credit 2 - Optimize Energy Performance **(1-18 Points)**
- **MATERIALS AND RESOURCES**
  - Prerequisite 2 - Construction and Demolition Waste Water Management
  - Credit 1 - Building Life-cycle impact Reduction **(1-5 Points)**
  - Credit 2 – Building Product Disclosure and Optimization – Environmental product Declarations (EPD) **(1-2 Points)**
  - Credit 3 - Building Product Disclosure and Optimization – Material Ingredients **(1-2 Points)**
  - Credit 4 - Building Product Disclosure and Optimization – Sourcing of Raw Materials **(1-2 Points)**
  - Credit 5 - Construction and Demolition Waste Management **(1-2 Points)**

IV.SUMMARY OF LEED® CREDITS FOR T.A. GROUP PRODUCTS

- **MATERIALS AND RESOURCES**

  - Prerequisite 2 - Construction and Demolition Waste Water Management
  - Credit 1 - Building Life-cycle impact Reduction **(1-5 Points)**
  - Credit 2 – Building Product Disclosure and Optimization – Environmental product Declarations (EPD) **(1-2 Points)**
  - Credit 3 - Building Product Disclosure and Optimization – Material Ingredients **(1-2 Points)**
  - Credit 4 - Building Product Disclosure and Optimization – Sourcing of Raw Materials **(1-2 Points)**
  - Credit 5 - Construction and Demolition Waste Management **(1-2 Points)**

- **INDOOR ENVIRONMENTAL QUALITY**

  - Credit 2 – Low-emitting Materials **(1-3 Points)**
  - Credit 5 - Thermal Comfort **(1 Point)**
  - Credit 9 - Acoustic Performance **(1 Point)**
  - INNOVATION AND DESIGN
  - Credit 1 – Innovation in Design **(1 Point)**

A total range of (14 – 46) Points may be earned when using T.A. group products and systems.

V.REFERENCES

- LEED V4 For Building Design And Construction Guide Updated To Reflect The April 5 2016 LEED V4 Building Design Addenda

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- www.leeduser.com

- www.kryton.com

- www.forta-ferro.com

- www.laterlite.com

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LEBANON | KUWAIT | QATAR

Sukkar & Suleiman Bldg., Makdissi Str., **P.O.box** 13-5095, Beirut, Lebanon
Tel +961 (1) 350 271 | +961 (70) 600 355 **Fax** +961 (1) 343 708 **Email** info@tagroup.com.lb
TA GROUP S.A.L (OFFSHORE) **Tel** +961 (1) 704 104