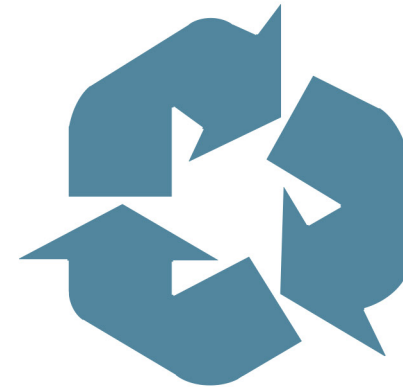


## LOW EMISSION LIVING



Master project in architecture, NTNU, spring 2015

Preliminary work

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## ABSTRACT

This master project is about how we can reduce the emissions related to housing. The emissions can be divided in categories. One is the emissions coming from producing the materials for the building. Another category is the emissions coming from producing energy to operate the building. A third category of emissions are related to what we fill up our home with. With the western lifestyle we possess so many things, and we throw away whatever gets old or broken. In this way a person can have a very high carbon footprint when living in an energy efficient building.



## **WHAT?**

Zero emission living. How can the emissions related to housing be reduced through architecture?

## **WHY?**

Reduce human impact on climate



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# SITUATION

One of the greatest challenges of our time is the climate change. It is caused by an increasing amount of climate gasses in the atmosphere, and leads to higher temperatures on earth. In cold Norway it might be difficult to see this as a problem, but it will also lead to a rising sea level and more extreme weather.

This is the tendency we have seen the last years, and what the experts assume will keep happening if we don't do anything. However, we can't know for sure. What we do know for sure, is that it is better to be safe than sorry.

Some of the experts say that to prevent catastrophe, the temperature can't rise more than 2°C. For this to happen, we need to lower our greenhouse gas emissions with more than 50%. Seeing that the building sector represents around 40% of the emissions in a global perspective, it is important that we as architects take our part of the responsibility.

In Norway the state is focusing on passive houses to reduce the emissions from the building sector. One of the problems with the passive house standard is that it only requires measures per square meter. In this way, the total emissions of a building can be huge, even if it's very energy efficient, because of a large built area.

A step further from the passive house is to say that the energy used should be covered with energy from renewable sources on site. Going even further, the energy used to produce and transport the materials of the building, should be given back through energy production on site - this is the zero emission building.



## TASK

In my master project I want to look at how we can build environmentally friendly. I am setting a goal to design a zero emission building and have chosen to work with housing. Even though landmarks are important to give a bigger focus towards low emission building, there have to be changes made for all typologies. I think it is important to look at the potential for housing to be zero emission buildings, seeing that it represents 25% of what is being built in Norway.

# STRATEGIES

**Reduce energy use in buildings.** The energy use in passive houses is 10% of what was the average 20 years ago. The government of Norway has chosen the use of passive houses as their strategy for lowering emissions in the building sector. Some argue that this is not the right way to reduce the emissions in Norway, seeing that the main source of electricity is hydropower. However, Norway is connected to an European grid of electricity. This means that the energy we don't use at home can be exported abroad and help reduce the use of fossil fuels in other countries.

**Reduce material use and choose environmental friendly materials.** The choice of construction can lower the emissions. By using less materials and choosing materials that are produced with renewable energy the emissions of the house can be lowered. Further the use of locally produced materials can lower the emissions from transportation.

**Reduce the built area.** There is a trend of an increasing floor area per person in Norway. In Europe we have the second biggest area per person(56m<sup>2</sup>), beaten by Luxembourg only(66m<sup>2</sup>). When someone builds a new house, they see how big a house they can afford and build nothing less than this size. By reducing the area in a house, both the material use and the energy use is affected. It is obvious that less materials will be needed, and additionally the volume of heated/cooled air is reduced.

**Change peoples attitude towards materialism.** Because of our increasing economy, our houses get bigger and bigger, and we own more and more things. Today everyone owns their own car, coffee maker, computer and washing machine. When the washing machine is broken, we buy a new one in stead of repairing it. It seems like everyone buys as much as their economy allows, and sometimes even more. If we used less money on buying things, we could have more money for cultural activities, and at the same time reduce our emissions.

