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# Green Building Technology and Sustainable Construction in Austria vs. the U.S.A

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7/10/2011

## **Abstract**

This research paper was written under the Marshall Plan Scholarship in Salzburg, Austria. The goal of this research is to determine the differences between the construction industries of the two countries with regard to environmental sustainability. This was accomplished by visiting significant buildings and business, conducting interviews and contacting relevant individuals. The results of this work are that Austria is much more focused on sustainability than the U.S. The U.S, though, is taking steps in the right direction and by offering more incentives and educational systems can effectively promote sustainability as well.

1. Introduction.....	4
2. Styles.....	6
2.1. Materials.....	7
3. Technologies.....	12
3.1 Passive houses.....	15
3.2 Energy types.....	16
4. Incentives.....	19
4.1. Monetary.....	19
4.1. Social.....	20
5. Awareness.....	22
5.1. Education.....	22
6. Summary.....	23
7. Works Cited.....	24

## Introduction

The construction industry is without a doubt one of the oldest on the planet. People have needed shelter for as long as they have existed. It provides protection from all forms of harsh weather as well as from the wild. Buildings have created civilization as we know it today and without them the human race could not survive. When construction first began, shelters were built by the homeowner with whatever material they could obtain from their surroundings; these were generally small temporary shelters. As time progressed people became less nomadic and opted for a more stationary lifestyle. This gave birth to desires for larger, more comfortable shelters. Skilled carpenters undertook the job of constructing homes for paying customers and so began the industry.

Along with the 18<sup>th</sup> century came the industrial revolution. First beginning in Great Britain then expanding to Europe and finally the United States, this was a time during which many coal burning factories were built to produce textiles and other products. The smoke from chimneys, factories and machinery soon made it apparent that effort should be given to avoiding pollution. Measures were taken by governments to clean up cities and protect the environment but no real environmental protection standards were created until the modern green movement that began in the late 1960s through the 1970s. Mandates such as the United States' Clean Air Act and Austria's Forest Act have shown that this is a serious issue for many. Since then the rising prices of fossil fuels and the increasing atmospheric temperature, which many attribute to the burning of fossil fuels, has sparked a newfound interest in sustainability. The Kyoto Protocol that aims to reduce greenhouse gas (GHG) emissions has currently been signed by 191 countries. Many countries have also established mandatory efficiency standards for energy consumption and production that will become stricter over time.

In order to meet these new requirements and maintain the same standard of living that we enjoy today, it is imperative that humanity continue to strive for ecological ways of living. The building industry, because it is amongst the oldest industries, presents difficulties in instigating change and therefore may require more time and effort than some others. Methods and materials for construction have been time tested and proven and many who use them may have no desire to change their ways. These techniques that have proven themselves profitable need to be replaced by more sustainable ways. This industry, like all industries, is controlled by profit. The success of a business is determined by income; ideas that make money succeed while those that lose money are discarded. This has proven very useful in maintaining an economic balance but it can have negative consequences when something other than financial gain is the goal. All types of construction, residential, commercial and civil take a toll on the environment and consume valuable resources. Goals must be set to reduce these effects in order to assure that current resources will remain available for everyone's use.

As we begin to hear phrases like green building and environmentally friendly used more frequently, socially responsible organizations start emerging and popular opinion begins to sway toward a more eco-friendly state of mind. Despite these changes, there is still much resistance. Those people who have already taken the first steps must show that these techniques can be effective and profitable in order to convince everyone that building sustainably is necessary. Once shown that profit will be increased many others will soon follow suit in changing their approach to construction. There are many aspects to this industry with room for improvement. These aspects can be grouped into four main categories: building styles and materials, technologies, incentives and awareness. This report will focus mainly on the countries of Austria and the United States of America, with particular emphasis in the mid-west, and what these countries are doing in each of these categories with regards to sustainability.

## Styles

Many different climates, seasons and building materials available all over the planet have caused a huge difference in building styles from country to country. The style of a building goes much deeper than just appearance. Places with frozen tundra year round such as northern Canada can be built directly on the earth without even a concrete foundation whereas places below sea level like the Netherlands require a deep, sturdy foundation to keep the buildings from sinking. Different locations present many different obstacles that must be addressed through different building techniques. Some locations that receive excess snowfall require more reinforcement to support different types of live and dead loads. Other areas are prone to earthquakes, flooding or other natural disasters and the buildings in these regions must be built to accommodate. Another huge factor in determining building types is the availability of materials. People near forests build with wood, people in desert climates use adobe style building and in rocky areas people use stone. This has been the case for many years until recent technological advancements have provided ways to transport any material to any location in the world. This has had somewhat of a standardizing effect on the construction industry and has helped provide more efficient and safer ways to build.

