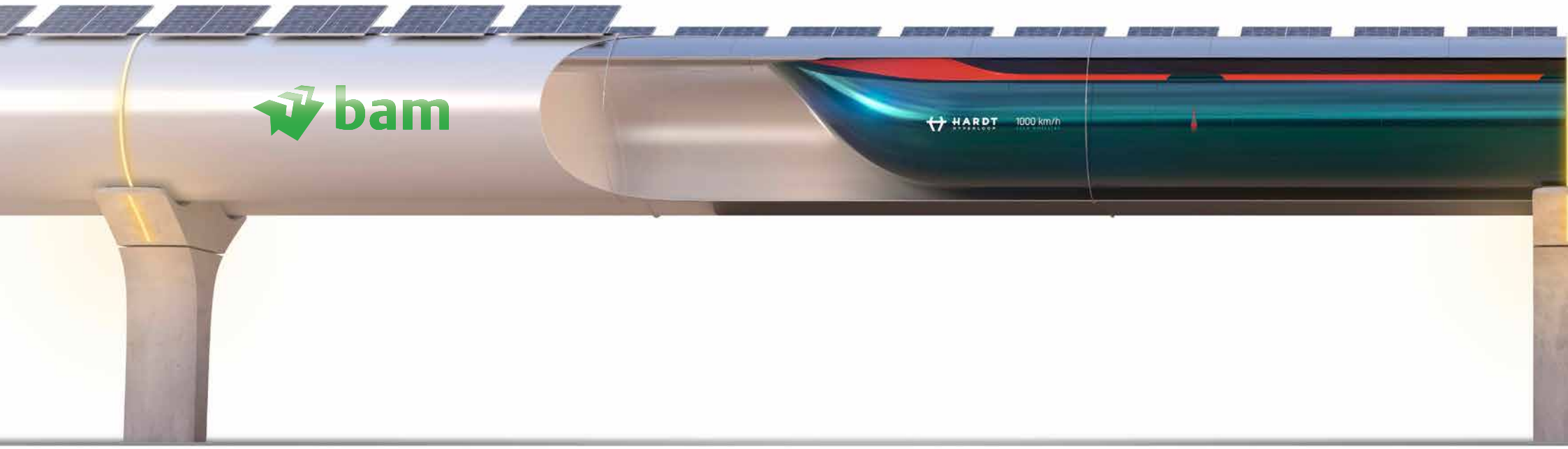
Hyperloop

Let's join this ride together

bam

bam



HARDT
HYPERLOOP

UNSTUDIO

TATA STEEL

invesis

dutch boosting group | vernieuw verbeter versnel

Foreword


Brussels
21:15 - 22:00
Frankfurt
21:05 - 21:55
Paris
HARDT
HYPERLOOP
1000 km/h

If anything sparks the imagination around the world, then it is the development of the hyperloop. Futuristic, innovative and ground-breaking, according to believers. Obsolete, unfeasible and surrealistic, according to non-believers. All these, sometimes conflicting, messages are part of the journey to a completely new mode of transportation. The demand for transportation will grow exponentially in the years to come, with sustainability a must. We believe hyperloop is the future as a sustainable, circular mode of transport. This is why we got on board – to co-create, to watch, to learn.

In this brochure, we share our vision on the development and construction of a new transportation system. What is important with regards to design, construction and safety? How sustainable is this system? And what is the public opinion about the hyperloop?

We created this brochure for our hyperloop partners, our co-creators in the Hyperloop Development Program, our Key Accounts, Clients, our sector, current and future colleagues, and for everyone interested in the development of the hyperloop.

Together with Hardt we designed and built the first low-speed hyperloop test facility in Europe. Tata Steel / Posco delivered the steel tube. We have learnt a lot on our hyperloop journey and want to share this knowledge. Why? Because our biggest lesson learned was that co-operation and an open attitude was exactly what brought us further. Just like the expression: ‘if you want to travel fast, go alone. If you want to travel far, go together.’

We thank our colleagues at Hardt, Tata Steel / Posco, UNStudio and Dutch Boosting Group for helping us put this brochure together. And not only for that, but foremost for what they’ve taught us along the way on this innovative journey. We are looking forward to share our knowledge and answer your questions.

Sander den Blanken

Director Commercial Business Development BAM Infra Nederland

Let’s join this ride together

Inhoud

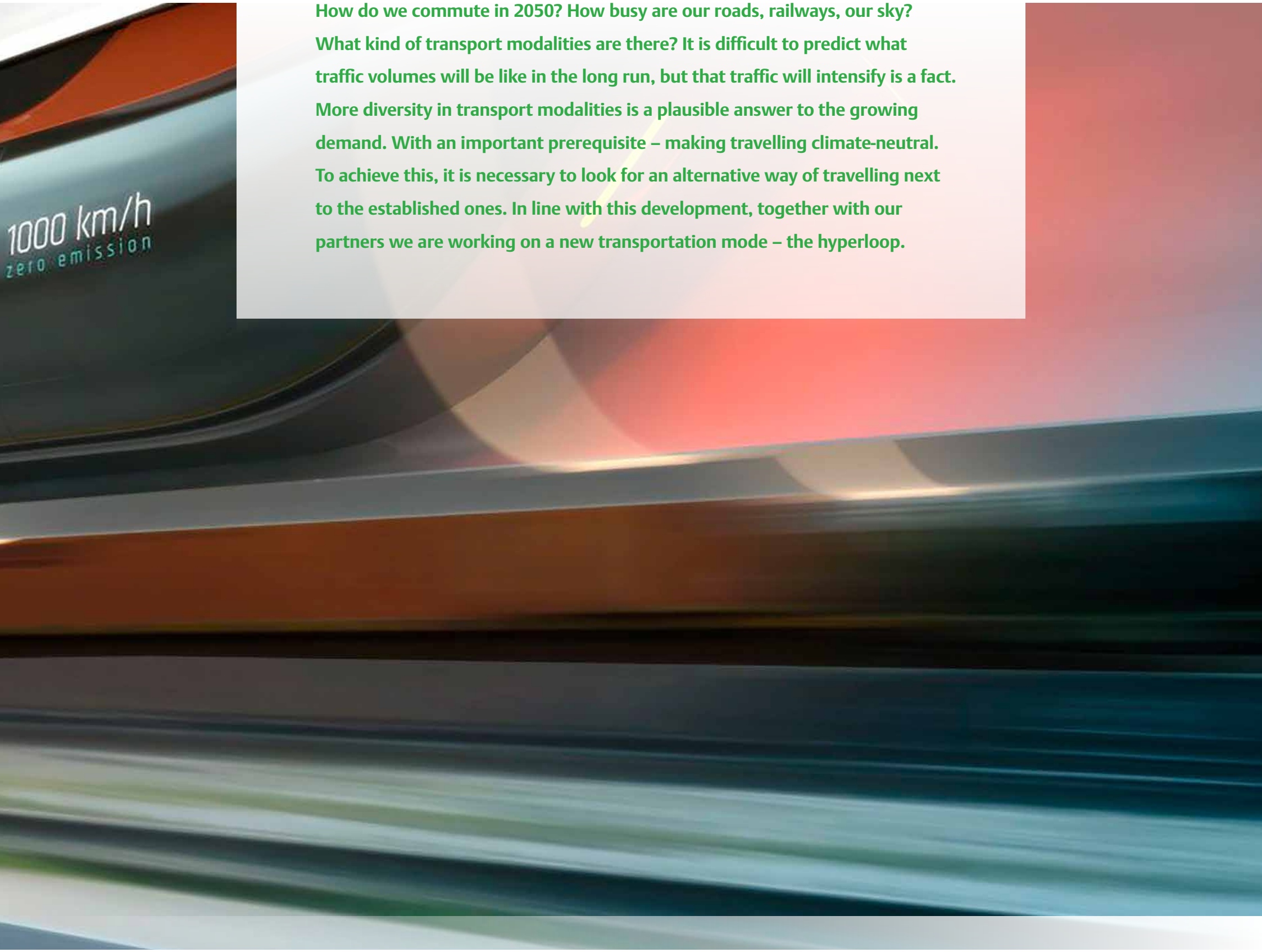
Part 3

Part 4

Part 1

A new mode of transportation

How do we commute in 2050? How busy are our roads, railways, our sky? What kind of transport modalities are there? It is difficult to predict what traffic volumes will be like in the long run, but that traffic will intensify is a fact. More diversity in transport modalities is a plausible answer to the growing demand. With an important prerequisite – making travelling climate-neutral. To achieve this, it is necessary to look for an alternative way of travelling next to the established ones. In line with this development, together with our partners we are working on a new transportation mode – the hyperloop.



Hyperloop: reaching all provinces within 30 minutes

Urban design hyperloop – Schiphol (2020). Hardt and Schiphol in co-operation with BAM, UNStudio, CE Delft, Stibbe, AirportCreators & Dutch Boosting Group and SEO Amsterdam Economics (advisor)

Quick, safe, sustainable and reliable. These are the key characteristics of the hyperloop. Currently, hyperloop encounters an intense development.

