



# **A Collaborative Approach for a Resilient Maricopa County: Sustainability Benchmark Recommendations**

**November 2018**

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# Table of Contents

<b>Introduction</b>	<b>3</b>
<b>Executive Summary</b>	<b>4</b>
<b>Vision Statement</b>	<b>7</b>
<b>Urban Infrastructure: The Journey, Destination, and Experience</b>	<b>8</b>
<b>Water: Residential, Commercial, Industrial, Agricultural, and Management</b>	<b>19</b>
<b>Energy: Management and Future Approaches</b>	<b>26</b>
<b>Waste Management: Air, Water, and Land</b>	<b>33</b>
<b>Food: Insecurity and Access</b>	<b>40</b>
<b>Agriculture:</b>	<b>51</b>
<b>Conclusion</b>	<b>54</b>
<b>Bibliography</b>	<b>57</b>

## Introduction

This report is for the participating municipalities within Sustainable Cities Network; with the purpose of developing sustainability goals and benchmarks for Maricopa County. Maricopa County (herein, the County) is the largest central county in Arizona, being 9,224 square miles with a population over 4 million. The County is also the fastest growing county in the United States<sup>1</sup> and it's expected the County population will reach 6 million by 2040<sup>2</sup>. Sustainability goals can help cities in the County prepare for unprecedented population growth and an overall increase in demand for basic resources such as, water, food, energy, and housing. Goals should also consider other regional vulnerabilities (e.g. climate change) and how they directly threaten resource security, infrastructure, and the economic stability of cities in the County. Many cities within the County (e.g. Phoenix, Tempe, Peoria, Avondale, etc.) have general plans that incorporate sustainability goals. However, the platform provided by the Sustainable Cities Network allows for an excellent opportunity to endorse regional sustainability goals, for the benefit of the County as a whole. We have developed regional sustainability goals using the benchmarking process; which starts by setting benchmarks that measure progress towards achieving goals. More importantly, our report will showcase some of the best urban practices compiled from academic literature and comparable cities around the world that can benefit the County.

In order to fully address the diverse issues that challenge the County, our report is broken into six chapters: infrastructure, water, energy, waste, food, and agriculture. We feel these topics are essential components to urban sustainability. Each topic contributes to the dynamic scope of issues facing the County and contains potential strategies to help make the County more resilient to hardships. Together these components create a good framework for regional sustainable action in the County. Adopting regional sustainability goals is an opportunity for Maricopa County and the Sustainable Cities Network to inspire other counties and communities to take part in a collaborative sustainability effort. Accomplishing these benchmarks will not be easy for the cities in Maricopa County, but it is an important undertaking that demonstrates responsible governance and a deep commitment to the residents of the County.

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<sup>1</sup> US Census Bureau. "Maricopa County Fastest Growing in US." The United States Census Bureau. March 27, 2018. <https://www.census.gov/newsroom/press-releases/2018/popest-metro-county.html>.

<sup>2</sup> Maricopa County Planning and Development Department. 2016. *Maricopa County Vision 2030 Comprehensive Plan*. Phoenix, AZ: Maricopa County Planning and Development Department.

## Executive Summary

### Infrastructure Goals

In the Infrastructure Section, we explore why cities within the County have had inefficient planning that has resulted in urban sprawl. This design lacks mobility and the expansive surface area of infrastructural materials result in the urban heat island (UHI) effect; which causes increased costs of energy, water, and fuel to the city<sup>3,4</sup>. Our infrastructure development goals are long-term investment goals for the year 2040; they are divided into short, medium, and long-term benchmarks. Our benchmarks address issues of mobility, connectivity, efficient materials, and ecosystem services in the city. These infrastructure goals are meant to improve city resilience and establish a deeper quality of life for residents in the County. We suggest by 2040: 10% of workers commuting by public transportation, 30% of the workforce population living within a 5 mile radius of their place of employment, develop 25% urban forest cover, develop 50 miles total of developed waterfront canal Space, 100% of city-operated buildings be at least LEED silver certified, all municipal parks within the County should serve 100% of their residents, and develop more affordable housing with families spending less than 30% of their income on housing costs.

### Water Goals

In the Water Section, we examine the current state of our water supply, and breakdown our water usage by sector for review of how each sector (Residential, Commercial, Industrial, Stormwater Management and Wastewater Management) uses their water, and conservation measures that can have a significant effect on water use levels in the Valley. Stream flows for the Colorado River are currently in a bleak state, with current droughts and forecasted reduced stream flows for the future. The groundwater supply that the region relies on for 43% of its water is also experiencing overdrafts due to a greater reliance on groundwater for water resources.<sup>5</sup> This reduced water supply makes water conservation in the Valley imperative.

Residential water usage is one of the leading uses of water in the County communities. Thus we recommend for the communities to reduce individual water use to 80 Gallons per Capita per Day by 2040, as well as to implement widespread rainwater harvesting by capturing and using 10% of rain that falls over residential communities by 2040.

Commercial buildings largely use water for outdoor landscaping, as well as indoor water use through appliances. We recommend that the communities in the County adopt rebates and incentives for ideas such as mesic landscape replacement, and watersense technologies to decrease their water use by 60% by 2040.

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<sup>3</sup> Grimm, Nancy B., Stanley H. Faeth, Nancy E. Golubiewski, Charles L. Redman, Jianguo Wu, Xuemei Bai, and John M. Briggs. "Global change and the ecology of cities." *science* 319, no. 5864 (2008): 756-760. P. 758

<sup>4</sup> Gober, Patricia, Anthony Brazel, Ray Quay, Soe Myint, Susanne Grossman-Clarke, Adam Miller, and Steve Rossi. "Using watered landscapes to manipulate urban heat island effects: how much water will it take to cool Phoenix?." *Journal of the American Planning Association* 76, no. 1 (2009): 109-121.

<sup>5</sup> Arizona Department of Water Resources. "ARIZONA'S WATER SUPPLIES AND WATER DEMANDS." AZ Water Resources. 2018. <http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/supplydemand.pdf>.

Industrial water use makes up 7% of the water use in the County, with groundwater, making up 55% of the allocation<sup>6</sup>. We recommend that the communities in the County utilize more effluent water, and reduce their groundwater consumption to decrease water use by 40% by 2040.

Regarding Agricultural water use, we recommend that the communities in the County reduce groundwater sourcing to 25% by 2040, through usage of drip irrigation and possible effluent water use.

We recommend that the communities in the County adopt green infrastructure techniques such as bioswales, vegetated basins and rainwater gardens to increase percolation of stormwater to aquifers and decrease the flooding experienced during monsoon season each year. Our goal for the communities is to build a rain garden for every 2000 residents by 2040 (9,000 total)

Communities such as Orange County in California, and Singapore in SE Asia have begun to treat and use wastewater for drinking water to solve their lack of water for human consumption/use. We recommend that the communities in the County look into these technologies, and utilize 50% of water reuse for drinking water by 2040.

### **Energy Goals**

In the Energy Section, we analyze the current energy production matrix, and provide benchmarks and policy recommendations regarding current energy production methods, municipal energy consumption, and light pollution in the County. Arizona's energy industry sector contributes 87% of CO<sup>2</sup>, with the majority of Arizona's net energy generation comes largely from natural gas-fired and coal-fired plants. These plants combine to produce roughly 6 million MWh of electricity<sup>7</sup>. To mitigate the high contributions of CO<sub>2</sub> that energy generation produces, we recommend that the municipalities in the County lead by example, and operate on 100% renewable energy for all municipal operations. We also recommend that by 2025 communities in the County should require that all new residential housing installments within the County should be built with rooftop solar installments.

Concurrently, energy efficiency is also vitally important to reducing the emissions that our energy sector produces. Decreasing emissions by altering city building energy practices towards green building techniques and energy efficient technologies can deliver up to two-fifths of total emission savings. Thus, we recommend that by 2035 all newly constructed commercial and municipal buildings within the County should follow green building standards such as International Green Construction Codes. We also recommend that by 2035, all pre existing commercial, industrial, and municipal structures should be retrofitted to meet green building standards such as International Green Construction Codes.

### **Waste Goals**

In the Waste Section, we delve into the negative effects of our current solid waste system as well as provide background, benchmarks and recommended policy for other facets of

<sup>6</sup> Arizona Department of Water Resources. "ARIZONA'S WATER SUPPLIES AND WATER DEMANDS." AZ Water Resources. 2018.

<sup>7</sup> U.S. Energy Information Administration. 2018. *Electric Power Annual*. Washington, DC: U.S. Energy Information Administration.

the waste dilemma, such as ozone and PM 2.5 levels in the air and wastewater. The waste stream has ecological, social, and economic aspects that are in jeopardy if business-as-usual operations prevails in the County. Therefore, the waste management system needs to be transformed to reflect the important responsibilities and values of Maricopa. To achieve this transformation, we recommend that the communities in the County increase their circular economy activity contribution to gross state product to 2% by 2040. To achieve this, we recommend that they have a 30% increase in their applied use of waste energy, and a 70% diversion rate from landfill and incineration. To reduce the rising amount of days of elevated ozone and PM2.5, we recommend that the communities in the County take steps to have less than 30 days of Reported Elevated Ozone and/or PM2.5 by 2040. Water is one of our most precious resource that requires deft management, which includes the usage of water effluent water to provide for our water needs. This is why, we recommend that the communities in the County require 100% greywater systems in new construction, municipal buildings and retrofit permits by 2040.

### Food Goals

In the Food and Agriculture Sections, we provide background information, benchmarks, and policy recommendations for the following five subtopics; 1) Hunger, Food Security, Food Access, 2) Diet Related Health, 3) Food Waste, 4) Food Literacy, and 5) Agriculture. We find that too many County residents are forced to suffer from lack of healthy, culturally appropriate, sustainable food as evidenced by high food insecurity prevalence, high obesity and diabetes prevalence, and low participation in locally produced food.<sup>8</sup> Furthermore we find that unsustainably large proportions of available food in the County are never eaten and that food grown in the County makes up a tiny minority of food consumed in the County. These failures are in part due to a lack of education of youths in schools and adults in public and private spaces but are also the result of several barriers imposed and supported by the municipalities. For example, municipal planning has and continues to encourage dangerous development that results in one third of census tracts in the County locating detrimentally far from full service grocers and farmland being gobbled up in the process.<sup>9</sup> Additionally, municipalities in the County have blocked the institution of a living wage adequate enough to facilitate the purchase of healthy sustainable food and continue to source most of their revenue from the middle and lower classes through regressive levies.<sup>10</sup> And finally, we describe the decline in local agriculture and the concentration of the means of production. In this report we recommend benchmarks for the near future and strategies on how to realize them. The recommendations we make include gender parity in farm acreage, banning advertising of unhealthy food to children, and the redistribution of the means of purchasing and producing food through a living wage and agrarian reform.

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<sup>8</sup> Food insecurity(FeedingAmerica), obesity, diabetes(CDC), CSA/direct to consumer (USDA)

<sup>9</sup> (USDA ERS); USDA Census of agriculture.

<sup>10</sup> For example, see Phoenix 2018-2019 Summary Budget. Retrieved on 10/7/18 from, <https://www.phoenix.gov/budget/annualbudget>

## **Vision**

By 2040, the County will have six million people living in a diverse, resilient, and well-connected community. Neighborhoods will have parks unique to our Arizona landscape, with native tree lined streets and rain gardens capturing and retaining stormwater which also add value to the surrounding area. City markets will use clean renewable energy and be built with safe, sustainable materials that add quality to the shopper's life while providing fresh and locally grown food farmed by workers paid a living wage. Food that is not purchased will be diverted from landfills and composted as part of the zero-waste program, or donated to local organizations. The County will have a variety of reliable and enjoyable transit options to connect residents to hubs of activity, such as work spaces or cultural events, perhaps along our developed and robust canal network. Residents of the County will feel a "sense of place" and connection to their County, and will work together to ensure an equitable, safe, and thriving community for the next generation.



