

FlexGate

This pre-study addressed widened functionality in mobility houses and its purpose was to investigate the design and potential of the FlexGate concept and to create a basis for subsequent implementation projects.



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1 Summary

Urban development trends include reducing private vehicle parking and introducing mobility hubs offering shared services. To ensure financial viability and flexibility, collaboration among stakeholders is necessary to explore additional services and create sustainable business models in the development and maintenance stages of city development projects.

The FlexGate concept aims to transform mobility houses into multi-functional spaces that offer more than just mobility services, adapting to the evolving needs of neighborhoods during both the construction and the maintenance phases. The project's purpose was to collaboratively explore the design and potential of FlexGate, and how it can foster sustainable lifestyle and businesses. The project involved 21 partners engaged via workshops to achieve objectives such as stakeholder needs analysis, formulating a prioritized function list, estimating overall benefits, and providing a conceptual picture of how functions may interact with each other.

Over 20 functions in 9 different categories were identified with potential for integration in a FlexGate. This includes parking, personal mobility services, logistics service, storage, waste recycling & reuse, energy, maintenance & operation, dialogue & meeting places and retail and services.

Some of the main takeaways is that there is a large interest to further develop the concept, dig into the details regarding: business models, regulations, the design of the FlexGate space, the interaction with surrounding areas, including more stakeholders and users, and demonstrating real solutions.

2 Swedish Summary

Dagens stadutvecklingstrender inkluderar att minska privat fordonsparkering och införa mobilitetshubbar som erbjuder delade tjänster. För att säkerställa ekonomisk lönsamhet och flexibilitet krävs samarbete mellan intressenter för att utforska ytterligare tjänster och skapa hållbara affärsmodeller under utvecklings- och underhållsfaserna av stadsutvecklingsprojekt.

FlexGate-konceptet syftar till att omvandla mobilitetshus till multifunktionella utrymmen som erbjuder mer än bara mobilitetstjänster och anpassar sig till de växande behoven i områden under både bygg- och förvaltningsfaserna. Projektets syfte var att gemensamt utforska FlexGate:s design och potential för att främja hållbara livsstilar och verksamheter. Projektet involverade 21 partners och genomförde workshops för att uppnå mål såsom analys av intressenternas behov, formulering av en prioriterad funktionslista, uppskattning av övergripande fördelar och skapande av en konceptuell bild om hur funktioner kan interagera med varandra.

Över 20 funktioner inom 9 olika kategorier identifierades som potentiella att inkludera i en FlexGate. Detta inkluderar parkering, personliga mobilitetstjänster, logistikservice, förvaring, avfallshantering och återanvändning, energi, underhåll och drift, dialog- och mötesplatser samt detaljhandel och tjänster.

Några av de viktigaste lärdomarna är att det finns ett stort intresse för att vidareutveckla konceptet, undersöka detaljerna kring affärsmodeller, regleringar, utformningen av FlexGate-utrymmet, interaktionen med omgivande områden, inkludera fler intressenter och användare samt demonstrera verkliga lösningar.

3 Background

3.1 Challenges and needs

A prevailing trend in the field of urban development is the reduction of parking facilities for privately owned vehicles to promote the necessary transition towards more sustainable modes of transportation, namely walking, cycling, and public transportation. Simultaneously, there is a demand for the development of existing surface parking lots in densification projects, which inevitably leads to a decrease in the number of traditional parking spaces. In such cases, private parking areas are frequently replaced by what are known as mobility hubs, primarily offering shared mobility services to residents, occasionally supplemented with storage lockers for package retrieval.

As a consequence, parking garages nearby property areas are being transformed into mobility houses that beside car parking also offer space for shared mobility, bicycle parking, bicycle workshop etc. However, achieving financial viability in these arrangements often poses a challenge, and the resulting solutions may also lack flexibility.

Additionally, there is a potential need to offer other services than mobility services nearby property areas such as storage, energy solutions, postal services, social spaces, café etc. Some of these needs may already arise during the construction and development phase of the areas including charging electric construction machines, reuse and recycling of building materials, showroom to potential buyers and so on.

Viable business models could be reached by moving beyond mobility houses and exploring potential additional services that could be offered, both before and after the area is inhabited. A key challenge is to gather different stakeholders involved in all stages of area development and maintenance, engaging them in collaborating to explore new business opportunities together offering shared services needed by customers and that would make the area more sustainable.

3.2 Contribution to Drive Sweden's vision

The project aligns with Drive Sweden's vision, of "Sweden taking a leading role in using digital technology to create a more sustainable transportation system.", by exploring which and how shared services including mobility services could be developed nearby property areas. Successful deployment would increase access to more sustainable modes of mobility to residents and employees living and working in the proximity. Shared services would require smarter and more connected solutions. In addition, FlexGate could be an enabler to demonstrate and implement autonomous solutions, e.g., robot deliveries and shuttles, in neighbourhoods.

4 Project setup

4.1 The FlexGate concept

The project builds on a hypothesis that mobility houses can be transformed to offer more than just mobility services, extending their usefulness over a prolonged duration, and involve a wider range of stakeholders. During the development of new neighborhoods certain needs apply and these needs changes when residents start to move in. Within the project this was considered as two phases: *construction phase* and *maintenance phase*. However, it is important to note that it is usually an overlap for some years between these two phases until the whole neighborhood is completed. In summary, the FlexGate concept can be described as follows:

- A dedicated space (open site or building) closely located to the housing/business that it serves.
- Flexible surfaces and functions/services that are altered, added, or removed depending on needs, as illustrated in **Fel! Hittar inte referenskälla..**
- Offering more than mobility services, simplifying people's everyday lives and businesses; being a meeting place that strengthens the area and stimulates more sustainable travel and transport.

