Facade Leasing Demonstrator Project
4.2.6.FLD D3. Business Delivery Report

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Facade Leasing Demonstrator Project

4.2.6.FLD D3. Business Delivery Report

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Facade Leasing Demonstrator Project Business Delivery Report

Annex 2.7.3. FLD D3

December, 2019

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ALKONDOR HENGELO

ABN·AMRO Lease

HOF Het Opdrachtgevers Forum in de Bouw

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0. Executive Summary

Incentivising investment and long-term collaboration in high-performance facade projects.

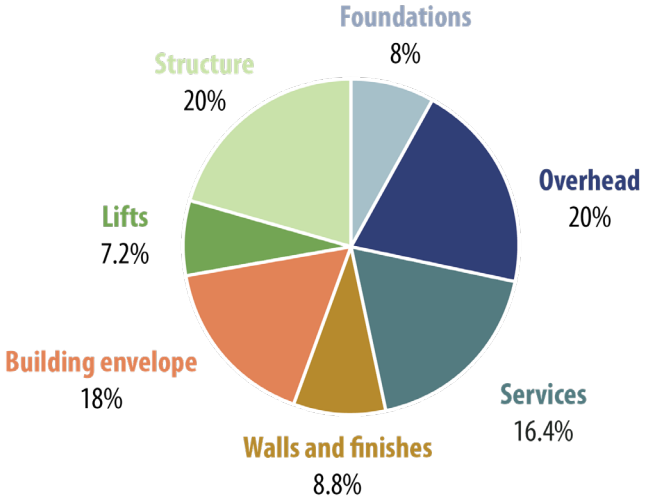
This technical report is an annex to the Facade Leasing Demonstrator Project 2019 performance report (2.7.3.FLD.D1). For general information on the Facade Leasing research project, its process, and objectives please refer to the aforementioned document.

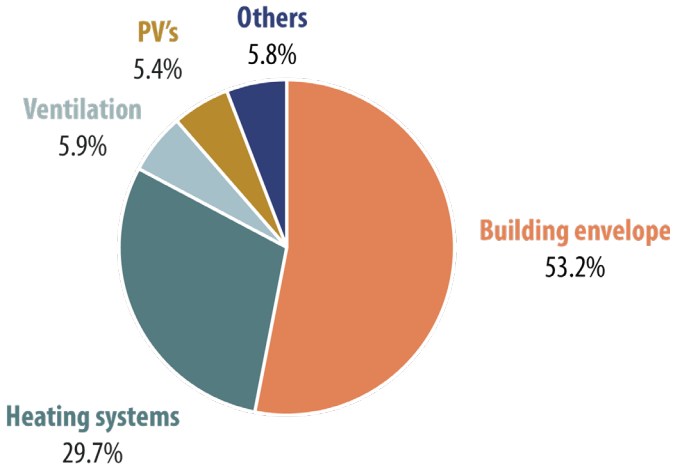
This technical delivery report focuses on the economic and business model aspects of the FLD project. The innovation behind the Facade Leasing research project lies not so much in the creation of new, energy-efficient facade technologies, but rather the creation of new investment and management processes leading to a more widespread and effective use of available and upcoming technology.

The present report starts by describing the large, and growing, market for economically feasible facade renovation solutions. The research presently focuses on the Dutch non-residential, (semi-)publicly owned market, which has been identified as an ideal early adopter, but extrapolations are made to other European segments in the "Upscaling" chapter. The report then presents the work done by the research and practice consortium of the FLD project, represented by real estate owners/ operators, facade fabricators, financial institutions, and other key stakeholders towards the definition of a promising business and financial model for the contracting of Facades-as-a-Service.

2018

1. The global economic and energetic challenge of building energy renovations



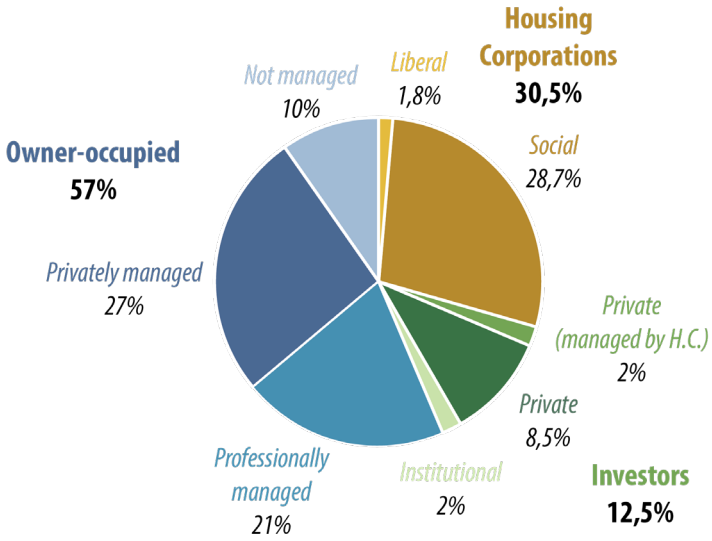


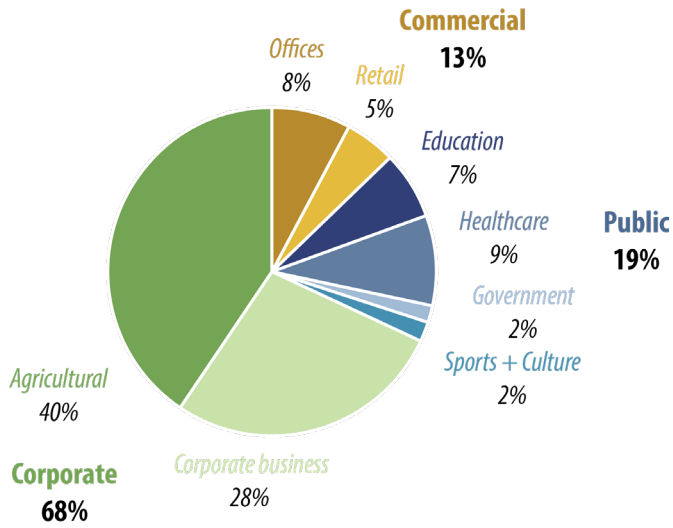
Comparison of initial cost breakdown for a new construction (left) and a deep energy renovation project (right). Based on data from:

Dall'O, G., et al. (2013). "Improvement of the sustainability of existing school buildings according to the Leadership in Energy and Environmental Design (LEED)® Protocol: A case study in Italy."

Klein, T. (2013). Integral Facade Construction. Towards a new product architecture for curtain walls. (Doctoral dissertation, Delft University of Technology), TU Delft

Parker, D. and A. Wood (2013). The Tall Buildings Reference Book, Routledge.





Breakdown of residential and non-residential property per sub-sector in the Dutch real estate market. Based on data from:

BZK (2012). Het functioneren van VvE's: update 2012 en verbetervoorstellen. Arnhem, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties.

Janssen, I., et al. (2017). Benchmark Gemeentelijk Vastgoed. Tilburg - 's-Hertogenbosch, TIAS School for Business & Society en Republiq.

Baines, T. and H. Lightfoot (2013). Made to Serve: How manufacturers can compete through servitisation and product service systems, John Wiley & Sons.

Stahel, W. R. (2016). "The circular economy." Nature News 531(7595): 435.

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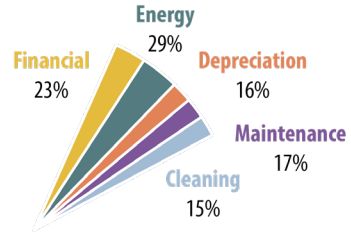
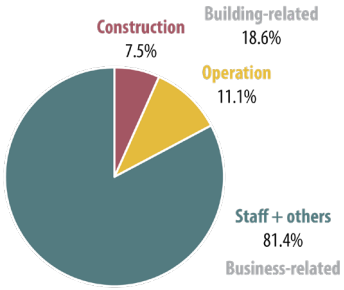
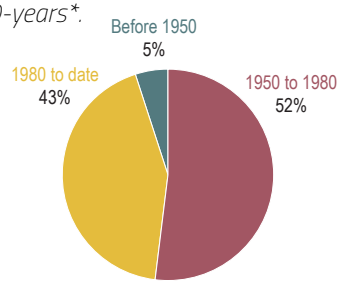


Typical building operating cost breakdown over 30 years.*



Typical building-related costs in relation to overall business expenses over 30-years.*



*Building stock of 14 publicly-funded Dutch universities by period of construction**.*

** de Jong, P. and M. Arkesteijn (2014). "Life cycle costs of Dutch school buildings." Journal of Corporate Real Estate 16(3): 220-234.*

*** den Heijer, A. C. (2011). Managing the University Campus: Information to support real estate decisions. Delft, Eburon Academic Publishers.*

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The last few years have seen the development and growth of a number of performance-based contracting models, or product-service systems. This has been particularly in advanced industrialized economies,. These models shift the value proposition in a business transaction, from the single delivery of material products to the ongoing delivery of performance services. Such a transition makes sense not only from a business perspective - as service-delivery tends to generate a considerably larger profit margin and client retention than product sales - but also from a Circular Economy perspective - as products and their embodied materials become a means to an end instead of the end itself (Baines & Lightfoot, 2013; Stahel, 2016).

The Facade Leasing research project, initiated in 2014, has been working on the development and implementation of models to facilitate this transition in the specific case of facades for new buildings and deep energy renovation projects. The reason for choosing such a complex technological product is simple, the facade and integrated building services represent a large part of a building project's initial investment (30% to 40% for a new building, 50% to 90% for a deep energy renovation project (Dall'O Et Al., 2013; Klein, 2013; Parker & Wood, 2013)). Such systems also have a determinant effect on the building's operational costs, particularly with regards to energy and maintenance.

