Compact Cities Electrified: Egypt

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EGYPT NEEDS BOTH EVS AND TRANSIT-ORIENTED CITIES

Addressing the climate crisis will require rapid, sustained transformation in every country and every sector of industrial activity. Recent research by ITDP and the University of California, Davis, modeled the global changes that will be necessary to decarbonize urban passenger transport and found that vehicle electrification and modal shift are both required. While the previous study was global and regional, this brief applies the same methods in a closer look at a single country: Egypt.[1]

Our research identifies four highly ambitious but feasible scenarios for the next 30 years of urban transport. It uses a backcasting approach to estimate the number of vehicles and the amount of infrastructure that would be required for each scenario, and it models the greenhouse gas emissions that each scenario would cause. The four scenarios are:

1. **BAU:** Business as usual.
2. **High Electrification:** Electrification of all new vehicles by 2040.
3. **High Shift:** Investment in walking, cycling, and public transport infrastructure along with a shift to compact urban development.
4. **EV+Shift:** Electrification and modal shift combined.

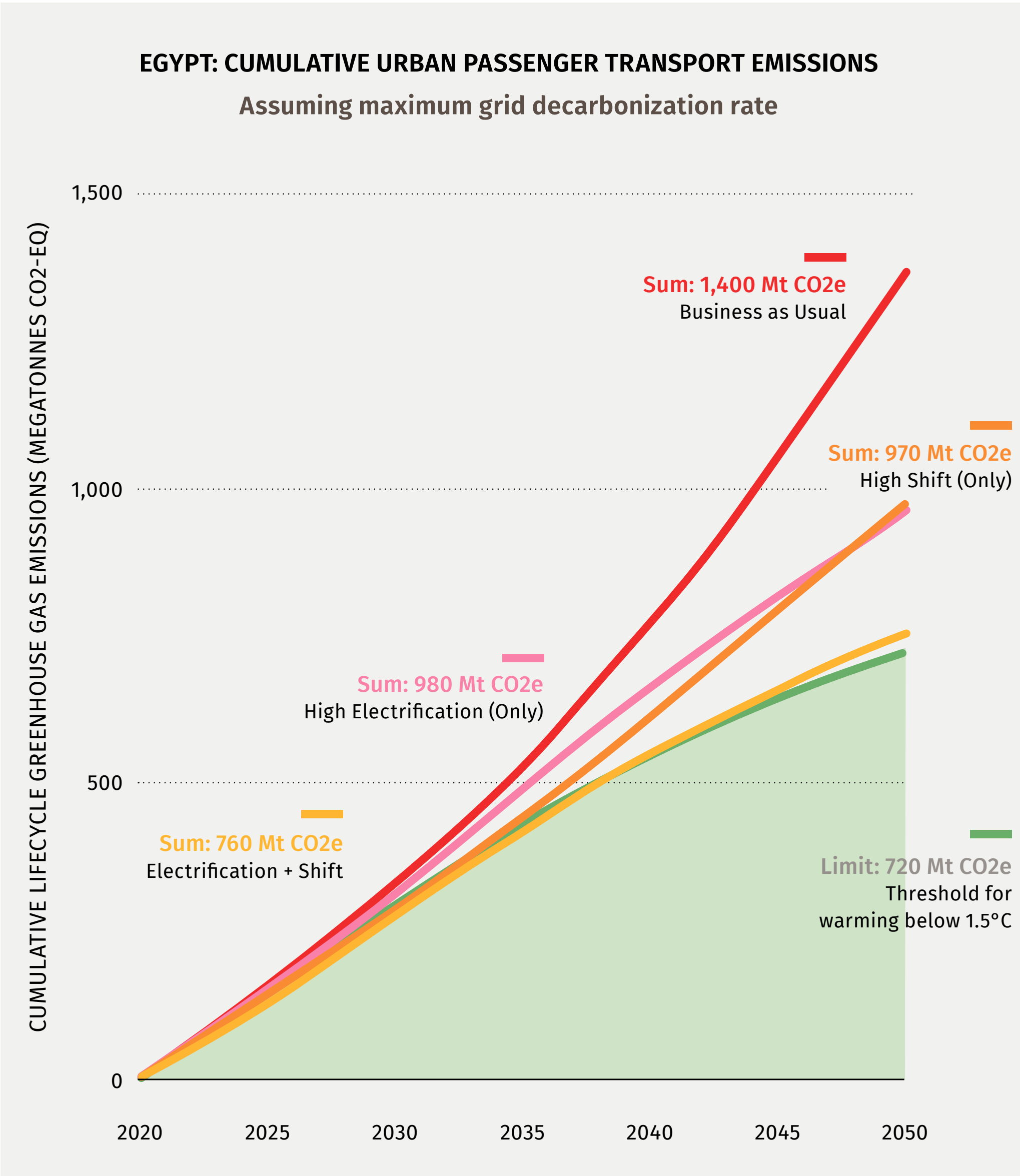

FIGURE A

Only the fourth scenario — electrification, compact cities, and modal shift all together, as rapidly as possible — is nearly consistent with keeping Egypt's emissions below the threshold required for meeting the Paris Agreement and having any chance of limiting warming to less than 1.5°C.

