Simple Calculator of Project Effects for Off-Street Parking Policy Reform (Off-Street Parking SCOPE)

Documentation

Acknowledgements

Lead Author:

D. Taylor Reich, Data Science Manager, ITDP Global
Correspondence: taylor.reich@itdp.org

Supporting Authors:

Manuel Blanco, Transport Data Intern, ITDP Global

Madeline Liberman, Associate for Monitoring and Evaluation, ITDP Global

Reviewers:

Lorena Freitas, Travel Demand Management Manager, ITDP Brazil
Yanwen Huang, Transportation Engineer, ITDP China
Tony Jordan, President, Parking Reform Network
Jacob Mason, Senior Director of Research and Impact, ITDP Global
Dr. Adam Millard-Ball, University of California – Los Angeles
Parin Visariya, Urban Development Associate, ITDP India

The inclusion of these reviewers' names is only meant to thank them for their support. All errors remain the responsibility of ITDP alone.

Contents

Introduction to SCOPE

This documentation describes the off-street parking reform module of the ITDP Simple Calculators Of Project Effects (SCOPE models).

The SCOPE models are meant for two audiences. First, for high-level climate funders to estimate the carbon mitigation impacts of potential projects. Second, for transportation planning at the local level, whether by mayors, transportation planners, or advocates, to understand not only the carbon mitigation impacts but also the other benefits of sustainable transportation projects -- benefits like air pollution reduction, economic impacts, and improvements to public health.

No matter how much information the user has available, the SCOPE models are useful. They can be used when a project is in the concept stage, relying on default assumptions to provide a first-order estimate of impact. Or they can be used after a project has been implemented, replacing those assumptions with observed data for a more accurate estimation.

The purpose of the SCOPE models goes beyond mere impact evaluation: they are designed to encourage high quality project design, support a holistic view of the connected parts of a city's transport system, increase consistency and maintain objectivity.

About the Off-Street Parking Model

The SCOPE model is an Excel spreadsheet. It should be filled out from top to bottom within the 'Off-street parking policy' tab before viewing results in the 'Results' tab.

This model is meant to help planners, policymakers, funders, and advocates who need to estimate the impacts that a planned or adopted policy for off-street parking might have on carbon emissions.

The results are intended to be generally correct rather than highly detailed. This means they give a good overall sense of the impact on emissions, even if the estimate is not exact, rather than providing a very specific but incorrect figure.

Off-street parking reform is only one way in which cities can use parking policy to reduce emissions. Other policies which impact both on- and off-street parking are also important, and these policies are most powerful when used together. Other on-street parking reforms include:

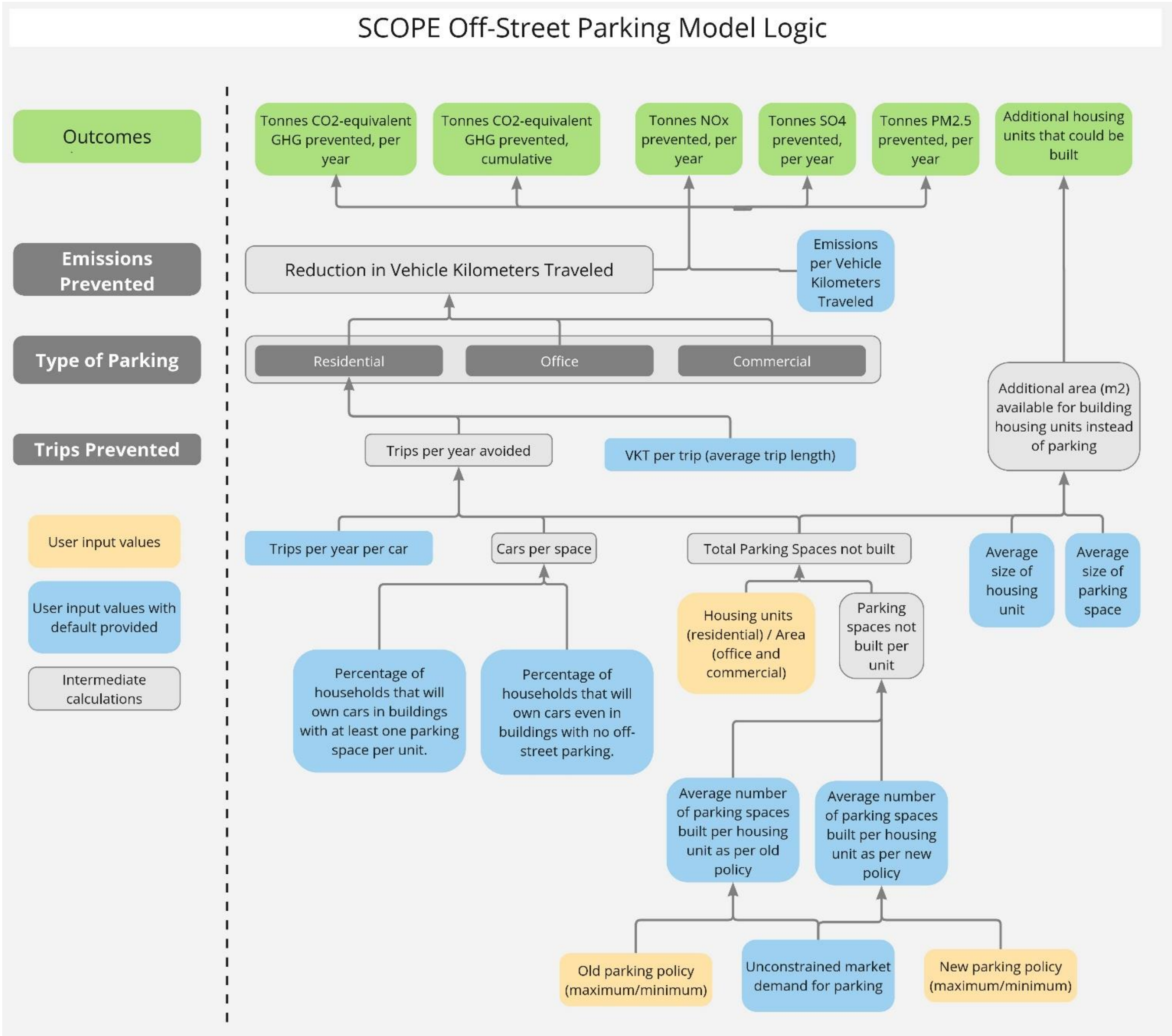
- On-street parking pricing (see this guide)
- Shared Parking / Opening private garages to paying public during off-peak times (measures that enable more people to access the parking that's built, at different times of day)

- Unbundling parking costs from the rent or cost of housing units
- Offering employee payback schemes to reimburse employees who do not drive to their offices
- Carsharing
- Regulation of informal (unregulated and/or illegal) parking
- Comprehensive curb management strategy that identifies and prioritizes all potential uses of curb space

For more information about parking management, please reference *The Opportunity of Reforming Parking: A Taming Traffic Deep Dive Report* at https://itdp.org/publication/the-opportunity-of-reforming-parking/.

Despite the importance of these other policies, this model is limited to estimating the impacts of off-street parking reform in particular. Its synergies with other policies can be reflected by adjusting some of the parameters of the model. For example, in a city with a market-rate pricing scheme for on-street parking in residential neighborhoods, the value of *Percentage of households that will own cars even in buildings with no off-street parking* will likely be lower than 33%.

How the Off-Street Parking Model Works



Mandatory user input	Estimate or assumption that may be replaced by user input	Data from a database	Output

The yellow sections, which are also labeled in yellow in the Excel file, represent basic information about a city or district and the old and new parking policies. They cannot be assumed from default values and must be provided by the user.

The blue sections, also labeled in blue in the Excel file, represent optional details that can be provided by the user so that the model calculates a more accurate result. For each blue value, a reasonable default assumption is provided in gray. These default values are mostly taken from Mexico City, and so they will be most accurate for middle-income cities, especially larger Latin American cities. For smaller cities or cities in low- or high-income countries, we encourage users to provide estimated values for their own city. The ideal source of values is a city-specific real-world study, but for many values (eg., *Car Ownership Rates* or *Average Trip Length*), any city-level statistical information will probably be more accurate than ITDP's defaults. In some cases, even if city-level statistical information is not available, expert judgment should be exercised to ensure that these assumptions are reasonable. For example, in Nairobi, a city where car ownership rates are estimated between 10-20%, the *Car Ownership Rates* should be adjusted to a local expert's best approximation.

There are some blue sections, especially *Parking Construction: New Policy*, for which a true value cannot be known until well after the policy has been implemented. If the model is being used before the policy has been adopted, this section must be left as the default or filled out according to a local expert's best judgment.

The green sections display the outputs of the model. Note that the emissions prevented are shown as positive values that reflect reductions in emissions. In the case of a parking policy that increases emissions, like a raising of parking minimums, the emissions will be shown as negative values that represent increased emissions.

