
Chemiring


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“It is in our cities that can be written the most beautiful but also the most efficient page of sustainable development”

- Anne Hidalgo, speech to the United Nations on sustainable urbanization

Executive Summary

Throughout the world, major cities are recognizing that they need to bring urban and natural landscapes closer together. At the forefront of this effort, urban green spaces offer benefits for humans and wildlife alike by limiting the environmental impact of cities while also providing habitats for plants and animals (EPA).

Bigger green spaces, however, do not always mean more biodiversity or a healthier city. They are generally too few in number and too far apart to form tenable networks for urban wildlife, as different types of urban green spaces offer different resources. In order to live in the city, wildlife must be able to travel between these green spaces to access the full range of resources they need to survive.

To tap into the full benefit of Paris' existing green spaces, the city must connect them through a network of smaller patches of vegetation, increasing bioconnectedness. While most cities can use their roofs to do this, Paris is limited by the slanted style of its Haussmannian roofs.

As of 2014, however, 90% of Paris' 135,000 chimneys are unused (Business Insider). Distributed throughout the city's core, the chimneys could create wildlife corridors between Paris' largest urban green spaces without requiring the city to create new infrastructure.

Inspired by brush border cells, Chemiring wants to tap into the potential of the city's underutilized surface areas. Installing a compact planter system on Parisian chimneys will offer stepping stones for wildlife living in the urban core. The Chemiring's design features a water catchment system, insect nesting spaces, and bird houses. It's small size and simple materials make it an economically viable option for roofers wishing to provide more services, all while tackling the challenges of bioconnectedness and urban biodiversity.

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The
Challenge

Bioconnectedness:

Bioconnectedness is the free circulation of species allowed by the quantity and proximity of natural habitats within a city.

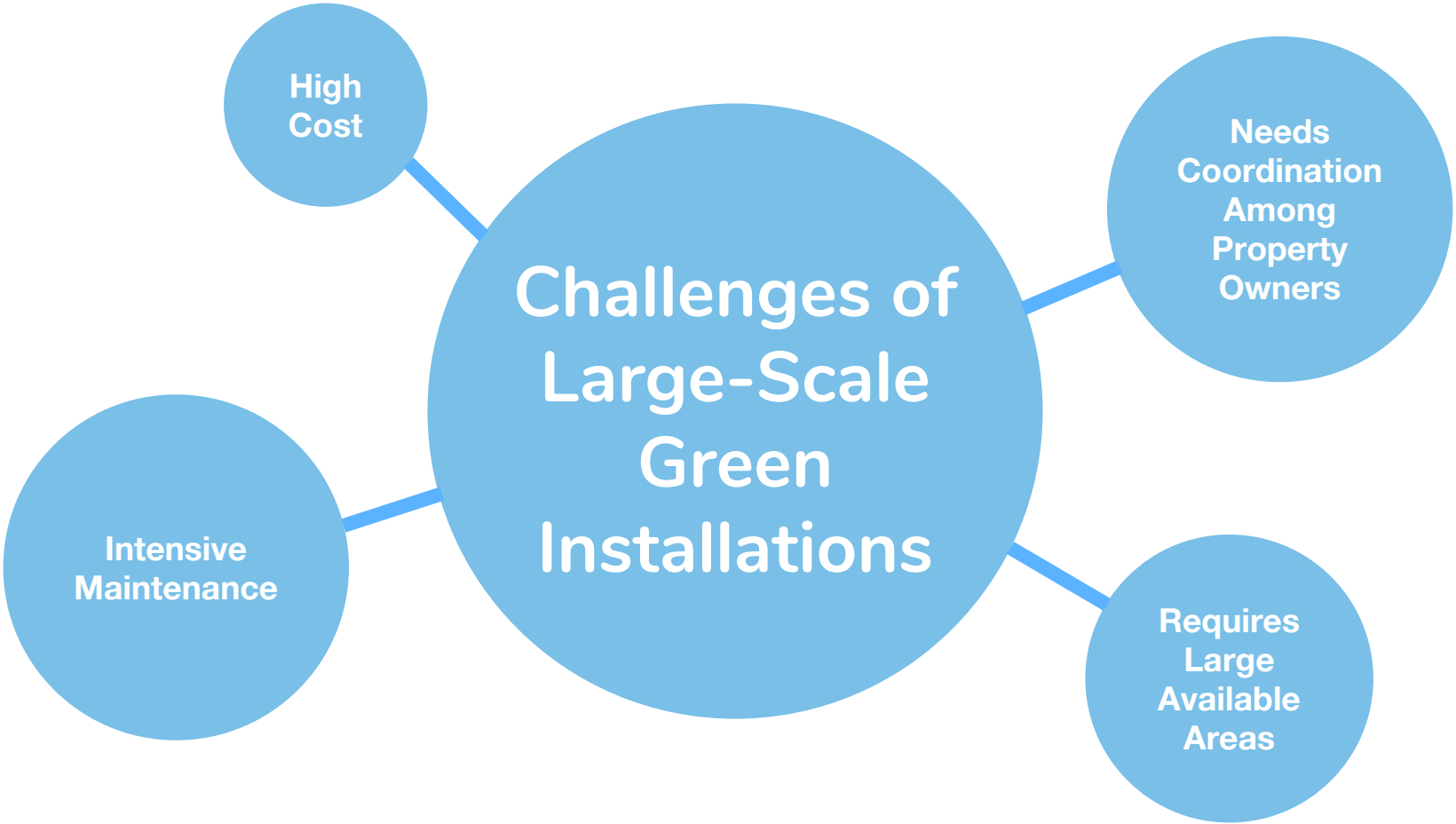
Different urban green spaces offer unique habitats for wildlife (Aronson et al. 2017). They can vary in form with anything from managed yards to large city parks. However, the disconnectedness of these spaces limits the biodiversity that is critical for the resilience of an urban area's flora and fauna.

"Urban green spaces throughout the city could be designed to form a network of interconnected spaces to better support biodiversity"

-Lepczyk et al. 2017

Growing research shows that small "stepping stone" patches of urban greenery can tap into the fuller potential of cities' large green spaces (Rudd et al. 2002). Pathways must be created through areas that would otherwise offer few resources to wildlife like birds, bats, and insects (Lepczyk et al. 2017).

Paris has many large green spaces, but they are isolated from one another


Challenges of Large-Scale Green Installations
High Cost
Needs Coordination Among Property Owners
Intensive Maintenance
Requires Large Available Areas


Previous
Approaches

Mairie de Paris

The city of Paris is very active in its efforts to increase the greenery and biodiversity of the city. In accordance with their city-wide green plans and commitments, they have launched many programs in order to achieve these long term goals. They have emphasized citizen participation and innovation, while also encouraging the allowance of the natural growth of plant life in small spaces.

100 Hectares Target Charter

In 2016, Mayor Anne Hidalgo and 33 private Parisian companies signed a charter committing them to "contribute to the greening of the city". The goal is to create 100 hectares of greenery on urban surfaces such as roofs, walls, and parking lots. Efforts aim to improve biodiversity and water management ("250 acres," 2016).

The Biodiversity Plan 2018-24

In early 2018, the Paris Council accepted the 2018-2024 Biodiversity Plan. Its objective is to "considerably increase the revegetation of the undeveloped areas of Paris." The plan encourages the growth of natural plants and wildlife in unused city spaces and informs citizens as to how they can create usable habitats for wildlife ("Biodiversité").

