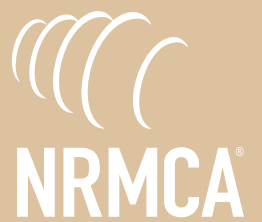




NATIONAL READY MIXED CONCRETE ASSOCIATION  
**SUSTAINABILITY INITIATIVES**



## About the National Ready Mixed Concrete Association

Founded in 1930, the National Ready Mixed Concrete Association is the leading industry advocate. The association's mission is to provide exceptional value for members by responsibly representing and serving the entire ready mixed concrete industry through research, education and advocacy.

## Acknowledgements

The NRMCA Sustainability Initiatives were developed by NRMCA members and staff. NRMCA would like to acknowledge the input and guidance of the Strategic Development Council of the American Concrete Institute, the Portland Cement Association and National Concrete Masonry Association for their inspiration and guidance in developing this document.



## Sustainability and the Concrete Industry

The ready mixed concrete industry is dedicated to upholding the principles of sustainable development—development that meets the needs of the present without compromising the ability of future generations to meet their own needs—by attempting to balance social, economic and environmental impacts. Sustainability has become part of the fabric of society. Corporations in every industry are shaped by their customers' desire to be more environmentally responsible. Companies that adopt sustainable practices will become preferred suppliers. While environmental performance, including greenhouse gas emissions, will be increasingly monitored and regulated, voluntary initiatives such as the one presented here will help achieve ambitious sustainability goals.

performance concrete wall and floor systems help improve energy performance of buildings. Light colored pavements reduce urban heat islands and minimize lighting requirements. Pervious concrete pavements reduce and treat stormwater runoff. Concrete is extremely durable and provides for long service life. And the industry continues to develop new sustainable products through research and development.

The concrete industry is dedicated to continuous improvement through product and process improvements. The industry continues to increase the use of recycled materials, including industrial byproducts, thus conserving valuable natural resources and re-

**The concrete industry is uniquely positioned to meet the challenges of sustainable development. Its products help improve the overall environmental footprint of the built environment.**

Construction industry stakeholders—including project owners, designers, contractors and product manufacturers—are especially affected by the challenges of sustainable development since the built environment has significant environmental, social and economic impact on our lives and planet. On one hand, our built environment provides us with places to live and work and contributes to a robust economy and societal needs. On the other, operating our buildings, houses and infrastructure consumes enormous amounts of energy and valuable resources. Building products require natural resources and energy to produce and transport. New construction projects can burden natural habitats.

The concrete industry is uniquely positioned to meet the challenges of sustainable development. Its products help improve the overall environmental footprint of the built environment. For example, high

ducting process energy required to manufacture concrete. The industry continues to explore new ways to further reduce carbon footprint through the development of innovative cements and concrete mixtures. Concrete companies also strive to improve manufacturing processes, including the use of alternative energy sources, to minimize the energy of production and associated greenhouse gas emissions. Finally, the industry continues to enhance transportation efficiency and delivery methods to reduce the environmental impact of the construction process.

This document outlines goals for reducing the overall environmental footprint of concrete construction and provides strategies for achieving these goals. The concrete industry has been a key contributor in building this nation's infrastructure and will continue to enhance the sustainability of our built environment for generations to come.

## Building Modern Society

The concrete industry plays a key role in building modern society—providing shelter and infrastructure to support our quality of life. Today’s built environment relies on concrete as a basic building block. Buildings use concrete for their foundations, walls, columns and floors. Every modern home uses concrete for footings and basement walls and many use concrete for above ground walls and floors. Highways and bridges are built with concrete. Airports and rail systems use concrete. Our drinking water is delivered from treatment plants made with concrete through concrete pipes.



## What is Concrete?

In its simplest form, concrete is a mixture of paste and aggregates. The paste, composed of cementitious materials and water, coats the surface of the fine aggregates (sand) and coarse aggregates (rocks) and binds them together into a rock-like mass known as concrete. Within this process lies the key to a remarkable trait of concrete: it’s flowable and can be molded or formed into any shape when newly mixed; strong and durable when hardened. It can be colored and textured and its properties can be customized

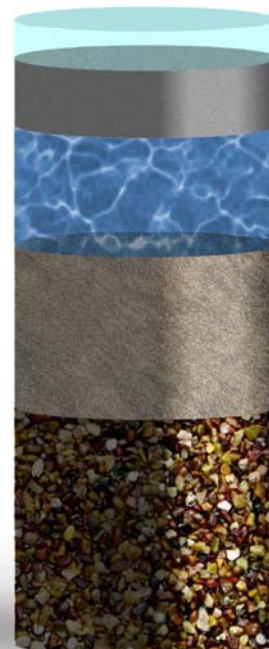
for any application. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks, superhighways, houses and dams.

Typically, a concrete mixture is by volume about 7 to 15% cement, 60 to 75% aggregates and 15 to 20% water. Entrained air bubbles in many concrete mixtures may also take up another 5 to 8%

The most common cement is called portland cement. Portland cement and water form a paste that surrounds and binds each particle of sand and rock. Through a chemical reaction of portland cement and water called hydration, the paste hardens and gains strength. Besides portland cement, concrete may contain supplementary cementitious materials (SCMs), including fly ash, a byproduct from coal burning electric power plants; slag cement, a byproduct of iron manufacturing; and silica fume, a byproduct from the manufacture of silicon or ferro-silicon

## The Mix in Ready Mixed Concrete

Air: 6%  
Cement: 10%  
Water: 18%  
Sand: 25%  
Gravel: 41%





metals. In addition, most concrete mixtures incorporate small quantities of chemical admixtures to improve the fresh and hardened properties of concrete.