The research project has focused on the specific target market of Dutch (semi-)public, institutional real estate owners and operators, particularly publicly-funded universities. Public clients as a whole are responsible for the management (and related procurement) of about 20% of the Netherlands' non-residential building stock, a ratio similar to that of other European countries. Public procurement is also frequently described as the ideal early adoption platform for innovation, due to a number of factors: It is not primarily driven by financial gains and profit, as the commercial procurement sector tends to be; It responds to "common good" values such as social and environmental responsibility; It is subject to wider scrutiny and criticism as it entails the investment of public money; and it is shaped by a long-term planning horizon that can span more than one human generation, rather than the span of a single financial payback projection.

Publicly-funded universities, in particular, are subject to internal and external pressures to innovate. Not only are they subject to constant changes in student enrollment, educational requirements, housing demands, technical changes, among many others, but they are also expected to lead the way into a sustainable future by applying (as early adopters) the knowledge they generate.

Publicly-funded universities in the Netherlands are meanwhile representative of a wider problem faced across the European Union: the simultaneous obsolescence of a large fraction of the building stock. An analysis of 14 large, publicly-funded universities in the Netherlands shows that over half their building stock was built during the post-second world war period between the 1950's and 1970's (den Heijer, 2011). These figures are similar to those which can be found across a number of European real estate sectors, both residential and non-residential. The 50- to 70-year technical service-life of building envelope components means this massive volume of buildings will require deep energy and functional renovation in the coming decade or two. This represents a daunting challenge requiring the investemnt of immense volumes of financial, material, and human resource.

2. The Facade Leasing schematic model

The basis for the Facade Leasing model is the redistribution of activities related to the design and engineering, construction, financing, management, and end-of-service reprocessing of the facade and its integrated systems among a number of key stakeholders. These activities are assigned on account of each party's core professional capabilities, and addressing their core business incentives.

A number of economic challenges for all stakeholders are addressed by the adoption of such a model. Suppliers of facade systems gain competitive advantage and increase the value of their product-service offerings, resulting in higher profit margins and financial stability during times of economic downturn. The experience of a number of Dutch facade fabricators and system suppliers during the 2008 Global Financial Crisis - when between a quarter and a third of all members of the Dutch Metal Facade Industry Branch Organisation (VMRG) ceased operations due to bankruptcy or mergers (Cleton, 2015) - still acts as a reminder of the importance of deriving a higher fraction of revenue from ongoing contracts such as maintenance and cleaning, rather than new projects.

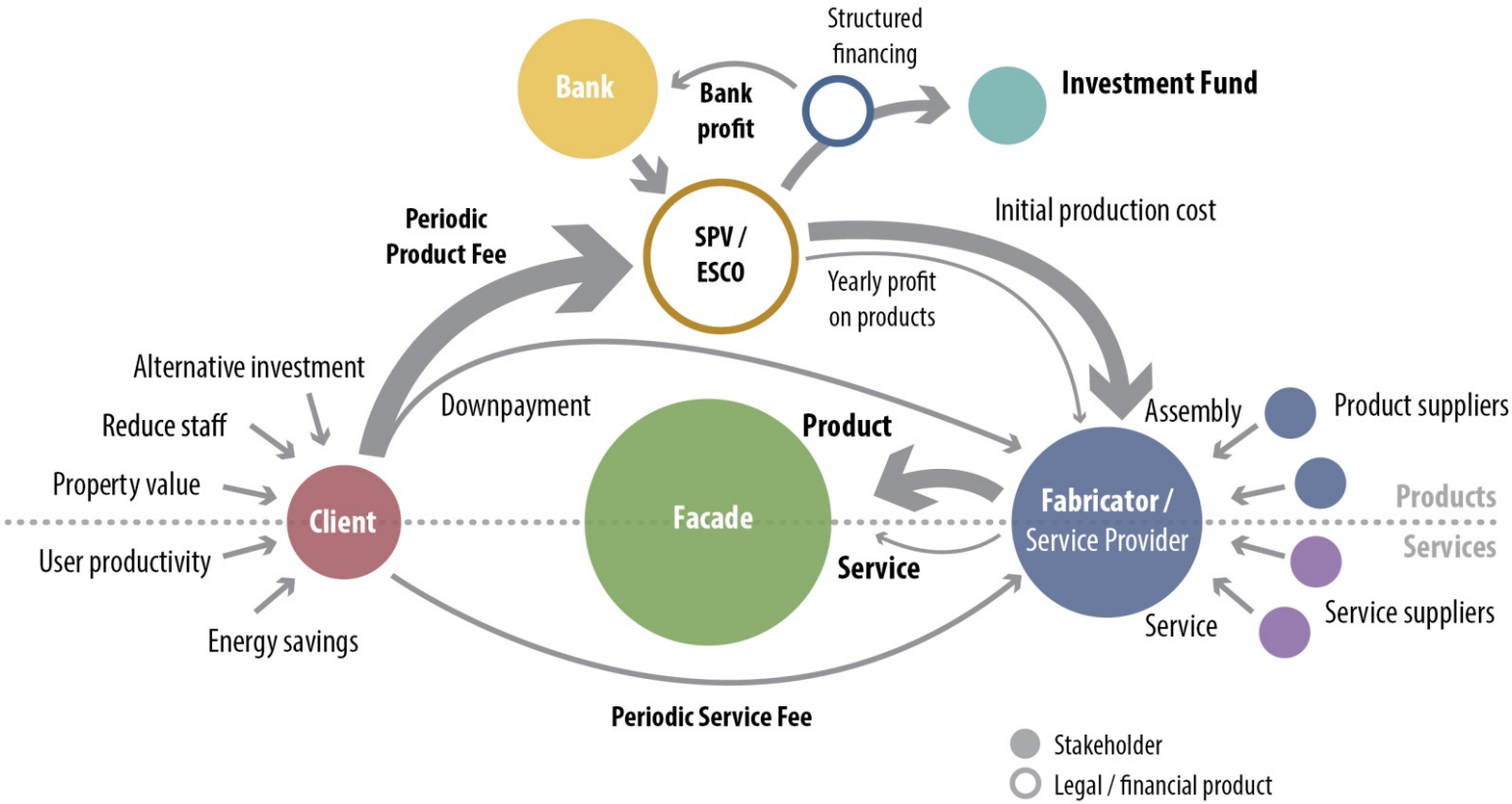
For clients the new model presents them with a new opportunity to improve the quality of their building portfolio, in terms of energetic and technical performance leading to real estate value and rentability, without the need for a large initial investment. Monthly or yearly service fees can more easily be balanced by profit from energy savings, rental increase, tenant retention, or occupancy stability. Institutional building owners and operators, such as universities, corporations, or government agencies, rarely use real estate as a core business activity, but rather as an opeerating asset to fulfill their core activities of education, business, and public administration. This means investment in building systems, such as facade upgrades, come at the cost of sacrificing investment in other, more strategically relevant fields. The large expense needed to renovate a facade and building systems is often difficult to justify in traditional terms such as Return on Investment (RoI); on one side energy prices are still too low for energy alone to constitute a justifiable business case, while on the other hand less tangible values such as the building's book value or staff productivity are difficult to accurately quantify from a long-term perspective.

By spreading the cost of the facade renovation into a series of yearly payments, the cash-flow analysis of costs and benefits can more easily be evaluated and many of the aforementioned challenges overcome. By removing the need for an initial investment the traditional RoI mentality can be left aside and priority can be given to alternative values beyond direct financial savings.

Lastly, financial institutions such as banks and investment funds can benefit from an entirely new market which also satisfies the strict requirements of ethical banking practices, promoting the energy and circular economy transitions. Facade fabricators are generally

The Facade Leasing value distribution model, presented in the journal paper "Façade Leasing: Drivers and barriers to the delivery of integrated Facades-as-a-Service." (Azcarate-Aguerre et al., 2018), annexed to this report and further described in the dissemination activities report 4.2.6.FLD.D4.

Azcarate-Aguerre, J. F., et al. (2018). "Façade Leasing: Drivers and barriers to the delivery of integrated Facades-as-a-Service." Real Estate Research Quarterly 17(3).



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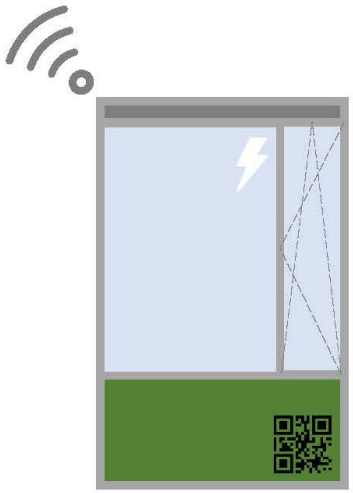
The Circular Facade-as-a-Service



Building Owner / User

- Buying / renting / using a façade with service on the basis of an agreed performance.
- Long-term relation (15+ years) with the circular facade provider (Alkondor).
- Can easily make changes (to the façade and tintegrated systems).

Receives indoor comfort and energy performance.

- *Clean air.*
- *Temperature control.*
- *Lighting control.*
- *Automated energy settings.*

Is essentially relieved from managing the façade.

Facade-as-a-Service provider

- Provides an energy- and comfort-based performance.
- Provides a circular facader with a service for 15+ years
- Delivers functionalities defined by Key Performance Indicators (KPI's), and gets paid accordingly.
- Provides for saving energy

Assistance in design and engineering.

Construction.

Facade performance monitoring.

Conduct technical maintenance.

Performs aesthetic maintenance and cleaning.

Performs updates, take responsibility for recycling.