## Infrastructure Goals: 2040

Effective infrastructure moves materials, energy, water, and people in a timely fashion throughout cities. Infrastructure in the County has mostly been built with an edge city design; edge cities are characterized by expansiveness, low living density, and grid-like connectivity<sup>11</sup>. This design pattern contributes to major inefficiencies for the County's metropolitan area. First, edge cities have a large surface area of urban materials that are heat conductive, this creates the urban heat island (UHI) effect<sup>12</sup>. UHI not only has a heavy environmental impact, but also causes higher financial costs for cities; UHI increases water consumption in single-family homes, estimated at an additional 290 gallons used for every 0.6°C (1°F) increase in overnight low temperatures<sup>13</sup>. Electricity demand is also increased due to UHI, it's estimated that UHI creates an 8% increase in total electricity load in the United States<sup>14</sup>. Other inefficiencies attributed to edge cities are automobile dependency, traffic congestion, and air emissions<sup>15</sup>. Infrastructure is linked to many challenges facing the County; however, it is can also adapt to meet the needs of the present and future populations. While it is impossible to change the city composition in the County; this report will cover development benchmarks that will make edge cities more connective, efficient, and resilient. This chapter will be broken down into three subchapters which incorporate aspects of urban life: the journey, the destination, and the experience had in cities.

These three aspects of the urban life cover the movement of people and materials through the city (journey), efficiency and function of places within the city (destination), and the attractiveness, feeling, and economic draw of the city (experience). The goals in these subchapters should help improve mobility and connectivity within and between cities in the County. Infrastructure reform is very difficult to accomplish; there are often environmental, economic, and policy restraints that make infrastructure change difficult. However, this section

<sup>11</sup> Hutter, Mark. *Experiencing cities*. Routledge, 2015. P. 100

<sup>12</sup> Grimm, Nancy B., Stanley H. Faeth, Nancy E. Golubiewski, Charles L. Redman, Jianguo Wu, Xuemei Bai, and John M. Briggs. "Global change and the ecology of cities." *science* 319, no. 5864 (2008): 756-760.

<sup>13</sup> Gober, Patricia, Anthony Brazel, Ray Quay, Soe Myint, Susanne Grossman-Clarke, Adam Miller, and Steve Rossi. "Using watered landscapes to manipulate urban heat island effects: how much water will it take to cool Phoenix?." *Journal of the American Planning Association* 76, no. 1 (2009): 109-121.

<sup>14</sup> Grimm, Nancy B., Stanley H. Faeth, Nancy E. Golubiewski, Charles L. Redman, Jianguo Wu, Xuemei Bai, and John M. Briggs. "Global change and the ecology of cities." *science* 319, no. 5864 (2008): 756-760. P. 758

<sup>15</sup> Hutter, Mark. *Experiencing cities*. Routledge, 2015. P. 100

hopes to offer implementable strategies from other cities and publications that could be advantageous to the County.

## I. The Urban Journey: Connectivity through Transportation

### Transportation Goals

#### **2040- 10% of workers commuting by public transportation**

Short-term Benchmark: 5% workforce commute by public transit by 2025

Mid-term Benchmark: 7% workforce commute by public transit by 2030

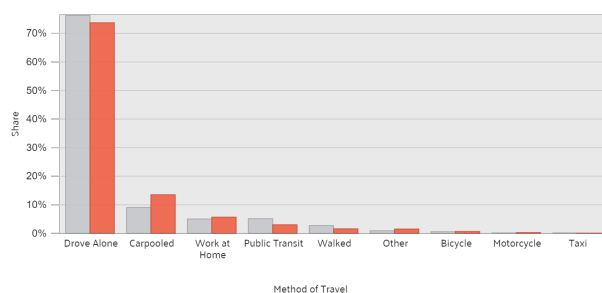
Long-term Benchmark: 9% workforce commute by public transit by 2035

Current (For County): ≈ 2.3% workforce commute by public transit (2016)<sup>16</sup>

Reducing automobile traffic is essential in order to avoid gridlock and reducing excessive energy expenditure. Making alternative and public transportation accessible and attractive is a difficult task for the County; but it's an essential step to reduce fossil fuel dependency and foster a growing population with transportation needs. Methods of alternative and public transportation in the County include: biking, walking, buses, and light rail travel. Modern cities should have easy and equitable access to most forms of alternative transportation; automobile ownership should not be necessary to travel the County. As of 2016, around 5% of the U.S. used public transit to commute to work, while the city of Phoenix had 3%<sup>17</sup>.

Commuter Transportation in Phoenix, Az

Please note that the buckets used in this visualization were not evenly distributed by ACS when publishing the data.



Dataset: ACS 1-year Estimate  
Source: Census Bureau

**DATA USA:**

<sup>16</sup> U.S. Census Bureau, Retrieved from:

<https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

<sup>17</sup> Data USA. "Phoenix, AZ", 2016. [https://datausa.io/profile/geo/phoenix-az/#category\\_transportation](https://datausa.io/profile/geo/phoenix-az/#category_transportation)

#### Recommended Methods for Achievement:

**Biking:** Increase wayfinding signs, bike facilities i.e. racks, valets, garages, increase the number of complete streets with bike lane buffers for urban areas, and shoulders for rural/suburban areas.

**Walking:** An increase in wayfinding signs, complete (green) streets, crosswalks, median islands, and curb cuts for people with disabilities would all make for a more comfortable pedestrian journey.

**Buses/ Rail:** Increase access to and frequency of stops, increase the number of employment opportunities near stops. Improve stop amenities such as shade, green space, zero waste can options, water stations, wayfinding signs. Ideally, neighborhoods should be located within ½ mile of these options.

Improving light rail and bus systems are sensible strategies for making progress towards this benchmark; the County already has the foundational framework for these transportation services through the Valley Metro. Portland Oregon has an effective light rail system called Metropolitan Area Express, which consists of 5 light rail lines that provide access to the majority of the city. Implementing more light rail infrastructure is expensive, however, Phoenix is moving in this direction through the Reinvent Phoenix initiative; which extends the current light rail system through the central Airport District to North Phoenix<sup>18</sup>. Neighboring cities could greatly benefit by adding intersecting lines to this rail system and make the metropolitan area of the County more connective.

A cheaper alternative to light rail is investing in the Valley Metro bus service. The primary issue with bus transit in the County is that it utilizes the same roads as private automobiles; making public transit by bus inconvenient due to traffic in between stops. Curitiba Brazil has designed a rapid bus transit system that is one of the highest used and lowest costing transit systems in the world<sup>19</sup>. Curitiba accomplishes this by creating alternative lanes that can only be accessed by city buses to avoid traffic congestion. Maricopa could adopt a similar strategy to make the Valley Metro buses more attractive and useful.

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<sup>18</sup> Planning and Development, *Reinvent PHX*. Phoenix, Arizona.

<sup>19</sup> Goodman, Joseph, Melissa Laube, and Judith Schwenk. "Curitiba's bus system is model for rapid transit." *Race, Poverty and the environment* (2005): 75-76.

The city of Austin, Texas' Strategic Mobility Plan<sup>20</sup> is a very comprehensive plan and an excellent reference that is working to promote methods like these for multi-modal transportation. Their plan not only looks at the functionality of these practices, but also describes policies they plan on implementing, and how to best meet the transportation wants and needs of their citizens. Some of the policies the plan includes that could be executed in the County are completing their sidewalk system, improving the reliability of public transit travel time, and maintaining an all ages and ability bicycle network<sup>21</sup>.

### **2040- 30% of the workforce population living within a 5 mile radius of their place of employment**

Short-term Benchmark: 10% of Employees living 5 miles in proximity to work by 2025.

Mid-term Benchmark: 18%% of Employees living 5 miles in proximity to work by 2030.

Long-term Benchmark: 25% of Employees living 5 miles in proximity to work by 2035.

Current: Average 10 miles away 25 minutes commute; population living within 5 miles of work unknown (2016)

This benchmark attempts to attack the core of excessive fuel expenditure and traffic congestion in cities. Currently, the average time that it takes for people to commute to work in the County is 25 minutes<sup>22</sup>. Long and redundant travel by automobile greatly increase fuel expenditure and CO<sub>2</sub> emissions. Concentric employment opportunities and intercity commute often cause heavy traffic congestion on busy roads and freeways. Reducing the distance to work can help decongest the city, reduce ecological footprint, and promotes equitable zoning and policies.

#### **Recommended Methods for Achievement:**

This goal is difficult to implement in the County, as redesigning zones of employment requires regional city cooperation. Future city development should strive for mixed-use development with land use policies that bring business and employees closer together; mixed-use planning is one reason the city of Curitiba, Brazil doesn't have congestion issues<sup>23</sup>.

<sup>20</sup> Department of Transportation, *Austin Strategic Mobility Plan; Draft Policies*, Austin, Texas.

<sup>21</sup> Department of Transportation, *Austin Strategic Mobility Plan Draft Policies Presentation*, Austin, Texas.

<sup>22</sup> U.S. Bureau of the Census, Mean Commuting Time for Workers in Maricopa County, AZ [B080ACS004013], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/B080ACS004013>, October 28, 2018.

<sup>23</sup> Goodman, Joseph, Melissa Laube, and Judith Schwenk. "Curitiba's bus system is model for rapid transit." *Race, Poverty and the environment* (2005): 75-76.

Residential areas should be decently equipped with nearby markets, commercial areas, and healthcare facilities to offer close proximity employment options for future residents.

One experimental method to achieve this benchmark is incentivizing people to live within close proximity to work. Housing subsidies have been used by Facebook and Baltimore County to incentivize employees to live close to work<sup>24</sup>. Their results have had mixed success due to landlords stifling these efforts by increasing rent. However, perhaps a public/private partnership could get better results with incentivizing housing policies. Overall, incentivizing businesses to move into different commercial hubs can also help make the County more resilient by spreading job opportunities throughout the County, helping to redirect traffic to other cities and spread employment opportunity.

## II. The Urban Experience: Making Maricopa Memorable and Combating Urban Heat

### **Urban Forestry Benchmark**

#### **2040- 25% Urban Forest Cover**

Short-term Benchmark: 15% urban canopy coverage by 2025

Mid-term Benchmark: 18% urban canopy coverage by 2030.

Long-term Benchmark: 20% urban canopy coverage by 2035

Current: 6.8% average city urban canopy coverage in the County (2015)<sup>25</sup>

In a state with an abundance of sunshine, providing shade and reduced ambient temperatures from trees and shade structure are important to improving the experience of the urban environment. Urban forestry can be implemented along streets, sidewalks, park, and populated places to add to the overall experience. Increasing the urban canopy can help to make public transportation and pedestrian life more attractive; the canopy can also help protect infrastructure from direct sun exposure, and improve air quality. The urban tree canopy in Maricopa can be vastly improved, with the average cover for County cities being 6.8%. According to American Forests, southwestern cities should have at least a 25% canopy cover to provide many of the benefits discussed here.<sup>26</sup> 25% canopy cover may not seem realistic for an arid city, but research conducted by Arizona State University illustrated its feasibility in a

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<sup>24</sup> Baltimore County, Retrieved from:

<https://www.baltimorecountymd.gov/Agencies/planning/housingopportunities/Inyw.html>

<sup>25</sup> Department of Forestry and Fire Management. *Arizona Urban Tree Map*. Arizona.

<sup>26</sup> Parks and Recreation. *Tree and Shade Master Plan 2010*. Phoenix, Arizona.