Reasonable defaults are available for almost all of the important variables in the calculation. The only variables that must be entered by the user describe the definition of the policy reform: how many households are in the area where it will apply (which is often the entire city) and how it will affect parking minimums and maximums. Once the user identifies these variables, estimated results are available. These results can be improved by adding more detail to override default values, especially the sections on *Market Demand* and *Car Use*.

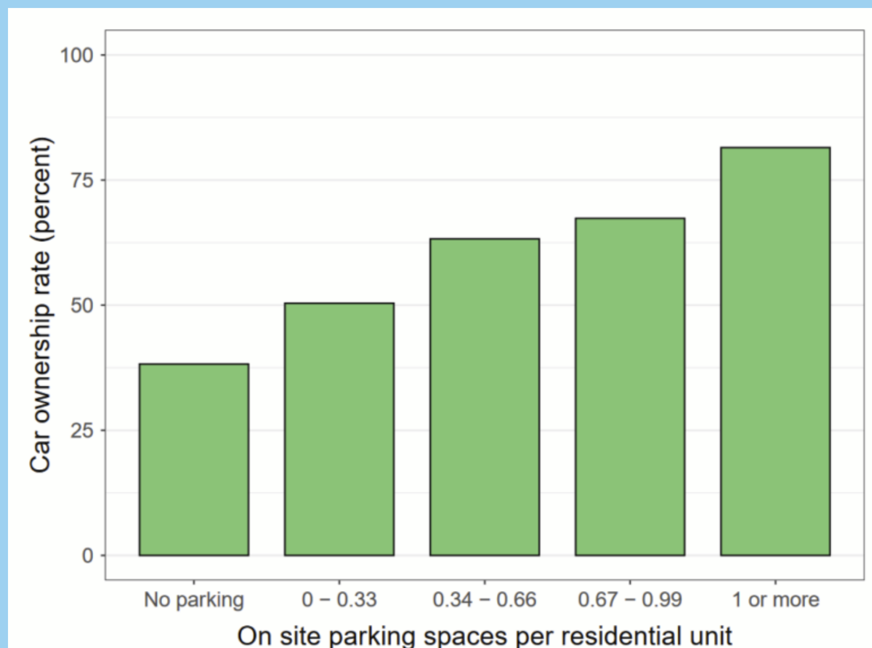
Mandatory user input	Estimate or assumption that may be replaced by user input	Data from a database	Output

Excel cells ("Off-street parking policy" tab unless otherwise designated)	Description
Rows 17:40	**Introductory information** This selection pre-populates the model with city-specific information and, based on country/region selection, appropriate emissions factors for pollutants from car travel based on ITDP & UC Davis (2021).

	The year selected must be after 2020. Growth rates refer to estimated average annual growth rates over the next 20+ years.
Rows 28:33	**Number of residential units, office space, retail space, and growth rate of jurisdiction** This assumes a constant per-year growth rate (as a percentage) that is the same for residential, retail, and office development. If it is necessary to model different growth rates across sectors or dynamic growth rates, you may manually edit rows in the 'calculations' section. Alternatively, you may use different Excel files and sum the results. Depending on the city, the extent of office and retail development in m^2 might be difficult to estimate. In such a scenario, an alternative approach could be to use the land use share data at city level and estimate the share of office and retail space for the particular area where the off street parking policy is being implemented.
Rows 43:51	**Market demand for residential parking** This value represents the number of spaces that the real-estate market would naturally provide per residential unit in the absence of any regulation. We provide a default of 0.5 (50%), an average of two empirically available numbers: 0.34 (34%) in London and 0.65 (65%) in Mexico City. Officer and retail developments in London were not studied, and so we have relied on the numbers from Mexico City (ITDP Mexico 2020, p.24; Li & Guo 2014, p.357, table 2). A local value can be estimated by calculating the average number of cars per household in the area where the parking policy will apply.
Row 53:67	**Scope of Policy Change** This section identifies the scope of the policy change: its inclusion of residential, office, and retail buildings, and the number of units and/or square meters of space within each category. In the case of a citywide policy, estimate the total number of units (or m^2) in the city.
Rows 69:91	**Old and new parking policies**