COVER PHOTO: The Alexandria electric buses were the first of their kind in Egypt. **SOURCE:** ITDP

1 This brief builds on The Compact City Scenario — Electrified. It follows the same modeling approach, which has been reviewed by technical experts representing the International Energy Agency (IEA), the International Transport Forum, the ClimateWorks Foundation, and the Global Fuel Economy Initiative.

BUSINESS AS USUAL

This traffic-clogged street illustrates the economic, human, and environmental costs of car-oriented planning. **SOURCE:** Shutterstock

Assumptions:

- Egypt continues the trajectory of the last decade. Car travel increases rapidly, in line with forecasts by the International Energy Agency (IEA), reaching over 600% of current levels by 2050.

Qualitative impacts:

- Increase in traffic fatalities
- High direct public and private costs
- Reduced access to opportunities for low-income people without cars, leading to increased wealth inequality
- Increase in local air pollution, causing many premature deaths and increased healthcare costs
- Increase in urban highways, dividing neighborhoods and subsidizing environmentally unfriendly sprawl
- Increase in carbon emissions, leading to climate catastrophe

HIGH ELECTRIFICATION

EV charging stations are necessary, but their effectiveness depends in large part on grid decarbonization.
SOURCE: Shutterstock

Assumptions:

- All new or imported vehicles are electric by 2040, in line with the COP26 Glasgow Declaration, and ¼ of new vehicles are electric by 2030.

Qualitative impacts:

- Sharp reduction in carbon emissions
- Sharp reduction in local air and noise pollution
- Increase in traffic fatalities
- High direct public and private costs
- Reduced access to opportunities for low-income people without cars
- Increase in urban highways, dividing neighborhoods and subsidizing environmentally-unfriendly sprawl

Key policies:

- Supply- and demand-side EV incentives
- Ambitious fuel economy and tailpipe carbon dioxide standards
- Battery reuse and recycling
- Public charging infrastructure
- Electric grid expansion and decarbonization

HIGH SHIFT

Urban cycling, including the new Cairo Bike bikesharing system, is necessary for Egypt to decarbonize transport, but it is not sufficient without electrification.
SOURCE: ITDP Egypt

Assumptions:

- Compact city planning is combined with reallocation of both funding and street space to walking, bicycling, and public transport. Car travel and infrastructure continue to increase but much more slowly, reaching less than 250% of current levels by 2050 (less than half of *BAU*).

Qualitative impacts:

- Reduction in traffic fatalities
- Increased access to opportunities, especially for low-income people
- Increase in walking and cycling, which improve physical and mental health, reducing healthcare costs
- High local air and noise pollution from internal-combustion (ICE) vehicles, relative to *High Electrification*
- Insufficient carbon reductions to meet the Paris Agreement

Key policies:

- Reallocation of transport budgets to walking, cycling, and public transport, especially BRT
- Street redesigns that shift space from cars to BRT lanes, physically protected bicycle lanes, and footpaths
- Promotion of bicycles, especially shared electric bicycles
- Modernization of the informal public transport sector

EV + SHIFT

Under an *EV+Shift* future, BRT offers fast, efficient mobility.
SOURCE: ITDP Egypt

Assumptions:

- Compact cities and mode shift, combined with rapid electrification: *High Electrification* and *High Shift* together.

Qualitative impacts:

- Reduction in traffic fatalities
- Increased access to opportunities for all
- Increase in walking and cycling, which improve physical and mental health, reducing healthcare cost
- Extreme reduction in local air and noise pollution
- Massive reduction in carbon emissions consistent with the terms of the Paris Agreement

Key policies:

- All policies listed for *High Electrification* and for *High Shift*, except growth in urban highways
- Creation of low-emission areas, especially in city centers, to simultaneously incentivize modal shift and vehicle electrification

The primary difference between these scenarios is the split of travel between different modes. *High Electrification* shifts travel to electric modes but leaves the overall split unchanged, while *High Shift* replaces cars with other modes but does not electrify vehicles. *EV+Shift* does both.

