Repurposing to Revitalize:
Changing Quito to ReviviQuito

Quito hosted the 2016 United Nations Habitat III Conference, which discussed housing and sustainable urban development. Quito's city planners attended the conference, heard the discussions, and became inspired to draft a general plan that would rethink, redesign, and revive Quito. This new General Plan, to be completed by 2117, set goals for housing, transportation, energy, and, most importantly, a network of public spaces. Quito's citizens voted to adopt this plan, which would improve their quality of life.

Today, in 2117, Quito is celebrating the completion of the city planners' vision by renaming the revived city to ReviviQuito! This beautiful city of 4.4 million citizens has a temperate climate of 48-69°F, an altitude of 9,000 feet, and a topography of rolling hills. This resort-city attracts tourists, who come for colorful carnivals, historical museums, traditional dancing, old Spanish architecture, and the national sport, soccer. ReviviVersity's students pioneer new and sustainable technologies. ReviviQuito's economic drivers include world-class companies, such as GrowLite Inc., Autonomous

Aerial Vehicles Manufacturing Headquarters, and Experience Ed: Augmented Reality Programs.

The General Plan redesigned Quito's city infrastructure. ReviviQuito features a pollution-free, autonomous aerial vehicle public transportation system: the Direct Airborne ReviviQuito Transit (DART). Citizens call the electric DART to their building's landing pad. It then transports them directly to their destination. Previous slum neighborhoods were redesigned to be a walkable city with a biophilic environment. Amenities include affordable, multifamily housing, roadside shopping and restaurants, transit landing pads, and rooftop sports facilities. These buildings are Living Building Challenge certified, the highest standard of sustainability. Living Buildings feature ecologically-restorative materials, on-site rainwater harvesting and sanitation, and decentralized, net-positive solar energy. ReviviQuito no longer depends on oil for its power source. Geothermal power plants replaced old oil wells.

Over time, the city planners also proposed additional city service upgrades, which would elevate the standard of urban living. The excellent education system includes personalized learning schedules, challenging work, and augmented reality field trips, which excite students' imaginations. Citizen's safety is a priority in ReviviQuito. Because the city is located on a fault line, it is vulnerable to earthquakes. Engineers designed seismic invisibility cloaks, which are underneath all new buildings and trap seismic waves in concentric rings. Carbon Fiber Wraps retrofit and strengthen support beams in historic buildings. The healthcare system is focused on sickness prevention. Medical monitors prevent sickness through DNA tests for custom diets, blood pressure monitoring, and early warnings of viruses and cancers. Advanced medical treatments include nano-scale targeted medicine delivery and antibacterial smart stitches, which monitor the healing processes.

Problems of the Past

After Habitat III, the city planners assessed Quito's many social, economic, and environmental issues. In 2016, there were critical problems with poverty, crime,

transportation, education, and food security. Roughly 35% of the population lived in poverty. Crime was high. Residents of the slums spent more weekly on transportation than on housing. Only 38% of the population had access to primary schooling. They spent 39% of their income on food and yet 81% reported food insecurity. Citizens in the slums did not have access to basic necessities, let alone places to play, relax, learn, and socialize.

Before: The roadways in the slums were dirt. Also, the Petroecuador fuel terminal polluted nearby residential areas.

