HOW TO GET COST REDUCTION IN GREEN ROOF CONSTRUCTION

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Abstract

Green roofs improve city environment and mitigate stormwater problems. But not all kinds of green roofs have the same ecological efficiency. A comparison between different kinds of green roofs shows that extensive green roofs have the best cost benefit ratio. Besides choosing the right kind of green roof the cost benefit ratio can either be influenced by providing bigger benefit or by cutting down costs. While many benefits work only long term and are hard to evaluate cutting down costs has an instant effect. The comparison between the German and US American green roof market shows a huge difference in prices. Why do German green roofs cost only 10% of what they cost in the United States? A closer look at material costs and market prices shows reasons for higher costs in the United States and how cost reduction could be achieved. Standardization and certification of green roof products and the introduction of complete green roof systems for example can help to minimize material costs. Specialization and training can reduce installation costs. The key to economical green roof installation however is the introduction of modern conveyance technology.

Many of North American Cities are affected by the heat island effect and have to fight stormwater management problems. Green roofs are an ideal tool to improve the urban environment and to retain stormwater. Their realization however depends on economical considerations for single projects. Building owners make their decisions mainly based on a mere financial comparison of additional costs for a green roof with additional benefits they may get. In this situation green roofs can be promoted either by extending benefits or by cost reduction for the building owner.

Choosing the right kind of green roof is the first step to influence the cost benefit ratio. For the given area of one single project, the ecological effect due to water retention can be increased by spending more money and by building an intensive greenroof rather than an extensive one.

But there are also situations where the area available for green roof installation is not limited, if for example a county is thinking about greening school roofs, or if a company or a college has many buildings that could potentially be greened. If the area is not limited than benefits can be optimized by covering as much roof area as possible by investing a given budget in extensive green roofs rather than in intensive ones. The crucial point is that not only ecological benefits like storm water retention and heat island effect mitigation correlate with the area covered by green but also most other benefits like roof life expansion, energy savings, smog and noise reduction, air quality and aesthetics improvement.

Scientific research in the United States is trying hard to prove more benefits of green roofs. For example it is certainly honorable to try to optimize green roofs for air pollution mitigation but the cost benefit ratio of greenroofs will be affected only marginal. Efforts like these become even more questionable if increased construction and maintenance costs associated with optimization are not even being taken into account.

Cost reduction on the other side could be a much more effective way to improve the cost benefit ratio, but costs strongly depend on the market development. Yet I am sure that there is still a very huge potential.

Before we start thinking about cost reduction let me explain first, why the following considerations are mainly based on extensive green roofs.

Modern green roof technology started in the early seventies in Germany when the first complete green roof systems where developed and marketed on a bigger scale. The first approach was to offer reliable technology providing sophisticated irrigation and reliable protection against root ingress for rooftop gardens. The second big step was the development of extensive green roofs in the late eighties. The goal was to create lighter and cheaper systems which could be applied to large scale flat roofs. Main motivation at those times has been recovery of nature and protection of roof membranes from temperature changes and the elements. Ecological benefits like storm water retention and heat island effect mitigation were only a kind of added value which gained importance as extensive green roofs more and more became object to scientific research.

Today more than 80 % of all German green roofs are extensive ones because they have the best cost benefit ratio and most probably the US market will develop in the same direction.

An average extensive green roof in Germany costs approximately 12.00 €/m^2 (1.33 \$/ft^2) not including the waterproofing. This very low price level is the result of a long market development which took more than two decades. The development of the German green roof market was

rather slow, because first of all the necessary know how had to be developed, new systems had to be tested and reliable standards had to established. Certainly not all of these achievements can simply be transferred to North America. Nevertheless there are lessons to be learned which might help to accelerate green roof market development.

Before I take a closer look at green roof prices let me make things comparable first. The 1.33 $/ft^2 range is for eco-roofs in single course construction greened with sedum cuttings. This type of green roof is not very common in the United States and is not applicable in all parts of the country.

My starting point is a typical mid size extensive green roof in the Mid Atlantic region without special features or difficulties. The comparison is an equivalent green roof located in Germany. It consists of a protection fabric with 15 oz/yd^2, a 1 " thick drain plate, a filter fabric with 9 oz/yd^2, 4" growing medium and 1.5 Sedum plugs per square foot.

