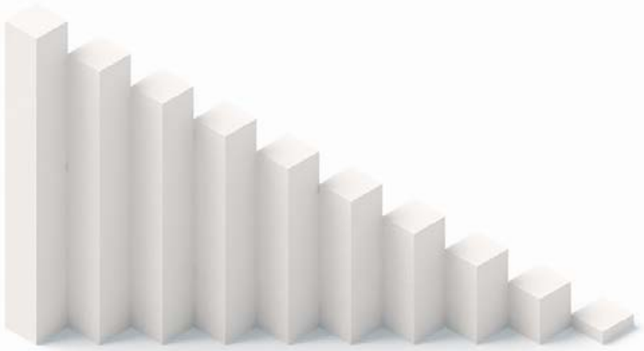
I. Reduction Roadmap



The Reduction Roadmap is initiated by:

The Reduction Roadmap is funded by:

The Reduction Target is set by:

“What happens in the next 10 years will likely determine the state of the planet we hand over for future generations.

Our children have every reason to be alarmed.

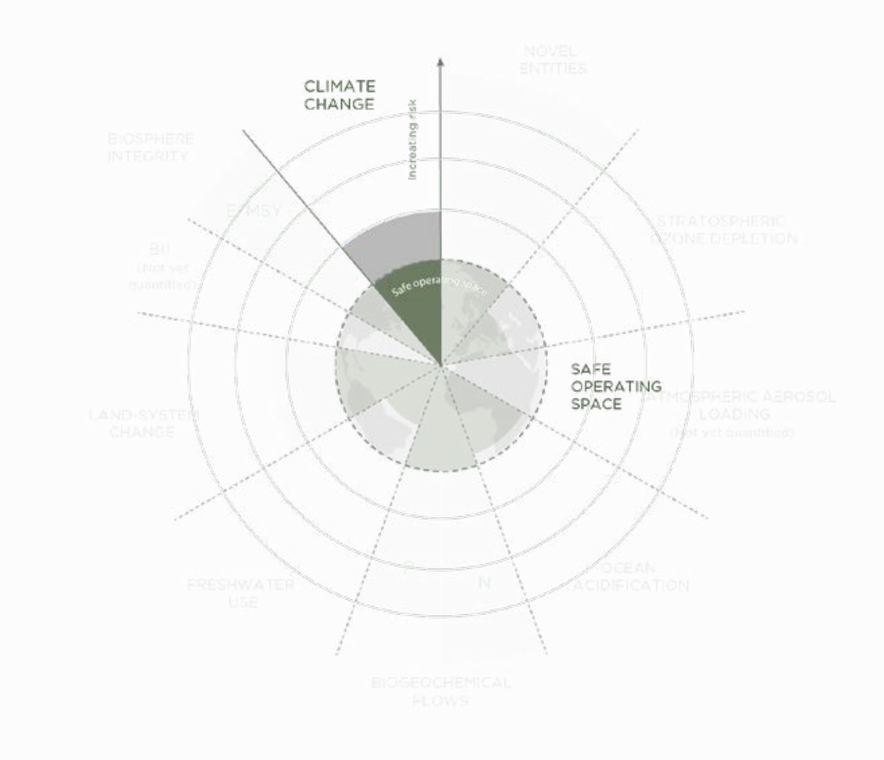
We need to get serious about stabilizing our planet.”

Johan Rockström, 2020,
Professor in Earth System Science

Planetary Boundaries

The Planetary Boundaries concept, defined by the Stockholm Resilience Center, makes visible a safe operating space for human impact on 9 essential planetary systems on a global scale. Once planetary thresholds are transgressed there is an increased risk of unexpected, irreversible, and abrupt environmental changes. Today, we have already transgressed 4 out of the 9 Planetary Boundaries. This means that we are in a zone of increasing risk and uncertainty about the future of life on planet Earth.

The Reduction Roadmap focuses on the impact of the building industry on the Planetary Boundary for Climate Change, which is affected by human emissions of greenhouse gases (CO_2eq). The Reduction Roadmap scales global greenhouse gas emission target levels, down to national, to industry-specific, to Danish housing - and finally to a target level.