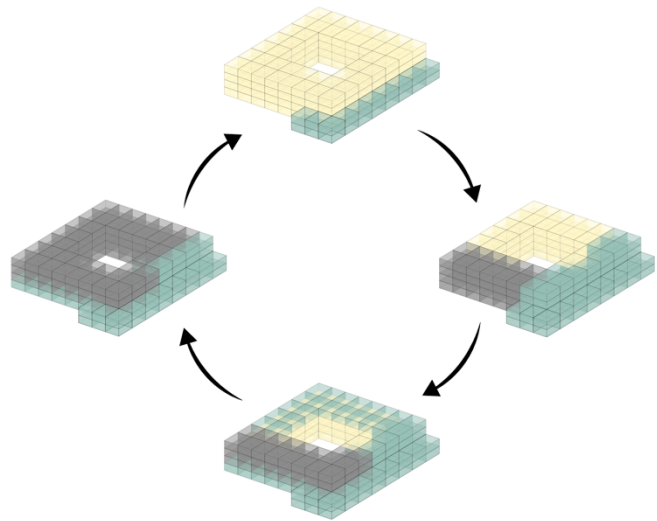


Figure 1. Illustration of changing functionalities in a FlexGate

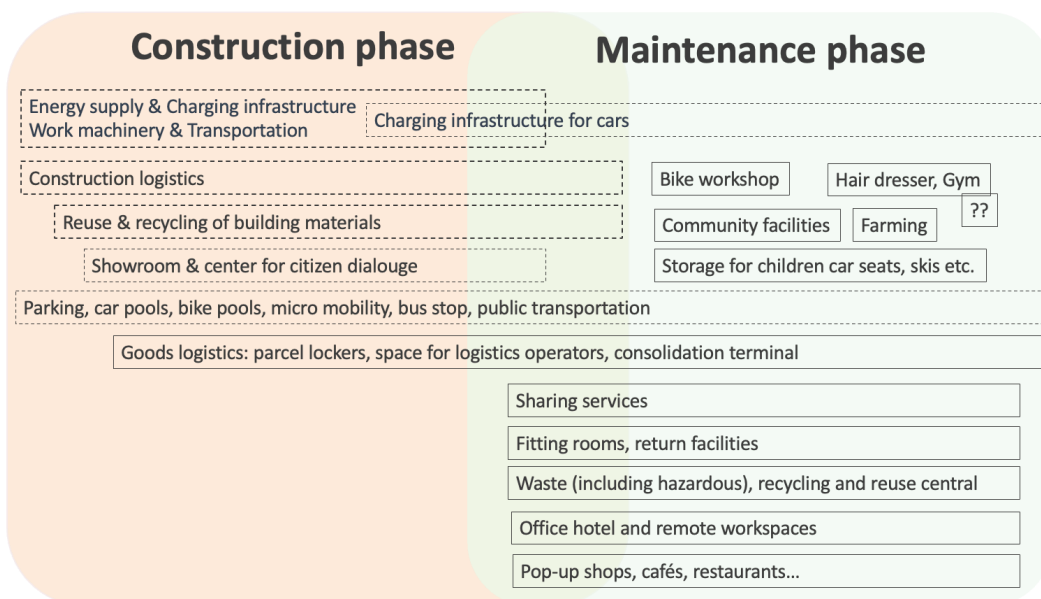


Figure 2. Possible FlexGate functionalities during construction phase and maintenance phase

Variations of a FlexGate can also be applied. It does not necessarily have to be deployed during new construction. It can be built in already developed areas or temporarily being set up during a renovation phase. **Fel! Hittar inte referenskälla.** above, illustrate some of the potential functions in a FlexGate over time. The functionalities stated are based on previous literature and initial discussions with several stakeholders.

4.2 Purpose

The purpose of this project was to collaboratively investigate the design and potential of the FlexGate concept with relevant stakeholders, creating a basis for demonstrating and utilizing the concept in real environments.

FlexGate is important because it investigates how new shared services nearby properties could be developed and deployed in an efficient way. By increasing access within neighborhoods to sustainable options to travel, to meet and to share, FlexGate could have a positive impact on changing people's behavior to make better choices for them and for the planet.

4.3 Objectives

The objectives of the project were to:

- O1: carry out a stakeholder needs analysis for the FlexGate concept
- O2: formulate a prioritized function list and define the concept
- O3: show a preliminary estimate of the overall benefits of the concept
- O4: form a conceptual picture of the interaction of prioritized functions
- O5: give suggestions on what a continuation project might include

4.4 Project period

The project lasted from 15th of November 2022 to 30th of June 2023.

4.5 Partners

The project included 21 partners:

Johanneberg Science Park, Lindholmen Science Park, MölnDala Fastighet AB, Mölndal Parkering AB, PEAB, Landvetter Södra Utveckling, Framtiden Byggutveckling, HSB Göteborg, Chalmers, GU, Riksbyggen, Mölndal Energi, Renova Miljö, Hub Park, Svensk Bygglogistik AB, UnitParking, Hugo Delivery, Keolis Sverige, Göteborgs stad, Volvo Personvagnar and Protek Development.

5 Method and activities

The main input from partners in the project came through five physical workshops that the project coordinators, Johanneberg Science Park and Lindholmen Science Park, arranged throughout the project duration. Each workshop was based on a different theme that brought the project forward:

1. Stakeholder and needs identification
2. Impacts of functions
3. Scenario analysis
4. Business analysis
5. Generalization

All partners were invited to the workshops and were expected to give input to each topic. Partners that could not take part were able to contribute by giving input on a later stage. Each workshop was summarized by the coordinator and the output was shared with all project participants. The workshops were held approximately one month apart. The preparation of the workshops and the analysis of the result were mainly done by the project coordinators.