### How is Concrete Made?

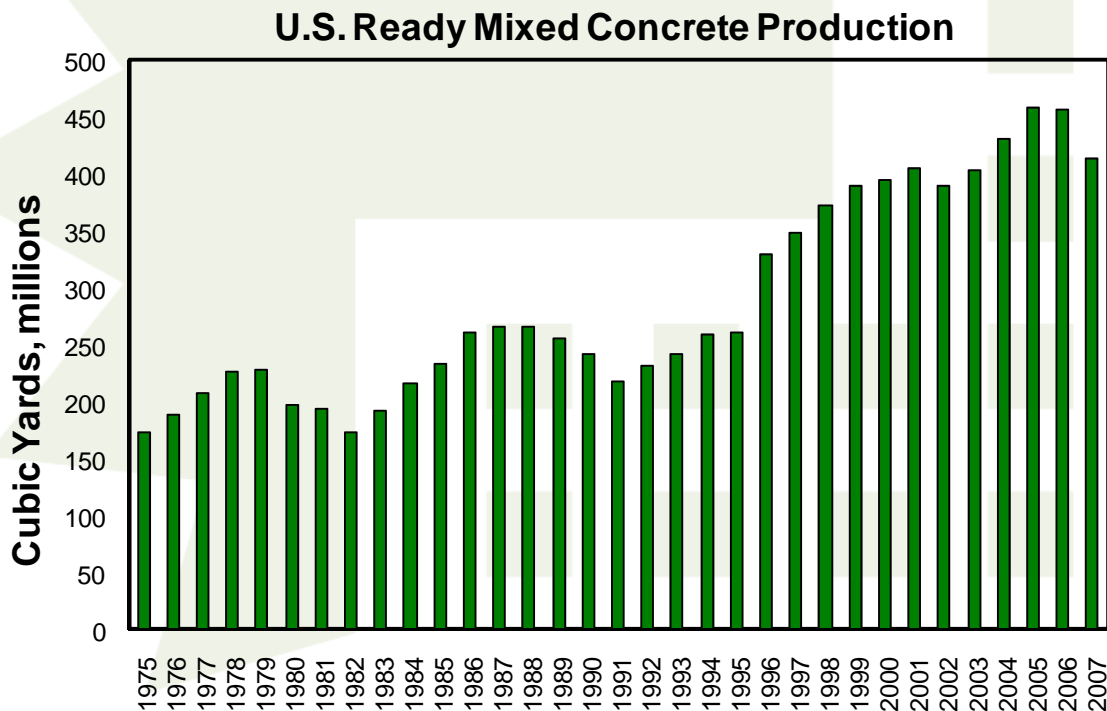
In general, concrete is produced at a production facility called a concrete plant where the ingredients are precisely measured and loaded into a plant mixer or directly into the drum of a concrete mixer truck using automated batching equipment. The mixing unit turns at fast speed to thoroughly mix the ingredients to ensure proper consistency.

The majority of concrete is delivered to the construction site in concrete mixer trucks. Once at the site the concrete is discharged from the mixer into forms that mold the concrete into its ultimate shape. Construction crews often use special pumps and conveyors to move concrete into its final location.

### The Concrete Industry Today

The demand for new construction in the U.S. has helped the ready mixed concrete industry flourish over the last several decades. Concrete production has risen from 175 million cubic yards in 1975 to over 415 million cubic yards in 2007.

Ready mixed concrete is one of the few building materials manufactured in close proximity to a construction site, thus minimizing the impact of transportation and contributing to the local economy. There are about 2,500 ready mixed concrete companies that operate over 7,500 concrete plants in the U.S. Companies range from small family-owned businesses with one concrete plant and several concrete trucks to large multi-national corporations with hundreds of concrete plants and thousands of concrete trucks. Together, these companies form an integral part of the nation's economy, representing \$40 billion of economic activity.



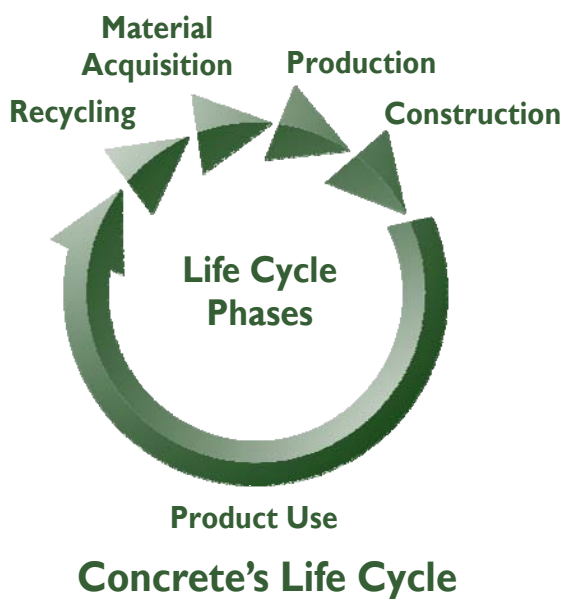
Concrete production has risen steadily over the past several decades, demonstrating the importance of this building material to our nation's continued growth.



The vision of the ready mixed concrete industry is to transform the built environment by improving the way concrete is manufactured and used in order to achieve an optimum balance among environmental, social and economic conditions.

## Objectives

The concrete industry will be a leading player in helping society build infrastructure to support our desired standard of living and achieve a built environment that will minimize negative impacts on our planet's natural environment. The concrete industry will continue to listen, observe, research, reflect, consult and collaborate with all stakeholders to achieve its vision.