Let's have look at current prices without getting too sophisticated. I can make my point with rather rough numbers. All prices are in US Dollar based on one square meter.

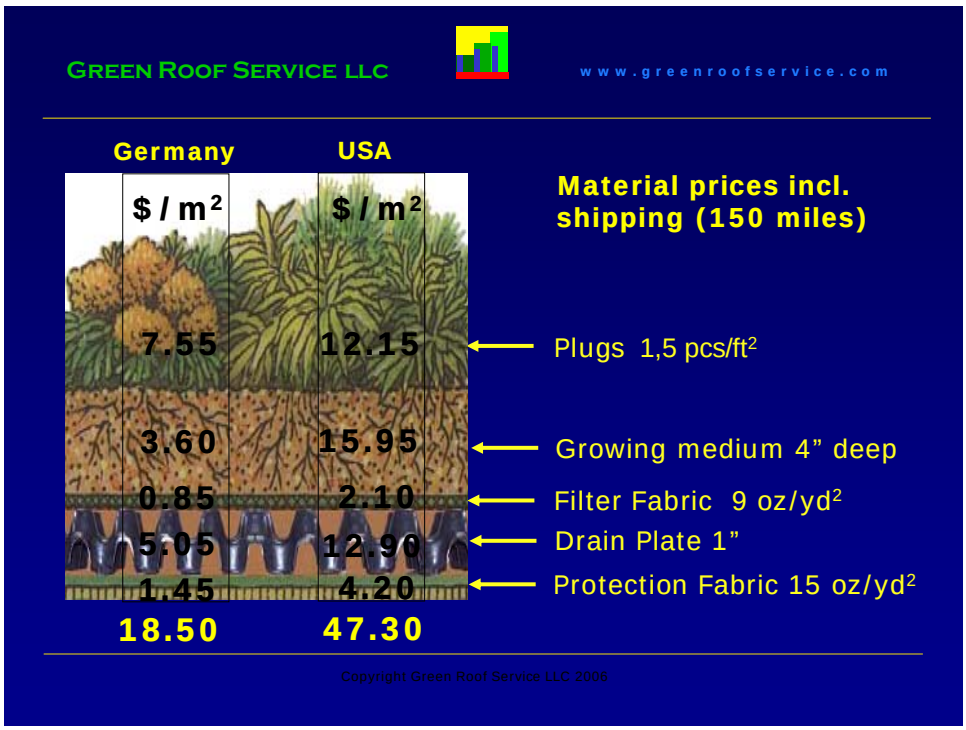

Figure 1: Price comparison for a defined green roof system between Germany and the USA

The comparison shows that all material prices are much higher in the United States. In my opinion the main reasons for these differences are rather small quantities of materials and little competition. As the market grows material demand will get bigger and also the number of suppliers. More competition will minimize margins.

The biggest difference is in media prices. In Germany lower media prices are due to the availability of natural lightweight materials like lava rock and pumice and also of recycled products like crushed bricks. Medium is the only material where transportation distances really matter. Even if the blender is located close to your project, transportation is a crucial factor since most of the components have to be shipped long distance till they reach the blender.

