

# Green energy in buildings in Kongsberg and Øvre Eiker

Hallvard Benum  
EnergyEngineer



**KONGBERG**  
KOMMUNE



**ØVRE EIKER**  
Kultur og livskraft

# Agenda

Some history of Kongsberg  
municipal building management

Examples from buildings in  
Kongsberg and Øvre Eiker

How to get there

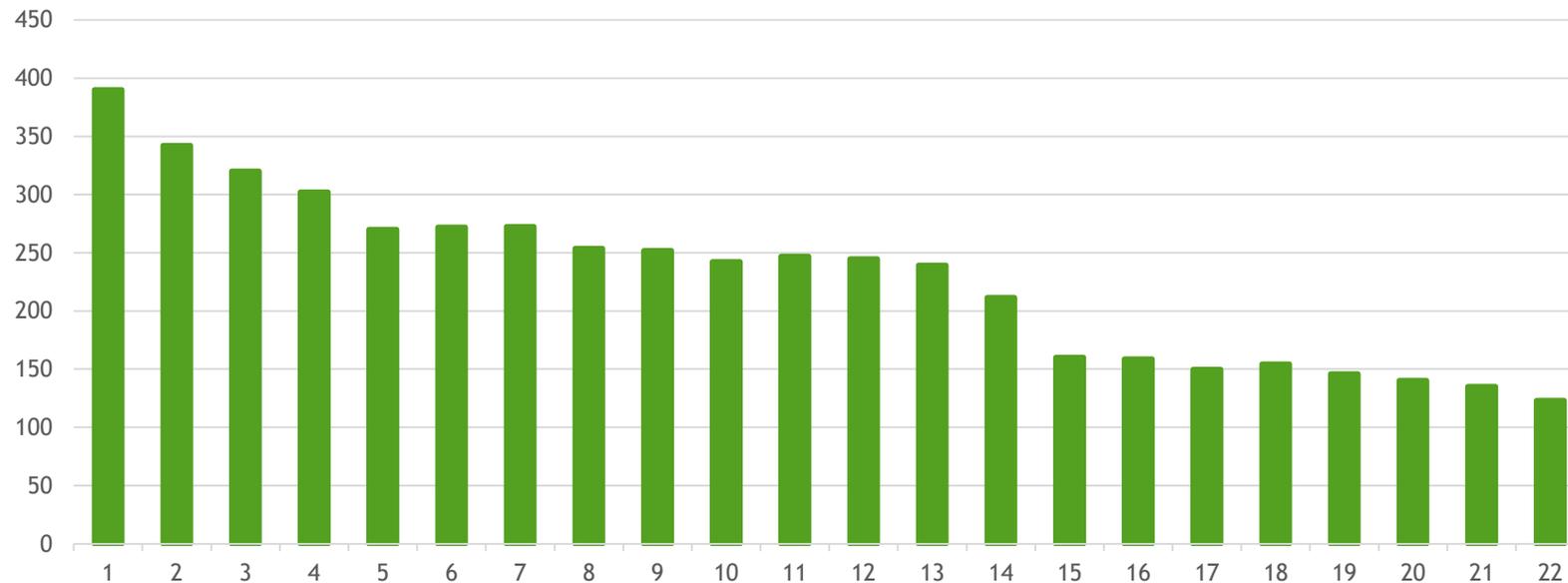
We work towards these  
UN sustainability goals.



# Some History

- ▶ Dedicated resources to reducing energy consumption was introduced when the building department of the municipality was made an independent municipal company in 2001.
- ▶ The reduction has undergone three distinct phases.
- ▶ First the «easy reaping» measures such as schedulers for ventilation and heating systems (2001 - 2005), Then a phase with slightly less rewarding measures. (2005 - 2013), and then the massive EPC which gives rapid reduction again. (2013 - 2015). Further on the energy producing measures has the greatest effect. (2019 - future).