To fully realize this vision, the concrete industry will approach sustainable development through the life cycle perspective. Concrete's life cycle phases include material acquisition, production, construction, use (operations and maintenance), and recycling. It has and will continue to evaluate all phases of its product life cycle in order to reduce its environmental footprint. It has and will continue to evaluate each

phase of the life cycle to employ strategies for reducing environmental impact with the following objectives:

- Minimize Energy Use
- Reduce Emissions
- Conserve Water
- Minimize Waste
- Increase Recycled Content

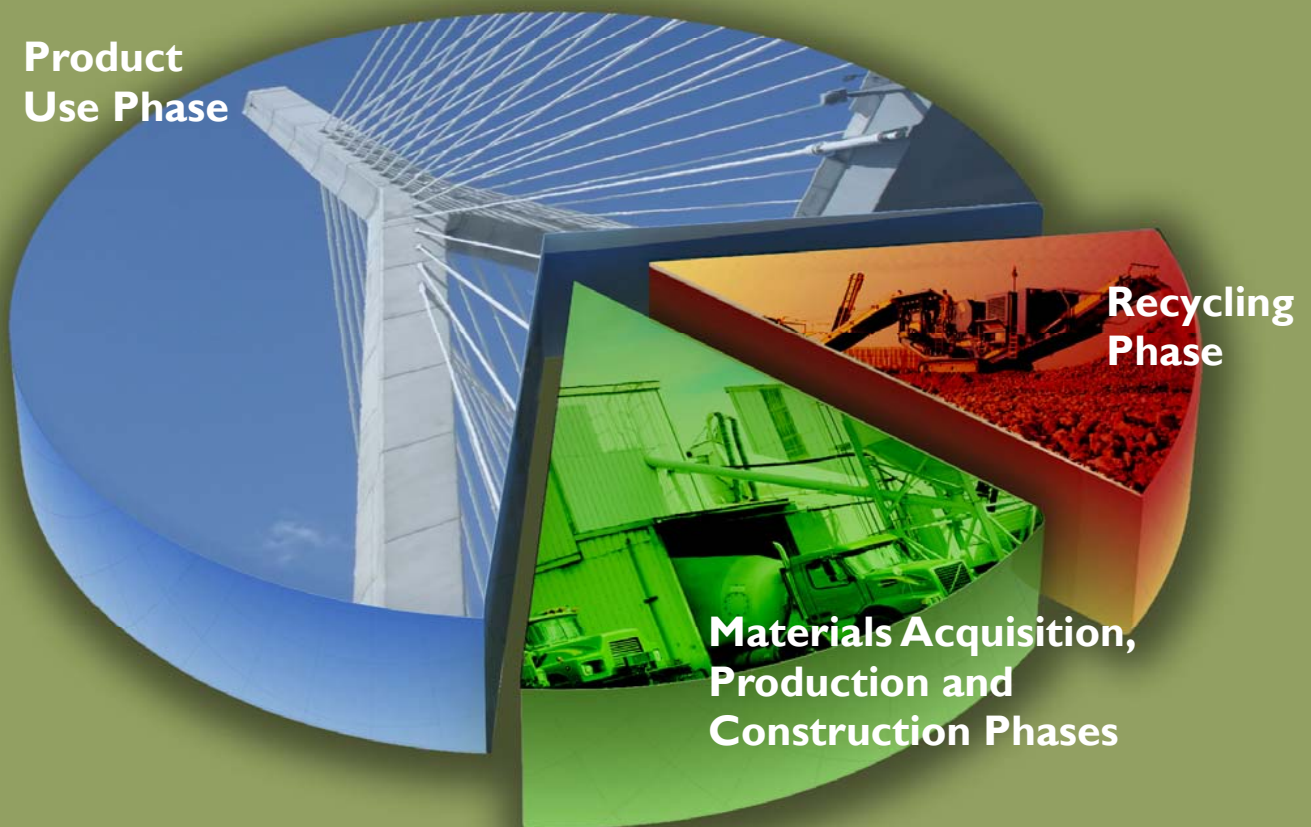
## Key Performance Indicators

The concrete industry intends to measure and report annually its progress toward meeting its sustainability goals. Progress will be measured on a per unit of product basis and compared to 2007 levels. Key performance indicators are:

- Embodied energy:
  - 20% reduction by 2020
  - 30% reduction by 2030
- Carbon footprint:
  - 20% reduction by 2020
  - 30% reduction by 2030
- Potable water:
  - 10% reduction by 2020
  - 20% reduction by 2030
- Waste:
  - 30% reduction by 2020
  - 50% reduction by 2030
- Recycled content:
  - 200% increase by 2020
  - 400% increase by 2030



**Concrete's very long environmental life cycle gives it extremely favorable sustainability characteristics.**



**Compared to other building materials, concrete has a relatively low total environmental life cycle impact.**

All human activity, including the manufacture and use of concrete, has potential environmental impact. Since concrete buildings, dams, roads and other infrastructure last so long, and since concrete is recyclable, concrete's total impact per year of use is very favorable, especially when compared to other building materials.

# MATERIAL ACQUISITION PHASE

## GOAL I

Reduce environmental impact during the material acquisition phase

## STRATEGIES

- Support material suppliers that adopt comprehensive environmental management systems, including wildlife conservation and quarry restoration plans
- Support material suppliers located near concrete plants
- Explore the use of innovative cements with lower carbon footprint through research, education and advocacy
- Encourage supplementary cementitious material (SCM) suppliers to improve distribution systems in order to increase material availability
- Increase the quantity of SCMs used in concrete through research, education and advocacy
- Increase the quantity of recycled aggregate used in concrete through research, education and advocacy
- Replace potable water with non-potable water used in concrete through research, education and advocacy





## Material Acquisition Phase

Ready mixed concrete companies acquire materials from material suppliers. Materials include cement, fly ash, slag cement, silica fume, aggregates, water and admixtures. They combine these materials in precise quantities to meet specific project requirements. Most of the materials used in concrete require the extraction of raw materials, processing and delivery and therefore have impact on the environment.

## Cementitious Materials

Cementitious materials make up about 7 to 15% of concrete by volume. The most common cementitious material is called portland cement. Portland cement is manufactured from a combination of naturally occurring minerals, including calcium from limestone, silicon, aluminum and iron. These materials are heated in a large kiln to over 2700 °F (1500 °C) to convert the raw materials into a product called clinker. Clinker is ground into the fine powder known as portland cement.

Carbon Dioxide (CO<sub>2</sub>) is generated from burning fossil fuels and from a process known as calcination during the conversion of raw materials into clinker. The primary options for reducing the quantity of CO<sub>2</sub> generated during the cement manufacturing process are to use alternatives to fossil fuels, change the raw ingredients used in manufacture and inter-grind additional materials with the clinker to produce blended cements. Some companies are exploring the development of new methods of producing cement that can potentially result in the capture of CO<sub>2</sub> rather than its release, dramatically reducing the carbon footprint of concrete.

