Phoenix: Urban Transformations Towards a More Responsive Environment

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ABSTRACT: Phoenix Arizona has grown during a period of urban development that completely ignored local topography, climate, culture and history. As a result we have a sprawling metropolitan area with an ever increasing heat-island effect, and with an urban infrastructure that works against its environmental setting rather than with it. This practice has led to the abandonment of the central city and propelled urban areas into former croplands and virgin desert lands. This paper provides an understanding of how people living in cities can actually modify the environment. It also explores some alternative ways to mitigate the urban-heat-island effect through implementation of more sustainable urban interventions that respond to the local setting.

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INTRODUCTION

In only fifty years, Phoenix metropolitan area has expanded from a small desert town into the fifth largest city in the United States. Ninety percent of the Phoenix area was built over the last half of the century, a period when urban development focused primarily on building highways and suburban tract housing and huge shopping malls (3). All these low-density building practices were powered by attempts to master-plan cities through the separation of uses and functions, hence ignoring the local topography, climate, history and culture.

Other challenges that can be attributed to the continuing practice of urban sprawl that affect the daily urban life include: increased traffic, pollution and population growth. In order to prevent the phenomenon of sprawl from eating away croplands and virgin desert land, we need to revitalize the central city and to provide ways to retrofit the city and its urban infrastructure so that we can accommodate people as well as cars.

The process of urban retrofitting requires an increase in the number of "mixed-use" urban pockets, provide more alternatives to the car, and provide cooling devices that offer comfort throughout the year in a hostile desert urban environment. This paper will discuss some of the urban interventions that can mitigate the urban-heat-island effect through the implementation of more sustainable urban design interventions such as: inclusionary zoning, cool-parking and tree planting program.

20th CENTURY PHOENIX

One hundred years ago no one imagined that Phoenix would be the site of one of the major communities in the country. Currently, the city of Phoenix is 1760 square miles and it would take two hours to drive from one end to the other end. The urban area is larger than Paris, Rome, San Francisco, and Manhattan combined, and the region is still growing. Planners anticipate over the next ten years the population will increase by another million (4).

Currently, the city's population has increased by 45% within the last ten years. There are some other areas in the United States that are considered to be growing rapidly, but growth in Phoenix is considered hyper-growth. For instance, the current population is 2.5 million, and it is expected that the region's population will increase by 100,000 new residents each year (4).

Typically, urban areas tend to grow in two ways _up or out. Commonly, cites are naturally bordered by rivers, mountains, or oceans. These natural elements force cities to grow upward from a limited base of available land. However, the case of Phoenix is different; here the urban growth has sprawled into the desert. Growth on the fringes has exploded due to a cheaper land and guaranteed access to all urban amenities such as: road, utility line, schools etc.

This low density model was a post-war strategy intended to house a growing middle class in low-density places knit together by the car. This model once delivered affordable single-family homes, low crime, open space, and greater mobility by car (1). However, the continuous practice of low density developments has resulted in a city and region that is socially, environmentally, and economically dysfunctional. Consequently, urban sprawl has been the one main cause for an increasing urban heat-island effect in the Phoenix area.

URBAN HEAT ISLAND EFFECT
The heat-island effect is more about urban growth than anything else, where the asphalt goes the heat-island follows. As the city grows and expands outward, the heat-island expands with it. In addition, urban-heat islands have numerous adverse effects on the physical and psychological well-being of city dwellers. Heat-aggravated illness and death are related to increased cardiovascular diseases that weaken the resistance to heat.

This phenomenon is one of the direct results of urban sprawl. According to Robert Balling, director of the Office of Climatology at Arizona State University, Phoenix metro area ranks as the world’s foremost "urban-heat island". The Phoenix metropolitan area is a place where the combination of sun, title roofs, unshaded streets, and lots of asphalt keeps people sweating into the night.

The rapid urbanization of the Valley of the Sun during the past fifty years has been associated with steady increase in temperatures of about .25ºF to 2ºF per decade. Currently the temperatures in the Valley of the Sun are hot with an average temperature of 85ºF, but the number of hours per day over 100ºF has jumped dramatically. It is expected that the heat will increase with the next generation when we have twice as many people in the valley.

It stays hotter longer in Phoenix than in most places. For instance, while the Sahara Desert cools off rapidly at night, dropping as many as 50 degrees between day and night, the Sonoran Desert around Phoenix does not. It is partly a matter of soil composition. For instance, the sand of the Sahara retains heat at a lower rate than the hardpan-like surface of the Sonoran Desert. More importantly the Sahara does not have asphalt surfaces.