The first four workshops were mainly based on a specific use case, an ongoing urban development project “Forsåker” in Mölndal. The district is centrally located in Mölndal and will, when fully developed, be home to 10,000 residents and employees. Forsåker is planning to build mobility houses to serve the future residents with mobility services. In this project, the developers are interested in exploring what other services could be offered and potentially expand a mobility house to a FlexGate. Several of the stakeholders that were part of the project are also engaged in Forsåker.

The last workshop was based on a different use case. Framtiden Byggutveckling, a public company in Gothenburg that builds rental apartments, wanted to explore how a FlexGate could be used in existing socio-economic weaker areas.

The workshops provided output to this report including output to the illustration of the FlexGate concept that was conducted by the project partner Tyréns, an architecture firm.

5.1 Stakeholder and needs identification

In the first workshop stakeholders were identified and their different needs were discussed and organized over different phases. The stakeholders were also prioritized in terms of their importance in the design process and development of

FlexGate buildings. From this, a list of functions divided into 9 different categories (see figure 6.) was constructed.

5.2 Impacts of functions

The second workshop focused on assessing the potential impacts of the different functions that were identified in the first workshop. The assessment was based on

Social impact
Safety
Social community and interaction
Accessibility
Good working environment
Physical health
Mental health/wellbeing
Economic impact
Areas
Resource utilization
Energy utilization
Cost/direct revenue
Property value
Environmental impact
Direct or indirect emissions to air
Direct or indirect emissions to soil and water
Biodiversity and other environmental effects
Technical requirements and safety
Fire
Traffic safety
Theft
Plumbing

impact factors, given by the project coordinators, based on four different categories, as seen in table 1. The participants were asked to rate each function from 1 to 5, 1 = negative impact, 3 = neutral and 5 = positive impact.

Participants were divided into different groups and were able to rate each function.

The assessment took into consideration the actual impact of the function itself, and also the impact of having the function in a FlexGate building. For instance, the functions in the category “Dialogues and meeting areas” were given high points regarding the social, economic, and environmental factors but low point in technical requirements and safety, due to an increased risk to fire

hazards. The output from the workshop gave an indication of which functions that were more favorable in different aspects.

5.3 Scenario analysis

In the third workshop the functions were further processed in a scenario analysis.

Participants were divided into three groups. Each group represented a scenario effecting the design of a FlexGate. The group had to select those functions that they believed suited that specific scenario. The

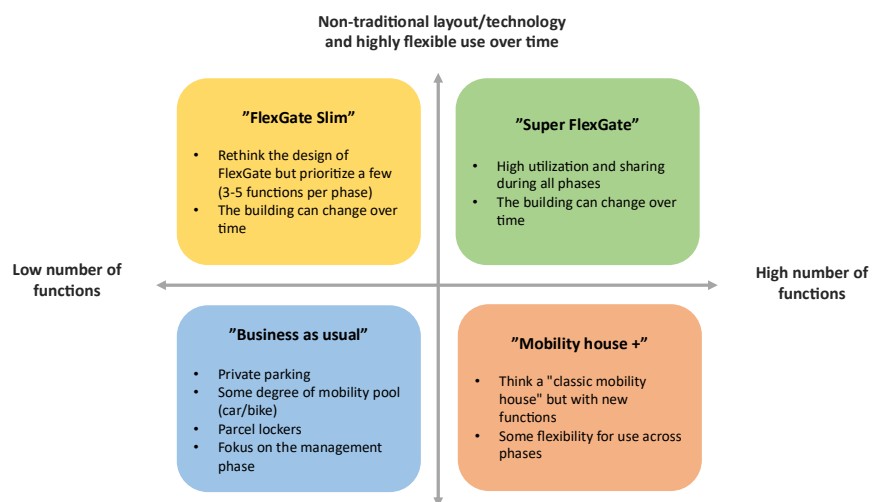


Figure 3. Different scenarios for a FlexGate

scenarios, see figure 3, were developed by the project coordinators and were based on two factors:

1. Number of functions, from low to high
2. The layout and flexibility of the building, from traditional design to non-traditional design.

The scenario “Business as usual” was not analyzed by any group. Instead, it was supposed to be an example of today’s mobility houses. The contrasting scenario “Super FlexGate” challenged the participants to completely rethink how the space could be utilized and what functions that could be offered. The other two scenarios, “FlexGate Slim” and “Mobility house +”, were something in between.

Functions identified from workshop 1 were mainly used, although the group were allowed to include new functions. The groups were encouraged to include functions that had a high score in workshop 2.

Each group had to first write down the functions they wanted to include, at what stage the functions were used and the main stakeholders for each function. Secondly, each group had to illustrate on a paper how the design of the space i.e., the shape of the building, number of stores, how the shape of the building could change over time etc.

The workshop gave a good insight in what functions all scenarios had in common and also first ideas of how a FlexGate building could be shaped. The building design ideas were presented to the architecture partner Tyréns, that made the FlexGate illustrations for this report.

5.4 Business analysis

Workshop 4 was dedicated to business analysis based on the functions that were prioritized after the impact and scenario analysis. A simplified business model canvas was used (see figure 4) that asked the participants to identify the potential customers for each function, the actors required to realize the function and how the payment flow could potentially look, including an assessment of the willingness to pay.

Name of function		Prio/"good to have"
<input type="text"/>		<input type="text"/>
Customer segments – who are the customers and what does their willingness to pay look like?	Actors – who are the main driving actors and which other actors need to be included?	The payment flow – what are the main expenses and what payment models from the customer are possible?
Synergy effects with other functions/other comments		
<input type="text"/>		

Figure 4. Business model canvas to be filled in for each function.

The functions chosen for analysis was those with the highest scores in the impact workshop plus those who were mentioned most frequently in the scenario analysis workshop. Some additional “good to have” functions were also analyzed.

