



# **Sustainable Reykjavik Capital Region 3: residential location, mobility patterns, and well-being of young adults (SuReCaRe 3)**

*Sjálfbært höfuðborgarsvæði 3: búsetustaðsetning og ferðamátar  
ungs fólks*

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# Executive summary

## Project targets

The three objectives of the SuReCaRe 3 project are:

1. To characterize mobility styles and travel-related GHG emissions of Reykjavik residents at the aggregate spatial levels based on individual travel patterns and residential locations
2. To provide detailed knowledge about motivations and rationales behind daily travel behavior and its associated factors such as car ownership and residential location
3. To explore the daily travel patterns and urban form at the residential location on subjective well being

## Materials and methods

The quantitative results are based on an online softGIS survey which combines traditional questionnaires with Internet maps. The target population of the survey was Reykjavík Capital Region residents aged 25-40. Distances to destinations were calculated and the related GHG emissions assessed with a life cycle assessment approach. Participants were grouped into 6 *modality styles* based on clustering of travel mode shares; *Bus commuters*, *Consistent car commuters*, *Non-commuters*, *Multi-modal car commuters*, *Pedestrian commuters*, *Bicycle commuters*. Factor analysis was used to group attitudes and preferences; *Suburban preference*, *Pro-car attitude*, *Preference for shared housing and transport*, *Preference for nature and privacy*, which were then analyzed spatially with global autocorrelation analysis.

The qualitative data was in the form of 20 semi-structured interviews, 45-90 minutes in length, with survey participants who had expressed their willingness to participate in further research. The interviews were transcribed, and Icelandic and Polish interviews translated into English. The method for analyzing the interviews was a two-step interpretation process; first each transcription was individually used to answer 17 research questions, and then a summary was produced from all transcriptions for each of the 17 questions.

## Results

### Mobility styles and travel-related GHG emissions aggregated in spatial units

Private car dominated travel in the region, with the majority of distances traveled by car. Although dominant in all locations, a spatial trend was found, where the car had a lower percentage in the city center than in the outskirts. The bus was used rarely, but most commonly in Mosfellsbær for commuting trips and in Grafarholt and Úlfarsárdalur for non-commuting trips. It was very rarely used for non-commuting purposes. While the share of commuting to work by bicycle was the highest in Seltjarnarnes (22%), the share of non-commuting trips in that area was only 4%. Residents from Laugardalur had the highest share of all trips by bicycle. The highest share of

commuting trips by car was found in 103 (Háaleitis and Bústaðahverfi), with 91% of trips, but residents in that area also had the highest share of trips by foot for non-commuting purposes. The lowest share of commuting trips by car was in Hlíðar and Vesturbær (60%).

The highest share of consistent car commuters was in Grafarholt and Úlfarsárdalur (70%), and the lowest in 101 (17%), where the highest share of pedestrian commuters was found (31%). Residents living in Hlíðar had the lowest average annual GHG emissions from travel within the region, and Grafarholt and Úlfarsárdalur had the highest. The longest weekly distance travelled was found in Mosfellsbær. Car ownership was 100% in 6 postal codes, but was the lowest in 101, followed by 111 (Breiðholt).

## **Motivations and rationales behind daily travel behavior, mode choice, car ownership, and residential location**

The spatial analysis of preferences implied that there are many suburban dwellers who actually do not prefer the private car as a travel mode choice, and that travel-mode related preferences are rarely a reason to reside in suburbs, but might motivate people to live close to the center in order to be able to move around by walking or cycling.

The qualitative analysis revealed that important residential location choice factors included preference for quietness or for liveliness, walkability, social networks, family-relations and greenness, but transport-related reasons were apparent too, where preference for city center living connected to preference of car-free living and having a designated parking place seemed to be a location choice factor for some who rather choose calmer and outside-the-immediate-city-center locations.

Two different attitudes towards daily travel needs were detected among those possessing vehicles and habitually driving. To some it is still important that the locations of the daily life are close and there is no need to drive too much around the city, but to some, car ownership means that they can choose locations further away and still reach them in a reasonable amount of time.

Vehicles are possessed by the majority of the respondents, as in the society in general. Some variation in the reasons for vehicle ownership was noticed, however, and include convenience, speed & time-management, carrying stuff, facilitation of trips away from the city, less exposure to bad weather, and some simply consider it impossible to live in Reykjavik without a car, especially when one has children. Environmental considerations came up in many interviews, but seldom are a strong-enough factor for choosing car-free living. Car ownership is clearly seen as a norm in Reykjavik, and those not possessing vehicles are regarded as extremists or poor.

Car ownership has a strong influence on the mode choice, and there is strong indication of habitual driving for many which have had cars at their disposal the whole of their adulthood. Reasons to choose other modes than driving include pro-environmental attitudes, disliking driving and inconvenience of being troubled with parking and traffic in the city center. The perceptions of the bus system seem to be relatively bad among those never or seldom using the system, but also those habitually using it brought up aspects reducing their own happiness with it, and potentially affecting the usage of others. A very strong thought seems to be that the buses are for young, old,

poor, weird and foreigners only, and those who can, have cars and drive. Factors related to not using the bus included price, low frequency and unreliability.

## **The influence of daily travel patterns and urban form on subjective well-being**

Neighborhood attachment contributes to social well-being and is connected to two main aspects regarding connections to a neighborhood; familial and friendship connections and feelings of belonging and rootedness to an area. While good neighborliness can be defined as neighbors who are deemed friendly and helpful, it seemed more common that neighbors were held in a positive light if they were quiet and didn't cause any problems.

While most participants were content with the walkability of their neighborhood and described the benefits of it for their physical and mental well-being, in the central areas walkability was more often connected to walking in town and access to services by foot, while in the suburbs there was more emphasis on recreational walking paths in nature. Interviewees living close to sources of noise pollution, such as the domestic airport, construction or heavy traffic, expressed dissatisfaction while others residing in calm and quiet areas were satisfied. In our assessment, noise pollution was not connected to any specific type of urban form and residents living in the city center were generally content with the calmness of their neighborhood. Slow traffic around the residential neighborhood was connected to satisfaction. Regarding the aesthetic appeal of a neighborhood, vegetation cover seemed to be the dominant factor. While all participants mentioned that they liked having vegetation, the importance of it to them varied. Positive benefits of vegetation included increased well-being, weather barriers, beauty and increased privacy.

Green space access was commonly connected with health and well-being benefits. Participants who had private gardens connected them with the social and physical benefits as well as privacy, while those who didn't have one didn't seem to mind. Balconies were enough outdoor private space for those who had access to them, and some stated that public parks were satisfactory to serve the same purpose as private gardens.

All interviewees found access to services to be an important factor contributing to their well-being, regardless of their preference for residential location. Although deemed important to all, participants living centrally seemed to express more interest in proximity to services and connected the city center with social well-being, and connected boredom with residing in suburbs.

Residents residing in both the suburbs and the compact area expressed their need for having privacy as affecting their well-being. However, there is indication residents can get used to higher density with time. One respondent connected density with social isolation, which in turn lowers well-being.

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## Background

Cities and their structural characteristics have been connected to the issue of local and global sustainability, and the compact city has emerged as a planning ideal promoted as beneficial from a sustainability perspective (Holden & Linnerud, 2005). To a large extent, the effect of compact urban form on sustainability benefits has been supported by academic research, but numerous questions and contextual differences remain. In particular, differences in geographical contexts, social norms, and individual preferences call for further research and consideration in planning and decision-making.

As part of its Municipal Plan 2010-2030, the City of Reykjavik aims to increase the share of public transport in travel from 4% to 12% and the share of active travel (walking and cycling) from 19% to over 30% in 2030. Realizing these ambitious goals will be necessary to achieve the promise to become carbon neutral by 2040 set by the City of Reykjavik (Reykjavík City, 2016) and the Icelandic government (Government Offices of Iceland, 2018). To achieve such modal shifts, the policies must be in line with the factors that guide travel behavior and practices of the residents. The planning interventions must also be well directed and focused on specific geographical areas and social target groups.

A quantitative and geographical data set has been collected in the project with a softGIS survey. The data include residential locations, daily travel patterns, long-distance travel patterns,

socioeconomic and demographic characteristics, life satisfaction measures, and residential preferences of 780 young adults (aged 25 to 40).

The data set allowed the SuReCaRe team to quantify individual travel behavior, assess its climate impact, and study its factors related to urban structure and individual characteristics. Preliminary results of this investigation have been presented at the Road Administration conference in November 2018. Among the main findings is a strong role of the distance to the city center in influencing travel modes used for commuting, along with the family types, pro-car attitudes, and other lifestyle orientations. Interestingly, distance to bus stops was found *not* to be related to commuting mode choice. We have also quantified the urban form of the region in relation to the residential location, including measures of urban density, access to public transportation, access to green spaces, distance to city centers, and travel-related urban zones. The results have been described in the report for the Road Administration in March 2019 and other publications.

A qualitative data set has also been collected as part of SuReCaRe 2 project (partially funded by Vegagerðin in 2018/2019) consisting of interviews with 20 participants. Interpretation of the interviews is the basis for this report.

The proposed project aims to expand this knowledge to provide a basis for the policy goals and develop academic knowledge. It is based on existing evidence from Nordic and other countries that is briefly summarized in the Background section.

# Project goals and outcomes

The overall goal of the SuReCaRe project is to improve our understanding of the premises of creating sustainable urban settlements, with the focus on Reykjavik Capital Region. It applies a novel mixed methods approach to study lifestyles, attitudes, perceptions, and behavior patterns related to residential location and travel, and associated greenhouse gas emissions. It provides a broad perspective on sustainability by focusing on both environmental and well-being consequences of lifestyles.

The proposed research (SuReCaRe 3) expands this ongoing project with three objectives:

1. To characterize mobility styles and travel-related GHG emissions of Reykjavik residents at the aggregate spatial levels based on individual travel patterns and residential locations
2. To provide detailed knowledge about motivations and rationales behind daily travel behavior and its associated factors such as car ownership and residential location
3. To explore the daily travel patterns and urban form at the residential location on subjective wellbeing

Realization of the 1st objective will help to inform spatial planning and transport policies in the region by identifying the regions with specific needs and potentials for a behavioral change. Realization of the 2nd objective will help inform the planning and policies with insights on the factors that drive behavioral choices and change. Realization of the 3rd objective will provide a broader sustainability perspective and background knowledge for motivating behavioral change.

There have been few studies on these topics in Iceland, and proposed research will contribute to international and national literature, and inform land use and transportation planning in the Capital Region. The novelty of this project lies in methods and units of aggregation. Studying dynamic relationships between urban form, infrastructure, social norms, and travel behavior requires combining qualitative material with the predominant quantitative data (Næss, 2016; Handy, van Wee & Kroesen, 2014). Transportation planning and urban design interventions, in turn, require the aggregation of quantitative data into appropriate spatial units such as neighborhoods, transport allocation zones (TAZs) or districts.

The following sections present background, methods and materials, and results in sections that refer to each of the objectives. The final section of the report includes general synthesis of the results and conclusions.

# Background

## The influence of urban form on daily travel behavior

Multiple studies in the U.S. show that compact neighborhood characteristics such as density and diversity of land uses, and the proximity of destinations, decrease car use (Ewing and Cervero, 2010). Distance to the main city center appears to be the most influential spatial factor, both in the Nordic (Næss 2012) and US context (Stevens 2016), which has been confirmed by models prepared in the project. There is currently relatively strong knowledge about relationships between urban form and daily travel behavior. The relationship between urban form and daily travel is also modified by individual preferences and social norms, whose influence is still debated in literature and more research is needed (Næss 2014; van Wee and Boarnet, 2014; Handy, 2017). Individual differences in preferences related to transportation and residential location (described as mobility styles, Ohnmacht et al, 2009; Prillwitz & Barr, 2011) and related differences between cities (described as urban mobility cultures, Klinger et al., 2013), are thus relevant factors in research on travel behaviors (e.g., from Wee and Boarnet, 2014). They are also relevant for planning and policy making, as they influence the demand for travel modes and transportation infrastructure, and the acceptance for policy measures. The influence on travel behavior of the environmental and cultural characteristics specific to Iceland and the Capital Region, such as high cultural and utilitarian importance of private cars (Colin-Lange & Benediktsson, 2011), relatively low density and high car-orientation of the urban structure (when compared to other Nordic cities) should be studied in more detail. Models prepared in the project showed that pro car attitudes strongly lower the likelihood of commuting by foot, bicycle or bus, and that the distance to bus stops does not influence fashion choice. Other factors are likely to be influential here, and more research is needed to inform the behavioral change set in policy documents.

## Factors of behavioral change in daily travel

Even though the literature largely confirms that compact urban form correlates with less driving, it is also evident that the expected behavioral change from densification policies is rather small (Stevens, 2016). As stated by Handy (2017, p. 28), “we need qualitative explorations of the processes at which households decide where to live and the formation of their preferences for different types of residential environments.” In such processes, other factors, such as culture, social norms, and personal attitudes may play an important role. Such factors as pricing, driving restrictions, and quality and image of public transportation may further influence travel behavior. Handy (2017) further states that compact development is a necessary but not sufficient step in reducing private driving in cities. It is the role of researchers to inform comprehensive strategies in this regard.

## Daily travel behavior and wellbeing

Long commutes from suburban neighborhoods are associated with less time spent at homes and residential areas, thus negatively influencing life satisfaction and relationships among families (Stutzer and Frey 2008) and local communities (Putnam 2000). Commuting negatively affects people's current mood (Kahneman et al. 2004), particularly by car or bus, while walking and cycling are associated with positive mood (Gatersleben & Uzzell, 2007; Morris & Guerra, 2014)

and health improvements (Pucher et al. , 2010, de Hartog et al. 2010). However, the effects of daily mobility are potentially modified by personal preferences or mobility styles. For instance, positive or negative outlook on a specific travel mode may modify its positive or negative impacts on well-being. A dissonance between travel-related preferences and a residential neighborhood may cause dissatisfaction, e.g., among people who would prefer walking to work, but their noncentral and more affordable residence only allows car or bus commuting. Such interdependencies are relevant for residential choices, travel behaviors, and potentially influence planning policies related to transportation, housing and land use.

## Urban form and wellbeing

Subjective well-being studies focusing on both an individual's quality of life and life satisfaction have found that higher density in residential areas can negatively affect individuals' mental well-being (Guite et al., 2006), and lower an individual's life satisfaction (Cao, 2016; Lawless et al., 2011), and this can be due to, perceived overcrowding, social inequality or an increase in noise pollution and traffic (McCarthy et al., 2018). Individuals living in less dense neighborhoods might have better psychological well-being, which raises their subjective well-being (Cramer et al., 2004; Fassio et al., 2013) which is due to an increased number of friends and a reduction in negative life events such as crimes prevalent in more dense areas. However, higher densities can improve an individual's overall social well-being (Kytta et al., 2016; Mouratidis, 2018). Proximity to the city center can improve an individual's social well-being due to the number of social networks (Mouratidis, 2018) while it has also been shown to lower individuals' life satisfaction (Brereton et al., 2008; Brown et al., 2016; Ma et al., 2018) due to congestion externalities coupled with the isolation factor. The quantity (Ambrey et al., 2013; Aoshima et al., 2018), access (Węziak-Białowolska, 2016), and proximity of green and open spaces (Bertram et al., 2015; McCarthy et al., 2018) fulfill an individual's ecological service needs while also promoting their overall health and well-being; mentally, physically, emotionally, psychologically, and socially (Davern et al., 2017; Lee et al., 2011). Life satisfaction has also been seen to increase with homeownership (Y. Liu et al., 2017; Ma et al., 2018; Vemuri et al., 2009), even while controlling for explanatory variables. Among the socio-demographic variables, studies have found that low levels of education (Brereton et al., 2008; Ma et al., 2018) and income (Appleton et al., 2008; Ma et al., 2018; Vemuri et al., 2009) as well as, unemployment (Ardahan, 2014; Ballas et al., 2011; Pierewan et al., 2014) and being single (Appleton et al., 2008) can reduce an individual's life satisfaction.

# Materials and methods

## Quantitative data collection and sampling

The quantitative results are based on an online survey administered between 12th of September and 7th of November 2017 in three languages: Icelandic, English, and Polish. The survey employed a softGIS method, which combines traditional questionnaires with Internet maps and allows participants to mark locations on a map and answer questions pertaining to these locations (Brown and Kytta, 2014; Czepkiewicz et al., 2018c). The questionnaire is available online at <https://app.maptionnaire.com/en/2294/>.

The target population of the survey consisted of all registered residents of the **Reykjavík Capital Region** (the municipalities of Reykjavík, Kópavogur, Hafnarfjörður, Garðabær, Mosfellsbær, Seltjarnarnes, and Kjósarhreppur), **aged between 25 and 40** as of 1st of August 2017. Sampling was done by randomly drawing **6000** target group members from Registers Iceland, (Þjóðskrá Íslands) using a geographically stratified sampling method, in which the proportion of residents of each municipality is the same in the sample as it is in the target population. About **5184** invitations have been properly delivered and resulted in **735** answers (response rate 14.2%), of which **588** were complete (response rate 11.3%).

## Trip distances and frequencies

Distances to local destinations were calculated along the street network data obtained from OpenStreetMap for walking and cycling, and i50v topographic map for car and bus. The distances between home locations and destinations were then calculated using the Route tool in the Network Analyst toolbox in ArcMap 10. The frequencies of local trips were measured in categories related to weekly or monthly periods (e.g. “five to seven times a week” or “once or twice a month”) and coded numerically to estimate the number of trips made during 12 months. The yearly distance traveled to each of the marked destinations was then estimated by multiplying distances and frequencies. The yearly distances were then multiplied by GHG emission coefficients described below.