Energy consumption pr. m2 for the period 2001 - 2022



The municipal building company has now reduced the specific energy consumption down 69% from the 1990-levels.



# From reduction to production of energy

- ▶ When energy consumption reaches an acceptable level the next step is to produce energy for the buildings.
- ▶ The goal is a society with zero emissions so there is no reason to try for anything less!
- ▶ Our first attempt at this was Vestsiden secondary school, followed by an apartment building for the elderly and then Skavanger primary school.
- ▶ All buildings commissioned after 2016 is built with the ambition of being an energy positive building.





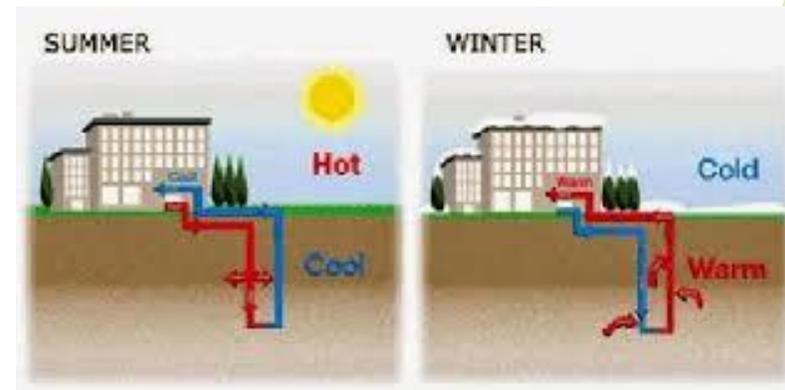
# Examples of buildings

# Vestsiden secondary school was constructed in timber with solar power and seasonal hydrogen storage



# Quick facts about the building

- ▶ Room for 15 classes of students
- ▶ Capacity of 480 students
- ▶ 4800 square meters
- ▶ 2100 square meters multiuse sports hall
- ▶ Was built in Cross Laminated Timber (CLT)
- ▶ The energy is supplied by geothermal heatpumps and solar panels.
- ▶ There is energy stores in battery, thermal and very soon also hydrogen.

