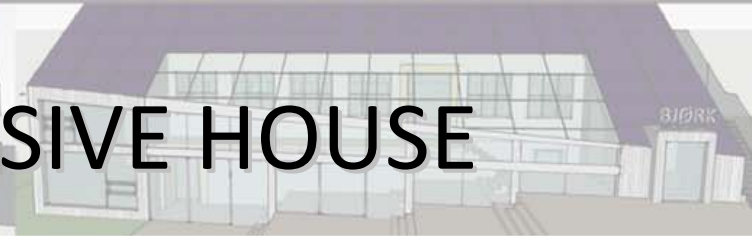
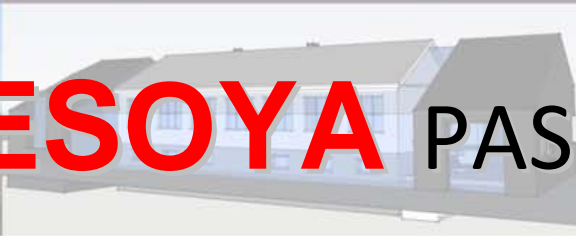


# LINESOYA PASSIVE HOUSE

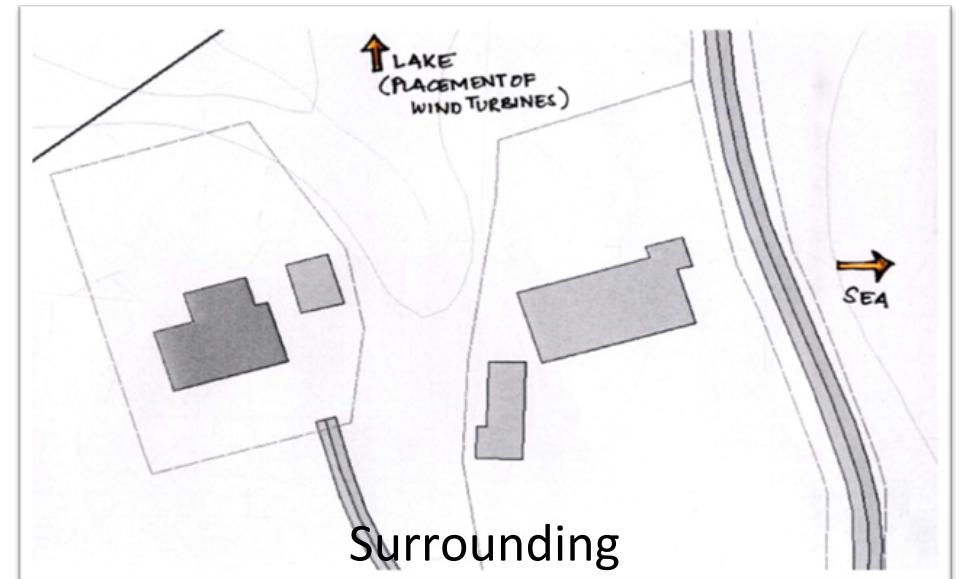
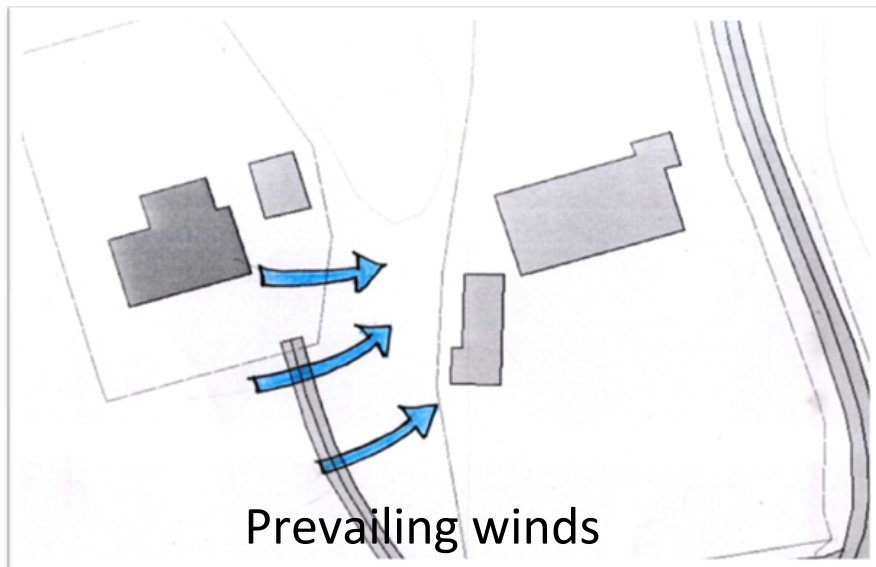
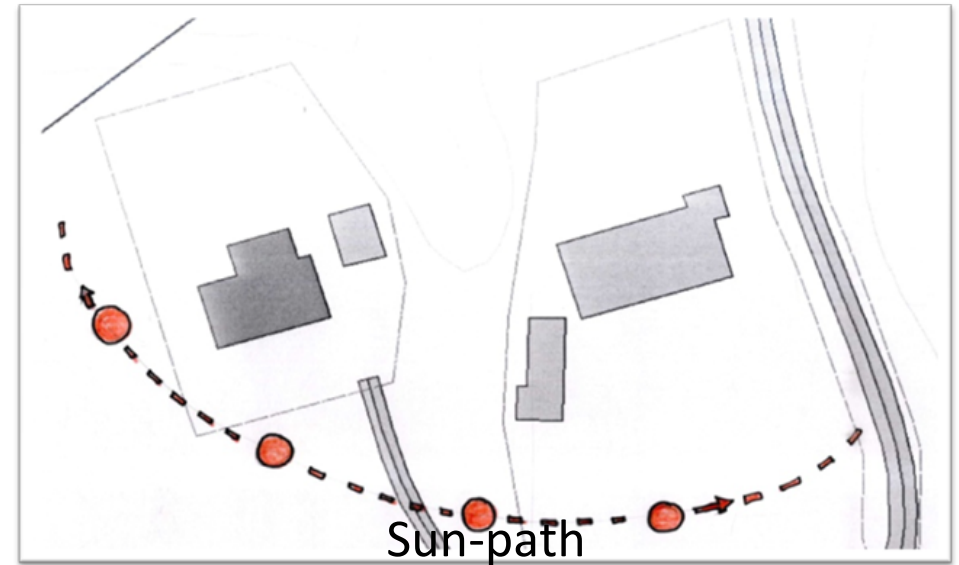
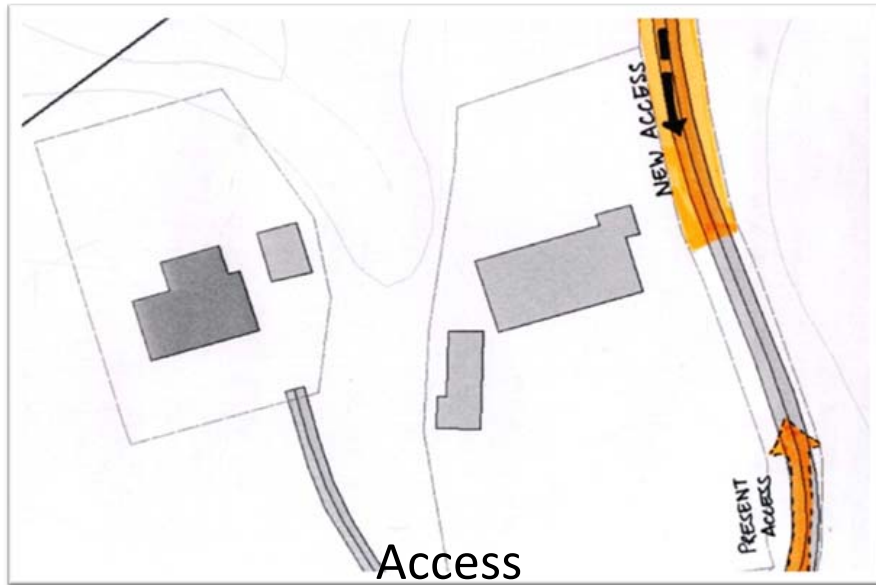