Today building styles and materials are mainly affected by the owner's preference and ability to pay although geographic location and local resources still have a lot of say. Because of this newfound accessibility one should consider carefully more options than simply appearance and affordability to make an unbiased judgment of the products, techniques and layouts that will go into the construction of a structure.

## Materials

With so many different materials currently available on the market it is important for potential home buyers, builders and architects to consider the pros and cons of all materials included in the building. Many materials that may seem to be good for the environment may actually contain hidden detriments that cause more harm than good. For this reason it is important to research the products that go into a building past their immediate affects. Building components that are manufactured through chemical processes often release a many harmful chemicals into the atmosphere. Some materials may produce hazardous or toxic byproducts and need to be disposed of. Others still can simply produce excess waste that fills up landfills and uses up resources.

Aside from the creation of products, the end of their useful life must be considered as well. When the building is demolished in the future, what will become of the components? Will they be reusable or recyclable, or will they simply be discarded and remain in landfills for centuries? Extruded polystyrene foam is a great insulator and is easily recyclable but there is no microorganism that can decompose it. Due to this fact, a large percent of the planet's pollution is polystyrene foam and other polystyrene materials. The same goes for many other chemically produced products. Other manufactured materials such as concrete, metals and even paper contribute immensely to the planet's energy consumption. These and other manufacturing industries combine to make up about one third of the all energy consumption.

In order to use less production energy it is necessary to begin using more recyclable materials and making more of an effort to recycle what is already in use. Some organic materials can be excellent building materials and have much less of an environmental impact. Hemp is a fast growing plant that can be used in many aspects of construction. Bricks with higher insulating value, wall cavity insulation and caulking that perform extremely well can all be made from this. Another good insulating material is straw. Straw insulated homes can be very effective and last just as long as other types of

homes. Bamboo is another example of a great building material that is extremely renewable. It is currently used as a flooring material and also has applications in the paper, technologies and clothing industries. In perfect conditions bamboo has been recorded to grow around 60 centimeters per day. The most common organic material used in construction today is wood.

Austria is one of the most forest covered countries in Europe with trees covering 47 percent of its 32,377 square mile area. As a result, much of the economy in this region revolves around the logging industry and its related products. Wood is one of the most important sources of external currency second only to tourism (Jezek p. 3). Many homes and businesses in this country are constructed almost solely from wood, universities are focused on the construction of new wood products and their responsible logging industry has been successful in harvesting the resource without depleting it. Many construction companies are striving to improve on the possibilities and modernization of wood construction and popular opinion towards this material's environmental aspects and construction capabilities is very high.

Through the efforts of these many companies and universities many of the downfalls traditionally associated with wood have been eliminated. Completely wooden buildings can be built many stories tall with no problems, often not containing a single metal fastener but using oven dried dowels that swell with the humidity in the air. Structures made from lumber have also typically presented a fire danger due to the flammability of the material. This has been addressed by using thick solid wood instead of just a facade or minimal structural support. Through the use of this technique wooden buildings have received fire ratings equal or greater than that of concrete. Another problem that has been addressed in Austria is the material's insulating capabilities. While it is true that solid wood has low insulation values, it is possible to



build entire homes using only wood for the walls and maintain excellent efficiency (Thoma).

The most important part in making a good insulating barrier is not the material used to make the insulation, it is air and how the material maintains air gaps without allowing the air to move. This is something that all insulating materials have in common. Generally, a more dense material has fewer insulating properties than those of a less dense makeup, depending on the ability of air to flow. This concept should always be kept in mind when constructing a building envelope. An excellent example of a company that does this with incredible results is Thoma. They are an Austrian company that builds homes from solid wood that have set world records for their insulating abilities. These homes are built off site and assembled at the desired location in several days. This huge time reduction compared to constructing a typical home helps to reduce the cost of using so much wood. The company strives to build products that follow the Cradle-to-Cradle® design concept. In this concept materials are always somehow reused towards new products so that, as in nature, there is never any waste (Environmental par. 1).