Selected facade performance indicators

- *Sunlight-regulating and heat.*
- *Humidity control.*
- *Overheating prevention.*
- *Wind- and water-proof.*
- *Reliable operation of systems.*
- *Facade kept in optimal aesthetic condition.*
- *The facade is changeable (removable, reusable, and 100% recyclable).*

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small or medium enterprises (SME's) with between 100 and 200 employees including administrative, engineering, and construction staff. This business structure does not allow them to make the upfront investment necessary to pre-finance a facade which they can then lease out to a client as a means to deliver performance requirements. Analysis of the supplier's cash-flow, done by the consortium during the project, show the balance sheet of the facade fabricator collapsing after a few projects and its credit-worthiness severely reduced. A financial institution must therefore remove this load from the facade fabricator, by pre-financing the facade system in exchange for a periodic financing fee. A number of alternative models to achieve this have been developed, discussed, and analysed by the consortium, and are summarised in page 14 of this report.

A series of open questions regarding financing are still in the process of being answered:

1. The facade's residual value needs to be accurately estimated to provide a salvage price and reduce financial risk. This residual value must also take into account possible upcoming legislation demanding a higher content of reused, remanufactured, or at least recycled components in future building projects. Such legistlation would be a much welcomed governance approach to force the real estate sector to engage in circular innovation, and assign a higher value to legacy components over virgin ones.

2. Another open question is credit-worthiness of the facade fabricator. A promising alternative to overcome this challenge is to focus on the cash-flow generated by the service contract, therefore relying on the credit rating of the client organisation responsible for the ongoing payment of these service fees. Such a construct seems promising as it reduces financial costs to a more competitive margin, but opens issues of risk distribution as the client bears a larger portion of the risk than the other parties.

Once these and other barriers are overcome the model will present opportunities for low-risk investors such as pension funds, or for funds with specific ethical requirements such as green funds or social development funds. By focusing on certain client segments with high credit ratings and non-commercial interests, the safety of the new financial product can be guaranteed. The targeting of deep energy renovations, leading to decarbonisation and circular use of components and materials, justifies an ethical banking perspective.

Alkondor's value proposition to "essentially relieve the client from the management of the facade". By assuming responsibility over all activities needed to guarantee performance of the facade systems Alkondor can exploit their core business and technical competences, delivering an integrated product-service offering to the client based on pre-determined technical metrics (4.2.6.FLD. D2)

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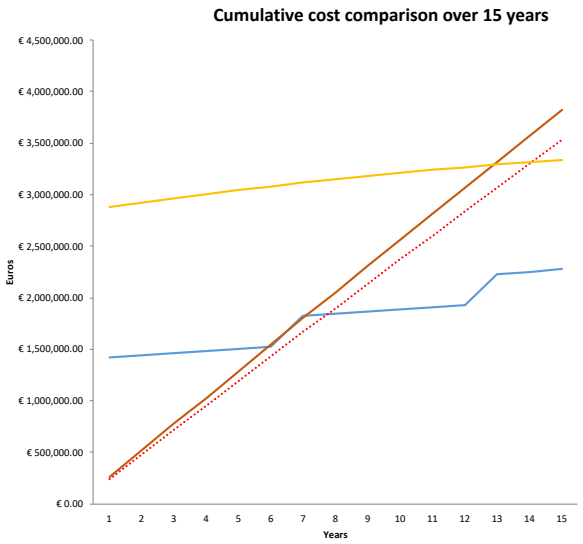

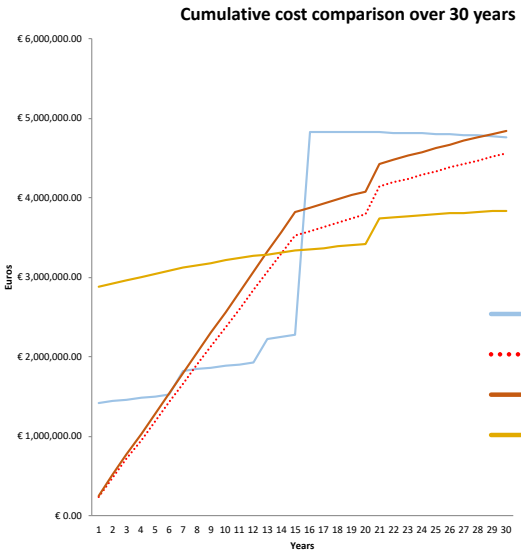

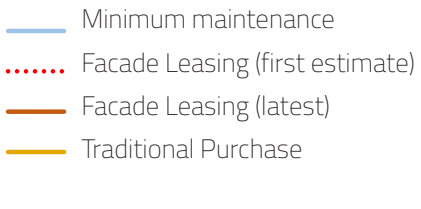

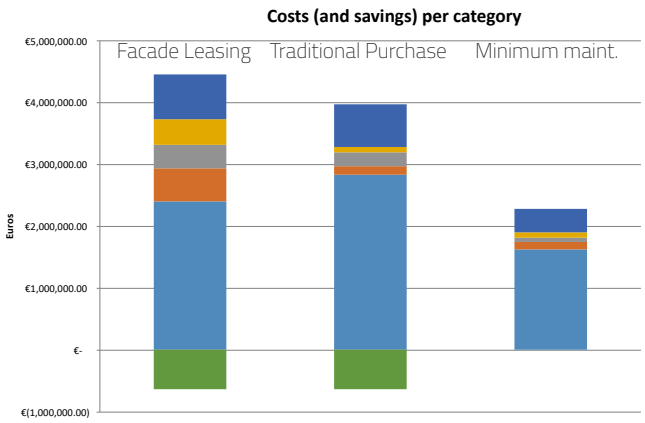

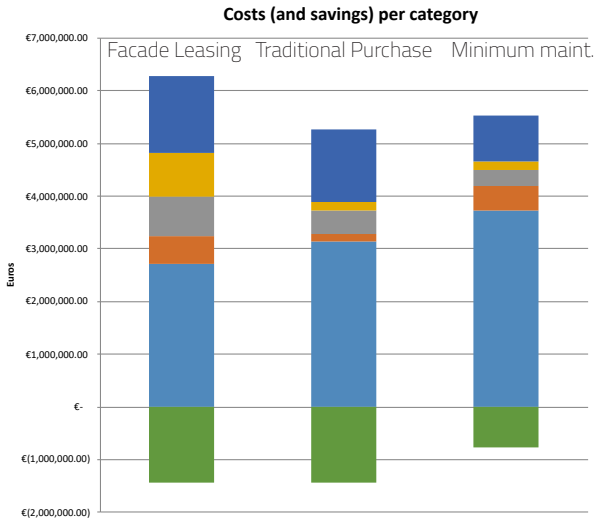

Financial comparison, over 15 (left) and 30 (right) years, of a "Façade Leasing" strategy against a "Minimum maintenance" scenario and a "Traditional purchase" scenario. Factors included in this analysis are:

- *Financial costs*
- *Maintenance*
- *Management*
- *Cleaning*
- *+ Energy savings*

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The Facade Leasing model relies on the value engineering of technical alternatives to meet the strategic priorities of the client. Rather than simply delivering a facade in accordance with prescribed technical specifications, the facade service provider becomes responsible for meeting the long-term demands of the building owner/operator and its end-users, as well as for managing expenses and meeting long-term Total Cost of Ownership projections. Value engineering can be based on a number of different objectives, such as lowering Total Cost of Ownership, maximizing energy and indoor comfort performance, increasing branding recognition of the organisation, allowing for flexibility of systems to future building typology changes, et. Many of these strategies can be desired in combination, in which case it is the task of the service provider to find the best balance to meet the client's long-term strategic goals.

The graph on the left shows the expected financial performance for the CiTG case-study building over a period of 15 years of full lease, followed by 15 years of service contract. It compares an entirely new facade, contracted under a "Facade Leasing" model, against the business-as-usual alternative in which the facade recives inly the minimum possible maintenance, while major maintenance works are deferred (i.e. delayed) until no longer technically possible in 2033.

As evidenced by the strategy followed by TU Delft Campus Real Estate on the West facade of the building, real estate operators frequently decide to defer major renovation decisions due to lack of long-term clarity on the broader portfolio strategy. Having come to the executive decision to continue operation of the building for another 10 years, the maintenance team at TU Delft CRE is left with a time-scope too short to justify a major renovation, but too long to avoid some kind of technical action.

Works on the west facade of the building therefore represented only the minimum possible technical maintenance needed to secure physical integrity of the facade components: The frames have been repainted and sealed, glazing has been cleaned and where necessary repaired, but overall performance of the facade is still as originally built in the late 1960's, with single glazing and an uninsulated steel frame with very low energy and indoor comfort performance. Such maintenance works are calculated to be necessary at a maximum of 6-year intervals, and the facade is deemed to be technical obsolete within 15 years. This means in 15 years a decision will have to be made whether to replace the facade or discontinue use of the building. Cleaning, maintenance, energy, and administration costs related to the facade lead to a steady cash-flow on a yearly basis, accounting for a slight discount rate applied to these costs to reflect future inflation.

In contrast, the "Facade Leasing" major renovation alternative does not require the initial investment of almost € 1.5 million of the "minimum maintenance" scenario, nor the roughly € 2.5 to € 3 million investment required by a traditionally purchased new facade. The

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outsourcing of cleaning, maintenance, and management costs, and the addition of new financing cost, leads to a steeper increase in accumulated yearly costs, dampened by the future value of energy savings. After year 15 the principal has been fully repaid and only operational costs must continue to be paid, under a service contract, as long as the facade remains in place. On year 25 there is a slight increase in this service fee to reflect the need for replacing certain facade systems such as solar shading and digital monitoring and control systems. This replacement investment, however, could again be financed through a "Facade Leasing" model, spreading the costs over the next 25 years of operation of the systems and accounting for their future residual value.