Phoenix neighborhood. An increase from the current 10% coverage to 25%, combined with cool roofs, resulted in a 3.6 F cooling benefit for average daytime temperatures<sup>27</sup>

#### Recommended Methods for Achievement:

First, preliminary tree inventories should be made in each city, with an increase in funding for tree planting and maintenance. The County should focus on maintaining healthy trees in order to lose less each year, which would help the cities gain more canopy coverage and save money on new tree plantings. The public should also be educated on the benefits of additional forest coverage, and become involved in the planting going on within their neighborhoods and surrounding areas. Edible varieties such as oranges, lemons, apples and the like should be prioritized and maintained by the city for citizen harvest and use. Arizona Community Tree Council Inc., with help from Trees Matter and SRP, puts on year-round volunteer events, such as Shade Tree Workshops and the Edible Tree program. The Shade Tree Workshop distributes free shade trees to attendees, with an average of 2,000 trees distributed at their September workshops each year<sup>28</sup>.

#### **Pavement Benchmark:**

##### **Adopting White roads - Downtown Area contain cool pavement roads by 2040**

This is an experimental development goal inspired by Los Angeles's white road initiative. The idea behind white roads is to increase the city's albedo, the ability to reflect heat and sunlight, to mitigate the Urban Heat island effect. The city of Los Angeles claims this process will cool street temperatures by 10°F using Coolseal, a solvent added to asphalt to make streets a light grey color. There are still many uncertainties with white roads such as reflectivity hazard, estimated cost, environmental effects, and how often the roads will need maintenance. According to the EPA, white roads have many benefits such as improving nighttime visibility, saving electricity on lighting, and cooling stormwater quality to protect microbial life in soils<sup>29</sup>. If

<sup>27</sup> Ariane Middel, Nalini Chhetri, Raymond Quay. "Urban forestry and cool roofs: Assessment of heat mitigation strategies in Phoenix residential neighborhoods" Urban Forestry & Urban Greening 14 (2015): 178-186

<sup>28</sup> Trees Matter. "Utility Shade Tree Program". (2018). Retrieved from <https://www.treesmatter.org/SRP>

<sup>29</sup> Environmental Protection Agency. "Using Cool Pavements to Reduce Heat Islands". Retrieved from <https://www.epa.gov/heat-islands/using-cool-pavements-reduce-heat-islands>

this strategy is successful in Los Angeles, Maricopa should look into implementing white roads and white roofs.

### **Waterways Benchmark: Canal Oriented Development (COD)**

#### **2040- 50 miles of Developed Waterfront Canal Space**

Short-term Benchmark: 15 miles of canalscape by 2025

Mid-term Benchmark: 30 miles of canalscape by 2030

Long-term Benchmark: 45 miles of canalscape by 2035

Current: ≈ 12 miles in planning through Grand Canalscape plans. (2018)

Urban renewal can take advantage of cultural and environmental features of a city or region. For example, the Cheonggyecheon River was a massive urban renewal project in Seoul Korea; it was an expensive project but it restored a much-needed connection to the environment and Korean history. This project will more than pay for itself; besides tourist attractions, their investment in local ecology effectively provides flood protection for up a 200-year flood event<sup>30</sup>. This urban renewal process also increased biodiversity in the city by over 600% and significantly reduced UHI effects along the stream<sup>31</sup>.

The County has a similar culturally significant water feature. 181 miles of Hohokam canals reside in the County<sup>32</sup>; currently, 131 miles of this canal space is in use for water delivery, owned by the Bureau of Reclamation and maintained by the Salt River Project<sup>33</sup>. These canals are generally barren with few amenities; it's likely residents of Arizona are not even aware of their cultural significance. The potential of the canal space has been realized, the grand canalscape plans are a collaborative effort by Tempe and Phoenix to renovate 12 miles of canal space near the I-10 through the Tempe/Phoenix border region. Although there are an estimated 150 additional canal sites that have the potential for vibrant community hubs and park space between Glendale and Chandler alone<sup>34</sup>. Building new canalscape can bring an authentic urban experience from the County, the benefits are unclear, but investment in ecosystem services helps combat flooding and UHI. Maricopa can develop robust, multimodal

<sup>30</sup> Land Performance Series. "Cheonggyecheon Stream Restoration Project" Retrieved from: <https://www.landscapeperformance.org/case-study-briefs/cheonggyecheon-stream-restoration>

<sup>31</sup> Land Performance Series. "Cheonggyecheon Stream Restoration Project" Retrieved from: <https://www.landscapeperformance.org/case-study-briefs/cheonggyecheon-stream-restoration>

<sup>32</sup> Ellin, Nan. "Canalscape: practising integral urbanism in metropolitan Phoenix." *Journal of Urban Design* 15, no. 4 (2010): 599-610. p. 602

<sup>33</sup> Salt River Project. "Canals". Retrieved from <https://www.srpnet.com/menu/water/canals.aspx>

<sup>34</sup> Ellin, Nan. "Canalscape: practising integral urbanism in metropolitan Phoenix." *Journal of Urban Design* 15, no. 4 (2010): 599-610. p. 602

infrastructure around canals to promote tourism, community events, local small businesses, and restore the native desert riparian environment surrounding the canals while also connecting to nearby trail networks and neighborhood parks.

#### Recommended Methods for Achievement:

Educate County residents on the untapped potential and benefits of COD. This would garner strong community support, and help incite developers. Partnerships between the community and developers would help safeguard the neighborhood's unique identity during the development. One way to accomplish a sense of place for COD is for the city and commercial developers to partner with local arts programs (schools, community centers, etc) to create projects displayed within canal development and get in touch with the historical roots tied to the Arizona canals. Both of which would incite tourism and use. Successful COD's have 4 main characteristics: Access and Linkages, Sociability, Comfort and Image, and Use and Activities<sup>35</sup>.

### III. The Urban Destination: Efficiency and Equity

#### **Buildings Benchmark:**

##### **2040- 100% of city-operated buildings be at least LEED Silver Certified**

Short-term Benchmark: 20% of city-operated buildings retrofitted for at least LEED Silver by 2025

Mid-term Benchmark: 50% of city-operated buildings retrofitted for at least LEED Silver by 2030

Long-term Benchmark: 75% of city-operated buildings retrofitted for at least LEED Silver by 2035

Current: 0% of current city-operated buildings (based on a mode average of all 27 the County Cities)<sup>36</sup>

This is a general overview of the best green management practices that should be implemented in cities if they wish to move towards a more sustainable and resilient future. Buildings and the overall built environment should enhance the quality of life for users, not take from it. This is what green building hopes to accomplish for generations to come. A way to achieve improved well-being while living in the built environment is by encouraging businesses to become Leadership in Energy and Environmental Design (LEED) certified. LEED, facilitated by the U.S. Green Building Council (USGBC), is a flexible, comprehensive green building certification for commercial builds, housing, neighborhood development, and cities and communities. For Commercial builds, projects can apply for certification in Building Design +

<sup>35</sup> Buckman, Stephen. "Canal Oriented Development as an Urban Waterfront Development Mechanism." Doctoral Thesis. Arizona State University, 2013.

<sup>36</sup> Green Building Information Gateway. "Explore Green Buildings". Retrieved from <http://www.gbig.org/>



Construction, Interior Design + Construction, and Operations + Maintenance<sup>37</sup>. Whether this be retrofitting old office spaces, or starting on a new living building project, LEED helps to guide designers and planners on making smart choices focused on the economy, environment, and society.

#### Recommended Methods for Achievement:

Educate developers and future business owners on the benefits of LEED certification and promote green building in general. Even without LEED certification, cities can also encourage the use of the International Green Construction Code (IGCC) for new building projects, and work towards maintaining quality spaces for community members and visitors.

### **Parks Benchmarks**

**2040- All municipal parks within the County should serve 100% of their residents (accessible by a 10 minute walking distance).**

Short-term Benchmark: 65% of residents served

Mid-term Benchmark: 75% of residents served

Long-term Benchmark: 85% of residents served

Current Average: 56% of residents served- Based on the County cities rated by ParkScore® (2018)

Parks and green spaces in an urban environment enhance the quality of life for citizens<sup>38</sup> and urban biodiversity<sup>39</sup>. They act as a hub for social gatherings, exercise, and are a way to increase the well-being of city residents. Parks should be accessible for all, and offer equitable amenities for its users. In the County cities, green spaces should reflect the natural, desert landscape as much as possible to maintain local wildlife connectivity. They should be spaced in relation to the surrounding population so city residents are never too far from the benefits that parks can offer.

#### Recommended Methods for Achievement:

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<sup>37</sup> U.S. Green Building Council. "Guide to LEED Certification: Commercial". Retrieved from <https://new.usgbc.org/cert-guide/commercial>

<sup>38</sup> Akbar Kiani, Masoume Javadiyan, Vahid Pasban. "Evaluation of Urban Green Spaces and their Impact on Living Quality of Citizens (Case Study: Nehbandan City, Iran)," *Journal of Civil Engineering and Urbanism* 4. (2014): 89-95.

<sup>39</sup> Aronson, Myla F. J., Christopher Lepczyk, Karl L. Evans, Mark A. Goddard, Susannah Beth Lerman, James Scott MacIvor, Charles H. Nilon and Timothy Vargo. "Biodiversity in the city : key challenges for urban green space management." (2017).

This report utilized research completed by the Trust for Public Lands' ParkScore® program, which evaluates park systems in the 100 most populous cities in the United States<sup>40</sup>. Currently, the city of Mesa serves 64% of their population with accessible park space, while the city of Phoenix serves 45% of theirs, with the average of all the County cities evaluated (Chandler, Glendale, Mesa, Phoenix, and Scottsdale) serving 56% of their populations<sup>41</sup>. This statistic is based on the number of residents that live within a ten minute walking distance to a park. In this scenario, a park must have the six "key amenities" of basketball hoops, dog parks, playgrounds, recreation, and senior centers, restrooms and splash/spray pads. If a park does not include these, it is deducted points from its ParkScore®. Acreage, which is based on median park size and parkland as a percentage of the city area, investment through public, non-profit spending and volunteer hours are also included in Parkscore®. One way cities can increase the number of parks is by gaining funding through municipal bonds. An ongoing study done by the Trust for Public Land shows that the voter approval for parks and open land acquisition bonds exceeds 75%<sup>42</sup>. This clearly illustrates the public's interest in increased parks and green space. The city of Phoenix has a Parks and Preserves Initiative Program that saves "one cent of sales tax for every \$10 of purchases to improve and renovate existing parks, and to expand and improve the city's desert preserve system"<sup>43</sup>. This program was voted to be renewed for 30 more years, and within that time will hopefully help the city residents gain more access to quality local parks. With this benchmark, we are focusing on developing more parks within cities and neighborhoods. Maricopa has a great regional park system<sup>44</sup>, but these tend to be at the edges of cities, with most requiring vehicular or bike transportation to access them. We would not want cities to continue to sprawl even closer to these boundary parks, so they were excluded from this "accessible parks" benchmark.

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<sup>40</sup> Trust for Public Land. "ParkScore®". 2018. Retrieved from <http://parkscore.tpl.org/methodology.php#sm.01blxs615rteun11r92712tg7yft>

<sup>41</sup> "ParkScore". Trust for Public Land. 2018  
<http://parkscore.tpl.org/city.php?city=Phoenix#sm.00000koxhgy2o6ff3vzwmqo9vz1ug>

<sup>42</sup> National Recreation and Parks Association. *Why Parks and Recreation Are Essential Public Services*. <https://www.nrpa.org/uploadedFiles/nrpa.org/Advocacy/Resources/Parks-Recreation-Essential-Public-Services-January-2010.pdf>

<sup>43</sup> Parks and Recreation, *Phoenix Parks and Preserve Initiative Program*. Phoenix, Arizona.

