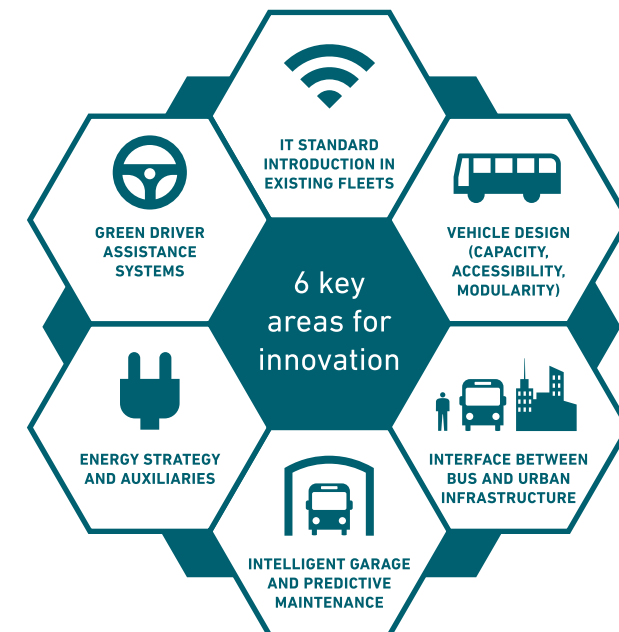European Bus System of the Future 2

DESIGN CHARTER
FOR INNOVATIVE ELECTRIC BUSES

EUROPEAN BUS SYSTEM OF THE FUTURE 2

EBSF_2 tests and evaluates more than 30 technological solutions for improving the efficiency of bus systems and their attractiveness to the users. Real-life demonstrations in 12 cities address several areas for innovation: energy management and auxiliaries, green driver assistance, exterior and interior bus layout, IT standards, intelligent garage and predictive maintenance, as well as how buses interface with urban infrastructures. The technological innovations deal with a wide range of bus services as well as all current propulsion technologies. Their technological maturity will ensure a short step for commercialization once the project is completed. The use of simulators and prototypes is conceived as a preliminary step for the validation of the innovations in real operational conditions, or as a necessary task to prove the potential of more futuristic solutions currently implemented at early stage of development.

6 key areas for innovation

GREEN DRIVER ASSISTANCE SYSTEMS

IT STANDARD INTRODUCTION IN EXISTING FLEETS

VEHICLE DESIGN (CAPACITY, ACCESSIBILITY, MODULARITY)

ENERGY STRATEGY AND AUXILIARIES

INTELLIGENT GARAGE AND PREDICTIVE MAINTENANCE

INTERFACE BETWEEN BUS AND URBAN INFRASTRUCTURE

SUMMARY

INTRODUCTION

For too long, buses as a mode of travel have lived on its gains. Nowadays, technological innovations such as electrically-powered transport modes present a world of opportunities for revamping the bus experience on its own terms, matching mobility industry trends and the wider social evolution. This Design Charter for E-buses has been designed to promote buses as a mode of transportation in their own right. The guidelines focus not only on the traveller but also on operators, rolling stock manufacturers and cities. Together, they form the ecosystem of the 'bus of tomorrow'. Design principles are illustrated by conceptual sketches, which should not be viewed as final design specifications. Manufacturers will be able to interpret and adapt these principles according to their own design culture and processes.
Have a pleasant read.

DESIGN CHARTER OBJECTIVES

ENVISIONING NEW PLATFORM ARCHITECTURES FOR E-BUSES

Electrical technology offers the possibility for creating new architectures. It permits technical components to be sited differently from those used in layouts inherited from conventional engine modes. Batteries **(1)** can be placed on the roof or the floor, the engine **(2)** can be placed at the front or the rear, the doors **(3)** can be centred or located at each end, the wheels **(4)** can be placed symmetrically or offset. This development allows designers to envision a new architecture, offering bold evolutions for the bus mode as a whole. The illustrations in the following pages are based on an ideal architecture hypothesis and are intended to show general design principles capable of being applied to all.

BATTERIES

1

ENGINES

2

GATES

3

WHEELS

4
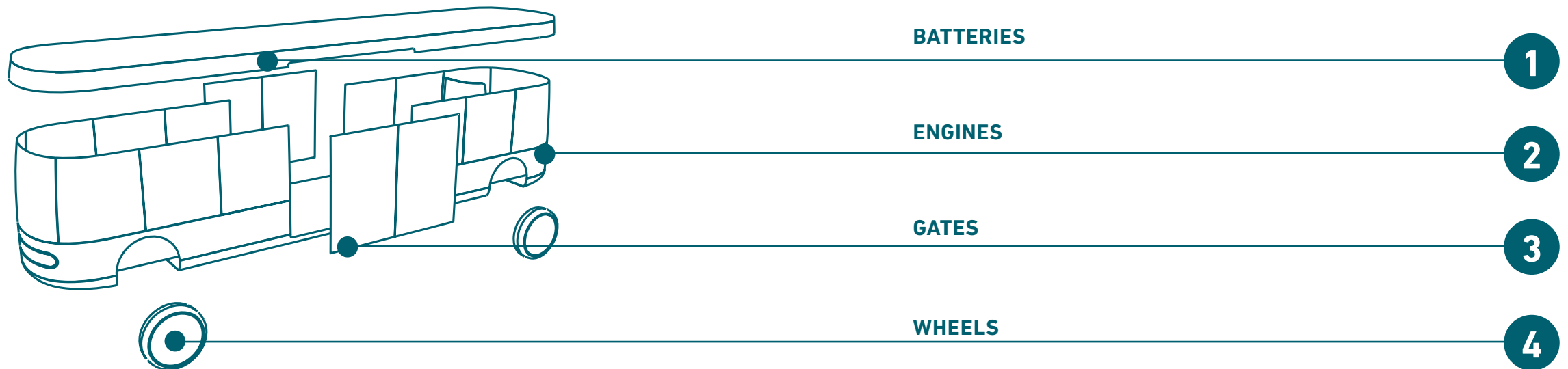
CREATING
SMART EXPERIENCES FOR...

Experience is determined by the final user. However, when it comes to thinking of a global system such as the Electric Bus of the Future, it is important to integrate the views of all the stakeholders to improve the experience in the widest sense. **Passengers, operators, manufacturers and cities** need to be consulted to deliver innovation on a global, systemic level.

PASSENGERS

CITIES

OPERATORS

MANUFACTURERS

PASSENGERS

RECOGNISABLE

The E-bus must be an object that is recognised as providing easy and natural access to the network. One does not seek it, one sees it.

ACCESSIBLE

The E-bus must be accessible to the entire population.

EASY TO USE

The E-bus should offer advantages, not disadvantages. It must provide the passenger with continuity throughout the day, allowing him to continue his activities without interruption.

INFORMATIVE

The E-bus must inform the passenger about its route, its current journey and the contextual elements affecting it.

COMFORTABLE

The E-bus must provide comfort. The comfort will be genuine, perceived through all five senses and apparent whether the passenger is sitting or standing.

SAFE

The E-bus must provide both active and passive safety. The security features will be fully integrated into the design. Passive safety will be subject to quality of design with soft, human-friendly forms.

HELPFUL

The E-bus must provide facilities that accommodate passengers in the optimal conditions, whatever their situation.

WELCOMING

The E-bus should be welcoming both by its attractive atmosphere and by the human services offered on board.

Recognisable / Accessible / Easy to use / Informative / Comfortable / Safe / Helpful / Welcoming

CITIES

INTEGRATED

The E-bus must become an integral and an extension of the city itself. As such, the bus will be designed to be a constructive contribution to the urban environment.

RECOGNISABLE

The E-bus projects the city's image. Like a new tram system, the E-bus should reinforce the perception of a modern, thriving and welcoming city.

SUSTAINABLE

The E-bus must display its cleanliness through its design. It will be simple, pure and will avoid any excessive references to aerodynamics or other sporting inspirations.

SILENT

The E-bus has to contribute to the acoustics of the city by providing silent transport.

ACCESSIBLE

The E-bus provides an extension to the view of the city and must eliminate any delineation between the city and the vehicle.

EMPOWERING

New E-buses must convey an impression of enhancing the status of the city.

Integrated / Recognisable / Sustainable / Silent / Accessible / Empowering

OPERATORS

EASE OF OPERATION

An E-bus must make bus operations simpler, easing passenger flows to reduce the dwell time at stops.

ECONOMIC

E-buses are more expensive to purchase, however their global lifecycle cost (based on 15 years) should be less than conventionally-engined vehicles. Vehicle design must align with this economic objective.

INTEROPERABLE

During its life, an E-bus may be used in several types of lines and can be operated by a number of contracted companies. The capacity to adapt to these different situations must be taken in account in the initial design.

BRANDED

The vehicles of their fleet must carry the Public Transport Authorities and Public Transport Operators visual identity. The logo positioning and the livery must be planned on the E-bus external body; the interior must also express these brands to the passengers.