Developments like these have allowed construction to enter a whole new level. A wooden supported high-rise building is currently being planned in Dornbirn, Austria. Named LifeCycle Tower, it will be the tallest wooden building in the world at 30 stories and will voluntarily conform to very strict environmental standards. This building will have the capability to be used for multiple purposes and will utilize all available space very efficiently (Michler par. 1).

Aside from its building capabilities, Austria has shown that wood contains many other useful properties. Energy stored in this material can be harvested for the creation of electricity and heat. A wooden home can be disassembled when it is no longer useful and can then be burned. This can be achieved through the use of heat plants or wood

burning power plants. These wood fueled plants are currently being used today and have proven affordable and sustainable. One such heat plant, located in Zell am Moos, Austria burns locally harvested or acquired wood in ovens to heat water. This heated water circles the town in a closed loop system to provide heating and hot water for the residents of the town. Once this heated water has been through the last house it then returns back to the heat plant to be reheated by burning more wood. Once the wood has been burned, the ash is filtered from the air and is then used as fertilizer thus creating more trees (Obauer). This technique has proven much cheaper and cleaner than their previous heating method which involved the burning of oil, and is also another excellent example of the Cradle-to-Cradle® technique.

The typical stick building style used widely in the United States uses minimal wood to form the skeleton so that insulation in the wall cavity can be maximized. Once the skeleton is erected, the exterior is typically covered in Oriented Strand Board (OSB) which is a wood product made from glue and wood chips. This provides a surface to fasten the exterior siding to and gives the building the necessary racking strength. Once the OSB has been attached, the insulation and drywall is attached to the interior and the exterior is covered with a siding material, usually made of vinyl. These are the most common building materials used in the United States and have been used for many years because they are easy to work with and relatively low cost. The U.S. is also extremely focused on safety. Safety standards continually get more and more strict and require a lot of attention by the supervisors of a construction site. An employee caught without the required personal protective equipment (PPE), especially if an injury results, can create huge fines for the company that may cause it to go out of business. This helps in creating a relatively safe work environment for the employees. Another thing that the U.S. has done well is the standardization of construction materials. Wood and drywall sheets, trusses, studs, windows and doors have all been standardized to fit together reducing waste and construction time. Unfortunately not much thought has been given

to the sustainability and the environmental impact that these materials have on the environment when the building is demolished.

The chemically produced sidings, insulating foams, asphalt shingles and everything else that is not biodegradable continue to fill up landfills and contaminate soil. Despite the continued usage of these things it is not as bad as one might think. There are many people in the United States that are concerned about the environment and sustainability. Measures are being taken to reduce wasting materials by people all over the country. Some universities are beginning to teach sustainable building techniques and although the level of environmental concern is far below that of Austria, the country is moving in the right direction.

New homes are increasingly built as air tight as possible to reduce heating and cooling costs and low-E windows and doors are becoming more and more popular in remodels and new construction. The use of organic materials is not practiced as widely as it is in Austria due to the price difference and lack of incentive but programs are being created to instigate change. Leadership in Energy and Environmental Design (LEED) is a point based system for green building that offers points for using certified wood, recycling materials, minimizing waste and utilizing local products.

While organic materials offer excellent solutions to sustainability issues they are not without their drawbacks like anything else. Materials such as straw, bamboo and hemp require space to grow. If demands for these products were to grow, the land requirement would follow which may lead to the clearing of more forest areas. Many people around the world are also concerned about the wood industry and the environmental side effects of over logging and deforestation. Illegal or harmful logging is taking place all over the world and is slowly depleting our planet's forest resources. Because of this, it can be easy for some to condemn the harvesting and use of wood for the building industry but this is not necessary. A properly managed forest can provide a

completely sustainable wood source along with many other benefits that a forest has to offer. The only problem with this is that it is nearly impossible to make every logging company or purchaser of lumber to run their operation from a moral and legal standpoint because their motivations lie with the profit. This is an area where consumers and producers need to work together to ensure that everyone follows the rules in order to protect our natural resources and this cannot happen until more people begin to think sustainably.

