



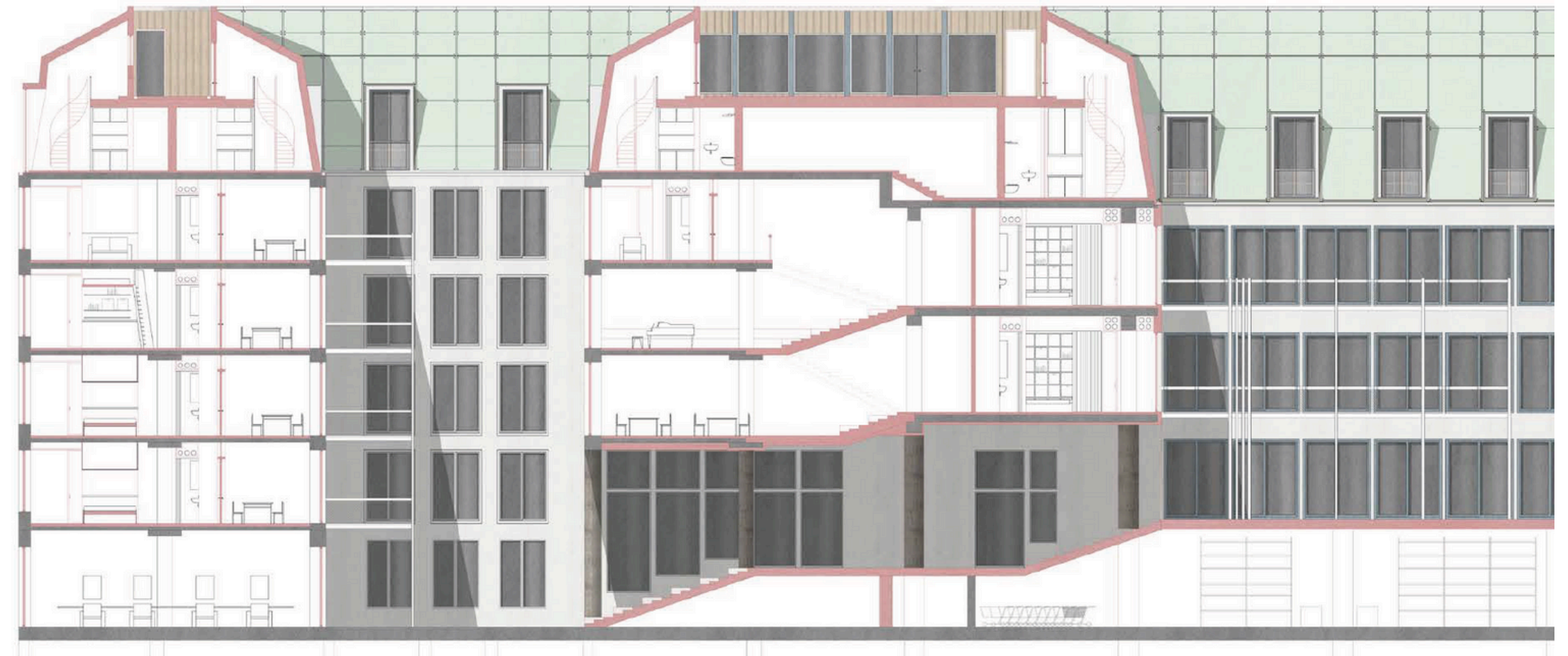
Uncovering the Value of Circularity

# Real Option Valuation of Detachable Aluminium Facade Components

P5 Presentation | Maximilian Nepomuk Sepp | 18. June 2025



## Real Estate Investor





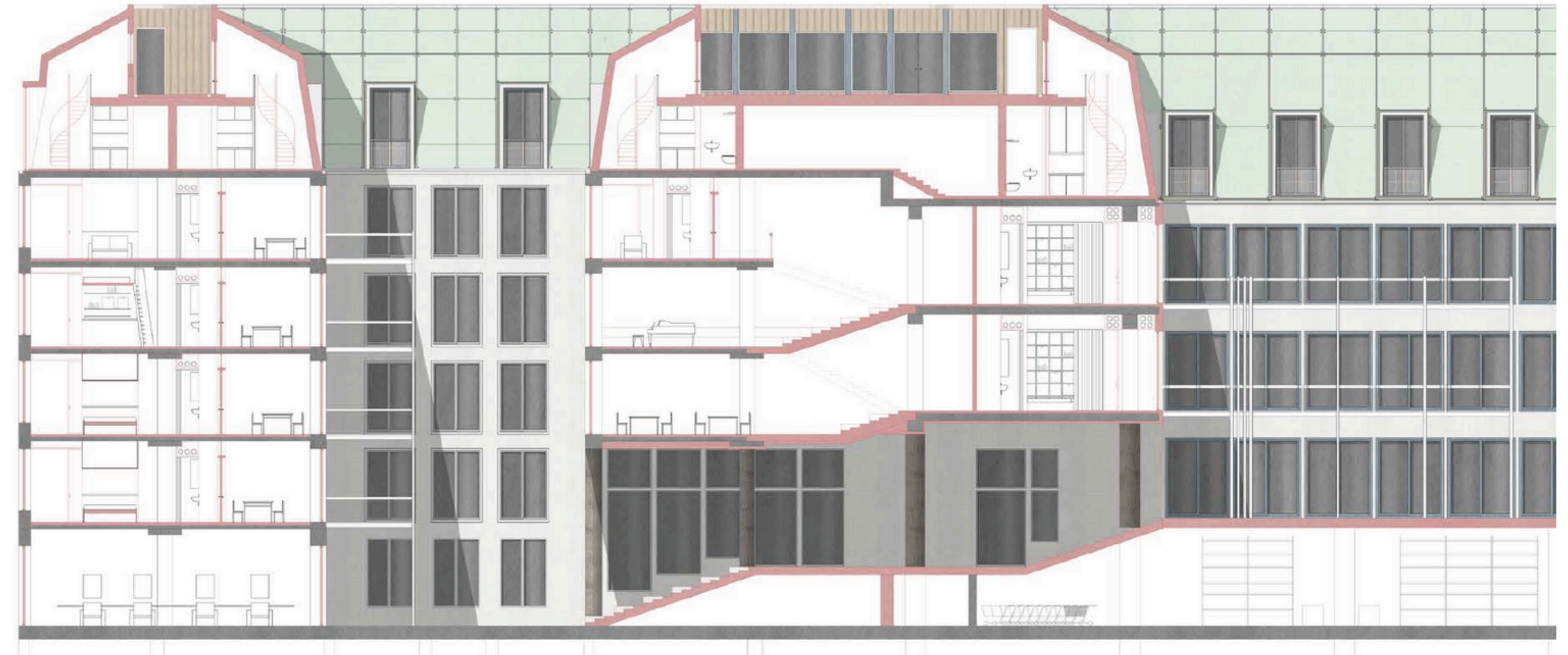
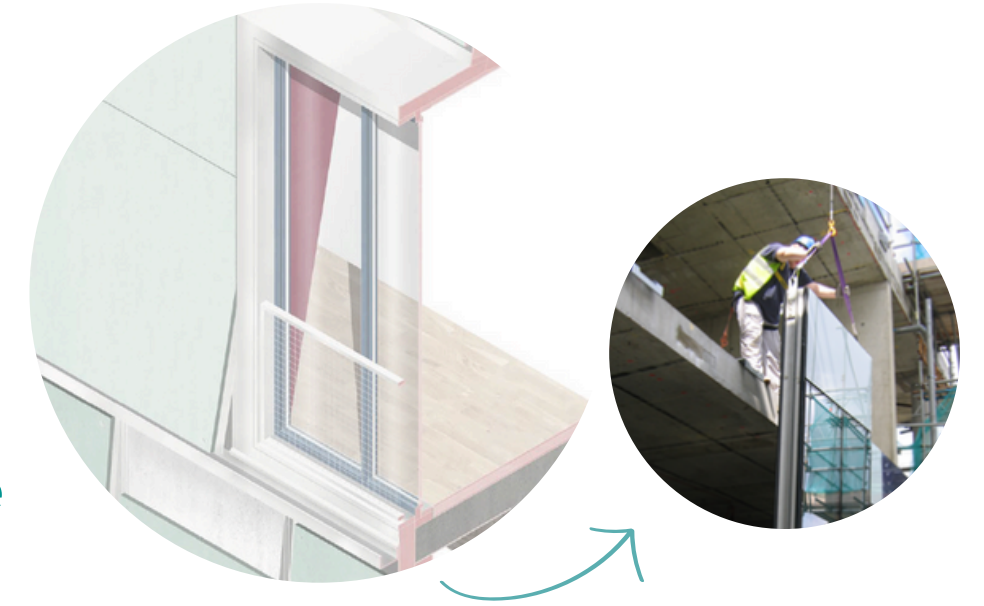