MAINTAINABLE

The E-bus maintenance processes must be facilitated by good design.

STANDARDISED

E-buses will exist in a range of sizes and layouts; however their components should be modular and scalable.

ASPIRATIONAL

E-buses are primary image builders for bus transport in the city. As a new urban object, an e-bus must immediately demonstrate that the quality and the status of bus travel have been upgraded.

Ease of operation / Maintainable / Economic / Standardised / Interoperable / Aspirational / Branded

MANUFACTURERS

COMPETITIVE

A comprehensive concept, well thought out and well designed, is easier to sell and will increase the demand for E-buses as differing significantly from existing buses.

REACHABLE

Thanks to specifications taking into account actual manufacturers' constraints, the quality of vehicles is raised to a new level and creates new industrial standards which eventually will contribute to enhance the experience of the bus mode.

SUSTAINABLE

While facilitating the global user experience, E-buses will generate a greater acceptance among users and the general public. On the other hand, materials are chosen and processed sustainably. Therefore, the whole innovation process delivers a substantial gain for the society and the planet.

STANDARDISED

Standardisation reduces the cost and effort for manufacturers. Where functionality is identical, there is a wider market of vendors. Components and assemblies are easier to procure and higher demand improves the quality of components available. This increases the benefits to manufacturers, purchasers, operators and passengers and simplifies usability and maintenance.

CUSTOMISABLE

With overarching functional specifications, design requirements and structured, consistent implementation processes, vehicles become simpler to industrialize, facilitating customisation according to any specific needs expressed by authorities and operators.

Competitive / Standardised / Reachable / Sustainable / Customisable

TEN KEY PRINCIPLES FOR GOOD DESIGN

01. INNOVATION

Technological advances continuously stimulate opportunities for innovative design. Yet good design always develops in tandem with use and industrial processes; 'looking innovative' should never be an end in itself.

02. USEFULNESS

A product is bought to be used. It has to satisfy not only functional but also cognitive, emotional and aesthetic criteria. Good design emphasises a product's usefulness while disregarding anything that could possibly detract from that.

03. AESTHETIC

The aesthetic qualities of a product are part of its usefulness, as products that are part of daily life impact on people's quality of life and well being. True beauty comes from style and meaning combined smoothly.

04. CLARITY

Design allows the product to express its function clearly.

05. UNOBTRUSIVENESS

Products that fulfil a purpose are like tools. They should express their purpose but are neither decorative objects nor works of art.

06. HONESTY

Design should not create the perception that a product is more innovative, powerful or valuable than it really is.

07. LONGEVITY

Design for public transport vehicles should avoid fashion. The attractivity created by their design should be perennial, even in today's rapidly-changing society.

08. THOROUGHNESS

No detail should be arbitrary or omitted. Care and accuracy through the entire design process demonstrates respect for the consumer and ensures industrial optimisation.

09. ENVIRONMENTAL FRIENDLINESS

Design makes a key contribution to a more sustainable world. It optimises resource consumption and minimises the global ecological impact of the product throughout its lifecycle.
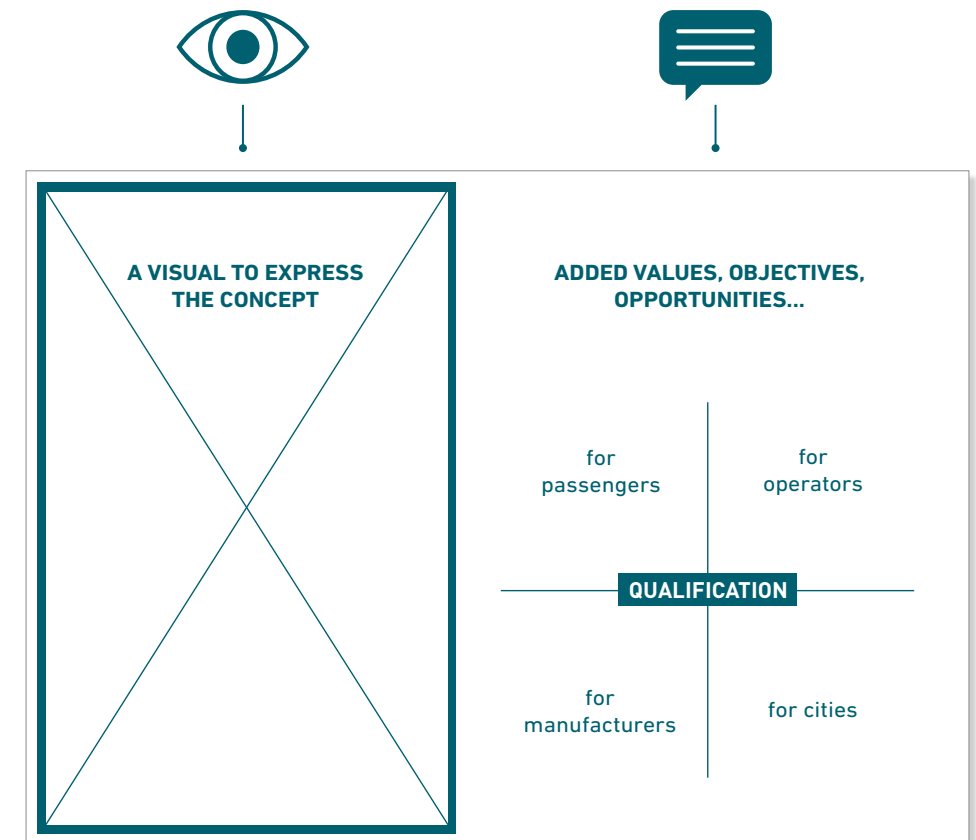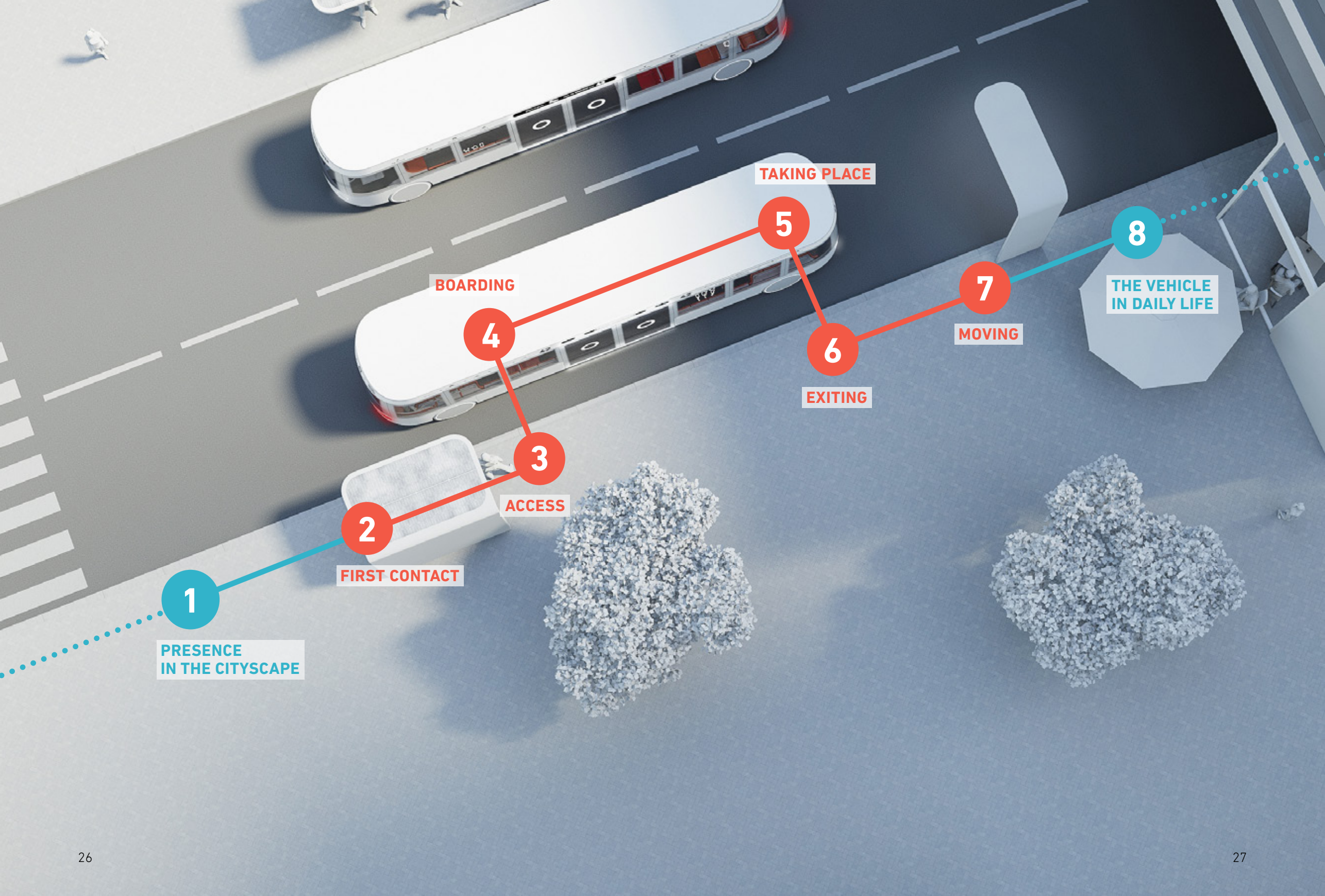
10. MEANINGFUL DESIGN

Focused on design essentials and on purity and simplicity, the E-bus provides an intuitive experience for intended users in urban, business and social environments.

