

**ODOO**  
PROJECT



# **SUSTAINABILITY BRIEF REPORT**

Budapest University of  
Technology and Economics

Decathletes

Áts-Leskó Zsuzsanna  
Dudás Kata

## INTRO

*Key features: environmental responsibility, social awareness, economic profitability*

Odoos was created by us, students, based on consultations with professors, companies and studying former SDE competition project manuals. It was both exciting and edifying for us to harmonise the demands of the various fields of expertise and the competition's 10 contests. The adaptation of sustainable technologies is still in its infancy in our country but we realized from the beginning that none of the contests can be accomplished without applying the principles of sustainability. During the consultations with companies we have learned a lot about actual innovations and ecological, environmental friendly technologies. We had the chance to get to know developments that we also would have happily built into our apartment. However, it was often a hard decision to choose the optimal solution from so many possibilities; during this we always preferred the potential sustainable technologies of the future. Two years ago when designing the architectural concept we decided to build Odoos to be the ICON of sustainable architecture.

## NEW WAY OF LIFE

*By spending more time outdoors we have a closer connection to our environment – sustainability means nothing else but living in harmony with nature.*

We believe that sustainability is not just an issue of technology. Without changing our expectations, consumption patterns and lifestyle it is impossible to live in a sustainable way. Our goal was to design a house where we can spend 50% of our time in the exterior and 50% in the interior. If we spend less time indoors we have to build less conditioned spaces saving lot of building material and energy used for assembly and operation. Designing flexible spaces makes it possible for the building to adopt different functions in the future ensuring a longer life-span. In the Odoos the residents live inside during the winter and basically outside on the terrace during summertime.



Winter

Spring/Autumn

Summer

The lighting, HVAC system, functionality was optimized for the use of the interior in winter and basically for the terrace in summer.

## NATURAL AND ARTIFICIAL IN BALANCE

The conditioned indoor space is separated from the outdoor living space with the southern glazed façade. Thanks to this the natural lighting of Odoos is eligible the whole year. Even when the sun shines in a low angle the summer wall does not overshadow the terrace. For sake of the efficient inner and outer heat protection there are horizontal and automatized vertical shadings, which made of special material. The interior gets optimal amount of light every day. The integrated LEDs in the suspended ceiling complete the natural lighting perfectly. With the building automation system and the dimming we use just as much artificial lights as we need.

## DYNAMIC STORAGE

*By duplicating the south façade our goal was to utilize completely the solar energy both active and passive ways.*

We kept the principles of passive design in mind by maximizing the energy gain and minimizing the energy loss to create a compact, well-insulated, air-tight, energy efficient building envelope, using proper shading and thermal mass. The existence of the thermal mass is always a critical point even when in case of a light-weight construction. We balance the missing statically mass by using a dynamic system.

By circulating  $3\text{m}^3$  water we achieve an „artificial increase of mass” of the building. Water is eco material, cheap and has a large heat capacity; it can be accessed anywhere, doesn't have to be transported to large distances and does not pollute the environment. The dynamic thermal mass of the floor can not only store the heat but transfer the heat there and back as well. Only one pump is needed to circulate the water.

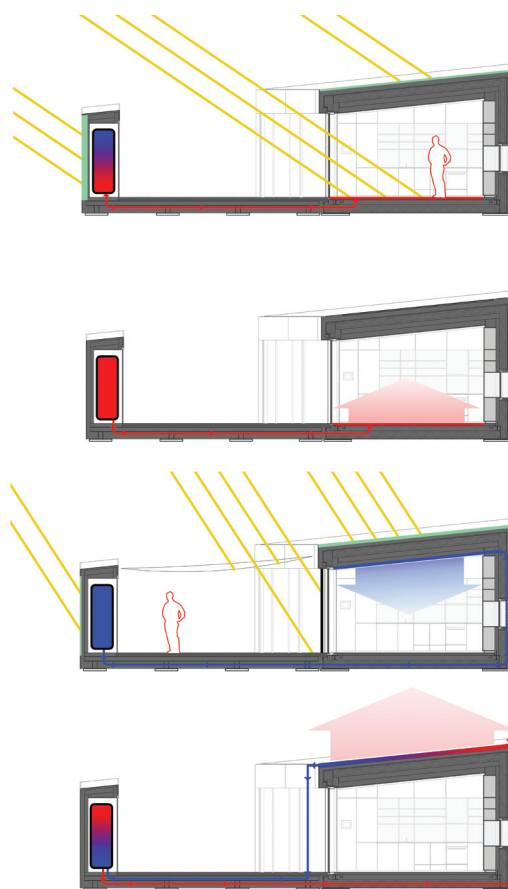
In winter, we let the sun directly in to the building through the southern glazed façade. We utilize this thermal energy gain with a dynamic thermal storage – water circulation piping system integrated into the floor and the suspended ceiling – in case of heating demand, we can recirculate the heat stored at night.