TRAVEL ACTIVITY: EV+SHIFT REDUCES ICE CAR TRAVEL THE MOST

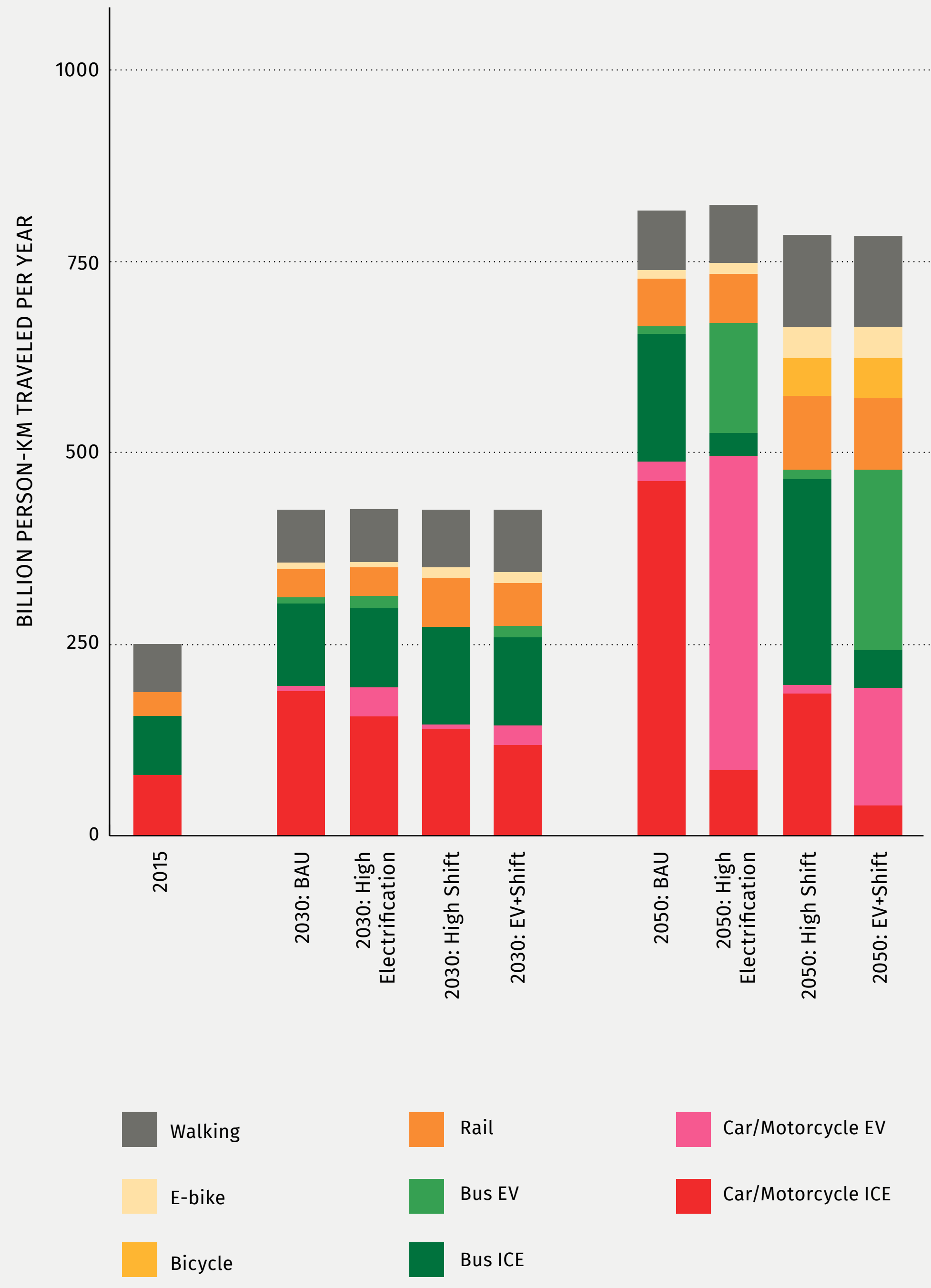

FIGURE B

LESS EXPENSE, LESS ENERGY

Through compact cities centered on walking, bicycling, and electrified public transport, the Egyptian economy could save more than USD $600 billion through 2050. This estimate accounts only for the direct public and private costs of urban passenger transport, such as the costs of vehicles, fuel, and infrastructure. It does not include indirect costs such as congestion, road traffic deaths or injuries, air and noise pollution, or sedentary car-oriented lifestyles, which would also be reduced through more compact cities.