Real Estate Investor

wants to build



Circular Facade





Real Estate Investor

wants to build



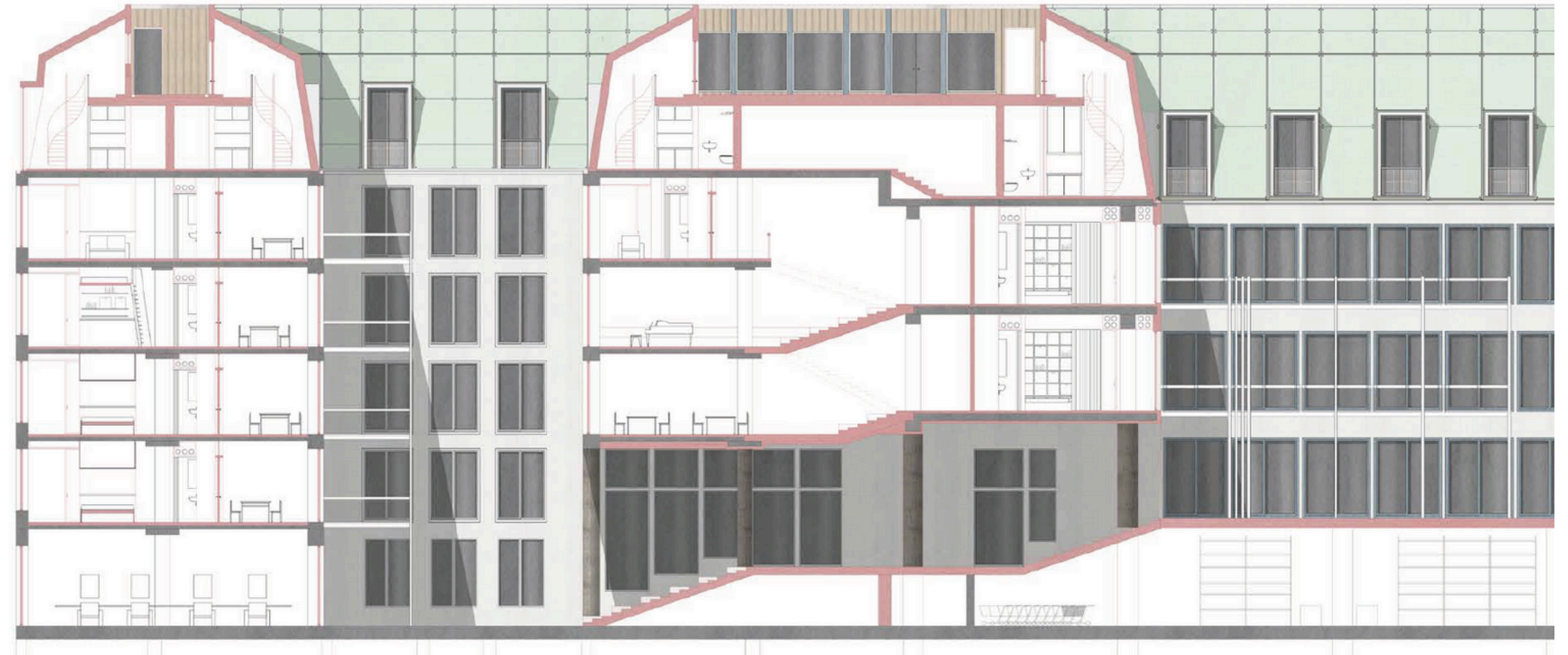
Circular Facade



contacts



Facade Producer







## Facade Producer

Wants to build circular  
aluminium facades...



## Real Estate Investor

Wants to build a circular  
building...



## Facade Producer

Wants to build circular  
aluminium facades...



## Real Estate Investor

Wants to build a circular  
building...

Both have  
Problems with  
Circularity....



**Wants to build circular and sell the buildings components after use...**

**Problem:**

Building circular costs more one can not necessarily charge more rent

+

What will the components and therefore the whole building be worth after use?

There is no market for used building components (yet) that could help



**Real Estate  
Investor**

# Circular Real Estate Business Case

What are key barriers?

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1

## Uncertain End-of-Life Values

What are building components worth at the end of use?

How to value this?

2

## Lack of Market Mechanisms

There is no market for (used) circular building components

Without having this?

3

## High Upfront Cost

Building circular adds cost

To justify this?





## Facade Producers Problems



## Real Estate Investors Problems

What is the **added value** of building **circular**?

How to **justify** and **finance** the added cost of building **circular**?