A new technique called “sustainable procurement” is used by concerned consumers of wood products to help ensure that the products they are purchasing have been harvested in a legal and sustainable way. Sustainable procurement is a guide that focuses on 10 issues regarding sourcing and legal aspects, environmental aspects, and social aspects to help customers decide where to place their purchasing power (World par. 2). As awareness grows and more wood product consumers begin to purchase from responsible suppliers, many others will begin to follow. Once the profit lies in operating sustainably it is just a matter of time before the entire industry will do the same.

## **Technologies**

Technology and its continual development is one of the keys to the sustainability of materials and the environment. It is currently the second most contributing factor to civilization next to construction. These two industries can be used together with extreme effectiveness. Today nearly all structures are built combined with some sort of technological advancement of the last 100 years. Electrical and plumbing systems, appliances, wall coverings and even the skeleton of the building have all been somehow affected through technology. Much of the lumber used in a home is now engineered to span much greater distances and carry heavier loads than solid wood. Concrete can be

manipulated in thousands of ways to acquire exactly the desired characteristics. Even the techniques used to harvest these materials have changed drastically.

In the past logging was done with hand saws and pulled by horses or floated down rivers and mining was by hand. Today machinery has sped up most processes allowing the rapid harvesting and, if not careful, the depletion of natural resources. Because the human population is continually increasing, the need for more resources is required to support it. To help reduce the need of so much material it is important that technological advancement be focused on increased efficiency in all aspects of industry. Currently there are many products already on the market doing just these things but it is not enough. Technology must be continually advanced to assure that future material demands can be met.

Many people in Austria are focused on green, sustainable technology. Cities in Austria frequently hold events to discuss energy efficiency or invite individuals to present their newly developed sustainable technologies. One such event held in Salzburg, Austria called "Energiefest" contained 52 presenters and was visited by 3,500 members of the public. Other similar events are held all over the country. Currently Austria is among the leaders in the promotion and creation of sustainable technologies. An organization titled the Master Plan Environmental Technology has been created in Austria with hopes to bring the country to the top of the industry. Four "Strategic fields of action" targeted toward sustainable technology industries have been established with the goal to become the world leader within ten years. These areas are promotion of exports, research and qualification, financing and making the domestic market more dynamic. "The basic idea of the Master Plan Environmental Technology is to strengthen the positive development of the environmental technology industry by joined forces of politics, administration, the industry and science." This project partnered with over 100 companies in the industry showing the huge potential impact that a program such as

this can have. The program also aims to cooperate with klima:active, the Austria climate protection initiative (Mut p. 8,9).

The United States of America on the other hand often receives criticism for the lack of environmental concern that is often perceived. While this country is currently extremely reliant on fossil fuels it is important to note that the size and population of the U.S. is a huge factor. It is much more difficult to provide a single reliable power source for a large country compared to a small one. The power produced by a windmill in the state of Utah averages 12 percent of the maximum possible output where a coal burning plant can run at 100 percent of the maximum output. The common misconception is that coal burning plants are extremely dirty producing black smoke and many harmful pollutants but in reality they are very strictly regulated and are relatively clean. Currently these plants are necessary and their use is not avoidable for the time being. Despite this, many U.S. citizens are still pushing to instigate change. A new bill called the Securing America's Future with Energy and Sustainable Technologies Act was introduced to the senate in March 2011 that would promote the increased use and production of renewable energy and technologies (GovTrack p. 1).

Many other organizations, universities and states are also encouraging the increased implementation of green energy and technologies. A renewable energy standard has been passed in California requiring 30% of the power usage be based on renewable sources which is pressuring some power plants to consider other fuel possibilities (Wood). The Environmental Protection Agency (EPA) has also taken steps towards reducing power plant emissions. The recently signed Maximum Achievable Control Technology (MACT) rule limits pollutants including several acidic gasses, organic gasses and metals. The new strain that has been put upon power production will create a price increase in the power industry. This increased cost for power will inevitably encourage more potential homeowners to consider low energy homes.

## Passive houses

Low energy buildings are the future of the construction industry. These buildings are called “nearly zero energy buildings,” others that use no energy are called passive houses. A nearly zero energy building is a building that produces most of its own energy and requires very little from outside sources. The little energy that does come from outside sources should be produced in majority by sustainable means. This differs from passive houses in several ways. These are homes that are one hundred percent efficient. They do not require any form of outside energy to maintain temperature and run appliances. In many cases these building can even produce excess electricity that can be put back into the grid for others to use as a green source of energy. The electrical company may then compensate the homeowner which creates another revenue source aside from just savings in energy costs.