Scaling global emsissions by 96%

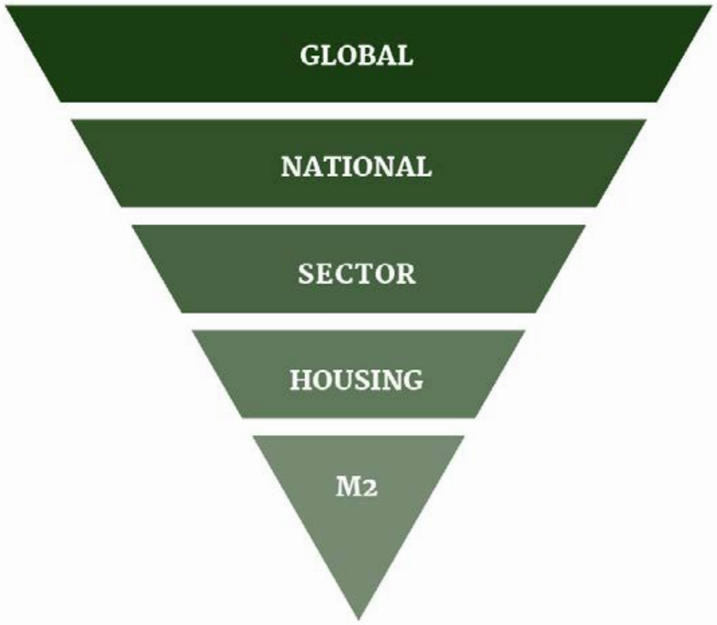
The Reduction Roadmap targets are based on findings documented in The Safe operating space for greenhouse gas emissions by Petersen, S. et al., (2022). Findings from this report tell us that globally we must reduce our emissions by 96% to reach the safe operating space, defined by the Planetary Boundaries. According to the IPCC AR6 (2021) report, we must do so within the next 7-14 years to stay within the Paris Agreement 1,5°C scenario for global warming.

If we continue emitting as we do today, we will use up the remaining carbon budget in the next 5 years. But if we begin reducing immediately, we can prolong the reduction timeline until between 2029 – 2036.

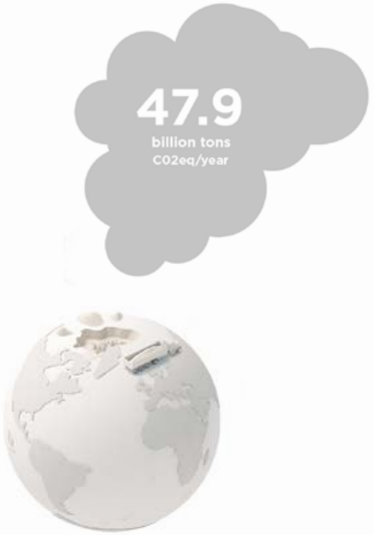
How do we allocate for the Danish building industry?

Allocation Principle

The Reduction Roadmap allocates the global emission budget and targets for the building industry. As such, we scale from global, to national, to industry, to housing, down to target emission levels. We do so by illustrating “today’s emissions” compared to “target emissions” levels. What we find is that a 96% reduction rate is needed for the building industry emissions.



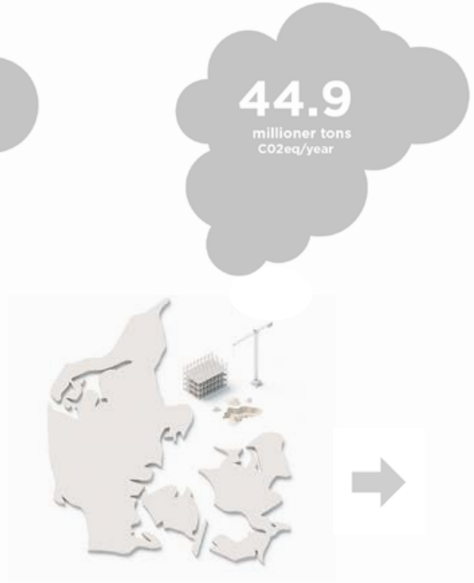
Emissions Today



Global Emission

In 2019, 46.9 billion tons of CO_2eq were emitted globally. (Climate Watch, 2022).

Emissions today



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In 2019, 46.9 billion tons of CO_2eq were emitted globally. (Climate Watch, 2022).

National Emission

Denmark emitted 44.9 million tons of CO_2eq in 2020 (EEA, 2022) exceeding the budget of 1.882.500 CO_2eq per year nearly 24 times.