## Facade Producer

**Aluminium is amazing to be reused and recycled!**

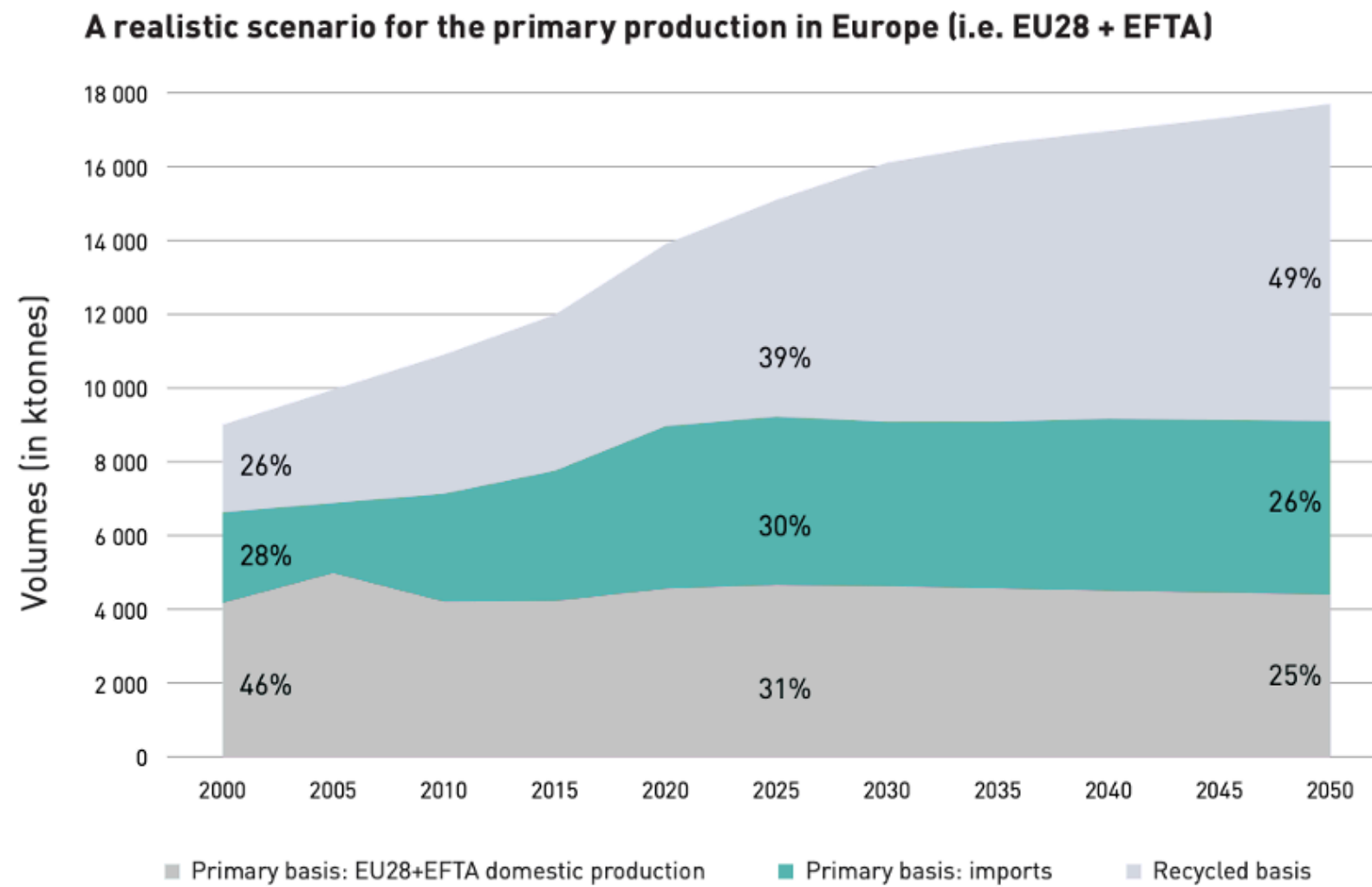
### **Problem:**

Aluminium prices have risen quickly in the last years and that might happen more often and more significantly....

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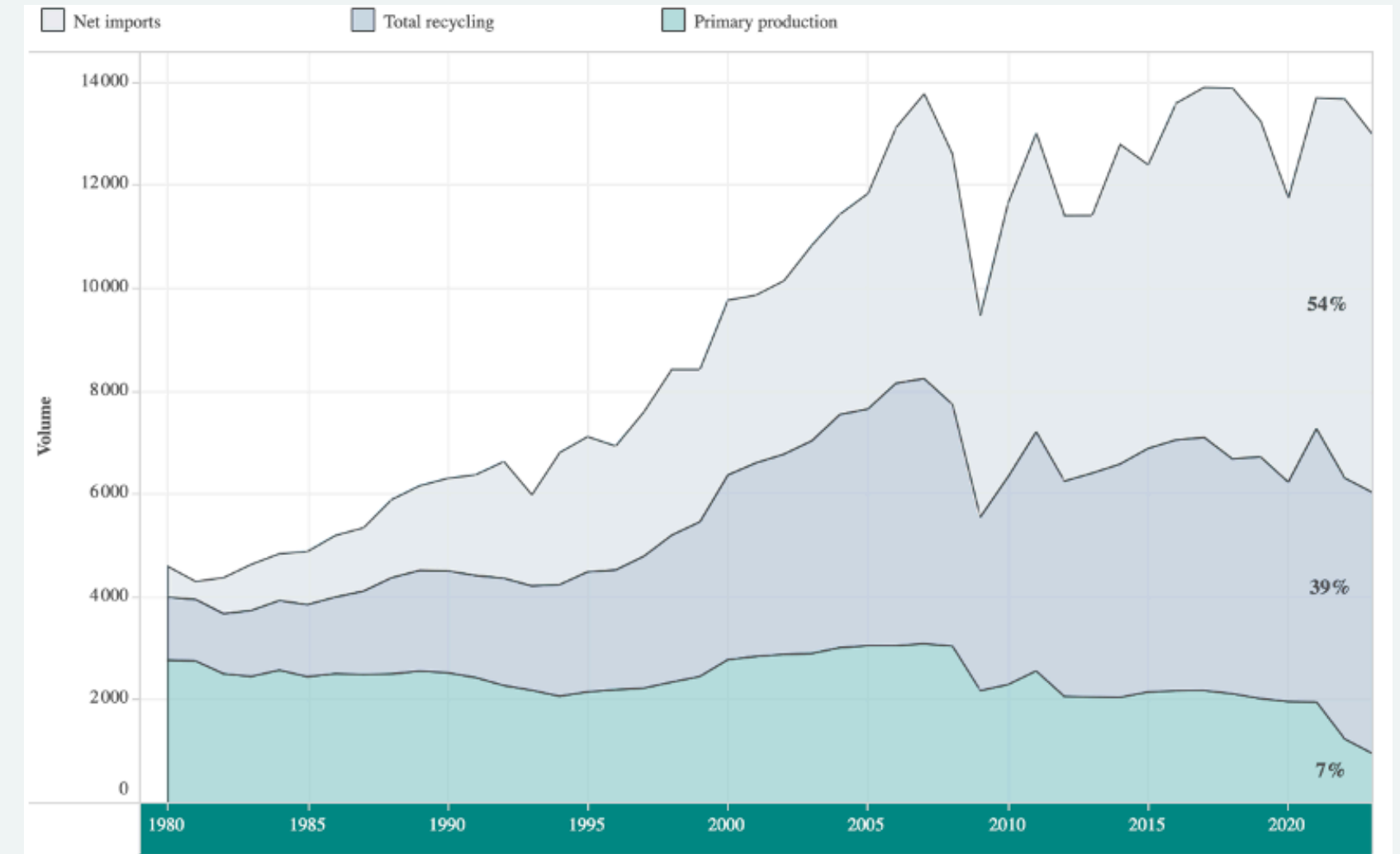
He gets repeated messages from suppliers that there delivery is not possible or takes longer than usual.....