**Group 4**

Lin Du,  
Arjun Basnet,  
Tina Viklund

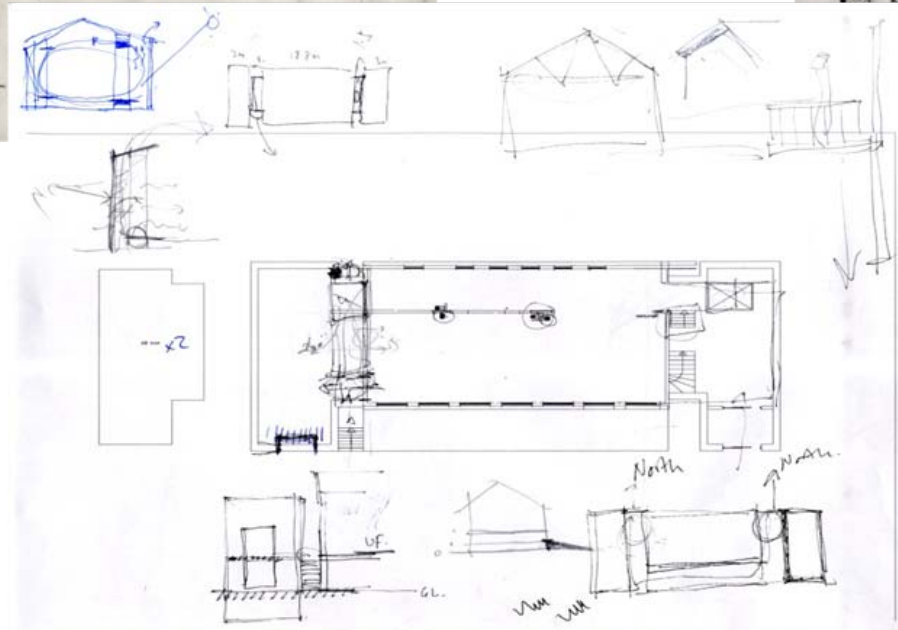
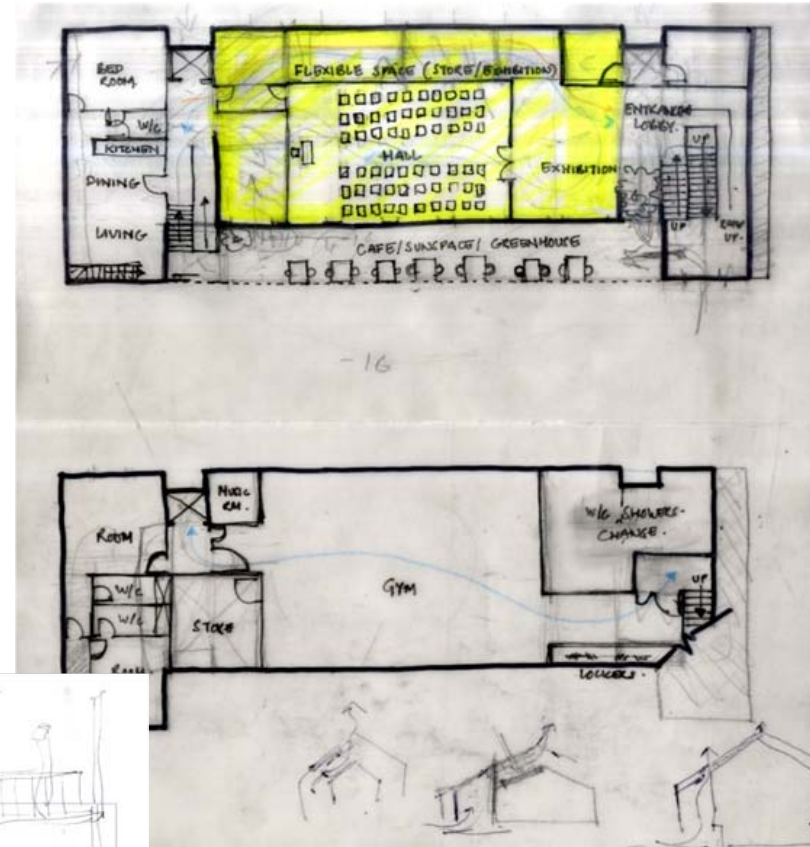
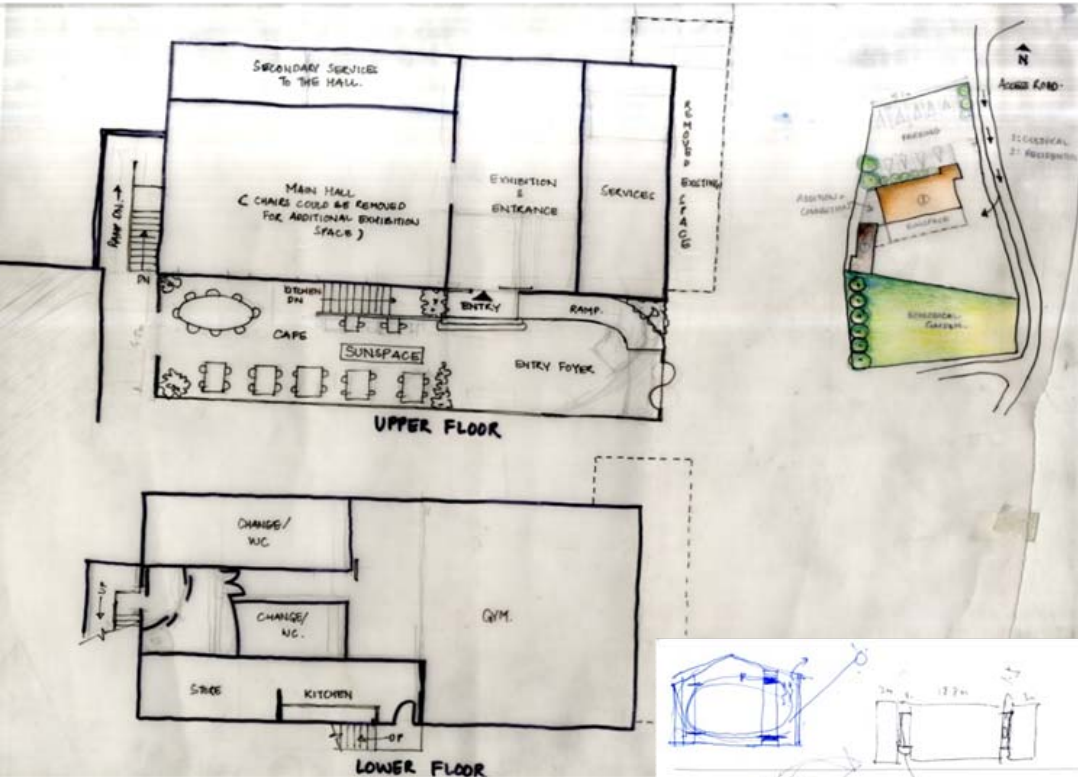
# LINESOYA PASSIVE HOUSE

## Site study



# LINESOYA PASSIVE HOUSE

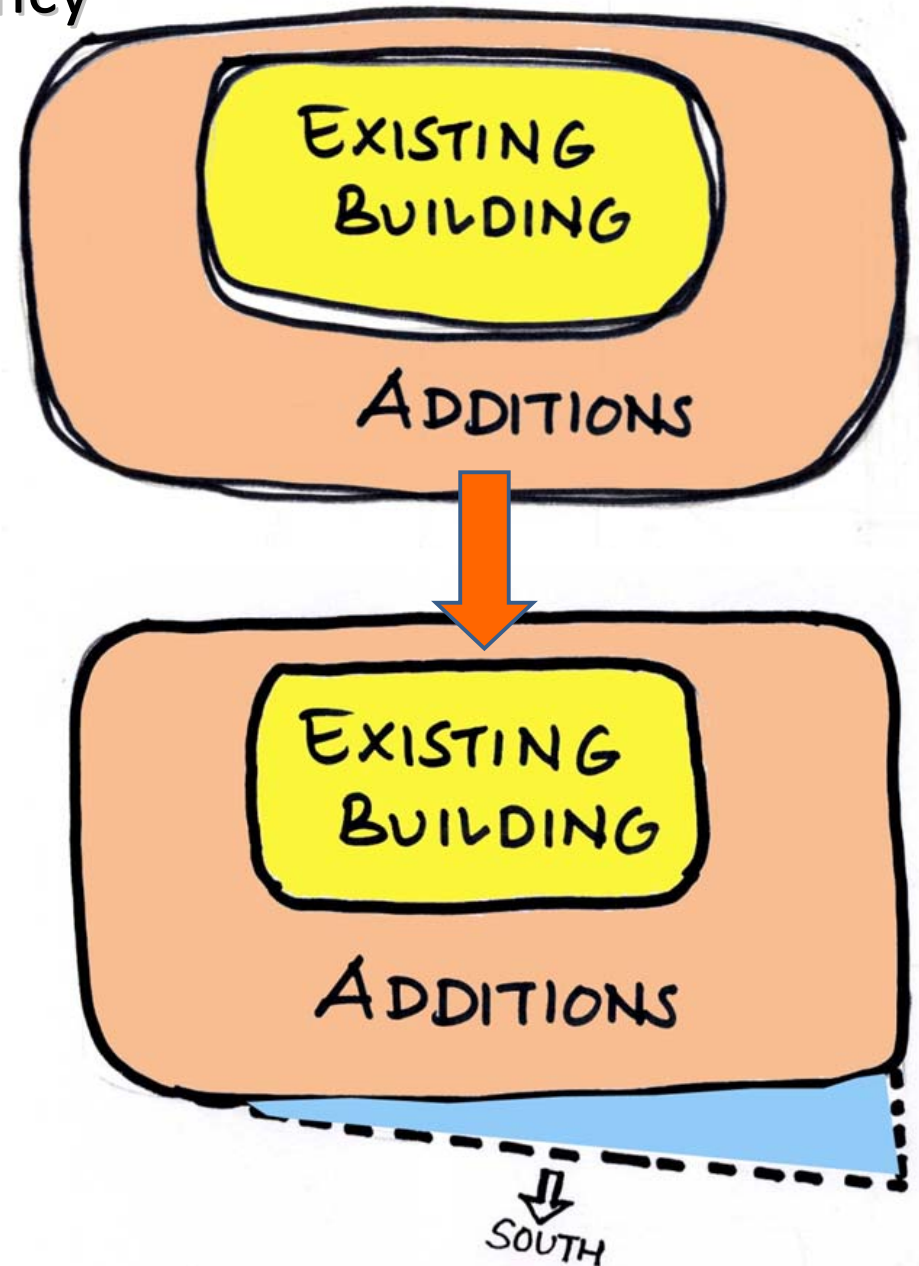
## Getting Started



# LINESØYA PASSIVE HOUSE

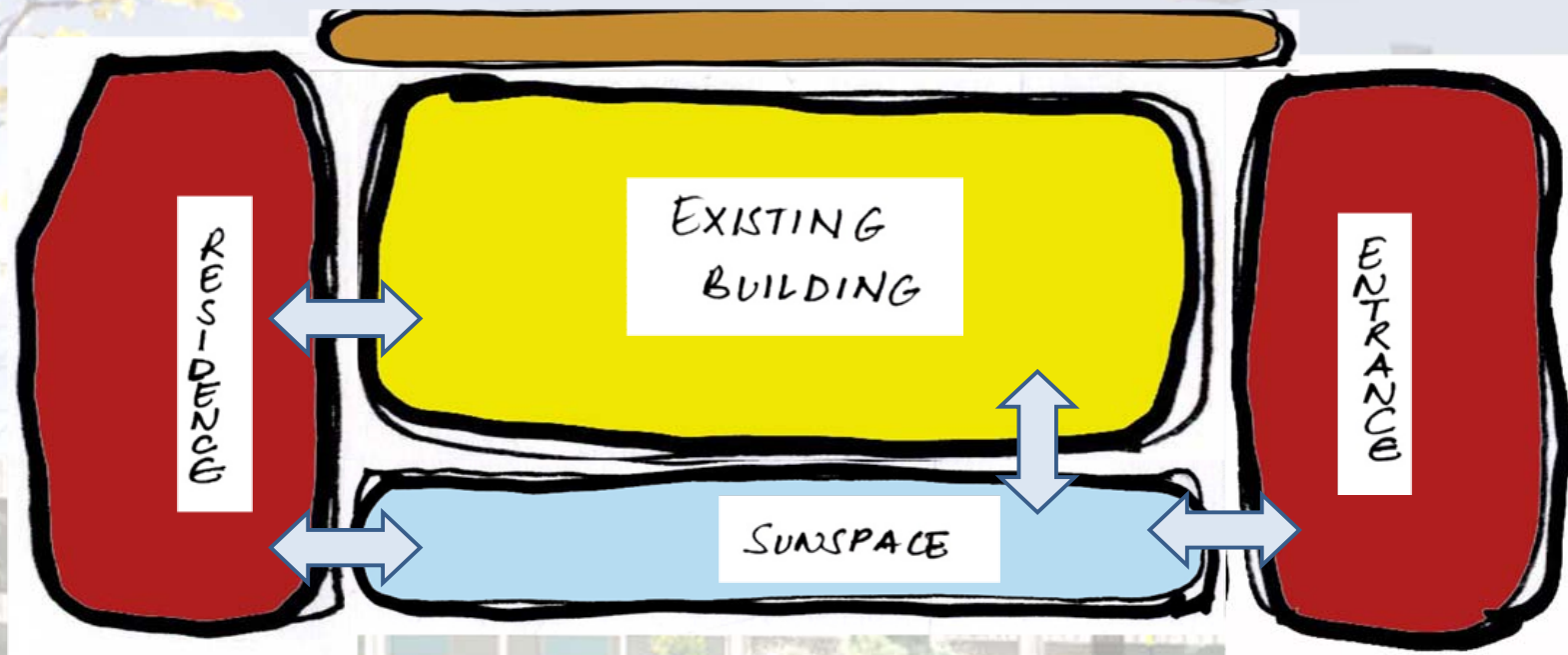
## Concept: “Cuddling for energy efficiency”

The assigned design project is situated in Linesøya, an island at the Atlantic coast at the end of the Trondheimfjord. Until the construction of the bridge is completed, the island can only be reached by a ferry from the neighboring island Stokøya. The existing building is in fact in a good state even though it has been built back around 1950. Our concept here is to retrofit the house with an envelop of insulation wrapping it around to keep it warm as a mother does to her child and we have termed it as cuddling- “cuddling for energy efficiency. There is not much intervention needed. Wrapping it around with extra “layer” could improve its efficiency in terms of energy use. Additions to the south are arranged such that there is ample penetration of sunlight.



# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”



# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Site Plan

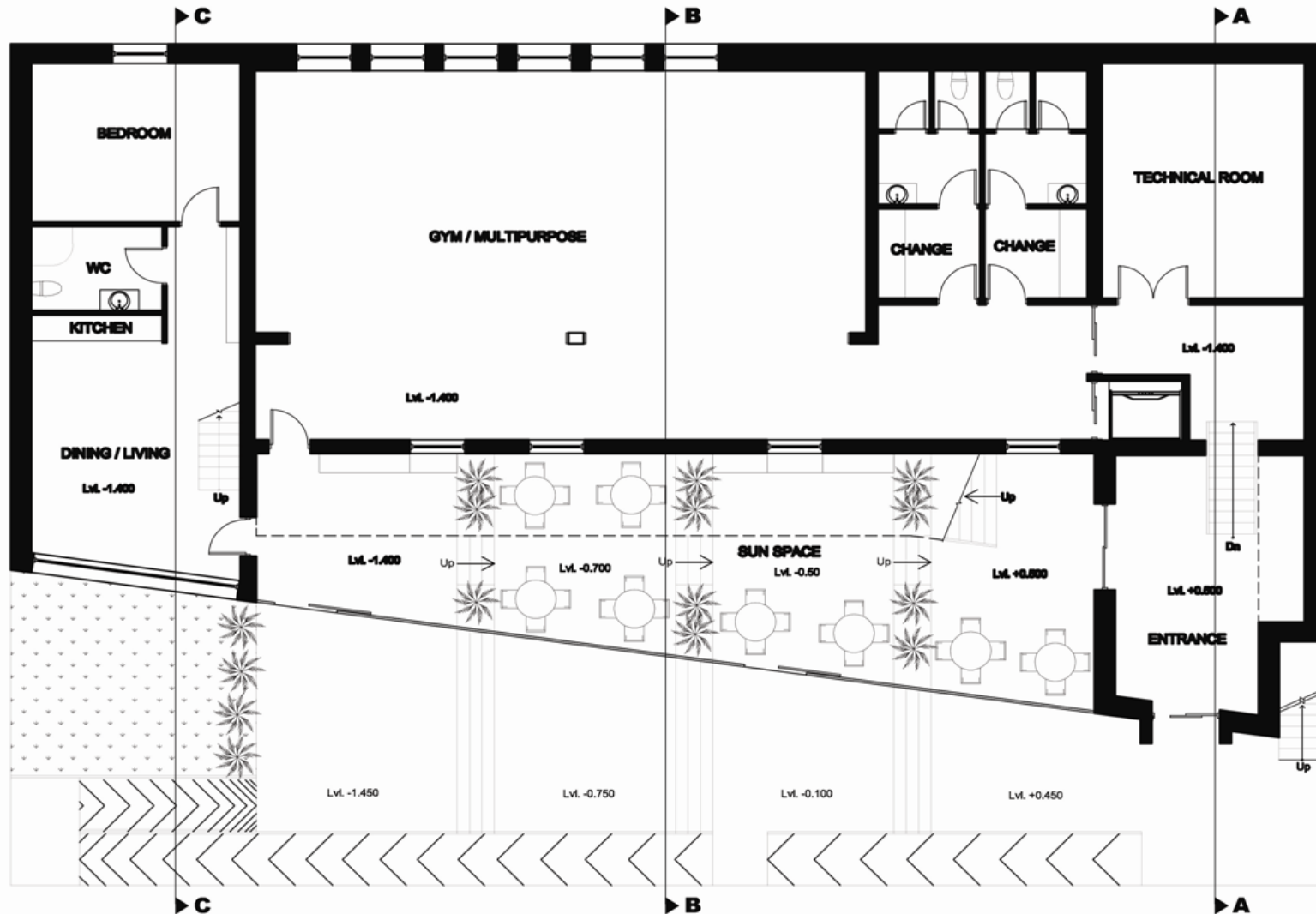
- Access leads the visitors to the parking which is to the south from where one can have a panoramic view of the house.
- Parking is divided into private and public.
- The walkways connect the parking to the building.
- Additions to the original building is done such that maximum sunlight utilized.
- Green areas are retained with further additions.
- The site is articulated as per international design.
- Eco-garden which uses the grey water from the building is to the north.



# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Plans

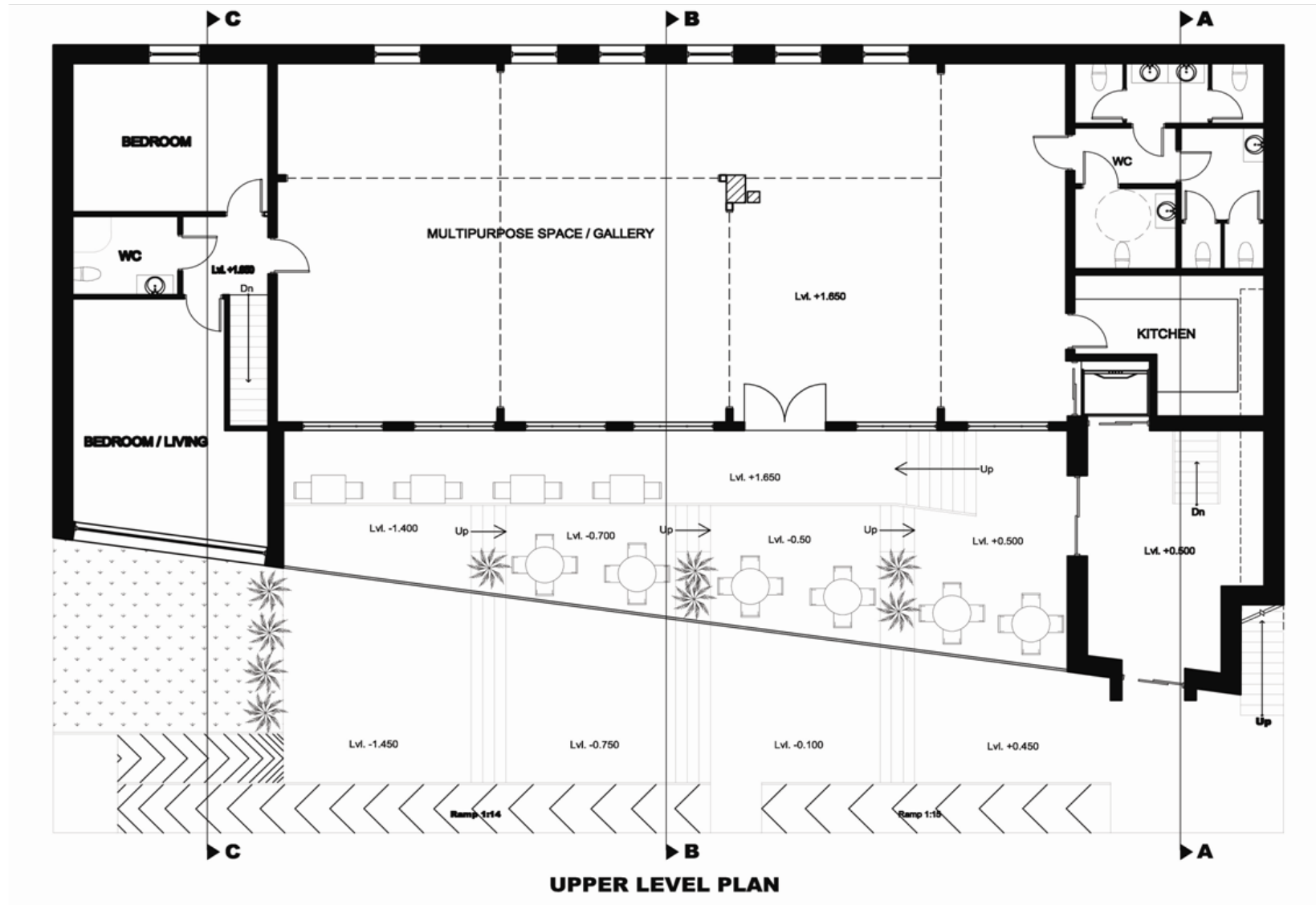


LOWER LEVEL PLAN

# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Plans

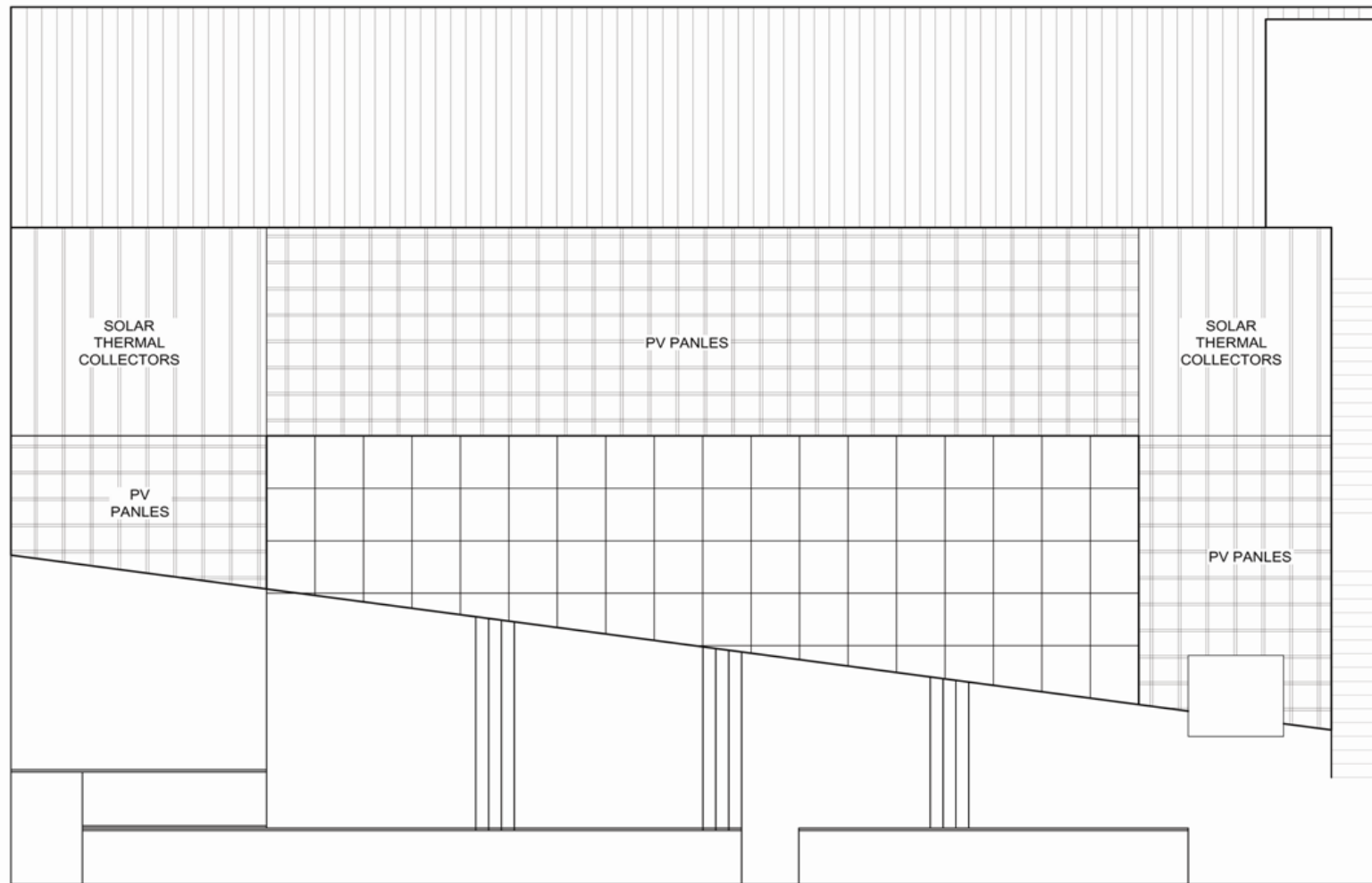




# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Plans

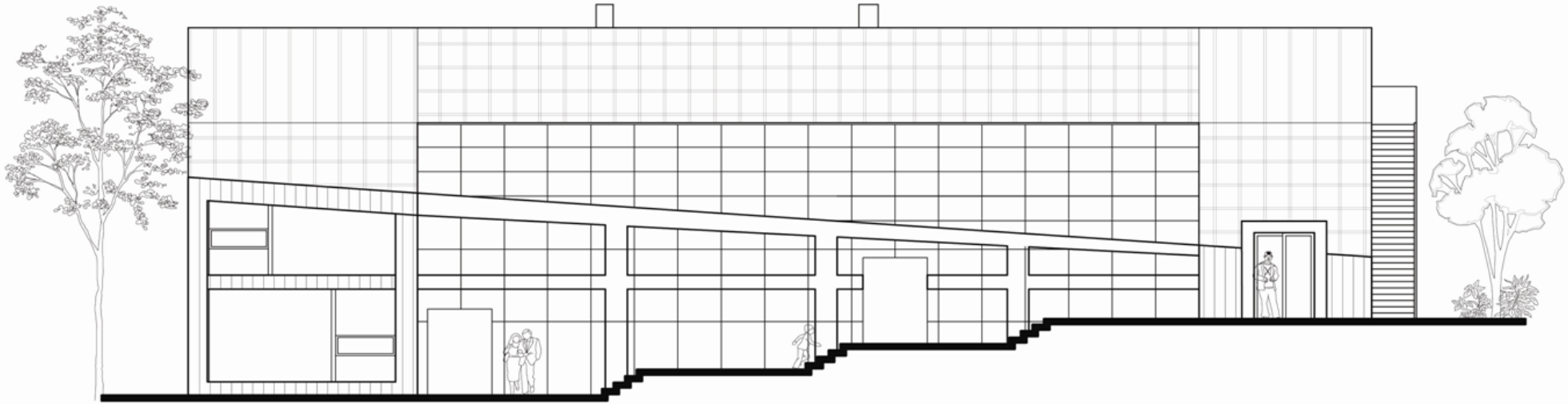


**ROOF PLAN**

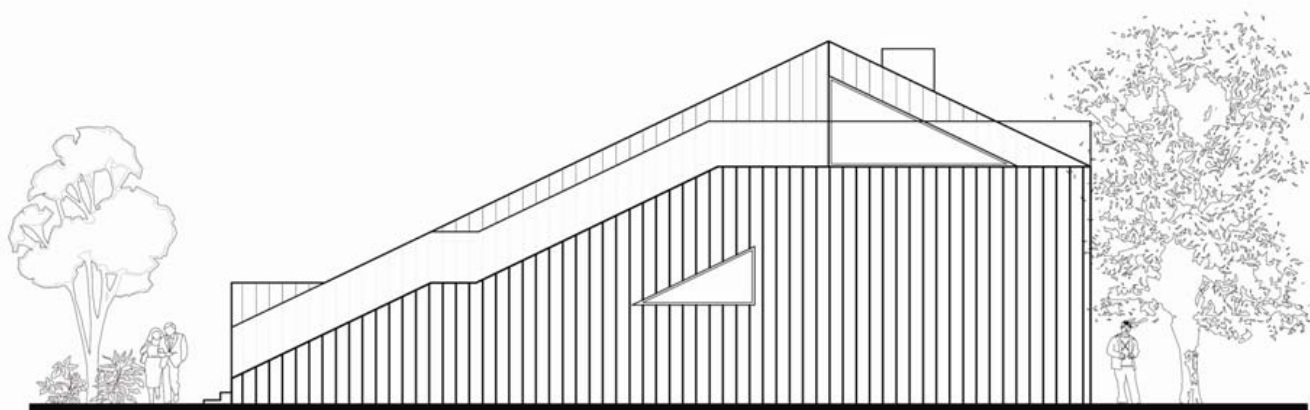
# LINESOYA PASSIVE HOUSE:

“Cuddling for energy efficiency”

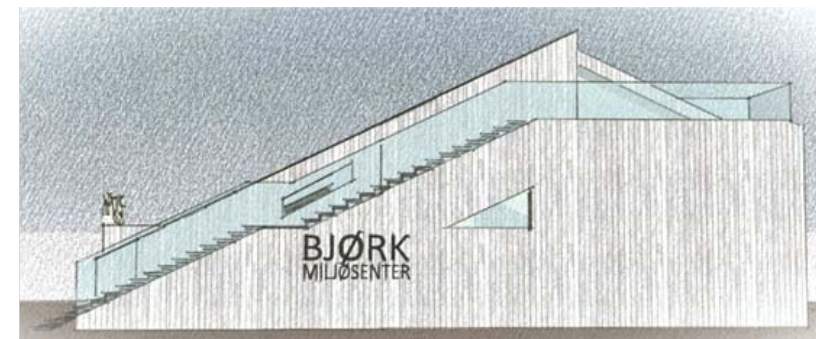
## Elevations



**SOUTH ELEVATION**



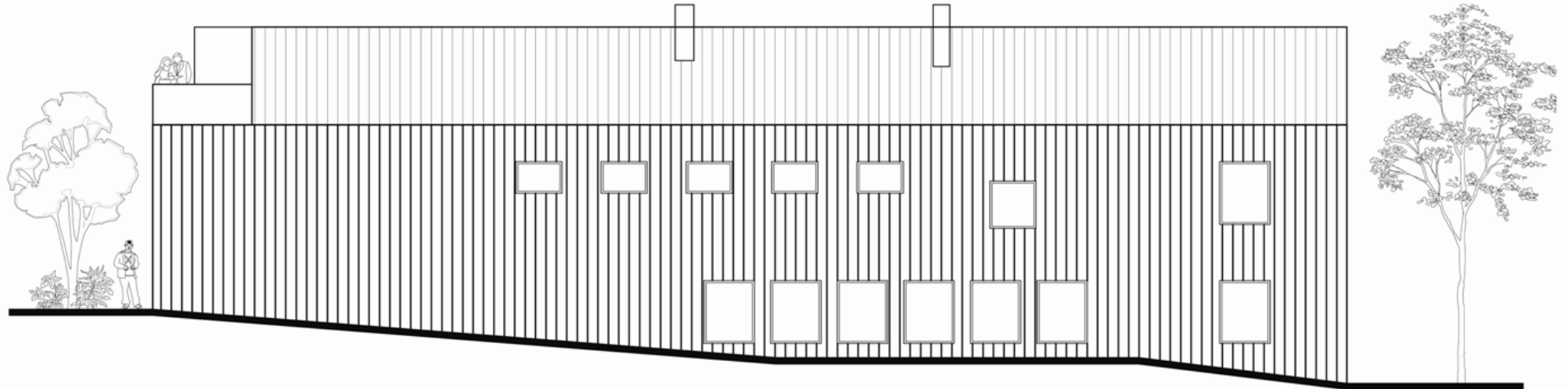
**EAST ELEVATION**



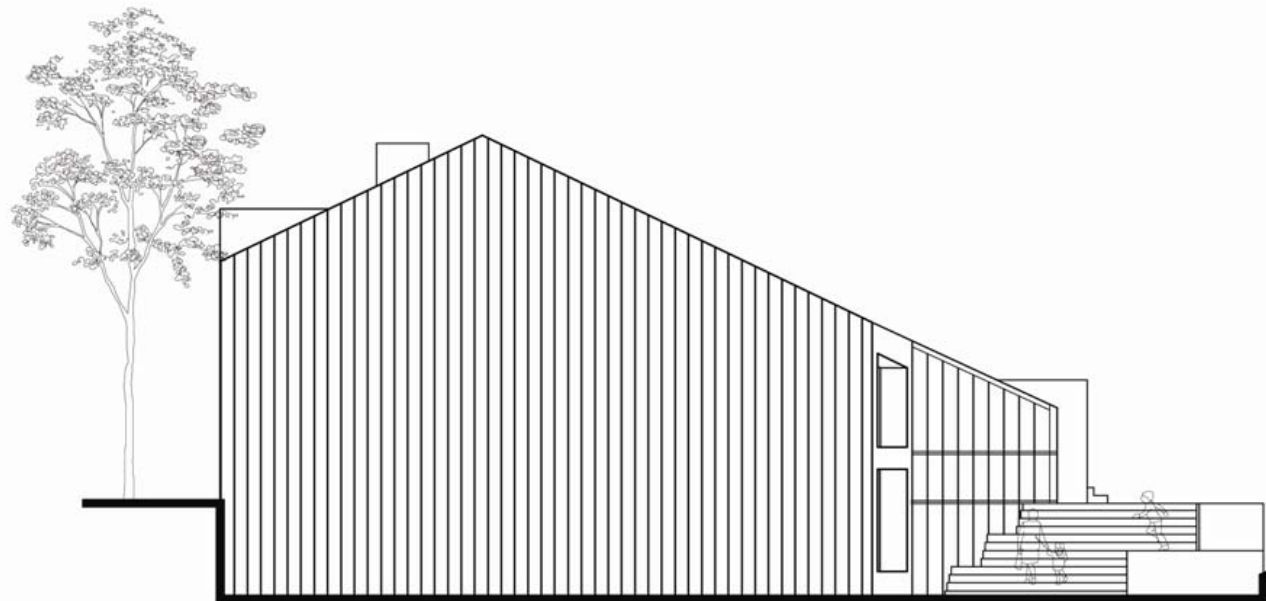
# LINESOYA PASSIVE HOUSE:

“Cuddling for energy efficiency”