Temperatures in Phoenix could increase as much as 15 to 20 degrees above historic average if the current development practice of buildings, roads, and parking lots continue to take over the former croplands and virgin desert lands. The continuous loss of open space due to sprawling development is alarming. As the development spreads, increasing amounts of asphalt and concrete absorb the sun’s radiations during the day. Those artificial surfaces then release heat at night more slowly than irrigated farmland or natural desert soils. The retained heat means higher electric demand for cooling just to compensate for the urban heat-island effect, more smog, higher wind velocities, and more water usage.

MITIGATING URBAN-HEAT-ISLAND EFFECT

In order to remedy the shortcomings of the 20th century policy and practice, we need a proactive approach. Several strategies are available that might mitigate the urban-heat-island in Phoenix. In the following section, I will discuss three of these: inclusionary zoning, cool parking, and tree planting programs.

1. INCLUSIONARY ZONING

The current zoning and land-use regulations promote sprawl, and contribute to the increase negative environmental and sociological effects in our city. Consequently, we end up with a fragmented city that does not contribute to the intensification of the urban fabric, due to the lack of pedestrian environments and the increasing heat-island effect in the region. For instance, the urban fabric of downtown Phoenix is made up by buildings that are randomly scattered and its open space lacks structure. Vacant dirt lots and asphalt paving are dominant elements in the urban fabric. These are the results of the current land use and zoning regulations that show a disregard for mix-use developments in general.

One of the major obstacles for the implementation of pockets of mix-use development in the downtown area are some of the obsolete zoning and land-use regulations that do not allow such type of development. Currently, most of the downtown area is zoned for high rise district, but since there is no demand for high rise building the land simply stays undeveloped for years or even decades (refer to fig.1).

Figure 1: Current zoning and parking requirements for downtown Phoenix.

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1. INCLUSIONARY ZONING

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Under the current zoning conditions if a high rise building is built it end up as a high tower surrounded by a sea of asphalt as parking lot; therefore, the implementation of mix-use development pockets throughout the downtown will help to increase the liveability of the area by adding more diversity of uses and functions (refer to fig. 2).

Inclusionary zoning has become a popular tool nationwide for addressing the shortage of affordable housing and bringing diversity. This zoning system requires developers to reserve certain percentage of new residential development as affordable to low and moderate income households. Through Inclusionary zoning developers are offered cost offsets and incentives such as density bonuses, expedited permitting, and flexible zoning among others.

At the local level Inclusionary zoning has become a common practice on hundreds of communities across the country in order to address affordable housing needs. However, Phoenix still is behind in this trend. The benefits that inclusionary zoning has to offer are multidimensional for instance:

- Strengthens communities: Inclusionary zoning produces affordable homes and apartments for low to moderate wage households.
- Stimulates economic development: It aids economic development efforts by providing housing for the workforce, and at the same time it helps to retain and attracts new business investments.
- Supports smart growth and protects against disinvestment: This will be a major helping the case of Phoenix because inclusionary zoning contributes to smart growth and reinvestment in already developed area by making it possible to produce affordable housing in the urban core and no just on the urban fringes.
- Enhances economic and racial integration: Inclusionary zoning promotes economic and racial integration that can lead to a host of positive social and economic outcomes such as improved schools, decreased crime, and reduced poverty (source?).

2. COOL PARKING

“Cool-parking” lots are surface parking areas that require the use and implementation of porous paving materials rather than asphalt, they are designed to share accommodations with different users, and they are under strict shading requirements.

Parking lots in downtown Phoenix are one of the most ubiquitous elements that contribute to the degradation of the quality of life. Aside from the aesthetics and social costs the there is an economic cost associated with parking lots.

The current zoning and parking requirements have a high cost that in the long range will impact the economic development of the downtown area. For instance, the high cost of providing parking often prevents developers from locating housing downtown.

Cost also prevents adaptive reuse of existing buildings and renovation of historic buildings. Also, expanses of asphalt interrupt the wall of continuous storefronts necessary to create successful appealing and walkable downtowns. Overall, Surface parking exerts a powerful undertow on local economies by taking up space that could be put to more profitable, tax-generating uses.

One strategy to provide urban liveability and to cope with harsh environmental conditions is by providing urban places that respond to the local environmental, geographical and cultural setting. These places can function as areas where walking, resting, and meeting places can revive falling or threatened commercial and residential areas.