The participants were divided into different groups, all groups going through in total 18 different functions. After the workshop, the output from the workshop was analyzed by the project coordinators and additional complementation was filled in by relevant stakeholders. The workshop gave insights into how functions could be developed into actual services.

5.5 Generalization

As mentioned previously, the fifth workshop focused on a different use case. It was based on a densification project, mainly a residential area, in Biskopsgården, which is a socio-economic weaker suburb of the city of Gothenburg. Framtiden Byggutveckling has extensive plans in developing the area and has interests to explore how a FlexGate concept could be integrated. Some of the prerequisites for this development project are:

- Build housing on existing ground parking and replace with mobility houses.
- Security and social aspects are important as well as financial viability.
- The residents generally have good interest in the sharing economy and recycling.

The workshop participants were divided into two groups with a representative from Framtiden in each group. Starting from the results from previous workshops, group 1 focused on analyzing functions and services that can create security and vibrant local communities, while group 2 focused on analyzing functions and services that could be economically viable in these areas.

5.6 Other input

Beside the project workshops, input was gathered via discussions and bilateral meetings with relevant stakeholders. Several project partners also participated in a study trip to Helsingborg and Malmö in the beginning of June 2023, visiting different multifunctional buildings and innovative mobility house solutions. There were discussions with the local facility developers and owners to exchange ideas about the future of mobility houses and their design. Findings and photos from the study trip have been included in this report.

6 Results and deliverables

This chapter presents a summary of the findings derived from the workshops. This includes functions that are considered to have the greatest potential or generate the most benefits for a FlexGate, the obstacles and difficulties associated with a flexible construction, and the regulatory issues and challenges that need to be considered. Additional perspectives that need to be considered when implementing FlexGate concepts in existing areas, with a specific focus on socio-economically disadvantaged areas, is also presented.

6.1 Potential functions in a FlexGate

Through the work process described above, a wide range of functions have been condensed into 9 main groups, which are presented in figure 6, followed by a more detailed description. Within each group the functions that have been considered as most prioritized and viable in a FlexGate are illustrated in the figure as well. Some of the functions were considered to be needed during both phases whereas some functions will change over time when the need changes.

Figure 5, illustrates an example of a FlexGate and where different services in the maintenance phase could be located in the building.

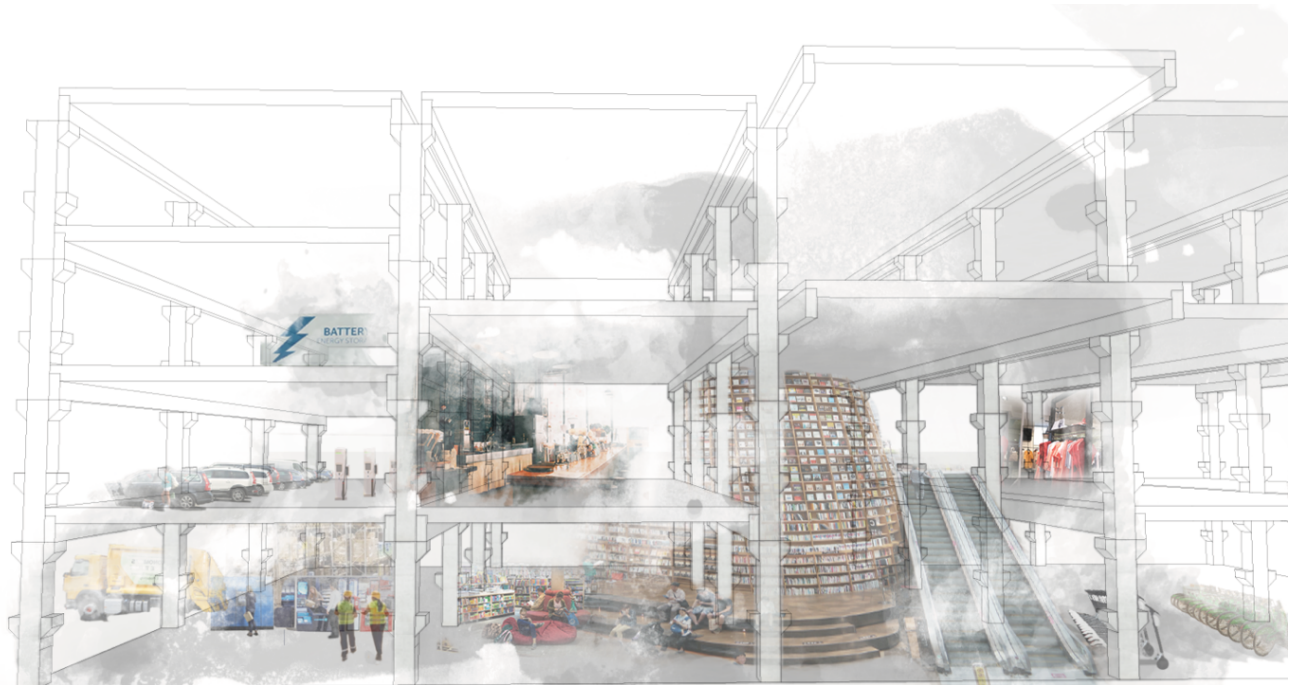


Figure 5. Illustration of a FlexGate to exemplify where different services could be located

Stakeholders that are considered as most important for a FlexGate are first and foremost the users. Both during construction phase such as construction companies

and their employees, and in maintenance phase the residents, but also real estate owners which could rent or subsidize certain functions in a FlexGate, to avoid having to provide a certain function themselves in all of their properties. Further, there are needs of different actors responsible for the construction and operation of the FlexGate. The set-up of this can vary and needs to be further investigated but in general terms it needs to be an owning party and a party in charge of the main operation of the FlexGate. This party could then procure different services and/or rent out space.