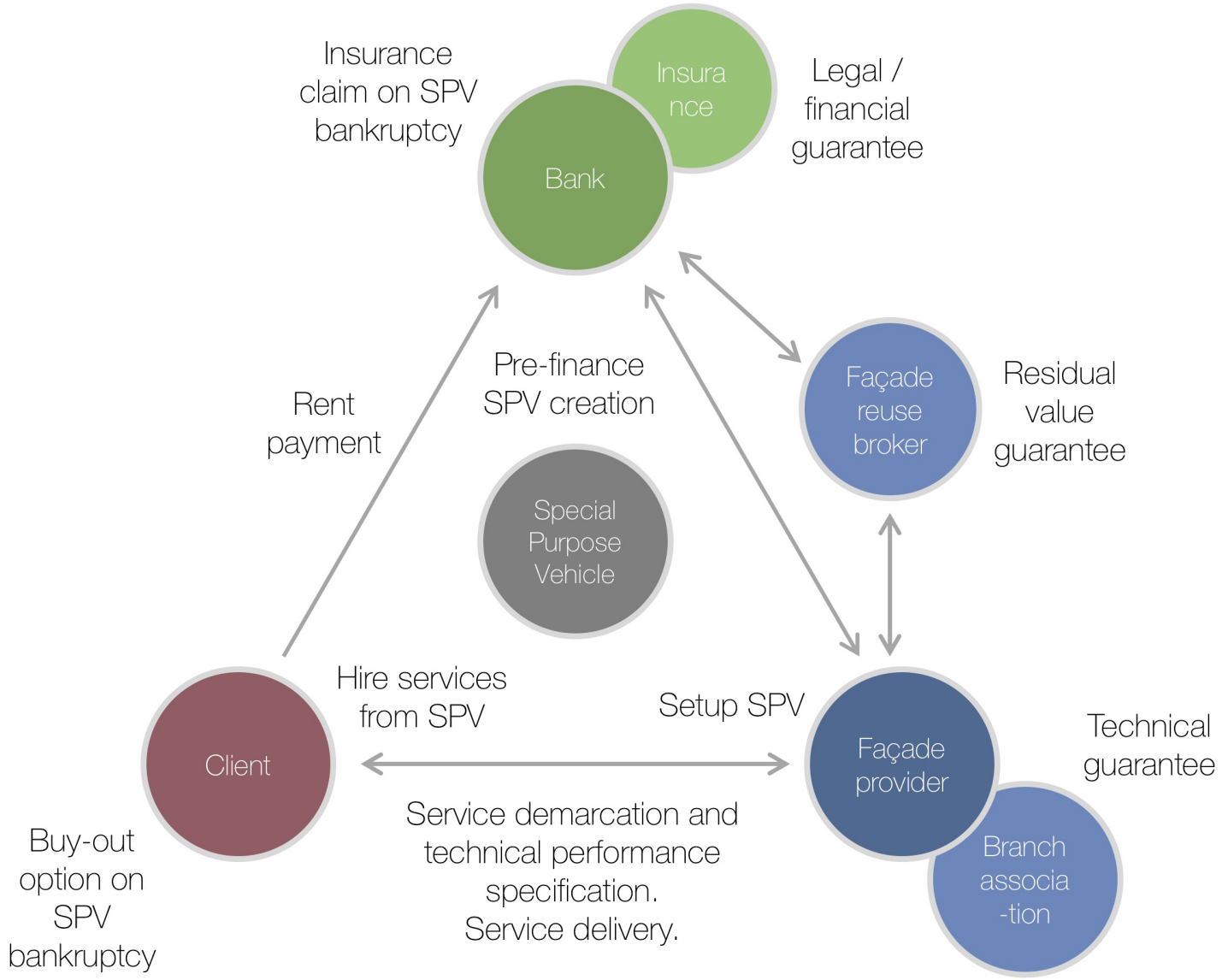
The comparison shows how a "Facade Leasing" contracting model can ease the decision to perform a deep energy renovation, by removing the high initial costs needed by a traditional purchase. While Total Cost of Ownership is slightly higher for the leased facade, the outsourcing of management and maintenance activities and their related risks, and the spreading of costs over time can be worth the extra cost from the client's perspective.

4. Alternative contracting models

Financial and legal aspects of the business model are deeply intertwined, and are the core topic of ongoing discussions and negotiations between the parties. As previously mentioned, the outsourcing of risks and responsibilities constitutes one of the key value propositions of the service contract, and must be reflected in the correct contracting model and legal agreement. The diagram on the right, elaborated by ABN AMRO Lease (subsidiary of ABN AMRO Bank, a large Dutch financial institution), shows the original model in which the three core parties are mutually tied by contractual agreements and financial obligations.

Open questions have lead to the creation and ongoing evaluation of alternative organisational models, with TU Delft having a direct relation to either the leasing company or the facade fabricator, who in turn is supported by the other partner for financing or service delivery respectively. Such models facilitate a "one-stop-shop" solution for TU Delft as building operator, as they would have a single point of contact with a single contracted partner, rather than split responsibilities for different aspects of the contract as is the case in the diagram on the right.

These questions, together with the definition of service performance KPI's, like those showed in 4.2.6.FLD.D2 Technical Delivery Report are, at the moment of writing, in the process of being clarified with the support of a large number of internal and external experts.



Initial proposal for a three-party contractual agreement for the financing and delivery of facades-as-a-service. This model and others are being evaluated to find the best solution with the lowest risk and highest value, taking maximum advantage of each partner's core business skills.

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5. Upscaling potential

The illustration on the rights provides a rough impression of the nearest potential upscaling markets. Publicly owned Dutch non-residential buildings are considered the most likely early adopters. Corporate real estate, particularly office buildings, is considered the next tier.

Corporate real estate is defined as property which is owned by corporations as operating assets. Commercial real estate, on the other hand, is the ownership and/or operation of real estate as a core business and direct source of revenue. An example of corporate real estate would be the headquarter offices of a large company, as long as the building is owned by the company itself and not rented. Corporate real estate also includes production facilities, warehouses, housing, among many other building typologies, but offices are considered the most promising market due to the high performance required from their facades, and the high investment and maintenance costs associated to this performance.

The five largest European countries are estimated to have over half a billion square meters of facades for office buildings alone, many of which follow the aforementioned trend of having been built in the post-war period and therefore approaching the end of their building envelope's service life. Meanwhile, growing competition for high-quality office-space, tightening indoor comfort, energy-performance, and safety regulations, and the increased risk of extreme weather and climate events place ever more pressure on office-building owners to renovate their building envelopes.

Work related to the upscalability of the model and its adaptability to other markets is ongoing, and will be further described in the 2019 reporting period, at the end of this project stage.

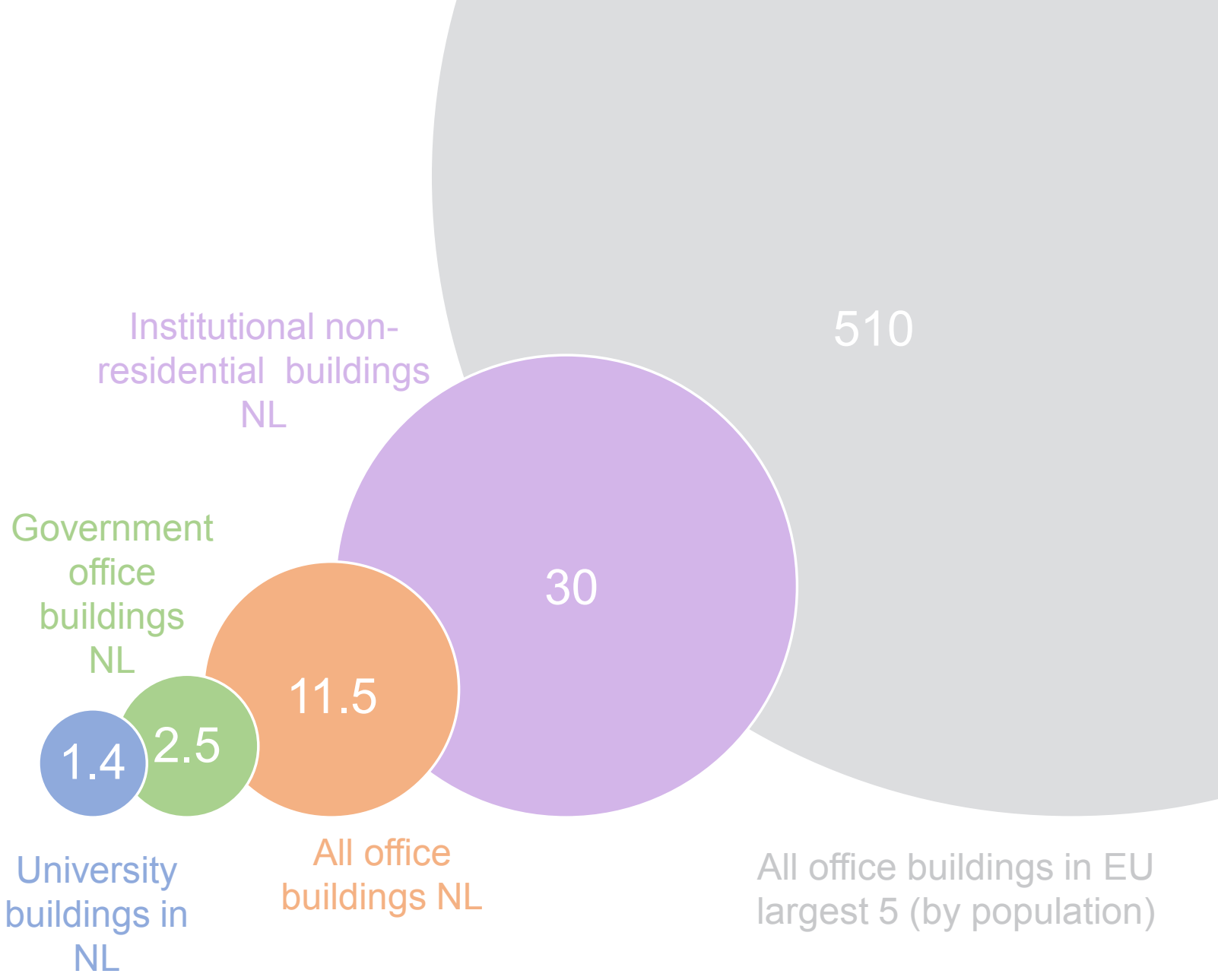

Diagram illustrating upscaling potential for a number of sectors and markets. Values are given in estimated million square meters of facade surface (Ebbert, 2008). The five largest countries in the EU by population are Germany, the UK, France, Italy, and Spain.