44.900.000 tons CO2eq x .033 = 1.481.700 tons CO2eq

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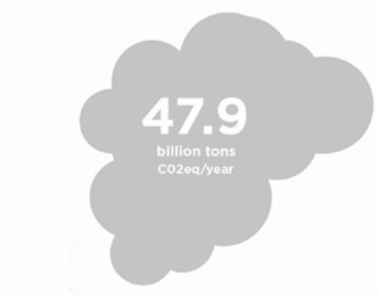
New housing emission

New housing accounts for 3,3% of all Danish carbon emissions, which is equivalent to 1.481.700 tons CO_2eq per year (Reduction Roadmap, 2022).

1.481.700 tons CO2eq / 3.072.000 m2 = .4824 tons x 1000 = 482kg CO2eq/ m2

Emissions today



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Housing Emission

On average Denmark builds 3.072.000m² of new housing each year (Devici, N.et al, 2020). This leads to an average emission level for new housing in Denmark, 482kg CO_2eq/m².

482kg CO2eq/ m2 / 50 = 9,6kg CO2eq/ m2/year

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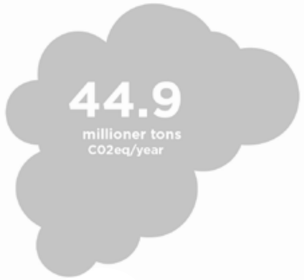

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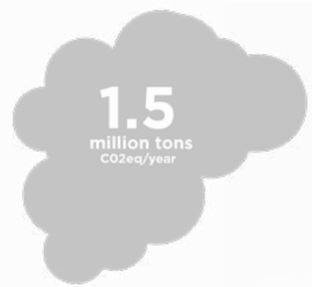

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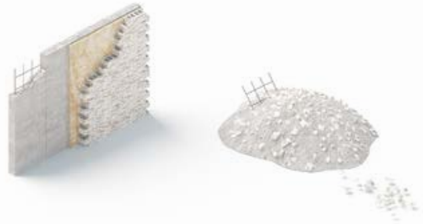


LCA emissions

Based on a 50-year reference period, the median footprint of Danish housing is 9,6kg CO_2eq/m² per year.

Emissions today

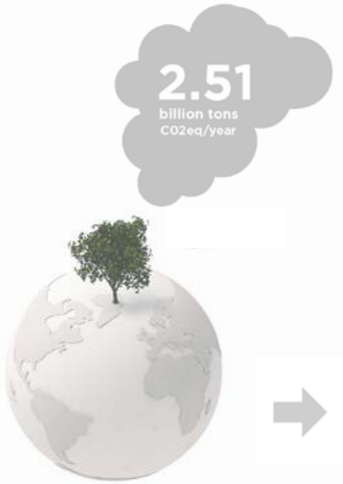
What´s our target

Global Target

The global carbon budget is 2.51 billion tons of CO_2eq per year (The Safe operating space for greenhouse gas emissions by Petersen, S. et al., 2022).

2.510.000.000 tons CO2eq x .075 = 1.882.500 tons CO2eq

Target emission



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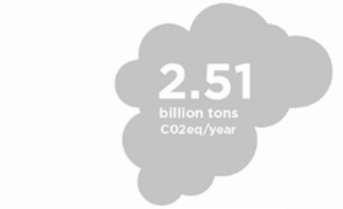
National Target

Denmark is allotted 0,075% of the global carbon budget (Paris Agreement, 2015). This equates to 1.882.500 tons CO_2eq per year for all carbon-producing activity in Denmark.

1.882.500 tons CO 2eq x .033 = 62.123 tons CO 2eq/year

Target emission



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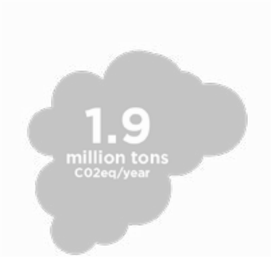

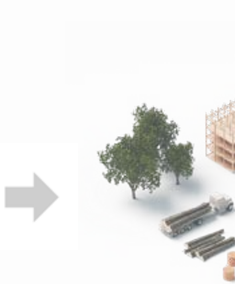

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New housing Target

If new housing is allocated the same share of the Danish carbon allowance in the future, as today then new housing in Denmark is allocated 3,3% of the total Danish carbon allowance, equivalent to 62.123 tons CO_2eq per year. (Reduction Roadmap, 2022).