## Scenario 2019

EU Primary production  
remaining stable until  
2050



## Reality 2023

EU Primary production  
down to 7% share of  
total supply

# Aluminium: A Future Outlook

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- High reliance on imports due to declining EU primary production
- Rising demand: EU use projected to grow 6x by 2050 for strategic sectors
- Construction demand: ↑ 28% by 2050

## Policy Responses:

- EU designates aluminium as a critical raw material
- European Steel & Metals Action Plan (2025)
- CBAM: Carbon fee on imported aluminium







## Facade Producers Problems

How to **protect against rising and volatile aluminium prices** in the future?

How to **secure material** for the future?



## Real Estate Investors Problems

What is the **added value of building circular**?

How to **justify and finance the added cost of building circular**?



Can both maybe  
help each other?



## Facade Producers Problems

How to **protect against rising and volatile aluminium prices** in the future?

How to **secure material** for the future?

## Real Estate Investors Problems

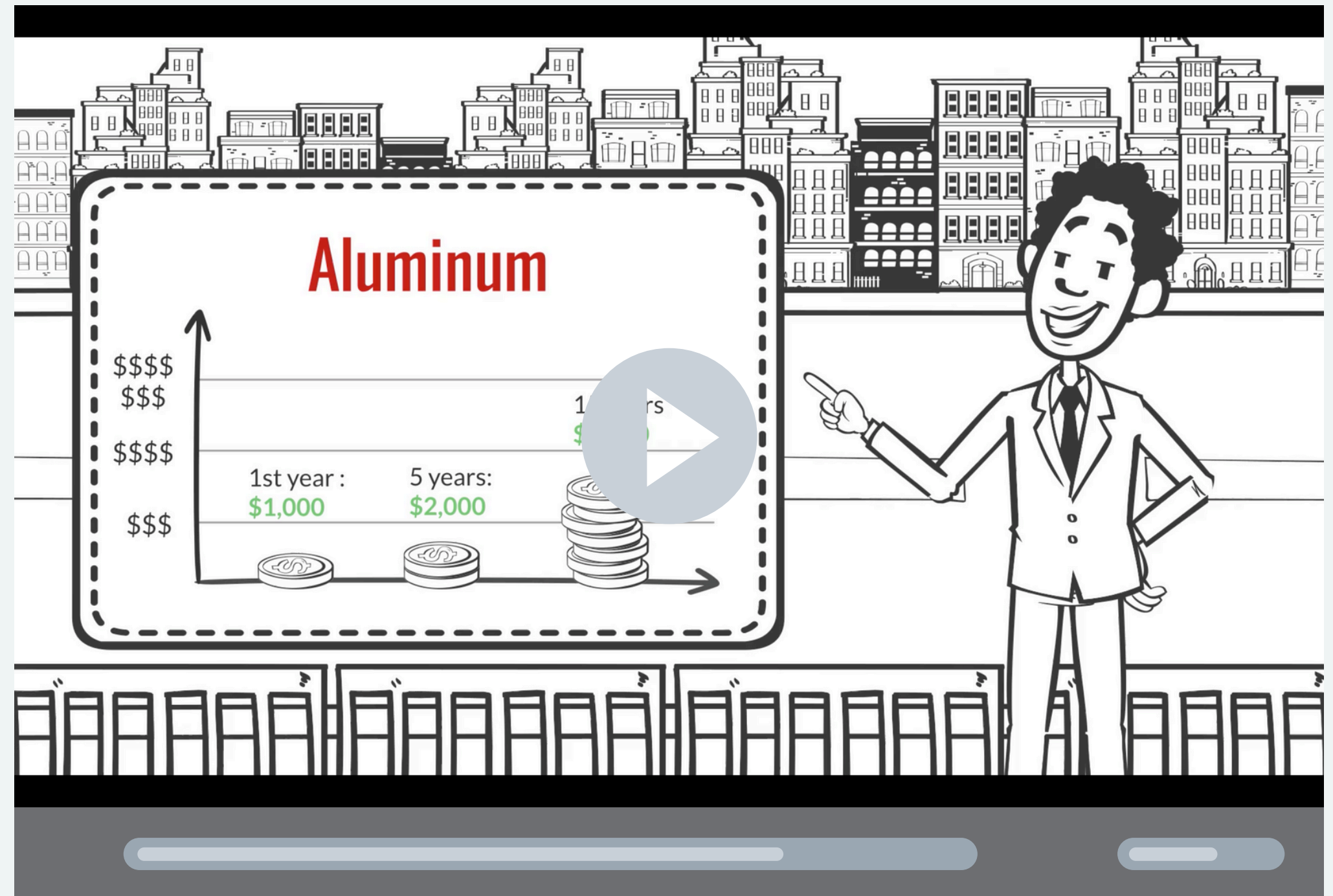
What is the **added value of building circular**?

How to **justify and finance the added cost of building circular**?

# A Real Option Scenario

Real Options on circular building components? How does this work?

Please watch the video carefully!





So, the facade of our building has 40 tons of aluminium which has a value of about 60.000€ today?



**Real Estate  
Investor**

Yes, exactly! And I want to have the option to buy back the facade in 30 years.



**Facade  
Producer**

Ok, I can offer you the option to buy it back for 100.000€ in thirty years.



**Real Estate  
Investor**

Ok, do I also have to deconstruct it myself and pay the cost of transport?



**Facade  
Producer**

Yes.

Additionally, to add the option to our contract you will have to pay a premium today. Please let me know what you can offer to purchase the option



**Real Estate  
Investor**

Ok, I will come back with an offer.



**Facade  
Producer**



How do I determine what I should pay for the option?

Let me see what I have and write it down on a list.....



**Facade  
Producer**

How do I determine what I should pay for the option?

Let me see what I have and write it down on a list.....



Facade  
Producer

Value of Aluminium:  
**60.000€**

Time until I can use the option:  
**30 years**

Price I pay + Cost to dismantle:  
 $100.000\text{€} + 80.000\text{€} =$   
**180.000€**

How do I determine what I should pay for the option?

Let me see what I have and write it down on a list.....

Let me do some research!



Facade  
Producer

Value of Aluminium:  
**60.000€**

Time until I can use the option:  
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 $100.000\text{€} + 80.000\text{€} =$   
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# What are Real Options?

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- Real Option = right (not obligation) to act on a real asset
- For circular real estate: e.g. option to repurchase building components at a future price (strike price)
- Option Premium = price facade producer pays today; Strike price = price the facade producer pays if option is exercised
- Value lies in uncertainty (material price volatility, uncertainty of supply)

# How to value Real Options?

**Valuation Methods** (Kodukula & Papudeso, 2006):

- Partial Differential Equations (e.g. Black-Scholes)
- Simulations (e.g. Monte Carlo)
- Lattices (e.g. Binomial Trees)

**Valuation Methods used in this Thesis:**

- Black & Scholes (1973)
- Binomial Tree
- Heston (1993)

Black - Scholes Form

$S_0$  = stock price

$X$  = exercise price

$r$  = risk-free interest rate



$$C_0 = S_0 N(d_1) - X$$

$$d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

# Recipe of Option Valuation

**You need an underlying asset with value (S): Aluminium**

Value of raw aluminium embedded in the facade today

**You need to project the price development of that asset: Volatility ( $\sigma$ )**

How will the price for aluminium change until the option can be exercised?