Most concrete producers also acquire industrial by-products such as fly ash, slag cement and silica fume to supplement the portland cement used in concrete. These products, that would otherwise end up in landfills, are called supplementary cementitious materials (SCMs). SCMs, when combined with portland cement in concrete, enhance both plastic and hard-

ened properties and reduce the overall carbon footprint of concrete.

## Aggregates

Stone, sand and gravel used as aggregates in concrete are typically mined from quarries or river beds. Although producing aggregates requires a relatively small amount of energy, they do comprise 60 to 75% of the total volume of concrete and therefore contribute to its environmental footprint.

Aggregates are among the most abundant materials on earth, but they are a valuable resource that should be conserved. Concrete producers can use recycled aggregate materials in concrete such as crushed concrete from demolition, crushed returned concrete and other products such as foundry sands and glass—materials that would otherwise end up in landfills.

## Water

Water is used in concrete to bring about the cement hydration process. For the most part, concrete producers use fresh drinking water from municipal systems or from wells on the plant site since most projects specify the use of potable water. However, concrete producers could use non-potable water for concrete production. There are standards that allow the use of water from washing trucks and other sources for concrete production. Concrete producers can recycle water from concrete production facilities or other sources into new concrete if permitted in project specifications.

## Admixtures

Admixtures are specially formulated chemicals that enhance both plastic and hardened concrete properties. Admixtures are powerful tools concrete producers use to improve concrete's performance. By volume they comprise a small fraction of the mix, however, as with most chemicals, they do require processing and extraction of raw materials and therefore do have impact on the environment.

# PRODUCTION PHASE

## GOAL 2

Reduce environmental impact during the production phase

## STRATEGIES

- Adopt rigorous environmental management systems to meet and exceed environmental regulations
- Use energy efficient plant equipment and delivery vehicles
- Increase the use of recycled materials to lower the overall embodied energy of concrete through research, education and advocacy
- Use renewable energy, including biomass, solar, wind, geothermal and hydroelectric power to reduce plant CO<sub>2</sub> emissions
- Implement rigorous quality control programs to optimize the use of materials





## Production Phase

For individual ready mixed concrete plants to become truly sustainable they must assess energy and resource consumption throughout the concrete manufacturing process. Plant design, production, maintenance and waste management should align with zero discharge approaches.



Concrete plants utilize energy in several different ways. They use electricity to run conveyor belts and batching systems and to heat, cool and light buildings on the plant site. Many use gas boilers to heat water or electricity to make ice to batch concrete in different weather conditions. They use diesel fuel to run earthmoving equipment on site to stock and move aggregates.

The amount of CO<sub>2</sub> embodied in concrete is primarily a function of the amount of portland cement in the mix. One way concrete producers can optimize

the use of cement in concrete is to implement rigorous quality control programs. As producers measure and manage the variability of materials they can optimize the quantity of cement in a mix to meet the required strength and durability.

Another way concrete producers can optimize the use of cement is by increasing the use of SCMs in concrete. SCMs are key to high performance concrete. When combined with cement in concrete they improve durability, strength and constructability. The environmental benefits of using these industrial by-products in concrete means a reduction in the amount of waste materials sent to landfills, reduced raw materials extraction, reduced energy of production and reduced emissions, including CO<sub>2</sub>.

Concrete producers use water during the production process. It's a necessary part of the cement hydration reaction. Water is used to wash trucks, equipment and plant yards. In addition, water is used to maintain certain water content of aggregates by sprinkling aggregate stockpiles. Most water used by concrete producers is obtained from municipal water systems or from wells drilled on site. Standards allow concrete producers to use wash water or non-potable water from alternative sources in the production process so long as it meets certain standards. Unfortunately, many project specifications do not permit the use of recycled water.

The concrete production process can result in some waste. Unused concrete is returned to the concrete plant in concrete trucks. Some water used for washing trucks, equipment and plant yards is discharged into stormwater systems after being treated. Older equipment and trucks become obsolete and must be managed in an environmentally responsible way. The industry strives to address these concerns and minimize waste associated with the product.

# CONSTRUCTION PHASE

## GOAL 3

Reduce environmental impact during the construction phase

## STRATEGIES

- Deliver concrete from plants near construction sites
- Use fuel efficient concrete trucks
- Conserve fuel by minimizing truck idling
- Use trucks made with advanced lightweight materials to reduce fuel consumption
- Use alternative fuels to power concrete trucks
- Use advanced technologies such as global positioning systems to minimize travel distances
- Advocate for increased truck weights on roadways
- Advocate for greater access to highways and special truck lanes on highways to reduce congestion and fuel consumption
- Increase the use of labor-saving products such as flowable fill and self-consolidating concrete through research, education and advocacy





## Construction Phase

Ready mixed concrete is produced on an as needed basis for specific construction projects. Once concrete is produced it is transported to the construction site in concrete trucks where it is discharged directly into formwork or other conveying equipment such as pumps, conveyor belts or buckets. Depending on the application, concrete contractors work the concrete into place using vibrating equipment and finishing tools.

Concrete producers can implement several strategies to minimize the environmental impact during the transportation, placement and finishing processes. They can deliver concrete from plants near the construction site. They can use global positioning systems (GPS) to optimize truck routes. They can use energy efficient trucks to transport concrete and use larger loads where permitted (most jurisdictions limit truck weights, therefore many trucks are not fully utilized.) Changes to truck weight restrictions could dramatically reduce fuel use and emissions associated with concrete delivery by enabling trucks to take fewer and more direct trips.

Currently, federal and state laws limit truck traffic on some highways and roadways which forces trucks onto residential streets further adding to traffic congestion. Concrete producers are in favor of opening truck access to more roads and building dedicated truck lanes. Increasing access to highways and providing truck lanes would relieve congestion and reduce fuel consumption.