62.123 tons CO 2eq/year / 3.072.000 m2 = .020 tons x 1000 = 20.22kg CO 2eq/m2

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20.22kg CO 2eq/m2 / 50 = 0.4kg CO2eq/m2/year

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20.22kg CO 2eq/m2 / 50 = 0.4kg CO2eq/m2/year

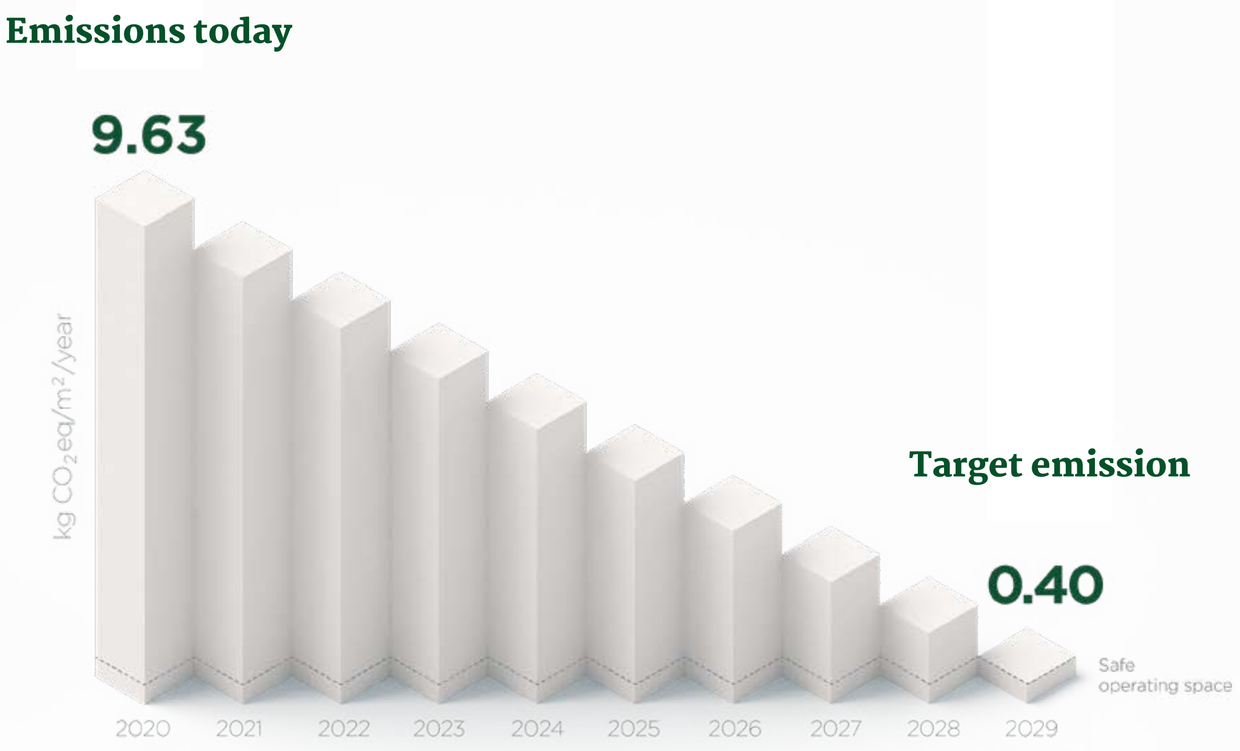
LCA target

Based on a 50-year reference period, the target footprint of Danish housing is 0,4kg CO_2eq/m² per year.

Target emission

Reduction Roadmap

From current emissins to target emissions
within planetary bounderies.



Reduction path

Scenarios

Global budget	Approximate global warming relative to 1850-1900 until temperature limit (°C)	Additional global warming relative to 2010-2019 until temperature limit (°C)	Estimated remaining carbon budgets from the beginning of 2020 (GtCO2)				
			17%	33%	50%	67%	83%
	1,5	0,43	900	650	500	400	300
	1,7	0,63	1450	1050	850	700	550
	2,0	0,93	2300	1700	1350	1150	900

To stay within the 1,5 degree warming scenario we have
a global budget of 300-500 Gt CO_2-eq emissions remaining (IPPC AR6)