Construction phase	Maintenance phase
1. Parking	
Ground parking	Parking shared and privately owned cars
Bicycles and other vehicles	
2. Personal mobility services	
Carpools, bicycle and micro-mobility pools, public transportation	
	Autonomous shuttles
	Mobility ambassadors
3. Logistics services for goods deliveries	
Checkpoint for construction deliveries and short-term storage, consolidation? (outdoors)	
Parcel handling, e.g., parcel lockers	
	Local distribution of goods (in combination with consolidation of waste/recycling materials)
4. Storage	
Storage building materials and tools	
	Storage for residents and property managers
5. Waste, recycling and reuse	
Central for reuse of building materials (not waste/recycling)	
Waste compactors	
	Consolidation area for waste and recycling materials
	Space for pop-up reuse days
6. Energy	
Charging infrastructure for work machines (trucks?)	
Charging infrastructure for cars and other vehicles	
	Local energy production and energy storage
7. Maintenance and operation	
Cleaning/washing facility for trucks	Workshop for bikes (service or self service)
8. Dialogue and meeting places	
Project office for property developers	Remote office space for residents
Showroom and dialogue center	Common areas for residents & associations
9. Retail and service	
Hardware store and rental service	
	Rental & sharing services within mobility
	Other rental/sharing services (tools, equipment etc.), Café, ATM etc.

Figure 6. Potential functions in a FlexGate over time

6.1.1 Parking

There is a need for parking already during the construction phase, e.g., for commuting construction workers, and a space within the FlexGate could be utilized for this purpose. However, it is crucial to regulate and review the pricing of parking already at this stage. This to encourage more sustainable travel for construction workers and prevent residents from surrounding areas from parking for free.

The developer of the FlexGate can provide the space for parking and a parking company can handle parking permits and payment solutions. For charging, an energy company also needs to be involved to set up temporary charging stations that can be integrated with a payment system. The payment systems and other infrastructure, such as charging facilities, can thus be implemented during the construction phase and subsequently refined during the maintenance phase.

During the maintenance phase, a FlexGate should accommodate parking for various types of vehicles and mobility services, including private cars, car-sharing vehicles, bicycle parking, and other micro-mobility options. Within the FlexGate, priority should be given to more sustainable alternatives, such as shared mobility services. One way of doing so is by allocating shared parking spaces in the most desirable locations e.g., ground level, while private car parking could for instance be situated on higher levels. Figure 7., shows an example of a bicycle room with a bicycle pool and bicycle kitchen within the same space. Purchasing bicycle parking in the FlexGate could potentially be an option for nearby residential and commercial properties to save space within their own buildings.

One challenge in determining the number of parking spaces and its design is the uncertainty around future needs. This uncertainty stems not only from the growing demand for shared mobility but also from technological advancements such as self-driving vehicles. Before fully autonomous vehicles become prevalent, there will likely



be self-parking vehicles, which will introduce new requirements for the design and layout of mobility houses. Additionally, emerging parking solutions, like automated parking systems, offer increased space efficiency but necessitate different design considerations compared to traditional parking structures.

Figure 7. Hyllie mobility house. A bicycle room, bicycle pool (in a locked cage) and bicycle kitchen in the same space.

6.1.2 Personal mobility services

Within this group several different functions have been highlighted as possible within or in connection to a FlexGate. These include car, bike and other micro-mobility sharing services, and public transportation. As mentioned in the section above, there is already a need for mobility services during the construction phase, such as for commuting construction workers, which means that the establishment of mobility services should be considered early on.

The economic viability of various sharing services is still uncertain, and there are many different service models to adopt. A deeper analysis is needed to understand the primary needs of the target groups, such as residents, visitors, and other stakeholders in the area. Different service providers can be contracted to utilize the spaces within the FlexGate for their services. Property owners could be willing to subsidize those solutions that have the potential to minimizing the creation of new parking spaces. In new housing developments the mobility services for residents, as well as private car parking, are often part of a mobility measure package and has a viable financing model. This opens up the possibility to use these solutions also for nearby neighborhoods and thereby promote their transition to more sustainable travel.

Further, closeness to public transportation was considered important to enable seamless travel and increase the overall utilization of the FlexGate. To enhance accessibility, self-driving shuttles within the area can operate from the FlexGate, offering transportation services for the first/last mile between homes and the FlexGate, or to major public transportation hubs.

In addition to micro-mobility services in the FlexGate, there should also be smaller hubs scattered throughout the area to increase accessibility. Another possibility connected to FlexGate is introducing mobility ambassadors: locals informing about different options and stimulating residents using them.

6.1.3 Logistics services for goods deliveries

The logistic services during the construction phase that have potential in a FlexGate include a checkpoint for construction deliveries. A checkpoint is an area where trucks arrive and wait for the right delivery time. Unloading can also take place in this area if there is sufficient space.

During the maintenance phase, there is a need for general management of incoming and outgoing packages in the area, not only for individuals but also for businesses and other establishments in the neighborhood. The specific type of service required needs further investigation. A parcel locker solution could be sufficient and could potentially be utilized for package deliveries even during the construction phase.

Food deliveries could also be directed to lockers if the lockers are equipped accordingly. An example of this is shown in figure 8. An interesting trend is widened functionality of parcel lockers to also support C2C deliveries and the sharing economy. This might also be reinforced by the introduction of internal goods distribution as discussed below. Furthermore, the parcel locker solution should be carrier-neutral to avoid the need for multiple lockers to be installed.



Consolidation and distribution of goods for the neighborhood could also be a function within the FlexGate. There are existing examples of successful solutions for this, such as "Lindholmsleveransen" in Gothenburg, "Älskade stad" in Stockholm, and "Urban Services" in Arenastaden, Stockholm. A common feature of these solutions is that certain waste is collected on the return trip after the deliveries are made. Autonomous delivery robots could be utilized for fast deliveries, such as medications from pharmacies.