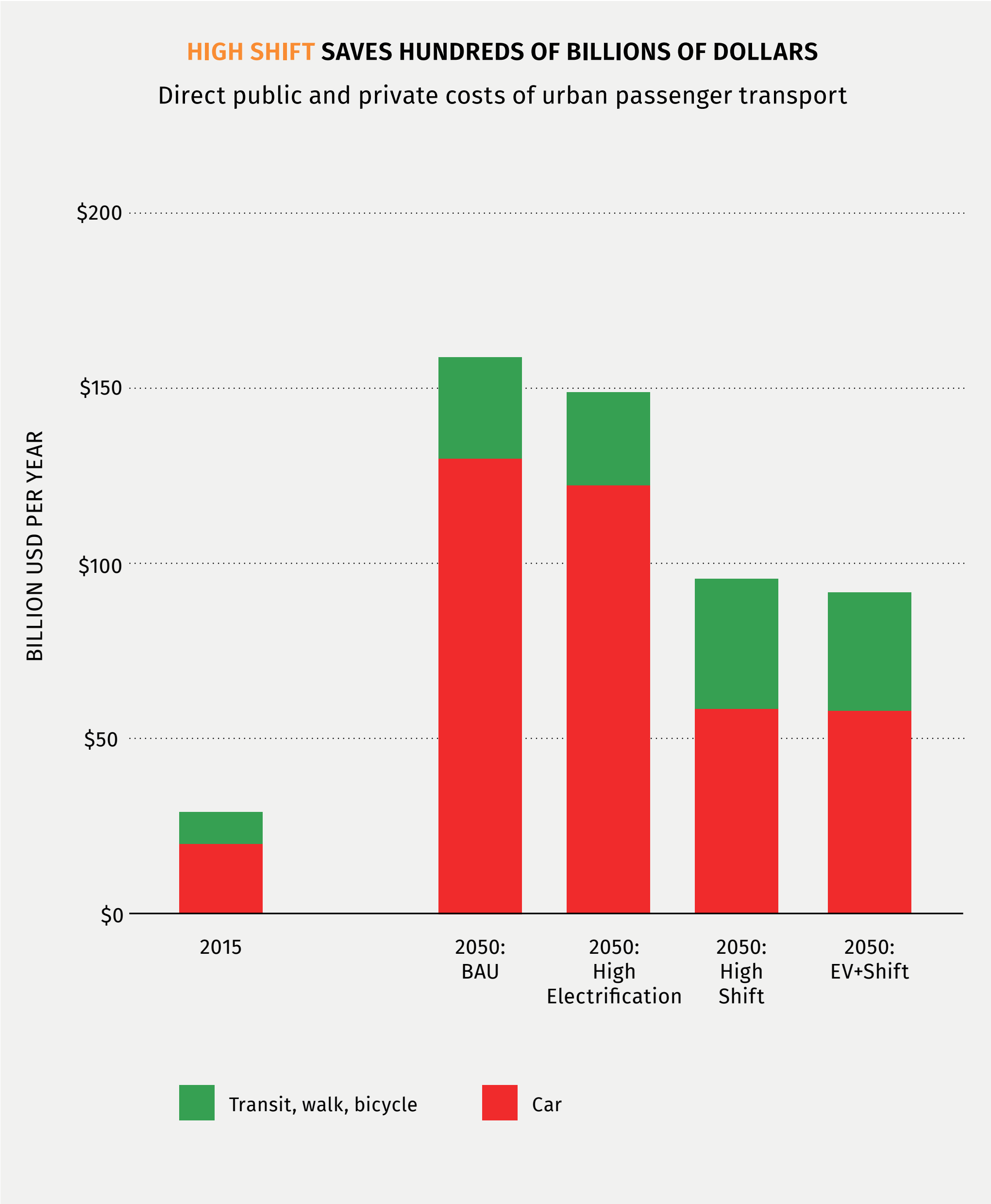

FIGURE C

These calculations include costs to all levels of government, to the private sector, and to individuals. A detailed breakdown of the direct costs to governments in particular are available in **Figure G** below.

The combination of compact cities and electrification reduces demands on the electricity grid relative to an electrification-only future, making the expansion and decarbonization of the grid more achievable. Compact cities and modal shift mean that more clean electricity will be available by 2050: 90 exajoules (25 trillion kilowatt-hours) per year, or about 160 times Egypt's entire present-day annual energy consumption.