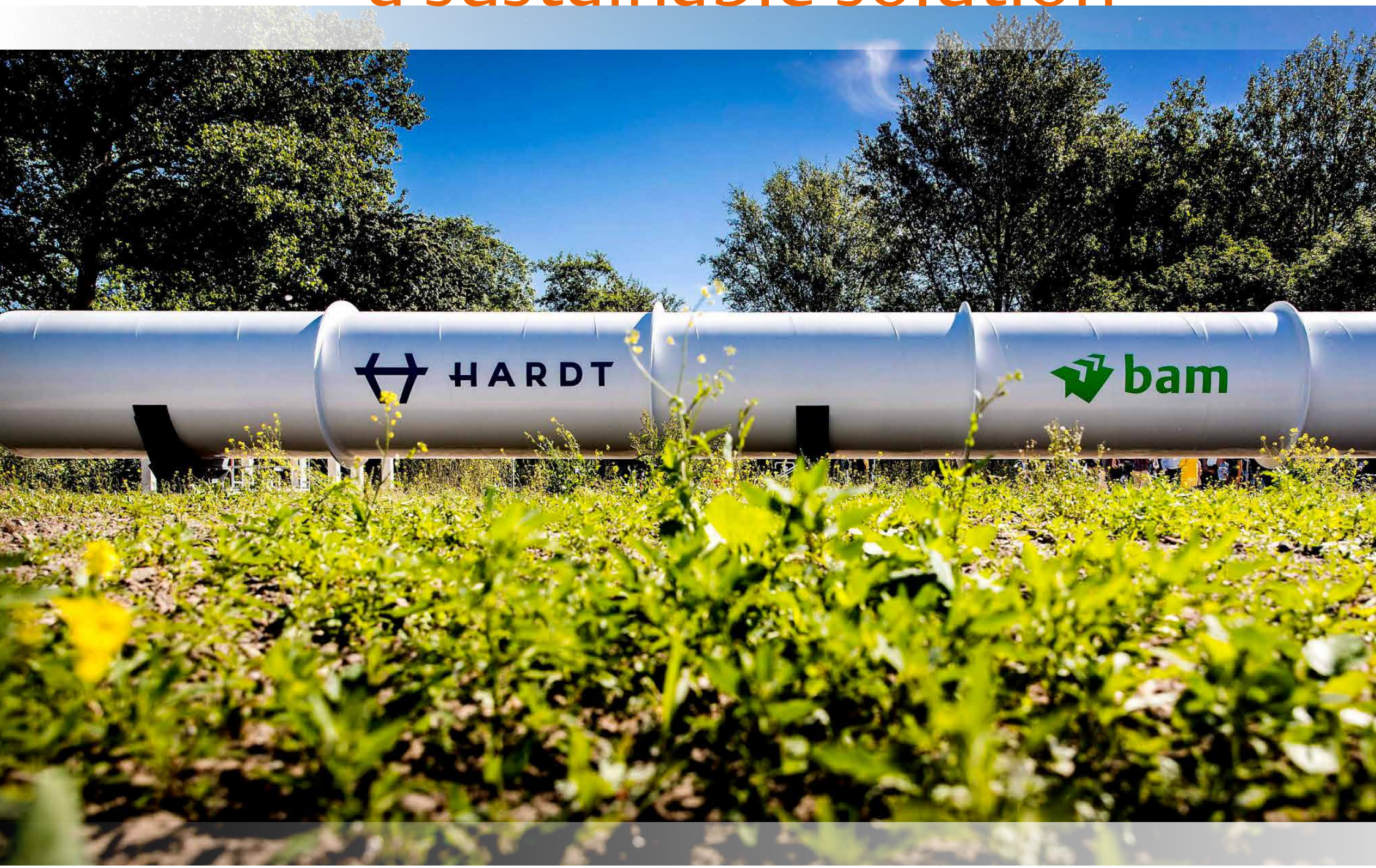
Travelling efficiently without air resistance

Hyperloop – a century-old concept recently picked up by Elon Musk – is a new mode of transportation, next to the existing 'famous four': car, train, plane and boat. Hyperloop is based on the idea that travelling without air resistance is much more efficient. Significantly high velocities are possible due to low air pressure in the system of hyperloop tubes. This makes hyperloop more time- and energy efficient compared to a plane or a train. With the hyperloop one can travel from Amsterdam to Paris in just 60 minutes.

In 2017 we took the first step in the co-creation of this new transport concept. Together with Hardt we built the first low-speed hyperloop testing facility in Europe, on the grounds of Green Village at TU Delft University of Technology. Our testing facility comprises a 30m-long and more than 3m-wide tube, prefabricated by Tata Steel/Posco.

Photo of the tube for the low-speed hyperloop testing facility on the TU Delft campus

In search of a sustainable solution



This really is a new, innovative way of travelling.

To provide a sustainable solution to the growing demand for transportation, we commit to the development of the hyperloop. For short trips, for instance to Berlin or Paris, hyperloop is a more sustainable, quicker and cheaper alternative for the plane. This way we prevent further airport expansion.

Low CO_2 impact in the use of hyperloop

The CO_2 emission in the use phase is lower for hyperloop compared to the existing transport modalities. With this in mind, hyperloop is becoming a factual alternative to air and road (cargo) transport.

High CO_2 impact in the construction of hyperloop

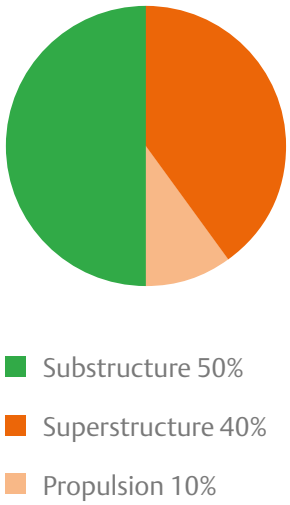
Before we can travel sustainably with the hyperloop, we are facing an enormous challenge: the construction phase. Based on our quickscan impact analysis, especially the CO_2 (eq) impact of material use for the superstructure of a hyperloop course is higher than the impact of e.g. a regular double railway track. Figure 1 exhibits the emission percentages per main system category. Our assumptions for the calculations are available upon request.

CO_2 break-even point

When hyperloop is in operation, we expect that its CO_2 emission is significantly lower compared to a double railway track in regular use. The CO_2 break-even point is heavily influenced by innovations in the super- and substructure. We expect to deliver a significant reduction in CO_2 emission on the substructure by implementing sustainable solutions with newly developed concrete usage. We developed our breakwater reinforcement units XblocPlus in a sustainable way with low concrete consumption leading to a significant lower CO_2 footprint.

Fig. 1

CO_2 material impact per main category



You could compare it with the rise of railways or airplanes.

We can do this, so we will

We are a large company. Every day we engineer sustainable innovations to reduce CO_2 emission and to build in a climate-neutral way. We apply this unique knowledge to the hyperloop trajectory.

XblocPlus®

Our patented sustainable innovation is the acclaimed breakwater reinforcement unit XblocPlus. These units deliver 56% CO_2 reduction on the Afsluitdijk. We achieve such a high reduction because we use significantly less concrete compared to alternative dyke reinforcement solutions.

Using opportunities for synergy

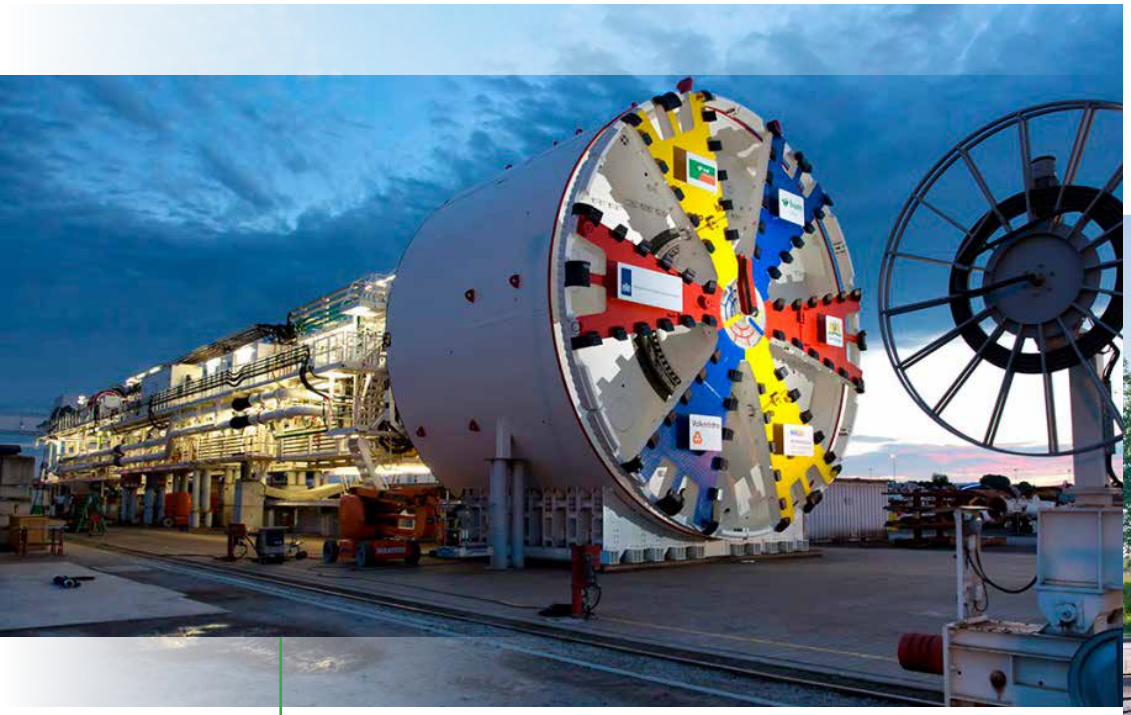
We examine the opportunities to create more value through synergy. For instance, we teamed up with the French company Colas to foster the development of Wattway. Together we came up with a solution to furbish the roads that we build with Wattway PV-panels, built in the road surface to generate sustainable energy. Similarly, we see PV-panel placement on the hyperloop tube as a realistic option.