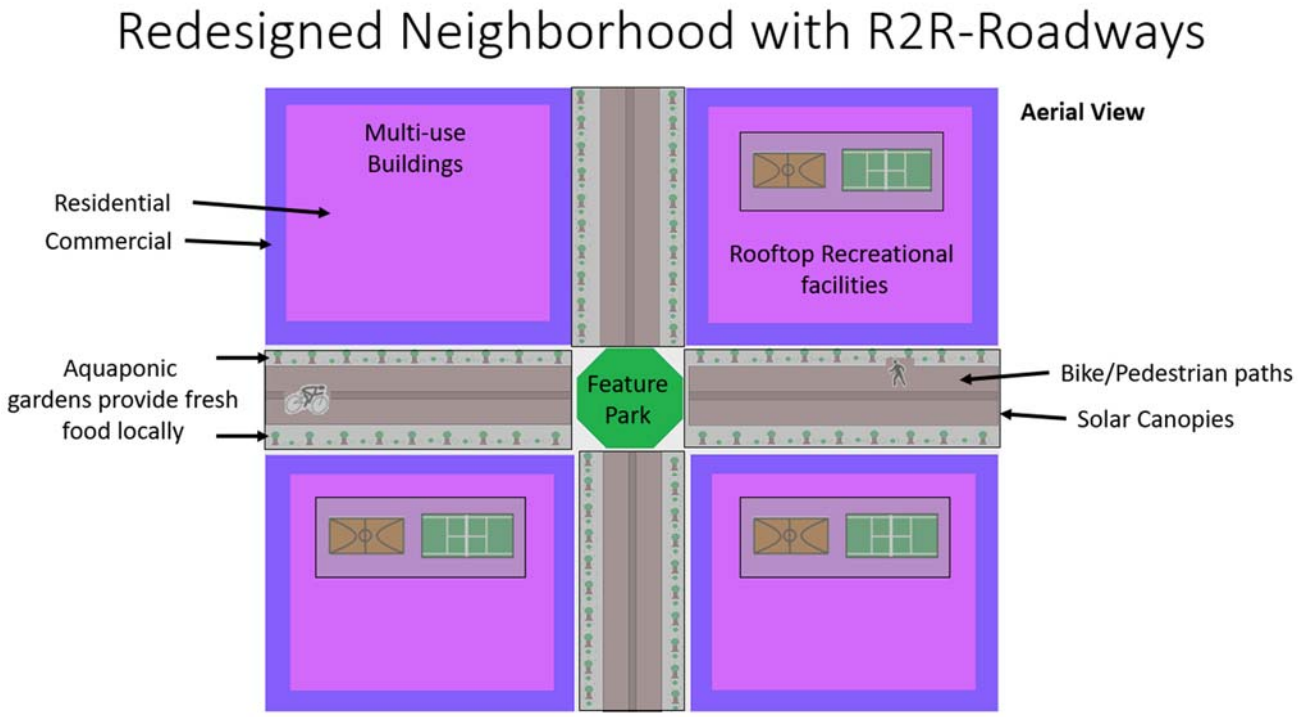
The Public Space Solution: Repurposing to Revitalize (R2R)

The city planners learned at Habitat III that these problems could be solved with public spaces, and conceptualized a network of public spaces that would cover 50% of Quito's land. Their solution, Repurposing to Revitalize (R2R), improved the health, happiness, and safety of Quito's residents. R2R had two parts:

- R2R-Roadways converted all roads.
- R2R-Brownfield converted an abandoned Petroecuador fuel terminal.

Repurposing to Revitalize-Roadways

In Quito's neighborhoods, roadways occupied 10% of the land. City planners realized this potential for public space and repurposed all of the land. They imagined new roadways that attracted ReviviQuito's diverse population and were walkable, with public gardens, interactive parks, and exciting recreational facilities.



Paths: These refurbished roadways feature bike and pedestrian paths. A glow-in-the-dark synthetic solar material coats the pathways, lighting the way for both pedestrians and cyclists. Solar canopies over the pathways have adjustable light levels and help power nearby multi-use buildings. These provide a sheltered space for people to exercise, even when it is raining. Redesigned bikes provide a healthy commute for the population, and include solar wheel coverings, a magnetic drive, and fingerprint-analysis to prevent theft.

Gardens: City planners knew urban agriculture would significantly lower food prices and provide available, fresh, locally-grown, and organic food. Aquaponic gardens line the sides of the repurposed roads. LED grow lights use specific wavelengths to

increase growth rates and vitamin content. Robotic harvesters, Agribots, use light sensors to determine when food is ripe. Chemical processing sensors regulate the water's PH and nutrient balance in the aquaponic system.