## Elevations



**NORTH ELEVATION**

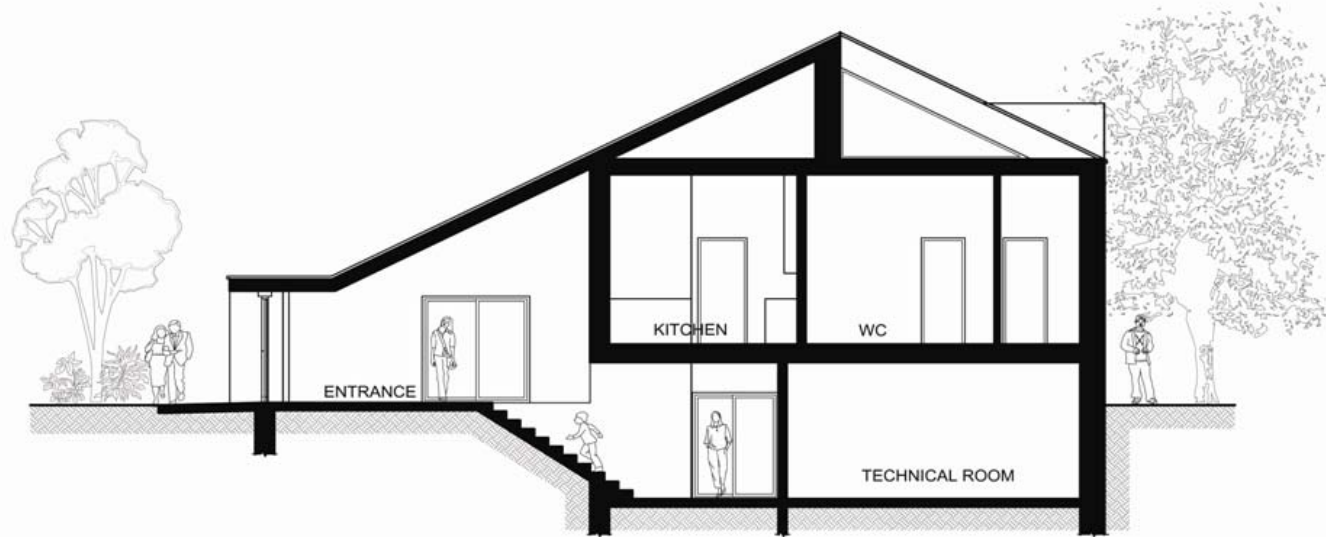


**WEST ELEVATION**

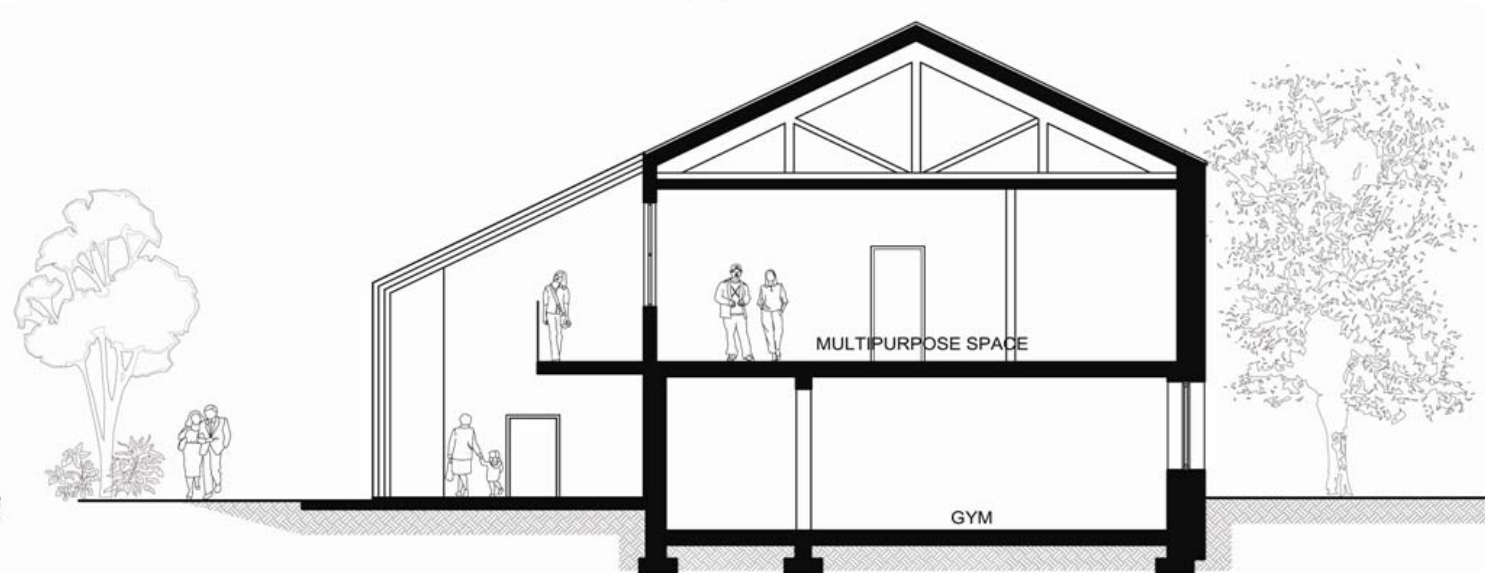
# LINESOYA PASSIVE HOUSE:

“Cuddling for energy efficiency”

## Sections



**SECTION A-A**

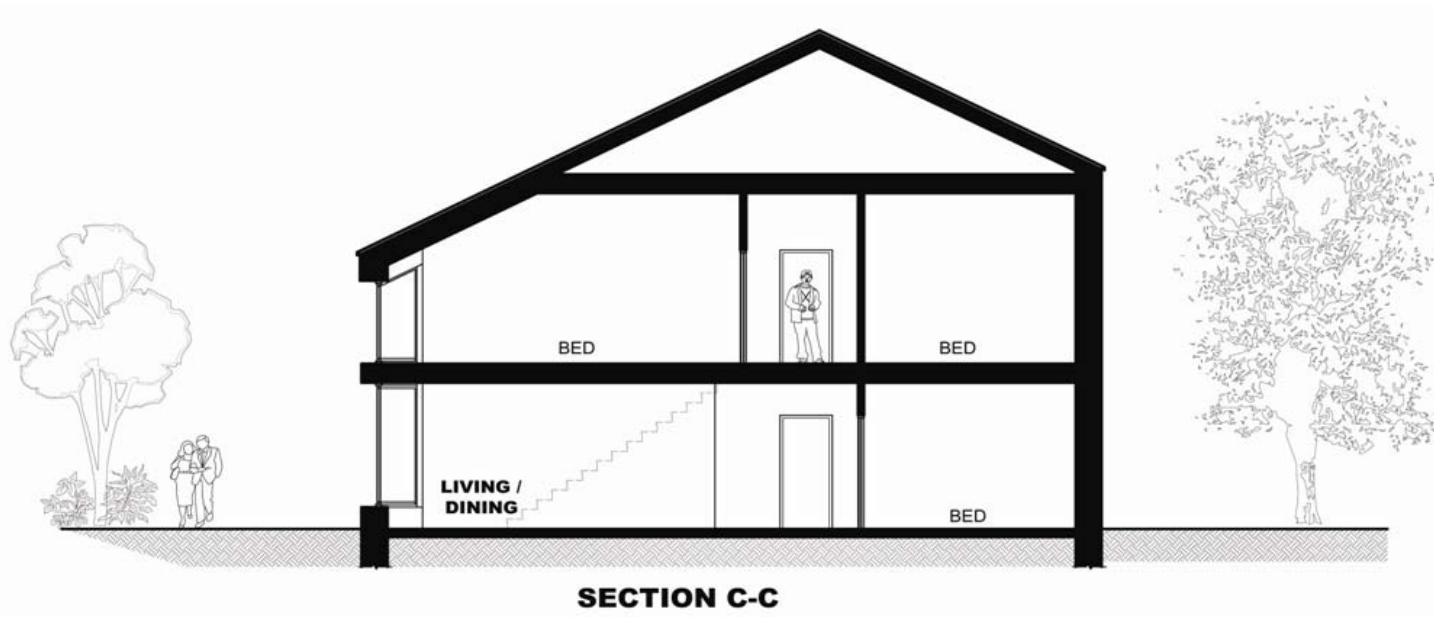


**SECTION B-B**

# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

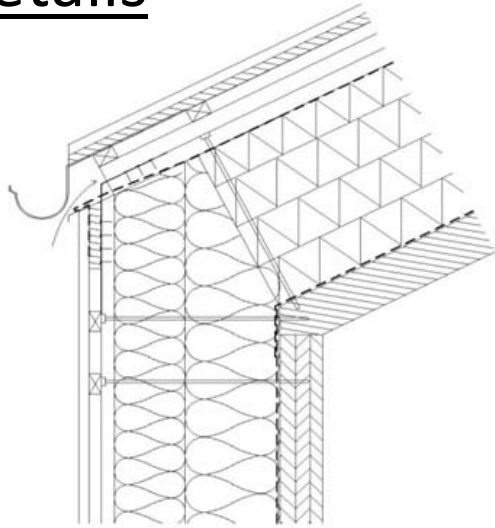
## Sections



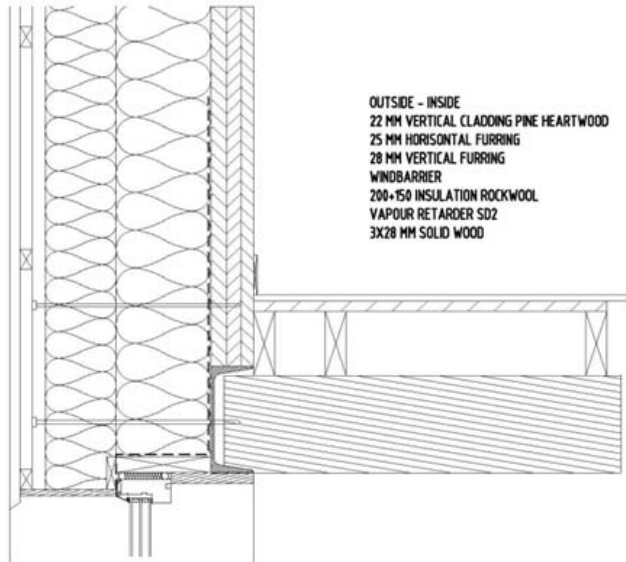
# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

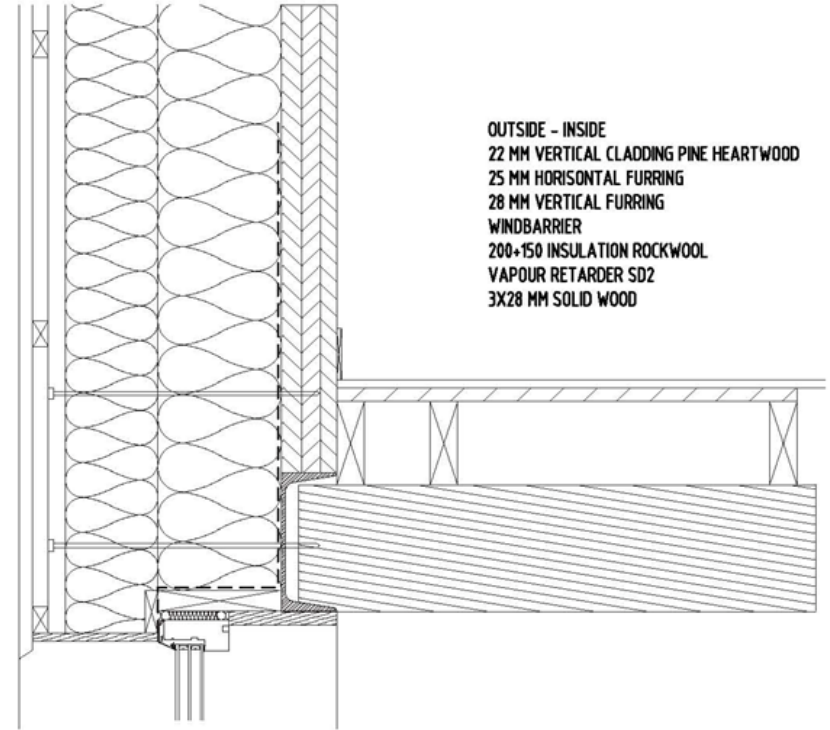
## Details



OUTSIDE - INSIDE  
22 MM CLADDING PINE HEARTWOOD  
30 MM HORIZONTAL FURRING  
2X36 MM FURRING  
ROOF MEMBRANE  
80 MM ROCKWOOL  
300 MM XPS  
VAPOUR RETARDER SD2  
6 MM WOOD FIBRE BOARD  
98 MM SOLID WOOD



OUTSIDE - INSIDE  
22 MM VERTICAL CLADDING PINE HEARTWOOD  
25 MM HORIZONTAL FURRING  
28 MM VERTICAL FURRING  
WINDBARRIER  
200+150 INSULATION ROCKWOOL  
VAPOUR RETARDER SD2  
3X28 MM SOLID WOOD