<sup>44</sup> "Park Locator". Maricopa County Parks and Recreation. <https://www.maricopaCountyparks.net/park-locator/>

## **Housing Goals**

Develop more affordable housing with families spending less than 30% of their income on housing costs.

Remove certain restrictions on single-family compact lots to allow for more housing diversity such as condos, townhomes, etc.

Incentivize nonprofits to become a Community Housing Development Organization (CHDO's)

Housing should be equitable, accessible, and affordable for all. In urban environments, it can be a struggle to achieve all three of these. Equitable housing means that homeowners are provided living situations that fit their needs, which may not look the same for everyone. Housing should be accessible by *multiple* modes of transportation, not just cars. Housing must be in close proximity or connected enough to not only basic resources such as fresh food, and water, but also essential experiences like parks, libraries, and schools. Affordable housing means that a family spends less than 30% of their income on their housing costs<sup>45</sup>. What this looks like for neighborhoods is providing a wide range of housing options to make their community inclusive. This section includes goals that should be considered when developing/ retrofitting Maricopa housing developments and ways to help citizens gain access to affordable housing.

Incorporating sustainability benchmarks into city infrastructure is an involved process, but worth the extra steps that need to be taken. Infrastructure is the foundation of a city, and building with durable materials in a thoughtful way will ensure a greater quality of life for residents. Including a comprehensive urban forest canopy cover, safe bike lanes, wayfinding signs, and waterfront development all work to improve inhabitant's well-being with easy access to nature and social activities. This kind of planning for the long-term and safeguarding a city's resilience will not only benefit current citizens but future generations as well. There is also a chance to educate the public about these goals and benchmarks, and let communities know about the efforts being made to improve their cities. This report does not benchmark fundamental aspects of infrastructure such as sewage/ pipelines or airports. Necessary metrics to provide benchmarks for city pipelines and cables were not readily accessible. Information regarding updates to said infrastructure should be made public and considered when discussing

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<sup>45</sup> Department of Housing and Urban Development. "Affordable Housing". United States of America. [https://www.hud.gov/program\\_offices/comm\\_planning/affordablehousing/](https://www.hud.gov/program_offices/comm_planning/affordablehousing/)

future sustainability plans for cities. Airports were also left out of this report, but should be designed and constructed with anticipation of new modes of travel in order to keep well connected to the serviced region, like the city of Austin, Texas is planning to do.<sup>46</sup>

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<sup>46</sup> Department of Transportation, *Austin Strategic Mobility Plan; Draft Policies*, Austin, Texas.

## Water Goals: 2040

### Background

The chance for decade to multi-decade long droughts will continue to increase through the 21st century in the Southwest<sup>47</sup>. This will give rise to conditions that may threaten water security. The future of water in the County looks bleak unless there is collective action throughout the County and the Southwest to address water usage. The region receives less than eight inches of precipitation a year and relies upon various surface and groundwater sources to provide water to vying constituents. Allotting water resources for personal, commercial and agricultural use in a fast-growing, highly populated desert requires intuitive, efficient planning for the current and future resource needs. The majority of the County's renewable water falls as snow pack in surrounding and distant mountain ranges. Business as usual scenarios suggest that the American Southwest will experience higher temperatures and will be drier, increasing the likelihood of water stress for communities in the County<sup>48</sup>. Water security will be vital for the County in coming decades.

Streamflows in the Colorado River Basin are already down 19% this century due to the current drought (the worst 15 year drought on record) and are expected to drop 20% by mid-century and a possible drop of 35% by 2100<sup>49</sup>. With the already experienced loss in tributary waters, the Colorado River is straining to provide the level of water resources the Western U.S. relies upon. The issue of drought and loss of renewable water resources such as the Colorado, Salt, and Verde Rivers will continue to worsen with the expected temperature rise and increased variability in extreme weather events that are projected to occur in the coming decades.

The County relies on groundwater for a significant amount of its water resources, and Arizona, as a state, sources 43% of its water from groundwater<sup>50</sup>. This reliance on groundwater has led to significant overdraft levels in the region. Areas with the most severe groundwater depletion are considered Active Management Areas (AMA) by the Arizona Department of Water Resources. the County is currently mostly covered by the Phoenix AMA. The Phoenix AMA is

<sup>47</sup> Cook, B. I., Ault, T. R., & Smerdon, J. E. (2015, February 1). Unprecedented 21st century drought risk in the American Southwest and Central Plains. *Science Advances*. American Association for the Advancement of Science. <https://doi.org/10.1126/sciadv.1400082>

<sup>48</sup> Stewart, I. T., Cayan, D. R., & Dettinger, M. D. (2004). Changes in snowmelt runoff timing in western North America under a "business as usual" climate change scenario. *Climatic Change*, 62(1–3), 217–232.

<sup>49</sup> Udall, Bradley, and Jonathan Overpeck. "The twenty-first century Colorado River hot drought and implications for the future." *Water Resources Research* 53, no. 3 (2017): 2404-2418.

<sup>50</sup> Arizona Department of Water Resources. "ARIZONA'S WATER SUPPLIES AND WATER DEMANDS." AZ Water Resources. 2018. <http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/supplydemand.pdf>.

committed and on track to meet the goal of balancing its groundwater withdrawal levels with artificial or natural recharge levels by 2025<sup>51</sup>. Much of the water utilized in the artificial recharge of depleted aquifers is sourced from the Colorado River. Thus, much of the groundwater actually used in the region can be thought of as coming from the Colorado River, which as previously mentioned, is already experiencing a significant reduction in streamflow. As of from 2005-2009, around 48% of water demand within the AMA was used for municipal purposes, while agriculture accounted for only 33% of total water demand<sup>52</sup>. The Arizona Department of Water Resources projected by 2025 municipal water demand would increase to around 60% and agricultural water demand would decrease to around 14%<sup>53</sup>. Action that will take place needs to be done on a collective basis through city and community cooperation. Progress can be seen through Phoenix AMA water usage reductions.

## Residential Water

Residential water usage is one of the leading uses of water within the County communities, one of the leading uses of water within residential usage is landscaping. Many residents prefer a grass mesic lawn to a desert-like xeric landscape. Mesic lawns do decrease the UHI effect within urban and suburban areas, while xeric lawns decrease the water usage of a household. The average water consumption within the Phoenix AMA between 2000-2009 was around 213 gallons per capita per day according to the ADWR<sup>54</sup>, with current estimates around 198 Gallons per Capita Daily (data to create this number comes from Harlan et al. 2009<sup>55</sup>, the U.S. Census<sup>56</sup>). The city of Las Vegas effectively reduced household water consumption from around 248 GPCD in 2008 to around 127 GPCD in 2017<sup>57</sup>. They were able to reduce the average water usage significantly through their “cash for grass” incentives and other types of

<sup>51</sup> Arizona Department of Water Resources. "Phoenix AMA Geographic Features." Phoenix AMA Geography. 2018. <http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/ActiveManagementAreas/Geography/PhoenixAMA.htm>.

<sup>52</sup> Arizona Department of Water Resources. "Phoenix AMA Geographic Features." Phoenix AMA Geography. 2018. <http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/ActiveManagementAreas/Geography/PhoenixAMA.htm>.

<sup>53</sup> Phoenix Active Management Area Water Demand and Supply Assessment 1985-2025. (2011). Arizona Department of Water Resources. Retrieved from: [http://www.azwater.gov/AzDWR/WaterManagement/Assessments/documents/PhxAMA\\_AssessmentSummarySheet.pdf](http://www.azwater.gov/AzDWR/WaterManagement/Assessments/documents/PhxAMA_AssessmentSummarySheet.pdf)

<sup>54</sup> GUAC. (2012). Phoenix Active Management Area. Retrieved from: [http://infoshare.azwater.gov/docushare/dsweb/Get/Document-10100/PrelimDraft\\_4MP\\_GPCD\\_Program.pdf](http://infoshare.azwater.gov/docushare/dsweb/Get/Document-10100/PrelimDraft_4MP_GPCD_Program.pdf)

<sup>55</sup> Harlan, S. L., Yabiku, S. T., Larsen, L., & Brazel, A. J. (2009). Household water consumption in an arid city: Affluence, affordance, and attitudes. *Society and Natural Resources*, 22(8), 691–709. <https://doi.org/10.1080/08941920802064679>

<sup>56</sup> Quickfacts Maricopa County, Arizona. U.S. Census. Retrieved from: <https://www.census.gov/quickfacts/fact/table/maricopacountyarizona/PST045217>

<sup>57</sup> Water Conservation Plan 2014-2018. (2014). Southern Nevada Water Authority. Retrieved from: <https://www.snwa.com/assets/pdf/reports-conservation-plan.pdf>

tiered tax incentives and rebates. Other strategies that could decrease individual water use include requiring appliances and plumbing to be water efficient in households, although the most effective intervention point in reducing individual water use remains targeting behavior. It is possible to live here using far less water than we currently do, tribal water demand throughout Arizona AMAs is around 57 GPCD<sup>58</sup>. This shows that our current goals and efforts fall short of what can be accomplished.

Rainwater harvesting presents an untapped water resource, according to US Climate Data, the rainfall average for the County is around 7.87 inches per year<sup>59</sup>, combining that with land use data obtained from the Maricopa Association of Governments, around 300,000 acre-feet of water fall on the County residential land per year (based on data from Maricopa Association of Governments<sup>60</sup> and U.S. Climate Data<sup>61</sup>) which, if fully collected and utilized could account for around 30% of current residential water needs, if per person water use was reduced to levels similar to Las Vegas, it could account for nearly 50% of residential water usage.

#### Residential Goals:

##### Implement Widespread Rainwater Harvesting: Capture and use 10% of rain that falls over residential communities by 2040

Short-term Benchmark: 3% rainfall capture by 2025.

Mid-term Benchmark: 5% rainfall capture by 2030.

Long-term Benchmark: 8% rainfall capture by 2035.

##### Reduce individual water use to 80 Gallons per Capita per Day by 2040

Short-term Benchmark: 150 GPCD by 2025.

Mid-term Benchmark: 120 GPCD by 2030.

Long-term Benchmark: 100 GPCD by 2035.

### Commercial Water

The commercial sector, similar to residential water use, utilizes water for outdoor landscape irrigation. Switching from mesic landscape types to xeriscaping on commercial

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<sup>58</sup> ADWR 4th Management Plan Assumptions. (2016). United States Bureau of Reclamation. Retrieved from: <https://www.usbr.gov/lc/phoenix/programs/lscrbasin/mdocs/2016-04-274thmgmtPlanADWR.pdf>

<sup>59</sup> Climate Maricopa - Arizona. (2018). U.S. Climate Data. Retrieved from: <https://www.usclimatedata.com/climate/maricopa/arizona/united-states/usaz0131>

<sup>60</sup> Residential land use in Maricopa County: Single family. (2018). Maricopa Association of Governments Land Use Explorer. Retrieved from: <http://geo.azmag.gov/maps/landuse/>

<sup>61</sup> Climate Maricopa - Arizona. (2018). U.S. Climate Data. Retrieved from: <https://www.usclimatedata.com/climate/maricopa/arizona/united-states/usaz0131>

developments can reduce the unnecessary water consumption by commercial entities. As part of their reduction of water consumption by 36% between 2002 and 2017, the Las Vegas Valley initiated several regulations regarding outdoor landscape use types. These regulations include prohibitions on any new turf in non-residential developments and qualification for rebates for removing turf from commercial property, as well as rebates for implementing WaterSense irrigation controllers.