It is often intimidating for a potential customer to consider building a low or no energy building. The words energy and efficiency are often synonymous with extra money and time investment, but this does not have to be the case. Planning is one of the most important keys to building a structure of this type. Much can be accomplished through simple things such as placement of the building and location of the windows. Typically the best layout of a home involves a large south facing façade with large windows and deciduous trees planted in front of them for shade. This works well because deciduous trees provide excellent protection from the sun in the summer but lose their leaves in the winter which allows the sun to enter the large windows and keep the home warm. Other things that can be done to improve efficiency without adding more cost are to assure that plumbing lines are as short as possible and HVAC vent lines are kept within the building envelope. These simple techniques along with many others can make a large difference in the energy requirement of the building. Through only the

use of careful planning, one can create a considerably efficient structure (Checkliste p. 1-3).

Due to the rising energy prices and the increasing environmental concern it is often not enough to rely solely upon careful planning during the preconstruction phase. Fortunately, there are ways to further increase the self-sustainability of a structure through advanced technologies. These technologies are quite expensive which can scare off those who have considered their implementation. It is important to remember that even though taking measures to be completely self-sufficient represents a significant upfront investment, this can generally be more than made up for in energy savings. In the future this may prove extremely useful for building owners because before long there might be no choice when it comes to efficiency. Many countries already have laws put in place. The European Union has enacted the Energy Performance of Buildings Directive that requires that all new buildings within the EU be nearly zero energy buildings by 2020 (Cliquot p. 3). Germany and Austria are leading the way with an estimated 25,000 passive houses already in use between the two. The United States is far behind this number with some passive house number estimates at less than 100 (Passive par. 2). This is because the first passive houses were built in the U.S. only several years ago making it a very new idea. Despite such a small number of homes actually in use, the idea is pickup up speed quickly and the future will show the construction of many more.

## **Energy types**

Even as more and more buildings become more and more self-sufficient, there is still a huge demand for external energy produced in power plants or through other forms of harvesting energy. Several types stand out as having the most promising outlook for the future. Wind, water, solar and biomass are among the possibilities to



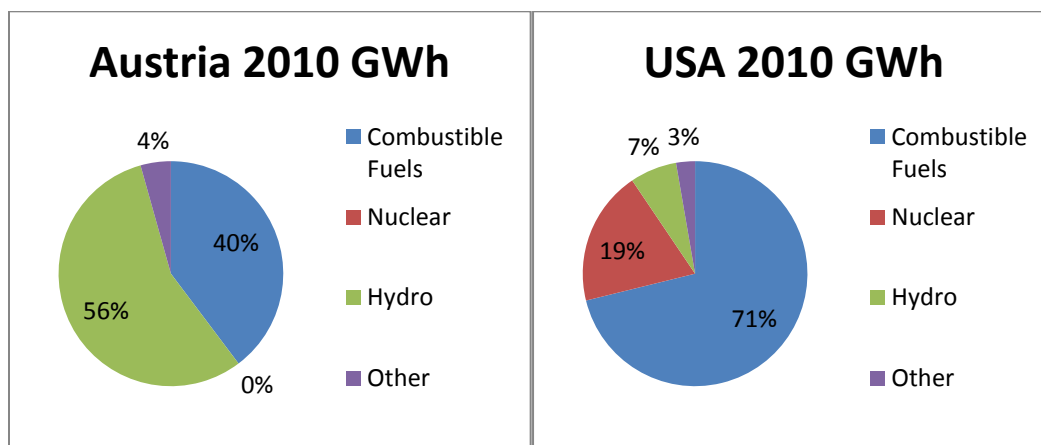
power the planet in the future. Wind energy can be harvested through the use of windmills but still presents several problems. Wind mills are dependent on the wind which cannot be relied upon for a continual supply of energy. Wherever windmills are used to supply power there must also be a backup supply to compensate when there is not enough wind to keep up the minimum output requirement. Solar energy presents a somewhat similar predicament because when the sun is not visible at night or in bad weather conditions it becomes impossible to use this resource. Water energy is very reliable and clean but also has its downsides similar to any other source. The main contingency with water energy is location. A powerful water force must be located nearby in order to harvest its power. This force is generally produced by construction a dam across a river to produce a lake on the upstream side. This lake pushing against the dam creates huge amounts of kinetic energy that can then be used to turn turbines and produce power. Unfortunately this man-made lake will cover land and trees that were originally used for other purposes which may cancel out some of the energy produced with energy lost.