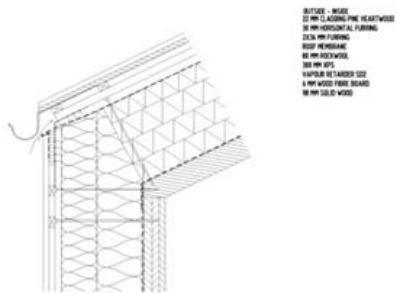


OUTSIDE - INSIDE  
22 MM VERTICAL CLADDING PINE HEARTWOOD  
25 MM HORIZONTAL FURRING  
28 MM VERTICAL FURRING  
WINDBARRIER  
200+150 INSULATION ROCKWOOL  
VAPOUR RETARDER SD2  
3X28 MM SOLID WOOD

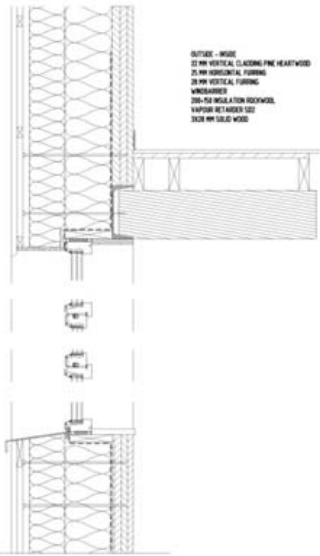
# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Details



OUTSIDE - INSIDE  
 22 MM HEARTWOOD PINE HEARTWOOD  
 20 MM HORIZONTAL FURRING  
 2200 EPS FURRING  
 ROOF MEMBRANE  
 80 MM ROCKWOOL  
 200 MM EPS  
 100 MM RETARDER SIDE  
 100 MM WOOD FIBRE BOARD  
 100 MM SOLID WOOD

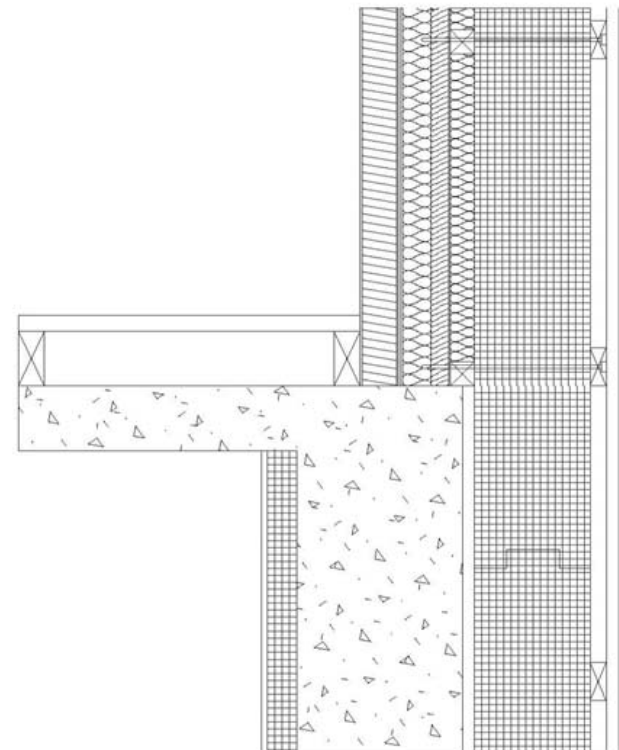
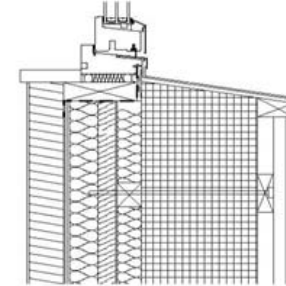
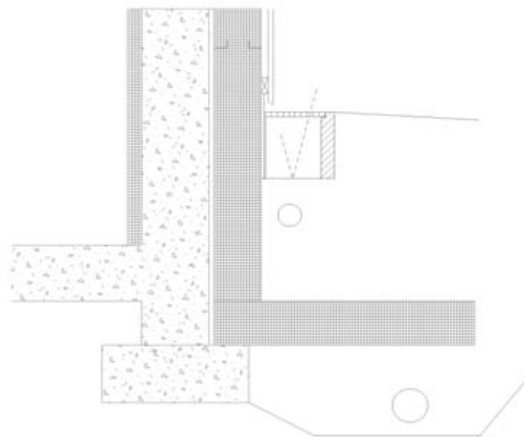


OUTSIDE - INSIDE  
 22 MM HEARTWOOD PINE HEARTWOOD  
 20 MM HORIZONTAL FURRING  
 20 MM VERTICAL FURRING  
 UNINSULATED  
 200 MM INSULATION ROCKWOOL  
 100 MM RETARDER SIDE  
 2000 EPS SOLID WOOD



INSIDE - OUTSIDE  
 MDF DENSE FIBRES GLUED  
 60 MM SOLID WOOD  
 PAPER  
 10 MM INSULATION  
 PAPER  
 50 MM MINERAL WOOL  
 30 MM WOODEN WALL PLATE  
 BLACK PAPER  
 42 FRAMEWORK INSULATION  
 200 MM EPS  
 28 MM FURRING  
 22 MM HEARTWOOD PINE CLADDING

INSIDE - OUTSIDE  
 STUCCO  
 50 MM FIBERCEMENT  
 290 MM CONCRETE  
 20 MM MORTAR  
 200 MM EPS  
 28 MM FURRING  
 22 MM HEARTWOOD PINE CLADDING



INSIDE - OUTSIDE  
 MDF DENSE FIBRES GLUED  
 60 MM SOLID WOOD  
 PAPER  
 10 MM INSULATION  
 PAPER  
 50 MM MINERAL WOOL  
 30 MM WOODEN WALL PLATE  
 BLACK PAPER  
 42 FRAMEWORK INSULATION  
 200 MM EPS  
 28 MM FURRING  
 22 MM HEARTWOOD PINE CLADDING

INSIDE - OUTSIDE  
 STUCCO  
 50 MM FIBERCEMENT  
 290 MM CONCRETE  
 20 MM MORTAR  
 200 MM EPS  
 28 MM FURRING  
 22 MM HEARTWOOD PINE CLADDING

# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Main View

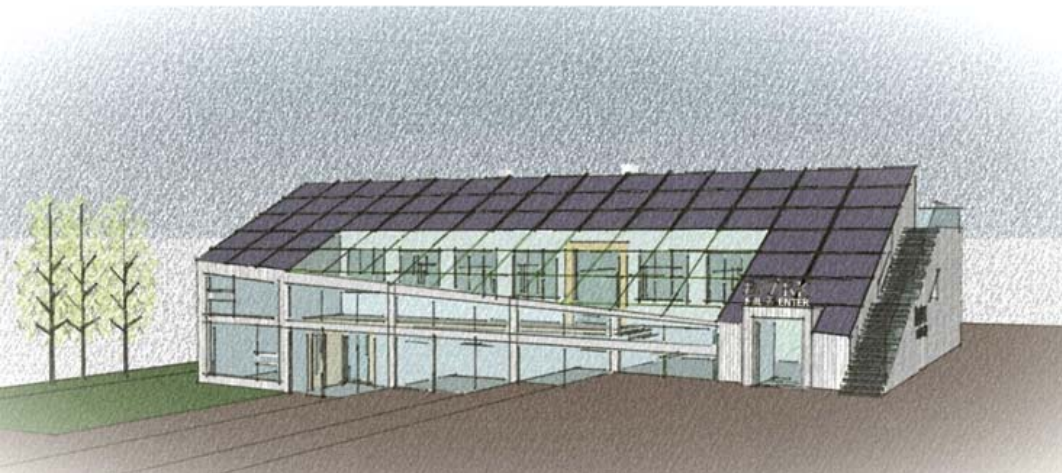
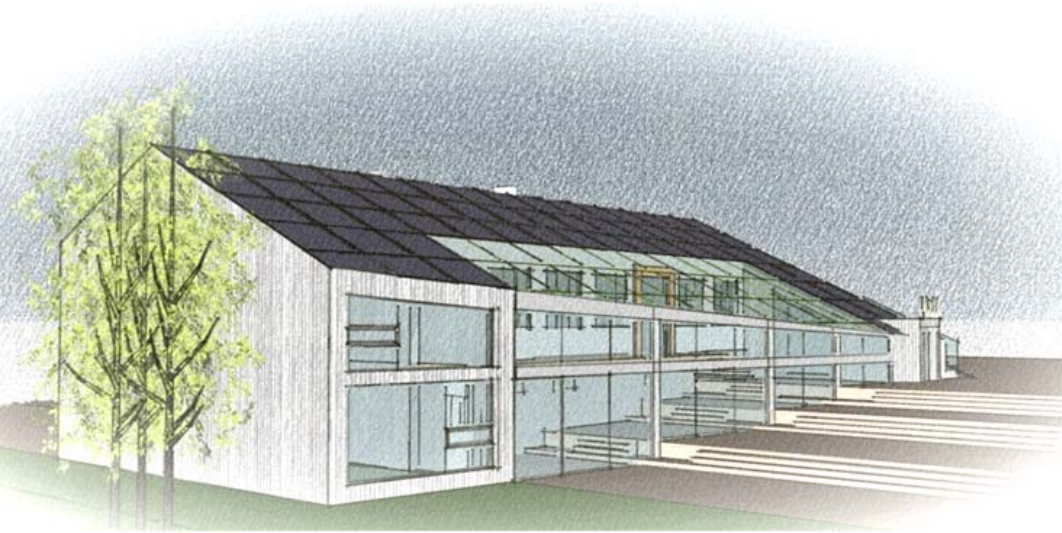




# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Views



# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

## Passive strategies

- Orientation of the sunspace
- Thermal mass
- Insulation
- Natural ventilation

## Active strategies:

- PV Crystalline PV (on the roof)  
Nominal power: 340W  
Area: almost 150m<sup>2</sup>
- Solar thermal collector (on the roof)  
Efficiency: 60%  
Area: approximately 26m<sup>2</sup>
- Heat pump  
Set temperature: 50 C  
COP: 2.8
- Wind turbine (in suitable location near site)
- Heat recovery system

## Energy budget:

For the energy calculation of this project, we divided this building into three different zones which are residential (106.6m<sup>2</sup>), culture/office (198.2m<sup>2</sup>) and sport area (159.6m<sup>2</sup>). So the total heated floor area is 464.4 m<sup>2</sup>.

Heating demand calculations:

Our main focus has been to document the design's potential to reach the passive house standard, which is less than 21.74 kWh/m<sup>2</sup> energy use in the building for space heating. For accuracy, we divided the model into four thermal zones and programmed different thermal temperatures and schedules for each zone. To estimate internal heat gains we also made a rough assumption of the amount of people using each zone.

From the result, we can see that the building meets the space heating demand of passive house standard, which is 19.2 kWh/m<sup>2</sup>.

## Heat balance

From the graph of the heat balance of the building, solar thermal collector and heat pump could provide enough heating demand for the house. In the summer, it produces much more heat which could be storage. But, in the winter, there should be some heat complemented by the electricity grid.

From the chart of electricity balance, the house needs some energy from electrical grid during the winter, and in the summer, the house will produce surplus electricity which could be sold to the grid.