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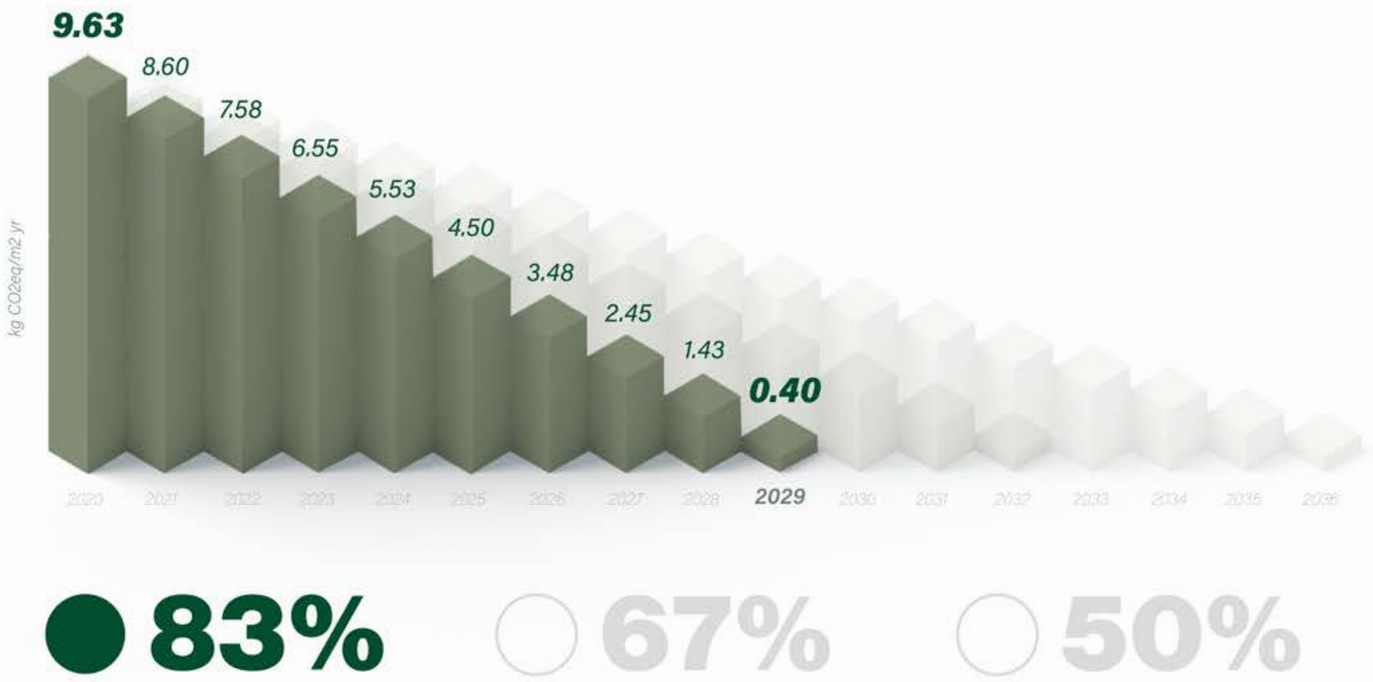
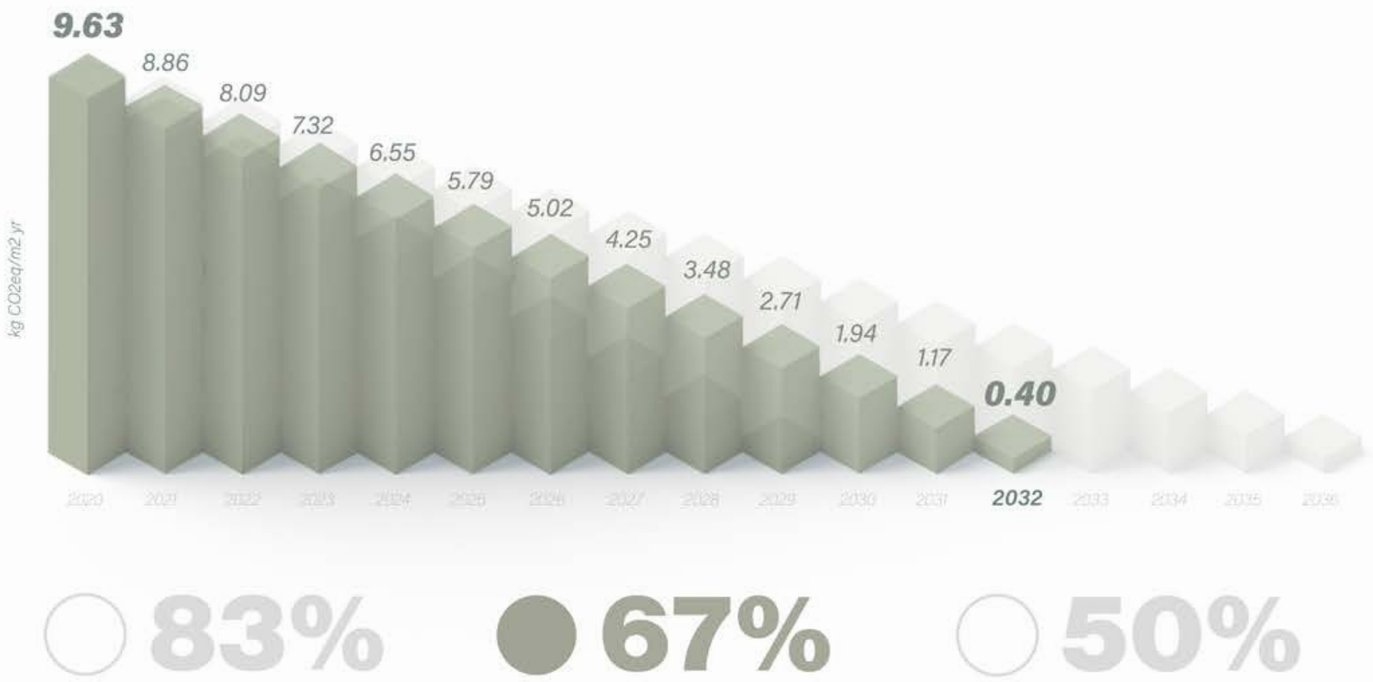
			17%	33%	50%	67%	83%
Danish budget	1,5	0,43	672	486	374	299	224
	1,7	0,63	1083	784	635	523	411
	2,0	0,93	1718	1270	1008	859	672