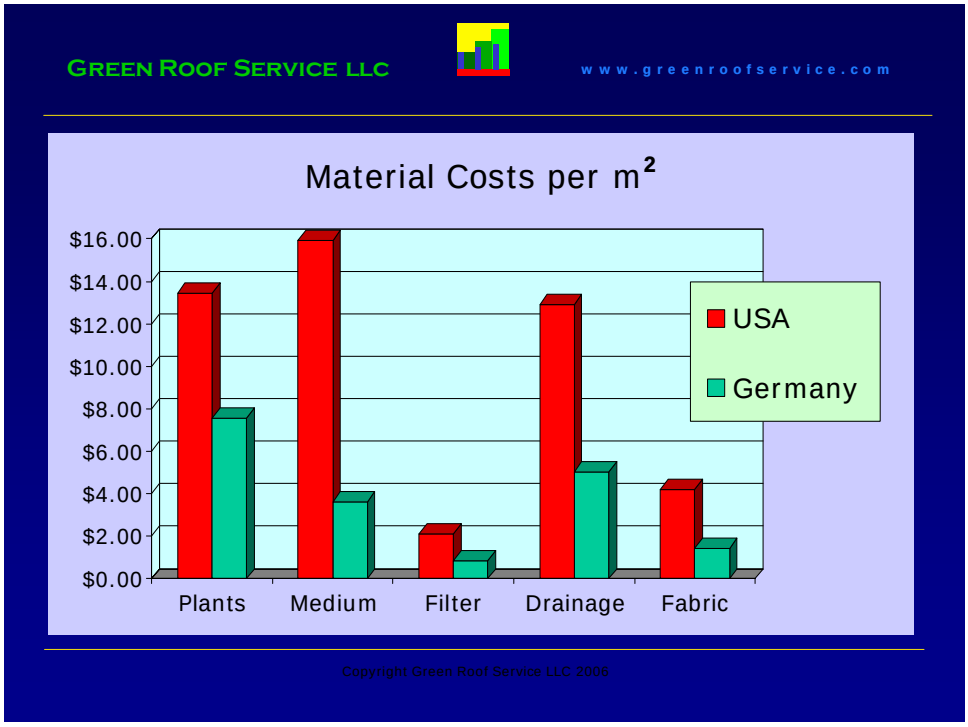

Figure 2: Price comparison for single materials as described in Figure 1

The German green roof market has mainly been driven by system providers like optima, ZinCo, Bauder and others. Establishing complete systems and selling them under a brand name had many positive effects. While green roofs became a standard product which was easy to design and specify, system suppliers got a reasonable share of the market and could invest in research and new products and technologies.

Until now, almost every green roof built in the USA is an individual solution. But custom made solutions are always complicated and costly. They also bear a rather high risk of failure.

Establishing complete systems with a certified quality standard would also make American green roof construction easier, safer and cheaper:

- Easier for architects to design and specify green roofs
- Easier for the contractor to calculate and purchase materials
- Safer for specifiers and contractors, because individual solutions can fail easily
- Cheaper for the client, because standardized materials can be produced and used more efficiently and with less risk

While American Standard Testing Methods (ASTM) regulations in this field are just being developed, existing standards developed in Europe certainly can be used. The goal is to provide a common basis and to avoid failures, as failures could impede further growth to the American green roof market.

The FLL has been working on standards for green roof technology for 25 years. Their 'Guideline for the Planning, Execution and Upkeep of Green-Roof Sites' (1) or in short 'FLL-guideline' reflects the latest developments in German acknowledged state-of-the-art technology. Although the guidelines don't give solutions for all green roof problems they are a basic tool for the construction of reliable and high quality green roofs not only Germany.

The latest edition dating January 2002 has been released in an English version in 2004. From the legal standpoint this German guideline cannot substitute or stop future American standards, but they are a very good source of reliable information which is based on the experience of almost one billion square feet of green roofs built.

Special attention should be paid to the vegetation support course, since the growing media is the main component of every green roof. For any kind of green roof the growing media is the main component. For extensive green roofs in their most simple version the media might even cover more than 95% of all materials necessary.

Growing media are the most important factor for plant growth and the biggest cost factor in green roof construction. Therefore the availability of standardized and certified growing media is an important step to better and cheaper green roofs.

Figure 3: One example of standardization and certification conquering the American Green roof market

The comparison of material costs as shown before with average market prices for the finished green roof uncovers even bigger differences between Germany and the USA. While the price margin in Germany is 62% in the US it is more than tree times higher and reaches 194%. Of course this margin isn't all profit. It covers all additional costs like mark-up, allocated burden, insurance, overhead, labor, tools, machines, vehicles and on-site transportation.

Although it would be interesting to split up all the costs involved and to compare cost factors in detail getting the necessary data would be quite difficult. Companies are not very inclined to open up their calculations. Nevertheless for people being familiar with both markets some differences are very obvious.

First of all the German green roof market is very competitive. Only highly specialized contractors have a chance to get a job. Well-trained teams work very efficiently and cut down installation costs.

Furthermore modern pneumatic conveyance technology as being use in Germany makes a big difference. State of the art blower trucks minimize on-site transportation and installation costs not only for growing media but also for granular drainage materials and even river stone.