Concrete producers can provide innovative products, such as flowable fill and self-consolidating concrete (SCC) that can reduce the environmental impact of construction. SCC allows easier placement and flows into complex shapes to produce a high degree of homogeneity and uniformity. SCC requires less energy to place. Flowable fill provides for an efficient way to backfill utility trenches and provide solid bases for pavements and foundations without



the need for heavy excavation equipment, laborers in trenches or time-consuming compaction efforts.

Special concrete formulations can help reduce setting time and improve workability, thus reducing the time and energy required to finish concrete on site. Fast setting concretes can help improve construction schedules—buildings are built faster and roadways are opened to traffic sooner—thereby minimizing environmental and economic impacts of the construction process.

Every year, about 5% of the concrete produced is returned to the concrete plant. Returned concrete can be used for plant site paving and production of other products such as landscaping blocks or median barriers. Another option is to crush returned concrete for pavement base material, fill or aggregates that can be batched into new concrete.

## Contributing to Local Economies

Concrete is manufactured locally near construction sites. Not only does this limit the environmental impact of transportation but it also helps support local economies. Concrete companies are a vital part of communities they serve by providing jobs and building shelter and infrastructure to support our way of life.

## GOAL 4

Reduce environmental impact during the use phase of concrete construction

## STRATEGIES

- Provide expertise in the development of green rating systems for homes, buildings and roadways
- Educate engineers and architects on design techniques to benefit from concrete's environmental attributes
- Advocate for sustainability standards in national and local building codes
- Advocate for local ordinances that support the use of green building practices
- Conduct research to improve and enhance the positive attributes of concrete construction such as thermal mass, high reflectivity, durability and long service life
- Conduct research to enhance innovative products such as pervious concrete, tilt-up construction, insulating concrete forms, flowable fill and self-consolidating concrete





## Use Phase

The use phase of any construction project has the largest environmental impact, as much as 85 to 98%, when compared to the other phases of the life cycle. Operational energy of homes and buildings accounts for 39% of all energy consumed in the United States each year.

Operating our homes and buildings also consumes enormous amounts of fresh water for drinking, cooking and cleaning. In addition, our homes, buildings and roadways create impervious surfaces that generate significant stormwater runoff which carries pollutants into surrounding lakes and streams. As development increases, dark-colored roof and pavement areas increase, causing a phenomenon known as the urban heat island effect which raises temperatures in urban areas by as much as 7 °F (4 °C), further compounding our energy problems. Studies indicate using light colored pavements can reduce urban heat islands.

## Green Building Initiatives

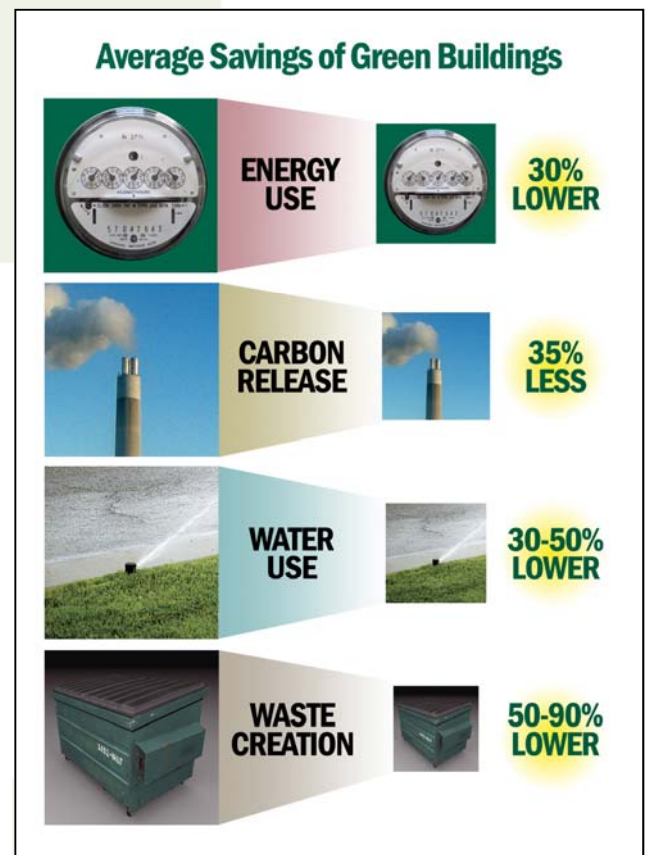
Green building initiatives such as Leadership in Energy & Environmental Design (LEED®), Green Globes, National Green Building Standard and the Green Highways Partnership provide stakeholders in the construction industry guidance for meeting sustainable development objectives. These guidelines and programs are helping transform the way we design, manufacture and construct our built environment.

The benefits of building green are numerous. Studies have shown that green buildings yield life cycle savings of more than 10 times the initial investment or 20% of total construction cost. A green building provides a healthy environment for employees, students or residents, yielding productivity increases up to 10%. According to one study, worker health can be improved and employee absenteeism may be reduced by 40%. Building green is a way of demonstrating social consciousness by minimizing pollutants and reducing demand on energy and water.

The concrete industry supports and participates in the process of developing green building standards for homes, buildings and roadways. It provides expertise to ensure that concrete building systems are properly addressed in the standards to maximize environmental performance.

LEED®, Green Globes and National Green Building Standards are efforts from several different organizations to provide national standards for what constitutes a “green building.” Through their use as design guidelines and third-party certification tools, they aim to improve occupant well-being, environmental performance and economic returns of homes and buildings using established and innovative practices, standards and technologies.

The Green Highways Partnership (GHP) is a voluntary, public/private initiative that is revolutionizing our nation's transportation infrastructure. Through concepts such as integrated planning, regulatory



flexibility and market-based rewards, GHP seeks to incorporate environmental streamlining and stewardship into all aspects of the highway life cycle.