HOW TO USE
THIS CHARTER

This design charter has been developed through a typical 'user journey' model, from the vehicle's exit from the garage to its re-entry to the same location, during which time it will be in contact with the passengers, the inhabitants and the city itself.

Each design principle is explained through a factsheet describing added value, objectives and the opportunities for each stakeholder – passenger, operator, manufacturer and city – all illustrated through conceptual sketches.

A VISUAL TO EXPRESS THE CONCEPT

ADDED VALUES, OBJECTIVES, OPPORTUNITIES...

for passengers

for operators

QUALIFICATION

for manufacturers

for cities

TAKING PLACE — 5

BOARDING — 4

ACCESS — 3

FIRST CONTACT — 2

PRESENCE IN THE CITYSCAPE — 1

EXITING — 6

MOVING — 7

THE VEHICLE IN DAILY LIFE — 8

1

PRESENCE
IN THE CITYSCAPE

1.1 RECOGNISABLE

E-buses are recognised as an innovative urban passenger vehicle, appealing for public transport and enhancing the cityscape.

A new urban object

- Creating a new category of recognisable urban vehicle
- Making usage values clear
- Attracting potential users

A transport service booster

- Highlighting the service offered
- Facilitating maintenance
- Providing citizens and passengers with real-time, readable information
- Carrying the PTO and/or the PTA branding

RECOGNISABLE

A positive branding opportunity for manufacturers

- Carrying the manufacturer's design signature
- Optimising industrial production processes

An image-booster for cities

- Delivering value and attractiveness for cities
- Making the urban environment calmer
- Increasing pedestrian safety

2

FIRST CONTACT
AT THE STATION
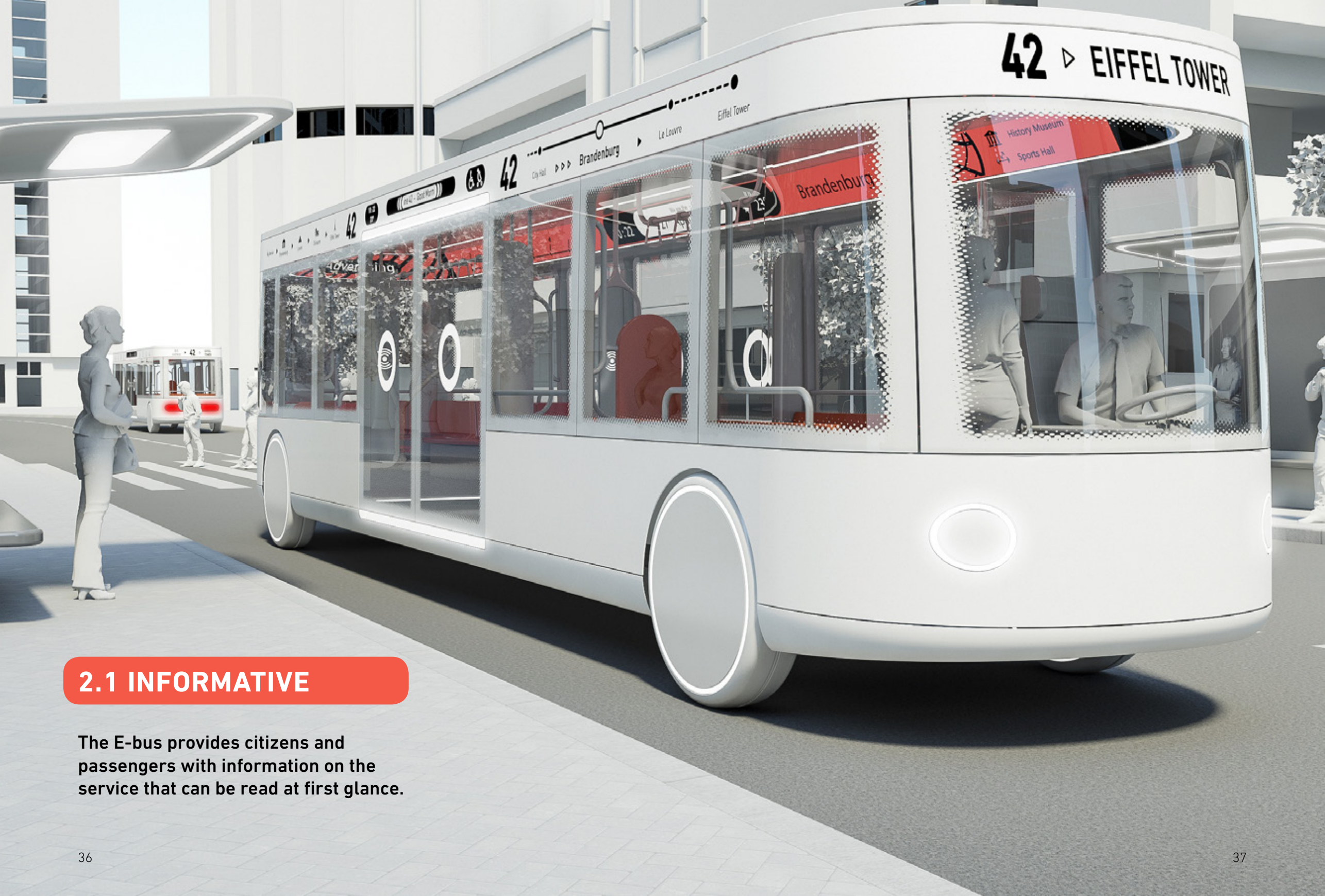
2.1 INFORMATIVE

The E-bus provides citizens and passengers with information on the service that can be read at first glance.

Information display for the customers

- Permitting rapid identification of the service
- Assisting anticipated choices through optimal readability

Value evidence through real time information

- Promoting the service value
- Expressing simplicity and friendliness

INFORMATIVE

Standardised information displays

- Allowing format and display standardisation
- Facilitating vehicle customisation

Information about the city

- Promoting and enhancing the city identity
- Encouraging multimodality and integration of the city transit system