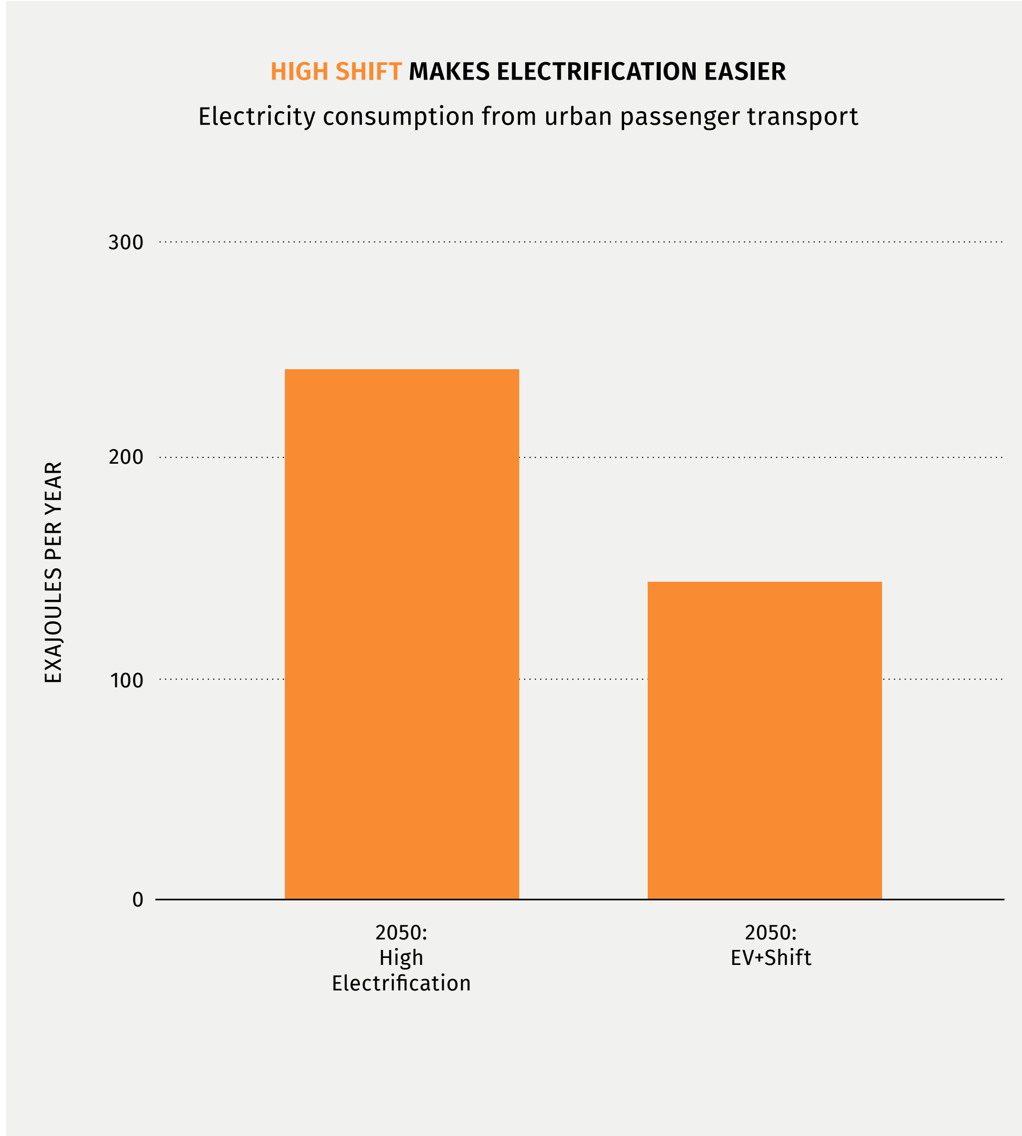

FIGURE D

ELECTRIFICATION AND SHIFT CREATE CRUCIAL REDUNDANCY

Although electrification offers great potential to reduce carbon emissions, the success of *High Electrification* is predicated on rapid and complete decarbonization of the electrical grid. Egypt's current electricity grid is relatively carbon-intensive, emitting 650 gCO_2eq per kilowatt-hour. If grid decarbonization is slower than planned, *High Shift* will be especially necessary to complement electrification.

In **Figure A** on page 2 above, we assume that Egypt's grid decarbonizes at the maximum plausible rate, consistent with the IEA's Sustainable Development Scenario (SDS), reaching around 80 gCO_2eq/kWh by 2050. We see that the *EV+Shift* scenario is the only one to remain near the approximate threshold limit of 720 megatonnes cumulative CO_2eq, meaning that it is the only one consistent with a future of less than 1.5°C of global warming.

The next graph, **Figure E**, compares that with a rate of decarbonization that is more moderate (though still ambitious), reaching 300 gCO_2eq/kWh by 2050. This moderate rate of decarbonization is in line with the IEA's Stated Policies Scenario (STEPS), representing a future in which governments meet the policies they have set for clean electricity.

Under this assumption, not even the *EV+Shift* scenario stays below the 720-megatonne threshold, although it comes closer than any alternative (850 Mt). The *High Electrification* scenario suffers, with cumulative emissions (1,100 Mt) substantially higher than the *High Shift* scenario (1,000 Mt).