## Greenhouse gas emissions calculation

The GHG assessment was conducted with a life cycle assessment (LCA) approach, which considers both the direct and indirect emissions from travel. Typically only the direct emissions, those from fuel combustion, are included in an assessment, which might lead to biased outcomes and policy-guidelines (Chester & Horvath 2009). The sources of indirect emissions include fuel and electricity production (for electric vehicles), vehicle manufacturing, and infrastructure construction, which are also major contributors to the GHG emissions from transport. The measures of global warming potential over 100 years (GWP100) were employed.

Following emission data sources were utilized:

1. Due to the absence of data sources from Iceland, the direct combustion emissions of buses were taken from the LIPASTO database produced by the VTT Technical Research Centre of Finland Ltd (VTT 2016).
2. The indirect emissions coefficients were taken from Chester and Horvath (2009), including roadways, tracks, stations, runways, and other infrastructure, vehicle production and maintenance and fuel production. The uncertainty of the measures lies in the assumptions that the emissions are compatible between the U.S. and Iceland.
3. For trips with private cars, the fuel efficiencies and occupancy rates reported by the survey respondents were used. The fuel efficiency was asked with a five-category question with options from below 4 liters per 100 km (l/100km) up to over 10 l/100km with two-liter intervals and separate options for electric vehicles. For those who did not answer the question on fuel efficiency, the average of 7.6 l/100km was assumed. For the trips without data on car occupancy, the average occupancy rates of 1.3 for local trips were assumed, following the LIPASTO database.
4. The estimated fuel consumption was turned into GHG emissions with a multiplier of 2.36 kg CO<sub>2</sub>e/liter (US EPA, 2008).

Table 1. GHG emission coefficients per travel mode in CO<sub>2</sub>e kilogram equivalents per person kilometer traveled [kg/PKT]

Travel mode	Explanation and sources	Direct emissions: combustion	Indirect emissions		Total emissions
			Fuel production	Life-cycle	
Car	Reported fuel efficiency (liters per km, survey data) times 2.36 kg CO <sub>2</sub> e/liter (US EPA, 2008), divided by 1.3 car occupancy (VTT, 2016). Indirect emissions for San Francisco Muni (Chester & Horvath, 2009).	0.138 (average)	0.026	0.074	0.238
Bus	Natural gas bus, the average occupancy rate in local traffic, 18/50 passengers (VTT, 2016).	0.069	0.031	0.050	0.150

## Modality styles

The grouping of participants into *modality styles* was carried out in the following steps. Firstly, we calculated variables used to define the clusters. These were eight variables taken from *softGIS* data about destinations visited within the Reykjavík Capital Region: 1) the share of travel modes to work- or study places (i.e. commuting destinations), weighted by trip frequency, represented with four ratio variables, one per each travel mode (car, bus, foot, and bicycle), 2) the share of travel modes to non-commuting destinations, weighted by trip frequency, represented with four ratio variables, one per each travel mode (car, bus, foot, and bicycle). Secondly, we applied an agglomerative hierarchical method with Ward's method and squared Euclidean distance, using a *hclust* package in R. After examining the clustering tree, and summary of travel behaviors of each cluster, we decided to retain six clusters. Thirdly, we labeled the clusters for easier interpretability and communication, using the most discernible characteristics of their members' travel behavior. The names are *Bus commuters*, *Consistent car commuters*, *Non-commuters*, *Multi-modal car commuters*, *Pedestrian commuters*, *Bicycle commuters*.

## Preferences and attitudes

The analysis of preference and attitudes is based on answers to 17 statements from page 12 of the softGIS survey referring to residential environments and daily travel modes. The whole list of items is presented in Table 4. Responses to the items were given on a five-step scale from 1 to 5 with the following labels: 1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree. 525 respondents answered all statements and were included in the analyses.

To reduce the number of variables, the factors analyses (i.e. principal axis factoring with oblique rotation) were performed separately on answers to the statements. The results of factor analyses are presented in Table 4. The factor scores were then estimated and used in analysis of the spatial association of attitudes within the urban region.

To see whether certain attitudes or preferences cluster spatially in the Capital Region, we performed a global autocorrelation analysis of attitudinal factor scores using Moran's *I* statistic and a local autocorrelation analysis using Hotspot Getis-Ord  $G_i^*$  method, both in ArcGIS 10.6 (Esri, 2018a,b). The former provides an indication of whether a variable is clustered spatially, and the latter shows in which areas of the region values higher or lower than the average for the whole region are concentrated.

## Qualitative data collection

The first step of qualitative data collection was to create an interview protocol that would provide data related to all relevant topics of interest. The protocol was tested and evolved further after 9 pilot interviews were taken, transcribed, translated and coded. Three rounds of 30 invitation letters were sent to selected survey participants who had expressed willingness to contribute to further research and had provided us with their email address. A follow up email was then sent to those who didn't respond, resulting in a total of 20 positive responses. A total of 20 semi-structured interviews were taken, which ranged from 45-90 minutes in length. Half-way through the data collection process, rough transcriptions and summaries were made from the first 10 interviews which concluded that the protocol was producing adequate data. The interviews took place in a setting of the respondents choosing, at the researchers' office, cafés or the respondent's home. At the start of each interview, the interviewee is informed about potential publication of the data collected and asked for verbal confirmation that he or she consents to the recording and use of the data. The audio files were transcribed and the 16 which were in Icelandic or Polish were then translated into English.

Residential locations of survey respondents and interview participants in Reykjavík Capital Region

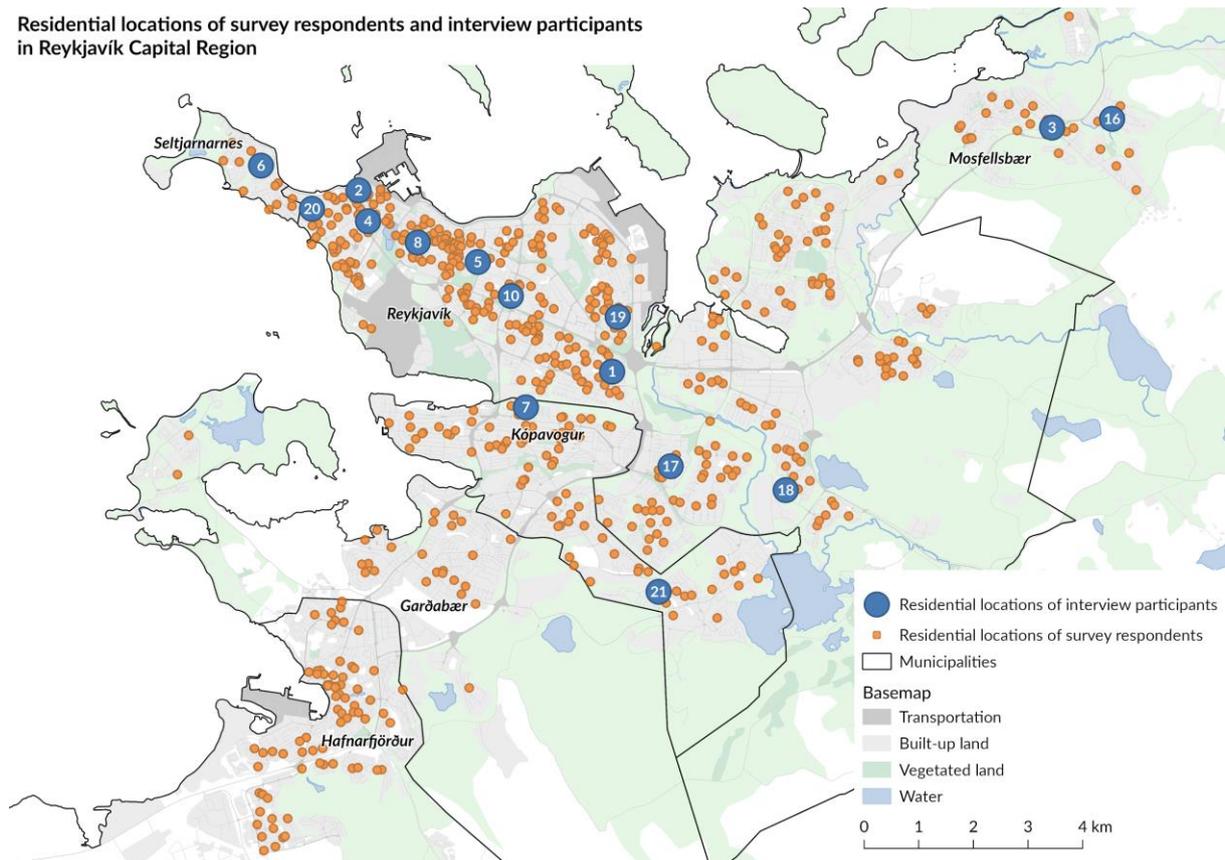


Figure 1. Home locations of study participants, both survey respondents and interviewees, within the Capital Region.

Table 1. Basic interviewee characteristics

Interviewee ID	Gender	Age	Dwelling	Household	Car in the household?
1	Male	40	Apartment	Family with children	Yes
2	Female	40	Apartment	Single or other	Yes
3	Male	29	Detached house	Single or other	Yes
4	Male	29	Apartment	Family with children	Yes
5	Female	29	Apartment	Couple	No
6	Male	41	Semi-detached house	Family with children	Yes
7	Female	40	Detached house	Family with children	Yes
8	Female	38	Apartment	Family with children	No
10	Female	37	Apartment	Single or other	Yes
16	Female	34	Apartment	Couple	Yes
17	Male	30	Apartment	Couple	Yes
18	Female	36	Apartment	Couple	Yes
19	Female	42	Semi-detached house	Family with children	Yes
20	Female	27	Apartment	Single or other	Yes
21	Female	42	Other	Single or other	Yes

## Qualitative data analysis

A slightly modified version of the explanatory qualitative research method (Næss, 2018) was employed in the qualitative data analysis. Despite the name, the method is suitable for exploratory as well as explanatory analysis, and in this project the exploratory perspective was mainly utilized. The method includes a two-step interpretation process of interviews. As the first step, the full transcriptions on the above-listed interviews were used for finding answers to and interpreting them against a predefined set of questions selected to answer the RQs of the qualitative part of the project. The interpretation questions are appended to this report as Appendix A. This first step interpretation was done individually for each interviewee through overall 17 questions under six themes. As the second step, the individual interpretations were summarized across each theme to a holistic interpretation on each theme. Quotes were also collected to illustrate each interpretation. The themes covered were:

1. Residential location choices
2. Car ownership rationales
3. Mode choice rationales
4. Daily travel behavior rationales
5. Wellbeing effects of daily travel behavior, and
6. Wellbeing effects of the built environment / urban form.

## Results

### Mobility patterns and GHG emissions in spatial units

The analysis of mobility patterns and greenhouse gas emissions in the region shows clear geographical patterns. Private cars dominate travel in the Capital Region. The majority of distances traveled by the studied group of young adults within the region are made by private cars (77%). Other travel modes are close to marginal: 8% of distances are made by bus, 9% on foot, and 6% by bicycle. The numbers have a relatively high margin of error due to a small sample size of this analysis ( $n = 684$ ), but it does not bias the general result of car dominance. There is a difference in the mode shares between commuting (i.e. getting to work- or study places) and non-commuting trips, particularly in case of walking and taking the bus. While only 3% of commuting distances are taken on foot, the share of non-commuting distances is much higher at 15%. Buses are more commonly used for commuting (11%) than for non-commuting purposes (4%). Of the reasons for this difference might be a higher average proximity of non-commuting destinations (such as shops, cafes, swimming pools, and other services) to residential locations compared to work- or study places many of which are concentrated in the main city center and at university campuses.

There is a spatial trend in mode shares. The private car has a lower percentage of trips made by residents of the city center than of trips made by residents of the outskirts (Figure 2). However, trips by car dominate in all parts of the city. Postal codes with the lowest percentage of distances traveled by car by their residents are: 105 (59%), 104 (63%), and 101 (66%). Centrally-located postal codes are also those with the highest percentage of distance taken on foot by their residents: 103 (23%), 105 (19%), 101 (14%), and 104 (13%). The most car-dependent postal codes are: 221 (89% distances traveled by car), 210 (85%), 112 (84%), 109, 203, 220 (83%), and 113 (82%).

Geographical differences in bus mode share are the most visible in commuting distances (Figure 3). Postal codes 107, 109, 105, 200, 101, and 201 have the highest percentage of commuting distances traveled by bus to work- or study places (all more than 15%, Figure 3).

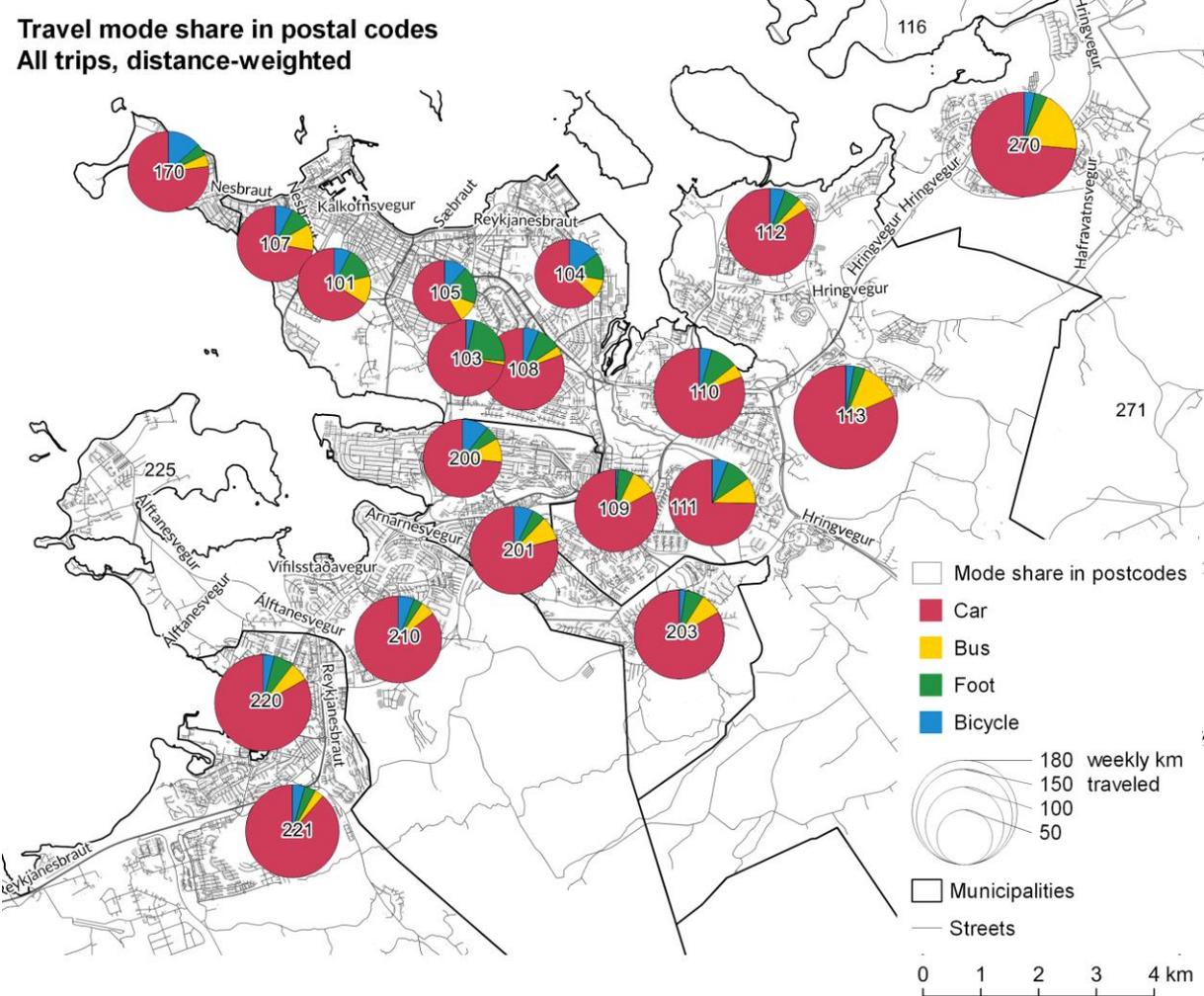


Figure 2. Distance-weighted travel mode share for both commuting and non-commuting purposes in Capital Region postal codes.