Several other energy types are currently in use today to provide the majority of the power consumed. The burning of fossil fuels and nuclear power are two forms of energy production that have been condemned in recent years. Fossil fuels provide a very steady and reliable form of energy but the earth's supply of this resource is finite. More and more drilling sights are becoming exhausted of oil while other potential sites such as the Arctic National Wildlife Refuge in Alaska, United States are becoming protected as wildlife and nature reserves. Fossil fuels are also thought by many to be a major contributor the planet's changing climate. As a result oil prices are rising causing global concern and increasing the desire for new alternatives.

At the other end of the spectrum nuclear power is a relatively clean and efficient way to produce power. The problem with it is that it can be extremely dangerous in the

event that something goes wrong as seen in the 1986 disaster at Chernobyl when the nuclear reactor exploded and more recently the earthquake disaster at the Fukushima nuclear facilities in Japan. Due to the safety concerns it presents, nuclear power plants are currently illegal in Austria.

The charts below show a simplified breakdown of the origin of the electricity used in both countries in 2010 according to the International Energy Agency (IEA). The main source for power in Austria is Hydro-Electric due to the small size of the country in relation to the prevalence of bodies of water. The other large contributor is combustible fuels meaning fossil fuels and combustible biomass. An estimated 18% of the combustible fuel used in Austria is biomass (The Austrian par. 1). The United States has much more of a dependency on fossil fuels at 71% combustible materials with less than 1% of this being biomass. It is important to remember the size and population differences when comparing the two countries. The United States has nearly 38 people to every one Austrian and is 118 times the area making it much more difficult to convert to sustainable techniques.



## **Incentives**

Incentives are an excellent way to entice future building owners to consider greener options when laws aren't enough or are difficult to pass. Earth's human population is approaching seven billion people. All of these people have their own opinions and ideas about many different things. Many of them desire to make a change but many more are content without it and are often skeptical about the actual price savings and effectiveness of sustainable measures. Providing an extra incentive to build sustainably will help to sway the opinions of those who would go either way and may also provoke interest and a desire to learn about sustainability where there would otherwise be none. These incentives come in many different forms and will have the possibility to effect many different people in many different ways.

## **Monetary**

The first type of incentive, and probably the one that first comes to mind for most people, is financial gain. Government or private organization can offer grants, rewards or low interest loans for complying with environmental standards that may be stricter than the law. Building sustainably has the potential of earning extra money in the future due to energy savings. This could provide the capability for business to sell green products at no or little upfront cost then be repaid over time by the energy savings of the home. Passive houses can even provide more incentive by producing more energy than they consume and receiving compensation from the power company.

Austria has adopted this technique extremely effectively. Many financing options are available for those who build efficiently beyond the requirements of the law. One of the nine states in Austria, Upper Austria, has created a very successful policy to change the housing market. Currently 95% of homes in this region have reduced their energy

consumption by 50%. “This was achieved with a combined approach of progressive building standards, financial incentives, targeted training of professionals and a comprehensive program to raise awareness of the general public and decision makers. (Öhlinger p. 1)”

The United States also has created programs to provide monetary incentive for green building and the promotion of research and development. The Department of Energy’s office of Energy Efficiency and Renewable Energy (EERE) awarded \$2.2 billion dollars in financial assistance for sustainable projects (EERE p. 1). There are also tax credits offered for the installation of energy efficient appliances, building materials and energy saving systems. The Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 was recently signed by President Obama to continue offering green building incentives in 2011 (Energy).