The Xbloc factory in Harlingen is constructed in a circular way. When the construction of the Afsluitdijk is finished, the factory is dismantled to be used elsewhere

Wattway test location, N401 road by Kockengen

Europe's most sustainable tunnel

Europe's most sustainable tunnel, the Rotterdamsebaan in the Hague, is also one of our sustainable projects. The Rotterdamsebaan exhibits a number of sustainable solutions applied. *'The fact that we are able to build a sustainable tunnel in a sustainable manner illustrates our dedicated attitude to creating a cleaner, greener tomorrow.'*



BAM built Europe's most sustainable tunnel commissioned by the city of the Hague

goinGDutch

GoinGDutch offers the ultimate work commute experience in urban areas with its interactive, fast cycling routes, a tailormade bike assistant and a bike academy. As the founder of goinGDutch, a collaboration between Microsoft, Schiphol Group, OrangeNXT and BAM, we see an opportunity to further develop and expand this concept in cities with a hyperloop station.

World's first electric asphalt roller by BAM Infra

Most sustainable contractor

Our innovations and attention to sustainability do not go unnoticed. In 2021 we won the prestigious accolade of *'Netherlands' most sustainable construction company,'* awarded by Cobouw and PWC

Zero-emission construction site

A number of our construction sites are already fully emission-neutral. We developed a range of world's first electric construction machines. In 2020 we introduced the electric asphalt roller, and in 2022 the world's first hydrogen-powered asphalt spreading machine and hybrid CPT truck.

Part 2

How do you build a hyperloop?

Needless to say, it is not directly possible to build a hyperloop after successful trials in a 30m-long testbed. What challenges will we face in the design phase? What do we need to take into account during construction and what are the key prerequisites?

The essential condition in the hyperloop development is safety, in construction and in use. At BAM, this is our priority. Besides that, a predictable cost performance and construction time are key. The construction method and a smart solution for the substructure play a big role in ensuring financial feasibility, limiting risks and the required construction time.

Design

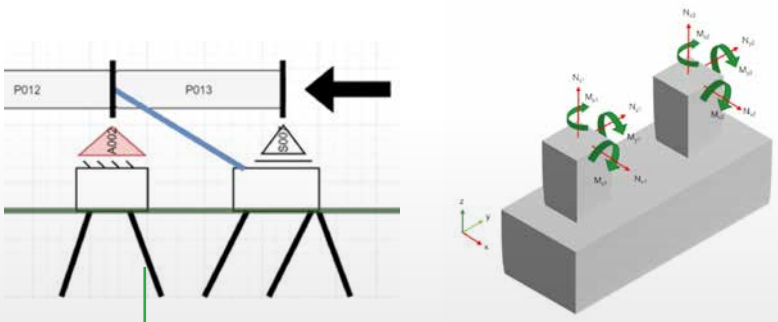
While designing the hyperloop, we examine which existing concepts are most suitable in terms of constructability. Example: LNG jetties often comprise a steel superstructure and a concrete substructure. Jetties face structural challenges similar to the ones of the hyperloop. We have extensive experience in the engineering and construction of such hybrid structures, among others in Panama, Sierra Leone, Jordan, Papua New Guinea, Qatar and Australia. Our practical exposure worldwide, combined with the recent contribution to the concept design within the Hyperloop Development Programme, equipped us with unique insights. We see possibilities in a design with minimal hindrance for the surroundings, a short construction period, and price certainty.

Concrete substructure and steel superstructure in one design

We design the steel superstructure and a concrete substructure in one integrated structural model. By doing so, we eliminate the risk of sub-optimalisations ('improvements to make things even better') in the total concept. During design we are facing a number of technical challenges. See three examples of such challenges, including bespoken solutions below:

Challenge 1: High frontal pressure on the head sides of the hyperloop.
Solution: Integrated force distribution by connecting the superstructure with the foundations in a smart way.
Challenge 2: Direct sun exposure of the steel tube leads to significant temperature differences and thus to differential settlement of the tube, with considerable deformations as a result. This requires an integrated structural model where sub- and superstructure align.
Solution: We are considering the application of flexible joints between tube elements. This reduces thermal deformations and the related force distribution to the foundation. Investing in lighter tubes brings about optimalisations of the foundation.
Challenge 3: Earthquakes lead to dynamic loads and fatigue damage.
Solution: We account for such scenario's already at the concept stage to prevent expensive, time consuming adjustments later on. Furthermore, our extensive experience in engineering in earthquake regions helps us in hyperloop foundation design.

The substructure of an LNG jetty in Port Moresby, Papua New Guinea



Left: a sketch of the force distribution on the head side.
Right: visualisation of the loads distribution from the superstructure.

Concrete tubes

In 2019 we conducted a feasibility study for concrete hyperloop tubes together with the TU Delft *(Braak, D.G., 2019, "A feasibility study on the application of concrete tubes in the Hyperloop Infrastructure")*. The results of this research are available upon request.

Parametrisch model

Hyperloop design is still in full swing. We are working with a parametric model. In this model, the system calculates the consequences of our design choices. The parametric model helps us improve the design in each iteration. Therefore, the design is more robust, more cost-effective and more sustainable. Through working in a 3D model, we directly observe the impact of our design choices and translate these in terms of quality and costs. All our partners work in this 3D environment, so as to bundle all disciplines in an integrated way and together come to the optimal solutions. Apart from further advancing our BIM 5D (3D + time + cost), our design becomes more and more transparent and reliable.

Modular and circular

We focus on modular and circular design. In circular design, we consider not only the construction method, but also think in the long-term. Modular, circular construction means that maintenance and repair works are easier and cheaper to conduct. And this in turn improves hyperloop availability as defect parts can be easily exchanged for new ones. Last but not least, we consider how the entire structure can be dismantled and potentially re-assembled elsewhere in the future.

The essence of modular construction is a plug & play system, based on factory produced elements. We applied this concept e.g. in the foundations of a land station Hollandse Kust Noord, a TenneT wind park. The pictures below illustrate how the separate elements come together in one foundation.

Visualisation of the substructure

Photos of a modular foundation of a TenneT land station

Construction

We apply innovative working methods in the hyperloop development. These methods help us improve construction processes and to reduce the impact on the surroundings during the execution phase.

High construction speed and reuse

In order to achieve a high construction tempo, we use prefabricated foundation elements. The formwork and casting takes place at the factory. We are also examining more circular material solutions. The concrete pile foundations, as well as the substructure, return to the factory upon lifecycle end in order to be reused.

LNG jetty built by BAM and partners

With or without a work road

Regarding optimal construction methods of the hyperloop, we principally consider two choices:

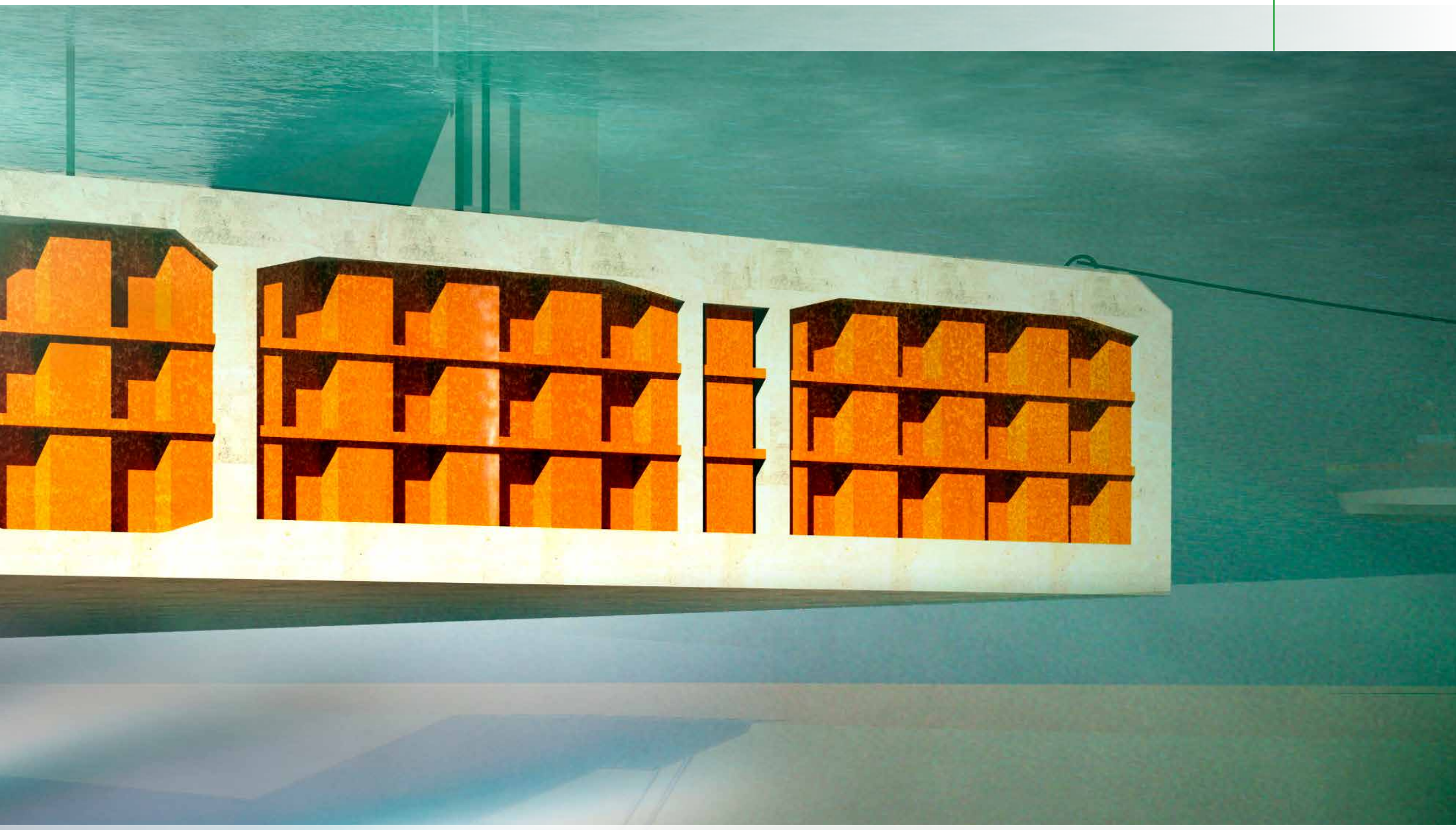
1. Hyperloop course equipped with a maintenance- and/or emergency road. We use this road during construction as a work road and site for pile drivers and telescopic cranes. In the future, upon the end of the use phase, this very same road can be used for dismantling the structure.