	The specifications of old and new policies, in terms of number of parking spaces per residential unit or per 100 square meters of office or retail space. Many policies will specify varying parking requirements based on the size, location, or other characteristics of buildings or of housing units. This level of nuance cannot be accommodated in a simple spreadsheet tool. To estimate the impacts of such policies, you can take one of two approaches: 1) Estimate the average requirement for parking per unit or per 100m^2, based on the distribution of building types in your city, or, 2) Use the tool multiple times, once for every sub-category of building, and sum the results. For example, imagine a city has a policy of requiring a minimum of one parking space for every two bedrooms in a housing unit, and that policy is being changed to a maximum of one space per unit regardless of size. The *New Policy* (F31:G31) is easy to fill out as Maximum: 1. The *Old Policy* (F30:G30) is harder to describe. The best approach is probably to estimate the average number of bedrooms per new housing unit in the city, and use that to enter the average number of parking spaces required per new unit. If the average new housing unit has 2.5 bedrooms, requiring 1.25 parking spaces, then we can list the *Old Policy* as Minimum: 1.25.
Rows 93:109	**New buildings only, or renovations?** (Optional) Will the parking policy only apply to new construction, or will it apply to renovations as well? The default renovation rate, 2%, assumes a building lifetime before renovation of 50 years. If the new policy will apply to only some and not all renovations, you can set this factor accordingly. For example, if 2% of buildings are renovated per year, but the policy will not be enforced on half of them, you would enter 1%.
Rows 111:129	**Parking construction rates before and after reform** These values are the keystone of the off-street parking model. Although we have been able to provide defaults based on the available literature, we encourage users to override these defaults with locally-specific estimates if possible. They estimate the number of parking spaces constructed per residential unit or per 100m^2 of office/retail development.

	Estimates are provided for parking construction under the old / current policy (minimums) and the new policy (maximums). In both cases, these estimates can be overridden by user input. In cases where a policy requires a minimum, the default is either a value relative to that minimum of 110%, empirically observed before parking reform in Mexico City (ITDP Mexico 2014, p.59) and very similar to the value of 115% observed before parking reform in London (Li & Guo 2014, p.357, table 2); or the market demand (row 42:46), whichever is higher. In cases where a parking policy imposes a maximum, the behavior is different for residential as opposed to office/retail. For residential, the default is either the maximum or the market demand, whichever is lower. For office/retail, the default is a value relative to that maximum of 94% for office and 93% for retail, based on data from Mexico City (ITDP Mexico 2020, p.24). In cases where there is no maximum nor minimum, the default is a value of the market demand for residential, 94% for office, and 93% for retail relative to the previous minimum, an assumption based on extrapolation from the post-reform Mexico City and London cases. This assumption is justified by Guo & Ren's (2012) finding that "Almost all of the reduction is caused by the elimination of the minimum standard, with a negligible 2.2 per cent reduction due to adoption of the maximum standard." (p.1197)
Rows 131:148	**Car ownership rates** The percentages of households with and without access to off-street parking who own cars. In areas where on-street parking is plentiful and free or cheap or poorly-regulated, it may be more likely for households without off-street parking to own cars. Conversely, in areas where on-street parking is scarce, costly, or inconvenient, it may be less likely for households without off-street parking to own cars. If your city has a plan to regulate or remove on-street parking, it may be reasonable to accordingly make a downward adjustment in this estimate of the percentage of households that will own cars without access to off-street parking. These values can be very difficult to measure empirically, because households who desire to own cars will often choose to live in

	buildings with off-street parking. The default values are taken from academic research in San Francisco (Millard-Ball et al, 2021), which observed a correlation between reduced parking and reduced driving that aligned with broader studies in North America (Currans et al, 2022; McCahill et al., 2016).  (Millard-Ball et al, 2021, fig. 3) Note that Weinberger (2012) has shown that that the effect of off-street parking on car ownership and driving behavior is relatively constant and unaffected by public transport quality, at least in New York City.
Rows 150:167	**Trips per car per day (residential)** The number of trips taken by an average privately-owned car in a single day. A ‘trip’ is a single origin-destination pair – so a daily drive from home to work, then the return from work to home, would be two trips. The conservative default value of 1.8 is based on an estimate of the total number of car trips in Mexico City in 2019 (Google, 2022), divided by the Mexican census bureau’s count of registered cars in Mexico City (INEGI, 2020).
	Trips per parking space per day (office, retail) The number of trips generated by an office or retail parking space on an average weekday – in other words, the number of trips that