Figure 8. Refrigerated parcel locker for food deliveries in a mobility house in Hyllie.

6.1.4 Storage

Storage for tools and/or construction materials could be a function in a FlexGate during the construction phase. This could potentially be combined with a tool rental service, described in section 6.1.9.

During the operational phase, storage solutions are considered to be of significant benefit to residents, as many tenants have a greater need for storage than what is typically offered in newly built apartments. The business model for this needs to be further investigated, but one possibility is for an established company that rents out storage spaces to establish its operations in the FlexGate. Spaces and other storage solution infrastructures could thus be introduced in the construction phase and then be refined in the maintenance phase.

An important aspect in relation to storage is safety and security. The design of the storage services must be burglar-proof, and it must feel secure to be present on the premises.

6.1.5 Waste, recycling, and reuse

Storage needs and waste management exist both during the construction phase and the maintenance phase. The question is whether and/or what should be included in a FlexGate. During the construction phase, centralized reuse is considered to have

potential, but it's probably more beneficial to have waste/recycling on each individual construction site.

New regulations related to the collection of packaging materials will be introduced in 2027, which means that all property owners must provide collection of waste near their properties. Therefore, a general waste collection point in the FlexGate will most likely not be necessary or viable. However, FlexGate could possibly function as a consolidation point. As previously mentioned, this could potentially be synchronized with the logistics services provided in FlexGate.

Having a compaction facility in FlexGate was also mentioned as a function - which would be suitable if the FlexGate functions as a consolidation hub for waste. Compactors could also be rented out to waste management companies even during the construction period.

A reuse center in FlexGate during the maintenance phase is considered to have potential but in general, for reuse solutions, an organization is needed to handle and sort the incoming goods. This to ensure that the product can be reused and that it is not just trash. Therefore, it would potentially be better to arrange pop-up exchange days, for example, in combination with the start of school terms or seasonal changes.

6.1.6 Energy



Figure 9. Mobility house with (elevated) solar panels on the roof.

Already in the construction phase there is a demand for charging infrastructure for both work machines and regular cars. It is assumed to be a relatively high willingness to pay among the contractors due to the convenience of not having to construct their own charging infrastructure or travel long distances for charging purposes.

Further, local electricity production could be well-suited in a FlexGate. An example of this is a mobility house in Sege Park (figure 9.) where solar panels are installed on the roof, and underneath there are parking spaces for cars.

If there is local energy production in FlexGate, it would also be advantageous to have local energy storage. Figure 10 shows batteries that are installed in the mobility house Solkvarteret in Hyllie, operated by Hub Park. There they also plan to offer battery storage for surrounding properties which also could be an option for general FlexGate concepts. Through energy storage, energy companies and property owners can even out peak loads and act on balancing markets. It is also possible to control the charging power of different vehicles over time. For example, slower charging during the peak hours for privately-owned cars, but higher power for carpool cars.



Figure 10. Local energy storage in mobility house Solkvarteret, Hyllie

6.1.7 Maintenance and operation

The main two functions that have been discussed are self-service and service workshop, and vehicle and equipment washing. There could be a demand for vehicle and equipment washing facilities, particularly for trucks during the construction phase. Such facilities are already prevalent in several large-scale construction sites. However, with a washing facility comes several technical requirements such as oil separation. Setting up an outdoor washing area in proximity to FlexGate is probably beneficial, as indoor washing tends to cause significant wear and tear on the property. This type of function presents an opportunity to offer entry-level employment opportunities, such as through partnerships with organizations like Samhall. Employment agencies and the local municipality may also express interest in collaborating on these initiatives.

For the maintenance phase the focus has been primarily on providing bicycle services and bike washing for residents. Here it is important to note that there is a relatively low willingness among residents to pay for these services, especially bike washing. It might be possible for other property owners to consider subsidizing these services. This way, they can avoid the need to provide their own facilities/spaces for this. When it comes to providing a staffed service, there are various models to consider. For instance, one option is to establish a permanent workshop, while another option is to have a pop-up bike kitchen that visits periodically.

6.1.8 Dialogue and meeting places

Site sheds for nearby construction sites could potentially be replaced by utilizing spaces within FlexGate. An example of this can be seen in Sege Park, where a local



Figure 11. Previous project office for the contractor, Sege Park.

space was used as a project office for the contractor during the construction period, figure 11.

Furthermore, spaces for showrooms and a dialogue center were considered a high priority during the construction phase, which can be used to promote various mobility offerings and the possibilities for a sustainable lifestyle for residents in the neighborhood. This function can be adjusted during the maintenance phase, as the needs decrease, and be rebuilt to common areas for residents. Property owners have the option to purchase shares in these common areas instead of providing them in their own properties, and associations or individuals can rent these facilities.

A specific emphasis here is placed on the social values held by these types of functions: they can become a gathering point and have the potential to enhance the status and security aspect of the FlexGate.

6.1.9 Retail and service

Rental services and a basic hardware store during the construction phase could be a function in FlexGate. There are examples of facilities like this near construction sites in other places. One example is Peab, through Lambertsson, that has operated a rental facility in Partille, Gothenburg, that has been widely used by both construction staff and nearby residents.

The highest priority for sharing services in FlexGate are those connected with mobility solutions. Other sharing services, such as renting tools, equipment, and other gear, are considered advantageous to have but not crucial. For a rental service, there are various business models to consider. One option is to have a local sharing service entrepreneur, while another is to have an unmanned setup, possibly on a C2C basis. For instance, there are different locker solutions available for rental purposes.

Additionally, other services such as a café, ATM, or a small convenience store, can be located in a FlexGate but the need of such services are dependent on whether there are other options nearby or not.

6.2 FlexGate in existing areas, focus on socio-economic weaker areas

The last workshop focused on exploring the potential and what is important to consider if a FlexGate were to be built in an already developed area, here with a specific focus on socio-economically weaker neighborhoods.