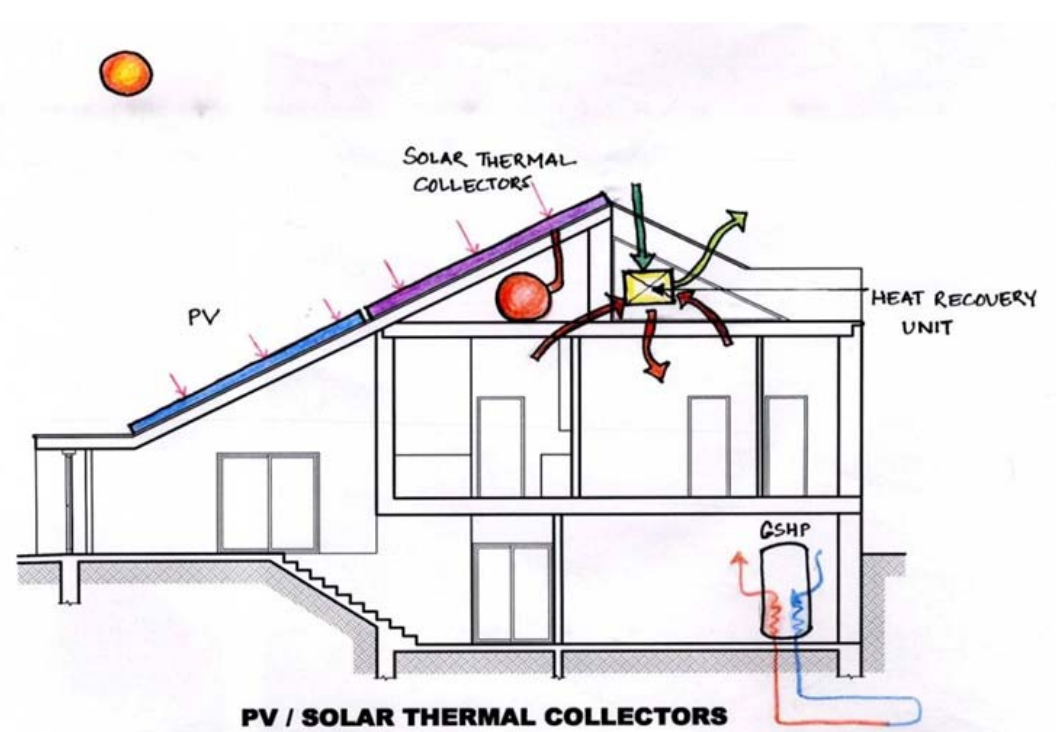
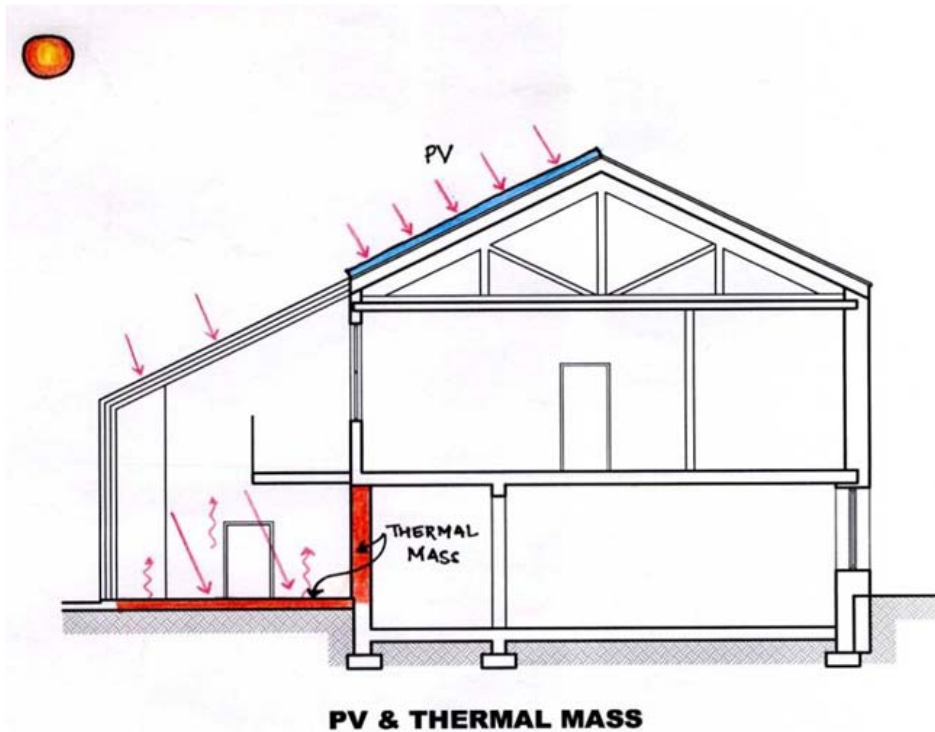
## CO2 emissions

The chart shows that the CO<sub>2</sub> emissions of the building from the energy perspective. In summer, the building could produce much more green electricity which could be sold to the grid; thereby compensating CO<sub>2</sub> production during winters.

# LINESOYA PASSIVE HOUSE:

“Cuddling for energy efficiency”

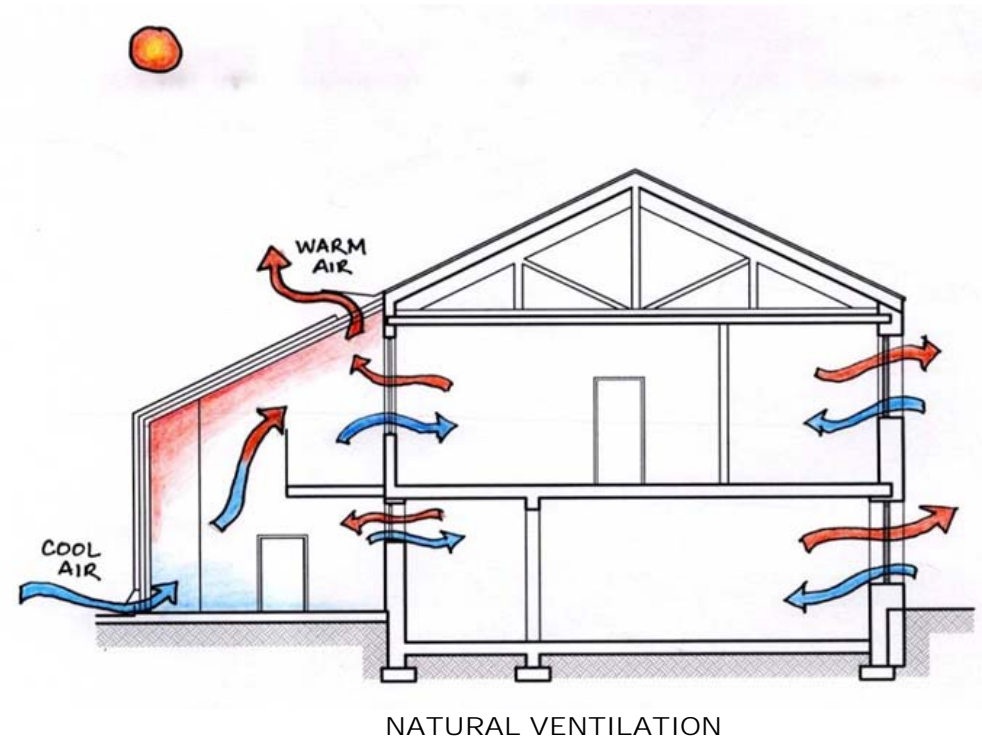
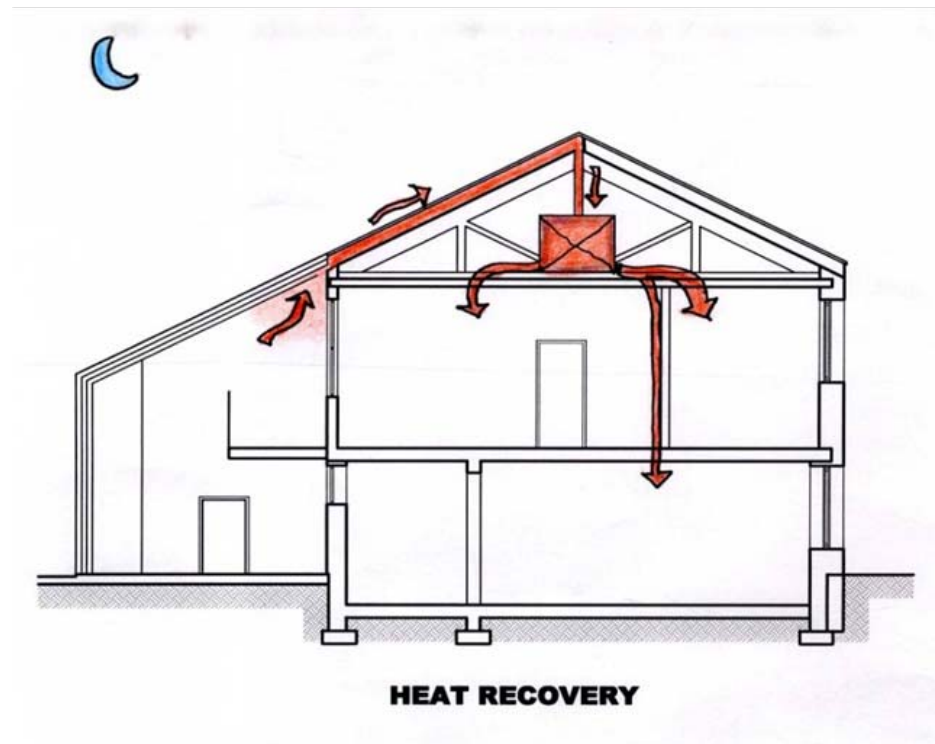
## Strategies



# LINESOYA PASSIVE HOUSE:

“Cuddling for energy efficiency”

## Strategies



# LINESOYA PASSIVE HOUSE:

“Cuddling for energy efficiency”

## Wind turbine

### General

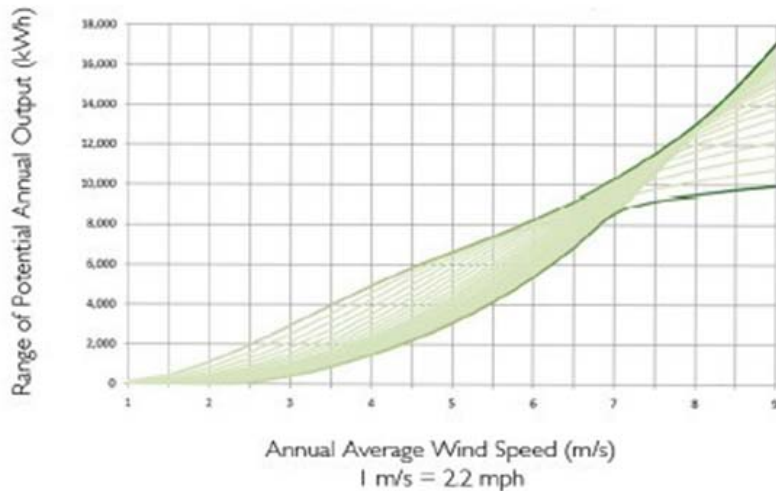
Axis \_\_\_\_\_ Vertical  
 Height \_\_\_\_\_ 4.60 m (15.10 ft)  
 Width \_\_\_\_\_ 3.00 m (9.85 ft)  
 Weight \_\_\_\_\_ 461 kg (1016 lb)  
 Swept Area \_\_\_\_\_ 13.8 m<sup>2</sup> (149 ft<sup>2</sup>)  
 Blade Materials \_\_\_\_\_ Carbon Fiber and Fiberglass