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2019

6. Facades-as-a-Service Business Model Canvas validation

The Business Model Canvas for the Facades-as-a-Service model has been validated throughout 2019 in two main ways:

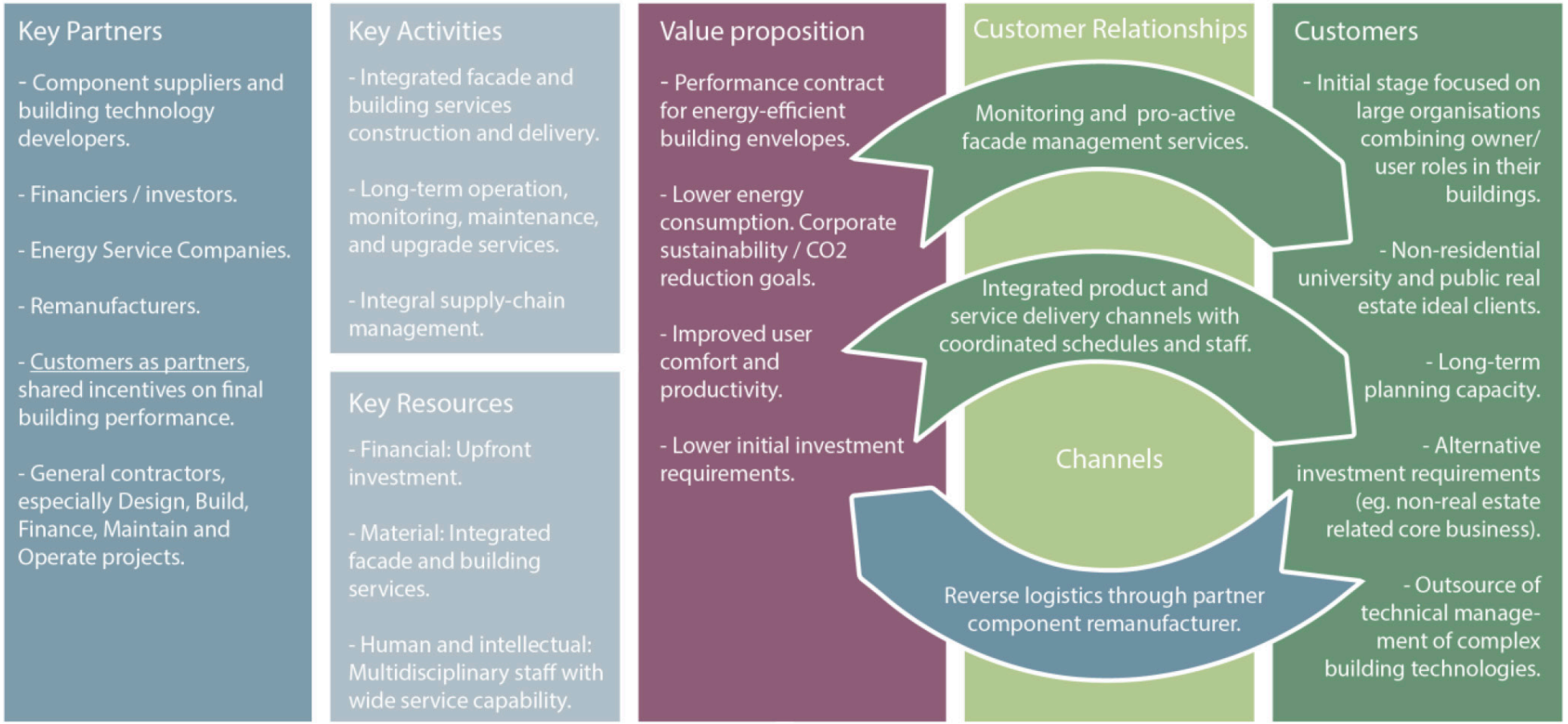
1. Internal validation: The project consortium has exhaustively reviewed and validated the technological, legal, financial, and managerial aspects of the model in dozens of meetings, discussions, and workshops on different aspects of the business and financial models. Key to this process have been representatives from TU Delft Campus Real Estate (building developer, owner, and operator), TU Delft Finance (financial comptrollers for the university), TU Delft Legal (legal advisory department of the university), Alkondor Hengelo BV (facade builder, system integrator, and Facades-as-a-Service provider), Houthoff (legal and fiscal advisor to TU Delft), and ABN AMRO Lease (potential financier of the leasing model).

As described below, in Chapter 9, the specific circumstances of TU Delft as a building owner and potential client resulted in the financial aspects of the project not being fully implemented in the case of the CiTG large-scale renovation prototype. However, most of the technological, legal, and managerial aspects of the business model were successfully tested in the demonstrator, and are ready to be implemented in a commercial setting. The lessons learnt, described below in this report, will be instrumental to future market uptake efforts, many of which are already currently ongoing:

2. External validation: Alkondor Hengelo BV has, since the 3rd quarter of 2019, started conversations with a number of different market players interested in testing the Facades-as-a-Service model in their ongoing development and re-development projects. These parties include the entire range of the Dutch real estate sector, from short-term commercial developers, through Homeowners Associations and corporate real estate operators, and up to (semi-)public organisations such as TU Delft's Campus Real Estate.

Each of these investor groups has different characteristics, strategic priorities, financial circumstances, and planning time-frames. As a result of this the BMC described in the following page is likely to apply to each of them in very different ways. A new key resource developed in 2019 is the Facades-as-a-Service model contract, developed by Houthoff, TU Delft, and Alkondor, and which can be used as a legally-binding agreement in future cases. This model contract is the first of its kind, and outlines the distribution of responsibilities and risks between all stakeholders with a long-term involvement in the project. The transition towards more circular building procurement models requires building a new level of trust between the collaborating parties, which does not exist or is often lost in the traditional culture of lowest-initial-cost procurement.

As shown in the contracting model on page 15 of this report, Facades-as-a-Service represents a long-term agreement between building owner, service provider, and financier, which should lead to a focus on ongoing performance value over one-time product transactions, shared incentives among stakeholders, and a more sustainable use of human, material, and financial resources.



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7. Total Cost of Ownership comparison - Client's perspective

In 2019 a more detailed Total Cost of Ownership analysis was elaborated for the three scenarios considered: Business as Usual, Facade Purchase, and Facade Leasing.

A distinction is made in the study between hard, tangible costs and values, and soft, intangible values. Hard costs represent all monetary expenses which must be made throughout the study period, such as initial investment, costs of capital / financing, maintenance, cleaning, and management, and Value Added Taxes. On the hard values side could be considered energy savings according to simulated data, though monitoring throughout 2018 to 2020 will show if the expected energy-performance improvement is reached in practice. An added complexity of taking energy-savings into account is the uncertainty of energy price trends when looking into the distant 30-year future. If energy prices drop during this time, the actual financial performance of the investment, in relation to avoided energy costs, will be lower than expected.On the other hand, a sharper increase in energy prices would lead to a better-than-expected financial performance.

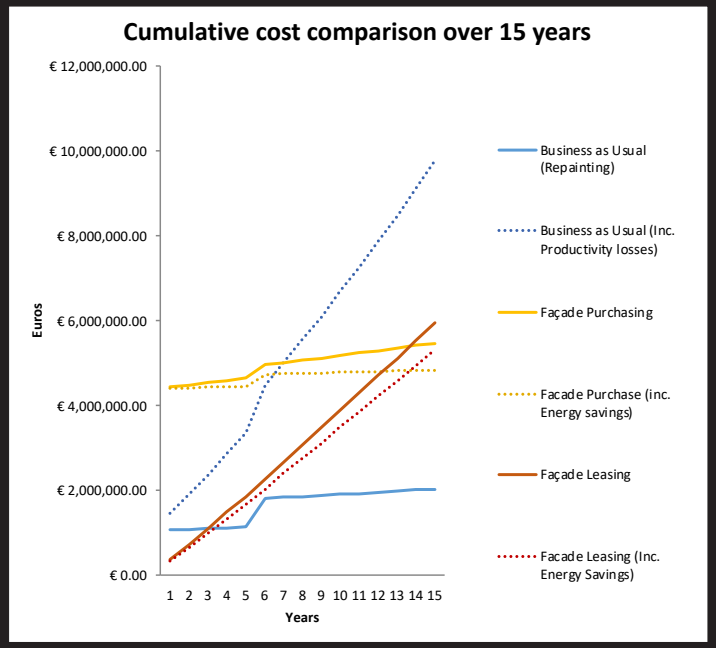
In terms of intangible values, the study is limited to those values which can be relatively accurately monetised, such as the productivity of employees subject to a more or less comfortable indoor environment. Various indoor comfort studies point to a figure of between 2% and 4% in employee productivity related to a more or less comfortable indoor environment. These figures, however, are often scieentifically disputed due to the difficulty of measuring productivity, particularly in office activities and spaces. The uncertainty of user productivity value or cost, and the less uncertain but still hard to determine value of energy savings have been considered in the study by separating them into an alternative graph (shown in dashed lines on the right). This way they can be visualised and taken into account during the decision-making process, but not confused with the hard costs and values which can be more certainly expected during the project's service-life.