**Travel mode share in postal codes  
Commuting trips, distance-weighted**

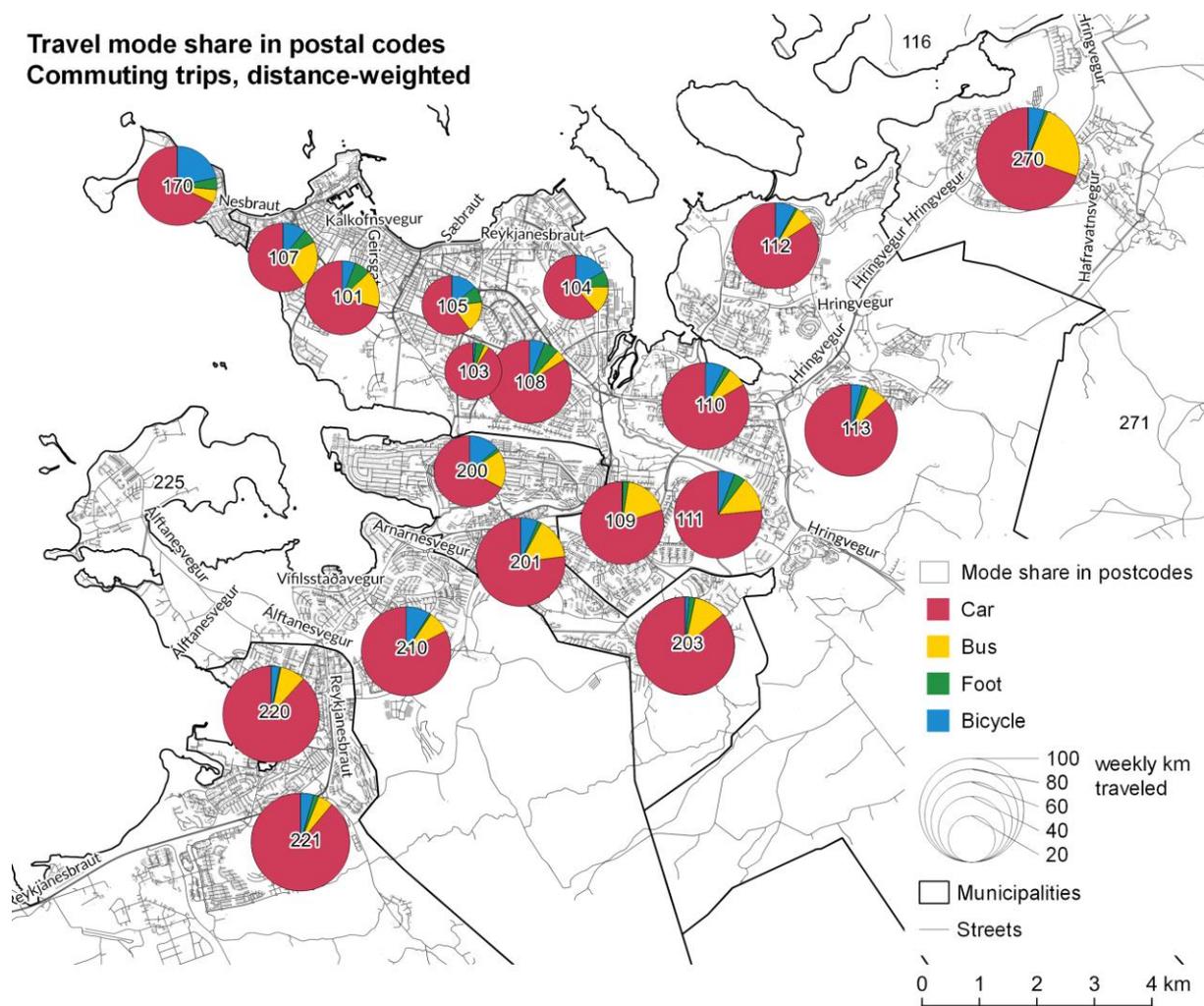


Figure 3. Distance-weighted travel mode share for commuting purposes in Capital Region postal codes.

**Travel mode share in postal codes  
Non-commuting trips, distance-weighted**

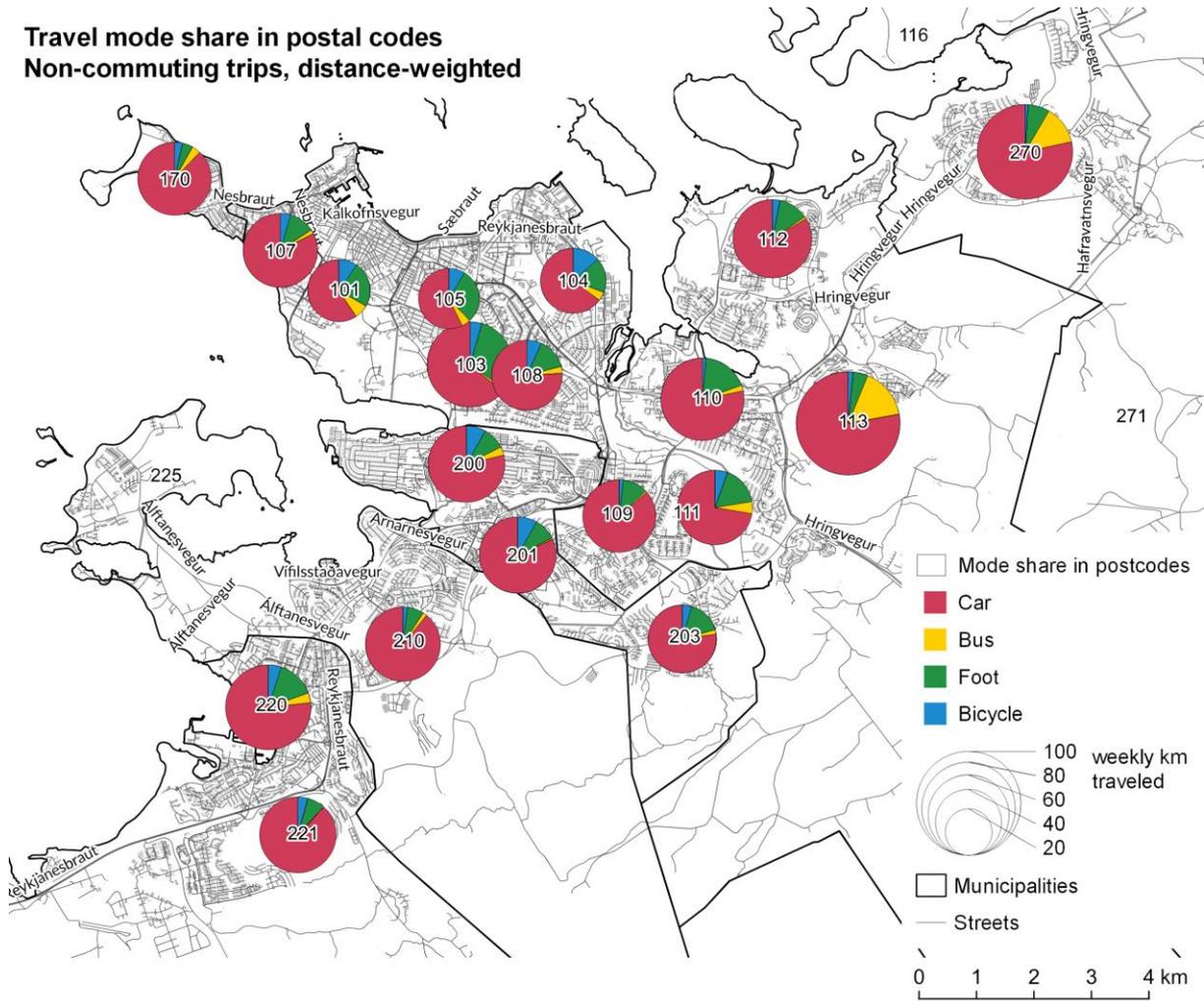


Figure 4. Distance-weighted travel mode shares for non-commuting purposes in Capital Region postal codes.

Table 2. Distance-weighted mode shares in Capital Region postal codes in all trips, commuting trips, and non-commuting trips.

Municipality	Postal code	N	Distance-weighted mode shares											
			All trips				Commuting trips				Non-commuting trips			
			Car	Bus	Foot	Bicycle	Car	Bus	Foot	Bicycle	Car	Bus	Foot	Bicycle
	101	83	66%	13%	14%	7%	71%	16%	7%	6%	59%	7%	24%	10%
	103	41	72%	2%	23%	4%	91%	3%	5%	1%	64%	1%	31%	4%
	104	41	63%	9%	13%	15%	61%	14%	8%	17%	65%	4%	17%	14%
	105	69	59%	11%	19%	11%	60%	17%	9%	14%	57%	5%	29%	9%
Reykjavík	107	33	72%	11%	9%	7%	60%	22%	7%	11%	83%	2%	11%	5%
	108	66	81%	4%	9%	6%	84%	4%	6%	6%	76%	3%	14%	7%
	109	20	83%	10%	6%	1%	80%	17%	2%	0%	86%	1%	11%	2%
	110	36	81%	5%	10%	5%	83%	7%	2%	7%	78%	2%	18%	1%
	111	18	75%	10%	10%	6%	77%	13%	4%	6%	72%	5%	17%	5%

	112	39	84%	4%	6%	6%	84%	7%	1%	8%	84%	1%	12%	3%
	113	20	82%	12%	3%	3%	86%	8%	2%	4%	78%	16%	5%	2%
Seltjarnarnes	170	10	77%	5%	5%	13%	68%	6%	5%	22%	88%	4%	5%	4%
	200	45	73%	10%	6%	11%	67%	17%	2%	14%	79%	4%	9%	8%
Kópavogur	201	22	79%	9%	5%	7%	77%	15%	1%	6%	82%	1%	9%	8%
	203	14	83%	8%	7%	2%	86%	11%	2%	1%	77%	2%	16%	4%
Garðabær	210	24	85%	5%	3%	6%	83%	8%	1%	9%	89%	2%	7%	2%
	220	49	83%	6%	7%	4%	88%	8%	0%	3%	77%	4%	14%	5%
Hafarfjörður	221	25	89%	3%	4%	4%	89%	5%	2%	4%	88%	0%	7%	4%
Mosfellsbær	270	26	74%	19%	4%	3%	70%	24%	1%	5%	78%	13%	7%	1%
Capital Region	681	77%	8%	9%	6%	78%	11%	3%	7%	75%	4%	15%	5%	

There are multiple possible explanations of these patterns. Non-commuting travel to destinations located relatively far from homes is primarily done by car, even in neighborhoods with relatively good local access to services. These destinations are visited by walking or cycling by a part of the population on the condition that there are such locations within a walkable or cyclable distance from home. The majority of the neighborhoods in the region allow for some non-commuting travel by walking or cycling. Some neighborhoods, such as Grafarholt or Mosfellsbaer do not seem to have many destinations within walking or cycling distance from homes and therefore motivate some of their residents to travel by bus for non-commuting purposes (besides the car, which dominates all travel). In general, bus is rarely used for non-commuting purposes, and if it is, it is mostly in locations with poor walking access to non-work destinations.

A geographical analysis of modality styles shows that when people and their primary travel modes are counted instead of distances, car dominance is less pronounced. The most common modality style in the region is *consistent car commuters*, which consists of people who commute by a private car, and also use it for most of their non-commuting trips. People who represent this style comprise 37% of the sample. There are visible geographic differences (Figure 5). Postcodes with the lowest percentage of residents representing this style include 101 (17%), 111 (22%), and 105 (25%). Postcodes with the highest percentage include 113 (70%), 112 (54%), 109, and 170 (50%). *Multimodal car commuters* include people who get to work- or study places by car, but use other travel modes for non-commuting purposes. People who represent this style comprise 21% of the sample. *Pedestrian commuters* comprise 13% of the sample. Postcodes with the highest percentage include 101 (31%), 107 (21%), 105 (19%), and 104 (18%). Postcodes with the lowest percentage include 203 (no such participants), 200 (2%), 112 (3%), and 220 (4%). *Bicycle commuters* make up 9% of the sample, and *bus commuters* 8%.

Share of modality styles among participants in postal codes

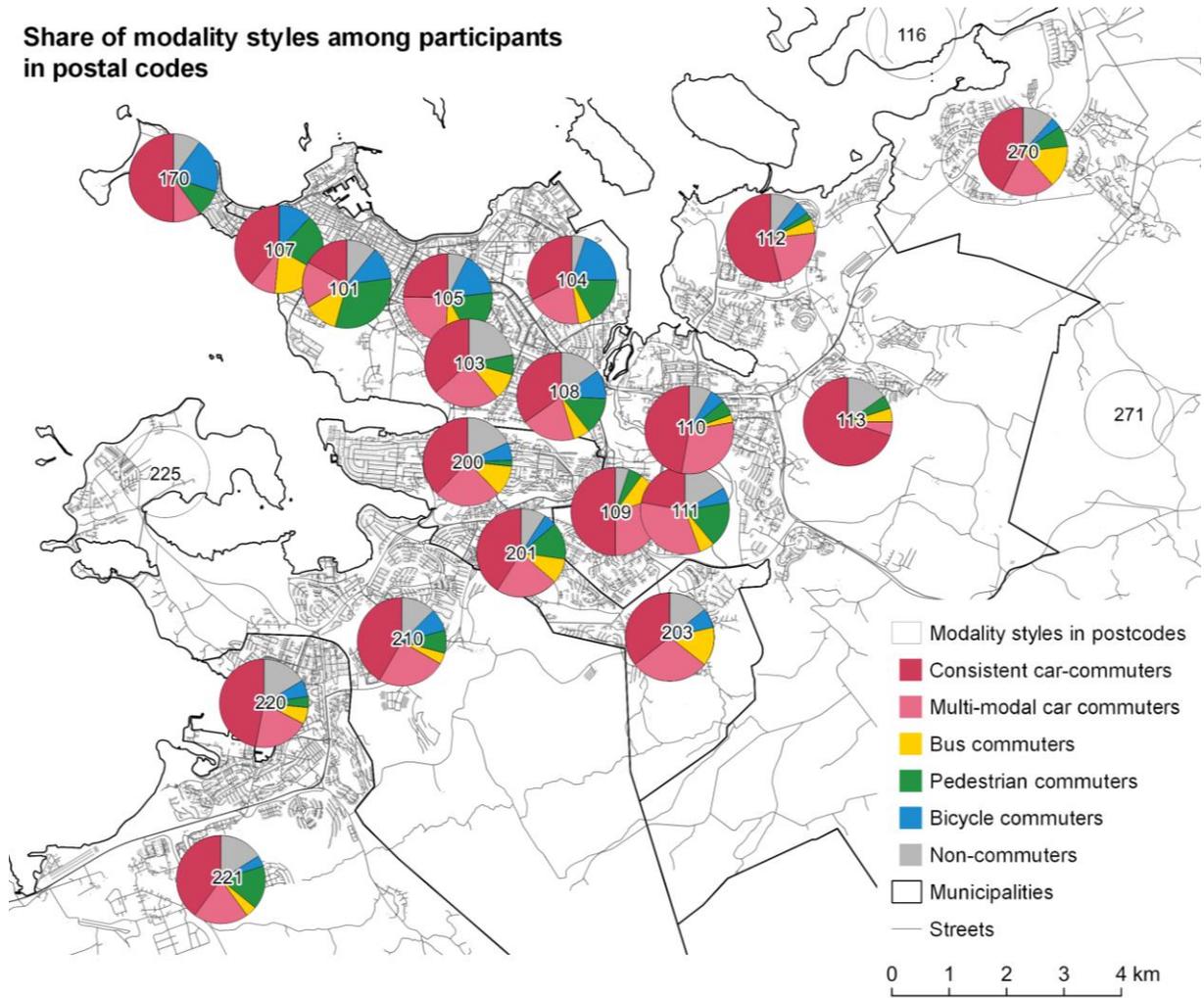


Figure 5. Proportion of participants with different modality styles in Capital Region postal codes.

**Greenhouse gas emissions in postal codes**  
**Full life cycle, trips within the Capital Region**

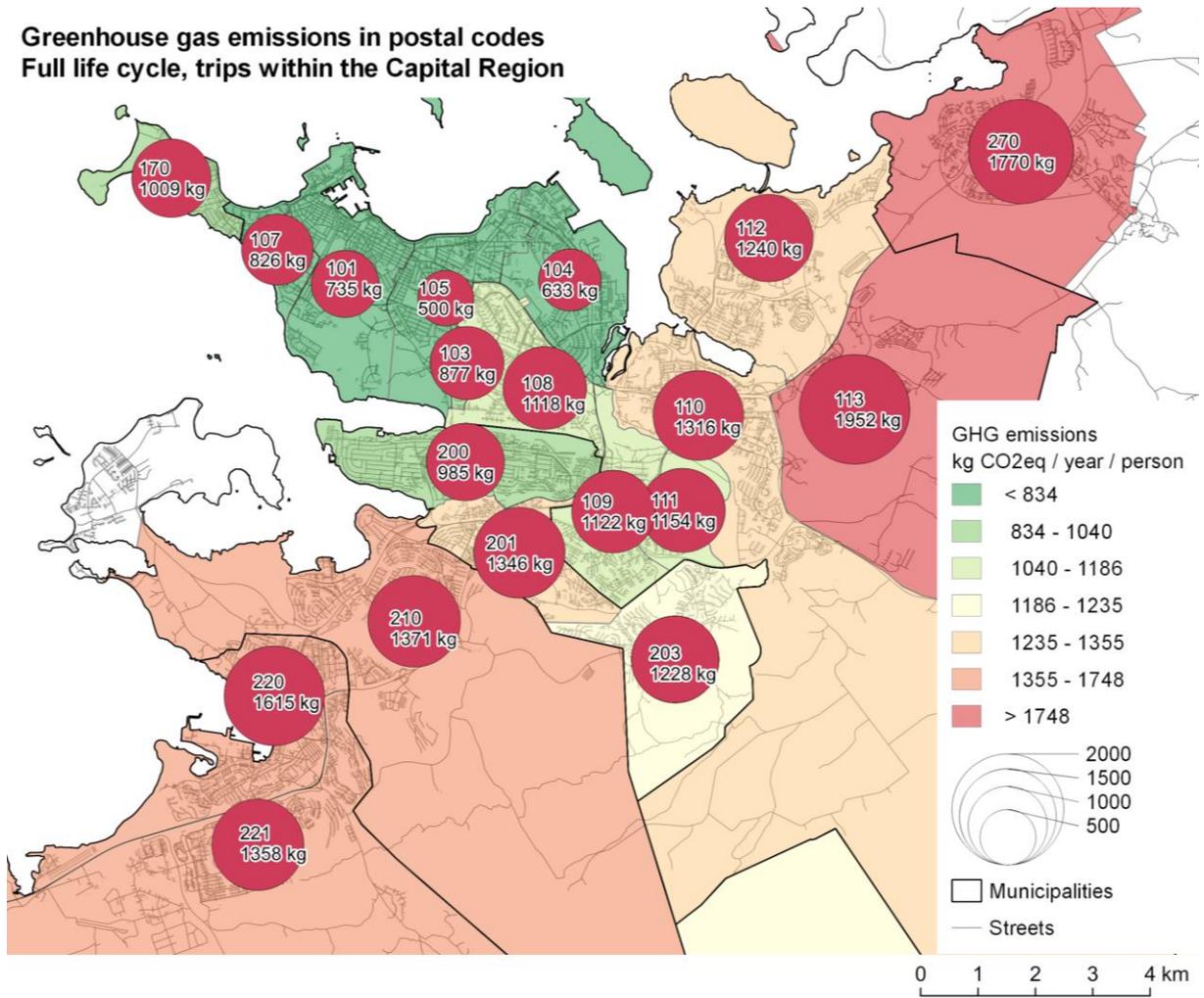


Figure 6. Yearly average GHG emissions resulting from travel within the Capital Region aggregated to postal codes based on participants' residential location.