Like the Phoenix Metropolitan Region, the Las Vegas Valley also has a robust golf industry. Golf courses require a substantial amount of water for maintenance of lush green turf, a luxury in the arid desert of both regions. In the Las Vegas Valley, the municipal governments have initiated a five year ban on golf course construction, as well as strict regulations regarding water usage on golf courses in the Valley. Each golf course is restricted to 6.3 acre feet per acre annually, with exceptionally high surcharge rates for any water usage over the 6.3 acre feet. The Water Authority of Southern Nevada also offered the same “cash for grass” initiatives as it did for commercial and residential landscape conversions, dealing out over \$25 million to the areas golf courses alone in the removal of 1,000 acres of turf, with accounts for nearly 20% of the total areas golf course property<sup>62</sup>. All of the courses in the Las Vegas Valley also are required to use effluent (reused) water in the watering of their courses as well, rather than potable (drinking) water as previously used prior to the strict regulations as part of the areas 2003 drought and conservation plan<sup>63</sup>.

#### Commercial Goals: Decrease water use by 60% by 2040

Short-term Benchmark: 15% Decreased water use by 2025.

Mid-term Benchmark: 25% Decreased water use by 2030.

Long-term Benchmark: 45% Decreased water use by 2035.

#### Industrial Water

The Phoenix AMA utilizes 7% of its water resources for industrial uses<sup>64</sup>. The industries already source a significant portion (39%) of that water from effluent (recycled) water sources, with the other significant source, groundwater, making up 55% of the allocation<sup>65</sup>. The most water consumptive industrial usage of water is electrical power production, which makes up

<sup>62</sup> Leslie, Mark. "Water Hazard." United States Golf Association. January 2012. [https://www.usga.org/content/dam/usga/pdf/Water Resource Center/water-hazard-includes-case-studies-of-nevada-golf-facilities.pdf](https://www.usga.org/content/dam/usga/pdf/Water%20Resource%20Center/water-hazard-includes-case-studies-of-nevada-golf-facilities.pdf).

<sup>63</sup> Water Conservation Plan 2014-2018. (2014). Southern Nevada Water Authority. Retrieved from: <https://www.snwa.com/assets/pdf/reports-conservation-plan.pdf>

<sup>64</sup> Arizona Department of Water Resources. "ARIZONA'S WATER SUPPLIES AND WATER DEMANDS." AZ Water Resources. 2018.

<sup>65</sup> Arizona Department of Water Resources. "ARIZONA'S WATER SUPPLIES AND WATER DEMANDS." AZ Water Resources. 2018.



43% of the Phoenix AMA industrial water usage<sup>66</sup>. Water is utilized in electrical production for cooling water, which pushes the steam turbines that create power<sup>67</sup>. Several cities within the County already mandate utilization of effluent water for industrial uses, especially within thermal power plants and nuclear power plants<sup>68</sup>. The combination of increased usage of effluent water sources, decreased usage of groundwater, and adoption of newer, more efficient technologies and processes can significantly reduce the water consumption of the industrial sector.

#### Industrial Goals: Decrease non-recycled water use by 40% by 2040

Short-term Benchmark: 10% Decreased water use by 2025.

Mid-term Benchmark: 20% Decreased water use by 2030.

Long-term Benchmark: 30% Decreased water use by 2035.

### Agricultural Water

the County agricultural water usage has dropped from 55% of total usage in 1985 to 33% in 2006, with the projected water demand for the Phoenix AMA at 430,000 acre-feet. This is largely due to the removal of farmland for housing, illustrating an increase in residential and municipal water usage. The trend is expected to continue, as the cities in the County slowly push development outward. The majority of agricultural irrigation is inefficient flooding of fields, that results in water loss due to evaporation. Drip irrigation is far more efficient but is expensive to implement and may take many years to see the economic benefits. Between 1985 to 2006 groundwater usage for agricultural demand dropped from 51% to 37%<sup>69</sup>.

#### Agricultural Goal: Reducing groundwater sourcing to 25% by 2040

Short-term Benchmark: 10% reduction of groundwater sourcing by 2025.

Mid-term Benchmark: 15% reduction of groundwater sourcing by 2030.

Long-term Benchmark: 20% reduction of groundwater sourcing by 2035.

### Stormwater Management

Urbanization in the Phoenix Metro area has increased impervious surface cover, not allowing for natural percolation of stormwater. The increase in impervious surface cover leads to increased risk of flash flooding, erosion, loss of property/economic value, as well as a

<sup>66</sup> Arizona Department of Water Resources. "ARIZONA'S WATER SUPPLIES AND WATER DEMANDS." AZ Water Resources. 2018.

<sup>67</sup> Power. "Water Conservation Options for Power Generation Facilities." POWER Magazine. September 01, 2012.  
<https://www.powermag.com/water-conservation-options-for-power-generation-facilities/>.

<sup>68</sup> City of Phoenix Water Resources. "Water and Wastewater Facts." City of Phoenix. 2018.  
<https://www.phoenix.gov/waterservices/about/water-and-wastewater-facts>.

<sup>69</sup> DRAFT Demand and Supply Assessment. (2010). Arizona Department of Water Resources. Retrieved from: <http://www.azwater.gov/AzDWR/WaterManagement/Assessments/documents/PhoenixAMAAssessment11-8-2010.pdf>

reusable resource (the water itself). In the past, the County has utilized grey infrastructure to combat stormwater, with examples such as concrete channels, pipes and retention basins. This grey infrastructure increases flooding downstream, destroys natural wash and stream habitat, and does not allow for ground infiltration/recharge. Green infrastructure can be supplemented instead for usage as stormwater management, with ideas brought forward by the Watershed Management Group in their work with the City of Tucson, such as rainwater gardens, bioswales, green belts and vegetated basins for bioretention and percolation/filtration of the water.<sup>70</sup> The WMG currently work with the Flood Control District of the County. In Tucson, the inclusion of just one rainwater garden in a community can allow for the retention of 12,000 gallons of water annually, providing \$2,600 in community benefits as well as 4,000 gallons of groundwater recharge, which would have otherwise been pushed downstream and possibly contaminated with pollutants residing on the impervious surfaces of the city<sup>71</sup>. Constructed wetlands can help capture water runoff from flood prone areas and help recharge aquifers, such as a 2 acre wetland serving a 1,500 acre area of residential land in Aliso Viejo, Laguna Hills, and Laguna Woods, California<sup>72</sup>

### Stormwater Goals: Build a rain garden for every 2000 residents by 2040 (9,000 total)

Short-term Benchmark: a rain garden for every 5000 residents by 2025 (2,250 total).

Mid-term Benchmark: a rain garden for every 4000 residents by 2030 (4,500 total).

Long-term Benchmark: a rain garden for every 3000 residents by 2035 (6,750 total).

## Wastewater Management

Wastewater can be a valuable source of water for many communities in the County especially during water stressed months. Some cities already reuse wastewater, such as the city of Phoenix which sends much of its recycled water to the Palo Verde Nuclear Generating Station, while pumping a smaller amount underground. Peoria recently announced plans to recharge the underground aquifers with around 1 million gallons of wastewater per day, resulting in around 1,100 acre-feet of water being recharged from wastewater per year. Around 82% of the wastewater effluent created in the Phoenix AMA is already being reused or

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<sup>70</sup> Green Infrastructures for Desert Communities. (2017). Watershed Management Group.

<sup>71</sup> Green Infrastructures for Desert Communities. (2017). Watershed Management Group. Pg. 15

<sup>72</sup> Dairy Fork Constructed Wetland and Habitat Restoration. Retrieved from: <http://www.cityofaliso Viejo.com/city-hall/departments/public-works/dairy-fork-constructed-wetland-and-habitat-restoration/>

recharged into aquifers<sup>73</sup>. A main issue currently within the County is that reusing effluent for drinking water was against the law, now that laws are beginning to change to reflect growing concerns of the limitations of water demand, though public perception of drinking reclaimed wastewater is still a major challenge. Constructed wetlands can offer the three-fold benefit of providing a tertiary cleaning process that further purifies water, while also adding natural habitat for birds and animals, and groundwater recharge<sup>74</sup>. This has already been proven in Phoenix with Tres Rios which provides year-round habitat for many species, while cleaning wastewater effluent<sup>75</sup>. Sweetwater wetlands in Tucson is a similar project that cleans effluent before it is delivered to Tucson parks, schools, and golf courses<sup>76</sup>.

### Wastewater Goals: 50% of water reuse designated for drinking water by 2040

Short-term Benchmark: 13% reuse for drinking water by 2025.

Mid-term Benchmark: 25% reuse for drinking water by 2030.

Long-term Benchmark: 38% reuse for drinking water by 2035.

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<sup>73</sup> Middel, A., R. Quay, and D. D. White. 2013. Water reuse in central Arizona. Decision Center for a Desert City Technical Report 13-01. Tempe, AZ: Arizona State University

<sup>74</sup> CA Sanchez, DL Childers, L Turnbull, RF Upham, and NA Weller. 2016 . Aridland constructed treatment wetlands II: Plant mediation of surface hydrology enhances nitrogen removal. Ecological Engineering 97:658–665  
doi.org/10.1016/j.ecoleng.2016.01.002

<sup>75</sup> Tres Rios Wetlands. Retrieved from: <http://weel.asu.edu/tres-rios-wetlands.html>

<sup>76</sup> Sweetwater Wetlands: Water, Wildlife, and People. Retrieved from:  
[https://www.tucsonaz.gov/files/water/docs/Sweetwater\\_Adult\\_Web.pdf](https://www.tucsonaz.gov/files/water/docs/Sweetwater_Adult_Web.pdf)

## Energizing the Future of Maricopa

The newest report produced by the Intergovernmental Panel on Climate Change examines the impacts of global warming of 1.5°C degree Celsius (2.7°F degree Fahrenheit) above pre-industrial levels. Within this report, pathways were created to limit the warming of earth to the above mentioned 1.5-degree mark. It was found that “Limiting global warming requires limiting the total cumulative global anthropogenic emissions of CO<sup>2</sup> since the preindustrial period”<sup>77</sup>. Arizona’s energy industry sector contributes 87% of CO<sup>2</sup> while its’ transportation sector contributes 33.1% of CO<sup>2</sup>. Currently the majority of Arizona’s net energy generation comes largely from natural gas-fired and coal-fired plants combining to produce roughly 6 million MWh of electricity. These high emission energy sources dwarf the roughly 7 hundred thousand MWh produced by non-hydroelectric renewables from Maricopa<sup>78</sup>.