2. The hyperloop can equally likely be built without a work road. For a 2,4 km-long LNG jetty, featuring a steel superstructure and a concrete substructure, we developed a unique construction process, encompassing a long bearing structure, a distribution platform and a loading platform. By stacking construction flows above one another, we don't need a separate work road. We work from a narrow track with minimal space requirements, above land as well as water. We considered this approach as one of the plausible options for the development of a modular hyperloop system.

Tunneling

Will the hyperloop run above or below ground? Because of its experimental character, the first (test) hyperloop courses will have to be above ground. Regarding urban areas, an underground hyperloop is a much more suitable option. The definitive choice not-withstanding, we have a comprehensive portfolio in the design and construction of tunnels, across all stages – from concept design, through execution, to commissioning and closeout.

Visualisatie van het afzinken van tunnelelementen voor de Femernbelt



Immersed tube tunnels

In an international consortium we are building the Femernbelt tunnel, world's longest immersed tube tunnel. This 18 km-long road and railway tunnel connecting Germany and Denmark is 9 m high and 43 m wide. Thanks to our specialist expertise, we belong to the world's top tier in the field of immersed tube tunnels.

Bored tunnels

In 2021 we delivered an excellent example of a bored tunnel – the Rotterdamsebaan in the Hague, also Europe's most sustainable tunnel.

Bridges

Constructing the hyperloop above water is a realistic alternative for a tunnel solution.

Bus bridge in Zwolle

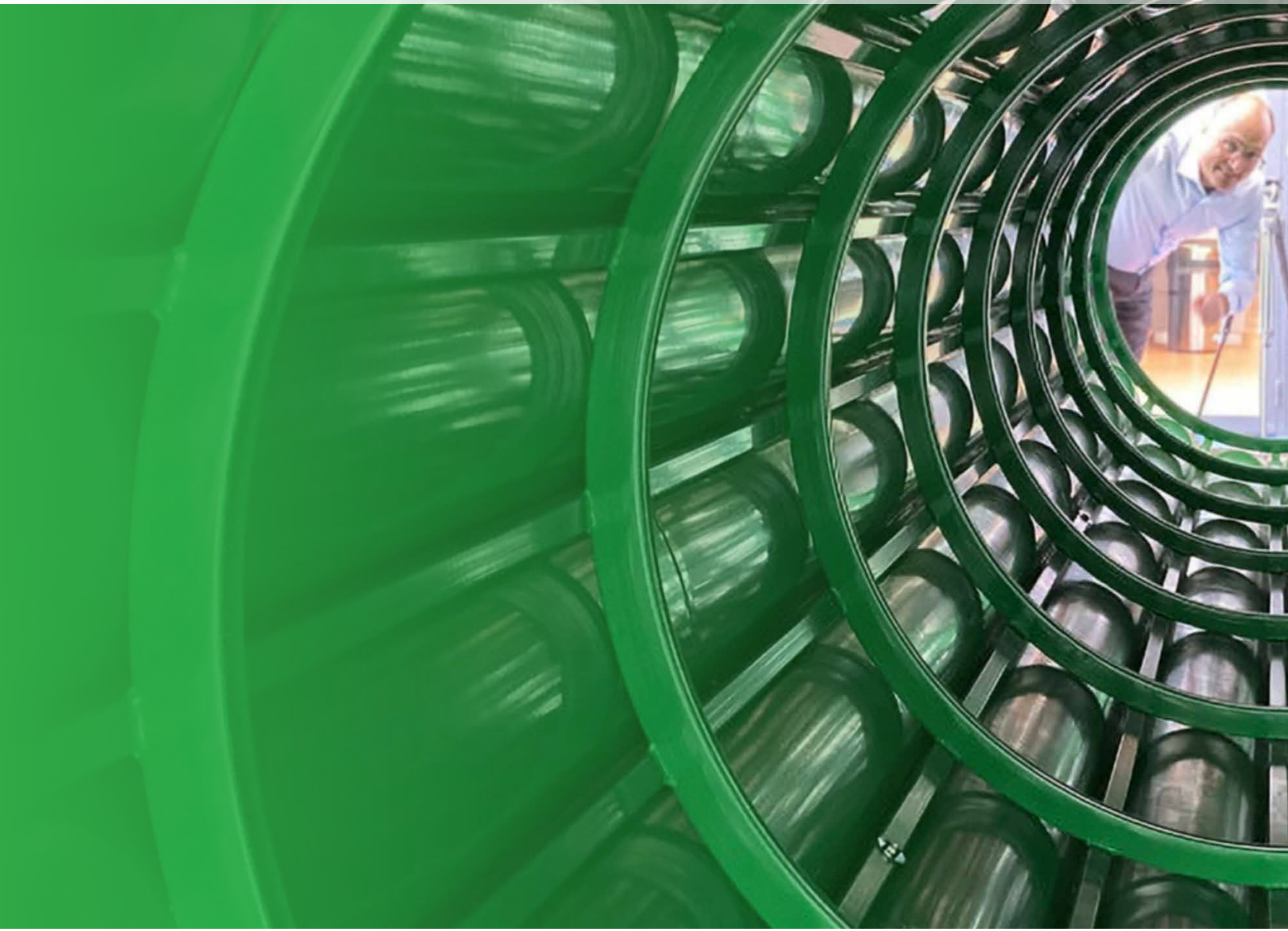
Hyperloop-specific bridge

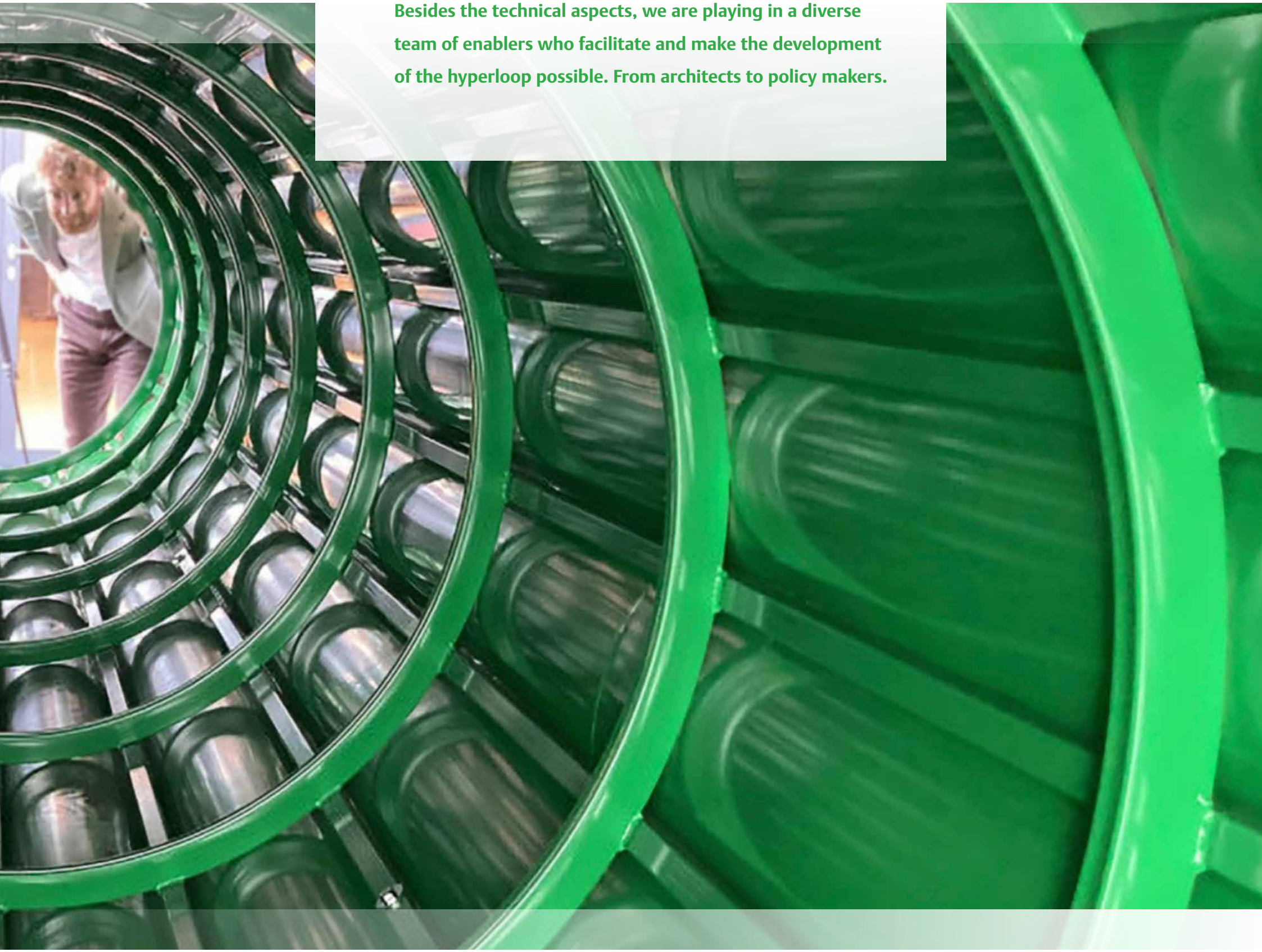
The alignment of a hyperloop bridge asks for a gentle slope, and therefore a considerably long ramp. Hence, construction costs become significantly higher, compared to a hyperloop course ‘on the ground.’ Still, we will not escape bridge solutions in certain future conditions. Also in this field we have the necessary knowledge, expertise, and experience worldwide.