3
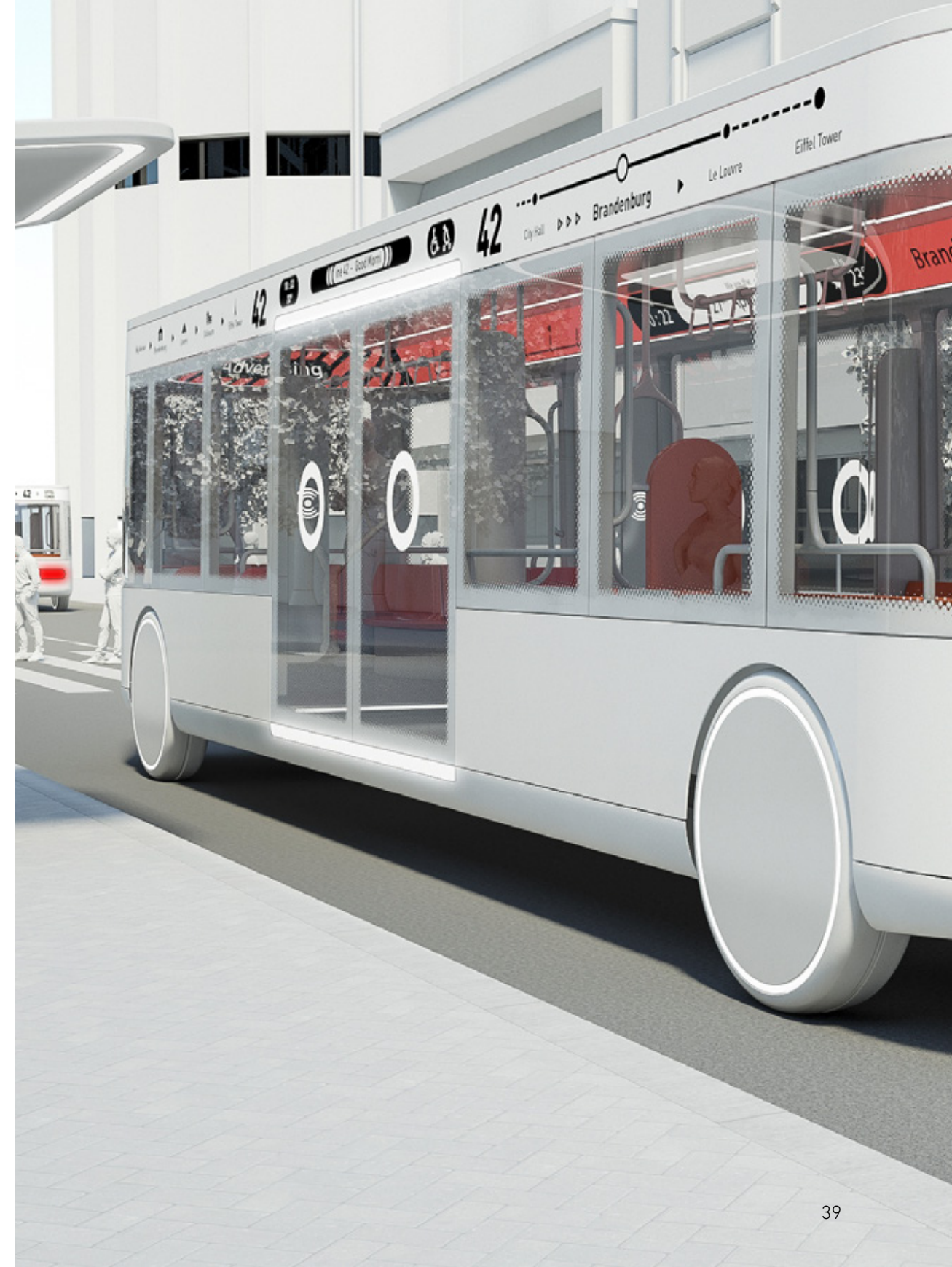
**ACCESS
AT THE STATION**

3.1 OPEN

The E-bus entrance welcomes users in a warm and friendly fashion.

Large and well-lit access

- Allowing safe and easy access
- Ensuring barrier-free accessibility
- Boarding and disembarking without constraint

Easy exploitability

- Reducing the stop dwell time through efficient flow organisation
- Rapid, safe access
- Reducing stress for the driver

OPEN

Modular solutions

- Allowing flexible layout arrangements

Continuity between e-bus and city

- Making E-bus a mobile extension of the city

4

BOARDING

4.1 WELCOMING

The E-bus is appealing
and welcoming.

Driver as a reception agent

- Focusing on the service
- Emphasising the driver as an integral part of the service
- Linking the driver presence to the passenger experience

Facilitation the driver's different postures

- Making the driver's welcome to passengers natural and relaxed
- Allowing the driver's movements to be relaxed and comfortable

RECEPTION

Standardisation

- Enhancing adaptability to the differing requirements of authorities or operators

Ambassador for the city

- Improving the city mobility experience
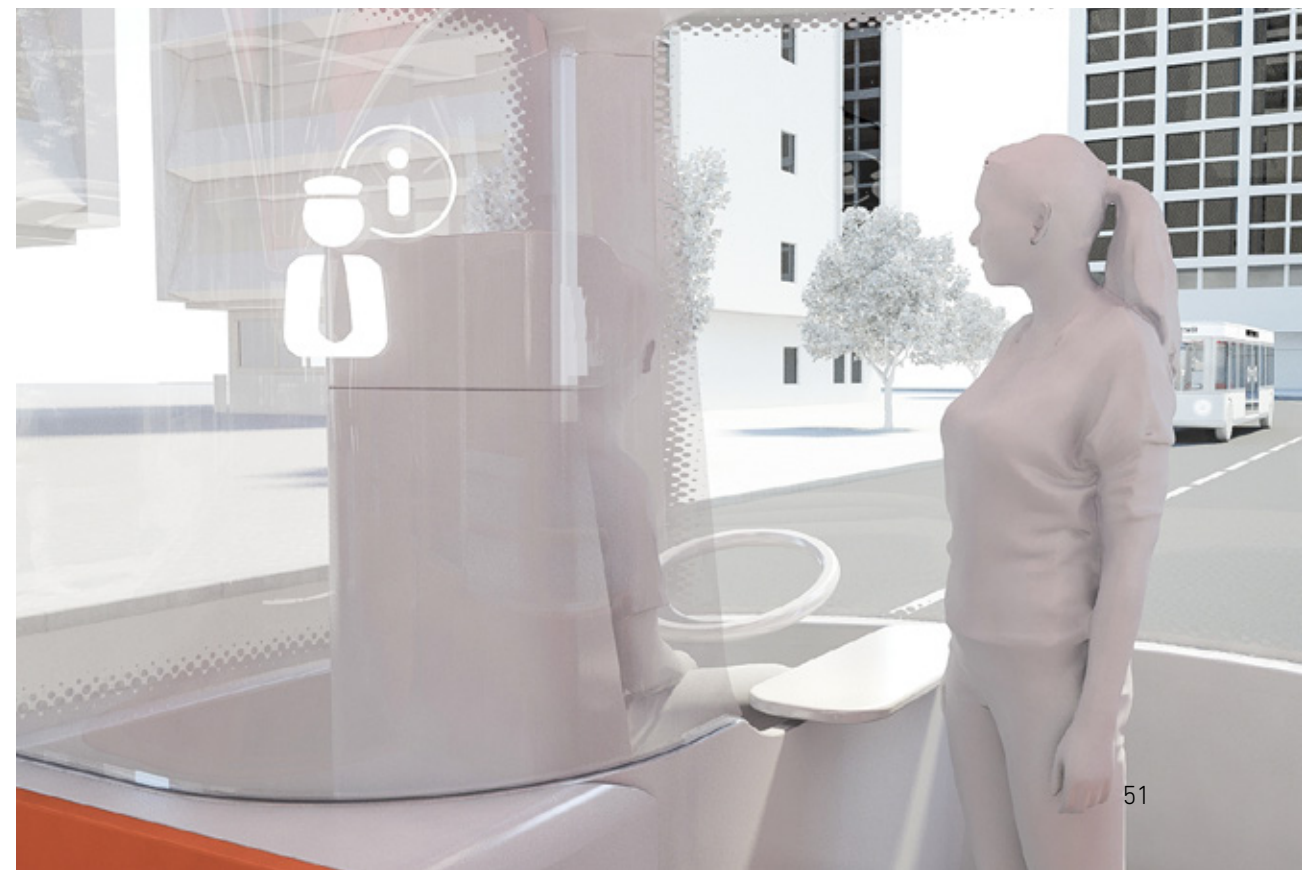
Easy and intuitive validation process

- Entry validation that is easy for passengers
- Providing a clear validation threshold

Clear validation threshold

- Making the validation experience simple
- Eliminating slow-downs on-boarding
- Optimising controls

VALIDATION

Integration and scalability

- Enhancing adaptability to requirements of different authorities or operators
- Providing flexibility to scale up and upgrade during the E-bus lifetime

5

TAKING PLACE

5.1 APPEALING

The E-bus offers a logical, intuitive internal space.

Clearly adapted layouts

- Ensuring an easy to understand layout with the most suitable place for everyone clearly identifiable
- Facilitating access to all seats and spaces

Adapted to operation

- Open to all different needs
- Increasing the liveability and the community spirit

LAYOUT AFFORDANCE

Industrial optimisation

- Enhancing adaptability to requirements of different authorities or operators
- Ensuring scalability during the E-bus lifecycle

A bus with a view

- Introducing wide windows or 'balconies' that provide spectacular views of the city

Global perception of the interior

- Using materials, colours and lighting designed to create a calm and positive atmosphere
- Careful choice of details such as ceiling, floor, bars, handholds, etc.

Global space optimization

- Optimising movement between seats, standing areas, doors, etc.
- Highlighting the choices available

GLOBAL DESIGN

Industrial optimization

- Enhancing adaptability to requirements of different authorities or operators
- Ensuring scalability during the E-bus lifecycle

5.2 COMFORTABLE

The E-bus offers adequate spaces for all users.

Welcoming for all

- Making easy for everyone to understand the layout and identify the most suitable place, particularly for people with disabilities or special needs
- Facilitating access to all seats and places, particularly for people with disabilities or special needs

Integrating all offers

- Layout minimising conflicts
- Proper balance between passengers types

UNIVERSAL DESIGN

Industrial optimisation

- Enhancing adaptability to the requirements of different authorities or operators
- Ensuring scalability during the E-bus lifecycle

Inclusion to the smart city

- Enhancing the perception of buses as integral to a smart and inclusive city

Balcony on the city

- Creating a pleasant travel experience, including in the rear area of the bus
- Offering spectacular views of the city

Increasing attractiveness of the rear area

- Facilitating passengers' ability to access the rear of the bus
- Improving the image from the outside, allowing passengers in the back to be visible

REAR AREA

Innovative features for the E-bus

- Taking advantage of the flexibility of E-bus architecture to differentiate the product from existing solutions

E-buses as mobile views of the city

- Rear sections of the E-buses participating in the city's life

Easy travel for passengers with luggage and bags

- Providing dedicated spaces for objects that could create clutter or obstacles
- Reassuring passengers that are travelling with luggage or bags

Intelligent offer in the e-bus

- Using the E-bus interior creatively
- Easing passenger movement when the E-Bus is busy

LUGGAGE AREA

Optimisation of the vehicle

- Making actual technical constraints creative opportunities for innovative design solutions
- Optimising the layout – no wasted space
- Efficient use of space

Expanding the continuity of the city

- Easy access and ample space for passengers carrying shopping or luggage

5.3 SAFE

The E-bus offers
a safe environment.

