

# Kouvola housing fair NZEB houses energy, cost & carbon analyses

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## Introduction

- Buildings are considered as one of the main source of **energy consumption** and **CO<sub>2</sub> emission**,
- Improving the energy efficiency and reduction of CO<sub>2</sub> emission **may require additional investment**,
- Based on **dynamic simulation approach**, the lowest cost of NZEB in many European cities has reported,
  - balanced heat recovery ventilation system, façade with high utilization of daylight, efficient HVAC, weather-related measures
- Many studies have stressed **to use timber elements instead of concrete elements** in NZEB to reduce GHG emissions,

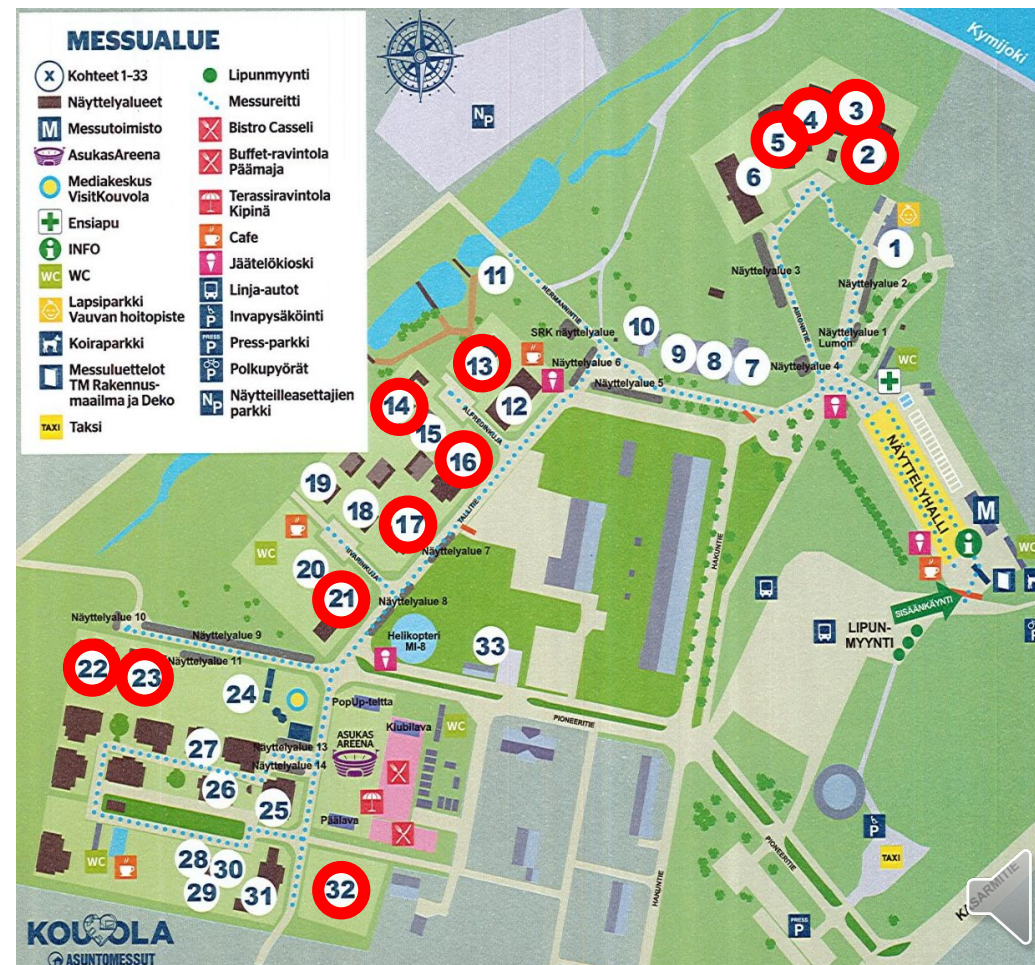
## Research Question

- What is the **investment cost** or cost segments of NZEB detached houses in Kouvola housing fairs?
- How much **the operational energy** cost and **CO<sub>2</sub> emission** of the district buildings?
- What is the impact of different **structural material solutions** on CO<sub>2</sub> emission?



# Methods

- Collected detailed investment cost data,
- Estimated CO<sub>2</sub> emission from wooden building, Insulated concrete building, blockhouse & log house,
- Life cycle assessment (LCA) for 50 years.