Parisculteurs

Parisculteurs is a competition where Parisian citizens submit proposals for innovative greening strategies on city property

Benefits

- Utilizes innovation
- Incentivizes citizen participation

Rues Végétales

Rues Végétales are streets in Paris that have been converted to soft traffic and lined with planters

Benefits

- Reimagines public spaces
- Involves community directly

Permis de Végétaliser

Paris issues permits that allow citizens the right to plant greenery in approved public spaces

Benefits

- Spread out
- Simple installation

Outside of Paris

Brike

Modulated bricks that serve as planters, bird houses and insect hotels

Benefits

- Cheap
- Low maintenance
- Spread out

Barcelona Plan Verde

Benefits

- Increases bioconnectedness
- Fits inside dense cityscape

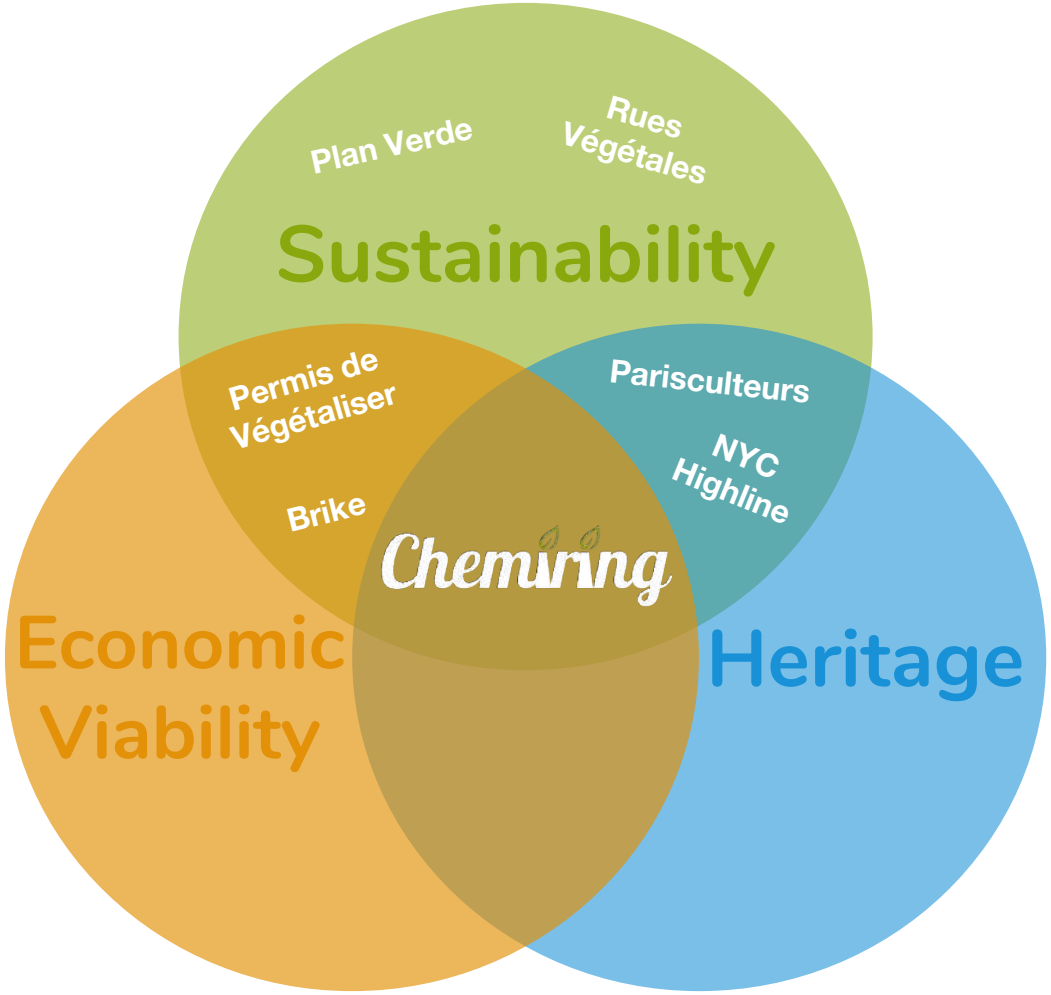
Barcelona plans to use trees to connect the large green spaces on the edge of the city

NYC Highline Park

Benefits

- Repurpose existing infrastructure
- Retains historical architecture

New York City converted an old rail line into a public park


Plan Verde
Rues Végétales
Sustainability
Permis de Végétaliser
Brike
Parisculteurs
NYC Highline
Chemining
Economic Viability
Heritage

The Chemiring

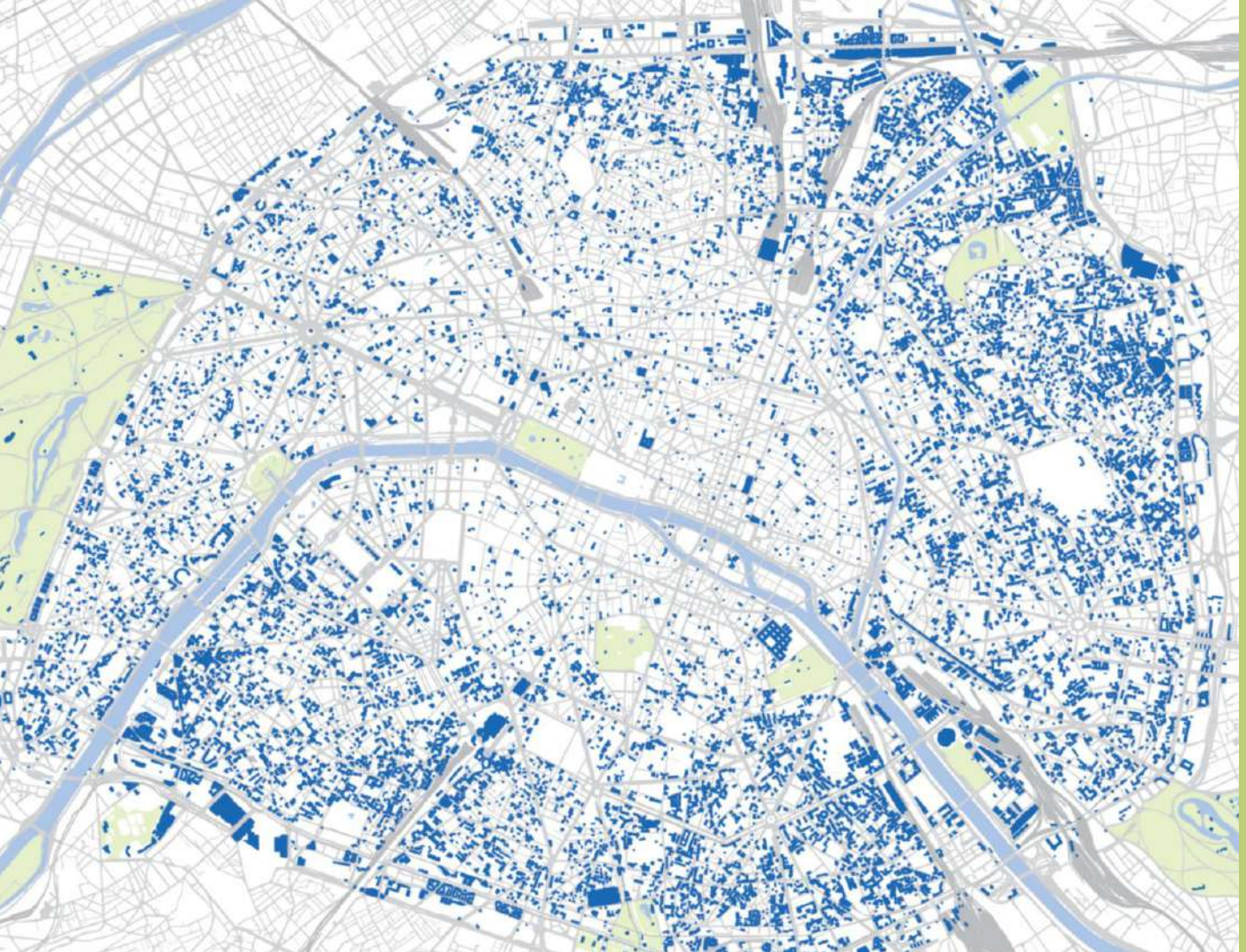
By spreading across large, dense, urban areas at minimal personal costs, the Chemiring can help to achieve the city's 100 Hectare Target and Biodiversity Plan within a few years of launching, while working within the historical framework of the city. In addition to the city's current efforts, it is another stepping stone towards a sustainable city.