### Car ownership rates in postal codes

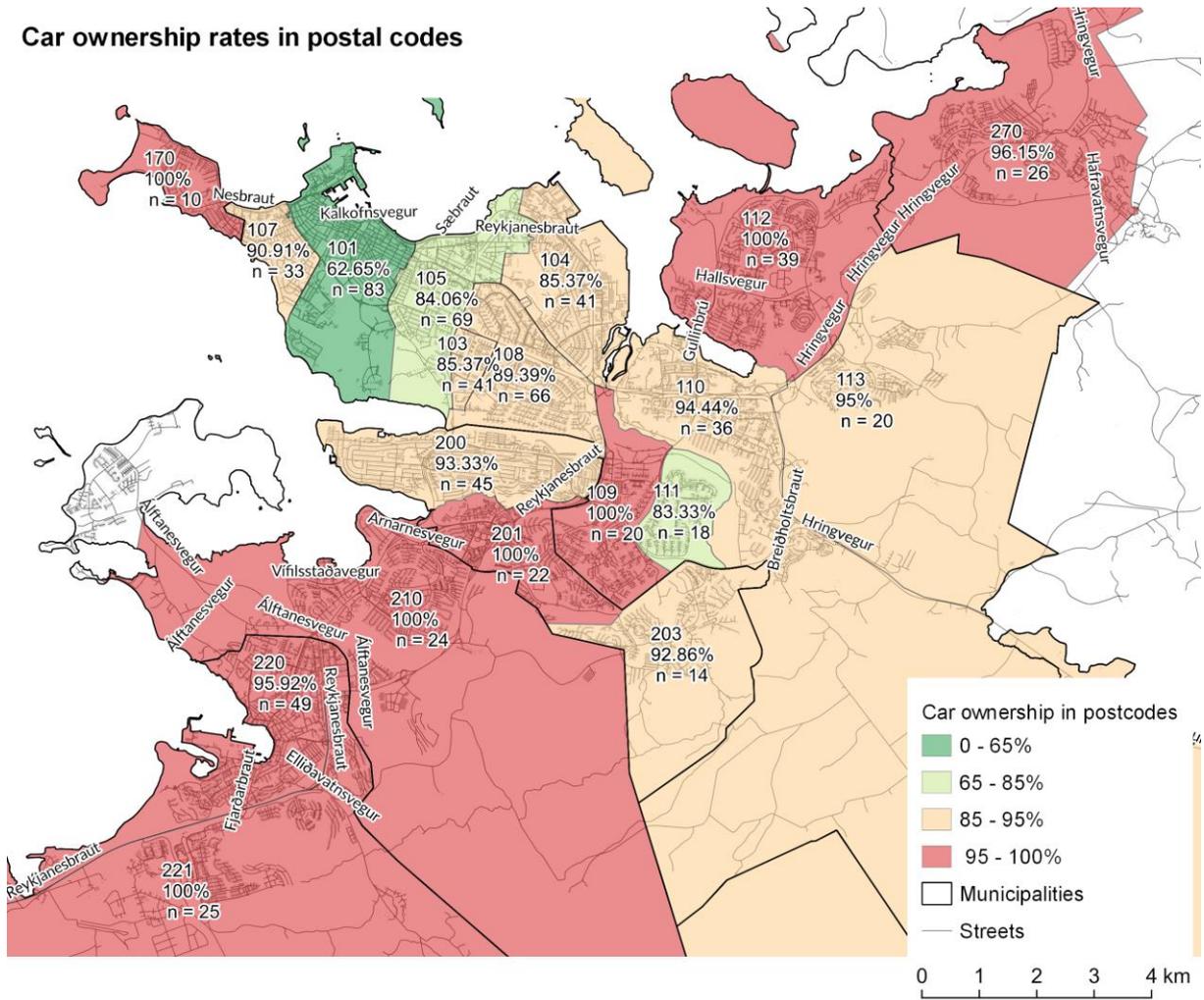


Figure 7. The rate of car ownership among study participants in Capital Region postal codes.

Table 3. Modality styles, average travel-related GHG emissions, average weekly distances traveled and car ownership rate in Capital Region postal codes.

Municipality	Postal code	N	Consistent car-commuters	Multi-modal car-commuters	Bus commuters	Pedestrian commuters	Bicycle commuters	Non-commuters	GHG emissions [kg CO <sub>2</sub> eq / p / y]	weekly distances traveled [km]	Car ownership rate
Reykjavík	101	83	17%	17%	12%	31%	12%	11%	735	87	63%
	103	41	37%	24%	10%	7%	0%	22%	877	98	85%
	104	41	33%	20%	5%	18%	20%	5%	633	78	85%
	105	69	25%	25%	9%	19%	16%	7%	500	67	84%
	107	33	39%	9%	18%	21%	12%	0%	826	95	91%
	108	66	35%	20%	6%	14%	11%	15%	1,118	111	89%
	109	20	50%	30%	10%	5%	0%	5%	1,122	113	100%
	110	36	47%	31%	3%	6%	6%	8%	1,316	134	94%
	111	18	22%	33%	6%	17%	6%	17%	1,154	123	83%
	112	39	54%	23%	5%	3%	5%	10%	1,240	126	100%

	113	20	70%	5%	5%	5%	0%	15%	1,952	177	95%
Seltjarnarnes	170	10	50%	10%	0%	10%	20%	10%	1,009	108	100%
	200	45	38%	24%	11%	2%	7%	18%	985	101	93%
Kópavogur	201	22	41%	23%	9%	14%	5%	9%	1,346	127	100%
	203	14	36%	29%	14%	0%	7%	14%	1,228	132	93%
Garðabær	210	24	42%	25%	4%	8%	8%	13%	1,371	125	100%
	220	49	47%	20%	6%	4%	6%	16%	1,615	153	96%
Hafarfjörður	221	25	40%	20%	4%	16%	4%	16%	1,358	143	100%
Mosfellsbær	270	26	42%	19%	15%	8%	4%	12%	1,770	182	96%
Capital Region	681	37%	21%	8%	13%	9%	12%	1,072	112	89%	

Car ownership rate in the Capital Region is high and is clearly differentiated geographically, reflecting (and influencing) the patterns of car use. The vast majority of the participants (close to 89%) have at least one car in their household. Postcodes with the lowest car ownership rate include 101 (63% of households), 105 (84%), 103, and 104 (85%). Postcodes, in which car-owning households comprise 100% of the sample are: 221, 210, 201, 170, 112, and 109.

Travel patterns, both traveled distances and mode shares, have their direct impact on GHG emissions. Again, these reflect similar geographical trends as described above. Primarily, centrally-located neighborhoods have emissions markedly lower than those of suburban areas. Postcodes with the lowest level of emissions include: 105 (500 kg CO<sub>2</sub>eq per person per year), 104 (633 kg), and 101 (735 kg). Postcodes with the highest level of emissions include: 113 (1952 kg CO<sub>2</sub>eq per person per year), 270 (1770 kg), and 220 (1615 kg).

The results are generally in line with previous research, which emphasizes the influence of city center proximity, neighborhood density, and access to public transportation as factors that decrease the rates of car ownership, car use, and associated emissions, and support the use of other travel modes, such as walking, cycling or public transportation (Ewing and Cervero, 2010; Næss, 2012).

## Takeaways for policy

Several different policy actions appear sensible in the light of results. Assuming that the main goal of transportation policies in the region should be decreasing car usage and travel-related emissions, while promoting good accessibility and livability, we suggest implementing policies in four main categories:

1. **The densification of the city center and its immediate surrounding** to maximize the number of people who can live in conditions that allow for car-less or car-light lifestyles. Optimally, this would include densifying the domestic airport area and other central areas and turning them into densely populated, mixed-use and walkable neighborhoods with good walking access to shops and services. This would allow a higher proportion of residents to now own a car and commute by walking or cycling.
2. **The development of a bus rapid transit system (BRT)** as proposed in the Borgarlína project, combined with transit-oriented development around the stations (i.e. densely built, walkable, mixed-use areas within walking distance from stations), thus creating the conditions for a higher proportion of residents commuting by bus and reaching other kinds of destinations on foot or bicycle. Implementation of the system should be combined with

a promotion of bus travel to improve its reputation among those who are not using it currently.

3. **Discouraging car ownership and use.** Besides structural changes suggested in points 1 and 2, local governments of the Capital Region could create other incentives and disincentives for travel modes they want to support or discourage. These might include reduced or free bus fares, congestion charges for private cars and car-free zones in the city center, or restricting parking provision in central locations and around workplaces.
4. **Promoting electrification of private vehicles.** As suggested in points 1-3, there is a potential for reducing car ownership and use with urban structural and fiscal measures. However, urban structure has strong inertia, and considerably improving compactness of the city would take decades. Moreover, attitudes and preferences related to travel modes, even if malleable, are also relatively stable. Therefore, in parallel, the local governments should support rapid electrification of the car fleet.

## **Rationales behind residential location choice**

Factor analysis of attitudes and preferences related to residential environments resulted in four factors. The factors summarize answers to individual questions that correlate with each other and are usually similar in thematic content:

1. *Suburban preference:* residents who score high on this factor, consider suburbs their favorite residential environment and want to live there even if it means traveling longer distances. They don't consider the suburban life boring, but indeed value calmness and tranquility over liveliness in their neighborhoods. Those who score low on this factor, consider suburban life boring, like living in a neighborhood where there is a lot going on, and appreciate walking access to shops and services.
2. *Pro-car attitude:* residents who score high on this factor, prefer getting around the city by car and appreciate good travel connections by car. Those who score low on this factor, prefer traveling with other modes of transport such as walking, cycling or public transportation.
3. *Preference for shared housing and transport:* residents who score high on this factor, are in favor of urban density and are comfortable living in apartment buildings close to their neighbors. They don't mind sharing rides with strangers and like when there is a lot going on in their neighborhoods. Those who score low on this factor, are less comfortable sharing transportation or housing with others.
4. *Preference for nature and privacy:* Residents who score high on this factor, like having private yards or natural areas close to their homes. They are in favor of single-family houses in calm areas. They also tend to prefer moving around in an active way (i.e. by walking or cycling).

Table 4. Rotated factor loadings retained in four-factor solution. Answers to statements on page 12/14 Please state how much you agree or disagree with statements below (1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree).

Item	Factor1 Suburban preference	Factor2 Pro-car attitude	Factor3 Preference for shared housing and transport	Factor4 Preference for nature and privacy
I prefer to live in a suburban neighborhood, even if it means traveling longer distances	0.883			
If I could live anywhere I would live in the suburbs	0.827			
Suburban life is boring	-0.71			
I like living in a neighborhood where there is a lot going on	-0.509		0.336	
I don't mind traveling a bit longer for the everyday services I use	0.458			
I appreciate tranquility and calmness in a residential area	0.387			0.253
I want to live close to the vast nature and recreational areas	0.319			0.457
Having shops and services within walking distance of my home is important to me	-0.281			
The car is my preferred way of getting around the city		0.903		
I appreciate good travel connections by car		0.679		
I prefer getting around in an active way such as walking or cycling		-0.599		0.285
I don't mind getting around using public transportation		-0.548		
I can be comfortable living in close proximity to my neighbors			0.834	-0.285
Living in a multiple-family unit would not give me enough privacy			-0.459	0.583
I am comfortable riding with strangers			0.331	
The neighborhood park is enough nature for me			0.274	
I like to have a large yard at my home				0.523

Two of the four attitude factors show geographical clustering, i.e. their high or low values concentrate in certain parts of the Reykjavik Capital Region. There seems to be a relatively strong spatial sorting of residents based on their preferences. The strongest clustering was observed for the suburban preference factor (Moran's  $I = 38.27$ ,  $p < .001$ ). Its low values concentrate in and around Reykjavik city center, and high values concentrate in the suburban areas (Figure 8). In comparison, clustering of the pro-car attitude is not as apparent (Moran's  $I = 4.04$ ,  $p < .001$ , Figure 9). This implies that there are many suburban dwellers who actually do not prefer the private car as a travel mode choice. Comparing the two maps of suburban preference and pro-car attitude suggests that travel-mode related preferences are rarely a reason to reside in suburbs, but might motivate people to live close to the center in order to be able to move around by walking or cycling.

Hot spot and cold spot analysis (Getis Ord Gi\*)  
 Factor scores of the "Suburban preference" factor

- Hot and cold spots
- Low values - 99% confidence
  - Low values - 95% confidence
  - Low values - 90% confidence
  - Not significant
  - High values - 90% confidence
  - High values - 95% confidence
  - High values - 99% confidence

- Basemap
- Airports, harbors, highways
  - Built-up land
  - Water
  - Forests and parks
  - Other vegetation
  - Municipalities
  - Postal codes
  - Streets

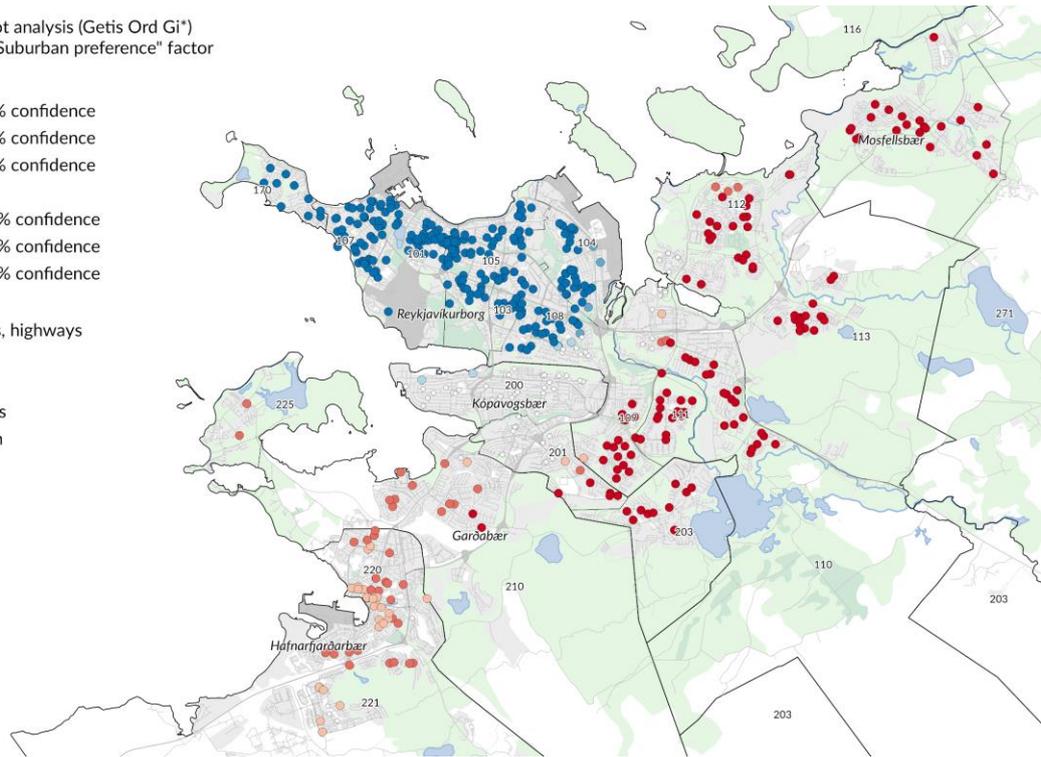


Figure 8. Hot spot and cold spot analysis of the factor scores of the "suburban preference" factor.