Safe and accessible floor

- Maximising the use of flat and horizontal surfaces
- Taking care of steps design (shape, height, lighting...) if steps are still necessary
- High-quality fittings and attention to detail

Easily-maintainable floors

- Allowing easy cleaning
- Permitting simple maintenance and replacement

SAFE FLOOR

Optimised industrialisation

- Streamlining industrial processes

Continuity

- Creating the perception of a seamless experience from the pavement to the vehicle interior

Visual and tactile quality

- Designing soft, friendly shapes and choosing materials that are pleasant to the touch
- Integrating comfortable materials and fabrics

Durability

- Adopting long-lasting solutions
- Design that avoids wear and tear

FRIENDLY

Optimised industrialisation

- Facilitating industrial processes
- Using known materials, easy to use and to maintain

Pride

- Making the cities proud of their transport systems and equipment
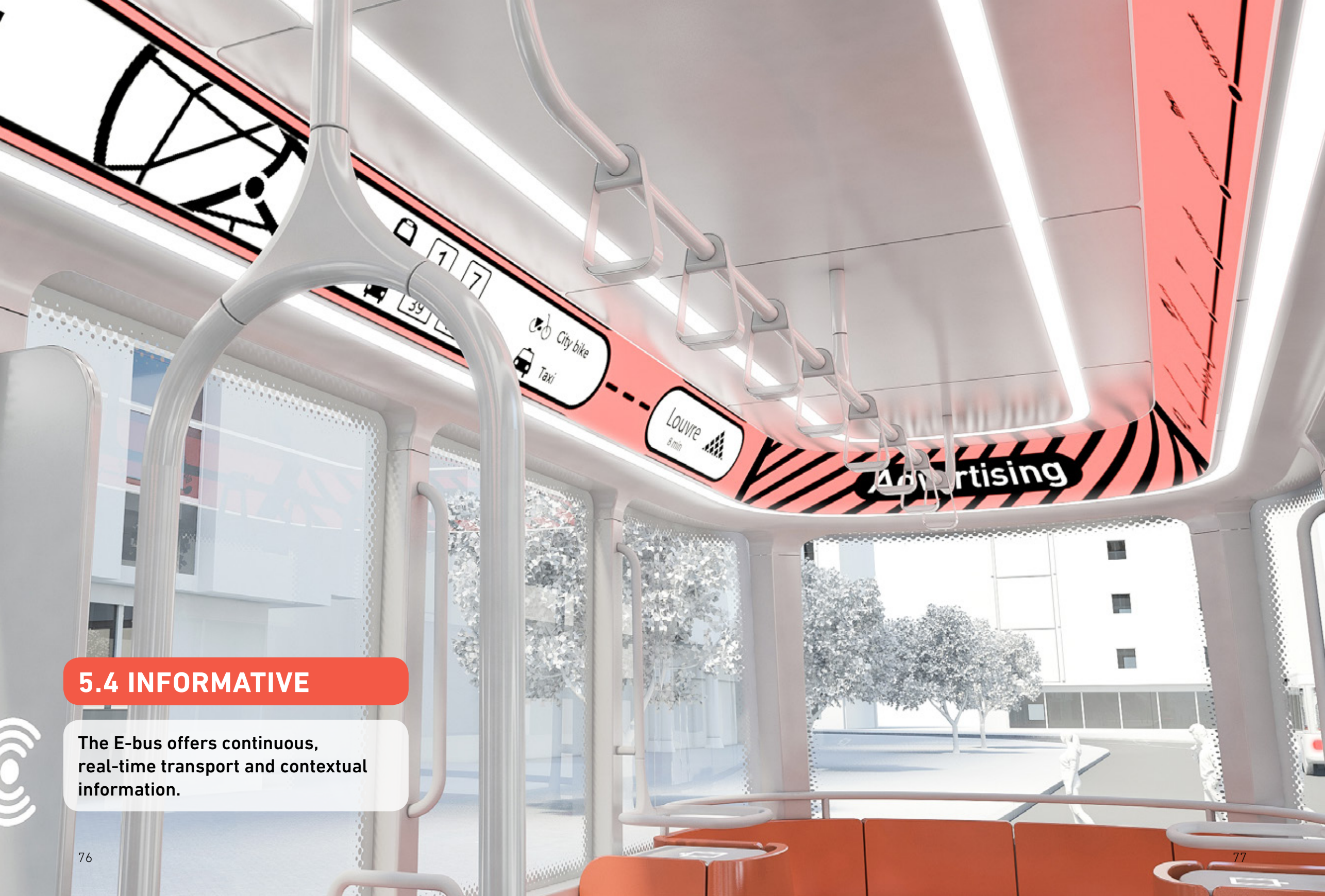
5.4 INFORMATIVE

The E-bus offers continuous, real-time transport and contextual information.

City bike

Taxi

Louvre
8 min

Advertising

Continuous navigation in the city

- Displaying the E-bus on its real-time route in the city
- Predictive, informative tools for time, inter-modality, places reached, etc.

Integration in the operator's digital ecosystem

- Ensuring seamless integration with the operators' information systems

DYNAMIC

Integration and standardisation

- High quality equipment throughout
- Enhancing adaptability to the requirements of different authorities or operators
- Flexibility to scale up and upgrade during the lifetime of the E-bus

Coordination with city information

- Interoperability/compatibility with the city's real-time information resources and content
- Interoperability/compatibility with third parties urban travel Apps

6
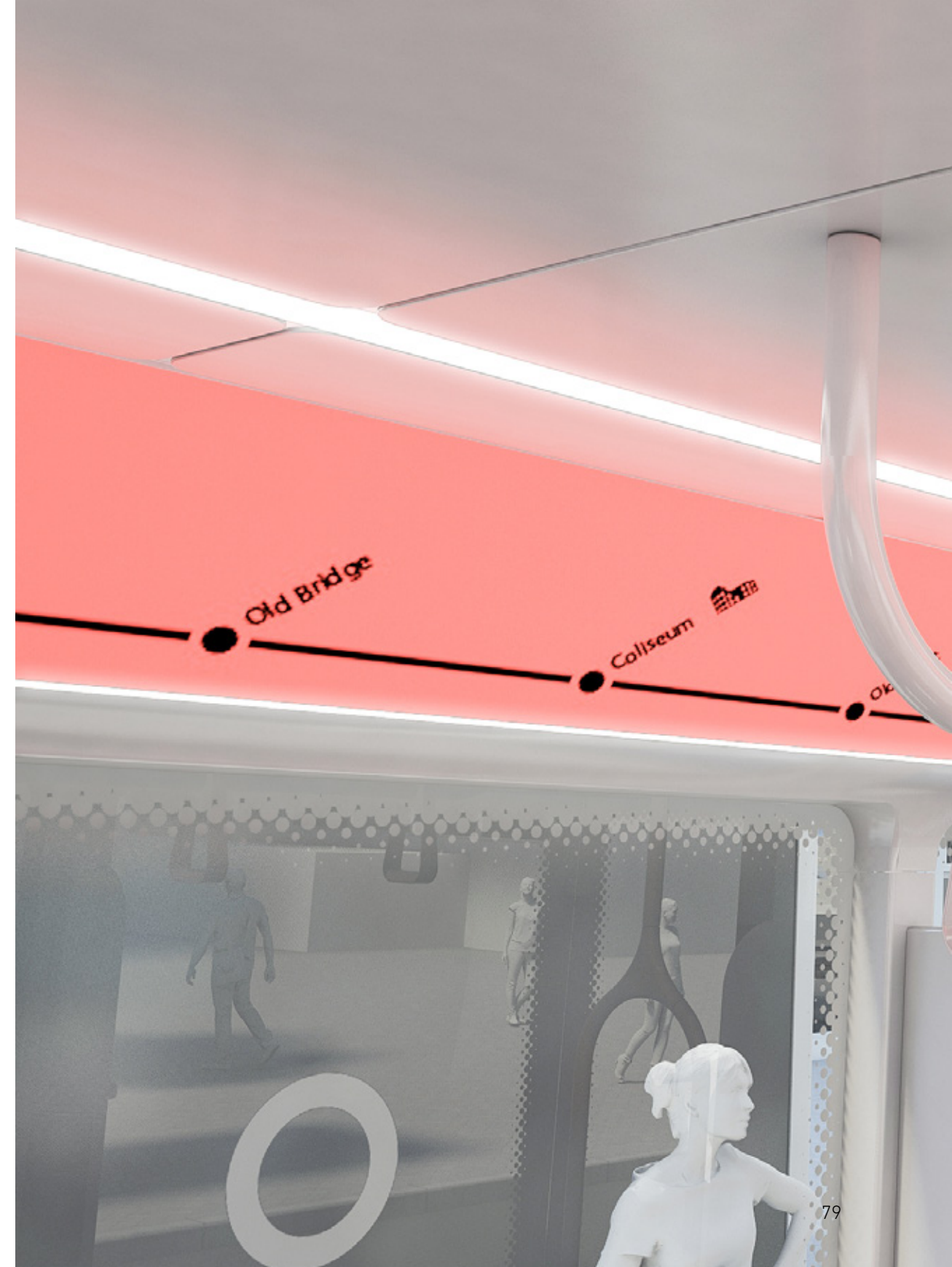
EXITING

6.1 REASSURING

The E-bus makes it intuitive to call for stops and ensures inner circulation towards the exits is optimised.