### Performance

Rated Power \_\_\_\_\_ 4000 W  
 Cut-in Wind Speed \_\_\_\_\_ 3.5 m/s (7.8 mph)  
 Cut-out Wind Speed \_\_\_\_\_ 30 m/s (67 mph)  
 Rated RPM \_\_\_\_\_ 110 RPM  
 Survival Wind Speed \_\_\_\_\_ 55 m/s (123 mph)  
 Rated Wind Speed \_\_\_\_\_ 12 m/s (27 mph)  
 Noise Level at 12 m/s \_\_\_\_\_ 49 dB

## UGE-4K Annual Power Output

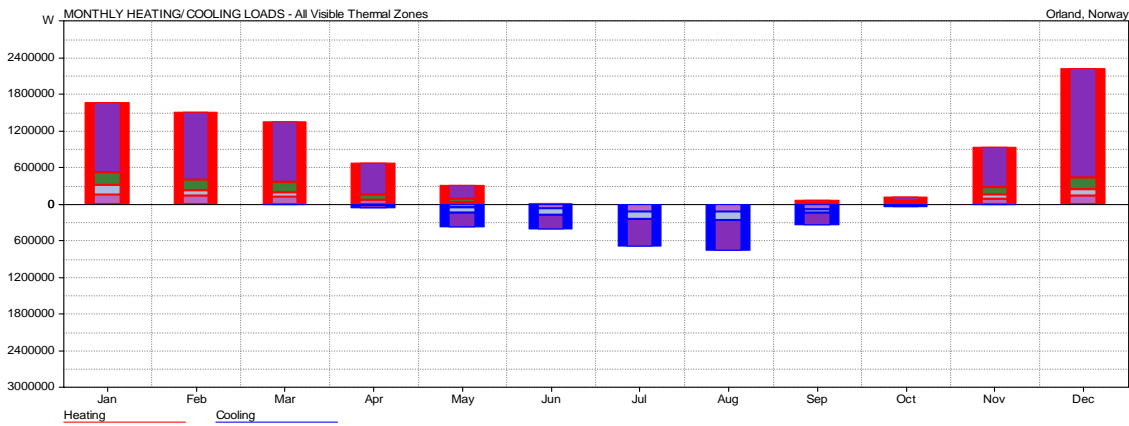


## Energy Budget

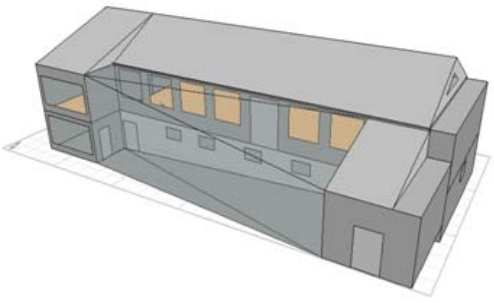
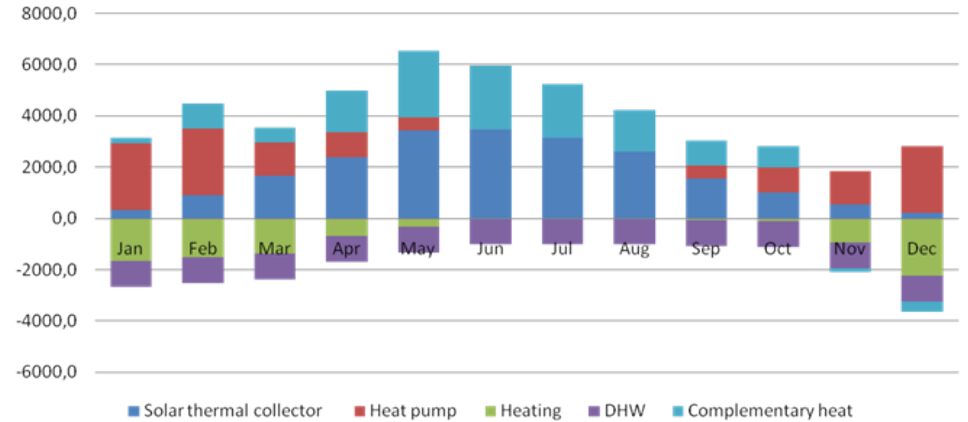
	heat		electricity		total
	Net energy demand [kwh/a]	Specific energy demand [kwh/(m <sup>2</sup> a) (464.4m <sup>2</sup> )]	Net energy demand [kwh/a]	Specific energy demand [kwh/(m <sup>2</sup> a) (464.4m <sup>2</sup> )]	
heating	10093.768	21.74			
domestic hot water(DHW)	12119.0918	26.10			
fans			4820.724	10.38	
pumps			1441.44	3.10	
lighting			6430.144	13.85	
technical equipment			4876.782	10.50	
cooling					
sum	22212.8598		17569.09		39781.95
		47.83		37.83	85.66

# LINESOYA PASSIVE HOUSE

“Cuddling for energy efficiency”

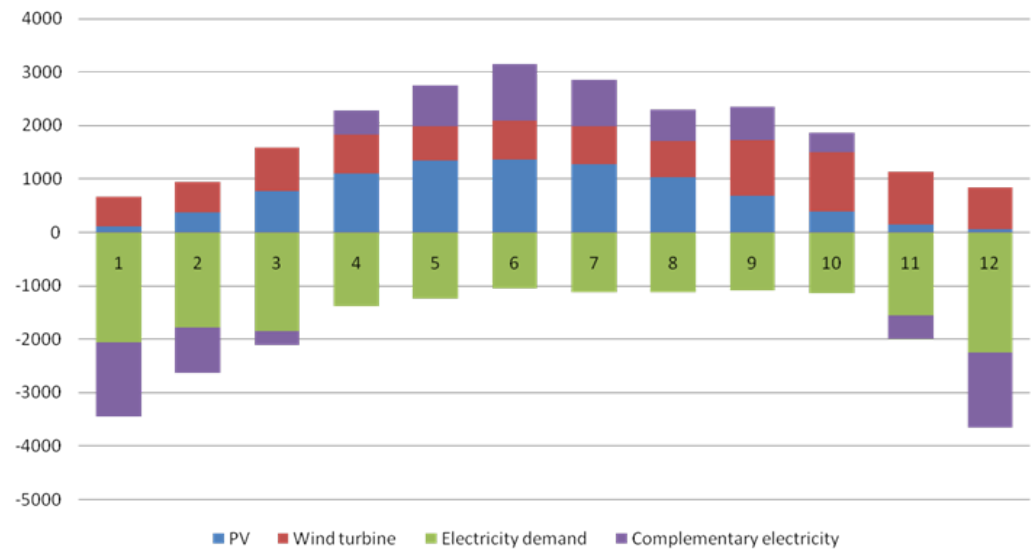


Heat balance



MONTH	HEATING (Wh)	COOLING (Wh)	TOTAL (Wh)
Jan	1667302	0	1667302
Feb	1505826	0	1505826
Mar	1358103	25953	1384056
Apr	684460	70939	755398
May	317166	375289	692455
Jun	13253	425503	438756
Jul	6498	695363	701862
Aug	5775	760896	766671
Sep	66788	348524	415312
Oct	117361	60807	178168
Nov	946406	24155	970561
Dec	2226450	3524	2229974
<b>TOTAL</b>	<b>8915389</b>	<b>2790952</b>	<b>11706342</b>
<b>PER M</b>	<b>19197.6507</b>	<b>6009.80189</b>	<b>41.3386105</b>
<b>Floor Area:</b>	<b>464.4 m2</b>		

Electricity balance

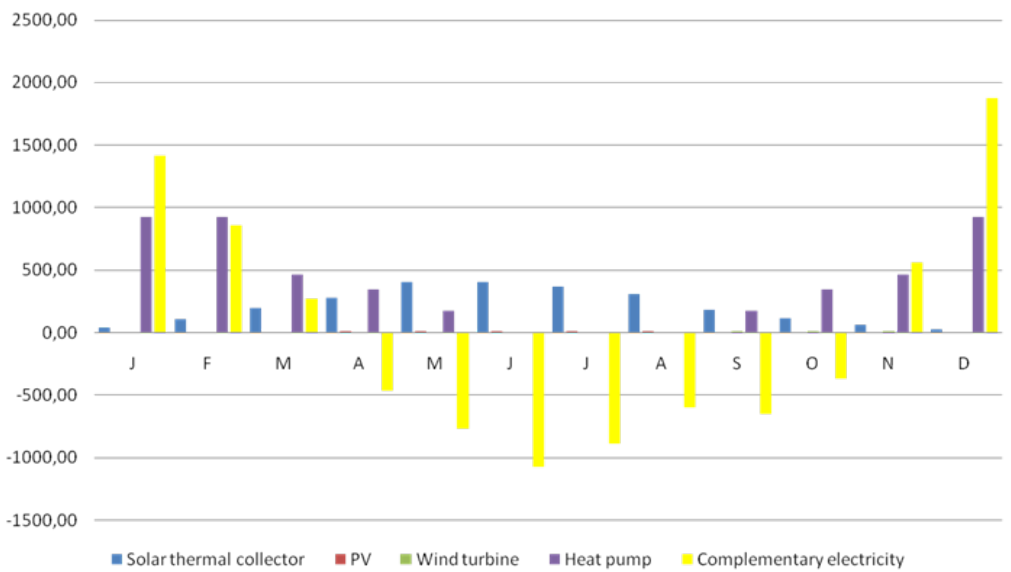


# LINESOYA PASSIVE HOUSE:

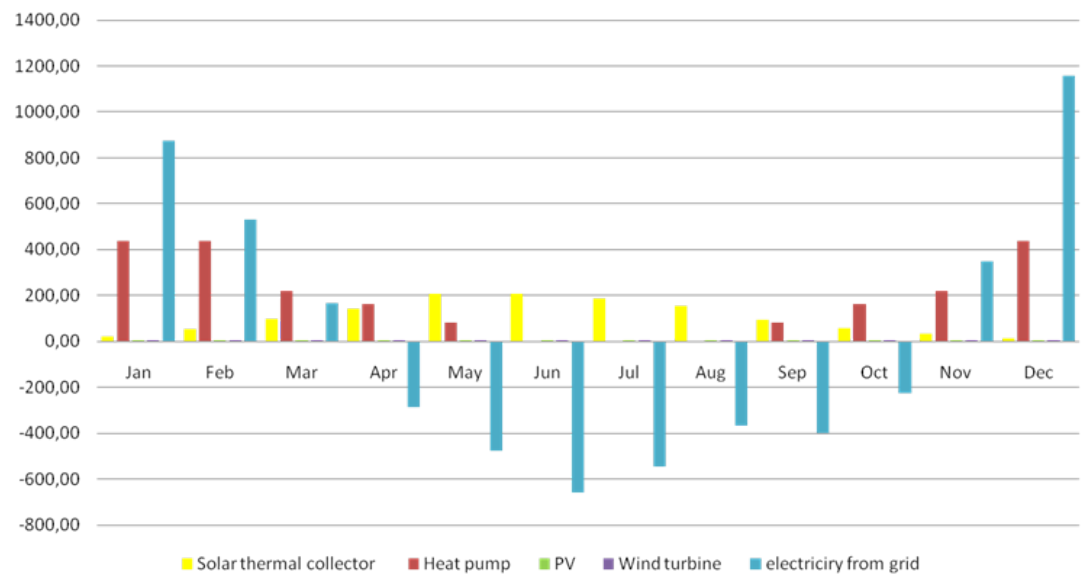
“Cuddling for energy efficiency”



Delivered energy



CO<sub>2</sub> EMISSIONS



Total CO<sub>2</sub> emissions(kg)