A key question is whether FlexGate can increase security in the area where the design plays an important role in this. Some security measures will be needed to guard the facility and some staffing would probably be required. The way to and from FlexGate must be perceived as safe throughout the day, at least from morning to evening. It needs to be a living place where people stay, being a natural meeting point for residents, employees and others who want to be there. This can be supported by having many different activities and services available on the site, e.g., associations, shops, taxi ranks, etc.

Economic viability is crucial, and functions need to be built up by three parts that are working together:

- Increase the economic value of the entire area. A more attractive area (cleaner, safer, etc.) means that more people want to live there and thus the land value increases,
- Sufficient willingness to pay from residents/customers,
- Functions which directly or indirectly can lead to increased employment and turnover for residents and businesses in the area.

Furthermore, it is important to achieve good cooperation with residents, associations, and businesses in the area. Existing actors should not feel increased competition but rather experience that FlexGate is an opportunity to reach out in a better way. Associations must be able to use the premises, businesses could have the opportunity to offer courses and so on.

Features/services that are particularly suitable and/or need adaptation in these use-cases are:

- Parking: Safety & Security, Price
- Mobility services: Mobility ambassadors, carpool characteristics, self-driving shuttles, geofenced micro-mobility
- Parcel deliveries: Consolidation, parcel lockers
- Storage: Great potential but requires security measures, temporary storage,
- Waste, reuse, recycling: Staffing, exchange days, active management
- Dialogue and meeting places: Sports facility (e.g., public–private partnership) premises for information, education, and co-creation

- Retail and service: Coexistence and complementary, to increase value and reach more users/customers

6.3 Regulations to consider

When developing a FlexGate certain policies and regulations must be considered. Below are some central examples but a firmer analysis is needed.

Distance to storage:

- Storage spaces should be located within 25 meters walking distance from the entrance of the residential property (size 1 sqm per resident, 1-3 sqm in practice)
- There must be lockable space for storing seasonal equipment e.g., in the residential apartment or in its vicinity.
- Near the residential apartments, there must also be room for storing prams, bicycles, outdoor wheelchairs, walkers and the like, as well as space for mailboxes.

Distance to waste and recycling:

- The distance between the entrance of the residential property and spaces or devices for waste should not exceed 50 meters.
- Residence-near collection of packaging recycling material will be introduced in Sweden by 2027.

Ceiling heights:

- Public premises at least 2.7 m, Residence at least 2.4 m, Temporary stay at least 2.1 m. (Additional installations in ceilings must be added)

6.4 General challenges with flexibility

There are several good reasons for making mobility houses flexible but there are also some challenges to consider:

- Change the use of spaces/premises:
 - Building permit/Local plan
 - Dimensioning of ventilation etc.
- Change the building:
 - Bring all installations with heating, water, ventilation, etc.
 - Thermal bridges, sound insulation, vibrations, fire cells, evacuation
 - Car ramps
 - Building permit, even if only additional premises are furnished
- Co-locate different functions and operations:
 - Generally, this works fine but there could be issues with organizing fire protection cells, and some operations can lead to higher risk for crime

- Distance between residences and FlexGate:
 - Promote FlexGate as a part of everyday life, intra-area mobility solutions
- Building flexibility might drive costs and environmental impact:
 - The benefits need to be greater than the costs and environmental impact. Further evaluations regarding this issue are necessary

6.5 Connection to the vision of Drive Sweden

This project was a pre-study aimed to both inspire others while developing, hopefully in the next steps, actual implementations.

FlexGate is a step forward towards several of Drive Sweden's vision and goals, mainly *“access to sustainable mobility is improved for both people and goods”*. Developing mobility solutions nearby properties and in neighborhoods are crucial to increase access since the term itself partially refer that solutions must be reachable within reasonable time and space.

A FlexGate could also be a great place to increase awareness, and hence also access, to alternative mobility solutions.

Another aspect of access is that solutions are affordable. In the long-term, affordability of mobility solutions could be increased by reaching a critical mass of users. Developing shared mobility solutions nearby residential areas have a big potential to increase access to mobility while lowering the carbon footprint.

Additionally, access to mobility solutions does not only mean access to vehicles but also access to other related services such as storage, parking, maintenance, and even access to a community. One of the main purposes of a FlexGate is to support a transition to cultures where people and businesses are willing to share with each other.

Finally, FlexGate services must apply digital technologies to be able to develop scalable solutions. Shared services can be complex and requires smart tools for booking, payment, advertising etc.

7 Conclusion, lessons and next steps

There are several takeaways from the project:

1. There is a clear demand and need from the stakeholders for additional services compared to those offered in today's mobility houses. This also include a demand for utilizing the space as early as during the planning and construction phase. This does not mean that this demand for additional services should be offered without a thorough analysis of the necessary prerequisites and finding viable business models. Some of the functions/services put forward have been tested before and have a viable business model while others need to be further elaborated on.
2. Flexibility of usage of the space and over time, although possessing regulatory and designing challenges, is crucial to the concept. This is both to optimize the economic value of the land/space and to being able to rapidly adapt to future demands and needs.
3. A main challenge remains and that is how the harmonization of functions and services should be coordinated. Multiple stakeholders are involved over different stages and with different areas of competencies, that are not used to collaborate together. Perhaps new actors are needed to fill in this gap, such as organizations that offers complete mobility (and beyond) solutions. What is clear is that property developers and procurers must have a key role in this coordination.
4. Nonetheless the challenge is also to coordinate the different units within each organization. A property developer usually has different units involved in the construction phase compared to the maintenance phase etc. For instance, current acceleration of the usage of electric vehicles and machines requires additional power usage from the energy grid both during the construction and maintenance phase. More effort is needed to harmonize these two different stages.
5. Connected to both point 3 and 4, one key takeaway is that all partners involved in the project were positive and very eager to collaborate and together come up with different solutions compared to what is offered today. This is not only because it is exciting work but mainly because new approaches and solutions are needed to achieve the ambitious visions and goals reaching sustainability.
6. The FlexGate concept is still in an explorative phase. Initially, it was mainly thought of as a concept when developing new properties and neighborhoods. This was challenged during the project, questioning whether the concept could be applicable in developed areas but also as a temporary solution when major developments are needed for an already existing area. In this example, a

FlexGate could be an upgrading of an existing parking house or even a fully built modular house that could be assembled and disassembled quickly.