## Description of distric buildings

- Heat recovery ventilation units,
- Temperature ratios are 70 - 77% (8 buildings) and 55% (3 buildings),
- Specific fan powers were 1.16 to 1.8 kW/(m<sup>3</sup>/s),
- Heat source: District heating, air to water heat pumps and fireplace,
- Heat distribution system: underfloor heating, supply air heating.

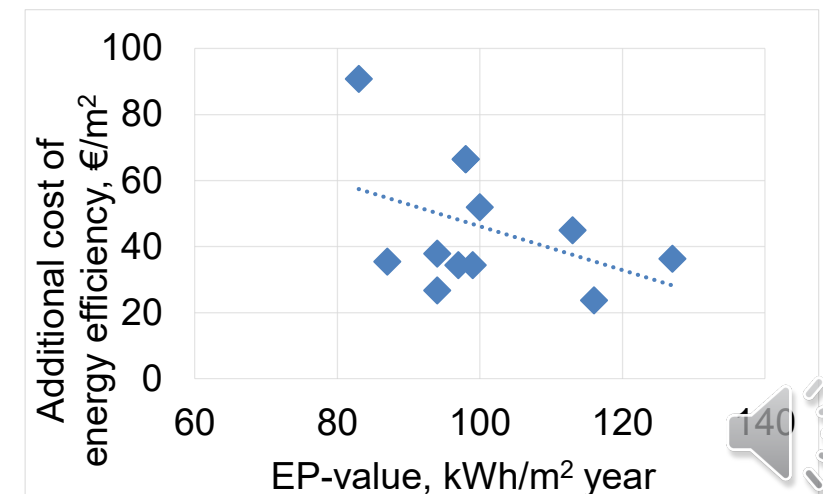
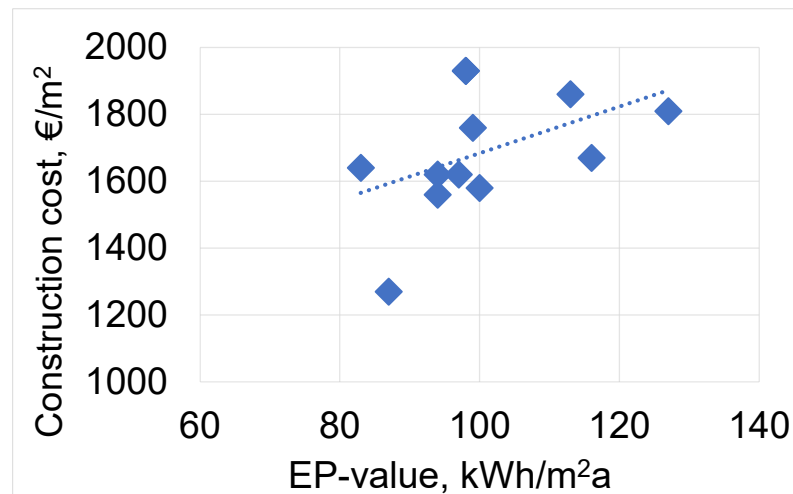
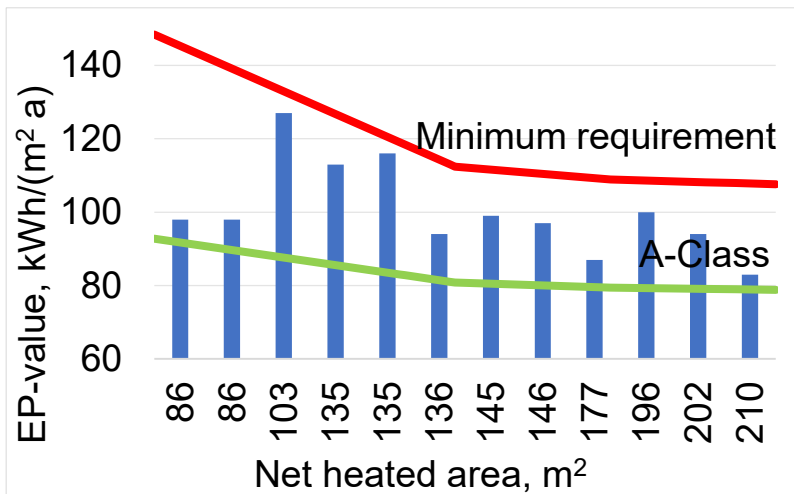
Building elements	U value
Exterior walls, W/(m <sup>2</sup> K)	0.16 - 0.17
Roof, W/(m <sup>2</sup> K)	0.08 - 0.09
Ground floor, W/(m <sup>2</sup> K)	0.11 - 0.17
Windows, W/(m <sup>2</sup> K)	0.84 - 1.0