**Holistic approach to sustainability.** In my opinion the strategies of reaching low emissions should be integrated in the design, and not added to fulfil some checklist that labels the building as environmental friendly. Additionally the user should be encouraged to a lifestyle that suits the building. For this to happen, the user has to learn how to lower his emissions. I believe that it is only realistic if people don't feel like they have to make a lot of sacrifices in their daily lives. Preferably the choice to live environmental friendly becomes the easiest one. Ideally a design also has a positive impact beyond its own users. Either educational by setting a good example, or by giving something back to the area.

# METHOD

**Energy use:** To create a concept for an energy efficient building, I will use the climate data for Trondheim. To verify that it is an energy efficient building I will use DesignBuilder. I will then compare the results with the passive house standard.

**Embodied emissions:** To lower the embodied emissions of the building I will look at which functions and areas can be reduced, shared, merged or removed. I will try to reach low emissions by challenging peoples way of living and the way our houses are increasing in size.

**Energy production:** The first strategy will be to lower the energy needed in the building. No matter how low the energy demand is, there has to be some energy production on site to “repay” the energy used for producing and transporting the materials.

## SITE

I have chosen Trondheim as the city for my master project. Trondheim has shown interest in being environmental friendly. They set the goal of reducing the emissions 25% before 2020, and 70-90% before 2050. Additionally they are part of a program called “Cities of the future” (Framtidens byer). This is a collaboration between the state and the biggest cities in Norway. They have chosen “Brøset” as an area for developing a climate neutral part of the city. Here they want to reduce peoples CO2 footprint to 3 ton per year, compared to the 8-11 ton we are using today.

Brøset seems like a natural choice, considering that trondheim kommune already wants Brøset as a low carbon part of the city. However, it also seems like the easy choice, seeing that it is an unbuilt area. At Brøset it would be easy to “cheat” my way to good sun and light conditions, seeing that I could design the surrounding buildings the way I want. To get a more realistic situation I wanted to choose a site in an already developed area. Densification is also considered important for making a sustainable city. It will help keep the city centres alive and the need of new infrastructure is very low.

When choosing a site I had one main criteria. **The site should be in the city centre, in walking distance form the city centre, or connected to the city centre with existing public transport.** This is necessary to make it possible for the people to choose public transport, and consider the alternative of not having their own car.

I chose three sites that are saved for housing. Two in the city centre and one on Ila, which is in a walking distance from the centre. Additionally it has a good connection to the centre with public transport.



# POSSIBLE SITES





### Site 1

Ila (416/297)

Area: 2494m<sup>2</sup>

Used as parking

Surrounding buildings 3-10 floors

Facing south and west



### Site 2

Centre (400/105)

Area: 644m<sup>2</sup>

Used for parking

Surrounding buildings 2-4 floors

Facing north and east



### Site 3

Centre (400/66)

Area: 413m<sup>2</sup>

Used for parking

Surrounding buildings 3 floors

Facing north and west







I choose the site on Ila for my master project, because I think the site has the best potential for improving. All the sites are used for parking, and the two sites in the centre seems to be working well for this. On Ila people have left their unwanted sofa, an old bus and various forms of garbage. I think this site has an unused potential. It is close to both Ilabekken and Ilaparken. The fjord can be seen from the site, even though the silos on Ila cover a lot of the view. It also has good light conditions being south oriented.