7. There is a further acknowledgement that the services developed must be user driven and/or friendly, mainly in the sense that they need to be adapted to local needs and circumstances. For instance, as stated in one workshop, a shared mobility service, like car rental, could be designed differently depending on who are the main users. Owning a private car is in some areas a clear marker for status and simply removing the striping of a rental car could make or break the success of the service. Other aspects such as interaction with humans (employing staff), considerations to increase the perceived security in FlexGate to be used day until night, designing beautiful spaces that people want to be in etc., needs to be taken seriously.
8. Finally, connected to the previous point, FlexGate was mainly assessed how it can coexist with nearby neighborhoods. This assessment must be extended and include a broader area to understand how the services offered in FlexGate can complement rather than outcompete services in the vicinity.

Some of the lessons learned taken from conducting the project are:

1. A wide range of actors, who normally do not meet and work on these issues, are needed as project partners. The project managed to engage 20+ partners and if it was possible, we would have wanted to engage even more stakeholders such as contractors, service providers, the user organizations and municipal services. It was still difficult to connect construction phase with maintenance phase, although FlexGate was a step in the right direction.
2. It was difficult to balance the visionary aspects of FlexGate with the more practical/operational aspects. Both sides need to be explored and this project did prioritize the visionary aspect a bit more.
3. Conducting workshops was a good method to let the partners get to know one another, to promote interaction and active thinking. On the other hand, it was hard to dig into details during those sessions. This is something that could be complemented by bilateral meetings.
4. The project coordinators had intense discussions between each workshop and were well prepared. It was still difficult to know whether the participants were balanced enough in each workshop and whether the criteria chosen made sense or not. This was especially true for the impact workshop, since it was difficult to make any assessment at all just based on describing a function. One challenging part was to distinguish between assessing the impact of the function/service itself from the impact of the function/service being located in a FlexGate.

Next steps

This pre-study investigated the design and potential of the FlexGate concept and created a basis for subsequent implementation projects where the concept can be demonstrated and used in real environments. Stakeholders involved in this pre-study are interested in taking things forward. There are many options to next steps and note that several of the points below could be combined into one project:

1. Deep dive: Continue the same approach as this pre-study, include a wider range of stakeholders, involving several property developers and deep dive into the details of the general concept. This will include understanding the main drivers, the main challenges in design and the main actors and what role they need to adopt for a successful implementation.
2. Feasibility study: Choose one or possibility two development projects and evaluate whether and how a FlexGate would be feasibly deployed. Quantitative evaluation of actual solutions, e.g., mobility houses planned, could be compared with parallel projection of FlexGate solutions.
3. Focus on one of the phases: Another option is to focus on one phase. The construction phase would in this case be interesting to focus at, mainly since solutions like mobility houses often only focuses on an already developed areas. A project can look at different construction projects, that are at different stages (planning/design/construction/redevelopment), interview stakeholders and dig deeper in what services could be developed.
4. FlexGate as temporary buildings: Another option is based on the output from workshop 5 and that is to analyze how a temporary FlexGate could be developed to support densification in existing areas, mainly in socio-economic weaker areas. Additionally, the project could dig deeper in how a FlexGate might interact with local town squares and other services in the neighborhood.
5. Design aspects of a FlexGate building and its environment: This project could focus more on the architectural, engineering, and regulatory challenges and how to solve them when developing a FlexGate. A key part of the FlexGate concept that would be interesting to analyze further is how physical spaces can be flexible and adaptable over time. Another aspect is how FlexGate might affect the planning and design of the surrounding area.
6. Real demonstrations: Sometimes, this can be the most effective way to understand whether a concept would work or not. In this approach, small real demonstrations would take place in one or several ongoing projects. The challenge is to find suitable projects. One solution would be to build on existing mobility houses and offer some services that was identified in this study.

7. Broader national perspective: Another aspect that could be included is to develop a network of property owners and cities all over Sweden interested in investigating the potential of the FlexGate concept.

8 Dissemination and publications

This pre-study involved 21 partners and additional stakeholders throughout the project duration. Two project webpages were maintained: one on Drive Sweden's platform and one on Johanneberg Science Park's website.

Project results was disseminated via a final conference that was held digitally and that was open for anyone to attend. The conference was recorded and uploaded to the project webpages. Advertising for the final conference was done through social media by using LinkedIn, by using partners network and by utilizing the large network of Drive Sweden.

This report was written in English to ensure that project result can be made available and shared with non-Swedish speakers. The report will be available on the project webpages. Additionally, the project will participate and present the project at Drive Sweden Forum held physically in Gothenburg on the 7th of September 2023.

Project webpage:

- Drive Sweden: <https://www.drivesweden.net/en/project/flexgate>
- Johanneberg Science Park: <https://www.johannebergsciencepark.com/projekt/flexgate>

Drive Sweden is one of the Swedish government's seventeen Strategic Innovation Programs (SIPs) - Drive Sweden consists of partners from academia, industry and society and together we address the challenges connected to the next generation mobility system for people and goods. The SIPs are funded by the Swedish Innovation Agency Vinnova, the Swedish Research Council Formas and the Swedish Energy Agency. Drive Sweden is hosted by Lindholmen Science Park AB.