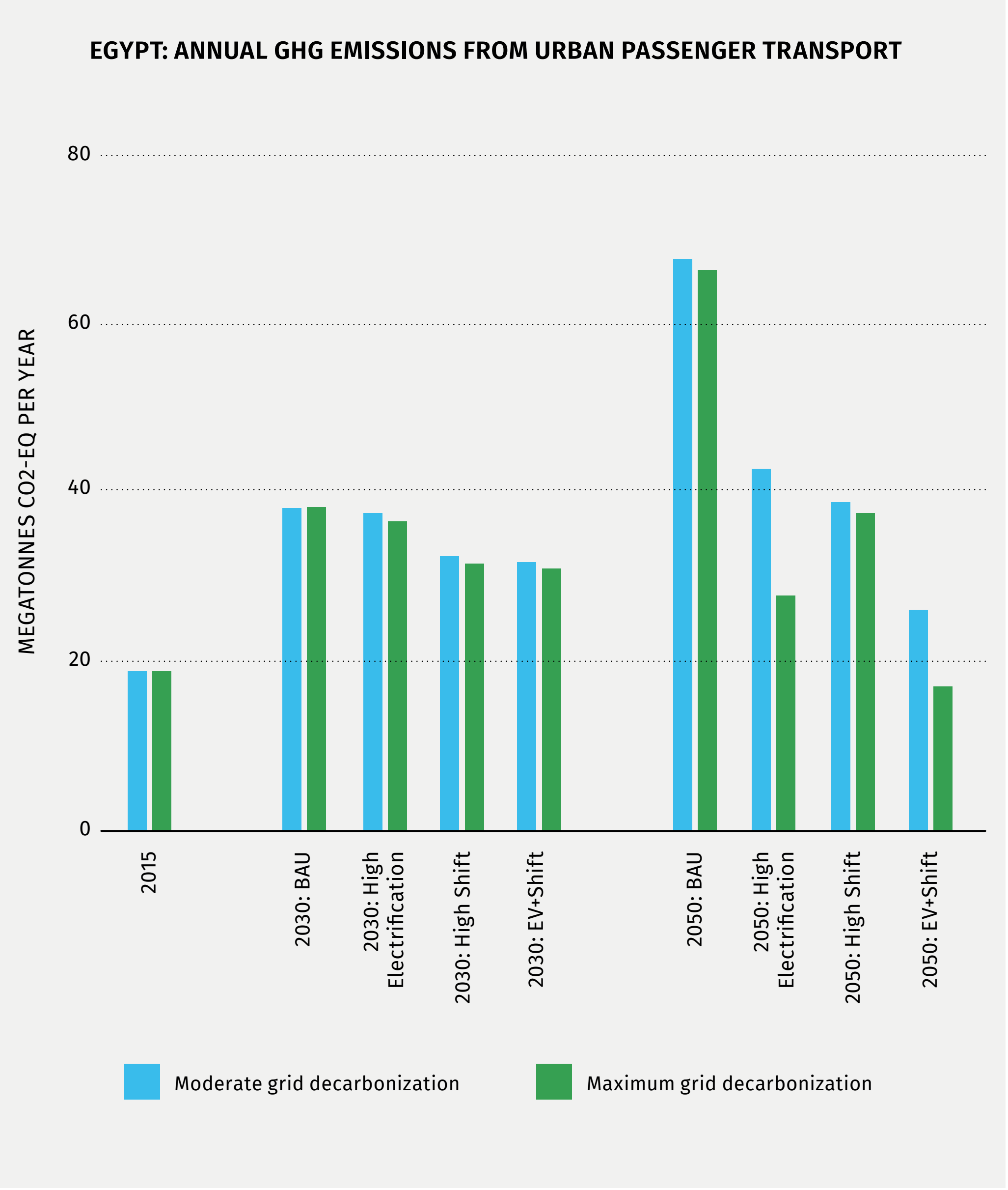

FIGURE E

Unlike many other studies, our analysis includes emissions from fuel and electricity consumption ("well-to-wheel") and also emissions from the manufacture of vehicles and batteries and from the construction and maintenance of infrastructure such as roadways. These "lifecycle" emissions contribute a substantial amount of CO_2, a contribution that increases in *High Electrification* compared to *BAU*. In our calculations of compatibility with the Paris Agreement we have weighted these emissions to account for the consensus that cement and steel are particularly difficult to decarbonize, though we do project some improvements in industrial emissions intensity.

High Electrification and *High Shift* are mutually reinforcing. By combining them, we come to a decarbonization strategy that is much more resilient than either approach taken alone.

HOW CAN EGYPT ACHIEVE EV+SHIFT?

For Egypt to build a future of compact cities with electric vehicles, the country will need to change its pattern of investment in the transport sector. In recent years, Egypt has pursued major expansion of its urban highway network. Going forward, transport investments should instead focus on bus rapid transit, protected bicycle lanes, urban passenger rail, pedestrian-friendly street design, and electric vehicles.