Efficient sound environment

- Creating a coherent informative acoustic alert library (validation, stops, connexions, etc.)
- Ensuring a high-quality sound system supervised through a centralised management platform
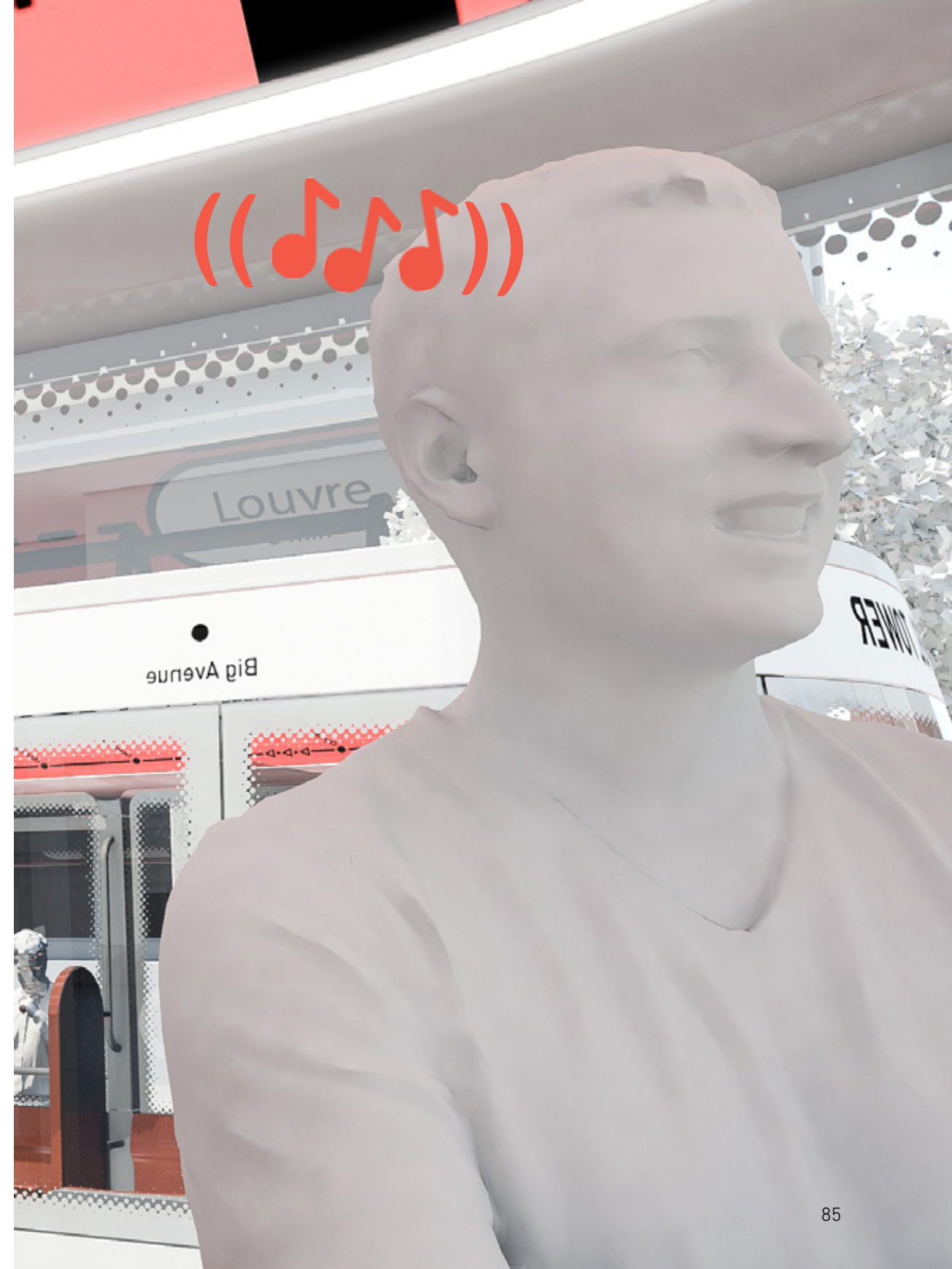
Fully integrated system

- Allowing the driver to action and supervise the sound channel through a centralised management platform
- Allowing content upgrades

ACOUSTIC DESIGN

Standardisation

- Enhancing adaptability to the requirements of different authorities and operators

Minimised impact

- Less noise and disturbance

Safe exiting

- Capacity to identify exits at a glance
- Sense of control over opening doors

Good exploitability

- Efficient floor organisation
- Reducing the exchange time by efficient flow management

INNER PATHS

Standardisation

- Enhancing adaptability to the requirements of different authorities or operators

Safe way to exit

- Contributing to the city's safety and security

7

MOVING

7.1 SIGNIFICANT

The E-bus leaves a specific and
pleasant impression when departing.

Distinctive design

- Making the back of the E-bus distinct and recognisable to avoid any misunderstanding between front and back

Attractiveness for the bus mode

- A rear space designed for passenger comfort, not technical equipment
- Integral safety features that enhance E-bus visibility

APPEALING

Cost optimisation

- Reducing the number of parts in order to optimise procurement, reduce stocks of spares and optimise the assembly process
- Identical modules for back and front, differentiated by graphics

Friendly

- Making the rear space of the bus inviting for tourists and city-dwellers to travel in
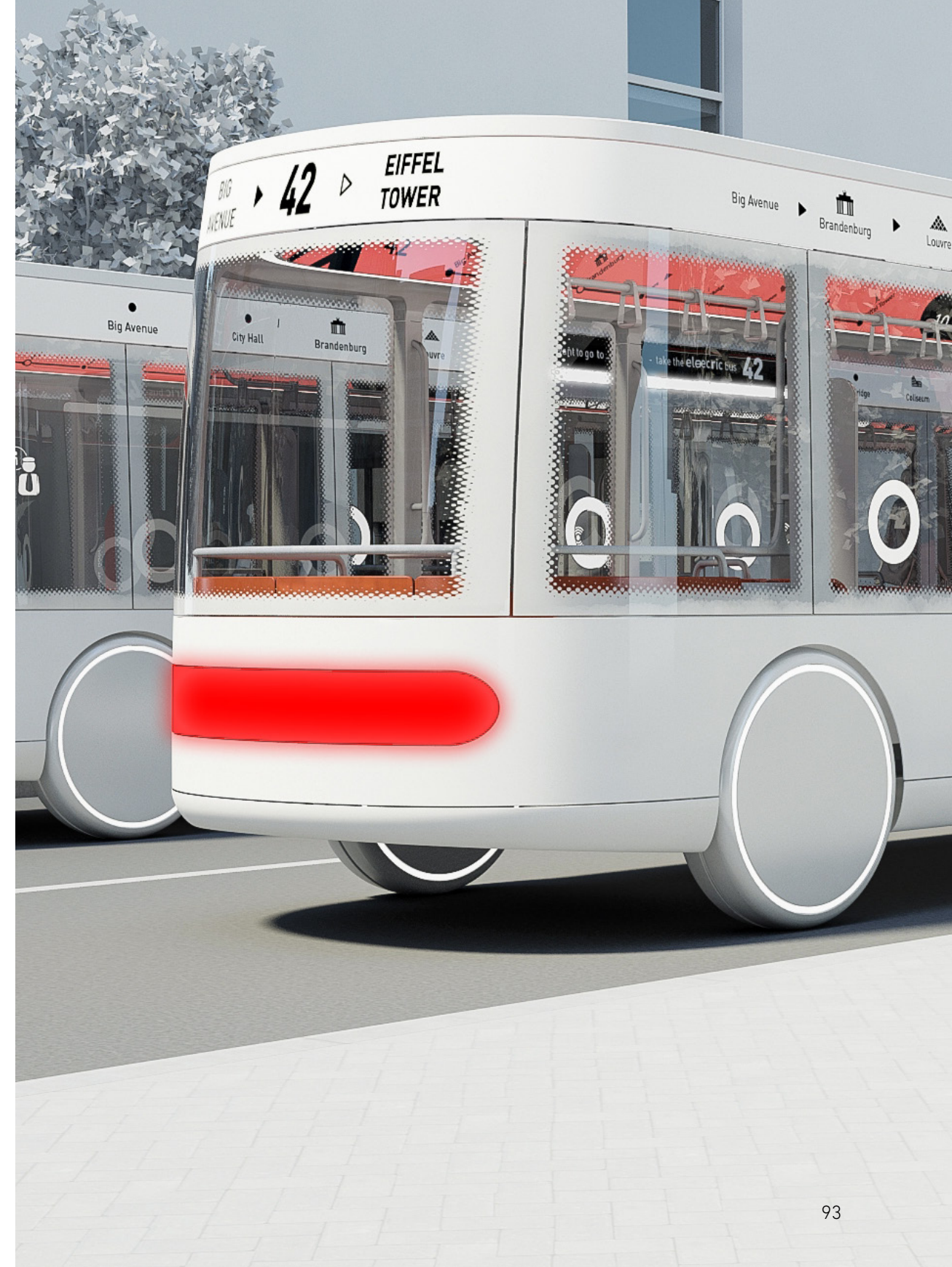
Agreeable acoustic signature