**You need the time (T) and strike price (X)**

When will the option be exercised and what will be paid for the facade?



**Facade  
Producer**

Value of Aluminium:  
**60.000€ = Asset Value (S)**

Time until I can use the option:  
**30 years = Time (T)**

Price I pay + Cost to dismantle:  
100.000€ + 80.000€ =  
**180.000€ = Strike Price (X)**





**Facade  
Producer**

Value of Aluminium:  
**60.000€ = Asset Value (S)**

Time until I can use the option:  
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Price I pay + Cost to dismantle:  
100.000€ + 80.000€ =  
**180.000€ = Strike Price (X)**

Aluminium Price Volatility:  
**21,30 % = Volatility ( $\sigma$ )**

Calculated Option Value:  
22.000€



Value of Aluminium:  
**60.000€ = Asset Value (S)**

Time until I can use the option:  
**30 years = Time (T)**

Price I pay + Cost to dismantle:  
100.000€ + 80.000€ =  
**180.000€ = Strike Price (X)**

Aluminium Price Volatility:  
**21,30 % = Volatility ( $\sigma$ )**

# Option Contract

Both parties agree on the option contract

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## Facade Producer

Has the Option to buy the facade including 40 tons of aluminium after 30 years for 100.000€ including deconstruction (cost 80.000€)



## Real Estate Investor

Receives 22.000€ Premium today to grant the option that the facade producer can buy back and deconstruct for the set price of 100.000€.



## Facade Producers Problems

How to **protect against rising and volatile aluminium prices** in the future?

How to **secure material** for the future?



## Real Estate Investors Problems

What is the **added value of building circular**?

How to **justify and finance the added cost of building circular**?





## Facade Producers Problems

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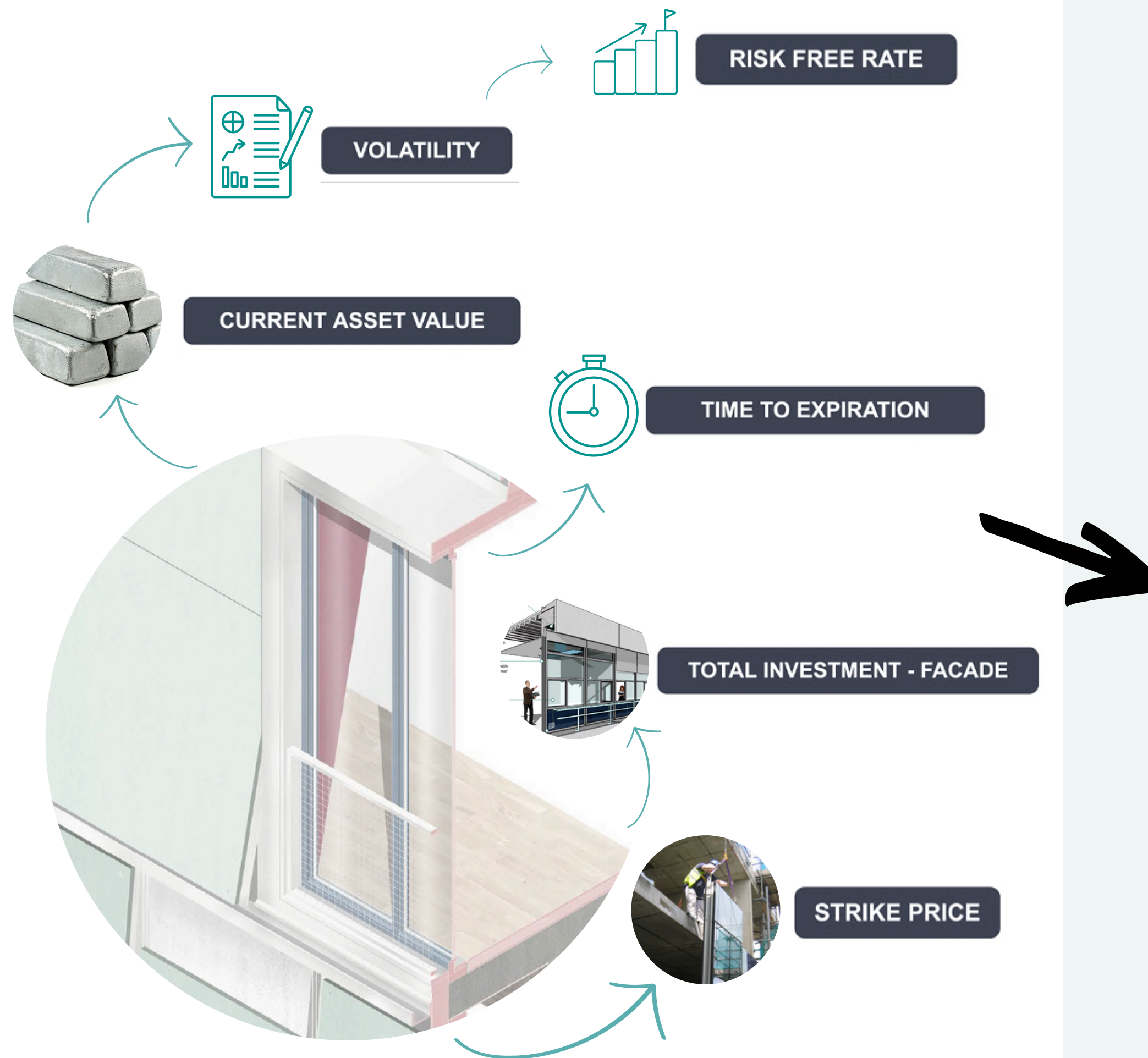
How to **secure material** for the future?