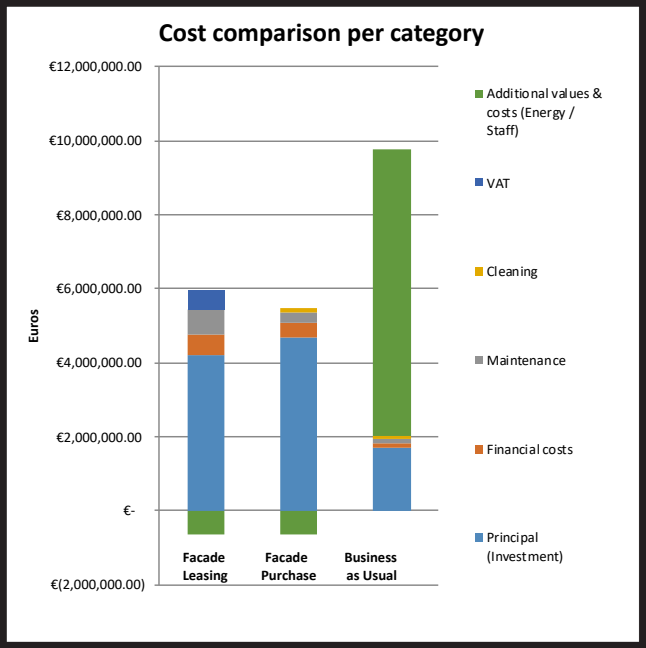
The study can be further developed to include even more intangible sources of cost and value, for example the branding cost (for the building owner) of having an unsustainable building which is perceived as such by the general public who is ever more conscious of the importance of energy efficiency. An intangible source of value is the facade appearance, as new and better-repaired facades will give the building a higher aesthetic value that a technically outdated or ill-repaired facade. Such intangible costs and values have been excluded from this study due to the difficulty of calculating their monetary value, and the lack of approved international valuation standards to do so.

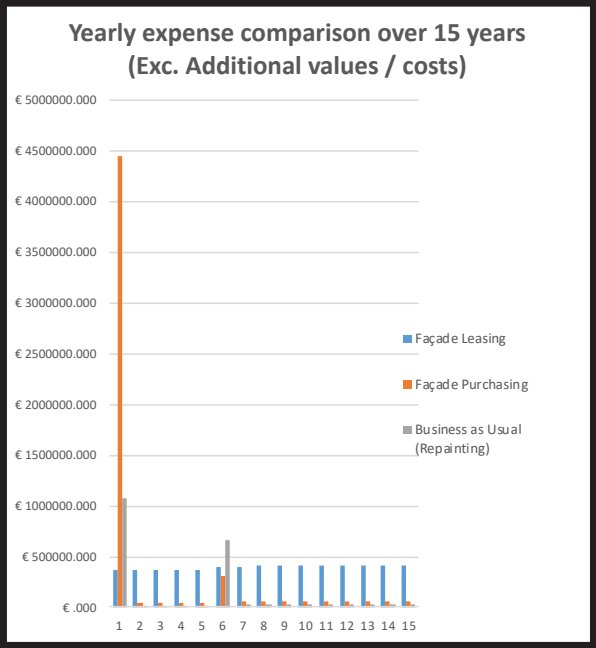
The study shows that, focusing only on tangible costs and values, facade leasing can be a solution for organisations dealing with uncertainty. As the CiTG case demonstrates, delaying a major renovation decision can have negative effects on the final financial performance of the project. This as the renovation works will need to be carried out eventually anyway, and the higher energy and maintenance costs incurred while the facade is not yet renovated which result in foregone savings during this period. Acting as early as possible is not only most likely better from a financial perspective, it is also the most sustainable alternative as we face the urgent challenge of massively updating our building stock to higher energy performance standards.

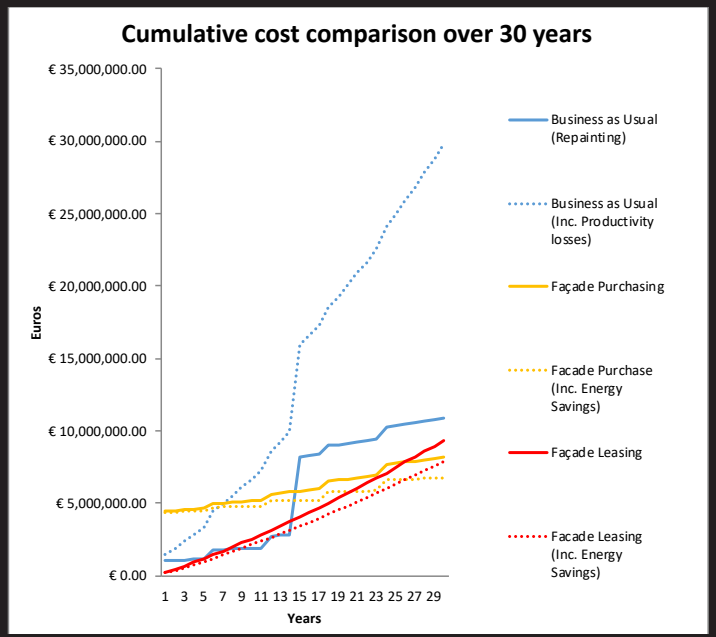
Diverse financial graphs showing Total Cost of Ownership comparison between the three studied scenarios over a study period of 15 years.

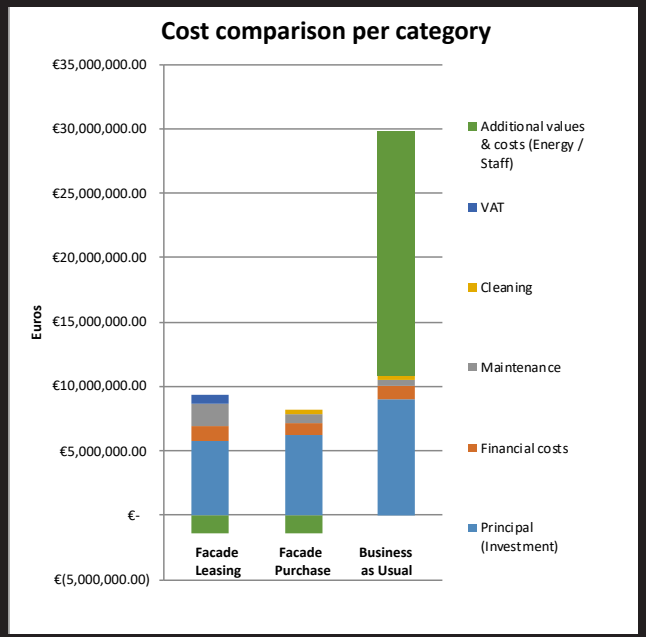
Diverse financial graphs showing Total Cost of Ownership comparison between the three studied scenarios over a study period of 30 years.

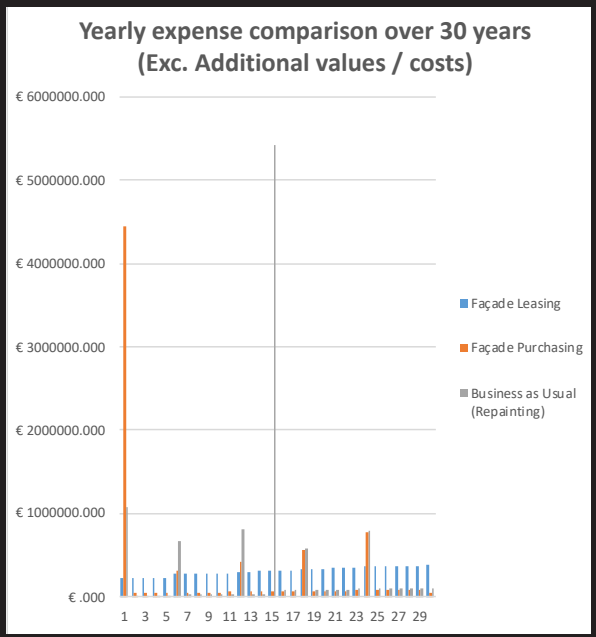

Cumulative cost comparison over 15 years
€ 12,000,000.00
€ 10,000,000.00
€ 8,000,000.00
€ 6,000,000.00
€ 4,000,000.00
€ 2,000,000.00
€ 0.00
Euros
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Years
Business as Usual (Repainting)
Business as Usual (Inc. Productivity losses)
Façade Purchasing
Facade Purchase (inc. Energy savings)
Façade Leasing
Facade Leasing (Inc. Energy Savings)


Cost comparison per category
€12,000,000.00
€10,000,000.00
€8,000,000.00
€6,000,000.00
€4,000,000.00
€2,000,000.00
€-
€(2,000,000.00)
Euros
Facade Leasing
Facade Purchase
Business as Usual
Additional values & costs (Energy / Staff)
VAT
Cleaning
Maintenance
Financial costs
Principal (Investment)


Yearly expense comparison over 15 years (Exc. Additional values / costs)
€ 5000000.000
€ 4500000.000
€ 4000000.000
€ 3500000.000
€ 3000000.000
€ 2500000.000
€ 2000000.000
€ 1500000.000
€ 1000000.000
€ 500000.000
€ .000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Façade Leasing
Façade Purchasing
Business as Usual (Repainting)