With the City Bridge in Nijmegen, as well as the Bus Bridge in Zwolle, the Netherlands, we have proven our excellence not only in construction of a bridge, but also in the design of state of the art landmarks, for which we won quite a few awards.

Part 3

What and who do you need?



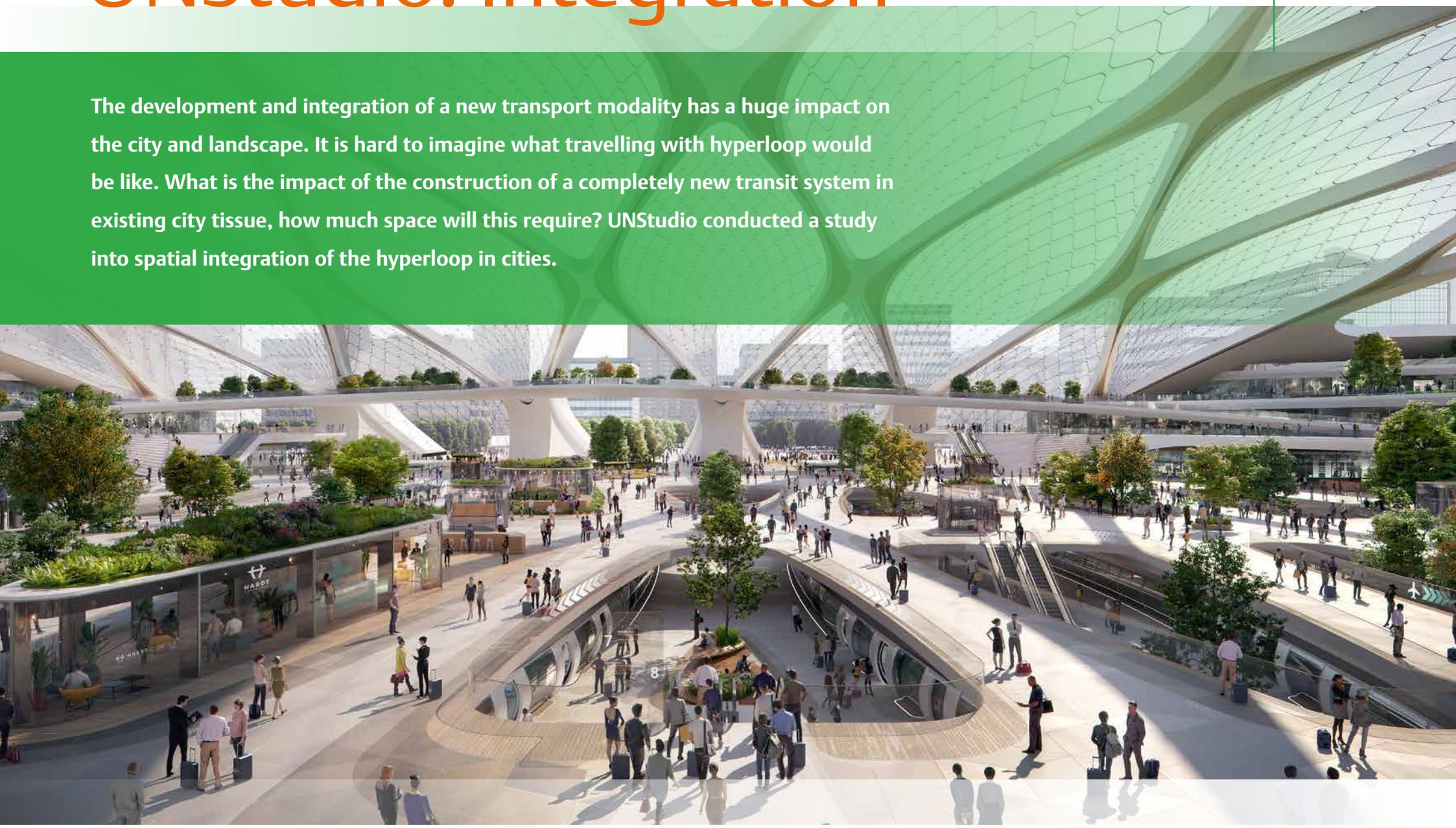


Besides the technical aspects, we are playing in a diverse team of enablers who facilitate and make the development of the hyperloop possible. From architects to policy makers.

UNStudio: Integration

Artist impression by UNStudio

The development and integration of a new transport modality has a huge impact on the city and landscape. It is hard to imagine what travelling with hyperloop would be like. What is the impact of the construction of a completely new transit system in existing city tissue, how much space will this require? UNStudio conducted a study into spatial integration of the hyperloop in cities.



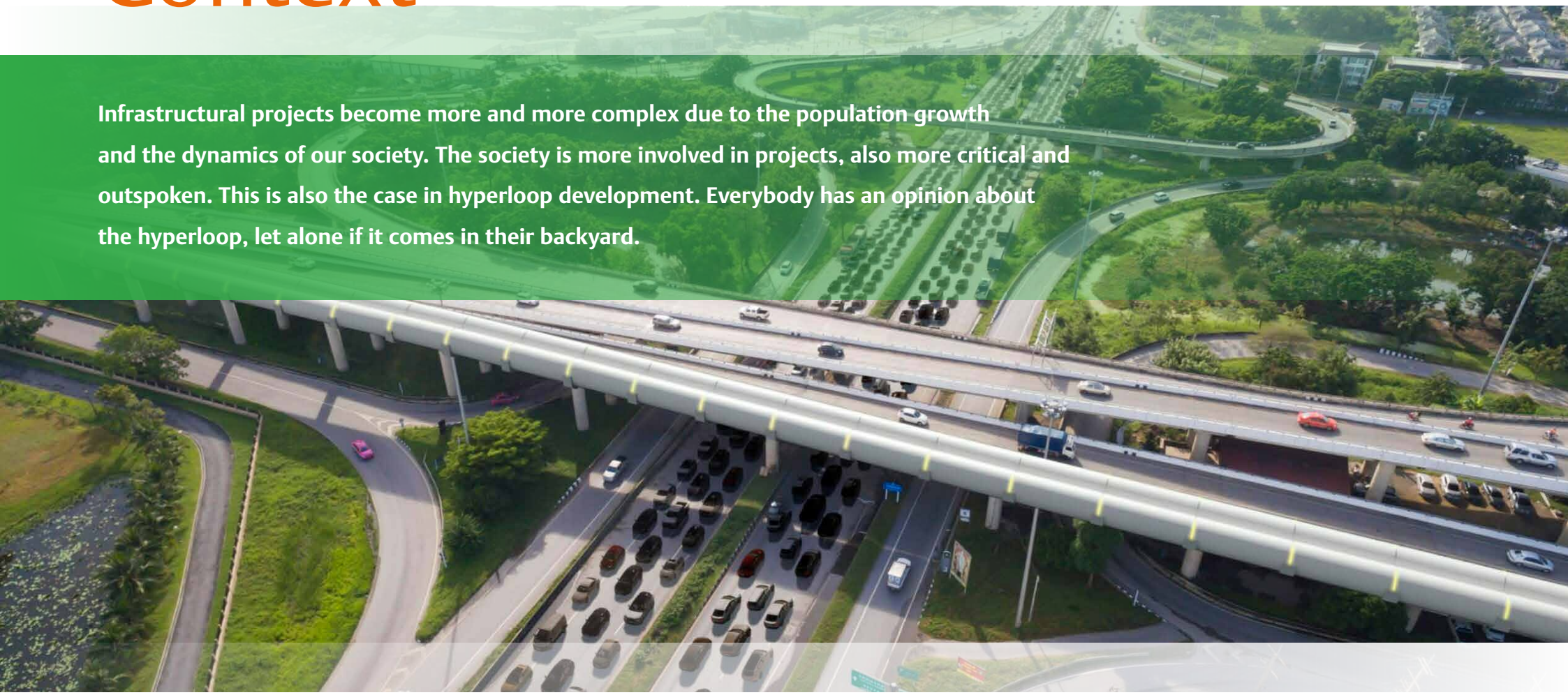
UNStudio examined the possible spatial integration of the hyperloop in the urban tissue through research by design and form studies. UNStudio designed a modular station concept for Hardt and created the first artist impressions of the station and the pods – trainsets.

The hubs are designed with modular principles in mind. Depending on the demand and location, a hub can comprise diverse functions and it size depends on the immediate urban context. The bigger the station, the more functions it can host. UNStudio is a world-renowned architecture office; together with Hardt they translate the abstract ideas into impressive spatial proposals, as shown in this brochure.

