

## **Generalized travel cost (GTC) calculations and emission calculations for the two NOMAD pilot user stories**

**In user story 1, labeled “Camilla”** we imagined a business traveler traveling from her home in a random residential address in the suburbs of Copenhagen to a random corporate office location in the suburbs of Stockholm, and then to and from her hotel there. She is imagined making three local customer visit/meetings whilst there, and then returning home using the reversed itinerary. On her outbound trip she uses the following transportation modes: on foot - bus - metro train - airplane - shuttle bus -rental car; and the same return trip in reverse order. It is estimated that she/her employer saves DKK 50.857 annually vs. using air travel and taxi in both ends, and DKK 102.688 instead of using a private car. In the same manner it is estimated that she saves 81 and 90 kgs of CO2 emissions, and 329 KWh and 8.937 KWh of energy consumption, versus the two alternatives, respectively.

**In user story 2, labeled “Karl”** we imagined a daily commuter traveling from his home at a random residential address in the suburbs of Stockholm to a random corporate office location in the suburbs of Copenhagen. He is then going to and from a business lunch whilst there, and then returning home using the reversed itinerary. On his outbound trip he uses the following transportation modes: Own bike – -train (Öresundstog) – EV car share (and city bike to and from lunch meeting), and then the same return trip in reverse order. It is estimated that he saves DKK 11.012 annually vs. a trip using a conventional travel planner for public transport, and DKK 209.442 instead of using a private car. In the same manner, it is estimated that he saves 78 and 570 kgs of CO2 emissions, and 237 KWh and 11.396 KWh of energy consumption, versus the two named alternatives, respectively.

**The calculations were done using the following procedure:** For the two user stories we have set up imaginary travel routes, which each can be broken down to individual travel segments by travel mode (by bus, airplane, train etc). The travel segments are estimated using a real online travel planner, so that the routes are realistic in terms of travel times, distances and ticket and fee costs etc. We have calculated likely itineraries using estimated travel times and cash cost for one “DANMaaS”-assisted trip, compared to one using an alternative conventional travel planner for public transport, and one using a private car. The travel cost for each travel itinerary is measured in Generalized Travel Cost (GTC) taking into account the out-of-pocket/cash (tickets, fees) + the **cost of time and disutility** in DKK per minute during travel. This time cost differs by travel mode (car, bus etc.) and travel purpose by type of traveler (business and commuter). The values used to calculate the non-monetary costs are the team’s transformation of the preliminary results from the Norwegian Value Of Time-study (Flügel et al. 2019). In addition to in-vehicle times, we factor in walk and wait times between modes, and the estimated disutility by switching modes, and inconvenience with using public transport, bike, car share e.g. vs. simply using a private car or taxi. (In the business traveler example Camilla also is assumed to take three roundtrip local trips to meetings or customers in the Stockholm area during the stay there.)

Then we add up the individual GTC for travel segments/legs and compare the total GTC by the different alternative travel itineraries. The trip GTC are multiplied by 30 business trips per year for the business traveler story for total annual GTC in DKK, and by 250 working days for the commuter user story.

**For the annual emissions and energy use calculations** we have calculated emissions/energy use for the same user stories by estimating travel distance by different transportation modes for the “DANMaaS”-assisted trip vs. two named alternative itineraries as explained above. The emissions and energy calculations are based on energy use and emissions by travel mode per passenger kilometer, which are derived from different published statistical sources, and then applied for each travel segment travel segments/legs. Estimated annual emissions and energy use units are then compared between the corresponding alternative travel itineraries.

The same procedure as for the GTC (i.e. assuming 30 business trips, and 250 commuter working days per annum) is used to arrive at annual estimates for emissions and energy use.