

ECO-FRIENDLY HOUSES

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Key words: *ecology, eco-friendly, houses, green construction, alternative energy, energy efficiency, resources, innovations.*

Abstract: *The project purpose is to solve the current problem related with the overpopulation in the biggest cities with polluted air and areas. The project idea is to build modern eco-friendly houses and choose the materials for them which can have a great influence on our future and the future of the planet. The role of green houses in modern construction is crucial and the support for such a construction must be strong by governmental and financial institutions.*

In general, an eco-friendly home is a type of house made of environmentally friendly materials and designed to be sustainable, focusing on the efficient use of various resources: water, energy, raw materials and many others.

1. PROJECT IDEA

The way we build our houses and choose the materials for them can have a great influence on our future and the future of our planet. The role of green houses in modern building is crucial and the process of constructing them must obtain a strong governmental and financial support.

An eco-friendly house is a house that ensures that both the fabric of the building and the family that live there have as minimum negative impact on the environment as possible. This means that a wide number of things need to be taken into consideration such as building materials, energy efficiency, alternative energy and water conservation

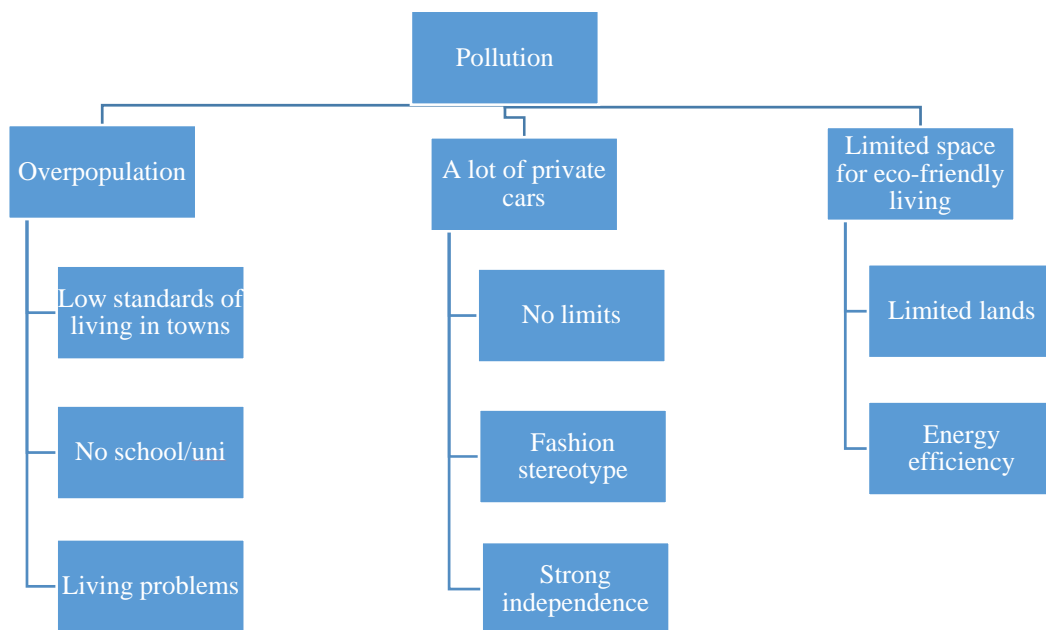
2. DEVELOPING THE IDEA

2.1 Interested parties (stakeholders)

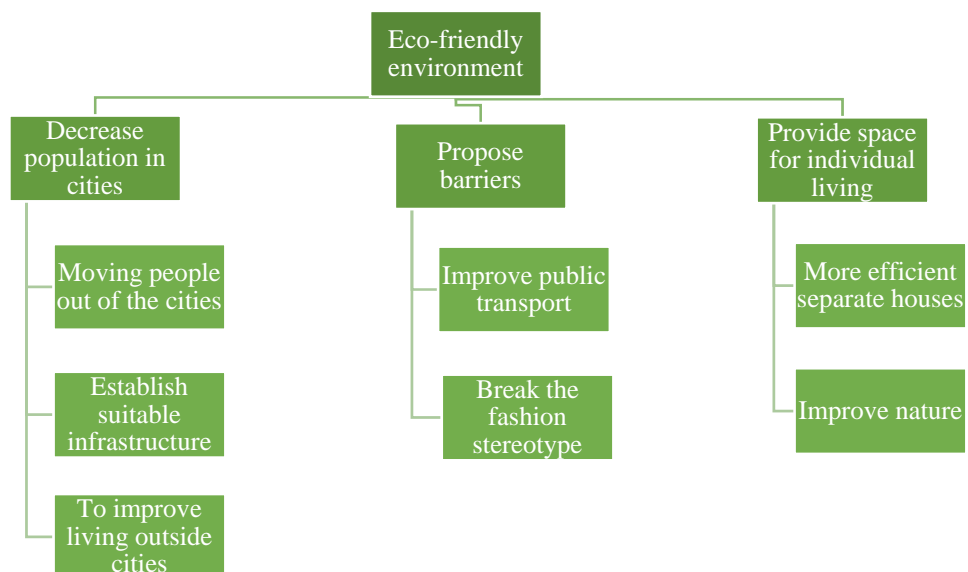
| 1 WHO? | 2 WHY? |
|-------------------------|---|
| Government of a country | To reduce pollution in the cities and make uninhabited areas available for living by increasing the standards of living in areas around big cities and inside villages. To make green living more popular and create healthy and eco-friendly image of a country inside the Europe which could bring additional interest from tourists from abroad. |
| Citizens of a country | An opportunity to live outside the overpopulated cities in environmental friendly places with high level of living standards and good ecology. |

| 1 | 2 |
|--|--|
| EU authorities | The green house concept is very perspective and gives the further generations a chance to live in harmony with their environment and nature by reducing used resources and using alternative energy. |
| Companies which rely on eco-friendly technology and construction companies | An additional market to supply with their products and services |
| Tourists | An opportunity to buy a not expensive house located close to the city in eco-friendly place perfect for kids holidays or peaceful retirement |
| Companies which are operating near area where eco-houses are planned | Businesses are interested in growing population where their shops/markets/services etc are to increase annual turnover. |

2.2 . Problem tree



2.3.Solution tree



3.1 PPR (pre-project research and appraisal)

SWOT-ANALYSIS

| Strengths | Weaknesses |
|--|--|