Window g-value is 0.47 - 0.64 (dimensionless)



## Results and discussion

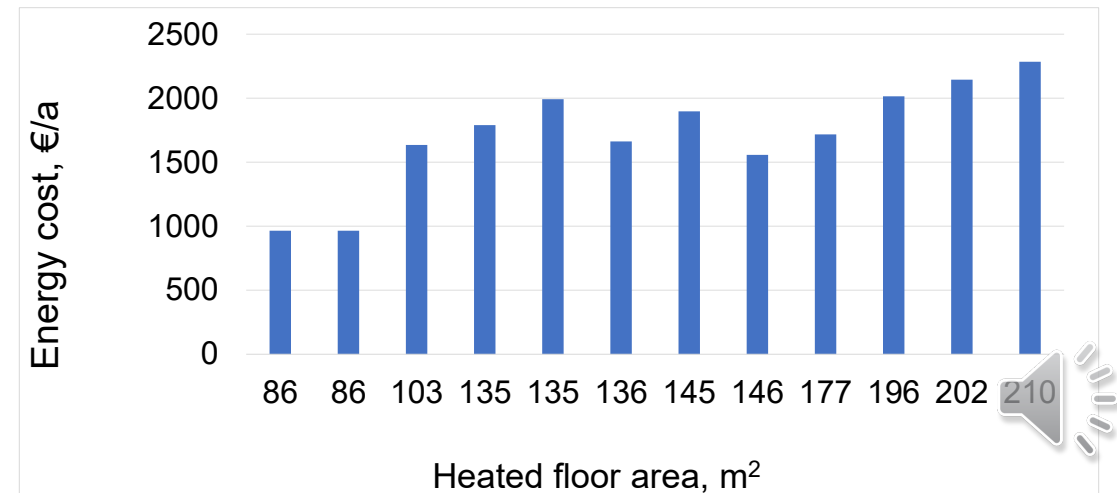
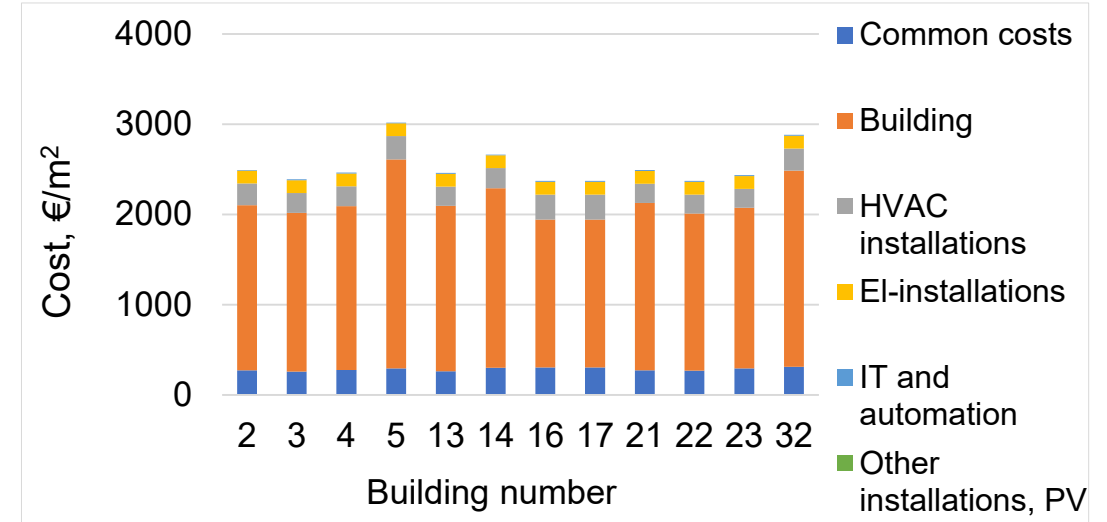
- All buildings achieved energy certificate **Class B (Finnish NZEB)**,
- Average EP value is **slightly higher** compare to EP value at the Tampere 2012 housing fair,
- **Negative correlations** between EP value and construction cost,
- Energy performance related additional cost was calculated relative to **electrical heating** and **minimum reference U-values** specified in the regulation,
- Improvement of **40 units of EP-value** has additional construction cost **less than 30€/m<sup>2</sup>**.