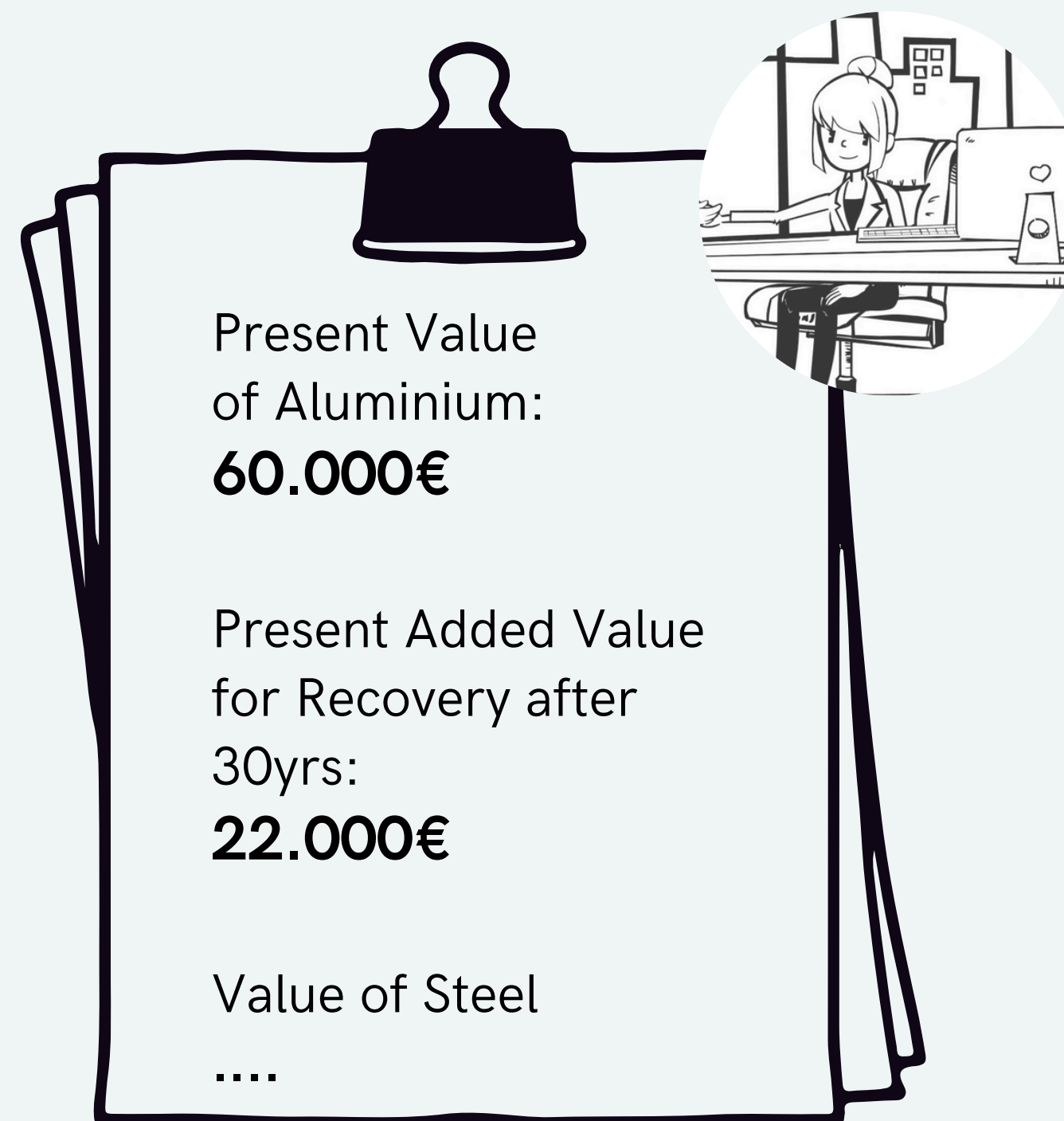
## Real Estate Investors Problems

What is the **added value of building circular**?

How to **justify and finance the added cost of building circular**?



## Option Valuation incorporated in total Building Valuation



# Mixed Method Research Design

Triangulation - Quantitative & Qualitative Research

## Quantitative Research

Real Option Analysis of Case Study Data using:

### "Classic Approach"

- Black & Scholes (1973) option pricing
- Binomial Tree option pricing
- Heston (1993) option pricing

### "Integrated Approach"

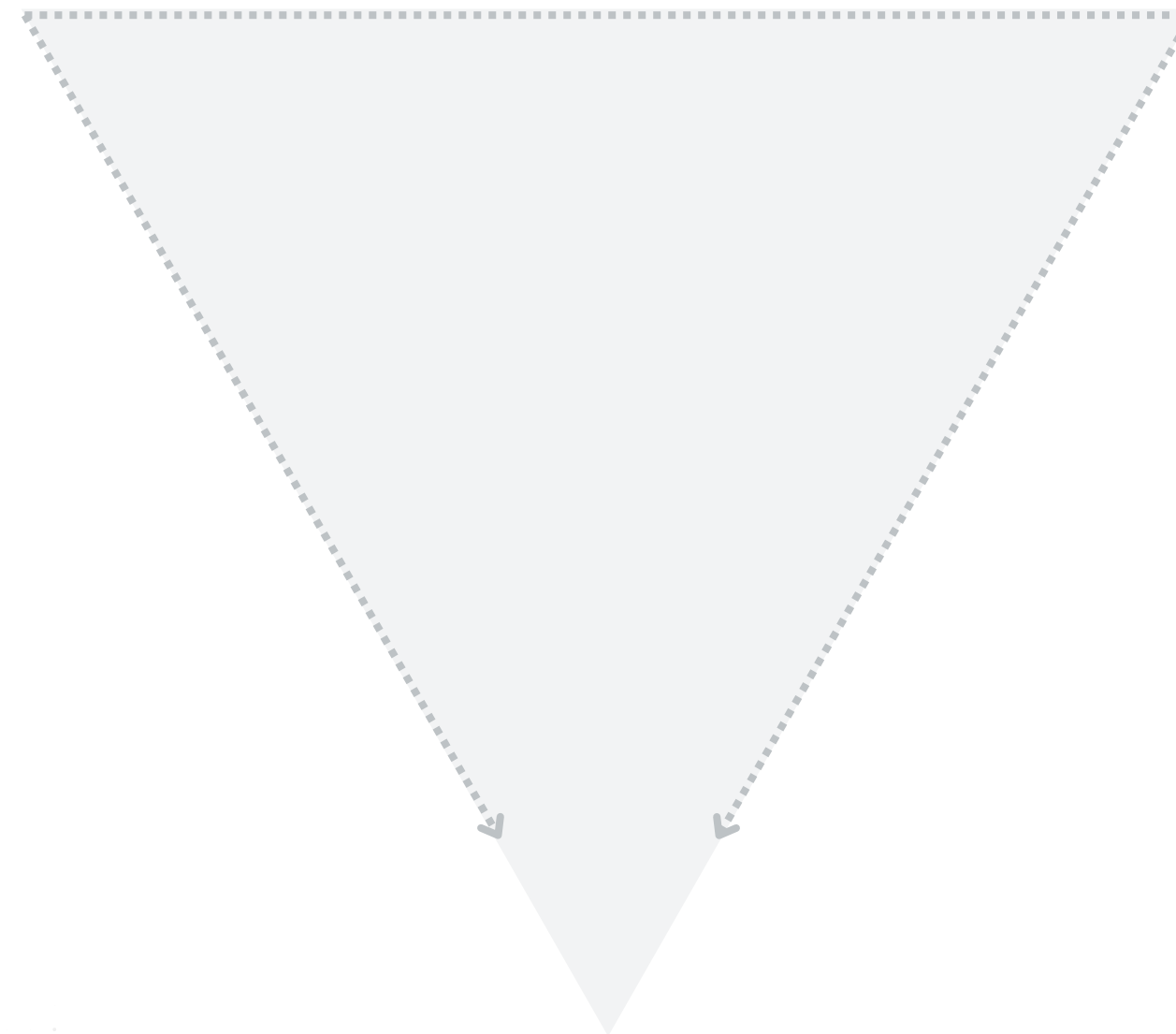
- Decision Tree Analyses

## Qualitative Research

Semi-Structured Interviews with different stakeholder groups:

- potential option buyers
- potential option sellers
- financiers

Online-Workshop with real estate valuation professionals:  
Data Collection through survey



