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PASSIVE HOUSING – NEW ROLES AND RESPONSIBILITIES FOR THE BUILDING CHAIN

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ABSTRACT

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Does passive housing really have better environmental performance than conventional housing? Three passive houses and four conventional houses were compared using a life cycle assessment (LCA) methodology. The comparison also provided an actor analysis for the building supply chain and building inhabitants. Actor analysis shows that inhabitants' and material producers' electricity choice are very important. The introduction of passive house technology shifts responsibilities from building constructors to municipalities and residents, which is not currently communicated. To avoid shifting responsibility within the building chain and to meet future trends, communication needs improvement. The findings highlight the importance of environmentally responsible decisions throughout the whole life cycle and the need for appropriate behaviours and actions, along with implications for improved communication.

INTRODUCTION

Passive housing is seen as the solution for environmental problems in the building industry in Sweden and elsewhere. However, the success of passive housing is based on the assumption, that reducing energy will also reduce environmental impacts. With a life cycle perspective it is clear that it is not the use of energy, rather the production of energy that is causing environmental impacts such as climate impacts. Still, most of the life cycle studies consider rather energy than environmental issues (Satori 2007). The question for the constructor is: do passive housing have better environmental impacts than conventional housing? This question will be answered with the example of three passive housing in Sweden and four conventional housing in Sweden.

This study is based on three levels similar to (Raab and Brunklaus 2012) to give the constructor an overview about those products and to gain important information for producers:

1st level: Environmental impacts of passive and conventional housing

2nd level: Constructors and other actors' possibilities for reducing environmental impacts

3rd level: Constructor's influences on their own and other actors' actions

METHODS

Data for the comparison of passive housing and conventional housing in Sweden are based on energy studies of Adalberth (2001) and Thormark (2007), described in Brunklaus et al (2010).

The energy for passive housing is connected to an electrical cartage, while the energy for conventional housing is connected to district heating.

The method used to calculate the environmental impact is based on the Life Cycle Assessment (LCA) methodology. Instead of using ready made LCA programs, calculation have been performed in excel, which is more appropriate within the development of the LCA methodology. Furthermore, this study has further developed the actor analysis (Berlin et al 2008) and the distinction of three levels, adapted from Brunklaus (2011). The actors of the building chain are the material producer, transport company, the building constructor, the residents, and the district heating company. Due to this actor analysis, the direct environmental impacts and possibilities of constructors and other actors can be shown. Furthermore, the constructors' influences on their own and on the others' activities can be analyzed.

RESULTS

The results are based on the calculation in 2008 and the article in 2010 (Brunklaus et al 2010). The following examples chosen are on climate impacts and acidification impacts (1st level).

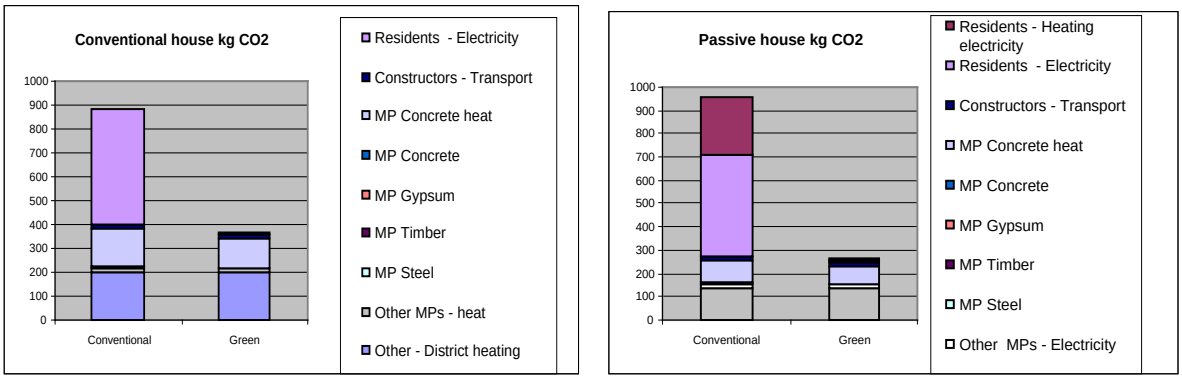

Figure 1: kg CO2-eq for passive housing and conventional housing in Sweden (based on Brunklaus et al 2010)

GWP: Conventional housing with district heating in Stockholm shows in total 900 kg CO_2-eq and half of them are caused by residents, and passive housing in Lindås shows in total also about 900 kg CO_2-eq. Figure 1 is based on average results of the studied buildings.

AP: Conventional housing with district heating in Stockholm shows in total 3200 kg SO_2-eq and half of them are caused by residents, while passive housing in Lindås shows in total over 4000 kg SO_2-eq.

Both conventional and passive housing have residents as their main contributor, both regarding climate impacts and acidification impacts.

The constructors' possibilities of reducing environmental impacts are low while other actors have larger possibilities (2nd level). Those green actions are: choosing renewable based electricity for residents, choosing renewable based production for material producers, while transport does not effect the result too much. Figure 1 "green" shows the results when all actors in the chain do make their green choices.

The constructors' influence (3rd level) on other actors can be direct or indirect. In this case the constructor can influence the residents, as well as the material producer and the transport directly, while the district heating companies can be influenced indirectly. Direct influence means also more power. Indirect influence is evident with all actors, since it keeps the building chain together, such as waste and recycling companies.

The results show passive housing is not always better than conventional housing, when residents do not make green choices. Together, the constructors' low possibilities and high influence on other actors, gives another picture of constructors' role and responsibilities. Constructors can influence residents and material producers directly. The introduction of passive house technology shifts responsibilities from building constructors to residents, which is not currently communicated.

DISCUSSION

The results show that we need to consider several actors in order to decrease the environmental impact of buildings, such as material producers and residents. This need to collaborate within the building chain is recognized by Cooper et al (2008).

The three analysis levels in the actor analysis in combination with LCA give new insights, like in the study of the food chain (Raab and Brunklaus 2012). Important and new knowledge could be gained especially for building constructors and residents. For constructors and residents the energy label is a start to raise awareness of environmental issues in buildings. On the one hand, energy labels are not enough, environmental requirements on energy production need to be set as well. And besides residents, municipalities have larger possibilities to set requirements here. On the other hand, other environmental and social impacts based on Life Cycle Assessment; such as health and socio-cultural issues might be important as well. The Swedish conventional housing is based on district heating, which has quite good environmental performance; while others European housing might use gas or wood-based resource for heating. The introduction of passive housing shifts the environmental impact from district heating to electricity production, which means larger possibilities for municipalities and residents.

CONCLUSIONS

Does passive housing really have better environmental performance than conventional housing? Three passive houses and four conventional houses were compared using a life cycle assessment (LCA) methodology. The comparison also provided an actor analysis for the building supply chain and building inhabitants. Actor analysis shows that inhabitants' and material producers' electricity choice are very important, while other choices (e.g. green

transport) are less important. The introduction of passive house technology shifts responsibilities from building constructors to municipalities and residents, which is not currently communicated. To avoid shifting responsibility within the building chain and to meet future trends, such as the recent trend of building passive housing in sheet metals or with district heating, communication needs improvement. For constructors' green strategy, decisions on renewable material production and renewable energy production are important. The findings give suggestions highlight the importance of environmentally responsible decisions throughout the whole life cycle and the need for appropriate behaviours and actions, along with implications for improved set of requirements and collaboration.

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