In summer or when the weather is hot we can dispatch the excess heat load from the rooms with the help of water. During the daytime cold water is circulated in the piping – integrated into the suspended ceiling – that we cool down during the night by spreading on the cold surface of the PVs.

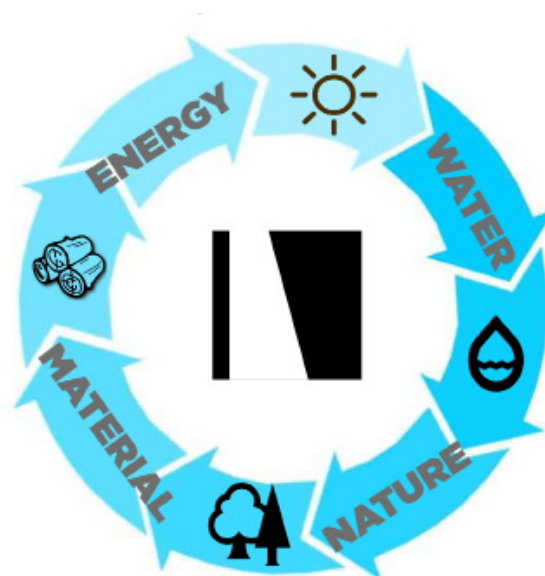
## EVERYTHING WE DO AFFECTS THE ENVIRONMENT AROUND US

*When we are cold, we have to put on winter clothes – and at this point building are not exceptions. Let's dress Odoo with a coat, and pull the zip up to the collar!*

We certainly need energy to produce the materials of the building, however, the amount used is considerably less than a well-insulated, energy efficient building can save. Our goal was to use building products which contain the least energy and carbon possible. We preferred local products even if our main priority was less embodied energy and higher energy efficiency. We chose durable, long lasting materials, since the Odoo will frequently be disassembled and assembled and will be visited by thousands of people.



Odoo semi-passive system-e:  
Winter day, Winter night, Summer  
day and Summer night



## INTEGRATED ENVELOPE

We designed the entire house, the façades and the roof as well, to be a one single envelope. The PV is suitable to integrate into the air ventilated façade cladding's mounting system aesthetic and efficient way. The air ventilating behind the envelope cools down the cladding that was heated by the sun and the photovoltaic panels. It increases the performance of the PVs and gives a passive overheating protection to the thermal envelope of the building.

## ODOO AND WOOD

*We are returning to the only building material that uses the sun's energy to renew itself in a continuous sustainable cycle – wood.*

The Odoos, the house and the summer wall's constructions and furniture were made of solid wood and the loadbearing structure of glued laminated timber panels. Wood clearly makes the grade as the green building material of choice - by sustainable forestry - that is guaranteed by FSC and PEFC qualifications of our products. We choose cellulose from recycled paper as the thermal insulating material of our house because it has an excellent thermal and sound insulating capacity. Cellulose contains low embodied energy and with recycling we can reduce the paper waste in the country.