A potential way to mitigate the extreme environmental and urban conditions in Phoenix is through the reduction of paving surfaces and the implementation of share-use parking areas as well as increasing porous paving materials in parking area. Currently over 60% of downtown Phoenix is covered by surface parking lots that do not take into consideration the desert environment, and soak up the sun’s radiation during the day (refer to fig.3). Surface parking breaks up connections between places, creating a harsh pedestrian environment. Those artificial surfaces slowly release the heat at night extending the 100°F+ well into midnight.

The benefits of shading parking areas are many. For instance, shade trees reduce solar heat gain by transferring the active heat-absorbing surface from buildings, cars, and pavement to living foliage. Shaded parking lots can reduce temperatures: asphalt as much as 36°F, cabin temperature of vehicles over 47°F, and fuel-tank temperature by nearly 7°F (1). The implementation of “Cool Parking” principles can greatly improve the urban-heat island effect in downtown Phoenix.

![Figure 3: Surface parking with 0% shade.](image)

![Figure 4: Surface parking with 50% to 75% shade.](image)
3. TREE PLANTING PROGRAMS

Planting trees and making urban areas more permeable can create less harsh and more sustainable urban environments. A tree planting program is an attractive strategy both for saving money through energy efficiency and for improving the quality of life in urban areas, but this has to include careful planning, wise selection of species, and designs that that fully use the hydrologic, ecologic, atmospheric restorative and aesthetic benefits that vegetation can provide. Some of the most common benefits of trees in urban areas include:

1. Promote summertime cooling and the conservation of air conditioning energy by reducing irradiance.
2. Allow the dispersion of air pollutants by promoting down- and- cross canyon circulation and mixing with moving air above the city.
3. Provide for solar access during the wintertime by increasing irradiance.
4. Shelter pedestrians from extreme winds, turbulence, and downdraft near buildings. (1).

In addition to trees, the use permeable surface is a great way to mitigate the urban heat island effect. The steps to make neighborhoods' surface more permeable and reduce the heat island effect include:

1. Create incentives for major tree planting programs, and use more permeable surfaces in urban development in all situations. Many paved surfaces—parking lots, alleyways, sidewalks, playing fields, driveways and some streets—receive only moderate to mild use, and yet are paved to standards that can accommodate heavy vehicular traffic.
2. Create more small-scale parks and open space areas that would allow people 1/4-mile walking radius with access throughout the city and region.
3. These open space networks could be publicly acquired to reclaim underutilized and often neglected spaces, and developed through structure partnerships with community-based organizations.

Aside from mitigating the heat island effect tree planting programs can improve social and economic outlook of urban areas. For instance, there are some very successful tree planting program in cities like Chicago, Sacramento, San Jose and Tucson.

Trees for Tucson, is a tree planting program in which residents of the Tucson metropolitan area can receive up to five gallon trees if they agree to plant them on the west, east or south side of the their street. Detailed planting and maintenance information is provided. Over 30, 000 trees have been distributed through these Trees for Tucson since it began in 1993.

Also, Sacramento California has one of the most successful tree planting programs in the nation. Through non-profit and community based programs shade trees are planted to directly shade buildings and homes, thus reducing air conditioning needs for up to 40 percent in the Sacramento area. In addition, there is a parking ordinance that requires a 50% shade rule rather that one tree for certain number of cars. The annual benefit provided by the current parking lot trees (8.1% shade) was valued at approximately $700,000 for improved air quality (source?). By increasing shade to 50% in all parking lots in Sacramento, the annual benefits will increase to $4 million.

When it comes to tree planting programs Phoenix is behind of most other cities due to the lack of strong support from local government and nonprofit organizations. For instance, in Phoenix Urban Forestry will only pay half the cost of trees that are planted on public property, i.e., right-of-ways, schools, etc.

Current parking requirements do not provide any shade requirement and there are no incentives for developers if they use more porous paving materials that will increase the urban permeability. The current parking requirement calls for four parking spaces for 1,000 square feet of development. These standards leave at least half of a shopping center's parking spaces vacant a minimum of 40 percent of the time.

CONCLUSION

Phoenix has grown tremendously over the last fifty years and it is expected to continue to grow. The growth in Phoenix is the result of the idea of planning during the 20th Century in which emphasis was on the separation of uses and functions and it was based around the automobile. As a result we have an urban
area that undermines the local topography and culture of the region. One of the serious consequences of this planning practice is the ever increasing urban-heat-island effect in the urban area. Three strategies for mitigating the urban-heat-island effect were discussed. The long term sustainability and liveability of the Phoenix urban areas would be improved by adopting these measures to reduce the impacts of urbanization on temperatures.

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REFERENCES