



For many visitors to Rio de Janeiro, one of the first stops is the Rua Cosmo Velho, where they can hop on a narrow-gauge, cog train for a 20-minute ride to the top of Corcovado. Once there, they will have a spectacular view over the city, Gaunabara Bay, and the famous beaches, as well as a close-up look at one of Rio's, and the world's, iconic images: the nearly 100-foot tall statue known in Portuguese as *Christo Redentor*, Christ the Redeemer—the largest Art Deco statue in the world.

The visitors to Corcovado may not even notice the forest they pass through on their way to the top. That would be a shame, because the forest is a rare jewel, an example of the Mata Atlântica, the Atlantic rainforest that once covered an area twice the size of Texas along Brazil's eastern seaboard. Less than 10 percent of that rich forest ecosystem remains, including about 15 square miles surrounding Corcovado, protected since 1961 as Tijuca National Park.

The story of the creation of the park may reveal part of Rio's future as well. The forest is a re-creation rather than a remnant of the one that greeted the first Portuguese explorers. By the mid-19th century, the Atlantic Forest surrounding Rio had been cut down to make way for sugar and coffee plantations. In 1861, the Brazilian king, Dom Pedro II, realized the deforestation would affect the city's supply of drinking water. He ordered the continent's first reforestation program. In less than two decades, employees and slaves planted more than 110,000 seedlings.

Another bold reforestation effort may now be needed—this one far larger than Dom Pedro's. Rio de Janeiro will likely be severely impacted by the effects of global warming. Temperatures are expected to rise by 1° C by 2020, according to the Urban Climate Change Research Network. Brazil's National Institute of Meteorology predicts that Rio will experience an increase of 3.8 degrees Celsius by 2080.

While Rio has extensive protected areas within the municipal boundaries—and Tijuca National Park by itself it more than 10 times the size of New York's Central Park—most are at the edges of the city with few entrances and distant from the central cores. Most Cariocas, as the residents of Rio are known, see relatively few trees on a daily basis unless they are fortunate enough to live in the wealthier neighborhoods near the Ipanema and Copacabana beaches.

That distinction highlights another challenge for Rio. In most cities, the urban heat island effect is most pronounced in the city centers. In Rio, however, people living in the working-class neighborhoods on the outskirts of the city and the densely populated slums called *favelas* experience the most intense effects of urban heat islands. According to a study conducted in 2000, the Bangu neighborhood, some 20 miles northwest of Copacabana, is the hottest in the city, while the richer areas of the South Zone and Barra da Tijuca are the coolest.

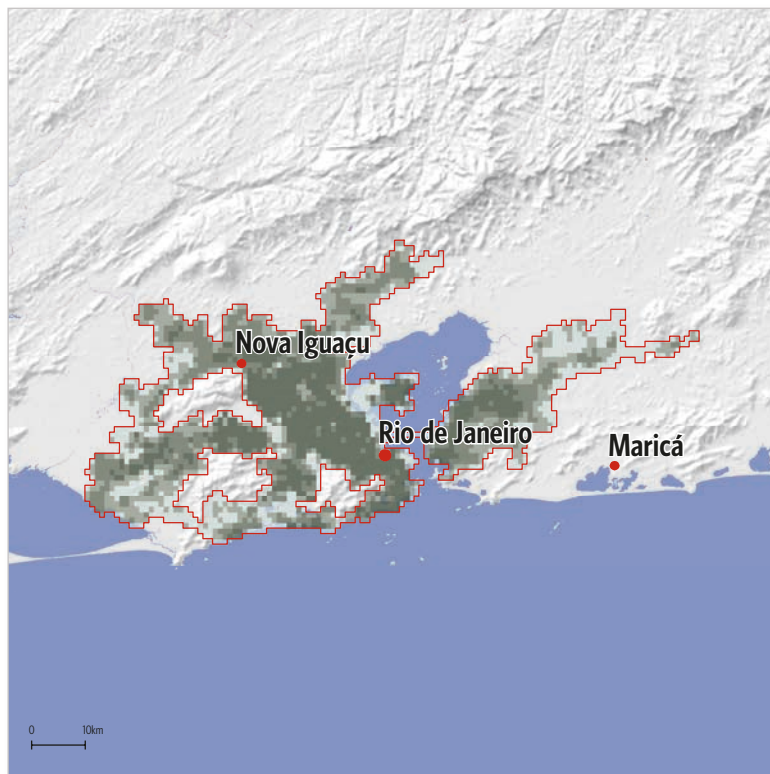
Rio has been working to reforest its hillsides for decades. Beginning in 1986, the city's Environmental Secretariat led a community reforestation program and planted over 6 million seedlings on 2,200 hectares of land within

the city limits. Once Rio won the right to host the 2016 Summer Olympics, the tree-planting effort accelerated. In 2012, authorities in Rio promised to plant 24 million trees (later increased to 34 million) by the end of 2015 in order to mitigate greenhouse gas emissions from the Olympic Games and to provide other benefits.

Unfortunately, only a fraction of the promised trees have been planted. The priority now is to make a full inventory of trees in the city, a two-year effort to determine the size, condition, and classification of every tree in the city, with the data feeding into Rio’s Greenhouse Gas Inventory.

Compared with other cities globally, Rio has moderate ROI from tree planting. The neighborhoods with the highest estimated ROI are downtown Rio and the southern portion of Duque de Caxias considered in our report. For an additional annual investment of \$2.4 million in street trees, we estimate that more than 900,000 people could have a reduction of 1.5° C (2.7° F) in summertime air temperature.

## Results from the Rio de Janeiro study



Map 26. Neighborhood-level ROI for Rio de Janeiro (temperature reduction).

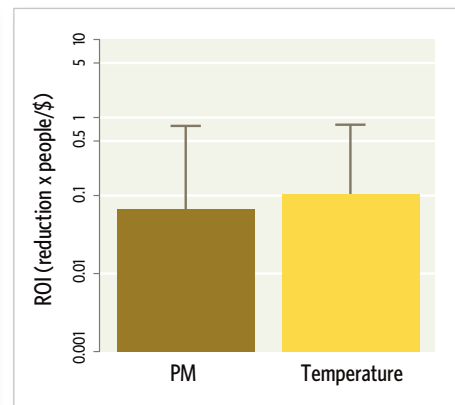


Figure 31. ROI for tree planting for Rio de Janeiro.

Investment	Annual Cost (\$)	> 1 ug/m <sup>2</sup> PM <sub>2.5</sub>	1.5 deg C
10% of sites	2,380,000	912,000	942,000
20% of sites	4,800,000	1,450,000	1,540,000
Full Investment	17,700,000	1,950,000	2,590,000

Table 19. Temperature and PM reduction benefits under three investment scenarios for Rio de Janeiro.