| <ul style="list-style-type: none"> • Low price of building • High quality of houses • Ecological/environmental friendly • Enough free space (land) • Focus on innovations | <ul style="list-style-type: none"> • Knowledge of customers • “Brand power” (we have no name brand) • History |
| Opportunities | Threats |
| <ul style="list-style-type: none"> • Trend to more flexible houses • Governmental assistance • Sustainable houses • Big demand of houses • Certifications • People look for cheap living solutions • Trend to smaller houses • People value functionally | <ul style="list-style-type: none"> • Real estate crisis • People do not earn enough money to buy their own house • Restrictions from government |

PESTE-ANALYSIS

| PESTE factors | Remarks |
|---------------|---|
| Political | <ul style="list-style-type: none"> • Growing global focus on importance of saving world’s resources. • Recent increase effort to fight corruption in Government will ensure political stability. • Scandals and anti-Russian speech by top political figures in Latvia, also repeated requests to protect country from possible Russian aggression, could scare people from West Europe to buy a house near Russian border. • Same standards for construction and health and safety procedures everywhere around EU zone which makes business less complicated. |
| Economical | <ul style="list-style-type: none"> • Economic-climate currently still suffering after EU crisis, banks may be reluctant to give out loans, people reluctant to buy our houses. • The EU zone crisis may effect trading with other European countries and affect our economy. May affect us if we are importing products or working with clients in countries that are affected. • Sanctions against Russia could make it more difficult and more expensive to import good for our business from there. • Increased pressure from shareholders. |
| Social | <ul style="list-style-type: none"> • Modern society tend to change their lifestyle to more healthier and more friendlier to ecology and it’s environment. • Cities are overpopulated and many people are willing and able to move trying to find a better (and cheaper) way of living. • Number of travellers coming to Latvia has increased in last few years. Tourism travel has been attracted by Latvian ecology, historical monuments and friendly-tourist country’s image. |
| Technological | <ul style="list-style-type: none"> • New technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by: Efficiently using energy, water, and other resources; protecting occupant health and improving employee productivity and reducing waste, pollution and environmental degradation. |
| Environmental | <ul style="list-style-type: none"> • As the effects of climate change are felt across the world and with the construction industry is responsible for as much as 40 percent of man-made carbon emissions, both governments and individuals are beginning to take the task of building eco-friendly houses much more seriously. • Green choices in the building or re-modelling homes in eco-friendly products and methods result in long-term positive effect on the environment. |

3.2 Economic appraisal – gross estimates

Our eco-friendly house is 197 foot square or 60 meters square (m2).