Benefits

- Cheap and easy installation
- Low maintenance
- Spreads biodiversity over large areas
- Specific to Paris' historical resources

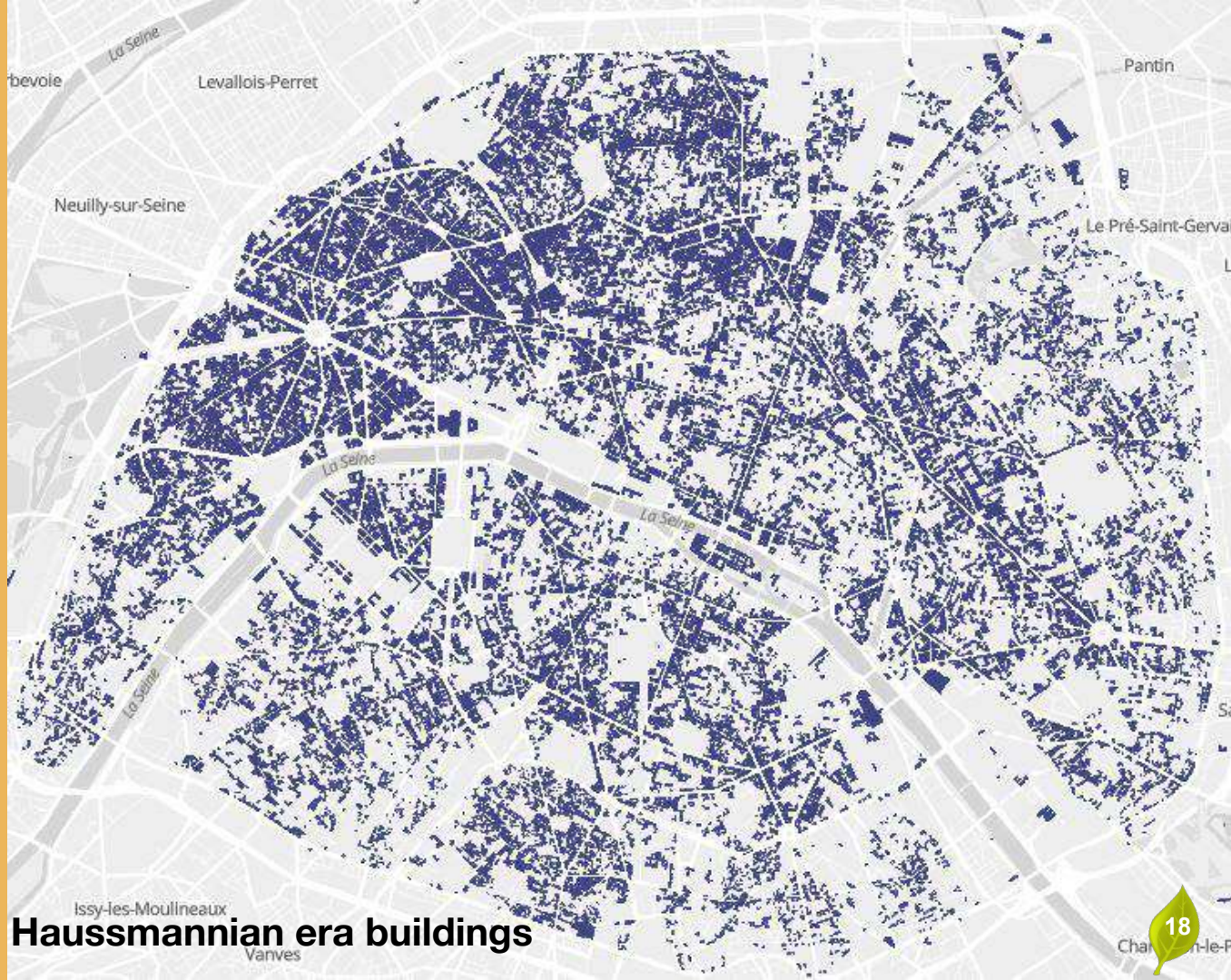
Bridging the Gaps


Our
Solution



Roofs could be greened to greatly increase bioconnectedness, but most in the central eight arrondissements are slanted and cannot be fitted with traditional green roofs

These same buildings were constructed during the Haussmannian period (1853-1870), meaning they also have the iconic Parisian chimneys



Haussmannian era buildings

Of the **130,000** chimneys in Paris,

only **10%** are still in use

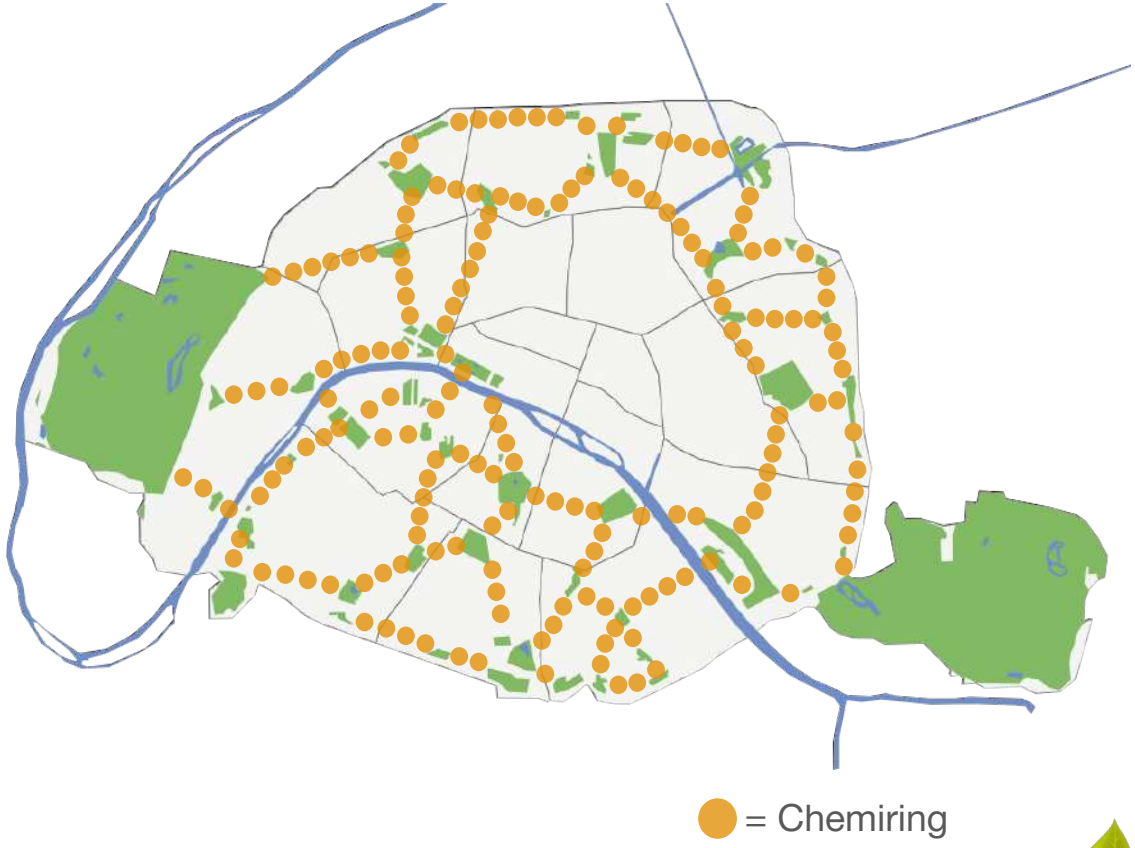
(Business Insider)