	would not be taken by car per day if the space did not exist. The default factors are taken from a shopping center and a city office observed in Mexico City (ITDP-Mexico, 2014, p.69). These observations were taken over the morning period, so they are multiplied by 2x to estimate total daily trip generation.
	Average trip length The length (in kilometers) of an average trip to or from a parking space in one of the given building types. Values are estimates based on Mexico City and produced by ITDP experts. ITDP encourages users to substitute values measured in their own city. In cities smaller or denser than Mexico City, this value will probably be lower. In cities more sprawling than Mexico City, it will probably be higher.
Rows 169:188	**Average size of a housing unit** (Optional) The average size of a new housing unit in the city in m^2, used to estimate the increased number of housing units that could be built under a change in parking policy.
	Average size of a parking space (Optional) The average size of a new residential parking space in the city in m^2, used to estimate the increased number of housing units that could be built under a change in parking policy. Default value from Schmitt (2016).
Rows 195-270	**Intermediate Values** These values are calculated by the model as intermediates to produce the final estimates of impact. They should not be edited except by an experienced user.
Tab labeled "Emissions Factors – default"	**Regional emissions factors** These estimates of CO2-equivalent greenhouse gas emissions produced per vehicle-kilometer traveled in various world regions are from ITDP & UC Davis (2021), ultimately derived from the International Energy Agency's Mobility Model. They account for the estimated percentage of the fleet that is electric (as opposed to internal-combustion). These estimates of the air pollutant emissions produced per vehicle-kilometer traveled in various world regions are provided by the International Transport Forum (ITF 2021).

	They may be replaced by custom emissions factors on the tab of that name by flagging that choice in cell G16.
Tab labeled "Results"	**Results of impact estimation**

Sources Cited

Arrington, Gb & Cervero, Robert & Portland, Oregon & Iboshi-Sloop, Kimi & Hull, Emily & Rosales, Jennifer. (2021). TCRP Report 128 Effects of TOD on Housing, Parking, and Travel.

Currans, K.M., Abou-Zeid, G., McCahill, C. et al. (2022). Households with constrained off-street parking drive fewer miles. *Transportation* https://doi.org/10.1007/s11116-022-10306-8

Guo, Z., & Ren, S. (2012). *From Minimum to Maximum: Impact of the London Parking Reform on Residential Parking Supply from 2004 to 2010? Urban Studies, 50(6), 1183–1200.* doi:10.1177/0042098012460735

Google (2022). Environmental Insights Explorer: Mexico City. (accessed Jan 20., 2022).

The ICCT: International Council on Clean Transport. "Roadmap v2.2 Documentation." (2023). https://theicct.github.io/roadmap-doc/versions/v2.2/.

INEGI: Instituto Nacional de Estadística y Geografía (2020). Vehículos de motor registrados en circulación.

Institute for Transportation and Development Policy and UC Davis (2021). "The Compact City Scenario – Electrified."

ITDP-Mexico: Institute for Transportation and Development Policy – Mexico (2014). Less Parking, More City: Case Study in Mexico City.

ITDP-Mexico: Institute for Transportation and Development Policy – Mexico (2020). More City, Less Parking. (Spanish)

ITF: International Transport Forum (2021). ITF Transport Outlook 2021.

Li, F., & Guo, Z. (2014). Do parking standards matter? Evaluating the London parking reform with a matched-pair approach. Transportation Research Part A: Policy and Practice, 67, 352–365. doi:10.1016/j.tra.2014.08.001

McCahill, C. T., Garrick, N., Atkinson-Palombo, C., & Polinski, A. (2016). Effects of Parking Provision on Automobile Use in Cities: Inferring Causality. *Transportation Research Record*, *2543*(1), 159-165. https://doi.org/10.3141/2543-19

Millard-Ball, A., West, J., Rezaei, N., & Desai, G. (2021). What Do Residential Lotteries Show Us About Transportation Choices? *Urban Studies.*

- In San Francisco, an unusually-inclusive affordable housing program results in an "as good as random" assignment of people into houses, creating conditions for a 'natural experiment' that is not usually possible in other cities. This 'natural experiment' found a roughly linear relationship between parking availability and car ownership, and our model predicts that this linearity will hold true in other cities.

Ntziachristos, L, and Samaras, Z. (2023). *EMEP/EEA air pollutant emission inventory guidebook 2023*: *1.A.3.b.i-iv Road transport 2023*. *European Environment Agency*. https://efdb.apps.eea.europa.eu/?source=%7B%22query%22%3A%7B%22bool%22%3A%7B%22must%22%3A%5B%7B%22term%22%3A%7B%22code%22%3A%221.A.3.b.i%20Road%20transport%2C%20passenger%20cars%22%7D%7D%5D%7D%7D%2C%22display_type%22%3A%22tabular%22%7D.

Schmitt, A. (2016). Parking Takes Up More Space Than You Think. *Streetsblog USA*. https://usa.streetsblog.org/2016/07/05/parking-takes-up-more-space-than-you-think/

Weinberger, R. (2012). Death by a thousand curb-cuts: Evidence on the effect of minimum parking requirements on the choice to drive. Transport Policy, 20, 93–102. doi:10.1016/j.tranpol.2011.08.002