At BAM Bouw & Techniek, we have all the know-how and technology in house in order to build the hubs as designed by the architect. We have a good record in station projects, among others for NS and ProRail. We are also the framework partner for buildings and infrastructure at Schiphol Airport.

Context

Infrastructural projects become more and more complex due to the population growth and the dynamics of our society. The society is more involved in projects, also more critical and outspoken. This is also the case in hyperloop development. Everybody has an opinion about the hyperloop, let alone if it comes in their backyard.



Creating common ground through stakeholder management

The discussion will go about the usefulness and necessity of this new transportation system, as well as the chosen location. The *'not in my backyard'* principle will certainly find application here.

The course, hub location, and the image of hyperloop are decisive for the public reception. The biggest takeaway from e.g. the High Speed Line (HSL) is that stakeholder management gets particularly complex and challenging. We experienced the consequences of the 'not in my backyard' attitude in practice and how stakeholder management could positively influence that. With a thorough context & stakeholder analysis and a people-oriented approach we understand the interests, chances and risk factors. With the means of that we can establish adequate conditions for and with the stakeholders; both before, during and after construction, in urban or rural context.

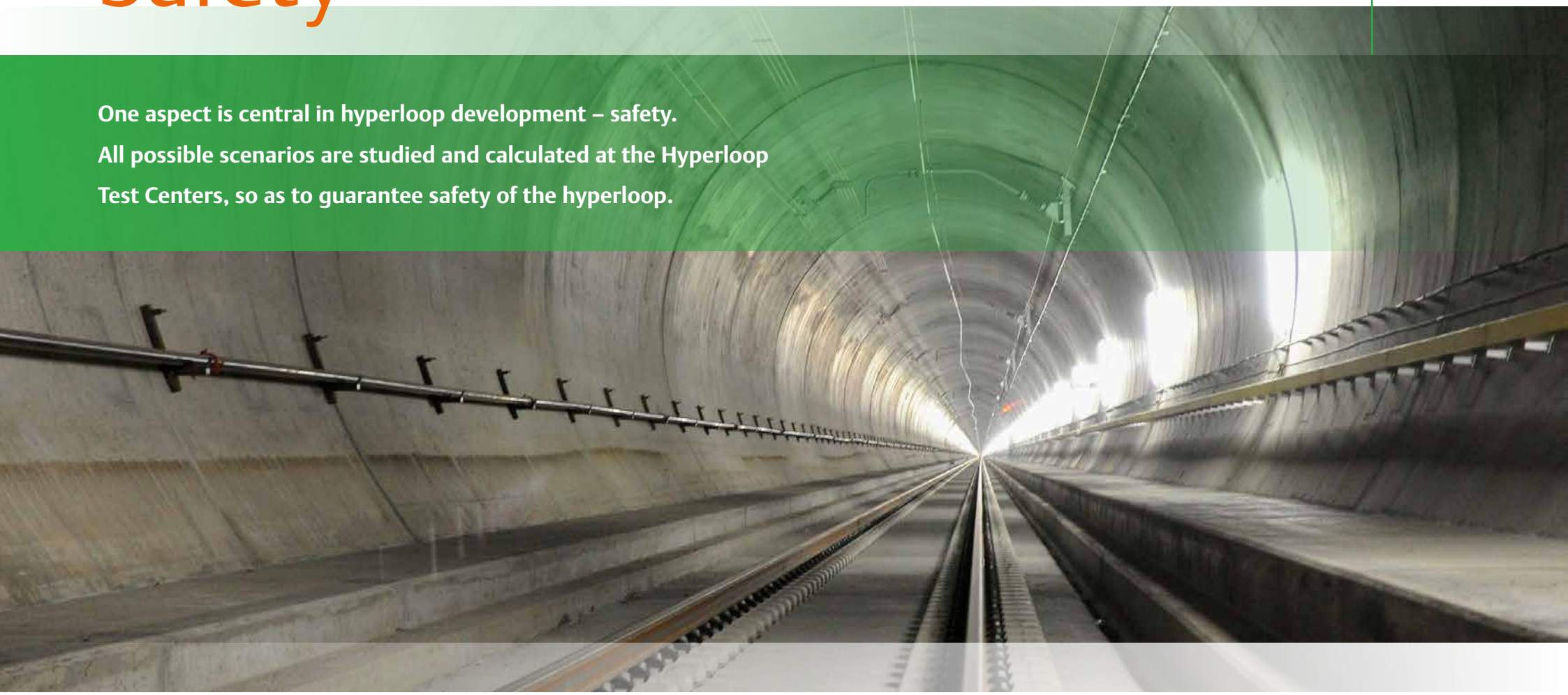
In the A12 road widening project (30 km) this approach helped us achieve a high satisfaction score (8,6 out of 10) among local residents, even though we worked in their very backyards. We were awarded the Nederlandse Bouwpluim (Dutch Construction Award) for creating a common ground with the stakeholders.

Permits from A to Z

With large projects such as Sea Lock IJmuiden, the new Sea Lock Terneuzen or the Afsluitdijk, we have a solid track record and in-house specialists to oversee the entire project permitting process, across all levels of complexity.

Safety

Groene Hart Tunnel, High Speed Line



One aspect is central in hyperloop development – safety. All possible scenarios are studied and calculated at the Hyperloop Test Centers, so as to guarantee safety of the hyperloop.

At the Hyperloop Test Centers we conduct large-scale, high-speed functional tests. For these to succeed, we need to execute a thorough system safety analysis. In this way, we prevent rework – we do not need to revisit design choices later in the process and rerun parts of the test program in vain. Testing at these facilities plays an important role in validating design functionality and safety at the same time. This allows us to deliver the best, safest hyperloop possible. As far as possible, the design is validated after the tests. Beforehand, we draft a safety plan where safety assurance is described in detail. For instance, in what way the Safety Case is carried out. We consider a vast array of safety aspects, among others distance between emergency doors, emergency routes, smoke displacement and ventilation, electrocution, stalled vehicles, collision risk, conduct of maintenance and inspections, communication with emergency services and emergency lighting.

It is desirable that a Safety Case is approved by a certified professional. Through construction of high speed railway lines, tunnels, stations and sea locks, we gained experience with the preparation and facilitation of Reliability, Availability, Maintainability & Safety plans, Hazard & Operability sessions, quantitative and qualitative safety analyses, maintenance safety analyses, as well as with conducting safety testing and validation and obtaining ISA / AsBo certificates.

With the High Speed Line (HSL) project we have proven successful in the construction and maintenance of a system fulfilling the highest safety requirements at a speed of 300 kmh. The hyperloop is a perfect opportunity to expand this unique knowledge for systems with even higher speeds.

Systems Engineering

The hyperloop is a completely new and a considerably intricate system. The application of Systems Engineering for the development, construction and maintenance of the hyperloop is a must. This due to the complexity of the diverse (sub)systems that need to function together as a whole and need to comply with the highest (safety) requirements.