MAIN MATERIAL - TIMBER

We have reused sound timber to be used for the new timber frame construction and ceiling cladding. The wood is unseasoned which avoids the huge energy use and allows work to be done with traditional tools.

THE ROOF

The roof is designed to use solar energy to heat the house. It also acts to reduce heat loss. The roof floor has dark coloured tiles to absorb sunlight. Underneath the roof there is a 200mm concrete slab to store heat, which is insulated from the ground by 50mm of Dow Floormate. The floor keeps the conservatory frost free throughout the winter with no extra heating.

During the summer it can provide cooling through natural ventilation. The roof has openable window at the top. During the summer when the house needs cooling, hot air in the conservatory rises out through this window bringing cool air through the house.

WALLS

Clay board - Building boards bringing the advantages of clay to dry wall construction.

GENERAL

Clay is one of the earliest used basic building materials and now it is available in board form - making it a thoroughly modern and convenient building material with outstanding natural properties. It is especially suitable for high comfort, low energy buildings.

Claytec clay board, which is manufactured in Germany, is a combination of clay, reed and hessian. Clay boards are heavier and thicker than gypsum plasterboards and have outstanding thermal and vapour diffusion properties. The boards can regulate temperature, are able to absorb moisture, and at other times, gently give it off again.

Clay also absorbs odours and is an effective sound insulator.

Claytec finishing plaster or Tierrafi no are recommended for giving the clay board a skim coat finish.

Claytec products, which include plasters, unfired clay bricks and mortars, embody experience gained from over 15 years of working with clay on a commercial scale. They are high quality products widely used all over the continent.

ADVANTAGES

- Clay boards are 100% natural
- Once coated with a clay skim finish the surface can take picture hooks, wallpaper and paints
- Clay surfaces absorb and diffuse water vapour
- Clay absorbs odours and is exceptionally good for reducing noise level
- Clay surfaces are cool in summer, warm in winter

FLOOR

Solid Timber floors are natural, optionally pre-finished floors available in various species and grades suitable for people with allergies to dust and synthetic chemicals.

Advantages:

- Timber from renewable and sustainable resources

- 100% recyclable

Installation & disposal

- No health risks for workforce or installers
- Durable and low maintenance
- Biodegradable

Performance

- High aesthetic value
- Good thermal properties
- Good acoustic properties
- Hygroscopic
- Absorbs VOCs and toxins



INSULATION

MultiPlex boards are 22mm thick tongue and grooved rigid insulation boards. They protect the building envelope from wind and rain and they also provide an additional layer of insulation which prevents cold-bridging across the timbers.

Composition & Manufacture

- Manufactured from renewable resources
- Manufactured from by-products
- Bitumen-free
- CO2 zero-rated
- Timber fuelled embodied energy
- Actively recycled



Installation & Disposal

- No known health risks for workforce or installers
- Easily cut to shape with handsaw
- Durable / Low maintenance
- Reusable / Recyclable
- Compostable

ACOUSTIC INSULATION

Rubber impact sound insulation matting.

GENERAL

Regupol[®] is a tough, resilient sound insulation material used for underfloor impact sound reduction on all types of subfloors. It is suitable for all floor finishes including ceramic tiles, wood and laminates, carpet and linoleum, sheet vinyl and vinyl tiles, and between structural floor elements. Regupol[®] can be used to reduce noise on stairs (4.5mm depth recommended). It can be used with underfloor heating.

Regupol[®] provides 25% reduction of surface sounds between 500 and 2.000 Hz. It is easy to install – simply bond to the subfloor beneath the final floor finish. It is temperature



resistant from - 40 °C to +110°C.