## Results and discussion

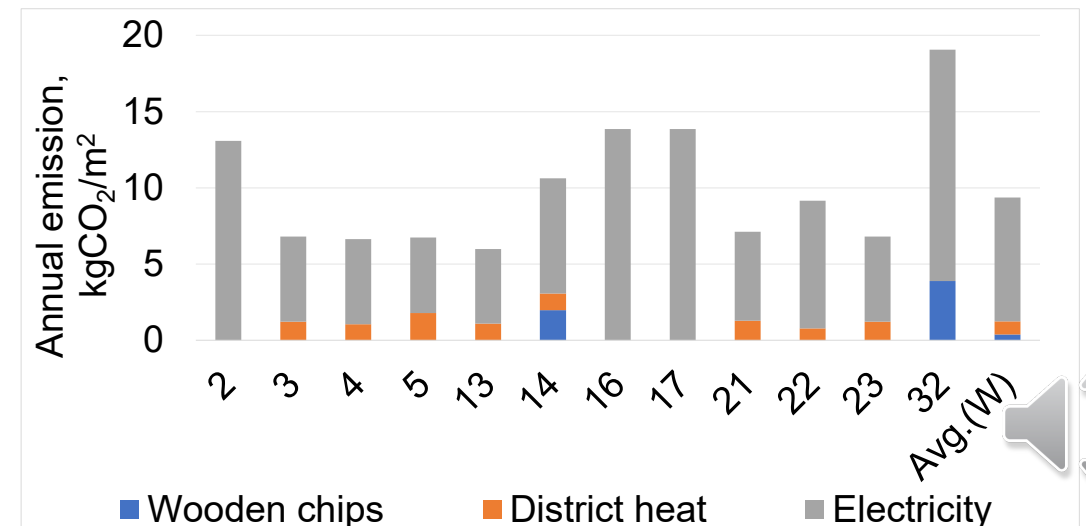
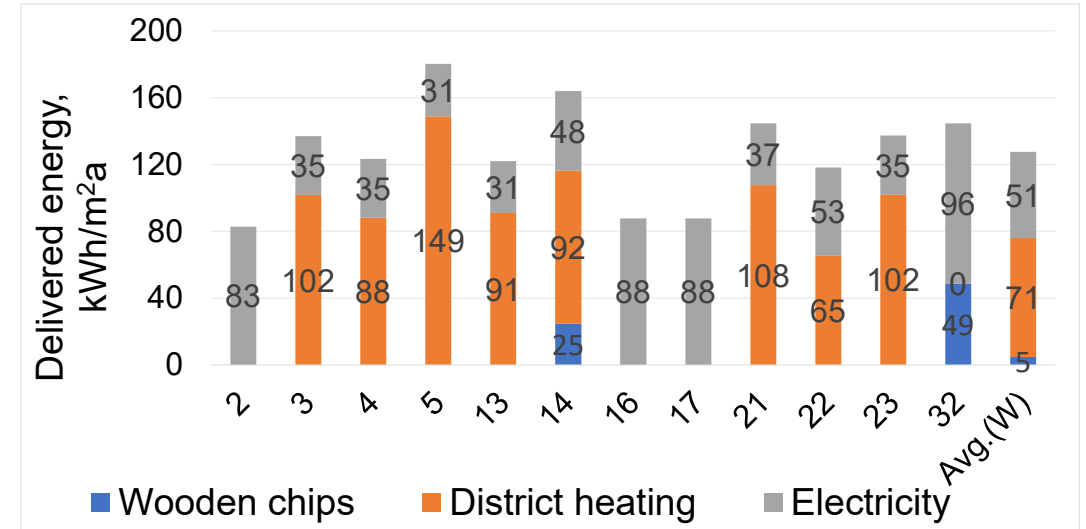
- Total cost - **construction** related cost is prime cost,
- Unit cost - **2371 to 3019 €/m<sup>2</sup>**
  - Shape, height, window to wall ratio, finishing materials, building story.
- Energy costs depends on **technical solutions**,