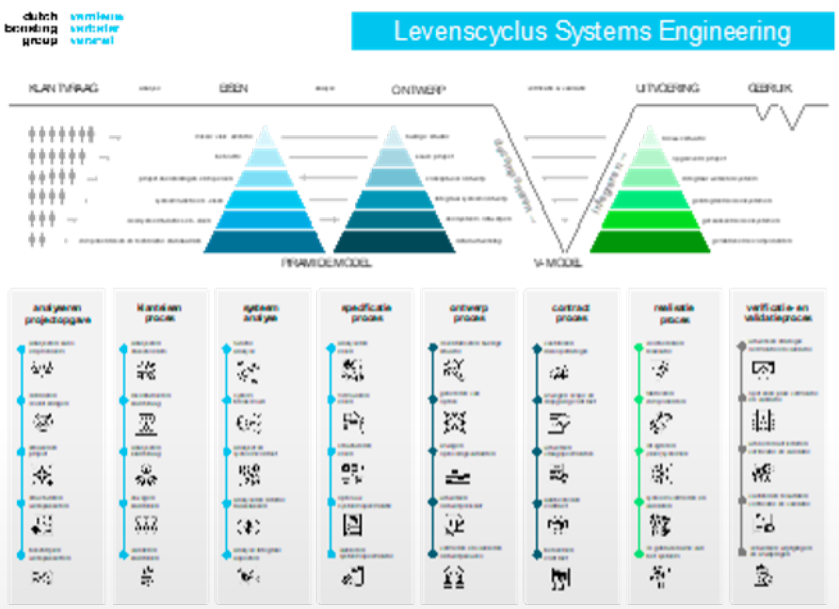


Fig. 2 - Systemic approach and management

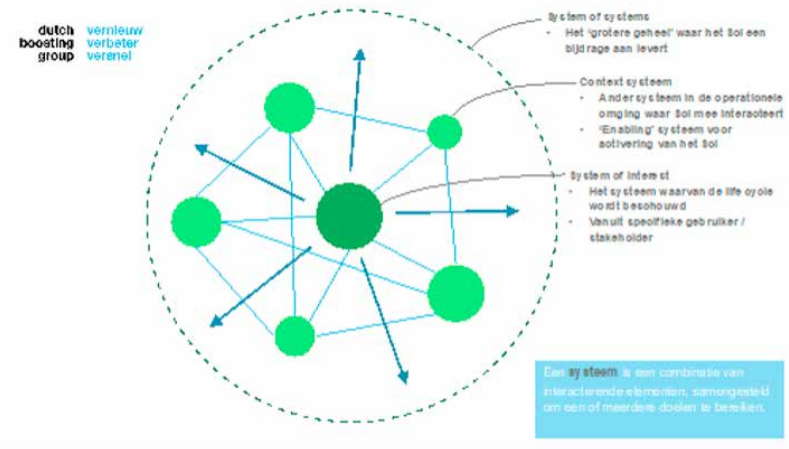
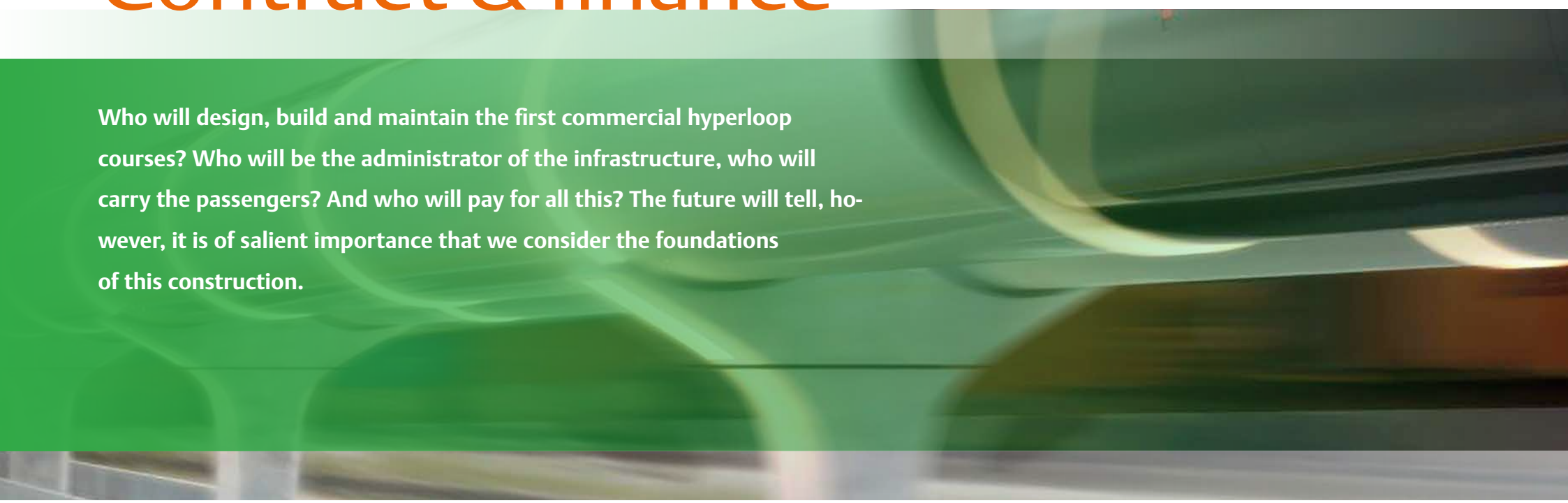


Fig. 3 - Systems thinking: the big whole, consistency and relationships

Dutch Boosting Group, experts in the field of Systems Thinking and Systems Engineering, apply their extensive experience and expertise to approach and manage the hyperloop in a systemic way (fig. 2). To achieve that, they work conform the principles of Systems Thinking: the big whole, consistency and relationships (fig. 3).

At BAM we are also weathered when it comes to Systems Engineering. We applied the systems approach in the design, construction and maintenance of the High Speed Line (HSL). It was such a success that it has been integrated in our standard process approach to integrated projects.

Contract & finance



Who will design, build and maintain the first commercial hyperloop courses? Who will be the administrator of the infrastructure, who will carry the passengers? And who will pay for all this? The future will tell, however, it is of salient importance that we consider the foundations of this construction.

In the end it will be about ground-breaking investments, with a scope too big for most contractors. Apart from that, local knowledge and experience will be just as important as experience in the realisation of large, complex projects. Basic, technical choices we make now can potentially influence the way such projects will be tendered in the future, if they are constructible and financially feasible. Next to the societal cost-benefit analysis, a timely closeout within the agreed budget is decisive to obtain an approval from the politics. The potential for a successful bid and for securing private financing are closely related aspects.

Price and construction time certainty are to a large extend defined by the design of the substructure and the construction method. Both aspects are the biggest variables in the definitive price and construction time of a hyperloop course. This is why we carefully consider these topics in our analyses.

A considerably high degree of technological complexity and novelty is also decisive. The public client will presumably not have the necessary knowledge and experience (yet) to manage this type of infrastructure on their own. It is viable that the client will assign this responsibility to a private party, and that the client will not pay for the infrastructure as such but for the degree of availability for travellers. Such a construction ensures that the party to design, build and maintain the hyperloop will go to all lengths to ensure operational security and safety of the system.

Through our 50% share in Invesis, we enjoy a direct access to the knowledge and experience with respect to structuring and financing of large, complex infrastructural projects. In such projects, the client (mostly governmental) pays for the actual availability of the system of for instance a road, tunnel or a high speel line. In their portfolio, Invesis has more than 50 projects developed this way, with a total of 12 billion euro invested capital. Invesis knows like nobody else how to create synergy between the financing and structuring of the project on the one side, and the technical possibilities, choices and challenges on the other.

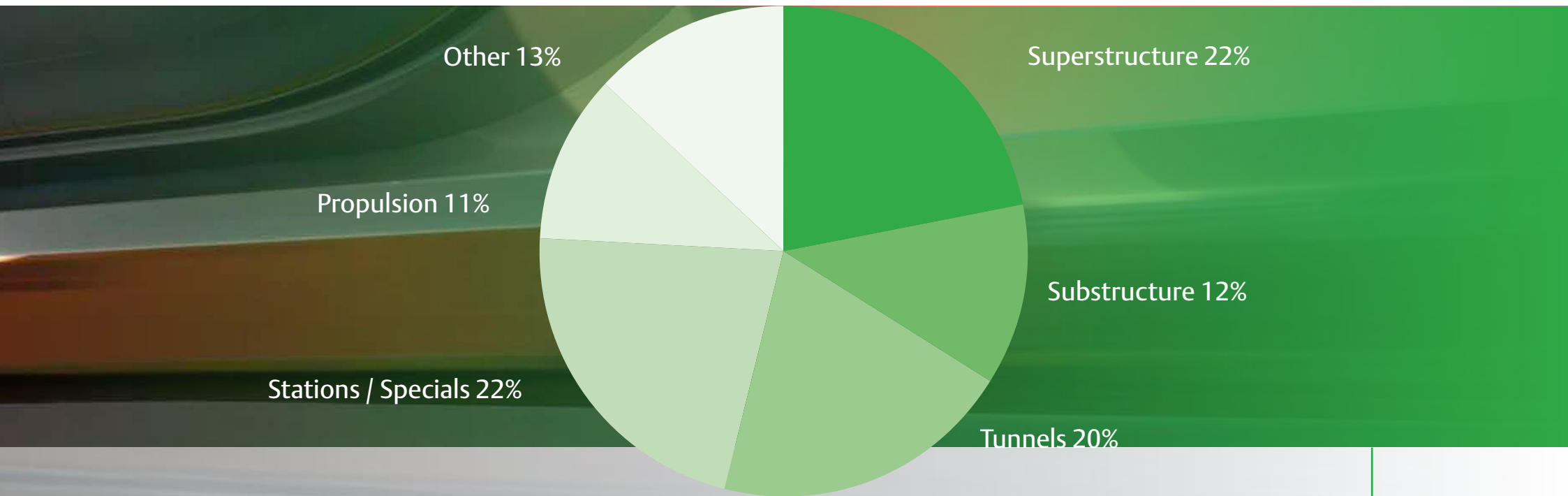


Fig. 4 - Indication of direct costs per main category

How much does such a hyperloop cost, actually?

Construction costs

In 2019 we conducted a cost feasibility study for a hyperloop line between Schiphol and Keulen, together with HARDT. What resulted is that the engineering and construction costs would equal to 50 million per km (2022 price level). In that study we also estimated the cost of a High Speed Train. Hyperloop construction cost is competitive in comparison to a High Speed Train. One of the conclusions of the study is that the context is decisive for the definitive price tag. Depending on the degree of urbanisation, construction cost grows or falls significantly (20%) as a result of additional tunnels or required nuisance mitigation. This is of course also the case for a High Speed Line.

The feasibility study Schiphol-Keulen examines a 300 km-long hyperloop line, includes the construction of 4 stations and excludes client costs, zoning, land acquisition and sales tax. The assumptions of this study are available upon request.

Fig. 4 illustrates hyperloop construction costs, divided into main categories. The cost of the hyperloop infrastructure (super- and substructure, tunnels and stations) comprise more than 75% of the total construction cost.

Project Management

Over the years we have built a comprehensive portfolio, entailing large, prestigious construction projects. We lead the market with our innovative approach.

Sea Lock IJmuiden during construction

Sea Lock IJmuiden, at the moment world's largest sea lock, the Maeslant Storm Surge Barrier, the Afsluitdijk, construction of the High Speed Line (HSL), numerous jetties, bridges, dozens of tunnels worldwide. We have the knowledge, expertise and experience to bring such complex, innovative projects to completion. This is why we have the ambition to contribute to the hyperloop development.

We realise that one cannot build a hyperloop alone. A total solution is necessary – this can be achieved exclusively by an effective collaboration of partners, such as HARDT, Tata Steel, UNStudio and Dutch Boosting Group. Next to the technical challenges, we need to be able to manage all phases of the project process, including maintenance and financing, modelled after best practices in Public Private Partnership (PPP) projects. We have proven that we can do that!