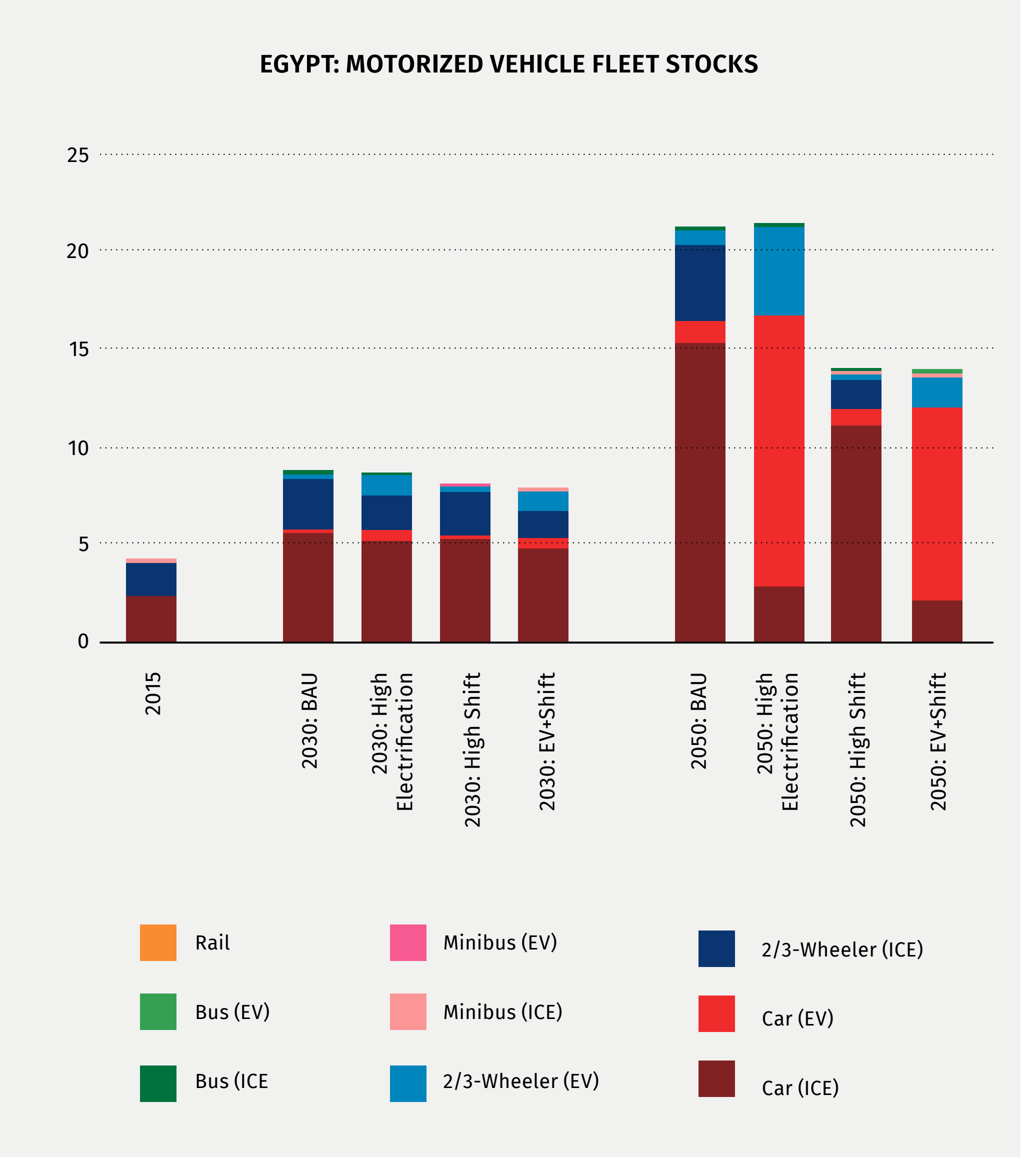

FIGURE F

To achieve *High Electrification*, most new vehicles must be electric by 2040. But electrification must begin well before then: One fourth of new LDV vehicle sales in Egypt must already be electric by 2030, only seven years from now.

High Shift substantially reduces Egypt's infrastructure needs relative to *BAU* or *High Electrification*. The necessity of building roads will be reduced by more than a third, saving vast amounts of capital and effort. The compensatory requirements in sustainable transport are relatively modest: roughly 7,000 km of protected bicycle lanes, 1,000 km of bus rapid transit, and 400 km of urban passenger rail. In addition, Egypt will need over 400,000 new buses and minibuses by 2050 (with about 70,000 of those needed by 2030), along with more than 4,000 railcars by 2050.

Compact land use is necessary. Projections of current trends indicate that by 2050 more than five million Egyptians will live in sprawling suburbs (fewer than 4,000 people per km^2.) To accomplish *High Shift* will require Egypt to pursue transit-oriented land use policies, encouraging compact, mixed-use development within walking distance of mass rapid transit corridors. Such a development pattern could mean that only 1.5 million Egyptians will live in neighborhoods of fewer than 4,000 people per km^2.

RECOMMENDED ACTION PLAN

Egypt should pursue the following seven policies to achieve the *EV+Shift* scenario:

1.
Build **wide, shaded walkways and dedicated cycle tracks** on all major streets, making active mobility safe and comfortable.

2.
Transform **public transport service** through networks of high-quality BRT as well as some rail.

3.
Improve **paratransit service** through professionalization, subsidies, electronic fare collection, and service contracting. Such efforts have been successful in other large cities like Jakarta, Indonesia.

4.
Refocus urban growth towards **compact development**, built around walking and cycling, and connected by a backbone of public transport. In any areas less dense than 4,000 people per km^2, plan for infill development to increase urban density.

5.
Introduce measures to bring the **cost o driving in line with its negative externalities**. This includes pricing and regulating on-street parking and removing requirements for off-street parking. This can also include congestion pricing mechanisms and the introduction of zero-emission areas.

6.
Set a timeline for **zero-emission vehicle purchasing targets** and ICE phase out targets for all public and private vehicles including cars, vans, buses, light- and heavy-duty trucks. Public vehicle targets can help set the stage for private vehicle markets. Targets should be set for new and used car markets.

7.
Introduce **incentives or the purchase o electric vehicles and e-bikes**. The most effective incentives combine an increased cost for internal-combustion vehicles with a subsidy for electric ones. These may include fee-rebate structures or low-emission traffic zones. Subsidies should be structured to consider social and economic equity parameters.

Our modeling approach includes not only estimates of emissions from all forms of urban travel, but also estimates of the various direct costs associated with all aspects of their functioning - from infrastructure and vehicle purchase to insurance, fuel, and driver time. This enables us to estimate the costs to governments (national, regional, or municipal) that would be associated with implementing the seven policies above:

INVESTMENTS REQUIRED FOR EGYPT TO ACHIEVE THE *EV+SHIFT* SCENARIO

		EV+Shift cumulative through **2030**		*EV+Shift* cumulative through **2050**	
Mode		Quantity purchased or built	Cost (billion USD)	Quantity purchased or built	Cost (billion USD)
Road	Infrastructure (lane-km)	100,000	$200	200,000	$500
	Electric car subsidy	2,000,000	$10	10,000,000	$70
	TOTAL ($bil)		**$200**		**$600**
Bus	Large buses purchased	70,000	$10	300,000	$60
	Minibuses purchased	50,000	$2	200,000	$9
	Infrastructure (BRT km)	400	$6	1,000	$30
	System (drivers, fuel, insurance, operation)		$80		$300
	TOTAL ($bil)		**$100**		**$400**

FIGURE G

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INVESTMENTS REQUIRED FOR EGYPT TO ACHIEVE THE *EV+SHIFT* SCENARIO

		EV+Shift cumulative through **2030**		*EV+Shift* cumulative through **2050**	
Mode		Quantity purchased or built	Cost (billion USD)	Quantity purchased or built	Cost (billion USD)
Rail	Train cars purchased	1,600	$1	4,000	$4
	Infrastructure (thous, track-km)	100	$40	200	$100
	System		$10		$40
	TOTAL ($bil)		**$50**		**$150**
Bicycle	Infrastructure (km)	400	$0.1	7,000	$1.4
	TOTAL		**$0.1**		**$1.4**
SUM			**$400**		**$1,100**

FIGURE G

A public-sector investment of approximately $1,100 billion USD will be needed for Egypt to meet the *EV+Shift* scenario. As shown in **Figure C**, this public investment will result in a total direct savings of over $600 billion USD for the Egyptian economy overall, largely through the reduced need for individuals to own cars or pay for fuel. Investment in sustainable transport will not only reduce emissions, it will create a major economic boost. And this calculation does not include the indirect benefits of *EV+Shift*, such as reductions in congestion, air pollution, noise pollution, and suburban sprawl. These indirect benefits may be even greater.