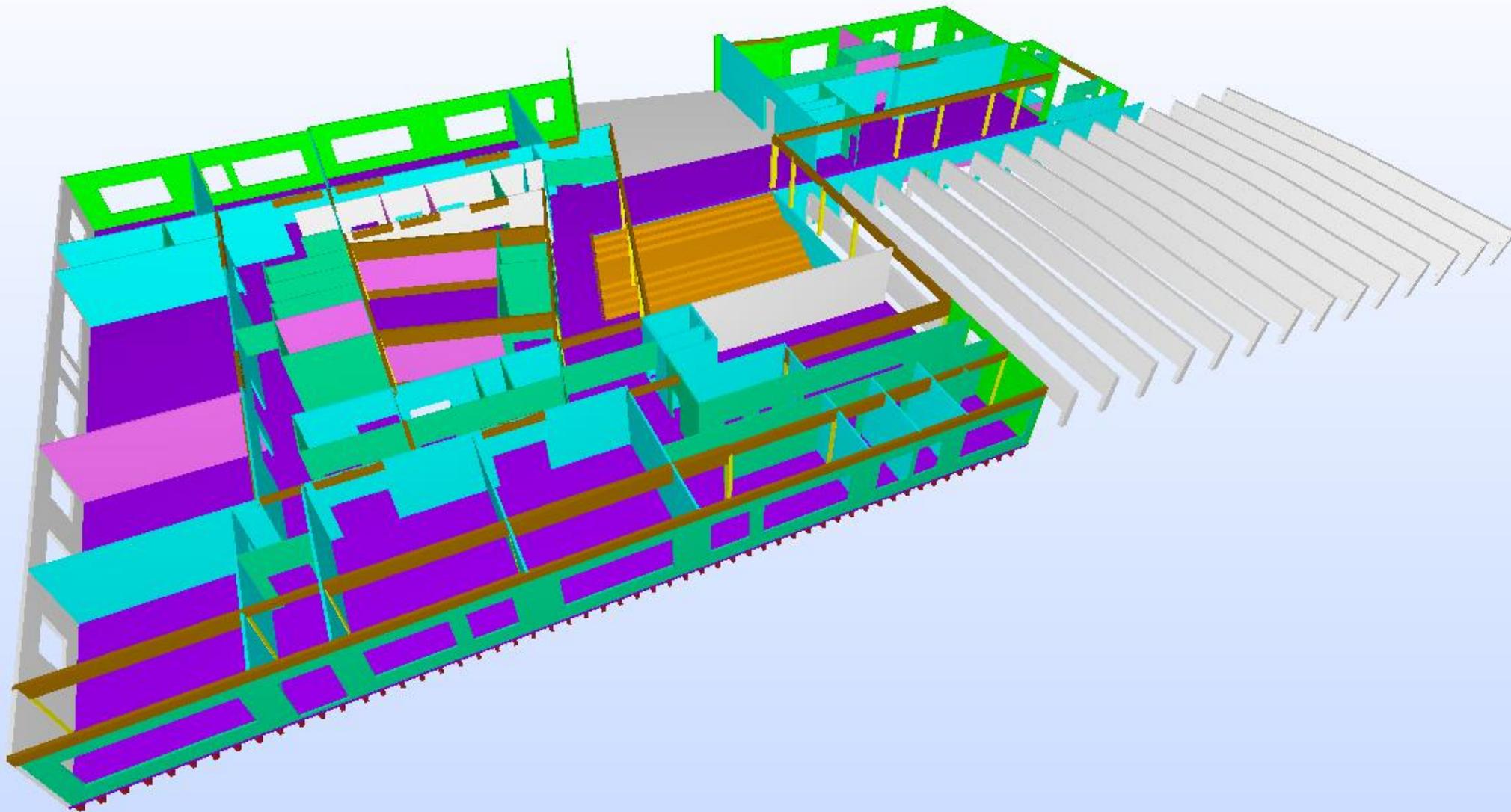


# Cross laminated timber

- ▶ Wood is a renewable resource that binds  $\text{CO}_2$ .
- ▶ The building weighs less and foundation then needs less steel and concrete.
- ▶ Wood is hygroscopic and gives a natural moisture balance which enhances the indoor climate in the building substantially.
- ▶ Even though the materials are more expensive, with the right logistics the building can be built a lot faster and become cheaper.



## Some of the CLT-elements at Vestsiden





## CLT – 920 m<sup>3</sup>, Limtre – 400 m<sup>3</sup>

CLT (Cross Laminated Timber) blir produsert av Stora Enso i Østerrike

4 651	<p>4 651 trær ble brukt til å bygge CLT prosjektet Vestsiden studentboliger, hua A og B.</p> <ul style="list-style-type: none"><li>• 60% av trærne ble brukt til byggemateriell</li><li>• 40% av trærne ble brukt til å lage papir, emballasje og energi</li><li>• Det er null-svinn av råvarene</li></ul>
1,5	<p>Det tar 1,5 timer for denne mengden trær å vokse i de Østeriske skoger på en sommerdag.</p>
3 853	<p>3 853 tonn er mengden karbondioksid som ble fjernet fra atmosfæren da dette ble bygget i CLT.</p>
182	<p>Når tiden kommer for å resirkulere disse CLT prosjektene, så kan materialene benyttes til å lage energi. 182 boliger kan varmes opp i ett år med denne mengden CLT.</p>
408 690	<p>Totalt 408 690 kg med fossil fyringsolje spares når rester etter hugging og revet byggemateriale blir brukt som energi.</p>

# The Energy system

- ▶ The production of heat is covered by a propan geothermal heatpump and a co2 geothermal heatpump for hot water.
- ▶ Production of electricity is covered by a 300 kWp solar panel system.
- ▶ The energy system has a shortterm storage in battery and thermal for running the school in evening and cutting energy peaks.
- ▶ The battery storage is today 50 kWh, we hope to expand it to 500 kWh.
- ▶ The thermal storage is 8000 liters.