'The reason why we want to co-create and contribute to the development of the hyperloop is that we have all in-house knowledge to make something complex and innovative, such as a modular circular substructure. We think beyond the borders of our scope.'

Joris van Papenrecht – Invesis

Partners

By participating in the Hyperloop Development Program (HDP) as a partner, we follow the development of the hyperloop closely. We stay in touch with the parties who will realise the hyperloop in the future.

What does the Hyperloop Development Program entail?

'The Hyperloop Development Program is a public-private partnership, between the Dutch Ministries of Economics & Climate and Infrastructure & Water Management, the Dutch Province of Groningen and a group of industry parties and knowledge and research institutions, dedicated to develop hyperloop as a safe, sustainable and commercially viable mode of high-speed transportation and to bring the hyperloop to commercialization.' (HDP definition)

HDP is developed as an inclusive ecosystem in which more than twenty companies and institutes from all relevant sectors work together, in order to support and accelerate hyperloop development.

HARDT

Launch of the low-speed testing facility by Hardt, Tata Steel, Royal IHC and BAM in 2018

HARDT is a European hyperloop technology provider, the first one to have developed a unique prototype of an exchange system for the hyperloop. Next to that, HARDT developed a unique pod concept, in the form of a 'hanging' rail system.

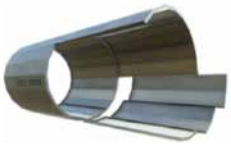
Together with HARDT we conducted numerous studies, among others a financial feasibility study for a hyperloop line Schiphol – Keulen. In addition, we advised HARDT in the development of the European Hyperloop Center (EHC) in Groningen. HARDT's agile working method is very effective for a startup. Their speed and high flexibility contributed to different dynamics than we were used to in the Verification & Validation process and Systems Engineering on complex Design & Construct projects. HARDT and BAM are open to one another when it comes to finding the right balance between dynamics and control. Lessons learned in a collaboration with a successful startup such as HARDT give us new insights; we incorporate them in our new, agile way of working, with HARDT as a partner.

TATA Steel / POSCO

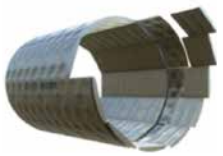
Polyhedral

Multi material

Segmented



Double wall



Skeletal

Together with steel producers Tata Steel and POSCO, working in a partnership, we developed the substructure and the superstructure as one integrated system, applicable for every hyperloop model, all over the world.

Tata Steel: ‘We approach the challenges offered by the realization of a hyperloop system mainly from a materials perspective. Thanks to the fact that we collaborate with numerous partners, we have a more complete picture and our solutions are more effective and unique.’

Next to the optimized steel quality, Tata Steel is looking for innovative optimizations regarding tube design. Tata Steel: ‘Within this development, we brought prototypes from the drawing table to 1:1 models. Shortly, we will be able to validate these concepts as the realization of the European Hyperloop Center unfolds. In this way we deliver an important contribution to the future of hyperloop and play a role in the execution thereof.’

Our collaboration with Tata Steel is characterized by openness and an honest interest in each other’s expertise. Only in this way we arrive at new insights, such as the integrated approach to the sub- and superstructure of the hyperloop. Add HARDT’s startup mentality to get a truly energetic project where no challenge is too big. It is the time to connect and to grow together. With governments, universities, knowledge centers, and with us.

Part 4

The future

[Def:] fu-ture (f) = the time ahead, the moments yet to be experienced

The future is actually not so far away. And so is hyperloop. We are standing at the beginning of an accelerating development. The first test tracks have been laid worldwide, the first passengers have been carried. The question whether the development will turn towards people or cargo transportation is not relevant. The fact that it will come, is. We are entering a phase where society gets involved. There will be proponents. And opponents. It will cost time and money. The discussion over usefulness and necessity will undoubtedly come as a valid concern. Because: do we want to develop something new, while we have just started making existing transportation systems more sustainable? Don't we need to limit the demand for transportation instead of perpetually trying to meet this demand? Can this transportation mode replace aviation, or is it complimentary? Fully aware, we ask ourselves these questions and by doing so we keep in touch with the reality and the contemporary societal discourse. Societal involvement is, in the end, one of the salient factors of hyperloop development.

'Social participation is extremely important. We realise that we are working on a new transportation system which will have a huge impact on the built environment. This cannot be underestimated.'

Machteld Kors - UN Studio

Let's never lose the focus on the why-question: we are working on an emission-free form of transportation and travelling. We travel from and to the center of one city to another, by which we limit the number of (short-distance) flights and (long) car and truck rides. This is the power of hyperloop. It will take years before everybody believes in the rise of the hyperloop and embraces this new mode of transportation. Let us already think about the future.

Because the future of the hyperloop is now.

We truly appreciate your feedback and ideas on the hyperloop.
Feel free to e-mail your suggestions to hyperloop@bam.com

Acknowledgment

For the creation this brochure, we had huge pleasure in collecting information and exchanging mutual interests among partners. We kindly thank the following persons for their professional knowlegde, inspiring insights and an occasional personal view on the Hyperloop.

Tata Steel Nederland – Huib Simon – Head of Marketing
Tata Steel Nederland – Tim Hartzema – Technical Manager
Tata Steel Nederland – Marcel Cruijff – Researcher
Stichting Hyperloop Development Program – Coen de Ronde – Director
Hardt – Mars Geuze – Cofounder/Chief Commercial Officer
UNStudio – Machteld Kors – Director Strategic Development
Dutch Boosting Group – Rik de Meij – Managing Consultant
Invesis – Joris van Papenrecht – Commercial Director
BAM Infra Nederland – Sander den Blanken – Director Commercial Business Development BAM Infra Nederland
BAM Infra Nederland – Daniel Lobregt – Program Manager Hyperloop
BAM Infra Nederland – Jos van Rijen – Manger Design Operations
BAM Infra Nederland – Marius Hendriks – Constructor
BAM Infra Nederland – Martin Kuis – Regional Manager
BAM Infra Nederland – Arie de Jong – Design Manager
BAM Infra Nederland – Patrick Kemperman – Head Department Environment Management
BAM Infra Nederland – Françoise van Buijtenen – Coordinator Hyperloop Brochure
BAM Infra Nederland – Reinier Bosman – Advisor RAMS

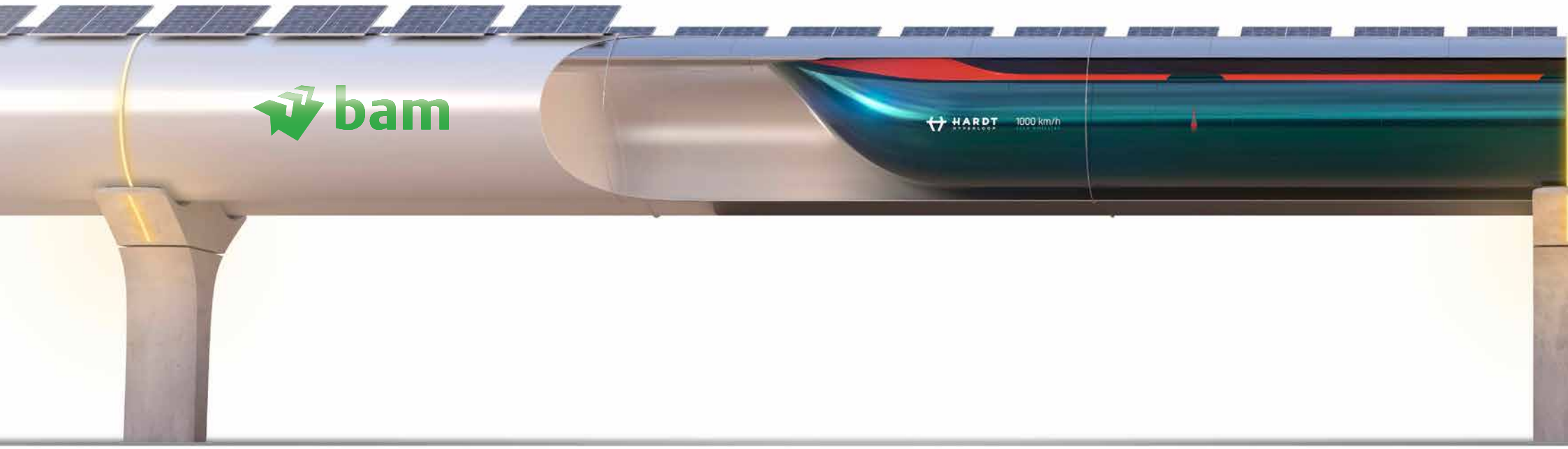
We warmly thank our partners Hardt, Tata Steel, UNStudio in corporation with Plomp and Dutch Boosting Group for the usage of their visual materials.

Colophon

© Copyright	BAM Infra Nederland
First print	november 2022
Contact	Daniel Lobregt
Graphic design	Esens Design
Images	UNStudio i.c.w. Plomp Hardt Dutch Boosting Group BAM Nederland BAM Infra Nederland

This brochure is a special edition of BAM Infra Nederland

bam



HARDT
HYPERLOOP

UNSTUDIO

TATA STEEL

invesis

dutch boosting group | vernieuw verbeter versnel

Let’s join this ride together

bam

BAM Infra Nederland

H.J. Nederhorststraat 1
2801 SC Gouda
The Netherlands

P.O. Box 63
2800 AB Gouda
The Netherlands

T +31 (0)182 59 06 00
info.infra@bam.com
baminfra.nl