- Enhancing recognition through sound
- Including a smooth and human character

Safety-oriented sound design

- Contributing to a greater awareness among pedestrians

SOUND DESIGN

Standardisation

- Enhancing adaptability to the requirements of different authorities or operators
- Anticipating new industrial standards

Contribution to the city image

- Making the sound of the E-bus a characteristic of the city
- Maintaining the peace of urban areas

8

THE VEHICLE
IN DAILY LIFE
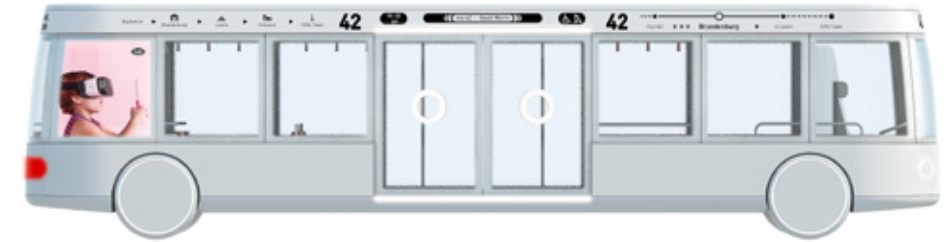
8.1 ADAPTED TO ADVERTISING

The E-bus provides a natural platform for advertising.

Entertaining and non-aggressive commercial information

- Natively equipping E-buses with advertising displays

Additional revenues

- Making the E-bus a highly-visible and effective advertising platform
- Maximising revenue opportunities
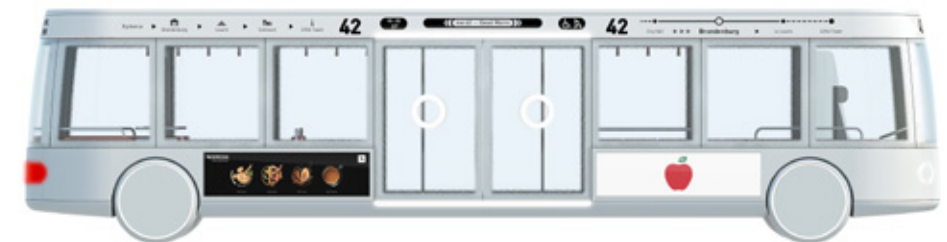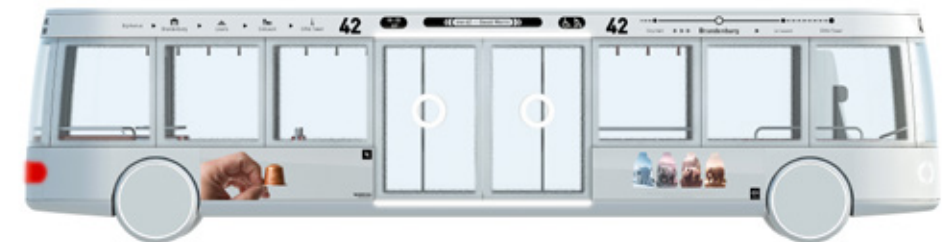
INTEGRATION

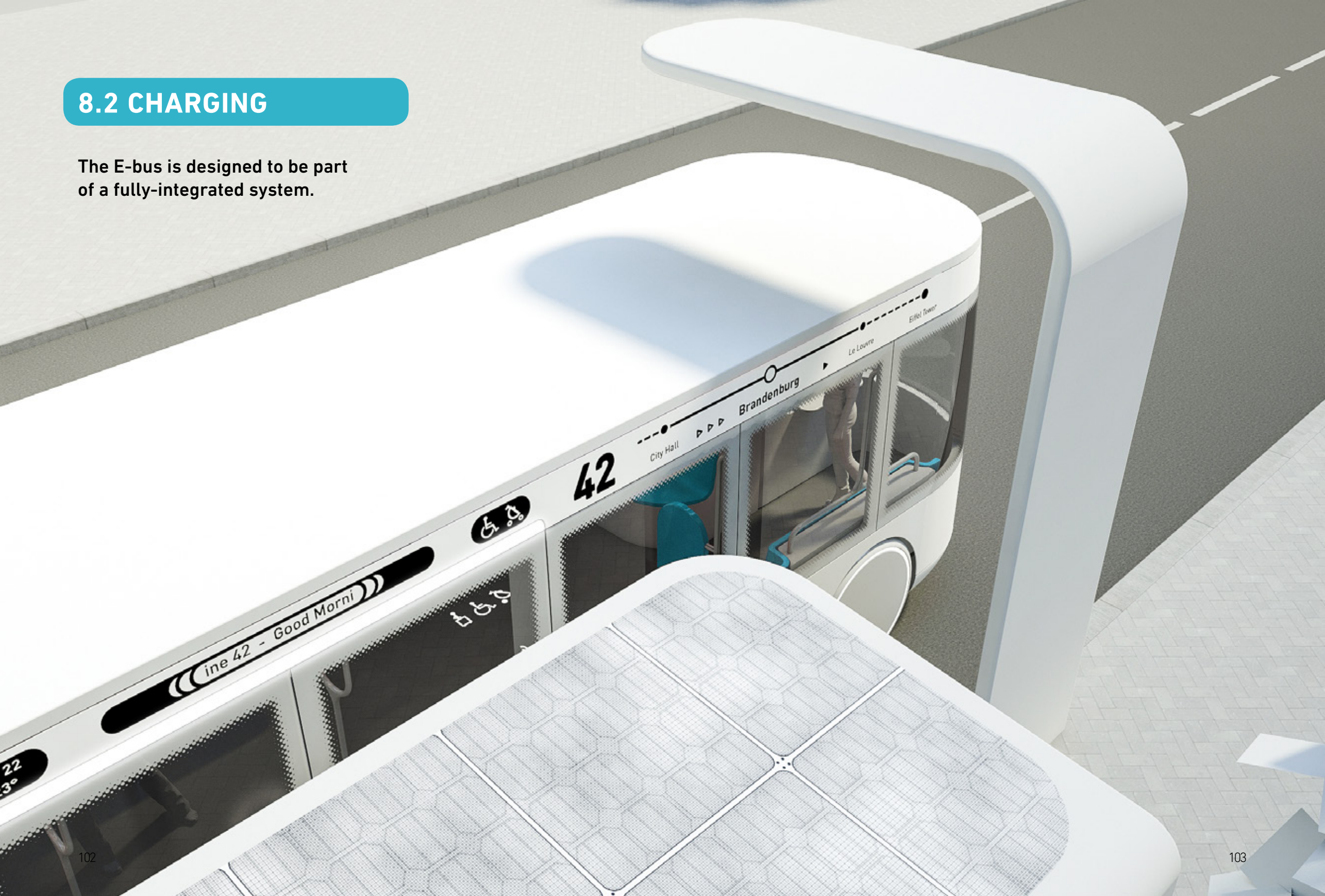## Optimised information systems integration

- Designed to integrate advertising and plug-in promotional platforms
- Ensuring scalability during the E-bus lifecycle

Contributing to city life

- Offering opportunities for innovative advertising, designed for urban environments

8.2 CHARGING

**The E-bus is designed to be part
of a fully-integrated system.**

Subtle and unobtrusive charging stations

- The charging technology blended into the surroundings
- Charging stations offers opportunities for passenger information

Easy deployment

- Sufficient discretion and flexibility to be acceptable in most of the urban areas

DISCREET

Standardisation

- Enhancing adaptability to the specific requirements of different cities'