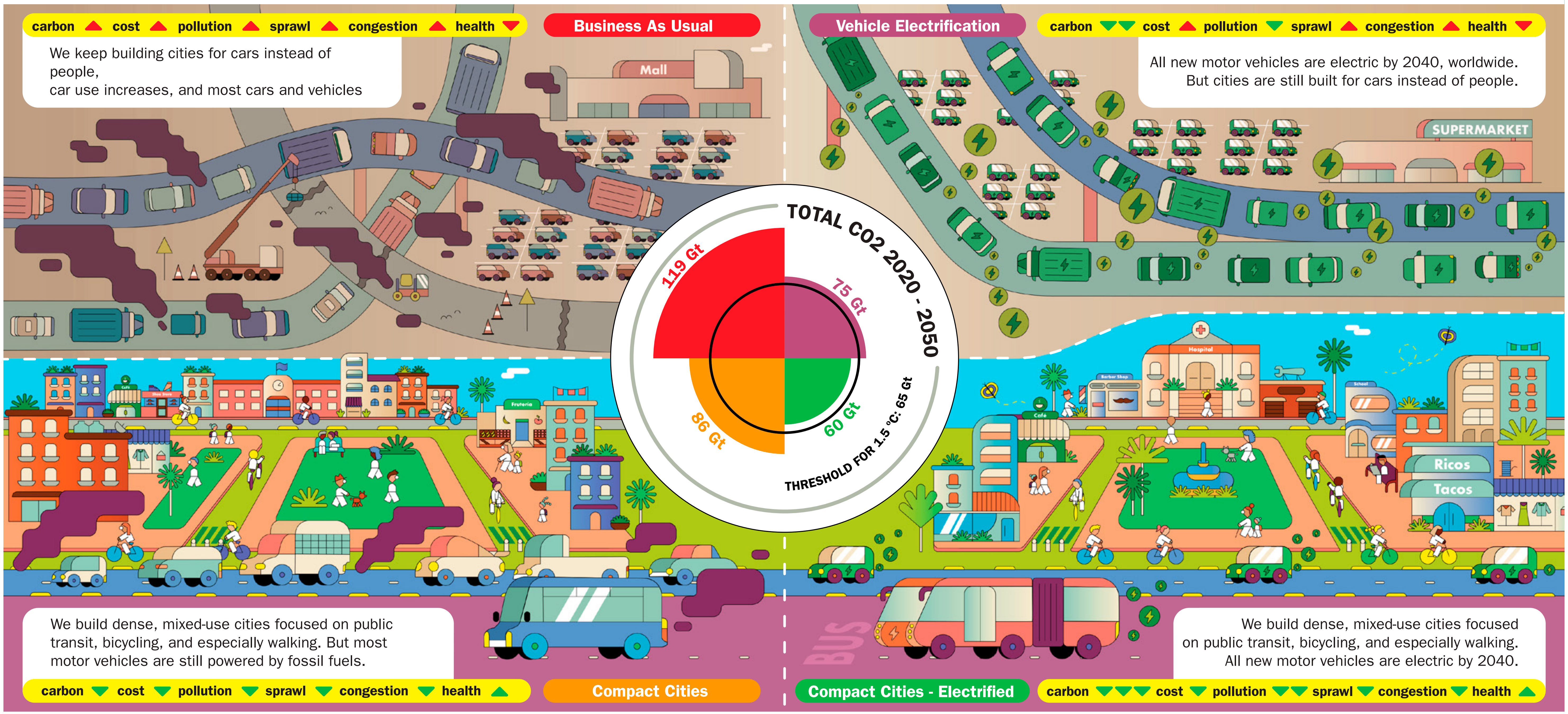
Egypt is growing. As the population and local economy expand, so will the demand for urban travel. The only question is how that growth will be accommodated. Will Egypt build a city for private vehicles that pollute the air and the streets? Or will it replace many of those with buses and bicycles and electrify the cars that remain?

COMPACT CITIES ELECTRIFIED ARE POSSIBLE.
THE TECHNOLOGY AND THE FUNDING ARE AVAILABLE.
ALL THAT REMAINS IS ACTION.

The Compact City Scenario Electrified

The Only Way to 1.5°C

As we recover from COVID-19, we must choose how our cities will grow. Recent research studied four possible scenarios for the future. Only one scenario is consistent with limiting global warming to less than 1.5°C and avoiding the worst effects of climate change.



Read the report, The Compact City Scenario - Electrified, by ITDP and UC Davis, at: www.itdp.org/publication/the-compact-city-scenario-electrified/

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