Heritage Preservation

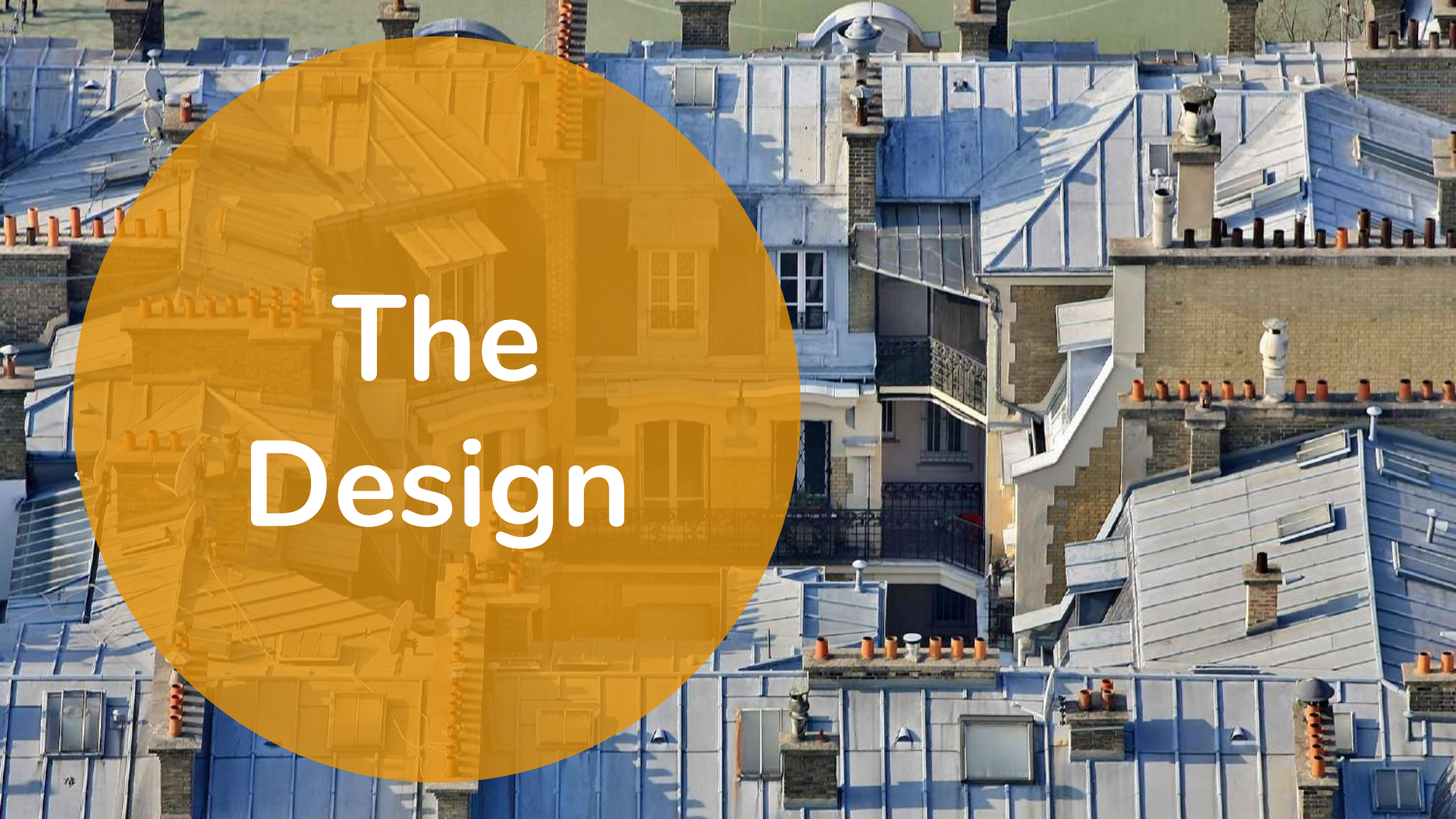
The conservation of heritage is critical for a historical city like Paris. It is ensured through municipal regulations and national laws, and chimneys are part of this historical legacy. Several Parisian district mayors are promoting the candidacy of Parisian roofs on UNESCO's World Heritage List. Roofers are likewise supporting this initiative that would help shine the spotlight on their unique expertise. Mayor Hidalgo and the majority of the city council are skeptical about the project. They are afraid that it could hinder urban planning and the transformations necessary for sustainability.

Our project would help preserve roofing jobs and Parisian heritage, all while helping to promote a more sustainable form of development. It preserves the past while preparing for the future

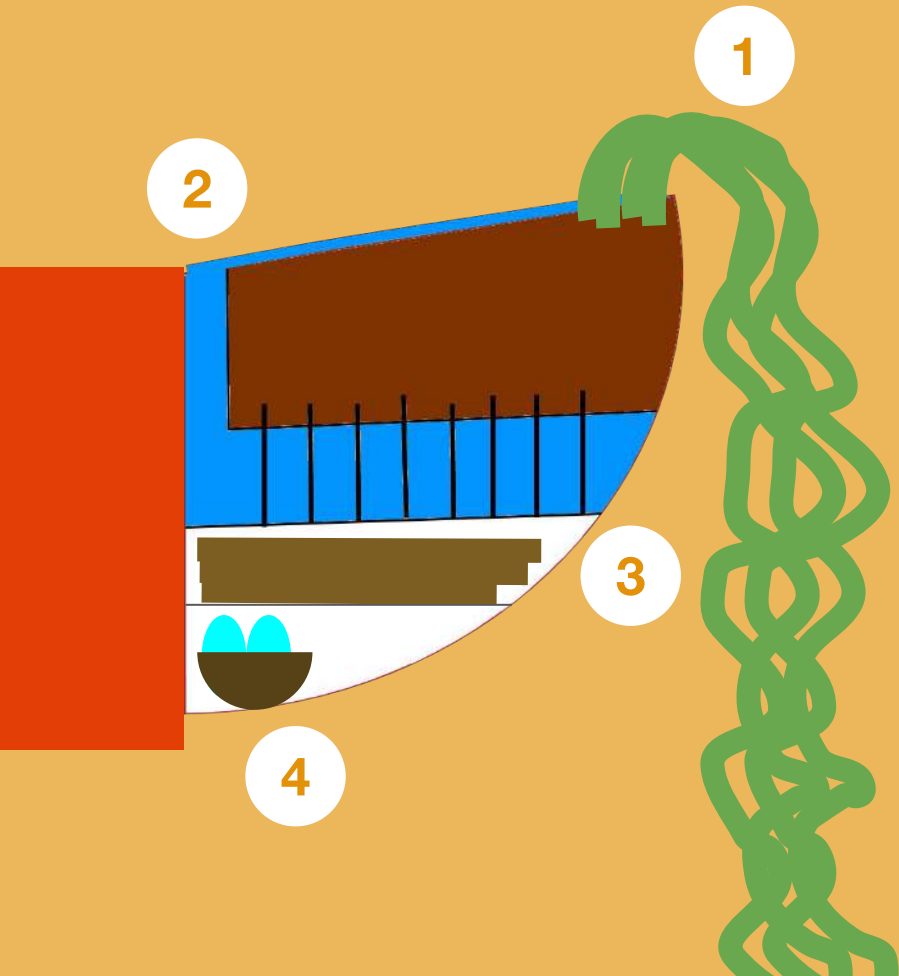
Because of the frequency of Haussmannian buildings, Chemirings will naturally form stepping stone corridors between large green spaces



Chemirings will create a network of greenery across the rooftops of Paris


The
Design

How The Chemiring Works



1. Planter: The Chemiring contains a planter with an opening for trailing species that are ideal for housing feeding insects in a warm and exposed area.

2. Water Catchment: The slanted cover of the Chemiring feeds water into a capillary system that stores and feeds water to the plants' roots.