Regupol[®] CR4515 is suitable for all floor finishes including ceramic tiles, solid timber and laminate finishes, carpet, linoleum and vinyl.

Regupol[®] CR4515 is made from a cork and polyurethane foam mix, and supplied in 1m wide rolls of 3mm and 4.5mm thickness.

ECOWATER SYSTEM

Very few people in the world would consider safe, clean drinking water to be a luxury item. But as the world population increases, and as the effects of global warming take hold, the abundance of this necessity is slowly coming under threat.

Conserving water in the home can go a long way to combating this threat. By using rainwater to do the laundry, flush the toilet and water the garden, the average household can cut its water consumption by 50%, with clean water reserved for drinking and bathing. **Rain-water harvesting system** will therefore save you money as well as help the environment.

The general concept behind domestic rain-water harvesting systems is fairly simple. Downpipes collect rainwater from the roof and filter it into a storage tank, removing leaves and other debris. A calmed inlet allows the water to enter the tank with minimal disturbance. The water can then be pumped, on demand, from the tank to toilet cisterns, washing machines and so on when needed. Most systems have safeguards in place, both for when rainwater is heavy and when it is scarce.

The underground tank is made of polyethylene and is heavily ribbed to ensure robustness. Three capacities are available: 3,300 litres, 4,700 litres and 6,500 litres.

Within the tank is a two-step, cross-flow, self-cleaning filter which captures almost 100% of the rainwater while leading any other materials, both large and fine, to the sewer. Its neat placement within the tank means that maintenance access will not be obstructed.

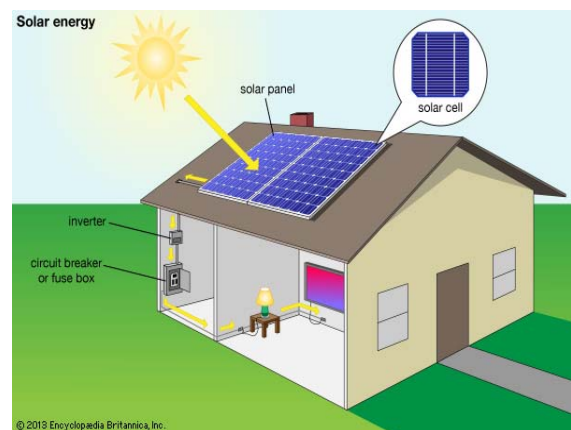


SOLAR POWERED HOME

Powering your home using solar energy does require more maintenance than using the regular old grid power. But not much.

Solar panels have no moving parts. They are part of a completely stationary system. So once they're installed, there's not a whole lot that can go wrong. Pretty much the only thing a homeowner needs to do is keep the panels clean. It's an important task, though -- too much dust and bird droppings on the panels can reduce the amount of sunlight striking them. Dust buildup can reduce the amount of electricity produced by the system by as much as 7 percent.

This type of maintenance is not something that needs to be done once a week, though. You'd probably only have to hose the panels down anywhere from one to four times a year. You don't need to get on the roof. A hose and nozzle from ground level works fine. If there's



construction in your area, you may have to clean the panels more often to avoid the extra build-up of construction-dust residue.

Aside from that, you're just looking at occasional check-ups to make sure all parts are in working order. You may eventually have to have the inverter replaced (and the batteries if you have a battery-storage system), but that's a once-a-decade type of maintenance event.

In the last 10 years, homes with rooftop solar arrays have gone from curiosity to commonplace. It's a trend perhaps best exemplified by Home Depot's decision to start stocking solar panels in 2001.

The technology has been available for decades -- NASA has been using solar-powered satellites since the 1960s, and as far back as World War II, passive solar heating systems (which turn solar energy into heat instead of electricity) have been used in U.S. homes.

Getting active solar systems in the mainstream residential market has proved a challenge, though. Active solar power uses arrays of photovoltaic cells to convert sunlight directly into electricity, and it has traditionally been a prohibitively expensive technology.

The benefits of residential solar power are obvious: Energy from the sun is endless (at least for the next 5 billion years, give or take); it provides clean energy with no greenhouse-gas emissions; and it can save people money on their electric bills. But there are factors to consider when deciding whether solar power would be a good choice for you -- and cost is only one of them.