VESTSIDEN UNGDOMSSKOLE

# Seasonal storage in lowpressure Hydrogen

- ▶ An electrolyser of 8kW will produce hydrogen with solar electricity in the summer and a fuelcell of 8kW will produce heat and electricity in the winter.
- ▶ The heat in both processes will be captured and used in the building.
- ▶ The hydrogen will be stored in metal hydrides which gives a compression close to liquid hydrogen with pressures of only 10 bar.
- ▶ We have now started a research project in collaboration with the university and two local companies that will develop an advanced control and optimization system for all the different energyflows in the microgrid that Vestsiden highschool encompasses.
- ▶ The storage will contain up to 83 kg of hydrogen equivalent to 3500 kWh.



# Edvardsløkka, apartments for the elderly



# Edvardsløkka, apartments for the elderly



# The building and energy use.

- ▶ Built in Cross Laminated Timber with some concrete for thermal storage.
- ▶ The apartment part of the building is energy positive with solarcells for power.
- ▶ It has 220kW of solar cells, and a 100kWh battery installed.
- ▶ The building also contains the main kitchen that supplies all the elderly homes in Kongsberg with food.
- ▶ The Lowex-system developed by Skanska is used for heating. It is underfloor heating and cooling.
- ▶ It achieves very good efficiency, since the working temperature can be so low, and varies minimally.
- ▶ We can then use very specialized heatpumps that has a great COP.
- ▶ The building also utilizes the heat from the cooling processes in the kitchen.

# Skavanger primary school



# Nye Skavanger skole



- ▶ Also built in cross laminated timber. And this was made by our neighbour municipality Modum. Very short traveled.
- ▶ Also a energy positive building with energy production from solarcells.
- ▶ The Lowex-system developed by Skanska is used for heating. It is underfloor heating and cooling. And gives a very high COP for the specialized heatpump.
- ▶ The building of 3500 m<sup>2</sup> is heated only with 15 kW when it is -10 degrees outside.
- ▶ It has a 100kWp of solar cells installed.

# Loesmoen primary school

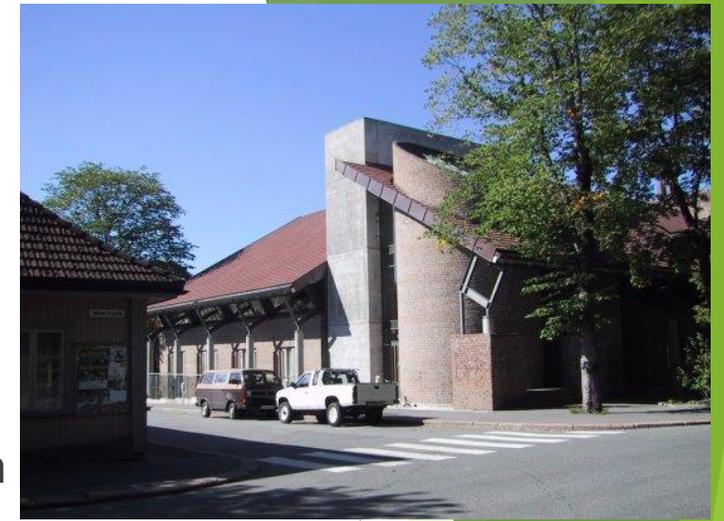


# The building and energy solution

- ▶ Being built on the same principles as Skavanger primary school.
- ▶ Skanska is building with the lowex heating and cooling system.
- ▶ An extra challenge for this building was the very great depth of the bedrock. We had to drill about 100 meters in soil and clay before we hit the bedrock.
- ▶ Therefore it was decided to drill especially deep wells, 500 meters.
- ▶ It will be interesting to see how these work since the great depth will give some extra heat that might give a bit less cooling.