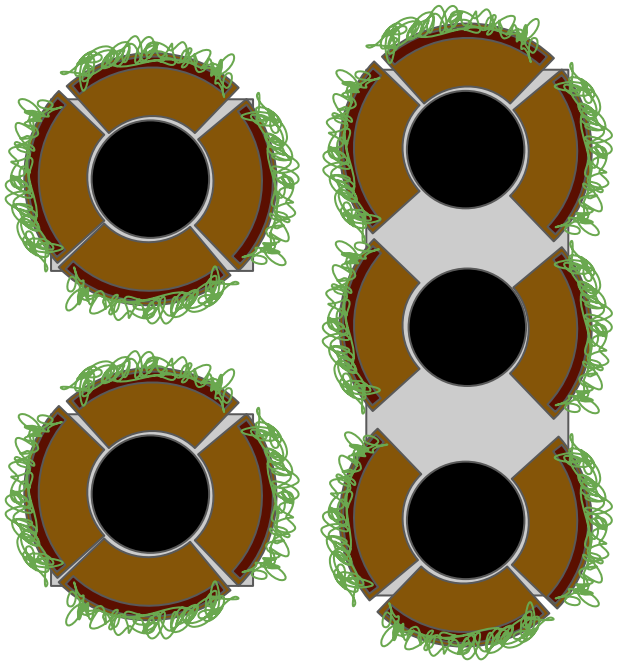
3. Insect Hotel: Specially drilled slats of wood make ideal nesting locations for bees and other pollinators.

4. Bird House: A habitat compartment offers sheltered housing for smaller species of cavity-nesting birds.

Standardized Design

Stand alone Chimneys

Line of Chimneys



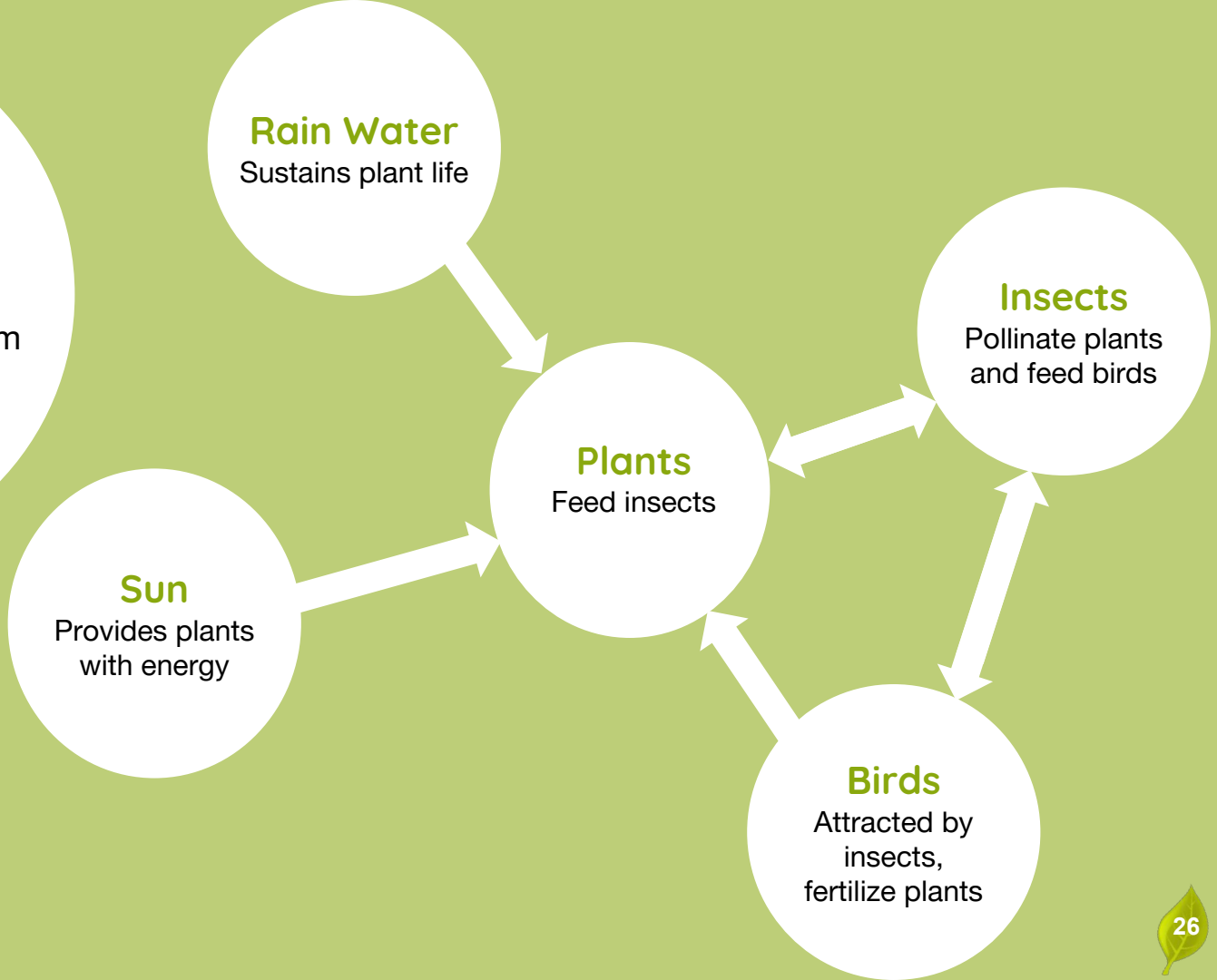
A top down view depicting how the Chemiring can fit onto chimneys regardless of roof layout.

By using a quarter circle design, the Chemiring can fit on chimneys regardless of how they are grouped together. If—as many chimney flues in Paris are—a chimney is closely paired with others, it can have two Chemirings placed on its sides. If a chimney stands alone, it can then receive four Chemirings.

The Chemiring thus has a flexible design that can be mass produced and fit onto any building that has chimneys. The standardization will allow the Chemiring to be produced with relatively limited expenses, while also easing the attachment process for roofers.

Chemiring

A self-sustaining biosystem



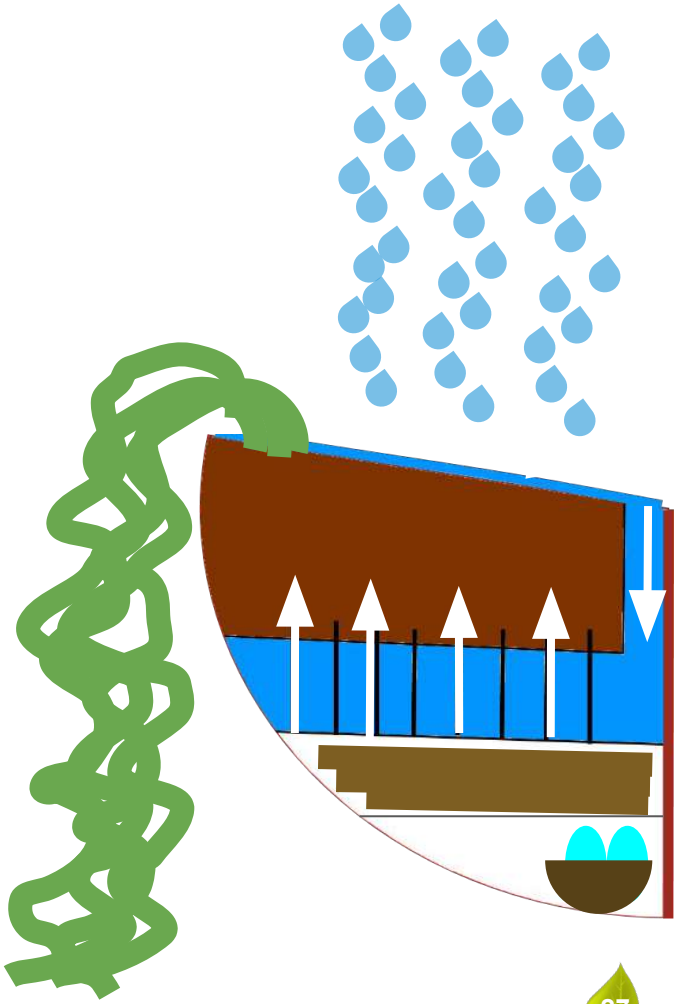
Water Catchment and Capillary System

The top of the device works to catch a large surface area of water. The furthest edge of the Chemiring away is raised higher than the inside, allowing water to flow into a hole. This opening will be covered with a net to prevent clogs at the water's point of entrance.