Ilabekken



Trondheimsfjorden

# DELIVERED MATERIAL PROPOSAL

Preliminary work

Diagrams

Visualisations

Site plan 1:500 / 1:1000

Plans 1:50 / 1:100

Sections 1:50 / 1:100

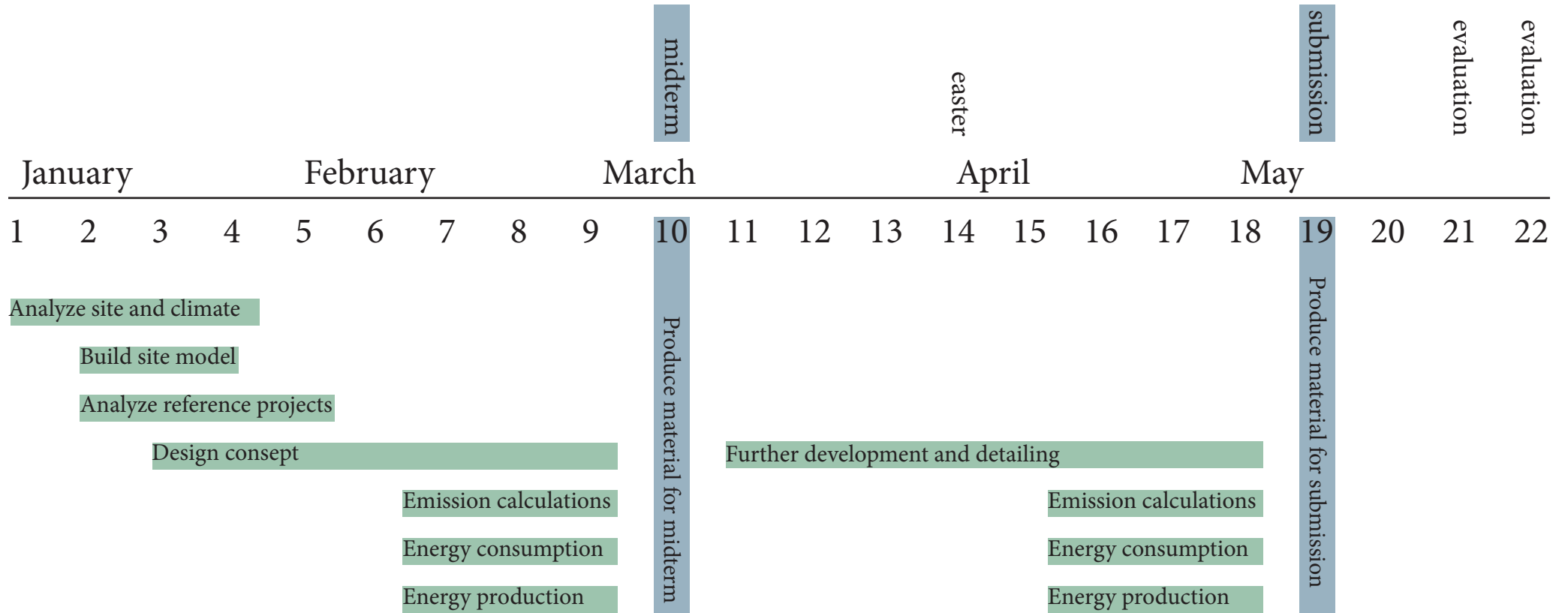
Facades 1:200

Simulations Design Builder

Energy/emission balance

Model 1:200

# WORK SCHEDULE



# LITERATURE

Voss, Karsten, Musall, Eike, *Net Zero Energy Buildings*, Detail, Munich (2012)

Hausladen, Gerhard, Saldanha, Michael, Liedl, Petra, *Building to Suit the Climate*, Birkhäuser, Basel (2012)

Hausladen, Gerhard, *Climate Desing: solutions for buildings that can do more with less technology*, Birkhäuser, Basel (2005)

Richardson, Phyllis, *Nano house: innovations for small dwellings*, Thames & Hudson, London (2011)

Scott, Janet, Letcher Trevor, *Materials for a sustainable future*, Royal Society of Chemistry, Cambridge (2012)

# SOURCES

## **Pictures:**

<http://www.nature.com/news/megacities-move-to-track-emissions-1.11937>, 6 nov

<http://www.clker.com/cliparts/E/e/G/3/m/V/idea-light-bulb-md.png>, 30 nov

## **Websites**

<http://shrinkthatfootprint.com/how-big-is-a-house>, 15nov

[https://www.bmwf.w.gv.at/Wirtschaftspolitik/Wohnungspolitik/Documents/housing\\_statistics\\_in\\_the\\_european\\_union\\_2010.pdf](https://www.bmwf.w.gv.at/Wirtschaftspolitik/Wohnungspolitik/Documents/housing_statistics_in_the_european_union_2010.pdf), 15nov

<http://www.ssb.no/bygg-bolig-og-eiendom/statistikker/bygningsmasse>, 17nov