This allows for a Danish budget of 224 - 374 Mt CO_2-eq emissions.

How long do we have to reach the target?



From this Danish budget a linear reduction path can be drawn with different scenarios with different risk levels



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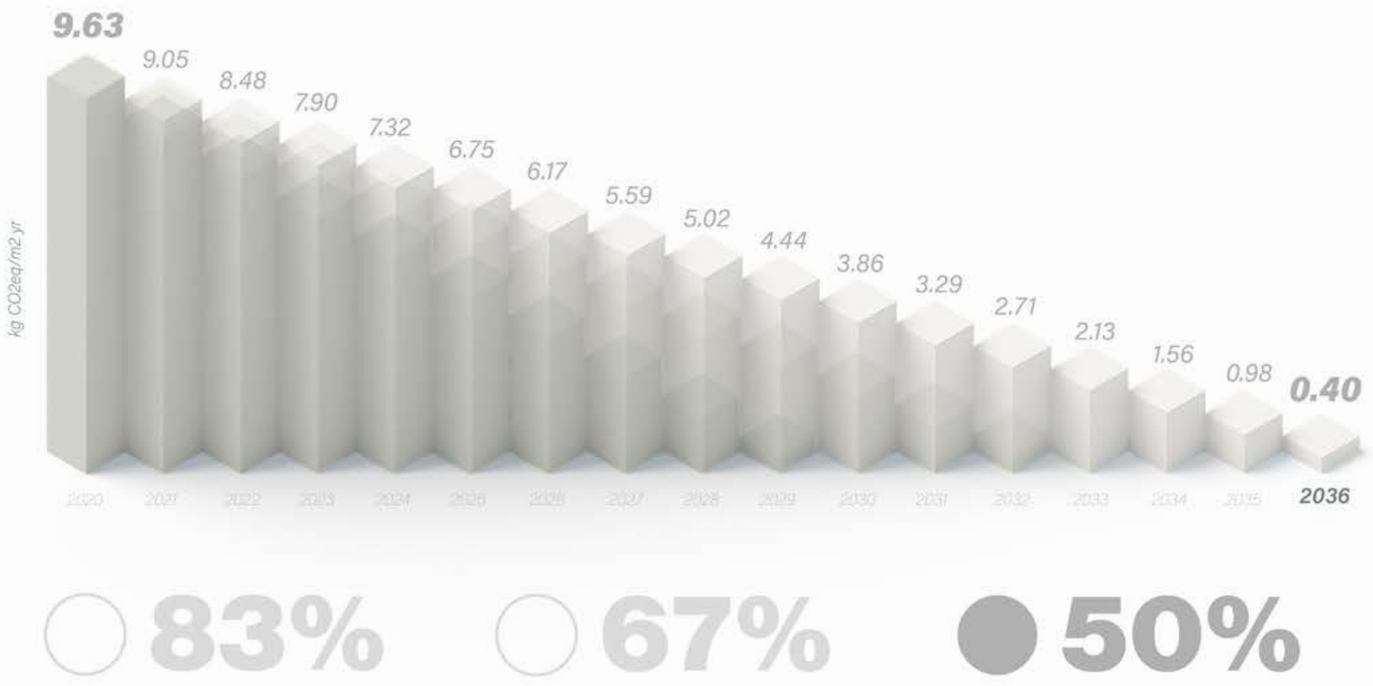
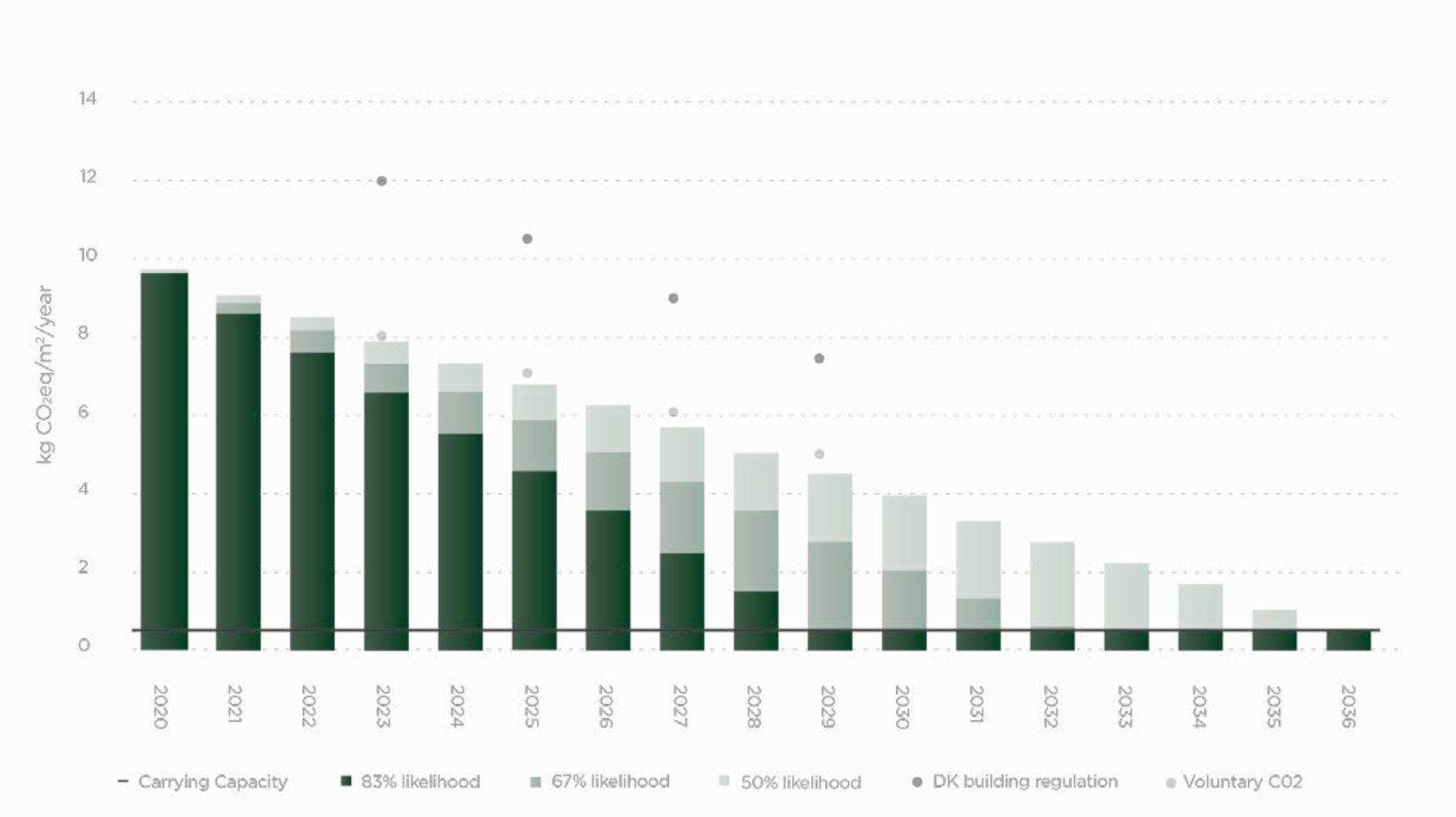
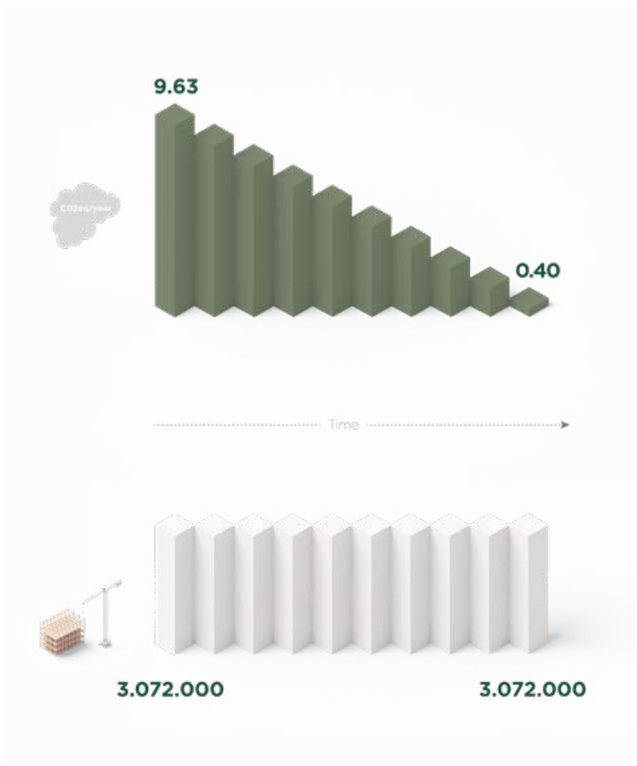