By trapping rain water before it reaches the city streets, Chemiring can help reduce stormwater runoff and reduce flooding if installed city-wide.

From this step, the water flows downwards into a chamber beneath the soil where it can be stored until the plant needs it.

The capillary system regulates this process. The plants have access to the rain water stored inside the Chemiring via tubes linking the soil and the water. The roots can access the water it requires, so there is no need for manual watering. Because the rain water is caught in the catchment system before it comes in contact with anything else, the water is nontoxic and it doesn't need filtration.



Plants

White stonecrop

Mother-of-Thyme

Nodding Onion

Oregano

The Chemiring will sit on top of chimneys, so the choice of plants must take into consideration the specifics of this environment. They must have a strong resistance to heat and ability to withstand direct sunlight. The amount of soil is limited in the Chemiring, so the plants should be able to grow without needing too much root space.

Even with these requirements, a number of plant species could excel in the raised environment of the Parisian roofs, tapping into their ample sunlight and rain water. Moreover, the widely dispersed, stepping-stone nature of the Chemirings will offer a rare opportunity for botanists to spread needed plants throughout the city.

Insects

European Honey Bee

Large Bee-Fly

Wild Bee

Hummingbird Hawk-Moth

The Chemiring can help make Paris a home to insects. On the one hand, the plants described before will offer food for pollinators and herbivorous insects, and they will provide shelter for a variety of insects that live in plant foliage. On the other hand, the Chemiring's insect hotel chamber will offer shelter for insects like some bees and wasps that specifically cannot make use of foliage or other common materials. The materials in this chamber can, like the plants, be tailored to the specific needs of the wildlife in a city or arrondissement. By doing so, the Chemiring can act as the fibers that weave together a city's biodiversity.

Birds

Mistle Thrush

European Robin

Eurasian Blue Tit

Tree Sparrow

The Chemiring also provides food and shelter for various species of birds. Its planter compartment attracts insects that most species of birds feed on, and the trailing plants it contains offer valuable nesting materials. These materials can then be used in the nesting chamber, which is located on the underside of the Chemiring. This compartment is ideal for smaller “cavity-nesting” birds that might otherwise struggle to find ideal nesting sites within city limits. Moreover, because the nesting cavity is below the hanging cover of the planting chamber, smaller birds will be able to nest under the cover and protection of the Chemiring. With this chamber, the Chemiring finishes its contribution to Paris’s wildlife.

Each chimney can hold at least 2 units, and if every chimney receives installations, a total of 240,000 units would be installed

Impact Projections

	Individual Units (1 unit)	Large Scale (240,000 units)
Water (L)	5	1,200,000
Plants	2	480,000
Insects	100	24,000,000
Birds	3	720,000

UN Sustainable Development Goals

The Sustainable Development Goals (SDGs) are a collection of 17 global goals set by the United Nations in 2015. Our project aims at addressing the three following goals:

SDG 3: To ensure healthy lives and promote well-being for all. As outlined by the United Nations, ambient air pollution results in an estimated 3 millions deaths per year, including 2,500 Parisians. Our project would help improve Paris' air quality.

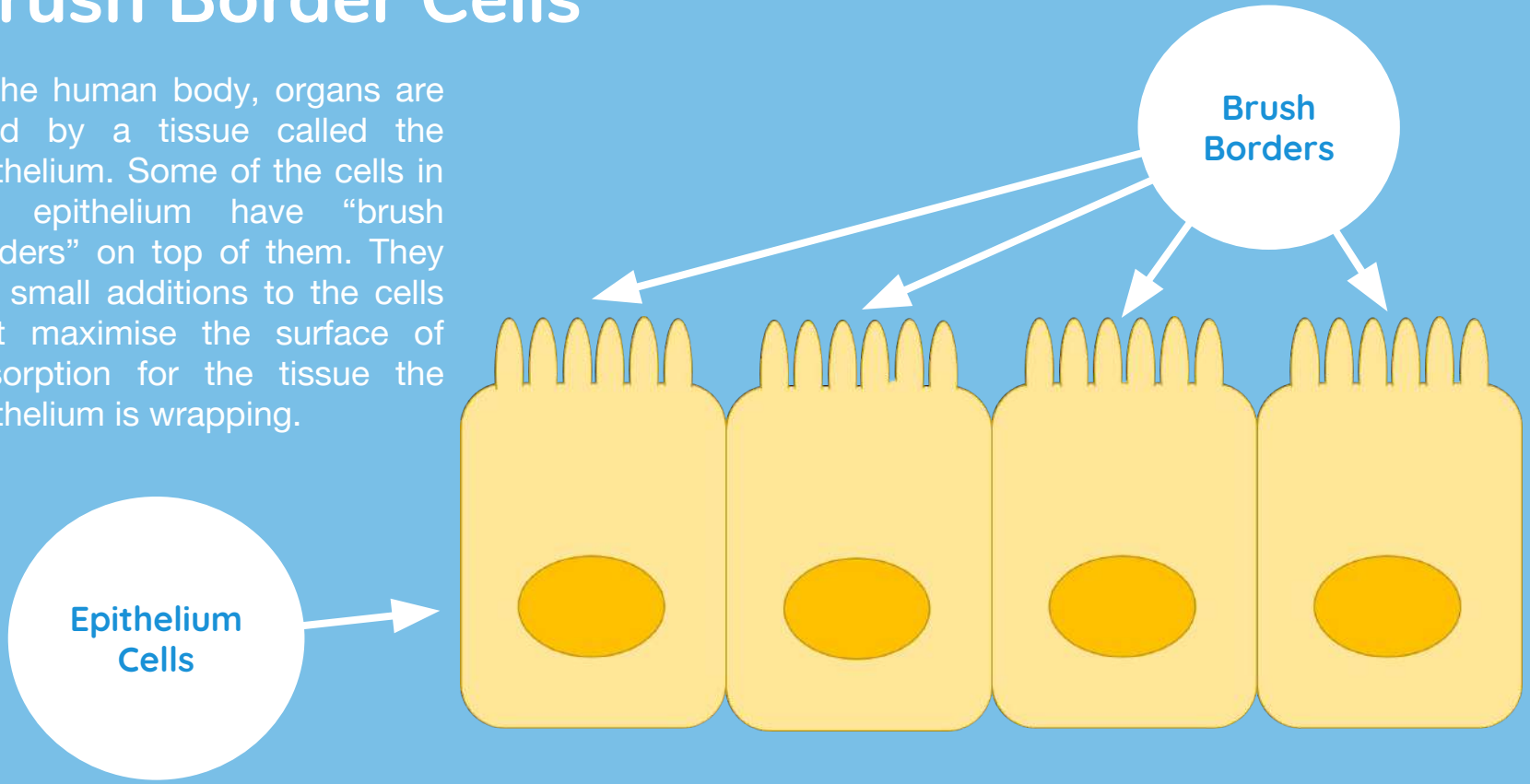
SDG 8: Our project would provide economic opportunities for roofers, improve global resource efficiency, and decouple economic growth from environmental degradation.