Interpretation

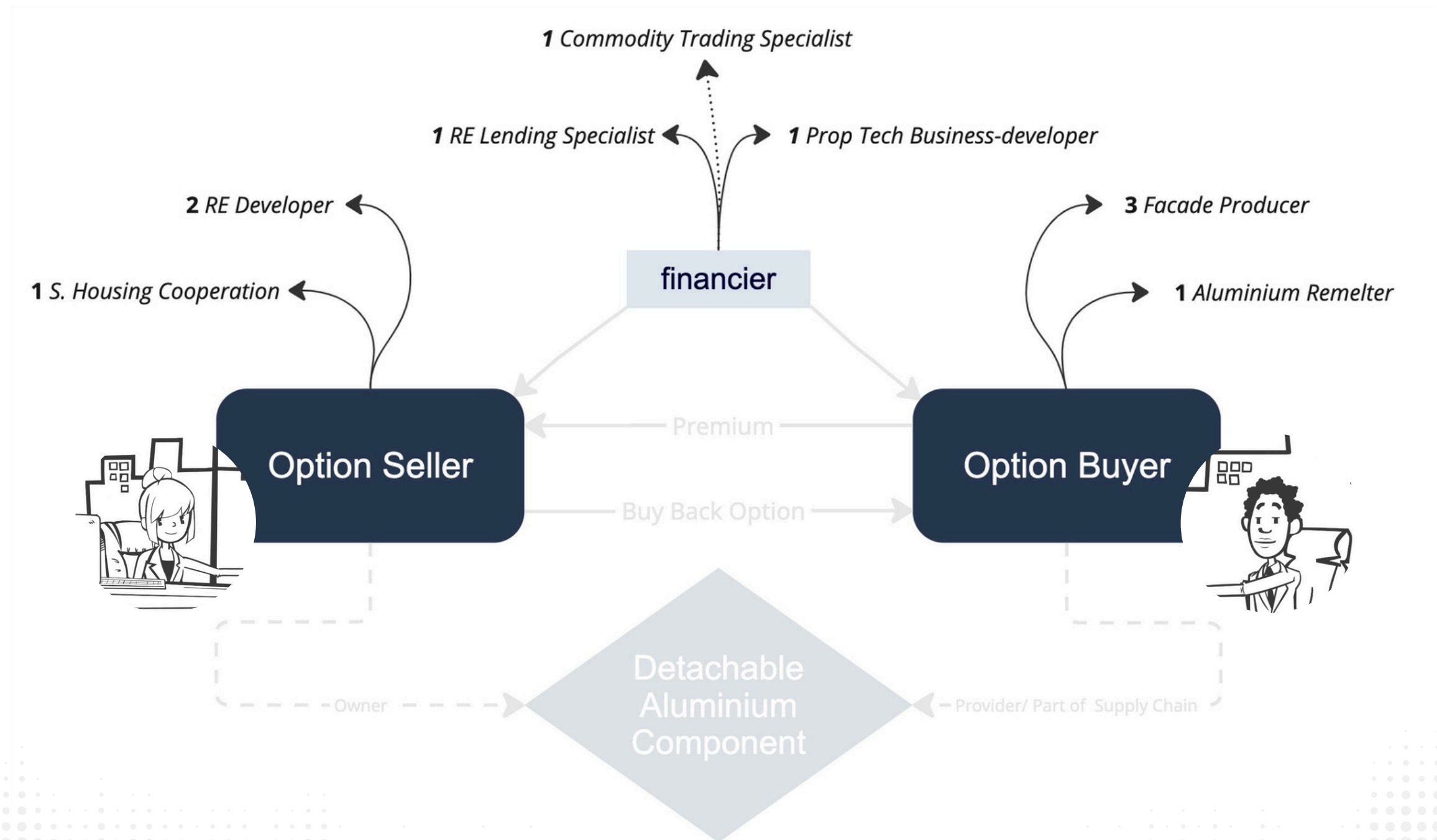
# Qualitative Analysis: Semi-Structured Interviews

Interviewing different Stakeholder Groups

  
**TU Delft**

  
**ALKONDOR**  
HENGLO

**Rabobank**





# Validation

## Real Options & Real Option Valuation a good and innovative idea?

*"(...) would we be open to a solution in this way?  
I think 100% yes."* - Facade Producer

*"The next step would be to have options to bring it back in  
30 years. This is logic, as you have presented it, makes  
sense to me (...)." - Aluminium Production Group*

*"I think it's a very nice idea."* - RE Developer

*"That's why your research and an option is interesting because  
it is not a guess."* - Real Estate Lending and Valuation Expert

*"Yeah, I completely agree. The conversations we had so far,  
this is completely what is happening."* - Facade Producer

# Semi-Structured Interviews

## Option Seller Group



- Struggle to quantify value of circularity
- Value of circularity is seen more societal (added cost)
- Option contract was perceived as an added risk & loss of ownership
- Need for additional agreements (replacement)



# Semi-Structured Interviews

## Option Buyer Group



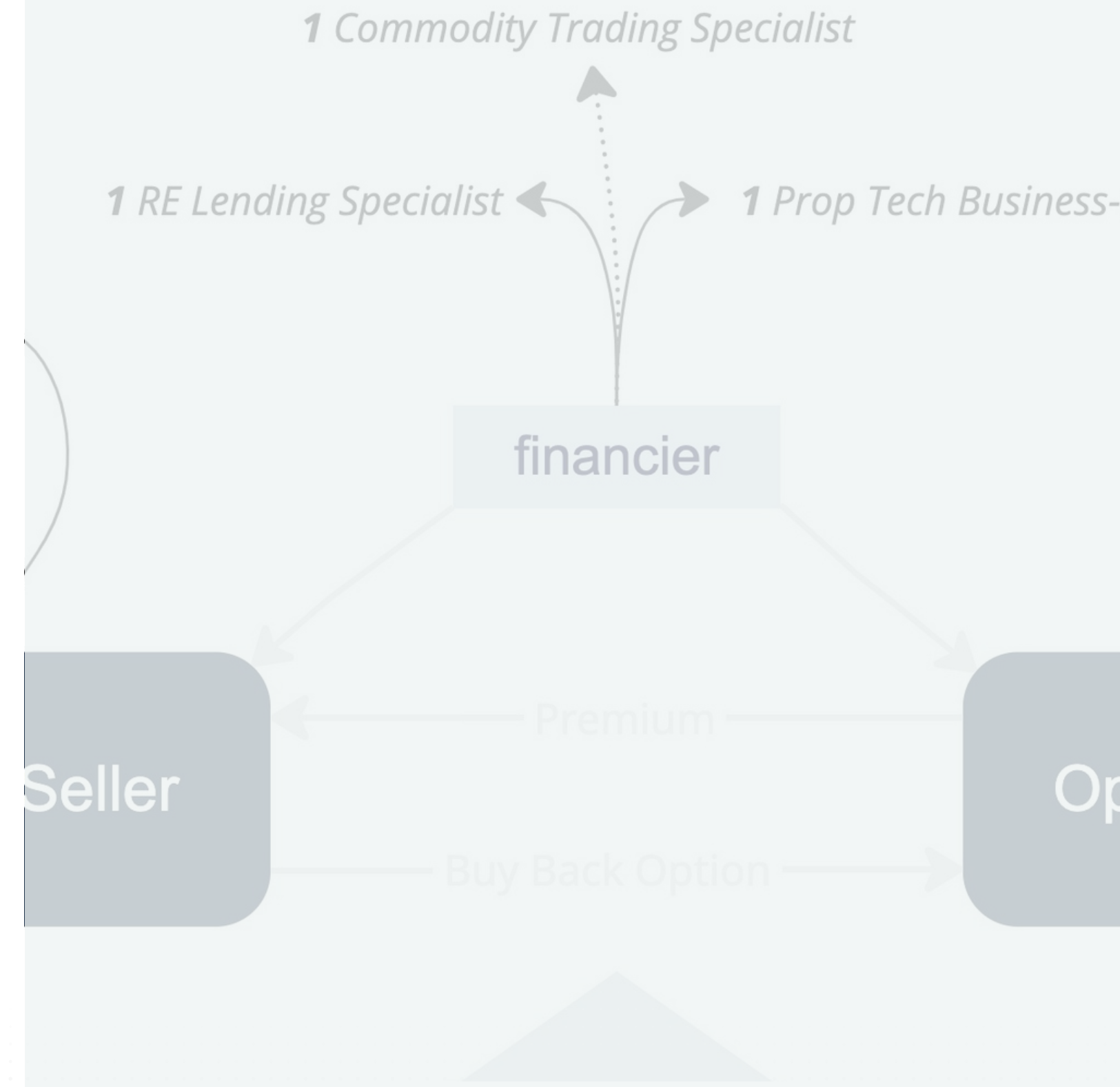
- Scrap Aluminium is very scarce already / Uncertain Future
- Fragmentation of aluminium supply chain
- No direct contractual ties with building owner
- Prices are taken “as they come” - no long term hedging strategies & strategic focus on own production capacities
- Scaling Issues (Aluminium production specifically)