Cumulative cost comparison over 30 years
€ 35,000,000.00
€ 30,000,000.00
€ 25,000,000.00
€ 20,000,000.00
€ 15,000,000.00
€ 10,000,000.00
€ 5,000,000.00
€ 0.00
Euros
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Years
Business as Usual (Repainting)
Business as Usual (Inc. Productivity losses)
Façade Purchasing
Facade Purchase (Inc. Energy Savings)
Façade Leasing
Facade Leasing (Inc. Energy Savings)


Cost comparison per category
€35,000,000.00
€30,000,000.00
€25,000,000.00
€20,000,000.00
€15,000,000.00
€10,000,000.00
€5,000,000.00
€-
€(5,000,000.00)
Euros
Facade Leasing
Facade Purchase
Business as Usual
Additional values & costs (Energy / Staff)
VAT
Cleaning
Maintenance
Financial costs
Principal (Investment)


Yearly expense comparison over 30 years (Exc. Additional values / costs)
€ 6000000.000
€ 5000000.000
€ 4000000.000
€ 3000000.000
€ 2000000.000
€ 1000000.000
€ .000
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Façade Leasing
Façade Purchasing
Business as Usual (Repainting)

	Discount	Equity (Exc. Residual Value)			Debt (Bank loan)			Special Purpose Vehicle (Lessor) Cashflow						
		Principal	Interest	Payments	Principal	Interest	Payment	Income (Nominal)	Income (Real)	VAT	Expenses (Nominal)	Expenses (Real)	Balance (Nominal)	Balance (Real)
1	1,03	€ 425.017,60	€ 21.250,88	€ 35.418,13	€ 1.487.561,60	€ 22.313,42	€ 71.898,81	€ 101.870,14	€ 98.903,04	€ 21.392,73	-€ 107.316,94	-€ 107.316,94	-€ 5.446,81	-€ 8.413,90
2	1,06	€ 410.850,35	€ 20.542,52	€ 34.709,77	€ 1.437.976,21	€ 28.759,52	€ 78.344,91	€ 101.870,14	€ 96.022,37	€ 21.392,73	-€ 113.054,68	-€ 106.564,88	-€ 11.184,55	-€ 10.542,51
3	1,09	€ 396.683,09	€ 19.834,15	€ 34.001,41	€ 1.388.390,83	€ 27.767,82	€ 77.353,20	€ 101.870,14	€ 93.225,60	€ 21.392,73	-€ 111.354,61	-€ 101.905,24	-€ 9.484,48	-€ 8.679,64
4	1,13	€ 382.515,84	€ 19.125,79	€ 33.293,05	€ 1.338.805,44	€ 26.776,11	€ 76.361,50	€ 101.870,14	€ 90.510,30	€ 21.392,73	-€ 109.654,54	-€ 97.426,64	-€ 7.784,41	-€ 6.916,34
5	1,16	€ 368.348,59	€ 18.417,43	€ 32.584,68	€ 1.289.220,05	€ 25.784,40	€ 75.369,79	€ 101.870,14	€ 87.874,07	€ 21.392,73	-€ 107.954,47	-€ 93.122,47	-€ 6.084,33	-€ 5.248,40
6	1,19	€ 354.181,33	€ 17.709,07	€ 31.876,32	€ 1.239.634,67	€ 24.792,69	€ 74.378,08	€ 101.870,14	€ 85.314,63	€ 21.392,73	-€ 106.254,40	-€ 88.986,39	-€ 4.384,26	-€ 3.671,75
7	1,23	€ 340.014,08	€ 17.000,70	€ 31.167,96	€ 1.190.049,28	€ 23.800,99	€ 73.386,37	€ 101.870,14	€ 82.829,74	€ 21.392,73	-€ 104.554,33	-€ 85.012,24	-€ 2.684,19	-€ 2.182,50
8	1,27	€ 325.846,83	€ 16.292,34	€ 30.459,59	€ 1.140.463,89	€ 22.809,28	€ 72.394,66	€ 101.870,14	€ 80.417,23	€ 21.392,73	-€ 102.854,26	-€ 81.194,10	-€ 984,12	-€ 776,88
9	1,30	€ 311.679,57	€ 15.583,98	€ 29.751,23	€ 1.090.878,51	€ 21.817,57	€ 71.402,96	€ 101.870,14	€ 78.074,98	€ 21.392,73	-€ 101.154,19	-€ 77.526,26	€ 715,95	€ 548,71
10	1,34	€ 297.512,32	€ 14.875,62	€ 29.042,87	€ 1.041.293,12	€ 20.825,86	€ 70.411,25	€ 101.870,14	€ 75.800,95	€ 21.392,73	-€ 99.454,12	-€ 74.003,20	€ 2.416,02	€ 1.797,74
11	1,38	€ 283.345,07	€ 14.167,25	€ 28.334,51	€ 991.707,73	€ 19.834,15	€ 69.419,54	€ 101.870,14	€ 73.593,15	€ 21.392,73	-€ 97.754,05	-€ 70.619,60	€ 4.116,09	€ 2.973,55
12	1,43	€ 269.177,81	€ 13.458,89	€ 27.626,14	€ 942.122,35	€ 18.842,45	€ 68.427,83	€ 101.870,14	€ 71.449,66	€ 21.392,73	-€ 96.053,98	-€ 67.370,33	€ 5.816,16	€ 4.079,34
13	1,47	€ 255.010,56	€ 12.750,53	€ 26.917,78	€ 892.536,96	€ 17.850,74	€ 67.436,13	€ 101.870,14	€ 69.368,61	€ 21.392,73	-€ 94.353,91	-€ 64.250,42	€ 7.516,23	€ 5.118,19
14	1,51	€ 240.843,31	€ 12.042,17	€ 26.209,42	€ 842.951,57	€ 16.859,03	€ 66.444,42	€ 101.870,14	€ 67.348,16	€ 21.392,73	-€ 92.653,84	-€ 61.255,10	€ 9.216,30	€ 6.093,06
15	1,56	€ 226.676,05	€ 11.333,80	€ 25.501,06	€ 793.366,19	€ 15.867,32	€ 65.452,71	€ 101.870,14	€ 65.386,56	€ 21.392,73	-€ 90.953,77	-€ 58.379,76	€ 10.916,37	€ 7.006,80
16	1,03	€ 212.508,80	€ 10.625,44	€ 24.792,69	€ 743.780,80	€ 14.875,62	€ 64.461,00	€ 101.870,14	€ 98.903,04	€ 21.392,73	-€ 89.253,70	-€ 86.654,07	€ 12.616,44	€ 12.248,97
17	1,06	€ 198.341,55	€ 9.917,08	€ 24.084,33	€ 694.195,41	€ 13.883,91	€ 63.469,29	€ 101.870,14	€ 96.022,37	€ 21.392,73	-€ 87.553,63	-€ 82.527,69	€ 14.316,51	€ 13.494,68
18	1,09	€ 184.174,29	€ 9.208,71	€ 23.375,97	€ 644.610,03	€ 12.892,20	€ 62.477,59	€ 101.870,14	€ 93.225,60	€ 21.392,73	-€ 85.853,56	-€ 78.568,16	€ 16.016,58	€ 14.657,44
19	1,13	€ 170.007,04	€ 8.500,35	€ 22.667,61	€ 595.024,64	€ 11.900,49	€ 61.485,88	€ 101.870,14	€ 90.510,30	€ 21.392,73	-€ 84.153,48	-€ 74.769,28	€ 17.716,65	€ 15.741,01
20	1,16	€ 155.839,79	€ 7.791,99	€ 21.959,24	€ 545.439,25	€ 10.908,79	€ 60.494,17	€ 101.870,14	€ 87.874,07	€ 21.392,73	-€ 82.453,41	-€ 71.125,04	€ 19.416,72	€ 16.749,03
21	1,19	€ 141.672,53	€ 7.083,63	€ 21.250,88	€ 495.853,87	€ 9.917,08	€ 59.502,46	€ 101.870,14	€ 85.314,63	€ 21.392,73	-€ 80.753,34	-€ 67.629,65	€ 21.116,79	€ 17.684,98
22	1,23	€ 127.505,28	€ 6.375,26	€ 20.542,52	€ 446.268,48	€ 8.925,37	€ 58.510,76	€ 101.870,14	€ 82.829,74	€ 21.392,73	-€ 79.053,27	-€ 64.277,55	€ 22.816,86	€ 18.552,20
23	1,27	€ 113.338,03	€ 5.666,90	€ 19.834,15	€ 396.683,09	€ 7.933,66	€ 57.519,05	€ 101.870,14	€ 80.417,23	€ 21.392,73	-€ 77.353,20	-€ 61.063,33	€ 24.516,93	€ 19.353,89
24	1,30	€ 99.170,77	€ 4.958,54	€ 19.125,79	€ 347.097,71	€ 6.941,95	€ 56.527,34	€ 101.870,14	€ 78.074,98	€ 21.392,73	-€ 75.653,13	-€ 57.981,83	€ 26.217,00	€ 20.093,15
25	1,34	€ 85.003,52	€ 4.250,18	€ 18.417,43	€ 297.512,32	€ 5.950,25	€ 55.535,63	€ 101.870,14	€ 75.800,95	€ 21.392,73	-€ 73.953,06	-€ 55.028,02	€ 27.917,07	€ 20.772,92
26	1,38	€ 70.836,27	€ 3.541,81	€ 17.709,07	€ 247.926,93	€ 4.958,54	€ 54.543,93	€ 101.870,14	€ 73.593,15	€ 21.392,73	-€ 72.252,99	-€ 52.197,10	€ 29.617,14	€ 21.396,05
27	1,43	€ 56.669,01	€ 2.833,45	€ 17.000,70	€ 198.341,55	€ 3.966,83	€ 53.552,22	€ 101.870,14	€ 71.449,66	€ 21.392,73	-€ 70.552,92	-€ 49.484,40	€ 31.317,21	€ 21.965,26
28	1,47	€ 42.501,76	€ 2.125,09	€ 16.292,34	€ 148.756,16	€ 2.975,12	€ 52.560,51	€ 101.870,14	€ 69.368,61	€ 21.392,73	-€ 68.852,85	-€ 46.885,44	€ 33.017,28	€ 22.483,16
29	1,51	€ 28.334,51	€ 1.416,73	€ 15.583,98	€ 99.170,77	€ 1.983,42	€ 51.568,80	€ 101.870,14	€ 67.348,16	€ 21.392,73	-€ 67.152,78	-€ 44.395,90	€ 34.717,35	€ 22.952,26
30	1,56	€ 14.167,25	€ 708,36	€ 14.875,62	€ 49.585,39	€ 991,71	€ 50.577,09	€ 101.870,14	€ 65.386,56	€ 21.392,73	-€ 65.452,71	-€ 42.011,60	€ 36.417,43	€ 23.374,96
		€ 425.017,60	€ 329.388,64	€ 754.406,24	€ 1.487.561,60	€ 453.706,29	€ 1.941.267,89	€ 3.056.104,06	€ 2.432.238,13	€ 641.781,85	-€ 2.695.674,13	-€ 2.169.532,67	€ 360.429,93	€ 262.705,46