SDG 15: Our project would allow the preservation of biodiversity in Paris by providing shelters to insects and birds by increasing bioconnectedness


Biological
Inspiration

Brush Border Cells

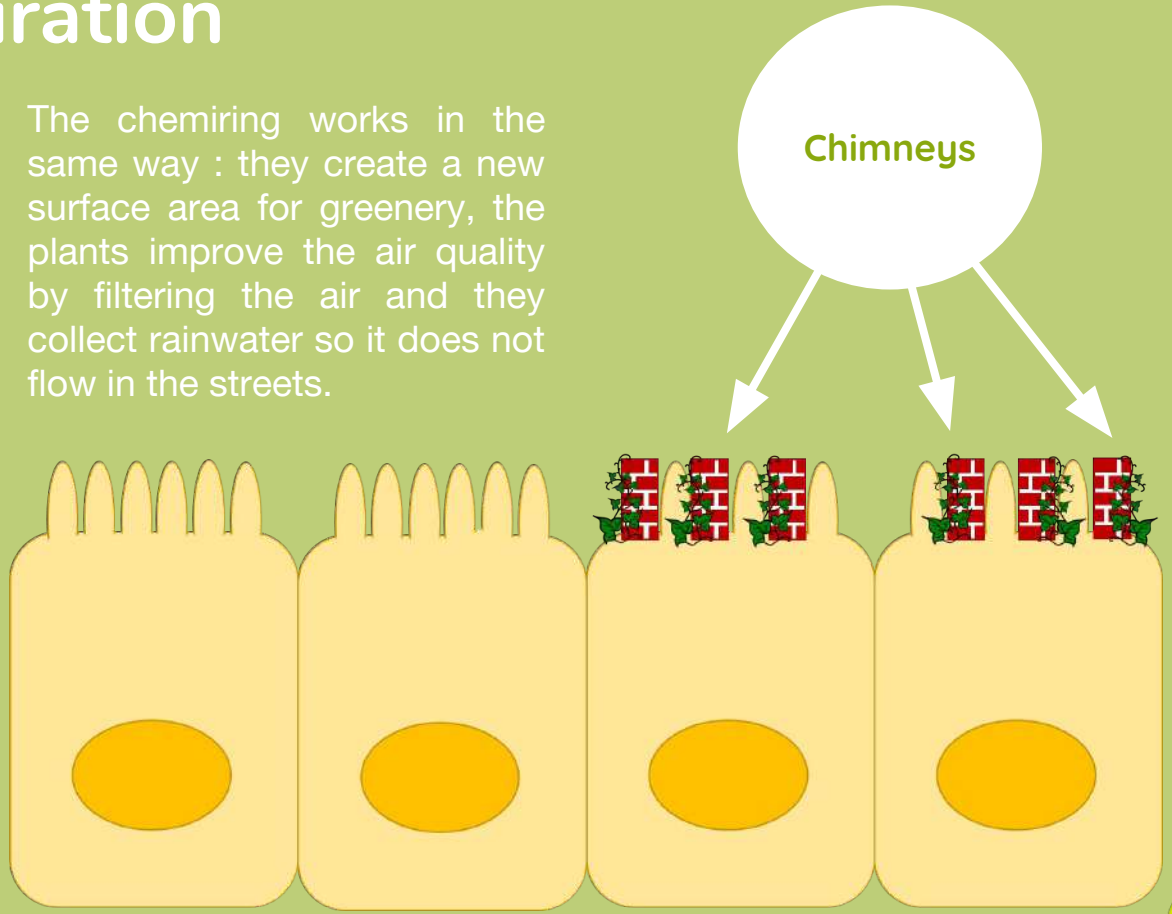
In the human body, organs are lined by a tissue called the epithelium. Some of the cells in the epithelium have “brush borders” on top of them. They are small additions to the cells that maximise the surface of absorption for the tissue the epithelium is wrapping.



Biological Inspiration

The brush borders are a system that increases the efficiency of the tissue and protect what is underneath. The folded lining increases the surface area and maximises the absorption capacity of the tissue beneath the cells.

The chemiring works in the same way : they create a new surface area for greenery, the plants improve the air quality by filtering the air and they collect rainwater so it does not flow in the streets.



Similarities

- Protect the ecosystem underneath
- Absorb the pollutants


Business
Plan

Next Steps

1

Test Prototype

First Year

2

Obtain Funding

Apply to Ile de France by September

3

Partner with Roofers

Second Year

4

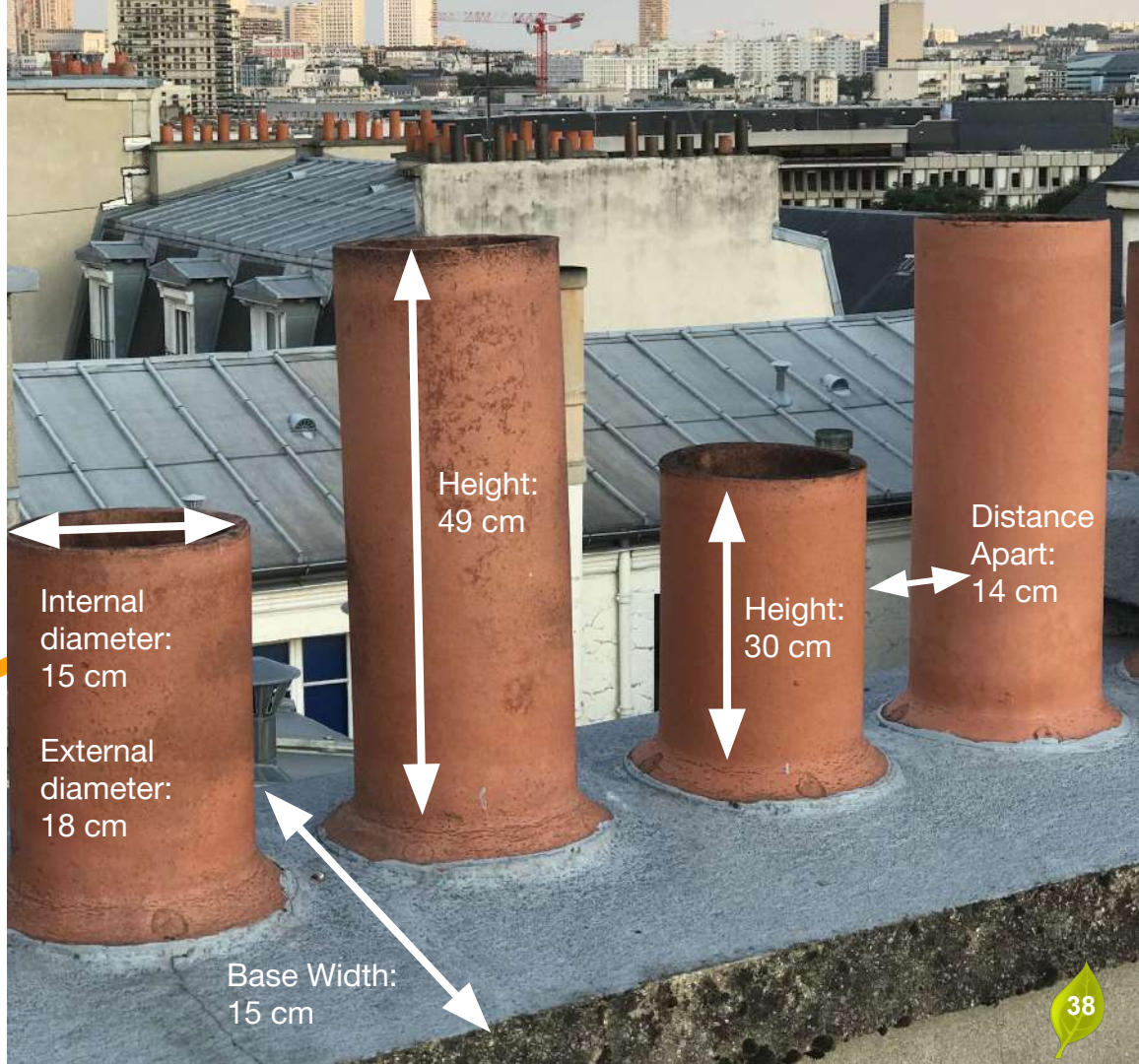
Expand Market

Fifth Year

1. Prototyping

In our prototyping phase, we will experiment with the physical constraints of our product, working to maximize the volume of water and soil, while balancing the weight bearing capacity of the chimneys.