# Semi-Structured Interviews

## Financier Group

- Need for new valuation methods
- Benefits of option being a financial product
- Option Contract would have an influence on financing condition - added risk through third party involvement + open end
- Real estate investor would need to prepare for loss of rental income
- Conservative risk averse valuation practices due to global financial crisis 2008 - no long term view "allowed"





# Results:

## (RE) VALUE online workshop

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- Strong recognition of growing importance of material value & risk in valuation
- valuation professionals recognise greater promise in the concept as a valuation method than in the feasibility of real option contracts
- Openness to including option in valuation:
  - 50% support for market value, 60% for investment value
  - 70% support applying methodology themselves
  - Only 20% currently account for residual material value; 70% do not



# Mixed Method Research Design

Triangulation - Quantitative & Qualitative Research

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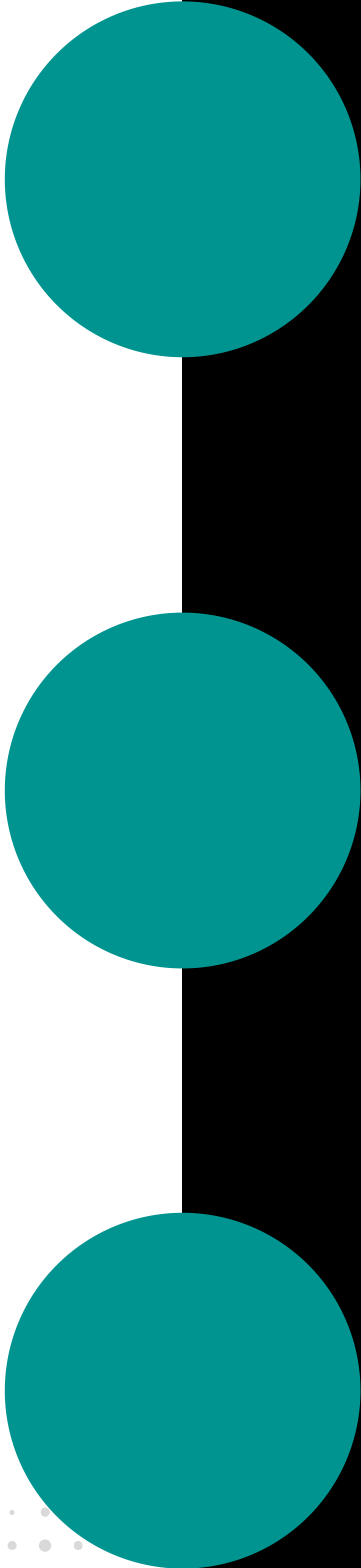
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Interpretation

# Contributions

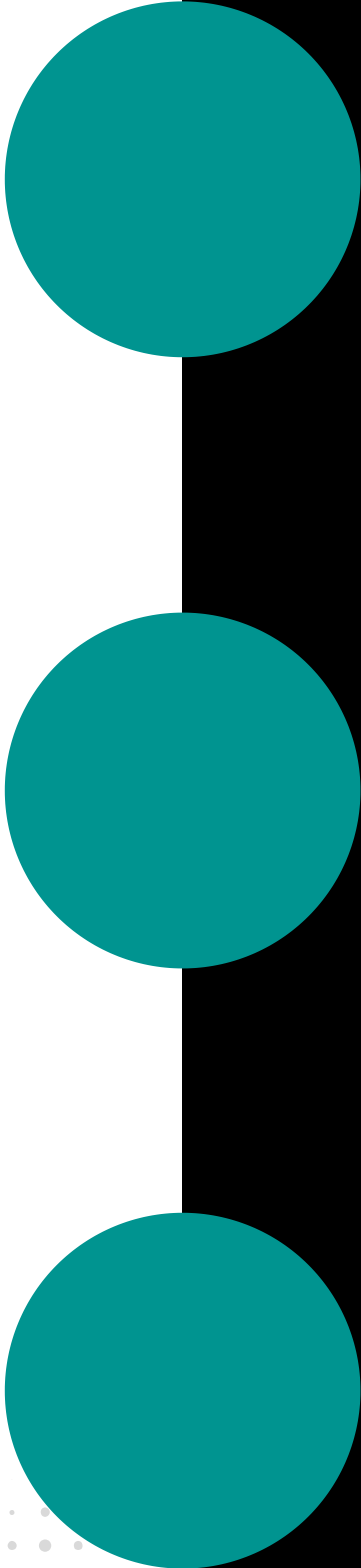


Introduces real option valuation to estimate the monetary value of material recovery in buildings

Enables professionals to assess the “moneyness” of circular component recovery based on commodity price data

Offers approaches to justify and finance upfront investment in circular construction and hedging against material price volatility

# Critical Reflection



Risk of incentivizing premature dismantling over product life extension

Focus on raw material value may undervalue (re)use potential / buildings as material storage

Real Option Valuations could create a opportunistic view on real estate → overvaluation

# Conclusion

Now we know that every model has an assumption, every model has an error, every model is an incomplete description of reality. How well does the model do in making predictions? And that's the key. Basically the model has done very well over time. There's a lot of people who say the model doesn't do this, the model doesn't do that, but it does pretty darn great."

- Myron Scholes, interviewed by Taylor (2025).





# Thank you!

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Questions?

# Sources - Illustrations

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