In 1956, solar panels ran about \$300 per watt. A 7.5-kW system would have been out of the question for all but the shockingly rich. Today, prices are down considerably. In most areas, solar arrays run about \$2,6 per watt.

According to data and prices we have done some calculations about solar system cost in our eco-friendly house:

Our eco-friendly house is 197 foot square or 60 meters square (m²).

According to statistics agency LAGUNA data we find out that:

- 0,23 kWh we use per foot per month
- 0,23 x 197 = 45,31 kWh per month in our eco-house
- 45,31 x 12 = 543,72 kWh per year
- 543,72 / 365 = 1,49 kWh per day

One solar panel produces 0,12 kWh per day. So we need:

- 1,49 / 0,12 = 12,41 ~ 13 panels.
- One panel's size is 142cm X 64cm = 9088 cm².
- 13 panel's size is 118144 cm² and it is 11,8 m² ~ 12 m²

How much it will cost?

- 1,49 kWh = 1490w.

As we know we buy solar panel approx. \$2,6 per watt.

- 1490 x 2,6 = \$387 = **3562 EUR.**

3.3 EVALUATING THE TOTAL COST OF ONE HOUSE

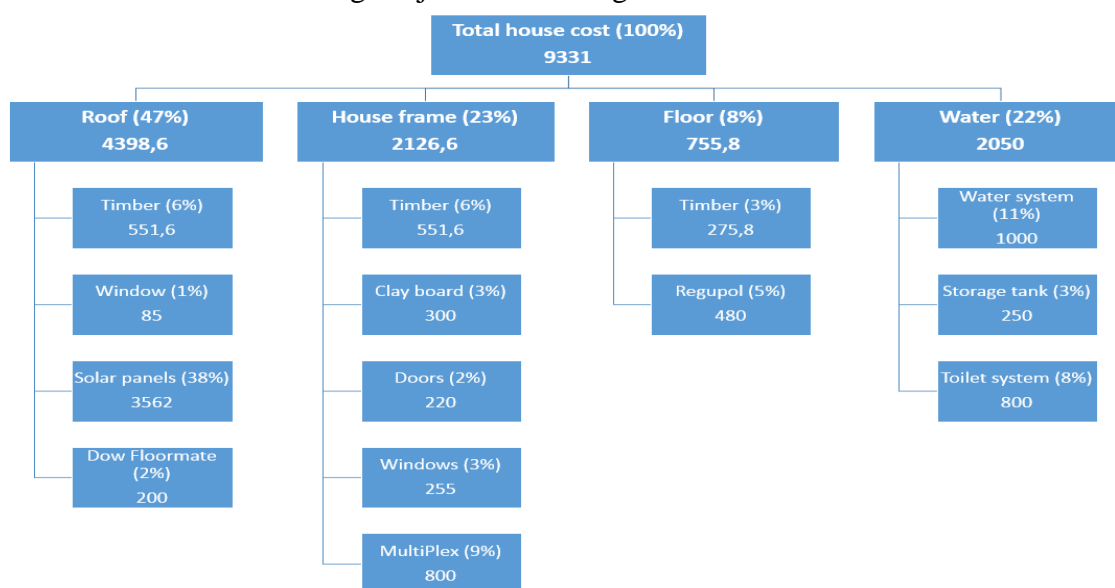
Our eco-friendly house is 197 foot square or 60 meters square (m²).

| MATERIAL | UNIT | COST per UNIT, € | QUANTITY REQ. | FULL COST, € |
|---|-----------------------|------------------|---------------|--------------|
| Timber | Sq foot | 7 | 197 | 1379 |
| Dow Floormate 50mm (100mm x 600mm x 2500mm) | Pack (incl. 4 Boards) | 100 | 2 | 200 |
| Clay Board(25mm x 625mm x 1500mm) | Board | 30 | 10 | 300 |

| | | | | |
|---|-------|------|----|-------------|
| MultiPlex boards 22mm(2500mm x 600mm x 22mm) | Sheet | 20 | 40 | 800 |
| RegupolCR4515 | Item | 12 | 40 | 480 |
| Windows (double glazed) | Item | 85 | 4 | 340 |
| Timber door external | Item | 80 | 2 | 160 |
| Timber door internal | Item | 60 | 1 | 60 |
| Ecowater system | Item | 1000 | 1 | 1000 |
| Water storage tank (3785 litres) | Item | 250 | 1 | 250 |
| Solar panel | Panel | 274 | 13 | 3562 |
| Centrex 2000 El. Waterless High Capacity Central Composting Toilet System | Item | 800 | 1 | 800 |
| All crucial materials in TOTAL | - | - | - | 9331 |

Work Breakdown Structure

Apportionment Method of Allocating Project Costs Using the Work Breakdown Structure.