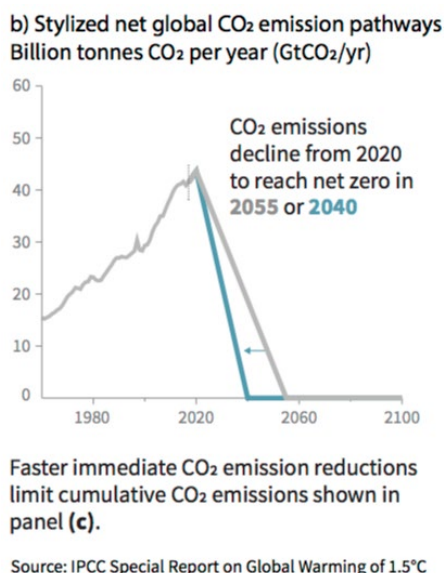
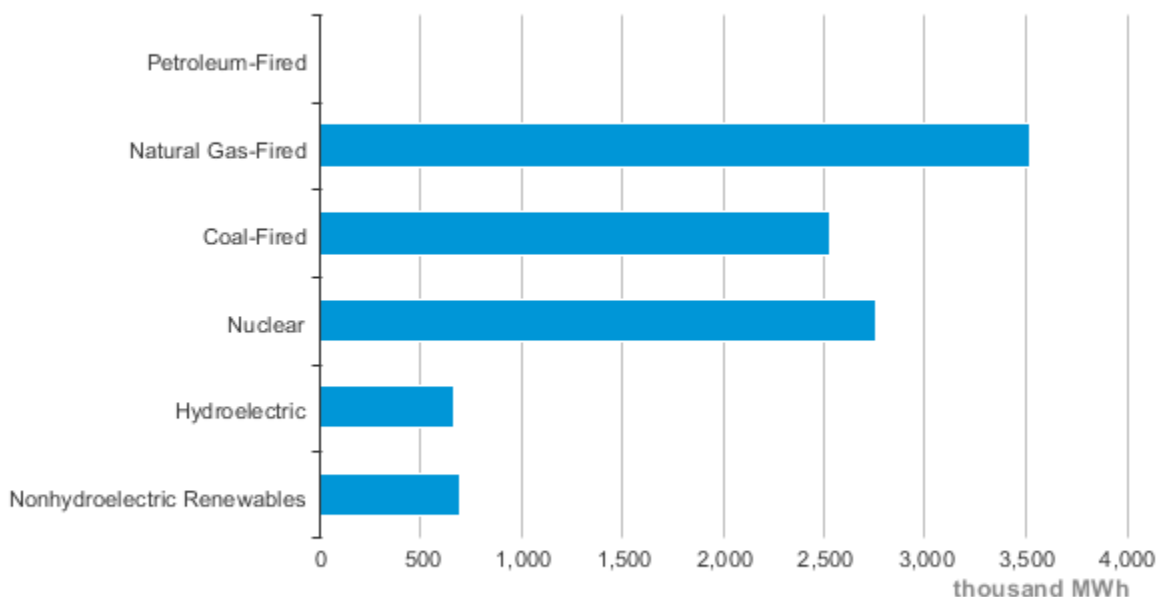


Figure 1. This graph shows necessary reductions in annual global emissions to reach 1.5 degrees C (blue) and 2 degrees C (Grey).

<sup>77</sup> Intergovernmental Panel on Climate Change. 2018. *Global Warming of 1.5 C*. Incheon, Republic of Korea: Intergovernmental Panel on Climate Change.

<sup>78</sup> U.S. Energy Information Administration. 2018. *Electric Power Annual*. Washington, DC: U.S. Energy Information Administration.

### Arizona Net Electricity Generation by Source, Jun. 2018



Source: Energy Information Administration, Electric Power Monthly

the County has seemingly recognized the need to alter their energy practices as of late by setting yearly goals to reduce energy and water use by 2, 5, and 8 percent in 2019, 2020, and 2021 respectively according to an interview conducted with the County representative Scott Unger for the purpose of this document <sup>79</sup>. Additionally, the County is home to 13 (9 thermal, 4 PV) solar energy production sites producing roughly 8 million KWh of electricity annually. Lastly, there has been talk about the County building its own solar array with hopes of generating an additional million KWh of electric power soon<sup>80</sup>. While these are great first steps, to truly lead the way at the County level, Maricopa needs to set more aggressive energy benchmarks.

Similar aggressive benchmarking has taken place at the city level around the nation. Examples of such progressive sustainable energy benchmarks are as follows:

#### Salt Lake City, UT

<sup>79</sup> Unger, Scott, interview by Ronald Turner. 2018. *Maricopa County* (October 22).

<sup>80</sup> Unger, Scott, interview by Ronald Turner. 2018. *Maricopa County* (October 22).

- 100% by 2032: 100% Renewable Energy for Community Electricity Supply by 2032. Goal includes 50% renewable electricity for municipal operations by 2020<sup>81</sup>.
- 80% by 2040: 80% reduction in community greenhouse gas emissions by 2040, compared to 2009 baseline. Goal includes at least 50% reduction in community footprint by 2030<sup>82</sup>.

#### Las Vegas, NV

- The city currently receives 100% of its municipal energy through renewable sources. An investment of \$70 million was made by the city for renewable energy and upgrades to efficiency<sup>83</sup>

### PROP 127

The failed proposition 127 of the 2018 Arizona General Election, called for electric utilities in Arizona to acquire a certain percentage of electricity from renewable resources. 127 called for utility companies to gradually increase their renewable energy portfolio from 12% in 2020 to 50% in 2030. The proposition was highly contested and lobbied against by current energy producers within Arizona with the leading argument being that it would cost residents (the elderly was highly targeted) a 40% increase to their monthly electric bills<sup>84</sup>. the County needs to explore further the real cost and benefit of expanding their renewable energy profile through independent studies and research. Perhaps following the steps of Salt Lake City who commissioned an independent study to examine the environmental and economic benefits of transitioning to 100% renewable energy<sup>85</sup>. The study found that transitioning to 100% renewable energy sources would be “achieved by modestly increasing the electricity rates of residents and businesses”. The study found that these increases would fall between 11% and 12%, not 40%. Additionally, the study states that this percentage would translate to a \$7 - \$8

<sup>81</sup> Salt Lake City Corporation Department of Sustainability. (2017). *Climate Positive 2040 Reduce pollution, save resources, & empower our city*. Salt lake City: SLC Green.

<sup>82</sup> Salt Lake City Corporation Department of Sustainability. (2017). *Climate Positive 2040 Reduce pollution, save resources, & empower our city*. Salt lake City: SLC Green.

<sup>83</sup> City of Las Vegas. (2018, November 9). *Las Vegas Nevada*. Retrieved from Sustainability: <https://www.lasvegasnevada.gov/government/initiatives/sustainability>

<sup>84</sup> Grand Canyon State Electric Cooperative Association INC. (2018, November 9). *Impact to Rural Customers*. Retrieved from Arizona Nightmare: <https://arizonanightmare.com/impact-to-rural-customers#bills>

<sup>85</sup> Burks, J., Mirich, G., Hendrickson, D., Hohlfelder, H., Peters, G., Ramirez, D., & Kimball, B. (20147). *Salt Lake City Communities Renewable Energy Study: Analysis of impacts and benefits associated with transitioning to 100 percent renewable power*. Salt Lake City: Energy Strategies, LLC.

increase to residential customers per month. These minimal increases come with great environmental and economic benefits. The study estimates that the transition to 100% renewable energy would yield 6,000 direct jobs and 7,600 indirect jobs to the community. Additionally, the study points out “indirect and induced economic benefits due to construction activities are projected to add almost \$1.2 billion to Utah’s economy”<sup>86</sup>. Lastly, the study concluded that Salt Lake City’s energy transition could mean the avoidance of 775,000 to 1,800,000 tons of CO2 emissions in 2031 alone.

This study shows the discrepancy between an independent study and the rhetoric that slowed the passing of Proposition 127. It is therefore appropriate for the County to commission its own independent study if avoiding a transition to 100% renewable continues to be unsupported. The County needs to remember however that the benefits of this type of transition go beyond politics and instead, move towards “providing more affordable and stable electricity prices in the future, enhancing economic resiliency, improving air quality, and reducing GHG emissions”<sup>87</sup>. With this in mind please consider the following sustainable energy benchmarks for the County.

### **Benchmarks**

Currently Arizona’s net Electricity Generation consists of over 3,000 MWhs of electricity by burning coal and less than 1,000 MWh’s from non-hydroelectric renewables<sup>88</sup>. To move to a more sustainable future, the County and its communities should focus on lowering the amount of fossil fuel energy they consume and increase renewable energy consumption.

**By 2035** the County should be operating on 100% renewable Energy for all municipal operations. This benchmark should be reached by utilization of rooftop and parking lot solar units coupled with battery storage technology on the over 150 municipal buildings within the County.

City buildings emissions are associated with the supply of electricity and building-scale clean energy deployment in cities may deliver up to two-fifths of total emissions savings from

<sup>86</sup> Burks, J., Mirich, G., Hendrickson, D., Hohlfelder, H., Peters, G., Ramirez, D., & Kimball, B. (20147). *Salt Lake City Communities Renewable Energy Study: Analysis of impacts and benefits associated with transitioning to 100 percent renewable power*. Salt Lake City: Energy Strategies, LLC.

<sup>87</sup> Burks, J., Mirich, G., Hendrickson, D., Hohlfelder, H., Peters, G., Ramirez, D., & Kimball, B. (20147). *Salt Lake City Communities Renewable Energy Study: Analysis of impacts and benefits associated with transitioning to 100 percent renewable power*. Salt Lake City: Energy Strategies, LLC.

<sup>88</sup> U.S. Energy Information Administration. 2018. *Electric Power Annual*. Washington, DC: U.S. Energy Information Administration.

the energy sector in the next four years. Utilizing green building practices such as green roofs, utilization of energy efficient cooling and heating technology, and real time energy monitoring practices can lower the emissions emitted within the County. Additionally, “if every building was made green, the global carbon footprint could be reduced by 15-20% every year”<sup>89</sup>

**By 2035** all newly constructed commercial and municipal buildings within the County should follow green building standards such as International Green Construction Codes.

**By 2035** All pre existing commercial, industrial, and municipal structures should be retrofitted to meet green building standards such as International Green Construction Codes.

In 1986 shortly after the Chernobyl nuclear accident, a German particle physicist by the name Gerhard Knies became the first person to estimate how much solar energy was required to meet humanity’s electric demands. He concluded that in just six hours, the world’s deserts receive more energy from the sun than humans utilize in a year<sup>90</sup>. Obviously, the world’s energy demand has increased since 1986, however, so has the efficiency of solar energy capture. Understanding that the County is located within a desert landscape shows that the County has an obligation to attempt to harness clean energy by way of solar to the best of their ability. This means that rooftop and parking structure solar instalments should be increased Countywide where feasible. This most likely will come with some push back from current energy providers but presents an opportunity for the County to demand more from these providers by having them expand their renewable energy portfolios as well.

**By 2025** All new residential housing installments within the County should be built with rooftop solar installments.

Lastly, exploring energy waste could propel the County into the national spotlight regarding energy benchmarking. The issue of light pollution creates a unique opportunity of the County to confront energy waste, thus becoming more energy efficient.

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<sup>89</sup> Qureshi, Annie. 2018. *The Environmental Benefits of Green Building*. March 1. Accessed November 1, 2018. <https://greenbuildinginsider.com/67/environmental-benefits-green-building>.

<sup>90</sup> Hickman, Leo. 2011. Could the desert sun power the world? December 11. Accessed November 1, 2018. <https://www.theguardian.com/environment/2011/dec/11/sahara-solar-panels-green-electricity>.





Figure 2. International Dark Sky Association. 2018. *Light Pollution Wastes Energy and Money*. October 24. <http://darksky.org/light-pollution/energy-waste/>.

**Light Pollution:** About 15 million tons of CO<sub>2</sub> are emitted each year to power residential outdoor lighting in the U.S. 13% of residential electricity use in the U.S. is for outdoor lighting. About 35% of light is wasted by unshielded and/or poorly-aimed outdoor lighting. This translates to about \$3 Billion per year worth of energy lost to wasted light otherwise called light pollution<sup>91</sup>. Currently, the County has instituted a dark sky ordinance to “encourage good lighting practices such that lighting systems are designed to conserve energy and money, while increasing nighttime safety, utility, security and productivity”. It is highly recommended that the County should support Dark Sky initiatives for residential unity as well possibly through collaboration of such agencies as the International Dark-Sky Association.

<sup>91</sup> International Dark Sky Association. 2018. *Light Pollution Wastes Energy and Money*. October 24. <http://darksky.org/light-pollution/energy-waste/>.

## Conclusion

The Fourth National Climate Assessment released on November 23rd, 2018 warns that the energy system that is powering our country has already been affected by extreme weather directly related to climate change. The report stresses that this threat is likely going to increase in the Southwestern United States as longer periods of drought and higher average temperatures are experienced<sup>92</sup> Drought threatens our reliance on hydroelectric power generation while higher temperatures lower efficiency of our electrical system by way of creating resistance in our transfer lines. By utilizing the above mentioned benchmarks and transitioning the energy profiles of cities within the County to higher concentrations of solar power generation, the County will be able to increase their resilience to future climate change impacts.