# The buildings that are already there Kongsberg Town hall

- ▶ Geothermal heatpumps installed in addition to the old electric and oil - boiler.
- ▶ The heatpump is installed on the return water in the heating system to maximise the utilization.
- ▶ The electric boiler takes the peak heating on cold days, and the old oil - boiler can run the heating system without electricity for emergencies.
- ▶ The savings are almost 40%  
ca. 450 000 kWt annually.
- ▶ Government grant through  
EPC-project, 15%  
of the investment



# Øvre Eiker Town Hall

- ▶ Geothermal heatpumps installed in addition to the old electric and oil - boiler. Oil-boiler is refurbished to run on bio-oil.
- ▶ This site also have great depth to the bedrock and here 14 wells of 400 meters are drilled
- ▶ The electric boiler takes the peak heating on cold days, and the old oil - boiler can run the heatingsystem without electricity for emergencies.
- ▶ The savings will be about 40%, ca. 700 000 kWt annually.
- ▶ Goverment grant of 10% of the investment.

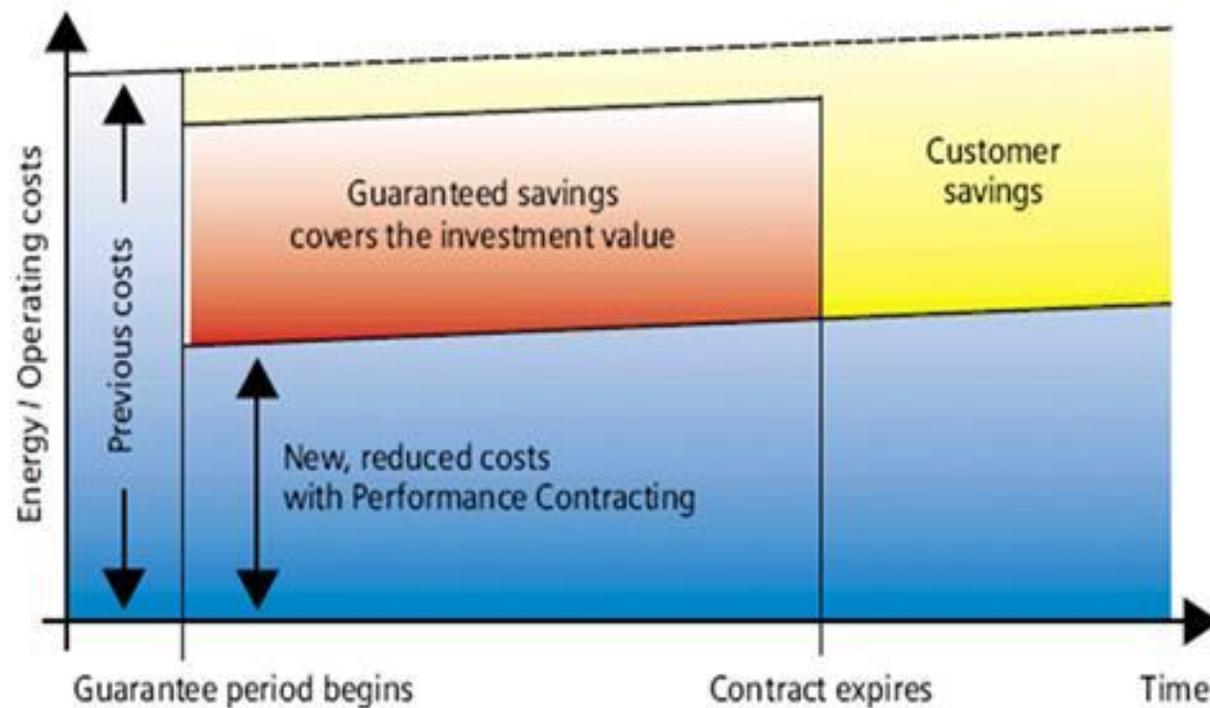


The background features a solid lime green area on the left, transitioning into a series of overlapping, semi-transparent green triangles and polygons on the right, creating a dynamic, layered effect. A thin white line runs diagonally across the right side.