We will also try multiple types of plants to find one that has the most beneficial effect on biodiversity, while being able to survive in the harsh rooftop environments.



2. Funding and Resources

The Region wants to fund Paris' biodiversity initiatives throughout Ile-de-France. They've implemented a call for projects—like the Chemiring—aiming to fight against the erosion of the city's biodiversity ("Recherche des Aides & subventions," n.d.).

The City of Paris provides citizens with seeds and topsoil to those who want to personally implement small-scale greenery. We're hoping to be able to redirect these resources as a way to cut down on personal costs for individual citizens (Paris, n.d.).

3. Partnering with Roofers

Roofers have the resources, connections and skills necessary to realize the full potential of our project, offering an invaluable partnership. Not only this, but the job of Parisian roofers is protected by the French Culture Ministry as a piece of intangible cultural heritage, making it a necessary component of the city's future in sustainability.

The roofers likewise add a viable economic path for the Chemiring's progress. Because roofers already take the initial insurance and hourly costs of climbing onto roofs during regular maintenance, they can offer the Chemiring to apartment owners as an "add-on" item in addition to mandatory inspections twice a year.

By eliminating the initial costs for the Chemiring's installation, partnering with the roofers will allow us to offer the product at a cost that is not much higher than the cost it takes to produce the Chemiring itself. The majority of the profits will go to the roofers, giving them an incentive to use their extensive networks to spread the Chemiring.

4. Expanding Market

Almost anywhere you see iconic Parisian chimneys, you can see the equally well known balconies that line the streets of Paris. Once we perfect the Chemiring system, we hope to adapt it to other vertical surfaces such as balconies and lightposts, making our product versatile enough for most urban environments. Making this transition requires only changing the Chemiring's fastener system, while maintaining its compact design.

Production Costs

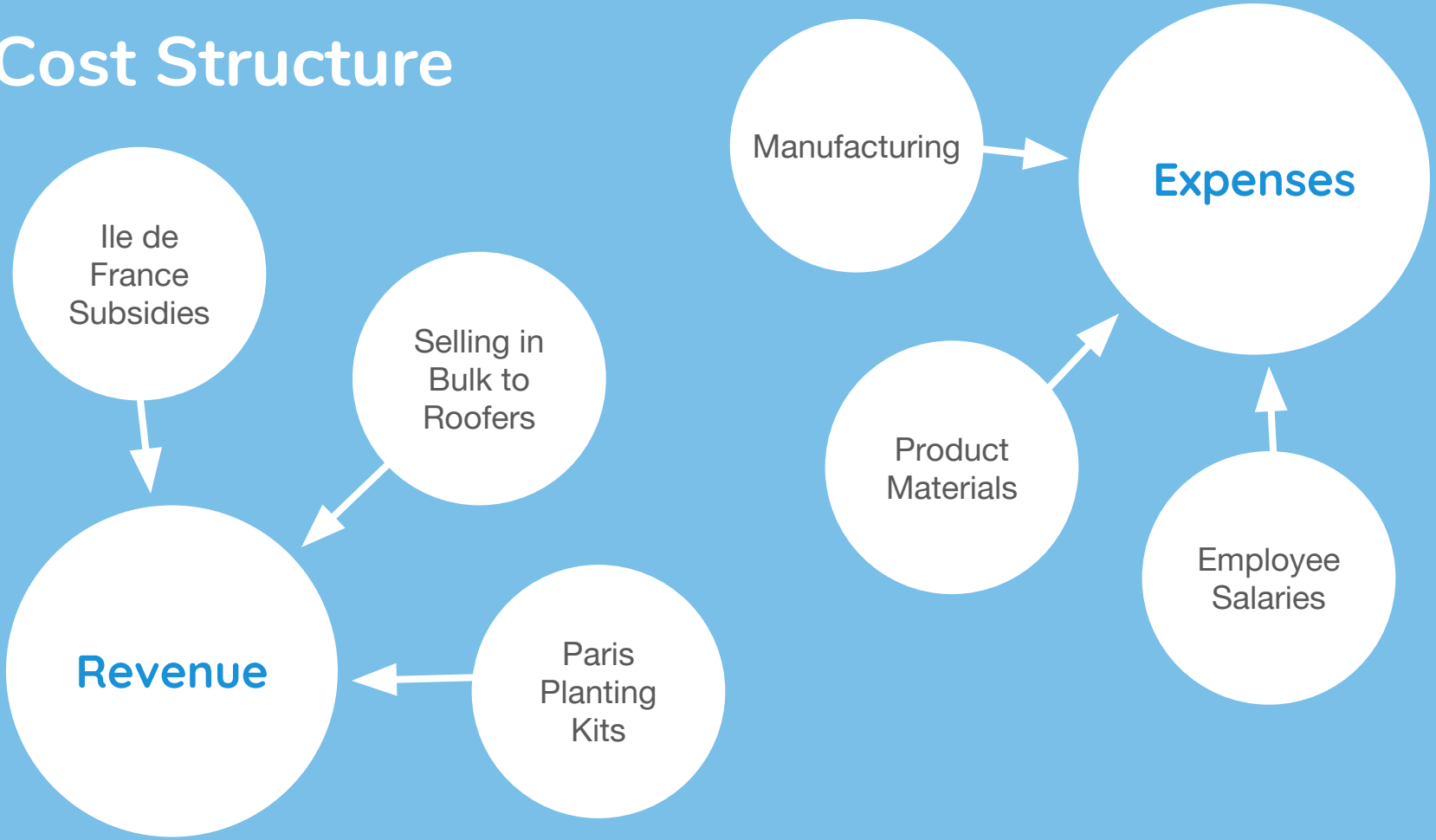
At right are our rough cost estimates for the production of each Chemiring. If we can spread this product across the city, we hope that costs will decrease with the large quantity we will be manufacturing. We will also hopefully receive funding from the region, which will make the Chemiring even more affordable for Parisian citizens.

1 UNIT (30 L) 15 x 30 x 50 cm	**30 €**
SOIL AND SEEDS (provided by city)	**0 €**
INSTALLATION	**18 €**
TOTAL	**48 €**

Our product can be standardized and mass-producible. Similar, high quality planters are generally available around 30 euros.

Our product is easy to install. In France, ten minutes of work costs an average of 6 euros, and we expect the installation to take around 30 minutes.

Cost Structure



Who Benefits?

Roofers

- More work
- Expanse in range of products
- Become major actors in the green economy

Citizens

- A more attractive and valuable property
- Improved health
- Closer to nature

Mairie de Paris

- Increase in bioconnectedness
- Help reach the city's green objectives

Assessment Plan

Economic Sustainability

Financial

Measurement

- Maintain a high margin on each sale
- Majority of revenue directed to roofing companies

Objectives

Have a sufficient enough net revenue to continue spreading and improving the planter

Scale

Objectives

Have units installed on the majority of viable chimneys, then expand to new markets

Measurement

- Number of arrondissements
- Total chimneys covered

Environmental Impact

Biodiversity

Measurement

- Increase in wildlife population, especially monitoring flying animals
- Diversification of wildlife species, including those that cannot currently nest in the city

Tools

The city's biologists can use malaise traps and similar tools to measure bird and insect biomasses and diversity

Quality of Life

Tools

The City of Paris has already installed a large network of measurement air stations via Airparif

Measurement

- Decrease in health complications due to air pollution
- Decrease in city temperature during summer months

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*Many pictures throughout the presentation and the film were taken by team members