Furthermore, there needs to be further transparency in relation to energy and the County. Many municipalities have easily obtainable information related to their energy use and consumption. This is not the case for the County and it needs to be in the near future. Transparency will help mend the divide this County currently displays when engaging in the renewable energy conversation. Furthermore, an independent energy study needs to take place at the County level to assist Maricopa in seeing clearly the cost and benefit of our impending transition to renewables. We need to move away from the political divide and focus more on what is right for the residents of the County in terms of energy consumption and production.

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<sup>92</sup> U.S. Global Change Research Program. (2018). *Fourth National Climate Assessment*. Washington, DC: U.S. Global CHange Research Program.

## Waste

### Becoming the leader in Waste Management Innovation Beyond Zero Waste in 2040

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#### Background

The County's six major municipal solid waste landfills hold over 85 million tons of waste.<sup>93</sup> This includes the following landfills: Butterfield Station Facility, City of Glendale Municipal Solid Waste Landfill, Northwest Regional Landfill, Sierra Estrella Landfill, Southwest Regional Municipal Solid Waste Landfill, and State Route 85 Landfill. However, because of Maricopa's spatial vastness, waste is hidden from the general public in these landfills and the problem is not consciously recognized; **out of sight and out of mind**. This causes a disconnect between consumers and the effects of their actions. Changing this mentality is key for the County to become resilient and for the maintenance of the population's livelihood.

The waste stream has ecological, social, and economic aspects that are in jeopardy if business-as-usual operations prevails in the County. Therefore, the waste management system needs to be transformed to reflect the important responsibilities and values of Maricopa. This includes waste stewardship and collective entrepreneurship. The following benchmarks were created to promote this. We believe there is opportunity not only in efficiency and reduction but in economic and social benefits. These opportunities may be achieved through many unique routes; such as, circular economy, critical analysis, and regulations.

A struggle that the waste sector possesses is lack of current feasible data. Unlike many other sustainability topics, waste statistics are not conveniently found; especially for the County. With this said, mandating the cities within the County to begin measuring waste management data will be beneficial and is highly recommended.

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<sup>93</sup> Environmental Protection Agency. State-Level Project and Landfill Totals from the LMOP Database. 2018. Retrieved from <https://www.epa.gov/lmop/project-and-landfill-data-state>

## I. AIR

### **By 2040, the County will have less than 30 days of Reported Elevated Ozone and/or PM2.5**

2025- Collaborate with local industrial and large scale farming operations to measure, reduce and minimize the release of noxious odors in the community.

2030- Work with state and regional partners to electrify truck stops to reduce idling and unnecessary emissions.

2035- Install green roofs on those not compatible for solar and install green plants along highway columns

Cleaner air is not a flippant request. Research has proven it impacts on our health and wellbeing can be lifesaving or detrimental.<sup>94</sup> An argument can be made that each of the benchmarks in this report is crafted to lower the amount of carbon being released into the environment. To that end, a part of the focus should be on improving and maintaining air quality.

In September 2017, Washington D.C. became the first U.S. city to participate in the United Nations campaign, *BreatheLife*. Harnessing momentum for other environmental concerns, such as growing transportation demands and increasing population, the campaign looks at ways of interjecting air quality improvements within these solutions. By tying the County's *Clean Air Make More* initiative to our place in global context reinforces a commitment to crafting our future.

In this section, we have used indicators from the STAR Communities for both the 2025 and 2030 goal.<sup>95</sup>

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<sup>94</sup> "Air Pollution." World Health Organization. November 08, 2018. Accessed November 08, 2018. <http://www.who.int/airpollution/en/>.

<sup>95</sup> <https://reporting.starcommunities.org/indicators/aggregate>

## II. Water

**By 2040, 100% greywater systems in new construction, municipal buildings and retrofit permits.**

By 2025, Implement a rebate program for residential installation County wide and improve current water measurements tools for efficiency and development.

By 2030, Conduct impact study of water loss on sewage system. New Construction is required to implement third system to support greywater.

By 2035, require greywater system use in industrial and commercial complexes.

As discussed earlier in this report, water is a one of our most precious resource that requires deft management. How we handle the water during and after use is just as vital in establishing sanctity and stewardship. Within an effective waste management stream, there is opportunity for intervention points that can supplement a rigorous water management strategy. According to the Green Building Alliance<sup>96</sup>, the majority of daily water use consumption, i.e. cooking, bathing and washing, is potable and can be used in a greywater system for future use. This would eliminate the need for drinkable water for tasks such as plumbing, irrigation or treatment facilities.

Greywater systems are the reuse of clean drinking water for daily use outside of consumption, such as bathing, washing and rinsing. In our desert ecology, every drop of water not used purposefully to its capacity should be viewed as a loss. Point in case, using greywater to flush toilets can reduce home indoor water use by 24%.<sup>97</sup>

Unfortunately, mismanagement of water can be found across the globe as our growing population and agriculture needs puts stress upon the resource. Cape Town, South Africa is a glaring beacon for water conservation action. A dynamic metropolitan, the area is currently in the fourth year of drought and has led to a crisis in what has been called "Day Zero"<sup>98</sup>, a day when the city will be forced to turn off the water supply to the city and its surrounding regions. Imagine if they had the ingenuity and creativity to actively handle their daily greywater to bolster both their population needs and prepare for pending crises.

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<sup>96</sup> "Greywater Systems." Promoting Healthy and High-Performing Places to Live, Work, Play, and Learn. Accessed November 08, 2018. <https://www.go-gba.org/resources/green-building-methods/greywater-system/>.

<sup>97</sup> *ibid.*

<sup>98</sup> <https://coct.co/water-dashboard/>

In more hopeful terms, Encinitas, California recently implemented ordinances requiring new construction be pre-plumbed with greywater.<sup>99</sup> With the devastating impact of wildfires recently in the news throughout California, we should take heed as our CAP partnership impels us to.

### III. Land

#### **Increase circular economy activity contribution to gross state product to 2%, by 2040**

2025- circular economy contributes to 1.3% of gross state product

2030- circular economy contributes to 1.5% of gross state product

2035- circular economy contributes to 1.8% of gross state product

Generated waste should not be considered profitless trash. Improving solid waste management has high potential to positively impact all three pillars of sustainability: social, economic, and environmental. Waste should be considered an inefficiency in the production and consumption process because it may still be utilized. One proposal to address this is that of the circular economy. The City of Phoenix and Arizona State University have taken steps towards this idea of a circular economy through the collaborative formation of RISN or the Resource Innovation and Solution Network<sup>100</sup>. Their objective is as follows, “to generate value, economic opportunity and jobs from the resources available in the waste stream<sup>101</sup>.” RISN has created an incubator where entrepreneurs may present and extrapolate their ideas on items created from waste.<sup>102</sup> The program utilizes waste from Phoenix and has been successful at launching 10 products as of May, 2018.<sup>103</sup> Previously, in 2016, ASU studied the economic impact of circular economy opportunities in the County, based on 2014 data, and estimated that these activities could create 35,454 jobs and provide \$1.9 billion to Gross State Product.<sup>104</sup> This translates to a maximum contribution of 0.9% to gross state product.<sup>105</sup> It should be emphasized that this statistic is based on 2014 data and was utilized as a baseline, leading to this benchmark.

Besides the RISN incubator, another route that the County could take forth to increase circular economy activities, is a materials marketplace. Already accomplished by the city of Austin and many others, a materials marketplace is a platform for businesses and organizations

<sup>99</sup> [http://encinitas.granicus.com/MetaViewer.php?view\\_id=7&clip\\_id=1180&meta\\_id=51145](http://encinitas.granicus.com/MetaViewer.php?view_id=7&clip_id=1180&meta_id=51145)

<sup>100</sup> Arizona State University. RISN Incubator. 2017. Retrieved from <https://sustainability.asu.edu/resourceinnovation/risnincubator/>

<sup>101</sup> Ibid.

<sup>102</sup> Ibid.

<sup>103</sup> Ibid.

<sup>104</sup> Arizona State University. Economic Impact of Circular Economy Opportunities in Phoenix. 2018. Retrieved from <https://sustainability.asu.edu/resourceinnovation/economic-impact-opportunity-circular-economy-phoenix/>

<sup>105</sup> Resource Innovation and Solution Network. Recycle, Repair, Reuse: Gross Economic Impact Estimates of Existing Circular Economy Activities in Maricopa County. 2014. Retrieved from <https://static.sustainability.asu.edu/giosMS-uploads/sites/18/2018/02/03135239/RISN-EIA-Phase-1-Final.pdf>

to link together and receive and/or give away reusable waste.<sup>106</sup> Essentially, material marketplaces allow for connections between groups discarding material and groups potentially in-need of these items to be made, that would not have otherwise connected. By doing so, prevents waste transported to landfills and increases community connectedness in the County. This may be executed digitally on a website or in a physical building. Austin has done so digitally and has been successful; the platform has diverted 925 thousand pounds of otherwise discarded material, avoided 959 MTCO<sub>2e</sub>, and is estimated to have saved over half a million in savings.<sup>107</sup>

### 2040- 70% diversion rate from landfill and incineration, 2040- 100% recycling rate with a contamination rate under 1%

2025- Perform analysis on waste characterization for the County,  
2030- Established neighborhood compost and recycling hubs,  
2035- Extended Producer Responsibility Legislation enacted

The main municipal solids waste landfills in the County are Butterfield Stations Facility, City of Glendale, Northwest Regional, Sierra Estrella, Southwest Regional, and State Route 85<sup>108</sup>. These landfills, together, hold over 85 million tons of waste<sup>109</sup>. Phoenix is known to be the leader in the state for waste management; therefore, recognizing the city's actions is a great starting point to revision and advance the waste industry in Maricopa. In 2013, Phoenix enacted a goal of a diversion rate of 40% by 2020<sup>110</sup>. To reach this goal, the city has established multiple green programs and performed a critical analysis on residential waste characterization. **They have found that approximately 60% of the city's waste was recoverable through composting or recycling.**<sup>111</sup>

These materials included organic materials such as leaves (17.08%), food (11.24%), and food-stained paper (6.05%); which made up the three most significant materials, by weight, of all waste collected.<sup>112</sup> This data entails that the amount of the waste sent to landfills could be dramatically decreased with proper recycling or composting. As for recycling findings, a study found that the City of Phoenix's average recycling contamination rate is 30.5%, food and small non-distinct items, such as bottle tops, make up most of this, as shown in **Figure**

<sup>106</sup> Austin Materials Marketplace. Join the Circular Economy in Austin. Retrieved from <https://austinmaterialsmarketplace.org/>

<sup>107</sup> Ibid. Current Program Metrics. Retrieved from <https://austinmaterialsmarketplace.org/success-stories>

<sup>108</sup> Arizona Department of Environmental Quality. Active Municipal Solid Waste Landfills. 2016. Retrieved from <https://legacy.azdeq.gov/enviro/waste/solid/active.html#maricopa>

<sup>109</sup> Environmental Protection Agency. Project and Landfill Data by State. 2018. Retrieved from <https://www.epa.gov/lmop/project-and-landfill-data-state>

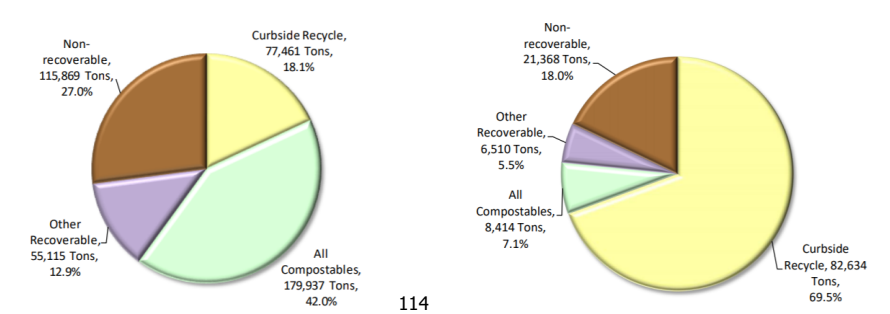
<sup>110</sup> Arizona State University. City of Phoenix Waste Diversion Development Plan. 2013. Retrieved from [https://sustainability.asu.edu/research/project/city\\_of\\_phoenix\\_waste\\_diversion\\_development\\_plan/](https://sustainability.asu.edu/research/project/city_of_phoenix_waste_diversion_development_plan/)

<sup>111</sup> Cascadia Consulting Group. City of Phoenix Residential Waste Characterization Study. April 2018. Retrieved from <file:///C:/Users/Dell%207Q3JB82/Downloads/2018%20COP%20Waste%20Characterization.pdf>

<sup>112</sup> Ibid.