▶ How to get there

# Energy Performance Contract

An EPC-project is very economically safe because the entrepreneur that performs the installation has to guarantee the energy-savings through the whole time of payback for the investment. If the energy savings do not live up to the prior analyses on which the contract is based the entrepreneur must pay the customer the inbetween cost.



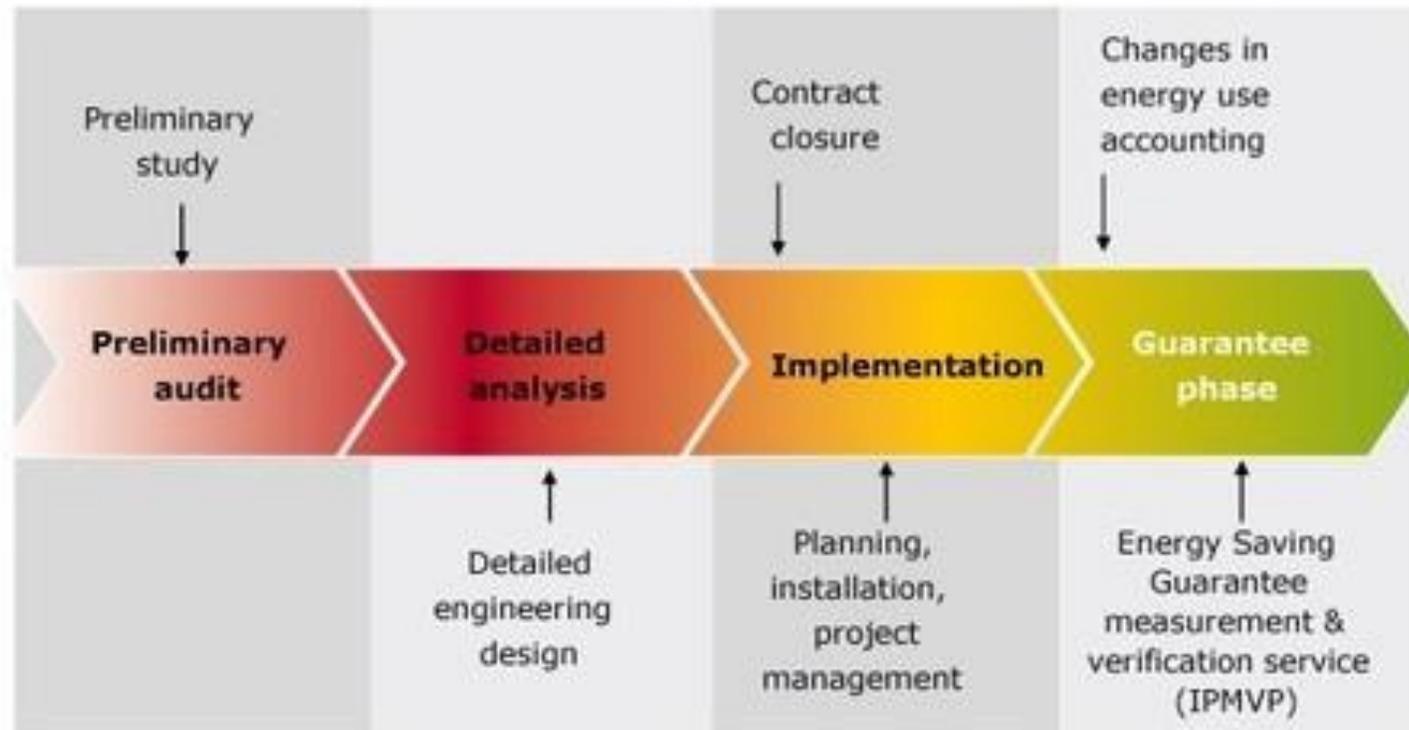
# Energy Performance Contract

This form of contract consists of three phases

Phase 1 is an analysis of the buildings and energy efficiency potential.