Hot spot and cold spot analysis (Getis Ord Gi\*)  
 Factor scores of the "Pro-car attitude" factor

- Hot and cold spots
- Low values - 99% confidence
  - Low values - 95% confidence
  - Low values - 90% confidence
  - Not significant
  - High values - 90% confidence
  - High values - 95% confidence
  - High values - 99% confidence

- Basemap
- Airports, harbors, highways
  - Built-up land
  - Water
  - Forests and parks
  - Other vegetation
  - Municipalities
  - Postal codes
  - Streets

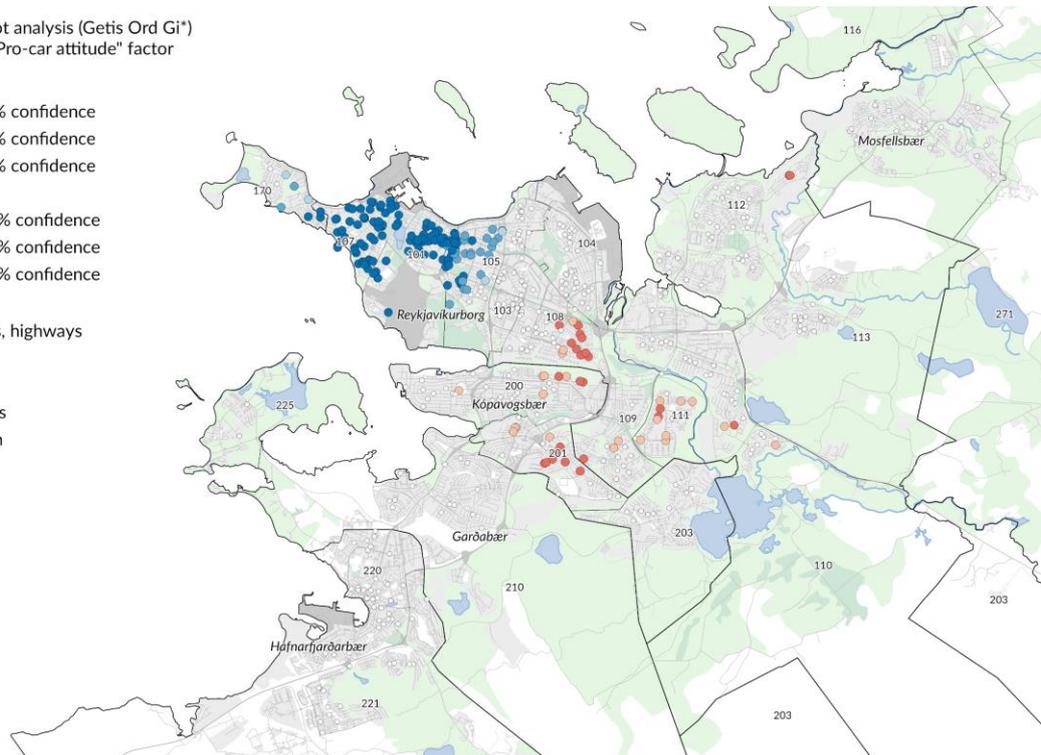


Figure 9. Hot spot and cold spot analysis of the factor scores of the "pro-car attitude" factor.

Factors affecting residential location choices vary substantially among the interviewees. We looked at them from the perspectives of neighborhood qualities, transport-related reasons and other factors affecting the location choice. Findings from the interviews related to these three

perspectives are summarized below with example quotes demonstrating how the respondents brought up their preferences and reasons.

## Neighborhood qualities

The prominence of the *suburban preference* and its opposite highlighted by the factor analysis also shows in the qualitative analyses. An important issue when choosing and evaluation residential locations appears to be the preference for quietness or for liveliness. It is not either-or, but seems to be so that the stronger the preference for liveliness is, the closer to the city center one is located. This preference also has to do with the life course situation of the respondent; respondents from families with children locate more often to calmer neighborhoods (interviewee 7: 40 y.o. woman, interviewee 19: 42 y.o. woman), and adult households seem to more often have higher preference for the city center liveliness (interviewee 2: 40 y.o. woman, interviewee 4: 29 y.o. man). Some respondents also directly called themselves either as city-center persons (interviewee 4: 29 y.o. man) or sub-urban persons (interviewee 1: 40 y.o. man). One respondent tells how she misses the downtown atmosphere now that they have moved to a suburb, but still considers the current location better for them as a married couple potentially having a child soon (interviewee 17, 30 y.o. woman).

*"...the area is very comfortable, short distance to most services, short distance to the center, but still not in it."* (interviewee 2: 40 y.o. woman)

*"I would preferably not want to go, you know, far outside a downtown core, basically it depends on the further away we go the less exciting it is for me, so..."* (interviewee 4: 29 y.o. man)

*"Quiet and child-friendly, ... middle-class environment ... I think it's a good area, such a mixed social group and lots of good kids and so I like it very well."* (interviewee 7: 40 y.o. woman)

*"This is also why I liked to buy there, because you are really outside of town even though you are in town."* (interviewee 18: 36 y.o. woman)

Some respondents brought up the importance of the local atmosphere (interviewee 5: 29 y.o. woman, interviewee 1: 40 y.o. man). Interviewee 5 (29 y.o. woman) even wanted to live exactly on the particular street they now live for the atmosphere she knew is there. Interviewee 6 (41 y.o. man) mentions that the atmosphere is something that keeps him where he is, but he did not know about it beforehand.

*"We intentionally bought and moved in the same street. Because we just love this street ... There is a very good atmosphere in the street."* (interviewee 5: 29 y.o. woman)

Service provision in close proximity was named as an important neighborhood choice factor by many respondents, even many living in the suburbs (interviewee 1: 40 y.o. man, interviewee 6: 41 y.o. man). Walkability of the neighborhood was also seen important by the majority of the respondents regardless of their dominant transport modes and car ownership.

Neighborhood greenness was mentioned by many respondents as an important location choice factor (interviewee 19: 42 y.o. woman, interviewee 21: 42 y.o. woman, interviewee 10: 37 y.o. woman). Interviewee 21 (42 y.o. woman) talks about good and bad neighborhoods, and how to her, nature and walking opportunities without fear of crime are important features.

*"...greener area so it's nice for us and for the dogs because that was important as well."  
(interviewee 19: 42 y.o. woman)*

*"What I don't want is burglaries and crimes and vandalism. I don't like that. What I want is close to nature and a good walking area." (interviewee 21: 42 y.o. woman)*

## Transport-related reasons

Transport-related reasons influenced the location choices of many respondents. As a broad picture, the preference for city center living connects to the preference of car-free living (interviewee 4: 29 y.o. man, interviewee 5: 29 y.o. woman), whereas the other way round having a designated parking place seems to be a location choice factor for some who rather choose calmer and outside-the-immediate-city-center locations (interviewee 17: 30 y.o. woman, interviewee 19: 42 y.o. woman, interviewee 21: 42 y.o. woman).

*"it was always in this area, the central area, where we could be carless, or pretty much carless, so it was very clear, it was 105, 101 or 107 that were considered, and not even everywhere within those neighbourhoods, so it was just that, sort of mainly that with the carlessness and local service." (interviewee 4: 29 y.o. man)*

*"...we had just purchased a car, ... And living downtown with the car was really difficult because we had no assigned parking." (interviewee 17: 30 y.o. woman)*

*"...we have to have parking space as we have so many cars, so we could never go and live downtown Reykjavik..." (interviewee 18: 36 y.o. woman)*

Many of those possessing vehicles, habitually using them, and even valuing private parking designated to their cars in their location choices, still brought up how the walkability of the neighborhood is important (interviewee 1: 40 y.o. man, interviewee 6: 41 y.o. man).

*"we can send our boys, or go with them for all sorts of entertainment there is, they can go ice skating, bowling, cinema and, you know, it just takes 5 minutes to walk out there" (interviewee 1: 40 y.o. man)*

Two different attitudes towards daily travel needs were detected among those possessing vehicles and habitually driving. To some, it is still important that the locations of daily life are close and there is no need to drive around the city, or generally drive too much (interviewee 6: 41 y.o. man). To some, car ownership means that they can choose locations further away and still reach them in a reasonable amount of time (interviewee 16: 34 y.o. woman).

*"...short distance to the shops aaand, uhh for example, with the children ... so you never need to drive them all around town for sports or something like that ...I have tried like, to steer myself [to avoid unnecessary travel], and even would choose a workplace based on it" (interviewee 6: 41 y.o. man)*

*"...if you have a car, this is not a problem ... Whether it's 10 minutes or 15, it doesn't make any difference" (interviewee 16: 34 y.o. woman)*

One respondent chose the residential location for other reasons than travel-related, and has found out that weak public transport connections really reduce her quality of life (interviewee 18: 36 y.o. woman).

*"What is also not good is the bus connection. Because it is just twice an hour, but it is also always empty, the bus, so I understand that they don't have a better bus connection because nobody is using it ... I need to take three buses home when I go home from work, which I still do but I still don't like." (interviewee 18: 36 y.o. woman)*

## Other reasons

For some respondents, other reasons than the spatial location and the qualities of the urban structure, or reasons related to travel, were the most important for choosing the residential location. For many, the home qualities themselves were an important factor (interviewee 1: 40 y.o. man, interviewee 5: 29 y.o. woman), and for interviewee 16 (34 y.o. woman) even the decisive factor. Price compared to the market was mentioned by interviewee 2 (40 y.o. woman) and interviewee 18 (36 y.o. woman) as an important decision criteria, even the most important. One interviewee with foreign background brought up that it is better to live in a location with other foreigners around as well (interviewee 17: 30 y.o. woman).

*"I have to say the price is a very strong influence and the size ... so that was more than actually the location..." (interviewee 18: 36 y.o. woman)*

*"...this apartment was new, for example. And that also had a big impact." (interviewee 16: 34 y.o. woman)*

Social networks and family relations were mentioned by several interviewees as an important reason to choose their current residential location (interviewee 1: 40 y.o. man, interviewee 10: 37 y.o. woman). Interviewee 21 (42 y.o. woman) goes even further and names family as the main reason to move to her current residence. She also mentions social relationships in general, be they family or friends, in their own neighborhood as an important factor.

*"...I both chose it because of the local environment ... and my dad is there, and also because of the location." (interviewee 10: 37 y.o. woman)*

*"that's the main reason why I bought this place. To be closer to my family grid. ... I think I wouldn't go to Mosfellsbær or Hafnarfjörður or somewhere far away just because I don't know anybody there." (interviewee 21: 42 y.o. woman) "*

## Main policy conclusions on the residential location choices

Several policy conclusions stem from this analysis:

1. **Local walkability should be given strong emphasis.** Even though there is often some confrontation between pedestrian-oriented and car-oriented infrastructure, the respondents seemed to unanimously appreciate walkability of their own neighborhoods.
2. **The amount of green structures in all forms, parks, streetside trees, green walls and roofs etc., should be increased.** The respondents commonly brought up appreciation of urban greenness, and dislike of locations lacking green elements.
3. **Service-levels outside the city center and the big shopping malls should be improved.** The appealing character of many suburban locations is significantly reduced due to lack of local services reachable on foot.

## Rationales behind car ownership

As evident from Figure 7, car ownership rate in the Capital Region is very high, and there is a geographical trend of centrally-located areas (such as 101 and 105) having somewhat lower percentage of households with a car than other areas. The geographical trend of decreasing proportion of households with no car or just one car when living farther from the city center is also visible in Figure 10 below.

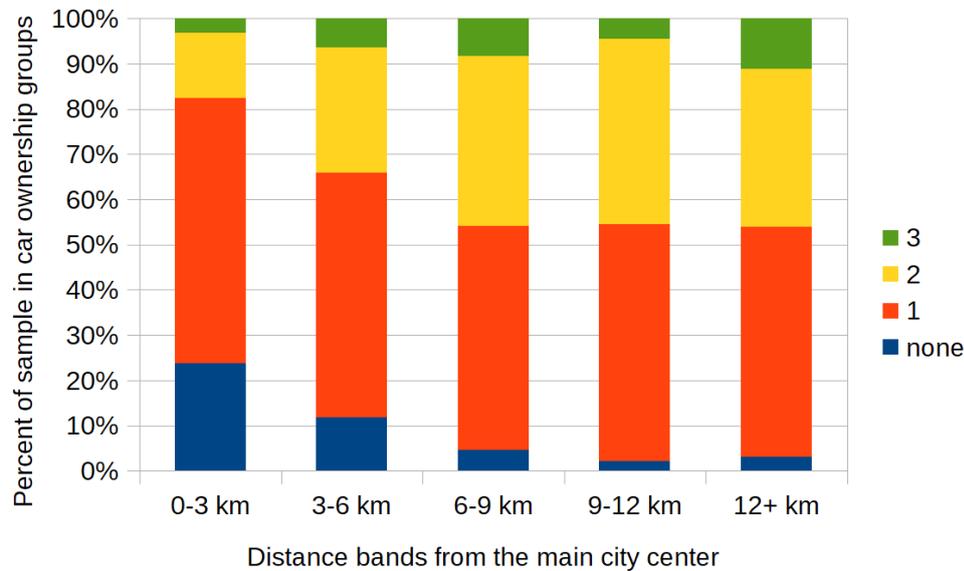


Figure 10. Car ownership in distance belts from the main city center in Reykjavik

These geographical patterns suggest that only the immediate city center supports car-less or car-light lifestyles. The analysis of qualitative material provides further insights at what are rationales behind possessing or not possessing a vehicle.

### Reasons for vehicle possession

Vehicles are possessed by the majority of the respondents, as in the society in general. Some variation in the reasons for vehicle ownership was noticed, however. For many it is simply an issue of everyday life convenience (interviewee 2: 40 y.o. woman, interviewee 18: 36 y.o. woman). A car makes it faster to get to places, allows for less exposure to bad weathers, is available at any time and so on. Some simply consider it impossible to live in Reykjavik without a car (interviewee 10: 37 y.o. woman). A few describe it from the perspective of something mandatory when one has children (interviewee 7: 40 y.o. woman, interviewee 6: 41 y.o. man, interviewee 19: 42 y.o. woman), just to be able to get things done. This reasoning is not far from the general convenience reason, but implies stronger dependence. Interviewee 6 (41 y.o. man) also tells how they plan on selling their second car when their youngest child goes to school and starts walking there. This further underlines the strong connection between car ownership and bounded activities due to children.

*"Like I live my life today, I think it's more comfortable to have a car..." (interviewee 2: 40 y.o. woman)*

*"I just feel that if you live in Reykjavik then you need to have a car, you can take the bus sometimes and you can actually do that, but ... if you have children and you ... need to drive to the playschool to pick them ... it really doesn't work out with public transport." (interviewee 6: 41 y.o. man)*

*"...we just recently bought a car, so up until that point we were able to be car-less with a small child..." (interviewee 4: 29 y.o. man)*

Cars facilitate trips away from the city, and two respondents to whom such activities are important, bring them up as reasons to possess vehicles.

*"I hike a lot. And ... you always need to, you know, drive to the mountains. And ... I go camping a lot. And just yeah. I need the car for those things, those activities..." (interviewee 21: 42 y.o. woman)*

*"it's a way to get out of the city." (interviewee 19: 42 y.o. woman)*

Two respondents say that they need to have a car for their work (interviewee 1: 40 y.o. man, interviewee 17: 30 y.o. woman) and have acquired cars particularly for work. Interviewee 1 (40 y.o. man) still considers himself more of a car-free type of a person, but interviewee 17 (30 y.o. woman) says that now after having had a car for a while, she could not see going back to car-free living.

*"I really didn't want to buy a car ... it was really just his work that kind of pushed us into buying one but now that we have one I can't see us not having a car." (interviewee 17: 30 y.o. woman)*

Interviewee 3 (29 y.o. man) has a car but uses it little. He reasons car ownership with the value of having one available when the need for using it arises, even if it happens seldom.

*"I could [be car-free] easily, but I would prefer to have a car just in case. ... it is better to have and not need, but to need and not have." (interviewee 3: 29 y.o. man)*

## Environmental considerations related to vehicle possession

Not possessing vehicles seems to be connected to pro-environmental attitudes among the respondents. Environmental considerations came up in many interviews, but seldom are a strong-enough factor for choosing car-free living. Only interviewee 5 (29 y.o. woman) says that for her environmental considerations are the main reason for car-free living.

*"We are very environmentally conscious people. We just try to use .... bicycles." (interviewee 5: 29 y.o. woman)*

Interviewee 4 (29 y.o. man) gives an example of a person that is against car-ownership for such reasons, but considers it a must now with a child.

Two respondents have chosen their current vehicles so that they are low-emitting (interviewee 7: 40 y.o. woman, interviewee 18: 36 y.o. woman). Interviewee 18 (36 y.o. woman) also discusses how she actually thinks that driving her Fiat Panda is likely not worse than taking a bus which runs almost empty.

*"I have a very cheap car. Which consumes little. I just decided to buy such a car, I could imagine buying an electric car next time if I ever buy another car."; "I'm on this little car, I think "yes, [s]he spends so little, [s]he's not polluting much", I think, ..."* (interviewee 7: 40 y.o. woman)

*"Fiat Panda from 2004, very low emitter..."* (interviewee 18: 36 y.o. woman)

The awareness of the environmental impact of private cars had led one respondent to consider changing to an electric vehicle, but in the end the price-difference was more important than the environmental aspect.

*"I recently renewed a car, was going to buy an electric ... because of the environmental impact, but ...it was much more expensive"* (interviewee 6: 41 y.o. man)

## General perceptions about car ownership in Reykjavik

Many respondents discussed also on a more general level why the motorization level in Reykjavik is so high, and how people not possessing vehicles are considered by others. Based on these views, car ownership is clearly seen as a norm in Reykjavik, and those not possessing vehicles as extremists and even in a negative way. Being poor was connected to car-free living by two respondents when they discussed the general attitudes towards car-free living (interviewee 2: 40 y.o. woman, interviewee 19: 42 y.o. woman).

*"„Yeah, ok you have money to own a car and just live your life“, I think that's like the normal thing."* (interviewee 2: 40 y.o. woman)

*"I think having a car it's like the norm. If you don't have a car you're like marginal. Since maybe that you don't have the money for it..."* (interviewee 19: 42 y.o. woman)

*"...he is driving, ...because he is Icelandic."* (interviewee 18: 36 y.o. woman about her husband)

It seems that not possessing vehicles might also be connected to getting kind of stamped by the society (interviewee 2: 40 y.o. woman, interviewee 19: 42 y.o. woman).