Feature Parks: Different Feature Parks are located at old intersections and have a variety of community activities. They include biodiverse green spaces, pop-up activities, forums, live entertainment, "8-80" playgrounds for all ages, natural urban habitat areas, featured public art spaces, and schools that encourage educational exploration. The Feature Parks also have adjustable solar awnings, bike and pedestrian paths, rainwater capture, and innovative safety features.

Repurposing to Revitalize-Brownfield

In 2016, Ecuador's national oil company, Petroecuador, had a one-million square foot fuel terminal located in Quito. After Quito switched to renewable energy, this station was abandoned. Environmental engineers decided to refurbish the site. They conducted environmental assessments, which showed both the soil and groundwater were contaminated with petroleum hydrocarbons. Instead of removing the soil, they used microbial degradation to break down the petroleum into carbon dioxide and sugars. Phytoremediation plants cleaned polluted groundwater by biodegrading the hydrocarbons.

The footprint of the brownfield made it an ideal location for a special kind of Feature Park. The engineers at Experience Ed. conceptualized and built the STEM Center, which would inspire students to dream, design, and build projects with real-world applications. In this public space, students can build anything from roller coasters to robots and test the project in virtual reality without getting injured.

The Impact of R2R

R2R solved many of Quito's social and environmental problems. The main benefit of reclaiming the roads was the increase in the amount of public space. Due to widely-distributed schools and the STEM Center, citizens were more educated and

crime rates were greatly lowered among the populous. Since pedestrian and bike paths are conveniently located, transportation costs were reduced. The aquaponic gardens provide low-cost fresh food and eliminated the previously used slash-and-burn agricultural method. Plants along the converted roadways perform carbon sequestration and eliminate the urban heat island effect.

Risks: Park system management was a risk. Information Technology engineers designed automatic systems to collect data about park usage through embedded IoT sensors to improve park services and safety. ReviviQuito's triple redundancy system ensured that a malfunction in the aquaponic gardens chemical system was not a risk. To prevent sickness from the Petroecuador site's pollution, environmental assessments guaranteed proper clean-up.

Tradeoffs: Funding R2R was a challenge, but the Inter-American Development Bank incrementally granted Quito money earmarked for capital improvement projects with social equity goals. These loans were offset by the increasing revenue generated from high-tech industrial exports. Another tradeoff was that citizens had to live with construction around them for several months so the city could implement R2R.

Public usage and quality of life: The city planners knew that the biggest R2R impact on Quito was from the converted roadways. Now, residents can buy locally-grown food from the seasonal menus and enjoy it in the plazas, while socializing with friends. They exercise through riding bikes to work and running on the paths, and are protected from the rain. The Feature Parks allow citizens to relax outdoors, enjoy entertainment, play games, and host social gatherings. The city planners designed the STEM Center so kids were excited to learn. They turned an education facility into a theme park.

Many Engineers Contributed to Redesigning ReviviQuito's Infrastructure

- Civil and electrical engineers provided renewable energy by changing abandoned oil wells into geothermal plants. They also designed seismic invisibility cloaks.

- Environmental engineers assessed and cleaned previously polluted brownfield sites.
- Aeronautical, mechanical, and transportation engineers provided efficient public transportation by creating the DART system.
- Agricultural engineers designed roadway gardens fertilized by aquaponic ponds.
- Chemical engineers developed a process to ensure the proper balance of the water chemistry in R2R's aquaponics system.
- Information technology engineers designed an automatic system to collect data about park usage through embedded IoT sensors to improve park services and safety.

The Repurposing to Revitalize solution created a high standard of urban living through a new network of public spaces. Quito was transformed from a polluted and impoverished city into ReviviQuito, a revived city.

Word Count: 1490

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