CaseDrill

LOW-CARBON HOUSING

Sustainability
Real Estate

Medium difficulty
Interviewer-led case

This case considers how to minimize a real estate project's greenhouse gas emissions within cost constraints. The candidate is expected to demonstrate strong business judgement in addressing unconventional questions.
The case can be solved by generalist candidates, but it is particularly suitable for candidates applying for more specialized sustainability or operations-focused roles.

Problem definition

Your client is a real estate developer who wants to answer a Request for Proposal (RFP) for the development of a new residential district in a Middle Eastern country. This new district should be a landmark in terms of environmental impact.

They would like support from us to be competitive in this RFP. The priority is to demonstrate how they would minimize the greenhouse gas (GHG) emissions of their project while maintaining a competitive cost structure relative to other bidders.

How could you support your client in achieving this objective?

Relevant information

If asked at this stage or later, please share that:

- We consider emissions during construction and during the use of the district by residents. We also have to consider emissions from suppliers. We can neglect emissions during the design phase of the project and at the end of the life of the buildings.
- There is no specified target for overall emissions. We will discuss specific targets while we work through the case.
- The client does not have its own capabilities in the Middle East. They would subcontract work to engineering, construction management, and construction companies.
- The client is purely focused on GHG emissions; they are not currently looking at other forms of environmental impact.

Question 1 (Structuring)

What drivers can our client consider to reduce the GHG emissions of this project?

Guidance for interviewer

There are different ways of structuring this case. If the candidate is familiar with how companies report GHG emissions, they could use a framework considering Scope 1, 2, and 3 emissions:

- Scope 1: direct emissions from the company
- Scope 2: indirect emissions from the company related to energy consumption.
- Scope 3: other emissions: generally, emissions from the company's suppliers and clients.

For a generalist candidate, a logical structure following the lifecycle of the project would be appropriate.

Possible answer

1. *Reducing emissions during construction, within cost constraints*
   a. *Construction materials (lower carbon footprint materials)*
   b. *Transportation of materials (local sourcing options, more sustainable logistics)*
   c. *Construction process (equipment, on-site energy generation)*

2. *Reducing emissions during use, within cost constraints*
   a. *District energy consumption (underground links between buildings to reduce cooling requirements)*
   b. *Energy efficient building design (passive cooling, better orientation, smart meters, better insulation and HVAC systems)*
   c. *Renewable energy integration (on-site solar panels)*
   d. *Sustainable transport systems and infrastructure (EV charging stations, public transport)*
   e. *Carbon capture (nature-based solutions or technology-based solutions)*

Question 2 (Judgment and insights)

Our client has already analyzed potential emission reductions through energy-efficient design and construction processes. They now seek support in reducing emissions by sourcing more sustainable materials.

Which criteria would you need to consider in selecting the most promising materials to recommend to our client?

Possible answer

1. *Environmental impact*
    a. *Carbon emissions generated during material production, transportation, and installation*
    b. *Resource renewability*
    c. *Energy efficiency*
    d. *Local availability*
2. *Economic viability*
    a. *Initial costs*
    b. *Lifecycle costs*
    c. *Scalability*
3. *Practicality*
    a. *Performance and durability*
    b. *Compatibility*
    c. *Constructability*
4. *Market and regulatory considerations*
    a. *Supplier network*
    b. *Compliance with safety and building standards*
    c. *Government incentives*
5. *Social and aesthetic factors*
    a. *Aesthetic appeal*
    b. *User comfort*

Question 3 (Math)

Our client has provided a table showing the project's proposed emission reductions with alternative materials (see Exhibit 1). While pleased with the emission reductions achieved, they are concerned that higher costs may affect competitiveness.

Which low-carbon materials could be removed to keep costs under 110% of the baseline and what would the impact be on cost and emissions?

Guidance for interviewer

If a candidate begins going through the tables line by line to calculate the total cost and emissions of each material, prompt them to look for shortcuts. If they are struggling to do this, walk through the relative cost per ton of concrete and low-carbon concrete as an example.