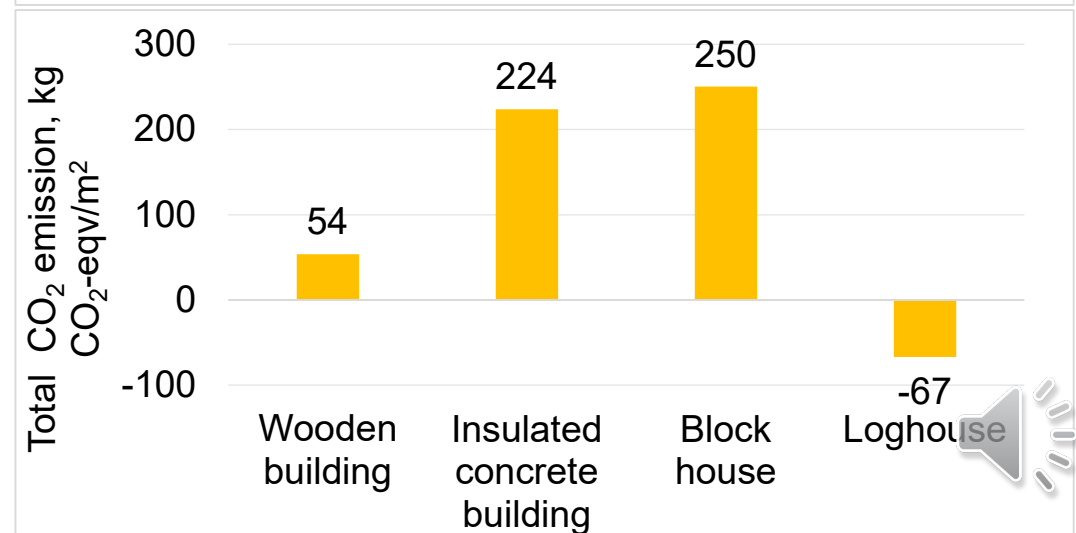
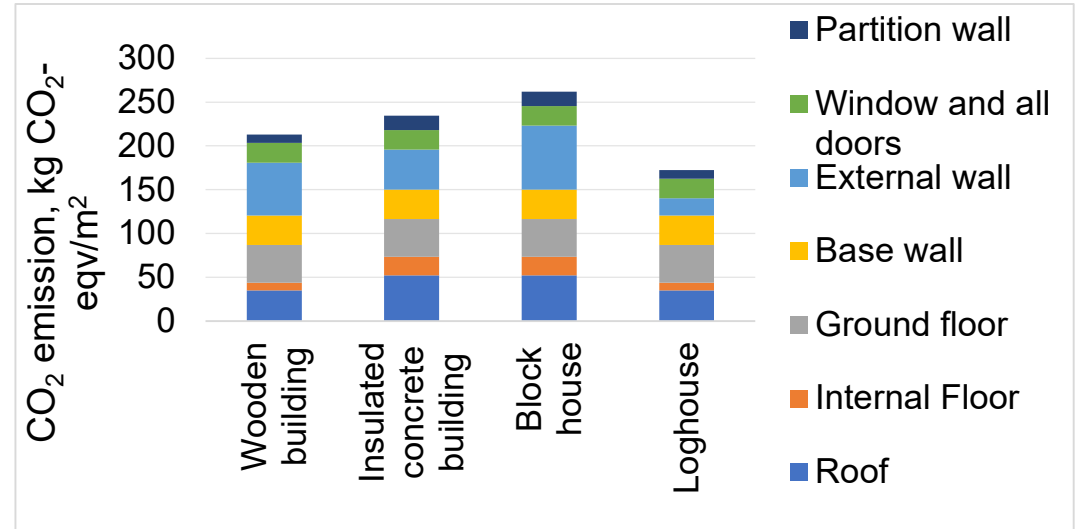
## Results and discussion

- High electricity consumption - High emission,
- District heating produce low CO<sub>2</sub> emission.



## Results and discussion

- Low emission – **Log house, Wooden building,**
- Wooden building stored a large amount of carbon,
- **External wall & floor finishing** materials are prime contributors,
- The log house's carbon balance was negative.