## Concrete Solutions

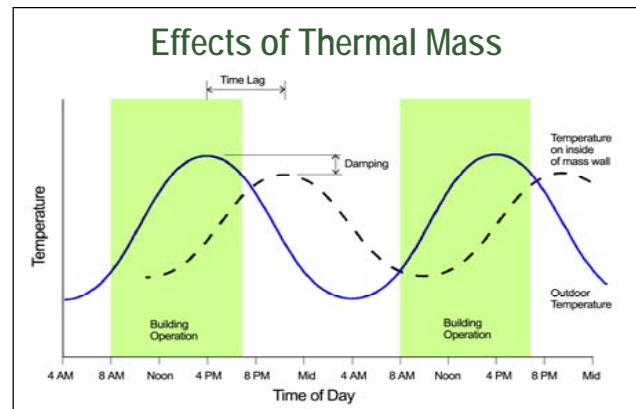
The concrete industry is dedicated to providing solutions that result in reducing the overall environmental footprint of our built environment. Concrete possesses many qualities that directly support sustainable development principles. Since the use phase has the greatest impact it also offers the greatest opportunity for improvement.

## Energy Efficient

Providing energy efficient buildings can reduce the environmental impact of our built environment. Buildings constructed of concrete have high thermal mass and are inherently more energy efficient. Thermal mass is a material's ability to store heat energy and release it over time. Benefits of thermal mass buildings include:

- Increased time lag between peak heating and cooling loads and outside temperatures thus delaying the need for heating or cooling energy to take advantage of off-peak energy demand.
- Lower peak heating and cooling loads allowing for smaller more efficient heating and cooling equipment.
- Less overall heating and cooling energy to maintain the same interior temperatures since temperature swings are moderated.

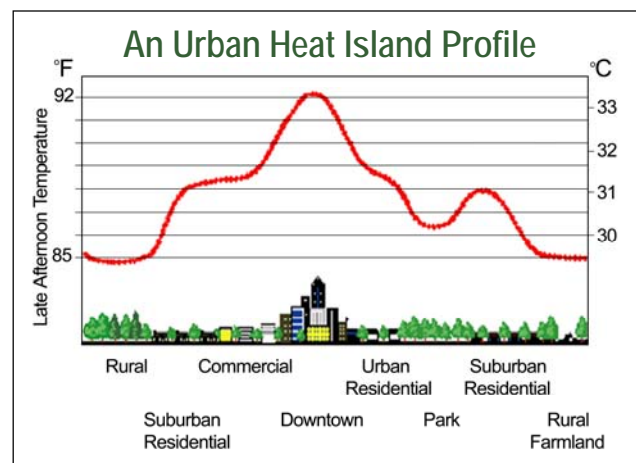
Concrete building systems such as insulating concrete forms and tilt-up concrete walls incorporate insulation, high thermal mass and low air infiltration to create energy efficient wall systems that save energy over the life of a building. The result is significantly lower CO<sub>2</sub> emissions related to building occupancy.



## Highly Reflective

Concrete provides a light-colored and reflective surface for parking lots and roadways. The light color and reflective nature of concrete allows for fewer lighting fixtures thus reducing energy demand. In addition, research shows that use of light-colored materials can help reduce the urban heat island effect by lowering the average summer afternoon temperature in some cities by as much as 5 °F (3 °C), cutting the need for air conditioning by 18%.

The cost of electricity used to offset the peak temperatures from the heat island effect in U.S. urban areas is estimated to be one million dollars per hour or approximately one billion dollars per year. In addition, lowering temperatures in urban areas reduces smog and pollution. One study estimates that





reducing the daily high in Los Angeles by 7 °F (4 °C), the amount resulting from the heat island effect, would eliminate two-thirds of the smog episodes.

### **Strong and Durable**

Concrete is the most widely used building material on earth because of its strength and durability. It's used in buildings for foundations, structure and envelope. The versatility of concrete, combined with extreme strength and durability make it an ideal construction material. It does not rot, rust or burn. It requires little effort or cost to maintain.

Concrete's strength and durability can reduce the overall environmental impact of the use phase since a long-lasting building or pavement does not require rehabilitation or reconstruction as often, therefore reducing the demand on virgin materials.



### **Stormwater Management**

Concrete can assist in protecting our natural waterways and reducing stormwater runoff. Pervious concrete pavements can be used for parking areas and roadways to allow rainwater to percolate through the slab and replenish natural aquifers. Pervious concrete pavement naturally filters stormwater, minimizes runoff and treats pollutants from cars and trucks.

### **Fuel Efficient**

Fuel consumption of trucks traveling on concrete highways is lower because concrete pavements are stiffer and thus reduce rolling resistance. One research study compared fuel consumption and emissions for a 62 mi (100 km) section of a major urban arterial highway, one paved with asphalt and the other paved with concrete. The study concluded that heavy trucks traveling on concrete pavement resulted in fuel savings of up to 7%. These fuel savings lead to reductions in greenhouse gas emissions and air pollution.

### **Low Air Emissions**

Concrete used as interior exposed walls, floors and ceilings can improve the air quality of a building because concrete is relatively inert. Decorative concrete can be used as a low volatile organic compounds (VOC) emitting flooring material. Exposed concrete walls may reduce the need for high VOC finish materials such as paints or other finishes.

## GOAL 5

Increase the recycled content in concrete construction

### STRATEGIES

- Advocate for recycled concrete aggregate, water and cementitious materials in national, state and local standards
- Support the use of recycled concrete aggregate as base and fill materials for new construction
- Educate concrete producers and specifiers on the proper use and benefits of using recycled concrete aggregate, water and cementitious materials in concrete
- Conduct research to demonstrate and improve concrete performance using recycled concrete aggregate, water, cementitious materials, and other pre- and post-consumer byproducts





## Recycling Phase

Concrete uses recycled materials in several different ways. The most widely used recycled products are SCMs such as fly ash, slag cement and silica fume. In 2007, the concrete industry consumed over 26 million metric tons of these industrial byproducts that would otherwise end up in landfills. In addition, concrete producers recycle returned concrete and wash water into new concrete.