Case Data	Project	Project capital cost	€ 2.125.088,00
	Lease	Equity Ratio	30,00%
		Equity	€ 637.526,40
		Cost of Equity Investor (Fixed IR)	5,00%
		Debt Ratio	70,00%
		Debt	€ 1.487.561,60
		CoD Debt (Fixed IR)	1,50%
		Residual Value	€ 212.508,80
		Residual Value (%)	10%
		Share Equity	1,00%
		Share Debt	1,05%
		WACC Lesor (IR)	2,05%
		WACC Lessee (IR)	2,60%

8. Cash-flow analysis - Service provider / Special Purpose Vehicle perspective

30-year cash-flow analysis from the perspective of the Facades-as-a-Service provider. A Special Purpose Vehicle with combined equity and loan capitalisation has been used in this example.

A cash-flow analysis has been elaborated from the perspective of the Special Purpose Vehicle created to own and manage the leased facade (page 15). The cash-flow analysis takes into account financial data provided by financial organisations involved in the project, such as possible interest rate on the transaction, and minimum equity investment needed as collateral to guarantee this cash-flow based financing model. The model therefore relies on a 30:70 equity to debt ratio, with an equity interest rate of 5% and a debt interest rate of 1,5%, resulting in a Weighted Average Cost of Capital of 2,05% and a potential financial cost to the Lessee of 2,5% to allow for a reasonable profit margin.

The study takes into account a residual value for the facade components of 10% at their end-of-service, as the cost of removing, cleaning, and eventually remanufacturing these components must be taken into account before the facade can be made available in the second hand market. This residual value is, at the moment, a source of great uncertainty. First, there is currently a very limited second-hand market for pre-used facades, meaning historical data is largely unavailable to determine residual value trends. Second, it s expected that tightening regulation aimed at promoting a circular use of materials will incentivise the use of more pre-owned components (or otherwise penalise the use of virgin materials and components). If this happens a new and much larger market for second-hand components is expected to arise, but at the moment this cannot be assumed. Third, while advancement in building and facade technologies is no longer occurring at the fast rate of the post-1970's oil crisis period, and facades have reached very high levels of energy and functional performance, it is unknown how technology will change in the coming years, and what effect this might have on the value of legacy equipment built in 2019.

The time-scales involved in the construction industry, easily reaching 30 to 50 years, make any projections related to these factors highly uncertain, and further research and time are needed to accurately address these issues. The project consortium is working with the Dutch metal facade industry branch organisation, VMRG, and other research institutes and projects, to advance our understanding of residual value and remanufacturing techniques for facades and other building systems, hoping this information will soon contribute to the bankability of such products.

As seen on the opposite page, the cash-flow analysis for the SPV over a 30-year contract period is promising, and results in positive gains a few years after completion of the project. This methodology must be further developed and tested on a number of different projects and scenarios, and with diverse stakeholder characteristics. The main financial challenge to implementation at the moment of writing is to identify the investor profile that could be better-suited to provide equity investment for such a model. The return on equity is lower than what is commonly offered by traditional real estate investments, while the cash-flow based form of financing makes full debt-based finance too risky a proposition. Under certain circumstances, and with certain types of projects and clients, the financial model is expected to eventually become safe enough for pension funds and other institutional investors to find it interesting. Early adoption, however, will most liklely be too risky for such parties, and a number of trials must be first successfully realised in order to build a positive track-record and support future investments.

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Interior view of a meeting room in the CiTG large-scale demonstrator prototype. The picture was taken shortly before completion of construction works in this section of the building.

In early 2019 we achieved a detailed breakdown of what the new financing model proposed by the FLD Project would mean for the cash-flow and fiscal situation of the various stakeholders involved. ABN AMRO Lease, the project's financial partner, visited Alkondor Hengelo BV (the Facades-as-a-Service provider) to study their financial situation as key participating member in the potentially large and long-term investment needed for the leasing of the CiTG large-scale prototype façade.

While the technological and managerial aspects of the Facades-as-a-Service model were successfully implemented in the CiTG case, the final implementation of the full Facades-as-a-Service model could not be achieved due to a series of difficulties faced in terms of time-frames, financial and fiscal consequences. Instead, the CiTG façade was traditionally purchased by TU Delft, and a service-contract has been established between TU Delft Campus Real Estate and Alkondor Hengelo for the ongoing maintenance of the façade, and the eventual take-back of the systems by the façade fabricator at the end of the facade's service life, or when it is no longer needed at the CiTG building.

The key factors contributing to the decision "not to lease" are important lessons of the project and are highly technical and specific to the prototype's context. Understanding them will contribute greatly to solving problems in future upscaling efforts, and they are summarized below:

Tight time-frame resulting in transfer taxes: The need to complete the CiTG large-scale prototype in 2019, established not only by this project's subsidized schedule but also by TU Delft Campus Real Estate's operational requirements, placed considerable pressure on the definition of final details in the leasing contract. The façade had to be ordered in March 2019, so that installation and fabrication could start in the summer and be completed (following a very tight and ambitious schedule) by the end of 2019. Details of the Facades-as-a-Service contract had not yet been finally defined back in March 2019, so an alternative was considered in which TU Delft CRE would pay up-front for the façade, which would then be transferred back to the Special Purpose Vehicle (SPV) which would be created to legally own the façade and manage the leasing contract, at a later date.

This became quickly unfeasible as, according to a number of fiscal advisors consulted, once the façade was being built on site, transferring its ownership from TU Delft CRE to the FaaS SPV would result in Real Estate Transfer Taxes of 6% of the asset's value (6% being the taxes corresponding to non-residential property transactions in the Netherlands). Due to the scale of the CiTG prototype this additional tax resulted in a transfer cost increasing by around €10.000 euros per week between June and December 2019 – as more of the façade was mounted – with the worst-case scenario being the payment of over €300.000 euros by transferring the façade at the end of 2019. This expense was considered unjustifiable and so the transfer could not be made. Considering this was possibly the largest barrier, it is fair to say that time

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pressure during the decision-making phase was the key contributing factor to the full leasing model not being implemented.

Specific financial situation of TU Delft Campus Real Estate: Working with publicly-funded organizations such as TU Delft has always been the focus of the Façade Leasing project, as these organisations have a long-term planning horizon and ownership, and are not primarily lead by financial profit as is the case with more commercial real estate developers and operators. Two unexpected drawbacks of having TU Delft CRE as client party in the project resulted:

1. As a publicly-funded organisation, TU Delft has access to a AAA credit rating and particularly low interest rates when borrowing funds for projects. While TU Delft would be the party guaranteeing payment of the Facades-as-a-Service model on the CiTG prototype, the existence of other parties (such as Alkondor Hengelo) on which the business model relies resulted in considerably higher interest rates when leasing than when purchasing. The incentive of lower initial investment and freeing capital for other projects (i.e. eliminating opportunity costs) was not attractive enough in the case of TU Delft CRE, as access to low-cost capital would be secure whether or not the project was executed.

2. Specific regulation in the Netherlands, targeting publicly-funded educational institutes, forbids such organisations from acquiring financing from non-AAA rated financial institutions. The SPV which would be created to own, operate, and manage the façade, and which would in fact be providing "pre-financing" to TU Delft for the construction and operation of the CiTG prototype, would be created with funds from a AAA-rated bank (ABN AMRO Lease), but would not itself be AAA-rated. This meant current legislation would not allow such a contract. This situation is highly specific to this client sector in the Netherlands, and was unforeseeable until the Facades-as-a-Service model contract had achieved a high level of resolution.

Impact on the value of the target building as collateral: One of the main reasons why building and construction law prevents split ownership of building fixtures is that legal conflict between parties, which could result in removal of these fixtures, would lead to a loss of functionality and value of the target building. As a considerable part of our financial system is built on real estate as collateral, the loss of value of property assets due to loss of functionality could have damaging consequences for the financial system. TU Delft Campus Real Estate, like most other real estate operating and developing companies, uses its buildings to leverage new loans to finance additional investments. While the outsourcing of the CiTG façade was not expected to have dramatic consequences on the book value of the building, it could not be determined by the commissioning deadline in March 2019 exactly how much this impact would be. This led to increasing time pressure and the resulting transfer taxes as described before.

Exterior view of the CiTG large-scale demonstrator prototype during construction.

Climate-KIC

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Meeting related to legal and financial models for the CiTG building facade leasing case-study. Participants include experts from TU Delft's academic research team, and TU Delft's Campus Real Estate and Board of Directors.


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