*"I think people who use the bus system... they kind of get that stamp: „ok, you don't have the money to own a car, or, you are a poor student“ or something like that."* (interviewee 2: 40 y.o. woman)

*"... if you go for a job interview then it would be seen negatively if you don't have a car, you know, like you're not flexible."* (interviewee 19: 42 y.o. woman)

## Main policy conclusions on car ownership insights

1. **Densification of the city center and transit-oriented development**, which would allow a higher percentage of people to live in environments that support car-free lifestyles.
2. **Active travel infrastructure should be improved.** Active travel could be incentivized more by improving the conditions and reducing obstacles. Wind directions and in general shelter from weather should be taken into account.
3. **The supply of parking places should be reduced to disincentivize car possession.** Parking places seem to provide surprisingly strong incentive for vehicle possession, and even though it alone does not lead to car acquisition or the decision to give up on a car, scarcity of parking space certainly provides an important push towards car-free living. The freed up space can be utilized for improving active travel infrastructure.

4. **Active travel should be incentivized instead of car travel.** The current perception is that the infrastructure is made for cars only and it limits use of other modes. The incentives should be both material (in forms of physical infrastructure or fiscal instruments) and symbolic, aimed at improving the perception of the bus system and car-less lifestyles.

## Rationales behind mode choice

Similarly as in the analysis of travel behavior in postal codes (Figure 2, Figure 3, and Figure 4). There is a clear geographical pattern, in which areas close to the main city center support travel with modes different from private cars. This is especially prominent in case of non-commuting trips, of which 45% are made on foot in the city center, compared to about 22-26% in other areas (Figure 12), and in case of modality styles: 26% of city center residents are *pedestrian commuters*, compared to 5-8% in other areas (Figure 11). Notably, buses are almost exclusively used for commuting, and there are no consistent differences in their mode share in different distance bands (Figure 11).

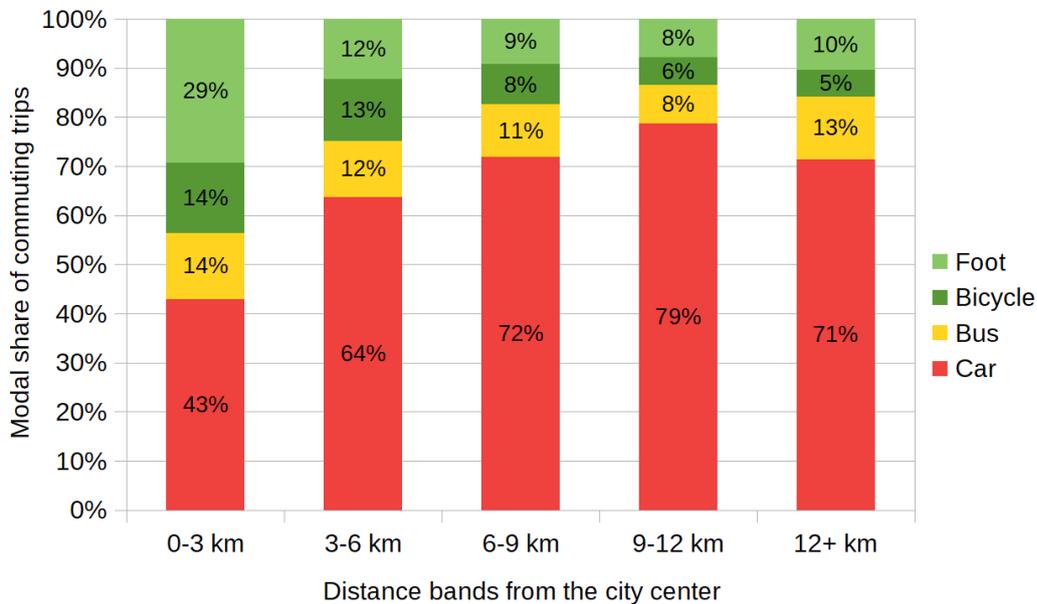


Figure 11. Mode shares of commuting trips weighted by trip frequency in distance bands from Reykjavik city center.

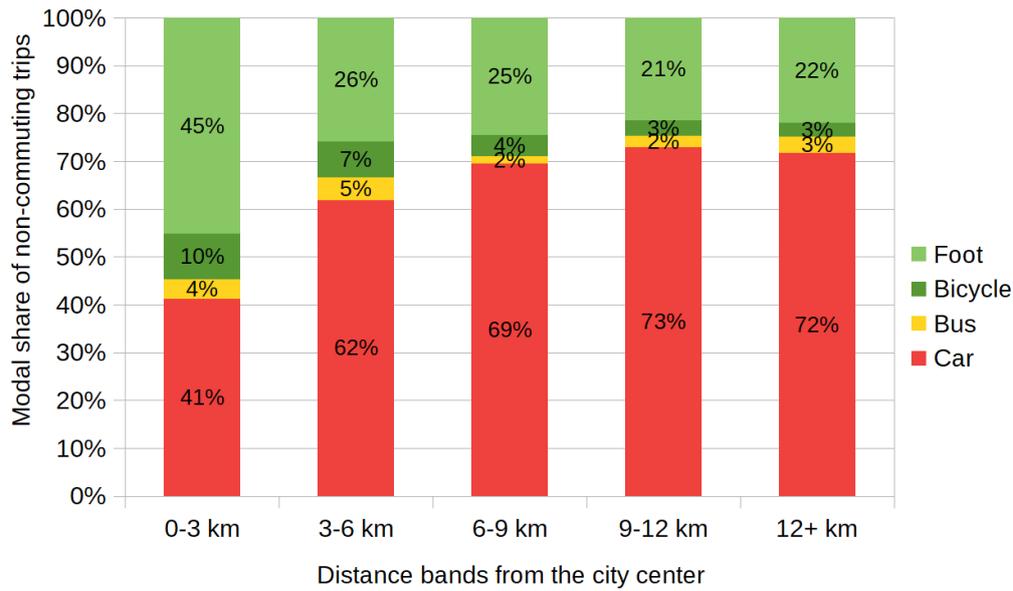


Figure 12. Mode shares of non-commuting trips weighted by trip frequency in distance bands from Reykjavik city center.

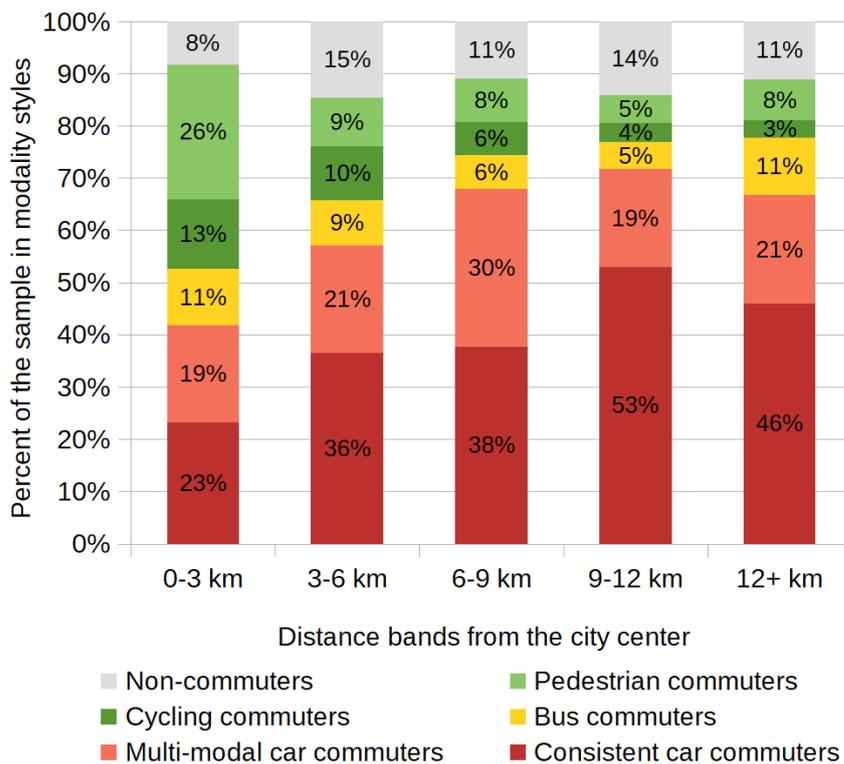


Figure 13. Percentage of respondents representing different modality styles in distance bands from Reykjavik city center.

An analysis of the qualitative material provides further insights into travel mode choice.

## Choice of the primary mode

Above it was told that the majority of the respondents are car owners. Car ownership has a strong influence on the mode choice, which is depicted by those having recently acquired vehicles quickly starting to use them more than what they had in mind at the time of purchase (interviewee 1: 40 y.o. man, interviewee 4: 29 y.o. man). For many, cars have been at their disposal the whole of their adulthood, and they are just habitual drivers without even considering other modes. One city center resident tells that he still walks to the majority of places and takes a bus occasionally to those further away, even though they have recently acquired a car after having a child (interviewee 4: 29 y.o. man). The main rationales for car use seem to be time-management (interviewee 18: 36 y.o. woman, interviewee 19: 42 y.o. woman), convenience in terms of carrying stuff (interviewee 18: 36 y.o. woman), and minimizing the exposure to bad weather (interviewee 19: 42 y.o. woman). For interviewee 7 (40 y.o. woman), the car gives the opportunity to appear at work dressed nicely and with a make-up in shape. She talks about the same avoidance of exposure to bad weather as others, but takes it a step further. However, the time-management rationale applies to interviewee 4 (29 y.o. man) as well, but from the perspective of avoiding the inconvenience of searching for a parking spot in the city-center.

*"I have to say it's very convenient in Iceland to take the car. It is warm. You don't have to wait. You don't have to spend a lot [of time waiting] for the bus." (interviewee 18: 36 y.o. woman)*

*"It's like you just don't want it to do it when it's freezing and you have to wait an hour at the bus stop. ... I mean a car is more comfortable if you have one definitely." (interviewee 19: 42 y.o. woman)*

*"[a car] allows us to do a lot more as a family as well." (interviewee 19: 42 y.o. woman)*

Practicality is one aspect of the convenience rationale brought up by many respondents. Doing grocery shopping without a car is seen as difficult by interviewee 18 (36 y.o. woman) who doesn't have a grocery store near to her home. She also says that going anywhere from her neighborhood in the evening time is difficult without a car due to bad bus connections. For interviewee 17 (30 y.o. woman), who avoids unnecessary driving, many daily life issues would become just too complex without a car.

*"I am not going to shop on the bus. So, yes, I use it, or if I have to go like in the evenings. In the evenings it is very hard to get back to Alftanes." (interviewee 18: 36 y.o. woman)*

*"...even just being able to do stuff like take bottles to the recycling. Yeah. We would have to like get my father-in-law to come get us and all of our bottles and go to the recycling. ... But I'm definitely very minimal on car desires." (interviewee 17: 30 y.o. woman)*

Three respondents are multi-modals with the car as only a secondary mode (interviewee 4: 29 y.o. man, interviewee 3: 29 y.o. man), or not in the modal mix at all (interviewee 5: 29 y.o. woman). The reasons vary from pro-environmental attitudes (interviewee 5: 29 y.o. woman) to disliking driving (interviewee 3: 29 y.o. man) and inconvenience of being troubled with parking and traffic in the city center (interviewee 4: 29 y.o. man). In addition, all the three non-habitual car users describe the travel time in itself valuable for them as time of their own, as a time to listen to music, enjoy the views or just not think of anything. Interviewee 3 (29 y.o. man) mostly commutes by bike even if the distance is relatively long, 16 kilometers one way.

*"...generally we find [walking] the most comfortable because it's not always too easy to find, we both work in Miðbær, not always too easy to find a parking space and kind of just unnecessary to be looking for it. So, it's a few hundred meters, then we usually try to go [walking]" (interviewee 4: 29 y.o. man)*

*"I might be an exception because I ride .... 32 km a day if I'm cycling back and forth from work." (interviewee 3: 29 y.o. man)*

*"I usually just prefer to walk to places." (interviewee 3: 29 y.o. man)*

The prevailing negative attitude on other modes than driving, as discussed above related to car ownership, came up also related to walking to places where one can easily walk even if a car would be at disposal.

*"...I have to say that the perception here is a bit, I mean, you could easily walk from here to Grandi and it doesn't take that much time. But in your mind, oh, you have to take the car." (interviewee 18: 36 y.o. woman)*

## Bus usage

Two respondents commute habitually by bus (interviewee 18: 36 y.o. woman, interviewee 17: 30 y.o. woman). Interviewee 18 (36 y.o. woman) does it due to their employers incentivizing it, but spends a lot of time in buses and does not like it very much. She also feels somewhat environmentally good about this choice. For interviewee 17 (30 y.o. woman) there is an efficient route available and she likes taking the bus. She also does not have a car in her disposal all the time, as they only have one car which is primarily utilized by her husband. She also seems to enjoy the time in a bus with no need to focus on anything else but what she wants to read or listen to.

*"I still have a car but I always use the bus because we have this vegasamningur. ... I agreed to this. I just do it but I'm not always happy. A) because I have to wait in Hamraborg, from the number 2 to the number 1, and it is not really well, it is like just an open area, you have like to go into the library if you want to have a little bit of shelter. And then I have to wait in Asgardur for half an hour, if I'm unlucky, and there you have a shelter, which always smells like pee because it is attached to where the bus drivers have their toilets. Yeah, it is quite hilarious and it's always dirty and you know also the bus stops in Iceland, it is always the air coming in." (interviewee 18: 36 y.o. woman)*

*"...this winter ... it kind of made me glad I didn't have to worry about going out and like scraping off our car in the morning and getting it running. ... And I just thought to myself like how nice it is. I just walk on to the straeto and it's warm and you know, no work required." (interviewee 17: 30 y.o. woman)*

*"I'm just like reading something like news article or something. I always give myself that time, like without schoolwork." (interviewee 17: 30 y.o. woman)*

Some still use buses on a pretty regular basis for various reasons. While many mention avoiding exposure to bad weathers as a reason to drive, interviewee 2 (40 y.o. woman) brings up taking a bus as a way to avoid driving in difficult conditions. interviewee 4: 29 y.o. man is a habitual walker, but commuted by bus when his workplace was temporarily located further away. (interviewee 5: 29 y.o. woman) prefers to cycle and walk, but takes a bus when it is further away where she needs to go, or the weather is too bad for cycling (to work).

*"... in the worst weather... then you're not fighting to drive in disgusting conditions, but just sitting calm in the bus and don't need to worry about it." (interviewee 2: 40 y.o. woman)*

*"...my work temporarily moved to Ármúli, then I always just took the bus, because there was a selection of buses to choose from, you know, within walking distance which took me at the most three four minutes to walk to..." (interviewee 4: 29 y.o. man)*

Quite many discuss the possibility of taking a bus more often if the service-level was better. Interviewee 2 (40 y.o. woman), who sometimes does take the bus, thinks that she would use buses more if there were shorter waiting times and overall shorter travel time. Interviewee 3 (29 y.o. man) and interviewee 21 (42 y.o. woman) also talk about the low frequency and long overall travel time as a factor hindering him from using buses more. Interviewee 21 (42 y.o. woman) has actually only pretty recently started driving habitually after experiencing bad bus service several times in a short time-period.

*"...if it would take me around half an hour, if it would be comfortable, then I would do it more often." (interviewee 2: 40 y.o. woman)*

*"The city bus, the Straeto, that works. But the communication to my neighborhood is not good." (interviewee 21: 42 y.o. woman)*

*"...one week it took me one and a half hours to get home three times. So then I was like "No, I'm, I'm finished with it". Yeah, yeah. It was quite annoying." (interviewee 21: 42 y.o. woman)*

## Perception of the bus system

The perceptions of the bus system seem to be relatively bad among those never or seldom using the system, but also those habitually using it brought up aspects reducing their own happiness with it, and potentially affecting the usage by others. A very strong thought seems to be that the buses are for young, old, poor, weird and foreigners only (interviewee 4: 29 y.o. man, interviewee 7: 40 y.o. woman), and those who can, have cars and drive. Interviewee 6 (41 y.o. man) talks about a "reputational risk" in taking a bus, meaning getting the reputation of being poor or weird if seen in a bus, although he says that he thinks that this situation is gradually improving.

*"...people find it maybe a liiiiittle bit embarrassing to take the bus, some people, but, but as I say I think that that attitude is changing a bit, but ... there is like some, reputational risk hehe that accompanies it" (interviewee 6: 41 y.o. man)*

*"...people are just really negative towards the bus often, like at my workplace there are a few that are really negative and they're like, very loud regarding it even though they have no experience of it, just hear it from the outside..." (interviewee 4: 29 y.o. man)*

*"People taking the bus, I think it's people who are looking at (concerned about) the money, and also people who are members of the home who don't care to bring the kids to the playschool." (interviewee 7: 40 y.o. woman)*

Typically those not using buses, have the worst opinion of the system. They consider the routes scarce and departures infrequent (interviewee 16: 34 y.o. woman, interviewee 19: 42 y.o. woman, interviewee 10: 37 y.o. woman).

*"I don't know, but ... I think the bus would have to be changed three times. And I don't know how it would work out in terms of time." (interviewee 16: 34 y.o. woman)*

*"...the main reason that I haven't used it here, and used it a lot abroad, is that, they, of course abroad they go every 10 minutes, you never need to wait really, and they stop almost everywhere so if, it's so easy to change, and easy to get the next one and, uhh, I just haven't put myself into it here, but I have just heard that there are usually 20 minutes between..." (interviewee 10: 37 y.o. woman)*

The respondents also frequently brought up the high prices of bus tickets, and this opinion goes across the division into those using and not using buses.