The greatest opportunity for recycling lies in crushing concrete for various applications after demolition. After decades or sometimes centuries of use in a home, building or roadway, concrete can be crushed and reused. The Construction Materials Recycling Association estimates that 125 to 140 million tons of concrete are recycled annually.

Recycling concrete from demolition can be used for aggregate base for new roadways or granular fill for building foundations. Some crushed concrete can be recycled as aggregate into new concrete. Recycling old concrete as aggregate for new concrete products protects natural resources by reducing the demand for virgin aggregate materials and eliminates the need to dispose of it into landfills.

According to a Federal Highway Administration study, 38 states recycle concrete as an aggregate base, but only 11 recycle it into new concrete. Some state departments of transportation allow for up to 100% of recycled concrete aggregate in some concrete pavement mixtures.

Recycled concrete can be used as a soil stabilization material. Soil stabilization is the incorporation of recycled aggregate, cement, lime or fly ash into marginal quality subgrade material used to enhance the load-bearing capacity of that subgrade.

Recycled concrete can serve as an aggregate for use as a stable bed or firm foundation for underground utilities. It can be also used as an aggregate base for boulder or stacked rock walls, erosion control structures and retaining walls. Recycled concrete can be sized to serve as a natural landscape feature.

Recycled concrete aggregates are lighter weight per unit volume (10-15% less than comparable virgin quarry materials) which reduces the weight per cubic yard of concrete. The lighter weight results in lower transportation and energy costs and a reduction in fuel use.

NRMCA has implemented several key programs to help its members meet their sustainability goals.

## Research



The RMC Research & Education Foundation, the ready mixed concrete industry's research organization, has sponsored several research projects to improve environmental performance of the concrete industry:

- Model Performance Spec Phase II: Guide to Specifying Concrete Performance
- Model Performance Spec Phase I: Preparation of a Performance-Based Specification for Cast-In-Place Concrete
- Experimental Case Study Demonstrating the Advantages of Performance Specifications
- Crushed Returned Concrete as Aggregates for New Concrete
- Recycled Water in Ready Mixed Concrete Operations
- New Technology-Based Approach to Advance Higher Volume Fly Ash Concrete with Acceptable Performance
- Effect of Pavement Type on Fuel Consumption and Emissions
- Side-by-Side Comparison of Pervious Concrete & Porous Asphalt
- Performance Assessment of Pervious Concrete and Maintenance Plan
- Air Emissions Testing Program at Ready Mixed Concrete Plants
- Pervious Concrete Mix Design for Wearing Course Applications
- Pervious Concrete Research Compilation
- Long-Term Field Performance of Pervious Concrete Pavements

## Education



**STEPS**® NRMCA's Seminars, Training and Education Programs (STEPS®)

SEMINAR, TRAINING & EDUCATION PROGRAMS

support the educational needs of the concrete industry with a comprehensive set of learning opportunities. STEPS® features dozens of seminars and workshops and individual course certification opportunities. Many of these educational programs specifically address sustainable development principles, including:

- Environmental Certification Course
- Safety Certification Course
- Fleet Manager Certification
- Plant Manager Certification
- Concrete Technology Training and Certification
- Concrete Durability Course and Certification
- Concrete's Role in Sustainable Development

**Continuing Education**—NRMCA delivers numerous continuing education programs for architects, engineers and contractors to help them better utilize concrete for green building applications. These seminars, delivered via the web and at numerous locations throughout the country, include:

- Building Green with Concrete
- LEED Green Building System and Concrete
- Pervious Concrete—A Stormwater Solution
- High Performance Concrete
- Pervious Concrete Contractor Certification
- Design of Concrete Pavements

**National Accounts**—NRMCA has a strong national account resource team and a program in place that provides ready mixed concrete support for large businesses. The program centers on direct contact with national accounts and coordination with regional and local concrete professionals to ensure that these accounts have current information and access to the highest level of expertise to solve problems and implement productive new solutions. The most frequent request for assistance has been on develop-



ing more sustainable and environmentally sensitive building practices. Pervious concrete pavement has been of particular interest because of the related “green” characteristics and economic benefits. Many accounts have also been interested in learning about the outstanding environmental benefits of “conventional” concrete applications, including concrete structures and pavements.

### Measurement



NRMCA is committed to promoting environmental stewardship within concrete plants through the NRMCA Green-Star™ Certification Program. This program provides guidelines through the use of the environmental management systems that would ensure an environmentally friendly concrete plant. NRMCA Green-Star™ Certification provides a nationally recognized standard for those industry members that are on the forefront of the environmental excellence.

### Sustainable Concrete Plant Guidelines—

NRMCA is committed to continuous environmental improvement through process and product innovation. NRMCA has sustainable concrete plant guidelines to support the efforts of the concrete industry toward sustainability. The guidelines provide a structured process capable of withstanding third-party oversight and serves as a useful mechanism to help concrete producers achieve their sustainability goals.

### Concrete Plant and Truck Certification—

Concrete is a manufactured product, the quality and uniformity of which depends on the control over its manufacture. It must be produced with suitable ingredients accurately combined to specific proportions. These must be thoroughly blended and the finished product delivered according to the requirements of the purchaser. Although success depends upon several factors, a vital prerequisite is well-maintained equipment and an efficient production facility. NRMCA Concrete Plant and Truck Certifica-

tion provides third party verification that concrete producers are meeting quality standards in concrete production.

### Advocacy



NRMCA is committed to continuous environmental improvement through product standards that lead to reduced environmental impact. NRMCA has implemented the P2P Initiative™ (Prescriptive to Performance Specifications for Concrete) that intends to provide concrete producers with more flexibility to optimize concrete mixtures to reduce environmental impact. Traditionally, construction specifications for concrete have required unnecessarily high quantities of portland cement along with other limits on the use of supplementary cementitious materials. The P2P Initiative™ intends to minimize many of these restrictions, thus providing more flexibility to meet performance requirements for strength and durability while minimizing environmental impact.

**Sustainable Development Standards—**The concrete industry also supports and participates in the process of developing green building standards for homes, buildings and roadways. It provides input to standards such as Leadership in Energy & Environmental Design (LEED®), Green Globes and National Green Building Standards. The concrete industry also supports the principles of the Green Highways Partnership.