## **Social**

Social incentive is somewhat less discussed but is just as important as monetary incentive because it has the power to convert entire regions quite rapidly through popularity. The desire of the community and its residents to instigate change can be a powerful force to overcome many obstacles. Neighbors encouraging their neighbors and friends will have effects similar to that of a fad. All people will want to be part of the change not just because of the money but because they want to make a difference, which will in turn make a difference. This type of incentive can be very powerful and can make changes in more than just the building industry. Industries like the fashion and automotive industries are very easily manipulated by customer demand which is greatly influenced by popularity. The same goes for almost all public businesses. Because of these reasons it is important to consider ways to increase the popularity of

environmentally friendly products and building techniques. Without any form of incentive, the construction industry will never be totally green.

This is one area that is extremely contrasted between the United States and Austria and may quite possibly be the main reason the U.S. often receives criticism on its sustainability. The U.S. was founded with the idea that “taming the wild” was the necessary and moral thing to do. It was often thought that the best moral action was to civilize the land (What sec. 7). This is often shown in the themes of western movies which generally revolve around civilization verses wilderness conflicts. The government has since tried to counteract these ideals with the establishment of national parks all over the country and regulation of forests but many argue that this mentality has been permanently engrained. Furthermore the more recent green movements have possibly caused the exact opposite of their desired intent. The actions of radical environmentalists such as chaining themselves to trees or burning buildings has given them nicknames like “tree huggers” and “eco-terrorists.” Because of this the ideas associated with the environmentalist are often negative ones and are very likely to contribute to many peoples reluctance to call themselves one.

Austria, on the other hand, has no qualms with the environmentalist and, in fact, people are often considered irresponsible and looked down upon if they are not an environmentalist to some extent. This is easily noticeable in one trip to a supermarket or gas station. Customers are charged for grocery bags, which encourages them to reuse and recycle. The price of bottles and cans often includes an added deposit called a pfand which can be redeemed with the return of the container. As a result of high petroleum prices, large vehicles are often seen as wasteful and unnecessary. With the constant incentive to conserve surrounding all aspects of everyday life, it is easy to see how these two countries have such different mentalities.

## **Awareness**

The final key aspect important to sustainability is awareness. This is somewhat similar to incentives in that it is pertaining to the general population and not strictly the industry. This means that this area is also easily affected by popularity. The difference between the two is simply that awareness must preempt incentives for a change to truly take effect. Incentives provide the reasons to build eco-friendly but all of the changes produced by them will eventually be undone if it is not backed by the knowledge of why it is so necessary. It can also be nearly impossible to implement wide scale incentives without public desire.

## **Education**

The education system is the key to promoting interest in sustaining resources. Curriculum related to sustainability from preschool through college will instill the necessity for change in the youth. This will have great impact in several years when these children become the workforce and have the desire to save energy and resources. Education is the most important aspect related to sustainable building. All other key areas will fall into place when the appropriate individuals desire to make it happen. This will also help in reducing friction between industries and increasingly strict environmental laws. Individuals will begin building passive buildings which will in turn reduce the requirement of external power but increase the need for jobs designing, producing and maintaining these new buildings and technologies.

Austrian universities and schools typically provide an environment that encourages sustainability. New school buildings are state of the art, designed to maximize useable space and minimize energy consumption. Old educational buildings are generally remodeled to be as efficient as possible. Aside from just the atmosphere,

many schools offer courses on sustainable technologies or building in which students work together on projects aided by professionals in the industry. It is not uncommon for educators from all over the world attend these events to help teach students and share techniques from their country.

Educational systems in the U.S. are not as orientated around sustainability as are those of Austria. There are green building classes that are offered at certain universities and through external organizations such as LEED but they are not as integrated into everyday lifestyle. This does not mean that the U.S. is careless; it simply means that the focus in the U.S. has not yet shifted to environmental development. The education system is slowly changing and before long there will be more of this type of course offered all over the country.

## **Summary**

Overall, the country of Austria is much more environmentally conscious than the United States of America. There is much more focus on new forms of energy and new ways of preserving them. The government also charges considerably higher taxes and offers more enticing tax breaks for green building. The higher taxes on energy and fuel have compelled Austrian citizens to build smaller, more efficient houses and drive smaller vehicles contributing to the overall efficiency of the country. United States citizens have typically rejected higher taxes which may remove this option from the list of possibilities for the U.S. and is one reason for the slower implementation of sustainable techniques. Despite this slow progress there are still those who are concerned and desired to make a difference. By implement a few small changes in the education system, and offering more incentives, the U.S. can rapidly decrease its energy consumption and hopefully gain a better reputation throughout the world.

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