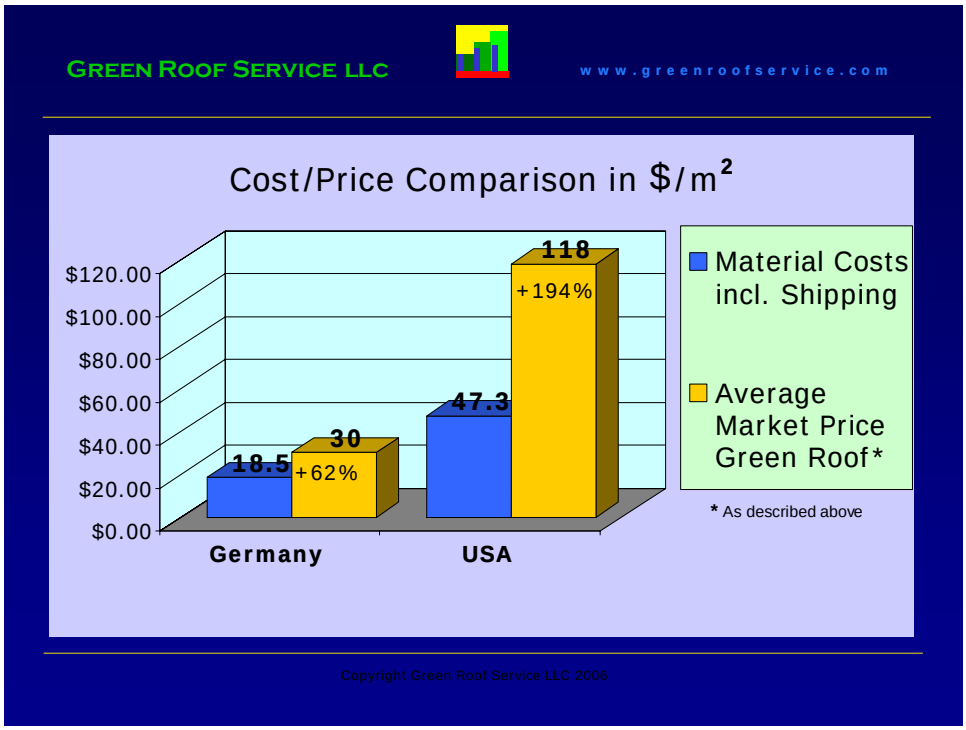

Figure 4: Comparison of average market prices for green roof systems as described in Figure 1

Although this technology is not yet available in the United States, availability is only a question of time. The purchase of foreign conveyors certainly is a big investment but as the market and material volumes grow profitability can almost be guaranteed. Examples from Germany and Switzerland show that specializing in pneumatic conveyance can be a very good business.

There are different types of blower trucks. Silos work as a closed system and have to be refilled at special loading stations. Thus they loose a lot of time on the road running back and forth between the media manufacturer and the job site. Silo trucks are only efficient if they are available in numbers and have to deliver short distance.

The latest development is called speedMaxx. It is an open system with a hopper at the back. One big advantage of this technology is that materials can be delivered to the construction site by conventional tucks. The system can be charged with a loader continuously and materials can be changed any time as the job requires. Another big plus is its unique performance. With an average flow rate of 35 cubic yard per hour it can reach as far as 500 yards and more. This makes it an ideal tool for the greening of big boxes like ware houses and shopping malls. At large scale roof structures conventional transportation devices can only reach a strip along the parameter of the building, while a huge area in the center of the roof has to be served with

wheel borrows. The rubber hose of a modern blower truck however reaches every spot even of large roofs and distributes all kinds of bulk materials exactly and continuously.

Photos 1 - 4: speedMaxx technology in action

The introduction of modern on-site conveyance technology will be a big step for the North American green roof market. It will make green roofs much more affordable and improve their cost benefit ratio dramatically.

Besides the factors I have mentioned there are additional ways of green roof cost reduction. The kind of green roof I choose for comparison of market prices actually is not very common in Germany because 30 $/m^2 (25 €/m^2) is still rather expensive. Most eco-roofs in Germany are build in single course construction, where a special designed growing media eliminates the need for a separate drainage layer and a filter fabric. Planting is replaced by spreading Sedum cuttings or by hydro seeding and at the bottom line costs are less split in half.

This kind of green roof however has less water retention capability because of the diminished organic content and improved drain function. Therefore green roofs in single course construction can only be used in areas with sufficient precipitation. It has not yet been determined which North American markets meet these criteria.

Photo 5: Typical German eco-roof in single course construction

References

(1) Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V., Guideline for the Planning, Execution and Upkeep of Green Roof Sites, Release 2002