**Model Ordinances—**One major initiative from NRMCA is to develop model ordinances that members and local partners can use in their state and municipal government affairs work. Two model ordinances specifically dealing with sustainability have been developed, one on adopting a green building standard for commercial construction and one on adopting stormwater management practices to include pervious pavements.



## NRMCA SUSTAINABILITY INITIATIVES

<h3>CONCRETE ENVIRONMENTAL LIFE CYCLE</h3>	<h3>MATERIAL ACQUISITION</h3>	<h3>PRODUCTION</h3>
<p><b>VISION</b></p> <p>The vision of the ready mixed concrete industry is to transform the built environment by improving the way concrete is manufactured and used in order to achieve an optimum balance among environmental, social and economic conditions.</p> <p><b>OBJECTIVES</b></p> <ul style="list-style-type: none"> <li>■ Minimize Energy Use</li> <li>■ Reduce Emissions</li> <li>■ Conserve Water</li> <li>■ Minimize Waste</li> <li>■ Increase Recycled Content</li> </ul> <p><b>KEY PERFORMANCE INDICATORS</b></p> <p>Measured on a per unit of production basis and compared to 2007 levels:</p> <ul style="list-style-type: none"> <li>■ Embodied energy:                             <ul style="list-style-type: none"> <li>■ 20% reduction by 2020</li> <li>■ 30% reduction by 2030</li> </ul> </li> <li>■ Carbon footprint:                             <ul style="list-style-type: none"> <li>■ 20% reduction by 2020</li> <li>■ 30% reduction by 2030</li> </ul> </li> <li>■ Potable water:                             <ul style="list-style-type: none"> <li>■ 10% reduction by 2020</li> <li>■ 20% reduction by 2030</li> </ul> </li> <li>■ Waste:                             <ul style="list-style-type: none"> <li>■ 30% reduction by 2020</li> <li>■ 50% reduction by 2030</li> </ul> </li> <li>■ Recycled content:                             <ul style="list-style-type: none"> <li>■ 200% increase by 2020</li> <li>■ 400% increase by 2030</li> </ul> </li> </ul>	<p><b>GOAL 1</b></p> <p>Reduce environmental impact during the material acquisition phase</p> <p><b>STRATEGIES</b></p> <ul style="list-style-type: none"> <li>■ Support material suppliers that adopt comprehensive environmental management systems, including wildlife conservation and quarry restoration plans</li> <li>■ Support material suppliers located near concrete plants</li> <li>■ Explore the use of innovative cements with lower carbon footprint through research, education and advocacy</li> <li>■ Encourage supplementary cementitious material (SCM) suppliers to improve distribution systems in order to increase material availability</li> <li>■ Increase the quantity of SCMs used in concrete through research, education and advocacy</li> <li>■ Increase the quantity of recycled aggregate used in concrete through research, education and advocacy</li> <li>■ Replace potable water with non-potable water used in concrete through research, education and advocacy</li> </ul>	<p><b>GOAL 2</b></p> <p>Reduce environmental impact during the production phase</p> <p><b>STRATEGIES</b></p> <ul style="list-style-type: none"> <li>■ Adopt rigorous environmental management systems to meet and exceed environmental regulations</li> <li>■ Use energy efficient plant equipment and delivery vehicles</li> <li>■ Increase the use of recycled materials to lower the overall embodied energy of concrete through research, education and advocacy</li> <li>■ Use renewable energy, including biomass, solar, wind, geothermal and hydroelectric power to reduce plant CO<sub>2</sub> emissions</li> <li>■ Implement rigorous quality control programs to optimize the use of materials</li> </ul>



## CONSTRUCTION

### GOAL 3

Reduce environmental impact during the construction phase

#### STRATEGIES

- Deliver concrete from plants near construction sites
- Use fuel efficient concrete trucks
- Conserve fuel by minimizing truck idling
- Use trucks made with advanced lightweight materials to reduce fuel consumption
- Use alternative fuels to power concrete trucks
- Use advanced technologies such as global positioning systems to minimize travel distances
- Advocate for increased truck weights on roadways
- Advocate for greater access to highways and special truck lanes on highways to reduce congestion and fuel consumption
- Increase the use of labor-saving products such as flowable fill and self-consolidating concrete through research, education and advocacy

## USE

### GOAL 4

Reduce environmental impact during the use phase of concrete construction

#### STRATEGIES

- Provide expertise in the development of green rating systems for homes, buildings and roadways
- Educate engineers and architects on design techniques to benefit from concrete's environmental attributes
- Advocate for sustainability standards in national and local building codes
- Advocate for local ordinances that support the use of green building practices
- Conduct research to improve and enhance the positive attributes of concrete construction such as thermal mass, high reflectivity, durability and long service life
- Conduct research to enhance innovative products such as pervious concrete, tilt-up construction, insulating concrete forms, flowable fill and self-consolidating concrete

## RECYCLING

### GOAL 5

Increase the recycled content in concrete construction

#### STRATEGIES

- Advocate for recycled concrete aggregate, water and cementitious materials in national, state and local standards
- Support the use of recycled concrete aggregate as base and fill materials for new construction
- Educate concrete producers and specifiers on the proper use and benefits of using recycled concrete aggregate, water and cementitious materials in concrete
- Conduct research to demonstrate and improve concrete performance using recycled concrete aggregate, water, cementitious material and other pre- and post-consumer by-products



For more information about  
**NRMCA Sustainability Initiatives**  
visit [www.nrmca.org/sustainability](http://www.nrmca.org/sustainability)

The vision of the ready mixed concrete industry is to transform the built environment by improving the way concrete is manufactured and used in order to achieve an optimum balance among environmental, social and economic conditions.



National Ready Mixed Concrete Association  
900 Spring Street  
Silver Spring, MD 20910  
Phone: (301) 587-1400  
[www.nrmca.org](http://www.nrmca.org)