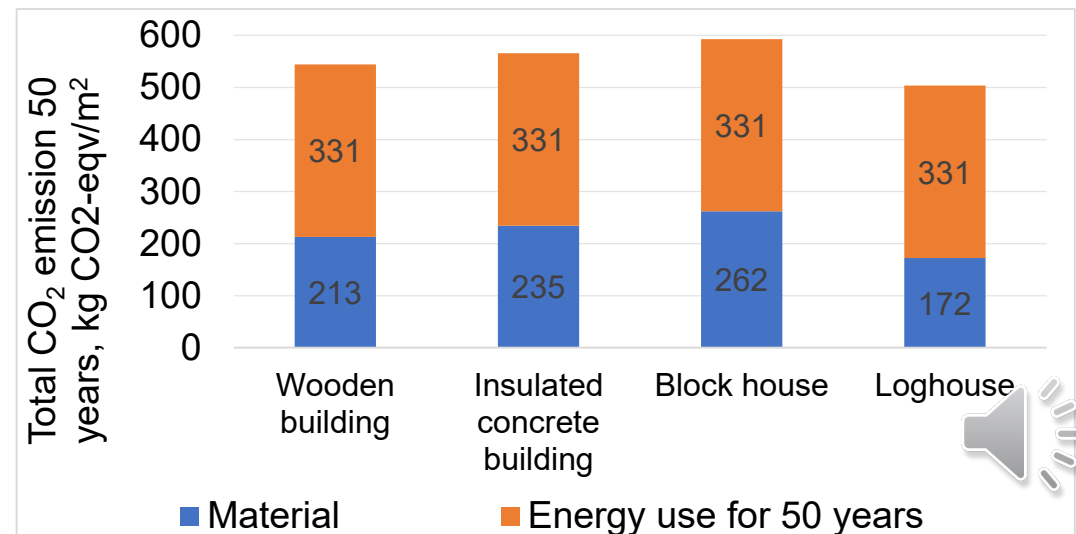
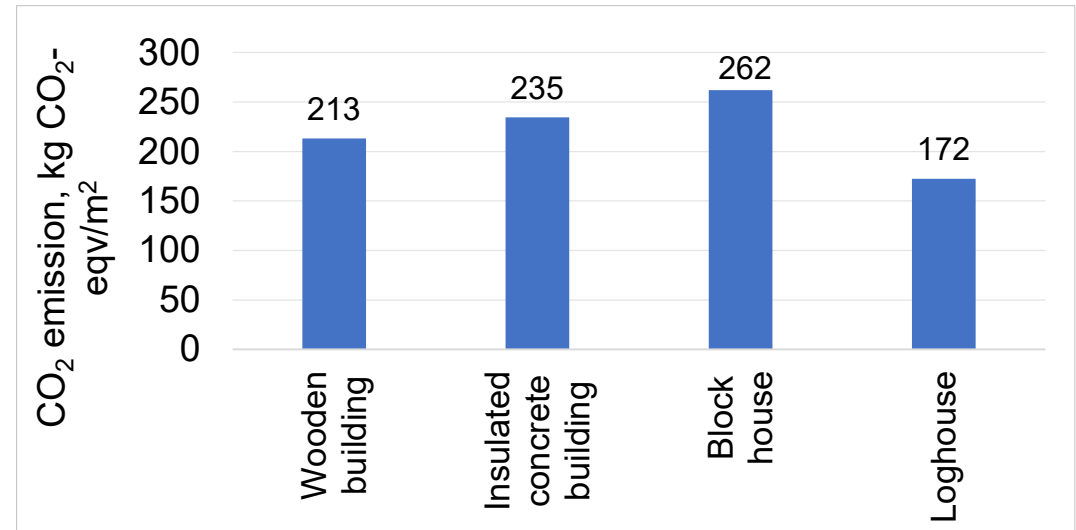






## Results and discussion

- Emissions – DH (11.75 kgCO<sub>2</sub>/MWH) & Electricity (158 kgCO<sub>2</sub>/MWH),
- Operational emissions were dominated one over construction one.





## Conclusions and future research

- All buildings achieved energy certificate **class B** so that energy performance **was close to NZEB limit**,
- Average EP value is **slightly higher** compare to EP value at the Tampere 2012 housing fair,
- **Negative correlation**, i.e. more energy efficient houses had a lower cost,
- EP-value is improved by **40 units** by increasing the **construction cost of 2%**,
- Key factors for increasing the construction cost - **irregular shape and height, double storied building, floor finishing materials**,
- **Electricity** contributes high CO<sub>2</sub> emission,
- **Wooden buildings** are found as environment-friendly,
- CO<sub>2</sub> emissions of **operational energy** dominated with about 60% share over materials,
- Contribution of material emissions to overall emission will increase due to declining CO<sub>2</sub> emissions from power generation in future.



# End of the presentation

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