Sympathy with the cityscape

- Concealing technical components
- Integrating into the city realm

City Hall ▷ ▷ ▷ **Brandenburg**
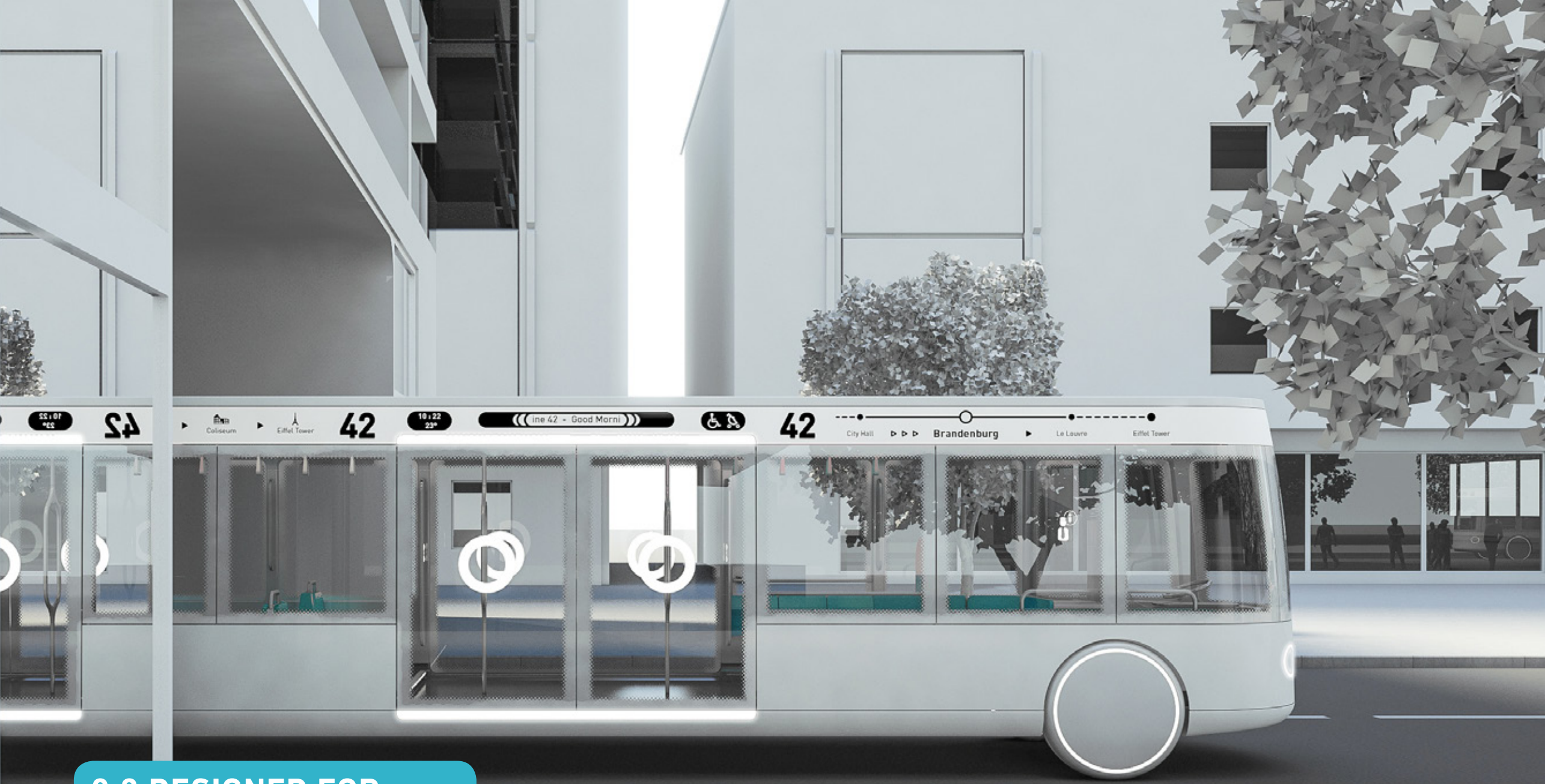
8.3 DESIGNED FOR INDOOR CIRCULATION

The E-bus is designed to evolve
for indoor deployment.

Gentle enough for indoor spaces

- Creating compatibility with interior spaces through the vehicle's shape, details and character

A possibility for operational innovation

- Creating the opportunity to design innovative indoor stations

INDOOR COMPATIBILITY

Innovative features for the E-bus

- Introducing new requirements for vehicles compatible with indoor spaces
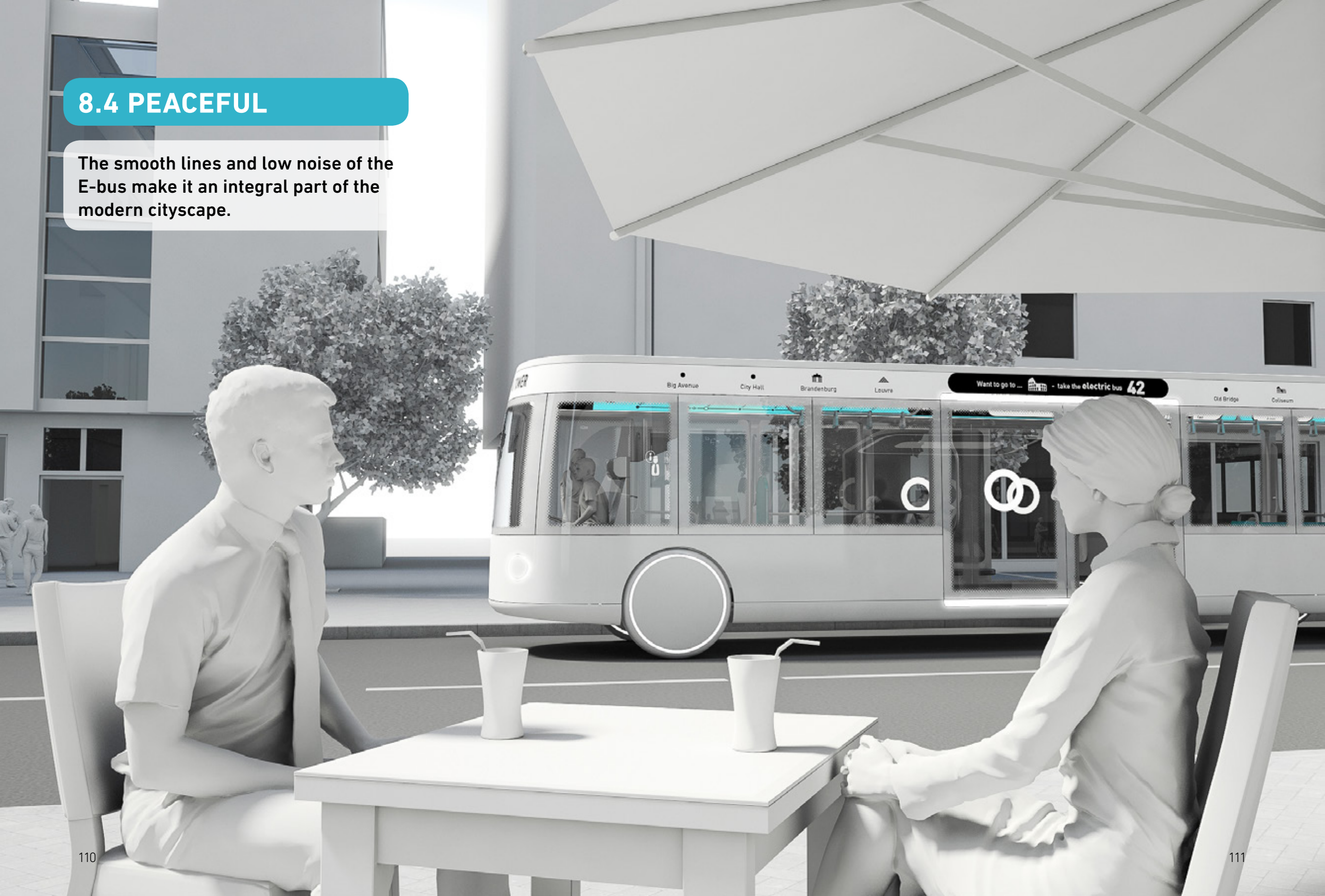
Possible hidden stations

- Creating stations or hubs in the city with lower visibility

8.4 PEACEFUL

The smooth lines and low noise of the E-bus make it an integral part of the modern cityscape.

Smooth and comfortable vehicle

- Fewer technical issues and greater proximity
- Greater comfort and less tiredness while travelling
- E-bus as a symbol of smart mobility

Balance with safety

- Ensuring a clear perception of vehicle approach in the traffic
- Providing an external sound signature consistent with that on the inside

QUIET

Standardisation

- Enhancing adaptability to the different requirements of authorities or operators
- Anticipating new industrial standards

A better city atmosphere

- Creating a more agreeable urban environment
- Symbolic contribution to a peaceful city

IN SUMMARY

- A recognisable, iconic new urban object
- Clear, obvious information displays
- An appealing entrance
- Fully welcoming and easily accessible
- Navigable, logical layout even when crowded
- Dedicated spaces for users with specific needs
- Careful attention to detail
- Maximising use of the back of the bus
- Providing real-time contextual information

Duration:
36 months (May 2015 – April 2018)

Project coordinator:
UITP (International Association
of Public Transport)
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