*"...the price of like a year bus card for just, you know, an adult is insane..." (interviewee 17: 30 y.o. woman)*

*"I mean, try to go by bus taking a daily ticket. You spend 1,000 isk a day, which is 5,000 isk a week, for the bus. You have to wait in the cold which doesn't make any sense to me." (interviewee 18: 36 y.o. woman)*

*"...it's still more work, like waste of time I would say to wait for the bus and go around with the bus and as well the bus is not that cheap." (interviewee 19: 42 y.o. woman)*

Related to the perceived relatively low frequency of departures, unreliability with the stop arrival times seems to be somewhat an issue reducing the perceived satisfaction with the system among those actually using buses.

*"I think it has never been on time a single time I've taken it in the past two months. Sometimes it's early, so it's not even like that." (interviewee 17: 30 y.o. woman)*

*"helps a lot the app they gave out, so you could just see where it is, and just go out when you know there is a short time until it arrives so I felt that it changed a lot but, more frequent trips I would say, and maybe more reliability..." (interviewee 6: 41 y.o. man)*

## Main policy conclusions on mode choices

1. **The public image of the bus system should be improved.** The image is worse than the perception by those using buses. This could be improved by e.g. marketing campaigns and fiscal incentives to try buses.
2. **Prices of bus tickets should be brought down.** A significant limiting factor seems to be the price level of bus tickets. The opportunity cost of traveling by bus when one has a car is negative, and works strongly against higher usage.
3. **Departures should be made more frequent.** The image of the system regarding infrequent departures prevails also among those habitually using buses. Improvement would reduce the negative perception of unreliable schedules, as the next bus would be arriving sooner. Experiences from other countries give support for the positive impact of increased departure frequency.

## Rationales behind daily travel behavior

Geographical analyses show how proximity to the city centers decreases total distances traveled (Figure 2, Figure 3, and Figure 4) and distances driven (Figure 14), besides the influence on mode choice and car ownership discussed in previous sections. The geographical pattern is stronger in commuting trips than in non-commuting ones. An analysis of the qualitative material provides further insights into rationales behind travel behavior in the Capital Region.

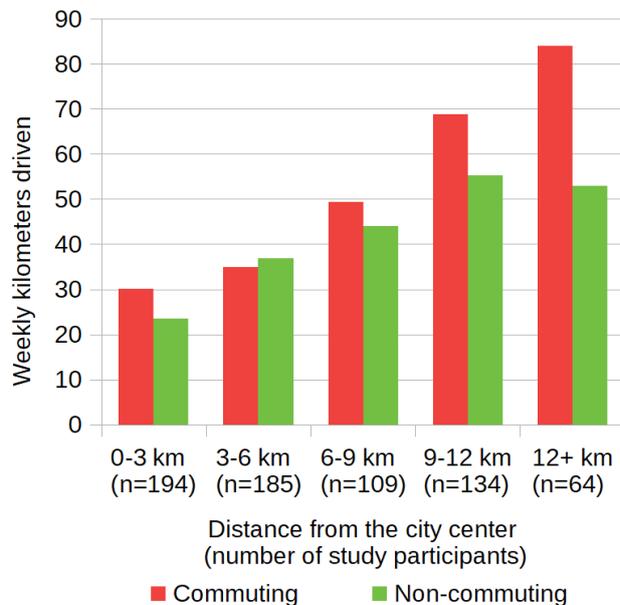


Figure 14. Weekly kilometers driven by respondents living in different distance bands from Reykjavik city center.

Cars seem to have a strong influence on the activity space of the respondents. Interviewee 5 (29 y.o. woman), who does not possess a car, and interviewee 4 (29 y.o. man), who avoids unnecessary car use, tell how they choose locations within walking distance. Those possessing vehicles are more free to choose locations from wherever as they anyway typically drive there (interviewee 7: 40 y.o. woman, interviewee 2: 40 y.o. woman, interviewee 16: 34 y.o. woman, interviewee 21: 42 y.o. woman).

*"...it's all within walking distance from me and it's very comfortable..." (interviewee 4: 29 y.o. man)*

*"I'm going to the gym. I drive there, there is a swimming pool in Kopavogur, I go there. I chose it, because it is best to go there. There I go 4-5 times a week. Then I go to Bónus or Krónan, ... Then I go up here to Höfði, at least 2 times a month ... Then I go to visit my sister, who lives in Breiðholt, maybe I go there weekly or something. Going to visit my parents ... maybe once a week. I drive in all these places." (interviewee 7: 40 y.o. woman)*

Interviewee 2 (40 y.o. woman) explains how for the routine she goes to the same gym where she started years ago even though it is not near. She also discusses that if she became a car-free person, she could not go to this gym anymore, and would likely quit going to gym overall. Several car owners anyway told how they try to minimize time spent in traffic, and therefore choose locations

near to their homes for leisure-time activities (interviewee 1: 40 y.o. man, interviewee 6: 41 y.o. man).

*"there's nothing that irritates me more than traffic" (interviewee 1: 40 y.o. man)*

*"I would mostly prefer not to travel at all, ...but I think I have minimized it pretty well, I think, I don't know if I could get the time down any more." (interviewee 6: 41 y.o. man)*

Some respondents not having cars at their disposal all the time described how it is a limiting factor if they don't have the services they would like to use in close proximity. For interviewee 17 (30 y.o. woman) cafés are such a service. Their use is limited by access without a car.

*"I'm a big fan of cafes and stuff like that. So they're important, and I still try to kind of incorporate that into like my lifestyle, but it feels a little bit silly to the bus just for one." (interviewee 17: 30 y.o. woman)*

One respondent living in suburban areas explained how the residential location reduces their activity participation. They are a couple who previously lived in the city center, and now in the suburb their lives have become more home-oriented and particularly less service use -oriented (interviewee 17: 30 y.o. woman).

*"...there's not much to do ... it's really boring. That's my main complaint. ... downtown we used to like listen to people like puking outside at like two in the morning ... but at least at the same time it like felt alive." (interviewee 17: 30 y.o. woman)*

Bus use is the most common for commuting (interviewee 17: 30 y.o. woman, interviewee 5: 29 y.o. woman, interviewee 3: 29 y.o. man, interviewee 18: 36 y.o. woman). Only interviewee 4 (29 y.o. man) tells that he habitually uses buses to reach leisure-time destinations further away. It would seem that those able to reach their destinations with one connection are relatively satisfied, or even like the travel time, and also accept relatively long travel times. However, when there are interchanges required, the level of satisfaction seems to go down quickly.

*"I think it's like 30 minutes, 35 minutes to get to school. So it's, it's really, I was really surprised with how great the bus was to get to school..." (interviewee 17: 30 y.o. woman)*

*"Well in the mornings, I drive a little bit with my boyfriend and take the bus there at 7:45, at Arnarsheight, the number 2, and then I'm at work at 8:05/8:10. So we leave home at 7:30, because it's on his way. And on the way back home, there it goes, I think the shortest I ever managed to be was 40 minutes, and the longest I think 1 hour and 20 minutes, yeah, like if everything, you know? I have to take three buses, if everything, if every connection doesn't work then I'm like that." (interviewee 18: 36 y.o. woman)*

Cars clearly facilitate activities further away, and whereas those either not possessing vehicles or avoiding using them tell about nearby locations and activities (interviewee 5: 29 y.o. woman, interviewee 4: 29 y.o. man, interviewee 1: 40 y.o. man, interviewee 6: 41 y.o. man), some car owners tell about engaging in activities outside the city to which there is no access without a car (interviewee 10: 37 y.o. woman, interviewee 21: 42 y.o. woman).

*"...I want to be more, hiking mountains and going to the countryside and something like that" (interviewee 10: 37 y.o. woman)*

"I hike. I ski. It's not possible to go skiing when you don't have a car in Iceland." (interviewee 21: 42 y.o. woman)

## Main policy conclusions on daily travel patterns

1. **The public image of the bus system should be improved.** Those habitually using buses describe them as places to relax, sleep and enjoy as time of their own. The appealingness could be improved by marketing campaigns.
2. **Walking and cycling infrastructures should be improved.** Regardless of the dominant travel modes, the respondents brought up their appreciation of walkability. Cycling seems to be somewhat suffering from infrastructure weaknesses.
3. **Evening and weekend bus service should be improved.** Both bus users and those willing to use it if the service met their needs, brought up the weak service-level in the evenings and weekends between the city center and the suburbs.

## Daily travel patterns and subjective well-being

Connections between modality styles and subjective well-being were studied quantitatively in the report from the SuReCaRe 2 project delivered to the Vegagerðin in 2019. Some differences were found between the mobility style groups on their stated subjective well-being. Car commuters (consistent and multi-modal) reported the highest levels of satisfaction, whereas bus commuters and non-commuters reported the lowest. This implies that bus commuting and non-commuting are not necessarily choices, but more a life course situation (non-commuting) or due to no other option being available or serving well (bus commuting). Those primarily commuting by foot were found to have the highest life satisfaction as a whole.

Table 5. Average scores of satisfaction with life domains among members of the behavior-based modality styles.

	Bus commuters	Consistent car commuters	Non-commuters	Multi-modal car commuters	Pedestrian commuters	Bicycle commuters	Summary
How satisfied are you with...							
...your material standard of living?	6.12	6.98	6.20	7.03	6.64	7.00	6.77
...your current state of health?	6.77	7.06	6.35	7.08	7.08	7.66	6.99

...your personal relationships?	6.98	7.77	7.19	7.69	7.62	7.82	7.59
...feeling part of your community?	6.23	7.00	5.90	7.37	6.97	6.80	6.83
...the amount of time you have to do the things you like doing?	6.03	5.76	6.08	6.22	6.46	6.28	6.05
...your main occupation such as job or studies?	6.83	7.11	6.34	7.47	7.60	7.08	7.11
...the quality of your local environment?	6.90	7.31	7.09	7.61	7.19	7.43	7.30
...things you are achieving in life?	6.75	7.00	6.33	7.12	7.01	7.00	6.91
...how safe you feel?	7.63	7.95	7.49	7.95	7.89	8.13	7.87
...your life as a whole these days?	6.77	7.40	6.87	7.55	7.62	7.38	7.33

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Note: Satisfaction scores in green represent a value higher than average and scores in red below average.

One of the lowest scores was found within the group “consistent car commuters” with satisfaction with the amount of time they had to do the things they like doing. This suggests that at least some of them are stuck in traffic for too much time, or that they drive between places rather than take other travel modes because of time constraints in life. However, the score for this satisfaction question was relatively low with all types of commuters. Non-commuters had a low score for satisfaction with feeling part of their community. They also had the lowest scores compared to other groups with satisfaction with how safe they feel, things they are achieving in life, their main occupation and their current state of health.

The score that was the highest compared to the average was the satisfaction with the current state of health, where bicycle commuters had .67 higher than average. This might be an indication of a positive effect the cycling has on physical and mental health that have been well documented in

previous studies (e.g. de Hartog et al., 2010), but may also be due to the able-bodied residents being more likely to start cycling in the first place.

The analysis of interviews provides insights into how daily travel patterns may influence well-being of the residents.

Some interviewees make a direct connection between their daily travel and wellbeing. Typically it is those who commute by active modes (interviewee 5: 29 y.o. woman, interviewee 3: 29 y.o. man, interviewee 4: 29 y.o. man) who brings up the wellbeing effect. Interviewee 5 (29 y.o. woman) talks about the mindfulness effect of walking and bicycling. Interviewee 3 (29 y.o. man), who anyway enjoys cycling to work (16 km each direction) and considers it important for his physical health, also brings up how inadequate cycling infrastructure reduces the wellbeing effect of cycling. Interviewee 2 (40 y.o. woman) makes an exception among the habitual drivers and says how she enjoys the time she is driving as a time for herself.

*"It is of course the most fun to ride the bike, because it is best to bike, there is both such a mindfulness to it, and start the day by not having to .... you know this is brilliant. I feel an incredible difference. It is best to ride a bike and the next best thing is to walk and the third one is to take the bus and then the worst is to drive." (interviewee 5: 29 y.o. woman)*

*"...to walk is just very pleasant because I find the neighbourhood comfortable to walk through and like, listen to music and something..." (interviewee 4: 29 y.o. man)*

*"Driving can be time for yourself. It's a good way to start the day and offers a chance to think without thinking" (interviewee 2: 40 y.o. woman).*

Even though in general the bus system was criticized by many respondents, those actually using buses habitually, and particularly when reaching their destinations with one bus, strongly connect the travel time to personal wellbeing (interviewee 2: 40 y.o. woman, interviewee 17: 30 y.o. woman, interviewee 4: 29 y.o. man). Interviewee 6 (41 y.o. man), who only occasionally uses buses, also tells about the relaxing feeling when in a bus with no need to focus on the traffic.

*"What I find positive about taking the bus is that you can a little bit like zone out completely..." interviewee 2: 40 y.o. woman*

*"I found it very comfortable to travel by bus listening to music ..., or a podcast or something similar, I find that very pleasant, ummm ... in the bus I could sit and zone out and even take a nap because at a certain point it would have arrived at work and if I needed to take a nap..." (interviewee 4: 29 y.o. man)*

Buses are seen even as a place for napping by many respondents (interviewee 4: 29 y.o. man, interviewee 3: 29 y.o. man, interviewee 6: 41 y.o. man).

*"...in the bus I could sit and zone out and even take a nap because at a certain point it would have arrived at work and if I needed to take a nap..." (interviewee 4: 29 y.o. man)*

*"I'm asleep. I only take number 15 and it goes straight to... as close to my workplace as possible." (interviewee 3: 29 y.o. man)*

Habitual drivers mostly did not make any direct connection between travel and wellbeing, except for interviewee 2 (40 y.o. woman) discussed above. Indirectly, many talked about the aim of

minimizing travel time, or time spent in traffic, and the satisfaction of feeling successful in this (interviewee 1: 40 y.o. man, interviewee 19: 42 y.o. woman, interviewee 10: 37 y.o. woman, interviewee 16: 34 y.o. woman, interviewee 21: 42 y.o. woman).

Some respondents discussed separately how the local environment around their homes brings wellbeing to them if they go for a walk or just spend time in a park nearby (interviewee 7: 40 y.o. woman, interviewee 5: 29 y.o. woman, interviewee 17: 30 y.o. woman, interviewee 6: 41 y.o. man, interviewee 21: 42 y.o. woman).

### **Main policy conclusions on wellbeing effects of local mobility**

- 1. Active model of travel should be emphasized on the cost of cars.** All actively using active transport modes experience wellbeing effects.
- 2. Bus system image should be improved.** Bus trips are associated with many wellbeing effects by the respondents, unlike car travel. This should be utilized for improving the public image of buses.
- 3. Smoothness and directness of bus travel should be improved.** The need to change on the way quickly reduces the satisfaction and erases the wellbeing effects of taking the bus.

## **Urban form and subjective well-being**

This chapter is split into the key themes that emerged as affecting an individual's physical, social and mental well-being from the neighborhood structural, functional and contextual aspects. Each section includes a few relevant quotes.

### **Neighborhood composition**

The neighborhood composition of an area in regard to linguistic, cultural and age diversity affected well-being both positively and negatively. While some spoke of the diversity of the composition in a very positive light, others found that language barriers between neighbours constrained their social well-being.

*“Such a mixed social group and lots of kids and so I like it very well” (interviewee 7: 40 y.o. woman)*

*“There are people who live there from many different origins and I think it's really positive.” (interviewee 5: 29 y.o. woman)*

*“although I don't have much contact with them, they speak very limited Icelandic and kind of no English ... I do think it's a negative, but it doesn't ruin living here for me” (interviewee 10: 37 y.o. woman)*

### **Neighborhood attachment**

Neighborhood attachment contributes to social well-being and is connected to two main aspects regarding connections to a neighborhood; familial and friendship connections and feelings of belonging and rootedness to an area. Most participants noted having friends and family in a walkable distance, and many mentioned that living in an established neighborhood was important to them. Although no major differences were evident between suburban and central residents in terms of social connections, it is worthy to note that it seemed common for people to choose to

live in the neighborhood that either they or their spouse grew up in, which in turn could be connected to both familial and friendship connections and feelings of belonging, sense of community and rootedness to an area.

### Familial and friendship connections

*“My mother still lived in the apartment where I grew up, very close to her. Just comfortable in many ways. I, of course, know the area very well. I am very happy to this point.” (interviewee 2: 40 y.o. woman)*

*“Yes, eh, my wife’s parents live relatively close by, well she grew up there and knows uh the neighborhood and all that, I grew up in Vesturbær, so she kind of persuaded me to go there and just, I’m satisfied with it.” (interviewee 6: 41 y.o. man)*

### Feelings of belonging, sense of community and rootedness to an area

*“There are many things which I find positive about the neighborhood and make me feel good and I have very positive emotions towards. I feel like I belong there.” (interviewee 2: 40 y.o. woman)*

*“Everything is really established, many people have lived there for decades, and I like that. ... one feels very good, it matters a lot, I at least can’t really imagine moving away.” (interviewee 4: 29 y.o. man)*

*“I think you know many of your neighbors, even though you don’t know them, you know like there’s this, auto.. automatic like neighborhood watch going on kind of and one can, yes, people are chatting together a lot so it’s a very comfortable environment,, just a somehow very friendly environment.” (interviewee 6: 41 y.o. man)*

*“It’s like, you recognize quite many around, more than I am used to from living elsewhere.” (interviewee 4: 29 y.o. man)*

### Good neighborliness

While good neighborliness can be defined as neighbors who are deemed friendly and helpful, it seemed more common that neighbors were held in a positive light if they were quiet and didn’t cause any problems. This lack of contact with neighbors didn’t seem to differ much between neighborhoods. However, helpful neighbors were mentioned in a few interviews. One resident living in Austurbær said that her neighbor lets her cat in when they’re away and another resident of Seltjarnarnes said that there is an automatic neighborhood watch, which creates a sense of security.