The 50% scenario for 1,5 degrees warming
is closing in on the 83% likehood for meeting 1,7 degrees warming.



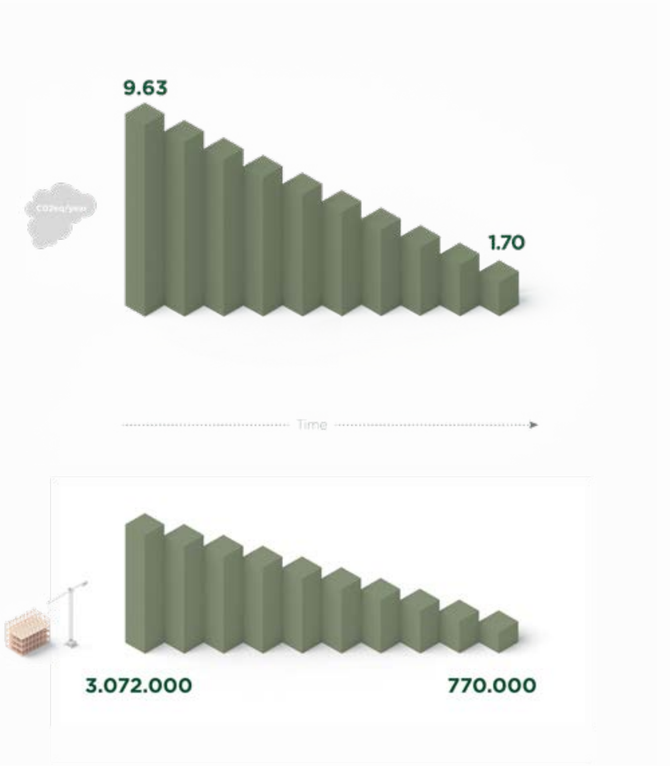
The target can be achieved in different ways

How do we reach the target?



Reduce emissions, while building at a constant rate

Same level of emissions, with a reduced rate of construction



Reduce emissions, while also reducing the rate of construction

Set an annual limit to the number of permitted square meters each year to reduce the amount we build.

(Legislators)

Life on less space, reduce the square meters per person.

(Citizens)

Reduce emission by selecting low-carbon, biogentic, regional materials and building methods.

(Designers, architects and engineers)

Apply life cycle thinking as a starting point for reducing carbon emmission and environmental impact of building materials.

(Material producers)

Utilize renewable energy and effiicent energy systems for heating, cooling, and electricity of buildings.

(Developers)

Collaborate in cross-sectoral partnerships to innovate new, low-carbon solutions.

(All)

We already have many of the design solutions we need to begin reducing the carbon emissions of buildings today.

We must act with urgency.

Knowledge creation is key.

We must change the goal.

Key Learnings