3.4 Critical Path Method (CPM)

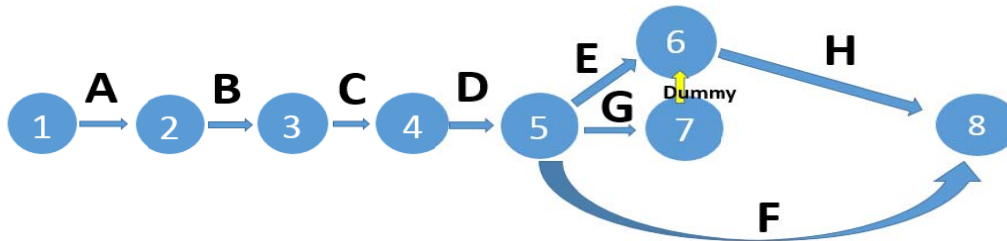
The Critical Path Method (CPM) is a technique for doing project planning. CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities.

List of activities

| Activity | Description of activity | Required Predecessor | Normal time, days | Normal cost, € | Crash time, days | Crash cost, € |
|----------|--|----------------------|-------------------|----------------|------------------|---------------|
| A | Project document preparation | (None) | 2 | 100 | 1 | 200 |
| B | Organisation of tender | A | 14 | 200 | 10 | 400 |
| C | Selection of tender's winner | B | 2 | 50 | 1 | 100 |
| D | Signing the contract | C | 1 | 50 | 0,5 | 200 |
| E | Construction | D | 30 | 12000 | 20 | 20000 |
| F | Eco-houses marketing | D | 30 | 10000 | 20 | 12000 |
| G | Monitoring of the construction process | D | 30 | 1000 | 20 | 5000 |
| H | Audit, final project report, ready to sell | G, E | 2 | 200 | 1 | 500 |

Diagram

A network diagram of the project that shows which activities follow which other ones. An AOA diagram has numbered "nodes" that represent stages of project completion.



Current spreadsheet before using solver:

(Project cost: 23600, Project time: 51 days)

After analysing project duration in days and it's cost, we got following results:

| Days | Project Cost |
|------|--------------|
| 51 | 23600 |
| 50 | 23650 |
| 49 | 23700 |
| 48 | 23750 |
| 47 | 23800 |
| 46 | 23850 |
| 45 | 23950 |
| 44 | 24250 |
| 43 | 25000 |
| 42 | 26300 |
| 41 | 27700 |
| 40 | 29100 |

The optimal parameters are: 51 day – 23600 €. However, there is still a possibility to speed up project by few days (up to 6) if it's necessary with no huge lost in budget.

3.5 BUDGET ABOUT RESOURCE DISTRIBUTION

Types of costs

- Direct Costs - Costs that are clearly chargeable to a specific work package: labor, materials, equipment, and other
- Direct (Project) Overhead Costs - Costs incurred that are directly tied to an identifiable project deliverable or work package: salary, rents, supplies, specialized machinery
- General and Administrative Overhead Costs - Organization costs indirectly linked to a specific package that are apportioned to the project

Total Bid Summary Cost

| | |
|--------------------|---------------------|
| Direct costs | 46655 EUR |
| Direct overhead | 23600 EUR |
| G&A overhead (20%) | 14051 EUR |
| Profit (20%) | 16861,2 EUR |
| TOTAL bid | 101167,2 EUR |