Phase 2 is the actual implementation of the measures found in phase 1.

Phase 3 is the energy savings guarantee phase

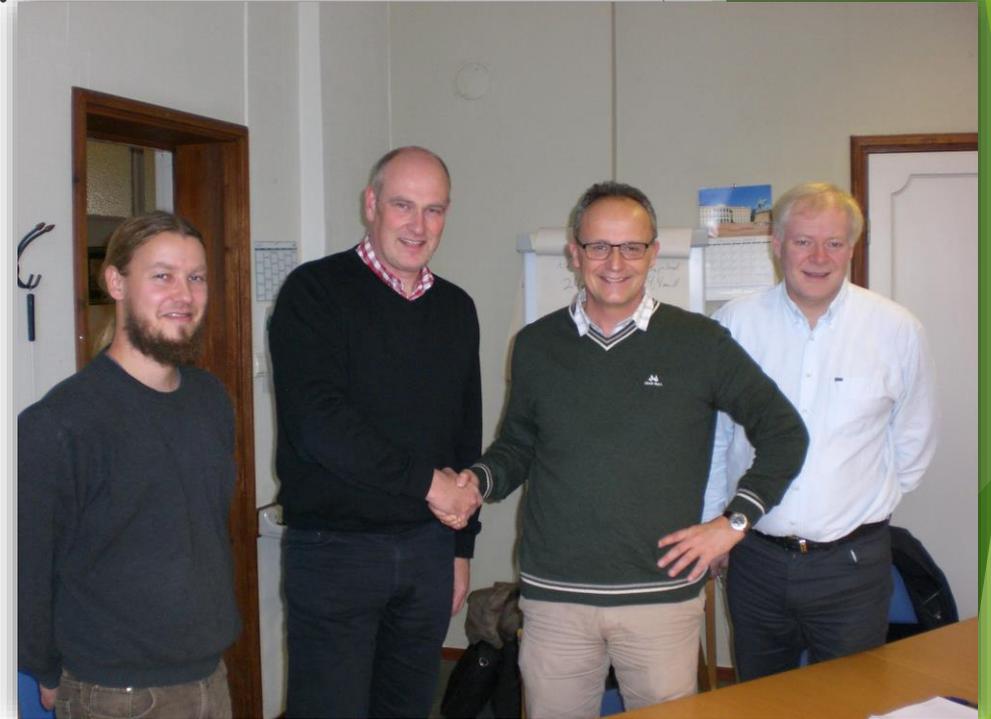


# EPC Benefits

1. The customer can invest heavy in efficiency-projects without any other financing than his own energy-bills. The energy-savings through the guarantee phase will pay for the investment.
2. The customer can get many efficiency-projects gathered in one big project with expert management.
3. Ensures high quality installations due to the guarantee phase from the entrepreneur.

# Kongsberg EPC

1. Phase 1 conducted in 4 months, July to Oktober 2012.
2. The contract for phase 2 included 32 buildings,  
Guaranteed energysaving of 36%,  
Energy reduction pr year is 6,35 GWh.
4. Contract value 46 million Nkr = 5,44 million Euros.
5. The investment is paid for by the energysavings in  
11 years. For that period Kongsberg has guarantee  
both for the energysaving and the equipment  
installed.



The background features a series of overlapping, semi-transparent green geometric shapes, primarily triangles and quadrilaterals, that create a dynamic, layered effect. The colors range from light lime green to a darker forest green. The shapes are positioned on the right side of the frame, extending towards the center.

Thank you for  
the attention!