## SOLAR ELECTRICITY

*The inexhaustible, renewable energy sources provide us clean energy years after their return.*

Our major concept was that the highest rate of the produced energy should be consumed at the place of the production and the energy acquainted from the network should be minimal. We can achieve this by having more balanced energy production of our photovoltaic system throughout the day/year. This is why Odoos' PV system is based on two separately operating subsystems. The larger producing capacity is provided by 28 pieces of noncrystalline solar cells placed on the roof and 14 pieces thin layer solar cells on the summer wall.

The thin layer solar cells produce energy the most efficient way in the morning and early evening hours and in wintertime too, thus we can reduce the energy amount received from the electrical grid. Thin layers are the least sensitive to shady conditions and high temperature; they react better to diffused/reflected light than other solar cells. They are not covered with snow in the winter; furthermore, the light reflected from the snow enhances the system's capacity.

For the most efficient local utilization of energy we sought for a system to be capable of receiving state-of-the-art technologies related to controlled energy storage and intelligent operating of consumers and in long term to be suitable for interacting the IT system of the system controller. The developments demonstrated hereinafter aim for creating a building meeting both sustainability and industrialization requirements in the future. The developments are certainly about to continue without the frame of the competition.

The system usage purpose is to act preventively as a function of its own actual state, previous measurement results and the prognosticated weather and energy prices. Developing the optimal model is virtually a mini-mum seeking problem and for the solution the cost function of each event must be defined first. For simulating the events a proper model was deployed in MATLAB environment. It will be capable for matching different energy price models and charging/discharging algorithms for specific systems too.

With our system it can be more easily assigned that how much CO<sub>2</sub> consumption is saved up momentarily by producing 1 kWh electrical energy (e.g. the night charging of the electrical car can be performed by the energy of non-adjustable nuclear power plants so CO<sub>2</sub> consumption really can be minimized).

## HVAC SYSTEM

*Energy saving is the most effective and the cheapest solution to reduce pollution.*

Our goal was to choose machines that are able to create and sustain the comfort conditions both during the sizzling hot Madrid summer and the cold Budapest winter days but otherwise they should not have larger capacity than actually demanded.

We have chosen the most energy efficient HVAC systems, home appliances and lighting solutions.

Thanks to the modular switching, the machines are variable and can be replaced part by part. Their operation is optimized by the building automation system. It only operates the equipment that is the most necessary thus it reflects the life-rhythm of the resident.

By using air-to-air and air-to-water mode the heat pump is capable of heating the living space - working as a heat source of the surface heating & cooling and the ventilation system. The heat pump can help, if it is necessary, the passive water cooling system.

In wintertime, the extracted air is preheated by the air of tempered indoor space and the warm mechanical room. In summer the fresh air extracted from outside is precooled by the air coming from the tempered indoor space.

There was a direct evaporating cooling unit built into the air handling unit so this way we don't need extra heat exchanger to use the heat extracted from the heat pump; thus the efficiency of the process does not decline. The recirculating chamber is responsible for setting the proportion of fresh and recirculated air. Dust and other solid pollutants are isolated by incorporated F5 category panel filters.

We strive for minimizing the amount of domestic water by using rainwater stored in a tank. Rainwater can be utilized extensively for example for washing, flushing toilet, cleaning and watering. The house's passive heating system is also based on rainwater.

## LET'S SPEAK ABOUT...

Popularizing sustainability constantly and expansively is an extremely important task for our Project. Our general experience - gained at conferences and exhibitions while promoting Odoo - shows that the wide audience is still poorly informed about the possibilities of sustainable technologies. There are several sources on the Internet, accessible in Hungarian as well, that offer 'green technologies' that only seems to be green or they are completely meaningless (e.g.: 'Let's turn off the light').

Therefore, we concluded that it would be useful to organize and create a knowledge database in the field of architecture, structure and building services engineering that provides a high standard source of information about sustainable, environmental friendly lifestyle and sustainable building practice.

We have been to several exhibitions and conferences where we presented the features of the production technology, the material and the building services system that we built into Odoo. We initiated the questions of sustainability related to Odoo, the sustainable approach and way of life. We have put some of them on our Blog as well as tasters. We also started a homepage, eco-friends (<http://ecofriends.zrn.hu/>), that deals with questions of general environmental protection.