Possible answer

1. *Solution: Keeping mineral wool instead of using hempcrete would bring the cost of the project to $25.5 million, which is under 110% of the baseline cost. This would have an impact on emissions of <1%.*
2. *Maximum cost for low-carbon alternative:*
   Max cost = 110% x Total cost (Baseline)
   Max cost = 110% x $23.6 million
   Max cost = $26 million
3. *The strongest contributors to emissions reduction are concrete and steel which represent a significant share of materials, with a cost premium <10%, so these two sustainable materials should be kept.*
4. *However, hempcrete has a significant cost premium so I would estimate the impact on costs and emissions of keeping 'baseline' mineral wool.*
   a. *Contribution to costs of using hempcrete vs mineral wool:*

      Cost delta = (Cost per ton (Hempcrete) - Cost per ton (Mineral wool)) x Total mass (Ton)
      Cost delta = (600-225) x 7500
      Cost delta = $2.8million

      *Keeping mineral wool vs hempcrete would bring the cost of the project to $25.5 million (28.3-2.8), hence **within 110% of the baseline cost** our client is willing to bet on for this RFP.*

b. *Contribution to emissions:*

Emissions delta = (Emissions factor (Hempcrete) - Emissions factor (Mineral wool)) x Total mass (Ton)

Emissions delta = (40-70) kg CO_2/ton *x 7500 tons*

Emissions delta= -225t CO2

It ***represents less than 1% of emissions*** *(225/72,275). The reduction in emissions will still be approximately 50%.*

6. *As a consequence, replacing mineral wool with hempcrete does not contribute enough to total emissions reduction to justify the significant cost increase it represents for the project.*

Exhibit 1: Comparison of emissions and costs

Baseline materials			
Baseline material	**Total Mass (Ton)**	**Emission Factor (kg CO_2/ton)**	**Cost per Ton (USD/ton)**
Concrete	90,000	450	110
Steel	15,000	1,900	700
Bricks	10,000	275	150
Mineral wool	7,500	70	225
		Total Emissions (t CO_2)	**Total Cost (million USD)**
		72,275	**23.6**

Low carbon materials			
Baseline material	**Total Mass (Ton)**	**Emission Factor (kg CO_2/ton)**	**Cost per Ton (USD/ton)**
Low-Carbon Concrete	90,000	150	120
Recycled Steel	15,000	1,200	750
Low-Carbon Concrete Bricks	10,000	200	175
Hempcrete	7,500	40	600
		Total Emissions (t CO_2)	**Total Cost (million USD)**
		33,800	**28.3**

Question 4 (Creativity)

As part of the RFP, our client would like to include a series of initiatives to enable and encourage future inhabitants to reduce their emissions.

What ideas can you suggest?

Possible answer

1. *Sustainable mobility infrastructure*
   a. *Partner with local authorities to design fast, reliable, convenient and cheap public transport systems.*
   b. *Build slow mobility infrastructure walkable streets, shaded pathways, and cycling lanes.*
   c. *Install a strong network of EV charging stations and incentives for EV ownership (free parking, …)*
2. *Energy consumption reduction*
   a. *Partner with energy players to allow residents to subscribe to renewable energy providers.*
   b. *Install smart systems to track energy use.*
   c. *Create urban gardens to promote local food production to reduce food transport emissions.*
3. *Awareness and education*
   a. *Develop a gamified mobile app for residents to encourage reduction of their household energy use.*
   b. *Organize social campaigns to teach residents about sustainable lifestyles.*
   c. *Involve residents in collective goals through sustainability challenges.*
   d. *Provide residents with easy access to carbon offset programs.*
4. *Circular Economy*
   a. *Design shared resources repositories for tools, appliances with limited daily use.*
   b. *Provide residents with infrastructure for sorting waste at home.*
   c. *Create community composting hubs for organic waste.*
   d. *Introduce recycling reward programs for residents who meet recycling targets.*

Question 5 (Synthesis)

What is your final recommendation to your client?

Possible answer

We have been asked to help create an answer to the RFP that will demonstrate how the project will minimize GHG emissions while maintaining a competitive cost structure.

Our client has already optimized the building's design and construction process. We believe that they improve their response by reviewing their material selection strategy and by enabling future inhabitants to reduce their emissions.

Retaining mineral wool while replacing concrete, steel, and bricks with low-carbon alternatives would reduce GHG emissions of materials by 50%, whilst keeping costs within 110% of the cost of conventional materials.

Our client should also propose a range of initiatives to enable and encourage future inhabitants to reduce their emissions, including by providing a robust sustainable mobility infrastructure, sustainable energy solutions, as well as energy frugality programs.

Moving forward our client should assess the most promising initiatives in terms of their impact on emissions.