*“They let our cat in when we are away, if it needs to go inside. Amazingly nice.” (interviewee 5: 29 y.o. woman)*

*“Yeah I at least find it to be a big benefit (the neighborly vibe), I didn’t choose this place because of that, but I think it’s a benefit after having experienced it there, it’s a certain security...” (interviewee 6: 41 y.o. man)*

## Neighborhood quality

Neighborhood quality is connected to four interrelated aspects; neighborhood walkability, calm traffic, aesthetic appeal of neighborhood and calm and quiet area versus noisy area.

## Neighborhood walkability/accessibility

Few interviewees were unhappy with either the lack of bicycle paths around the city, or that they are often a detour route rather than a straight one. For those individuals, this factored into them not cycling as much as they would like to, which in turn decreases mental and physical well-being. While most participants were content with the walkability of their neighborhood and described the benefits of it for their physical and mental well-being, in the central areas walkability was more often connected to walking in town and access to services by foot, while in the suburbs there was more emphasis on recreational walking paths in nature.

*“I just walk the streets, it’s quite comfortable to walk. Not hard. Just walk paths, and this neighborhood was made for walking traffic.” (interviewee 2: 40 y.o. woman)*

*“Another thing which is a complete luxury in Pingholt, I can walk on the street to work.” (interviewee 8: 38 y.o. woman)*

*“And that there is good accessibility, that matters to me. That I can walk and move.” (interviewee 5: 29 y.o. woman)*

*“There are lots of walking paths. ... I like to walk around there. Or, yesterday I walked to Helgafell, it’s a little volcano outside of town, which is a further walk, but, yeah, mainly I’d do that.” (interviewee 1: 40 y.o. man)*

## Quiet and calm area versus noisy area

Interviewees living close to sources of noise pollution, such as the domestic airport, construction or heavy traffic, expressed dissatisfaction while others residing in calm and quiet areas were satisfied. In our assessment, noise pollution was not connected to any specific type of urban form and residents living in the city center were generally content with the calmness of their neighborhood, which played a factor in their well-being.

*“it’s loud as hell.” (interviewee 3: 29 y.o. man)*

*“Of course, I know it’s temporary, there are always some machines and all day long. It’s tiring. The kids have also been complaining about it.” (interviewee 7: 40 y.o. woman)*

*“this location is actually perfect, because it’s both, both, such a short distance to umm, shops and services and work, in every direction, uhh, but also a bit remote from it, you know that it’s completely a neighborhood for itself.” (interviewee 8: 38 y.o. woman)*

*“The area is very comfortable, short distance to most services, short distance to the center, but still not in it. You don’t have the partygoers puking in your backyard.” (interviewee 2: 40 y.o. woman)*

## Aesthetic appeal of the neighborhood

Regarding the aesthetic appeal of a neighborhood, vegetation cover seemed to be the dominant factor. While all participants mentioned that they liked having vegetation, the importance of it to them varied. Positive benefits of vegetation included increased well-being, weather barriers, beauty and increased privacy.

*“...the environment, trees, vegetation and all that, have a great impact on well-being.”*  
(interviewee 5: 29 y.o. woman)

## Traffic

Many participants mentioned traffic negatively affecting their well-being, whether it was waiting in it or not wanting to live in close proximity to the noise pollution stemming from it. Slow traffic around the residential neighborhood was connected to satisfaction. Although it was rare that compact city residents complained over traffic noises, a suburbanite mentioned he would not want to live in Miðbær or Hlíðar due to the close proximity of the major traffic veins, which he at another point in the interview states he likes living close to in order to get on the main road faster. More centrally located residents mentioned not wanting to live in the suburbs because of the commuting time in traffic.

*“...but it’s really calm car traffic, which I really like.”* (interviewee 8: 38 y.o. woman)

*“but I would for example never want to be in Hlíðar, or Miðbær or something like that. Umm I feel that it’s too close to like, the main traffic vein... in Reykjavík lies through the Hlíðar, and I just find that terrible.”* (interviewee 1: 40 y.o. man)

## Green space access

Green space access was commonly connected with health and well-being benefits. The green spaces mentioned were private gardens, shared green spaces and vegetation cover in general, and many stressed the importance of proximity of their residence to either nature or public green spaces. Participants who had private gardens connected them with the social and physical benefits as well as privacy, while those who didn’t have one didn’t seem to mind. Balconies were enough outdoor private space for those who had access to them, and some stated that public parks were satisfactory to serve the same purpose as private gardens. Most were content with the access to green spaces, independent of their residential neighbourhood, but one respondents living in Kópavogur stated that she had had a hard time finding a residential area that was green enough and close enough to nature, which was important to her and her children’s physical well-being. Moreover, some interviewees living in both the suburbs and centrally expressed the psychological benefits of the vegetation cover in their neighborhoods.

*“It’s very good, we, of course, have uhh, Hljómskólagarðurinn just right by us, umm, there there’s a uhh, grill accommodation for example which is open to the public and we can through kids birthday parties there, you know that’s awesome.”* (interviewee 8: 38 y.o. woman)

*I feel it’s like, yeaah both to have more private, privacy you know it’s like, it’s a certain natural fence, between, and also just beautiful.”* (interviewee 6: 41 y.o. man)

*“the main thing was the environment in this neighborhood, and to have all green, we had searched a lot and there were not many places that were green...” (interviewee 7: 40 y.o. woman)*

*“We just live there right below Fossvogur. From there, natural paths are just in every direction. I was very much outside running and of course, I used it very much and the kids play there and there is frisbee golf, you can go out into Nauthólsvík, bicycle or walking or something like that. It will be useful in such leisure time.” (interviewee 7: 40 y.o. woman)*

*“Yeah, I just feel it is really healing (neighborhood vegetation), there are so many forests in there; this is kind of weird, you just feel the smell of the trees, I don't know what it is completely, you feel like this is a Swedish forest. It's a good feeling.” (interviewee 7: 40 y.o. woman)*

*“I'm of course raised in such a green neighborhood. and I think it might have had some effect. I couldn't think of going anywhere like everything was new and bare.” (interviewee 7: 40 y.o. woman)*

## Service access

All interviewees found access to services to be an important factor contributing to their well-being, regardless of their preference for residential location. Good access to services was connected with convenience and comfort, along with both a short travel time by car and having services within a walkable distance. Limiting travel time to work was also a factor mentioned as a benefit for well-being. Some participants mentioned that easy access to entertainment services and shopping centers was a large factor in residential location choice. Although deemed important to all, participants living centrally seemed to express more interest in proximity to services and connected the city center with social well-being, and connected boredom with residing in suburbs.

*“Yes, it's, of course, the center so there's, it takes maybe as I say, takes maybe a maximum of 10 minutes to walk to work, kind of 10 minutes to walk to most things because in the center there are most things, I sort of seek very little outside of the center.” (interviewee 4: 29 y.o. man)*

*“it's comfortable for my boys, umm, that we can send our boys, or go with them for all sorts of entertainment there. They can go ice skating, bowling, cinema and, you know, it just takes 5 minutes to walk out there. (interviewee 1: 40 y.o. man)*

*“I think it's very comfortable to be this close to the center, without being in it, and I find it very comfortable how short it is to a lot of services.” (interviewee 2: 40 y.o. woman)*

*“No, uhh, I wouldn't say that, it's of course in the city center, and that which uhh, places to meet people and places for uhh, social interaction, in general, are just the city center, all of it. ... It's very very important to me.” (interviewee 8: 38 y.o. woman)*

## Population density/number

Residents residing in both the suburbs and the compact area expressed their need for having privacy as affecting their well-being. However, there is indication residents can get used to higher density with time. One respondent connected density with social isolation, which in turn lowers well-being.

*“Whereas, with Icelandic housing and stuff, everyone's a lot closer. And your neighbors, it feels like they're practically in your house sometimes because you hear them on the balcony or*

*something. So that was really hard for me to get used to even just moving here. ... but I've gotten a lot more used to it, now almost six years of living here. So it doesn't really bother me as much.” (interviewee 17, woman 30 y.o.)*

*“I want to move to a smaller community, I feel that it’s lacking, like in Copenhagen I was more isolated than in Reykjavík, and I was more isolated in Reykjavík than in Mosfellsbær, so it’s somehow the smaller the town the less isolated” (interviewee 10: 37 y.o. woman)*

## Takeaways for policy

Our analysis suggests that no matter where one prefers to reside, proximity to services and recreation is an important factor for well-being, in addition to privacy and a quiet surrounding. However, integrating services into residential streets might decrease the well-being of some of the residents who stress the importance of recognizing the people who walk in their neighbourhood. Although privacy is important to many of respondents, there is indication of it being an adaptable factor and can change with time and circumstances.

Finding ways to minimize the amount of traffic should be emphasized, although respondents seem torn between wanting slow traffic around them and reducing travel time. The solution does however not seem to be improving traffic flow by widening streets or adding lanes, as many respondents express not wanting to live near heavy traffic streets, but the need to densify the city would result in dissatisfaction among those residing near those major traffic veins.

As the rootedness of a neighbourhood positively affects well-being, we suggest to minimize residential turnover with buildings that can evolve with the family structure. As many respondents expressed discontent for tourists staying in their neighbourhood, from a well-being perspective it is advised against integrating guest houses within residential areas.

Vegetation cover around the city should be increased and existing greenspaces should be protected, and keep their role as centres for outdoor recreation.

## Conclusions

The project was built around three objectives:

1. To characterize mobility styles and travel-related GHG emissions of Reykjavik residents at the aggregate spatial levels based on individual travel patterns and residential locations
2. To provide detailed knowledge about motivations and rationales behind daily travel behavior and its associated factors such as car ownership and residential location
3. To explore the daily travel patterns and urban form at the residential location on subjective wellbeing

The following conclusions are organized around these objectives.

## Objective 1

Private cars dominate travel in the region, with the majority of distances and trips traveled by car. Although dominant in all locations, a spatial trend was found, where the car had a lower mode share in the city center than in the outskirts. The bus was used rarely, but most commonly in Mosfellsbær for commuting trips and in Grafarholt and Úlfarsárdalur for non-commuting trips. It was very rarely used for non-commuting purposes. While the share of commuting to work by bicycle was the highest in Seltjarnarnes (22%), the share of non-commuting trips in that area was only 4%. Residents from Laugardalur had the highest share of all trips by bicycle. The highest share of commuting trips by car was found in 103 (Háaleitis and Bústaðahverfi), with 91% of trips, but residents in that area also had the highest share of trips by foot for non-commuting purposes. The lowest share of commuting trips by car was in Hlíðar and Vesturbær (60%).

The highest share of consistent car commuters was in Grafarholt and Úlfarsárdalur (70%), and the lowest in 101 (17%), where the highest share of pedestrian commuters was found (31%). Residents living in Hlíðar had the lowest average annual GHG emissions from travel within the region, and Grafarholt and Úlfarsárdalur had the highest. The longest weekly distance travelled was found in Mosfellsbær. Car ownership was 100% in 6 postal codes, but was the lowest in 101, followed by 111 Breiðholt.

The main policy takeaways related to mobility styles and GHG emissions are densification of the city center and its immediate surrounding, the development of a bus rapid transit system (BRT), discouraging car ownership and use and promoting electrification of private vehicles.

## Objective 2

To reach the second objective, 13 in-depth interviews were conducted among the respondents of the survey utilized in fulfilling the objective 1. A detailed two-step analysis was run on the interviews to reach a deep understanding of the perceptions and rationales of the respondents on their location choices and transport patterns. Following from the nature of qualitative research and interviews as a research method, the findings provide indication of causal relationships and reasons for certain behavior among broader populations, but should not be generalized if not supported by other data.

The main findings on the objective 2 are:

- 1) The preference for liveliness or calmness of the urban environment is a strong factor behind location choices.

Higher preference for liveliness seems to lead to residential locations closer to the city center, whereas preference for calmness leads to locating to suburbs.

- 2) Regardless the liveliness preference, greenness of the own immediate neighborhood is valued highly, be it parks, streetside trees, green structures such as walls or roofs, or full forests nearby.

Higher perceived greenness seems to lead to higher satisfaction with the own residential neighborhood.

- 3) Walkability of their own residential area is highly valued by almost all regardless of their dominant ways of travel.

Even though car-culture is strong in Reykjavik, even many car users highly value walkability around their homes, and could see themselves walking (or cycling) more if the infrastructure provided good-enough support.

- 4) Local services within walking distance are highly valued by suburban residents.

Large shopping malls such as Kringlan or Smáralind do not serve the need of local grocery stores, cafés and restaurants. Even those with high preference for calmness seem to value local services with pedestrian access, and vice versa, lack of them leads to dissatisfaction.

- 5) Bus system has a much worse image among those not using buses, than among those using.

Bus users typically enjoy using buses, as long as one single line without changes serves them. Those not using buses evaluate them typically as slow, infrequent, unreliable and the lines scarce.

- 6) Active travel modes lead to the highest satisfaction, followed by bus travel.

Those using active travel modes connect the daily local trips to wellbeing and satisfaction, whereas car travelers typically only try to minimize the time spent in traffic. Bus trips without the need to change buses were often connected to positive feelings.

Drawn from the above, a few directions for policies towards more sustainable urban transport can be drawn. More detailed suggestions have been presented in the end of each sub-section in the results part, and the below list only summarizes the main suggestions.

- 1) Local walkability should be given strong emphasis in urban planning and development.
- 2) The amount of green structures in all forms, parks, streetside trees, green walls and roofs etc., should be increased.
- 3) Service-levels outside the Reykjavik city center and the big shopping malls should be improved.
- 4) The public image of the bus system should be improved.
- 5) Prices of bus tickets should be brought down and the service-level in terms of shifts and routes should be brought up.
- 6) Number of parking places should be reduced to disincentivize car possession.

### Objective 3

Neighborhood attachment contributes to social well-being and is connected to two main aspects regarding connections to a neighborhood; familial and friendship connections and feelings of belonging and rootedness to an area. While good neighborliness can be defined as neighbors who are deemed friendly and helpful, it seemed more common that neighbors were held in a positive light if they were quiet and didn't cause any problems.

While most participants were content with the walkability of their neighborhood and described the benefits of it for their physical and mental well-being, in the central areas walkability was more often connected to walking in town and access to services by foot, while in the suburbs there was more emphasis on recreational walking paths in nature. Interviewees living close to sources of noise pollution, such as the domestic airport, construction or heavy traffic, expressed dissatisfaction while others residing in calm and quiet areas were satisfied. In our assessment, noise pollution was not connected to any specific type of urban form and residents living in the city

center were generally content with the calmness of their neighborhood. Slow traffic around the residential neighborhood was connected to satisfaction. Regarding the aesthetic appeal of a neighborhood, vegetation cover seemed to be the dominant factor. While all participants mentioned that they liked having vegetation, the importance of it to them varied. Positive benefits of vegetation included increased well-being, weather barriers, beauty and increased privacy.

Green space access was commonly connected with health and well-being benefits. Participants who had private gardens connected them with the social and physical benefits as well as privacy, while those who didn't have one didn't seem to mind. Balconies were enough outdoor private space for those who had access to them, and some stated that public parks were satisfactory to serve the same purpose as private gardens.

All interviewees found access to services to be an important factor contributing to their well-being, regardless of their preference for residential location. Although deemed important to all, participants living centrally seemed to express more interest in proximity to services and connected the city center with social well-being, and connected boredom with residing in suburbs.

Residents residing in both the suburbs and the compact area expressed their need for having privacy as affecting their well-being. However, there is indication residents can get used to higher density with time. One respondent connected density with social isolation, which in turn lowers well-being.

The main takeaways for policy from a well-being perspective would be to provide good access to services and recreation areas while ensuring the privacy of residents, as well as minimizing and slowing down traffic and increasing vegetation cover around the city.

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# Appendix A

## Motivations and rationales behind residential location

1. How did the neighborhood characteristics affect the location choice?
2. Is there an indication that travel related reasons or motivations affected the residential location choice?
3. What other factors affected the residential location choice?

## Motivations and rationales behind car ownership

4. How does the respondent reason possessing / not possessing a vehicle (or several)?
  - a. How does the respondent describe the rationales behind choosing or possessing a vehicle with specific qualities?
5. Is there an indication of societal underlying reasons for vehicle possession or avoidance of vehicle possession?
6. Is there an indication of other underlying reasons for vehicle possession or avoidance of vehicle possession?

## Motivations and rationales behind mode choice

7. How does the respondent describe his/her travel mode choices?
  - a. What are the rationales behind choosing or not choosing the car?
  - b. What are the rationales behind choosing or not choosing to walk?
  - c. What are the rationales behind choosing or not choosing the bus?
  - d. What are the rationales behind choosing or not choosing to cycle?
8. How does car-ownership influence the mode choice?
9. What other factors seem to affect the mode choice?
10. Is there an indication of societal underlying reasons for mode choice of the respondent?
  - a. Is there an indication of societal underlying reasons for mode choice of others? E.g., stereotypes or other social norms

## Motivations and rationales behind daily travel behavior

11. What are the travel needs of the respondent based on the activities and their locations?
12. How does the respondent describe his/her commute?
13. How does the respondent describe his/her travel to non-work activities?

## Wellbeing effects of daily travel behavior

14. Whether and how the respondents connect mode choice to wellbeing effects?
15. What are their experiences of wellbeing effects related to travel behavior?

## Wellbeing effects of the built environment / urban form

16. How do the neighborhood characteristics influence residential satisfaction?
17. How do the dwelling characteristics influence residential satisfaction?