| A | B | C | D | E | F | G | H | I | J | K |
|---------------------------------------|-----------------------|------------------|----------------|----------------|----------------|--|-------------------|----------------|-------|---|
| DIRECT COST | | | | | | Direct (Project) Overhead Costs | | | | |
| MATERIAL | UNIT | COST per UNIT, € | QUANTIT Y REQ. | FULL COST, EUR | FULL COST, EUR | Description of activity | Normal time, days | Normal cost, € | | |
| Timber | Sq foot | 7 | 197 | 1379 | 6895 | Project document preparation | 2 | 100 | | |
| Dow Floormate | Pack (incl. 4 Boards) | 100 | 2 | 200 | 1000 | Organisation of tender | 14 | 200 | | |
| Clay Board | Board | 30 | 10 | 300 | 1500 | Selection of tender's winner | 2 | 50 | | |
| MultiPlex boards | Sheet | 20 | 40 | 800 | 4000 | Signing the contract | 1 | 50 | | |
| Regupol CR4515 | Item | 12 | 40 | 480 | 2400 | Construction | 30 | 12000 | | |
| Windows | Item | 85 | 4 | 340 | 1700 | Eco-houses marketing | 30 | 10000 | | |
| Timber door external | Item | 80 | 2 | 160 | 800 | Monitoring of the construction process | 30 | 1000 | | |
| Timber door internal | Item | 60 | 1 | 60 | 300 | Audit, final project report, ready to sell | 2 | 200 | | |
| Ecowater system | Item | 1000 | 1 | 1000 | 5000 | TOTAL | | | 23600 | |
| Water storage tank | Item | 250 | 1 | 250 | 1250 | | | | | |
| Solar panel | Panel | 274 | 13 | 3562 | 17810 | | | | | |
| Toilet System | Item | 800 | 1 | 800 | 4000 | | | | | |
| All crucial materials in TOTAL | - | - | - | 9331 | 46655 | | | | | |

Our project consists of building five eco-environmental houses during 51 days. According to our calculations we will have profit **16861.20 EUR** per five eco-houses or **3372.24 EUR** per each house.

4.0 GREEN LIFESTYLE

As international concerns over climate change grow, the number of eco-friendly homes is increasing. Eco-friendly homes have now become more than just a trend. In the future, eco-friendly homes are likely to be essential, as more and more people strive to protect the environment. More environmentally friendly methods are being incorporated into the design of homes, with designers using sustainable materials. Many homeowners are also taking steps to transform their home into an eco-friendly environment. Eco-friendly homes are becoming more popular, as more homeowners begin to understand the importance of them. These types of homes not only help the environment but also enable you to save money. Many homeowners are now making changes to their home, such as using low-energy light bulbs, in order to lower their bills and make their home more energy efficient.

Eco-friendly homes are not only better for the environment but also provide a healthier living environment for the homeowner. The materials used to construct an eco-friendly home are recycled and are less likely to emit any harmful gases or chemicals. An eco-friendly home is also less likely to experience problems that a regular home often experiences, such as damp or mold. This is due to an eco-friendly home containing more green materials and making better use of sunlight and water.

An eco-friendly home enables you to cut down on spending due to it being far more energy efficient. In addition to low-energy light bulbs, other energy-saving methods are being introduced. Solar panels are becoming a popular choice for homeowners, as they enable you to lower your energy bills. An eco-friendly home will also require less money to be spent on maintaining it thanks to the durable materials used in its construction.

The increase in popularity of eco-friendly homes highlights their importance for the future. More and more homeowners are now choosing to focus on how eco-friendly a home is rather than just its overall appearance. An eco-friendly home has much more to offer and with

more people taking an interest in green living, ever increasing numbers of sustainable buildings are likely to be created in the future.

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ИЗГРАЖДАНЕ НА ЕКОЛОГОСЪОБРАЗНИ ДОМОВЕ

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***Ключови думи:** екология, екологосъобразен, зелени конструкции, алтернативни източници на енергия, енергийна ефективност, иновации.*

***Резюме:** Основната цел на проекта е да се реши нарастващата проблем с пренаселването на големите градове. Идеята е да се изградят съвременни екологосъобразни домове, които да подобрят живота на нашата планета в бъдеще. Ролята на „зелените“ домове в съвременното строителство е изключително важна и поради тази причина трябва да се вземе под внимание от правителствените и финансови институции.*

По същество, екологосъобразните домове представляват сгради, които са изградени от екологични материали, устойчиви са и са насочени към ефективното използване на ресурсите: водни, енергийни и др.