3.<sup>113</sup> This statistic may work well as a baseline towards the previously stated goal of a 100% recycling rate with a contamination rate of 1% benchmark. However, the County performing its own waste characterization analysis may be the most beneficial first steps to achieve these benchmarks. Another suggestion is to not only focus on residential waste but to also analyze commercial and/or industrial. Food waste is also of interest that will be discussed in detail further on. By executing a waste characterization study, the County can identify the strengths and weaknesses in its waste management system and begin creating intervention points.



**Figure 3.** Phoenix results from residential waste characterization analysis (left) waste (right) recycling.

A resident's individual stewardship is a large factor towards waste accumulation and recycling rate within the County. Alternatively, manufacturers creating these wasteful products are also responsible. The responsibilities of producers should be modified; in which, the entire life-cycle of their merchandise, from production to disposal, is taken into account. This way, the impactful environmental costs of products are on every company's agenda. Extended Producer Responsibility (EPR) Laws could make these adjustments. These laws extend manufacturer's responsibility past the status quo of consumption and promote environmental concern in product design, through governmental pressure<sup>115</sup>. EPR laws have been implemented by more than half of the fifty States<sup>116</sup>. Because EPR laws are not governed federally, most are done on the state level and some have been passed locally<sup>117</sup>. Currently, Arizona is one of the few states with no EPR laws. Implementation, as stated before, will help achieve waste diversion from landfills and increase recycling/reusing. Examples of EPR laws include the Carpet Stewardship program that requires disposed carpets to be reused for new products, implemented by Carpet America Recovery Effort (CARE) in California<sup>118</sup>. Another example are the prominent "Bottle Bills," or container deposit laws; that advocate the collection of reusable container and

<sup>113</sup> Cascadia Consulting Group. City of Phoenix Residential Waste Characterization Study. Pg 6. April 2018. Retrieved from file:///C:/Users/Dell%207Q3JB82/Downloads/2018%20COP%20Waste%20Characterization.pdf

<sup>114</sup> Ibid. Pg 19.

<sup>115</sup> Product Stewardship Institute. Definitions. 2018. Retrieved from <https://www.productstewardship.us/page/Definitions>

<sup>116</sup> Product Stewardship Institute. U.S. State EPR Laws. 2018 Retrieved from <https://www.waste360.com/generators/19-states-most-producer-responsibility-laws>

<sup>117</sup> California Department of Resources Recycling and Recovery. Policy and Law. 2018. Retrieved from <https://www.calrecycle.ca.gov/epr/policylaw>

<sup>118</sup> California Department of Resources Recycling and Recovery. Carpet Materials Management. 2018. Retrieved from <https://www.calrecycle.ca.gov/Carpet/>



beverages back to the distributor through monetary incentive<sup>119</sup>. Bottle bills have been enacted as far back as 1971 in Oregon and have room for flexibility. So much so, that no bottle bills are the same in any two states<sup>120</sup>. They may vary in the amount reimbursed, the allowable size and material make-up of containers collected, and the financial distribution of unredeemed deposits<sup>121</sup>.

Therefore, it is plausible for the introduction of EPR laws in the County. By doing so, transforms the perception of waste from a “not in my backyard” issue, to a greater, internal stewardship view towards waste.

## 2040- 30% increase in applied use of waste energy

2025- Complete analysis on current baseline of produced waste energy

2030- Achieve 10% increase

2035- Achieve 20% increase

“Global waste generation is increasing faster than any other environmental pollutant,” stated by the C40 Cities website<sup>122</sup>. For this reason, operations towards waste management would greatly decrease GHG accumulation. Previously stated, waste is not actively measured; as a result, data on emissions from waste locally is difficult to attain and observe. It would be a great starting point for the County to begin measuring these emissions from landfills. Once this baseline data is manifested, it may be utilized for calculating efficiency of different waste diversion approaches. This may be achieved using EPA’s Waste Reduction Model (WARM). With this model, the amount in million metric tons of carbon dioxide (MMTCO<sub>2</sub>) reduced due to waste mitigations such as recycling, composting, and combusting, are calculated<sup>123</sup>.

Out of the County’s six major municipal solid waste landfills, only two have an operational landfill gas collection system (LFG) in place<sup>124</sup>. These are the City of Glendale and Northwest Regional Municipal landfills<sup>125</sup>. Together, these landfills have directly reduced .27108 MMTCO<sub>2</sub>e for the current year<sup>126</sup>. More detail on these landfill’s LFG systems are illustrated in **Figure 4. Implementing**

<sup>119</sup> National Conference of State Legislatures. State Beverage Container Deposit Laws. March 2018. Retrieved from <http://www.ncsl.org/research/environment-and-natural-resources/state-beverage-container-laws.aspx>

<sup>120</sup> Ibid.

<sup>121</sup> Ibid.

<sup>122</sup> C40 Cities. Advancing towards zero waste declaration. 2018. Retrieved from <https://www.c40.org/other/zero-waste-declaration>

<sup>123</sup> Environmental Protection Agency. Basic Information about the Waste Reduction Model (WARM). February 16, 2018. Retrieved from <https://www.epa.gov/warm/basic-information-about-waste-reduction-model-warm>

<sup>124</sup> Environmental Protection Agency. Project and Landfill Data by State. 2018. Retrieved from <https://www.epa.gov/lmop/project-and-landfill-data-state>

<sup>125</sup> Ibid.

<sup>126</sup> Ibid.

Landfill Name	Waste in Place (tons)	LFG Collection System in Place?	LFG Collected (mmscfd)	Current Project Status	Project Start Date	Project Type Category	LFG Energy Project Type	MW Capacity	Current Year Emission Reductions (MMTCO <sub>2</sub> e/yr) - Direct	Current Year Emission Reductions (MMTCO <sub>2</sub> e/yr) - Avoided
City of Glendale Municipal Landfill	10,022,321	Yes	1.42	Operational	1/30/2010	Electricity	Reciprocating Engine	2.8	0.1265	0.01479
Northwest Regional MSW Landfill	18,201,705	Yes	1.973	Operational	8/1/2012	Electricity	Reciprocating Engine	3.2	0.14458	0.0169

**Figure 4.** LFG data from EPA's Landfill Methane Outreach Program (LMOP).

## Food Goals

### Hunger, Food Insecurity, and Food Access:

#### Background

Approximately 14.3% of County residents are forced to live with the burden of food insecurity. This means that at some point in the last year they were denied a full and balanced diet due to their inability to pay for it. Of this population, only 68% of them are considered to be eligible to apply for various governmental food assistance programs.<sup>127</sup> Also not every eligible person is able to participate. For example, Arizona has a Supplemental Nutrition Assistance Program (SNAP) participation rate of 80%.<sup>128</sup> These are considerable gaps left by programs that themselves do not come close to providing the sustainable food system each and every one of us deserves. One area that has received a lot of attention in urban areas is that of food access. Handbury et al. 2016 suggest that in the United States today, one-third of the disparity in healthy food consumption between socioeconomic groups can be explained by physical access to such food.<sup>129</sup> Though physical access is not the only reason for food insecurity in the county, it is an important issue that we will explore here.

**One third** (332 out of 918) of all census tracts in Maricopa County are considered to have “Low Access” to healthy food by the United States Department of Agriculture.<sup>130</sup> This means that one in three census tracts has a significant number (at least 500 people) or share (at least 33 percent) of its population that are greater than 1.0 mile from the nearest supermarket for an urban area, or greater than 10 miles for a rural area. The same statistic, accounting for population, reveals that 20% of county residents live in low access census tracts. Physical access is only part of the equation when it comes to getting enough healthy food to eat. Wealth strongly influences one’s ability to buy enough of the right foods. Overlapped together, 5.7% of county residents are considered by the USDA to be “low income (<200% poverty threshold) and low access”.<sup>131</sup>

#### Comparable Cities and Policy Recommendations:

<sup>127</sup> Feeding America 2018. Retrieved on 10/7/18 from, <http://map.feedingamerica.org/county/2016/overall/arizona/county/maricopa>

<sup>128</sup> Cunyningham 2017. Retrieved on 10/7/18 from, <https://fns-prod.azureedge.net/sites/default/files/ops/Reaching2014.pdf>

<sup>129</sup> Handbury, J., Rahkovsky, I., Schnell, M., Bitler, M., Case, A., Cuberes, D., Weinstein, D. (2016). Is the focus on food deserts fruitless? Retail access and food purchases across the socioeconomic spectrum. Working Paper Series Health Economics Series No. 2016-08.

<sup>130</sup> Data retrieved from USDA Food Access Research Atlas. Retrieved on 10/7/18 from, <https://www.ers.usda.gov/data-products/food-access-research-atlas/>

<sup>131</sup> Ibid.

The above statistics show that the county has a large problem with locating people and the right foods close to each other, but that income attenuates this challenge. We believe that cities should work on both fronts to combat food insecurity. **Low access census tracts, as the USDA defines them, should be immediately outlawed for all new development.** As a step towards this, the City of Phoenix, in their General Plan has stated that new Planned Area Development Zones will require a community garden.<sup>132</sup> In the District of Columbia, Code of Ordinances Sections 47-3801 to 3805 establish multiple, long-term tax incentives for supermarkets to locate in “underserved areas.” Prince George’s County Maryland also established similar incentives.<sup>133</sup> Insofar as full-service grocery stores can alleviate food insecurity and barriers to accessing the right foods, which they can, *and* insofar as these stores do not locate in low access census tracts due to taxes and permit fees that do not directly serve a beneficial purpose other than raising revenue, these revenues should be forgone by municipalities for the sake of public health and fulfilling the right to food.

The second and major factor that prevents county residents from accessing healthy and culturally appropriate foods is poverty. To this end, municipalities should reevaluate their role in wealth redistribution (i.e. taxes). The majority of municipal revenue comes from regressive taxes such as local and state shared sales taxes. A minority of municipal revenue comes from progressive taxes, like state shared income taxes.<sup>134</sup> Cities should restructure their revenue sources to come more from people that have the ability to pay (i.e. corporations and the uber rich) and less from people that lack the ability to pay (i.e. the food insecure). In this light, the City of Tempe should immediately repeal its sales tax on food for home consumption which further forces the food insecure to make difficult choices.<sup>135</sup>

Additionally, an effective and more direct measure that countries and municipalities have instituted is **a minimum wage that is equal to a living wage**. We firmly believe that a living wage of at least \$20 per hour (tagged to inflation) is necessary to alleviate hunger and food insecurity. For example, the USDA computed that households in the lowest quintile of income (those receiving wages below \$20 dollars per hour) spend 34.1% of their income on food while those in the highest quintile spend less than 10% (*even while spending three times as much*) on food (see **Figure 1** below). **We believe that the only way that we can ask food insecure residents to pay the full cost of sustainable food is to ensure that the compensation packages they receive allow them to do so.**

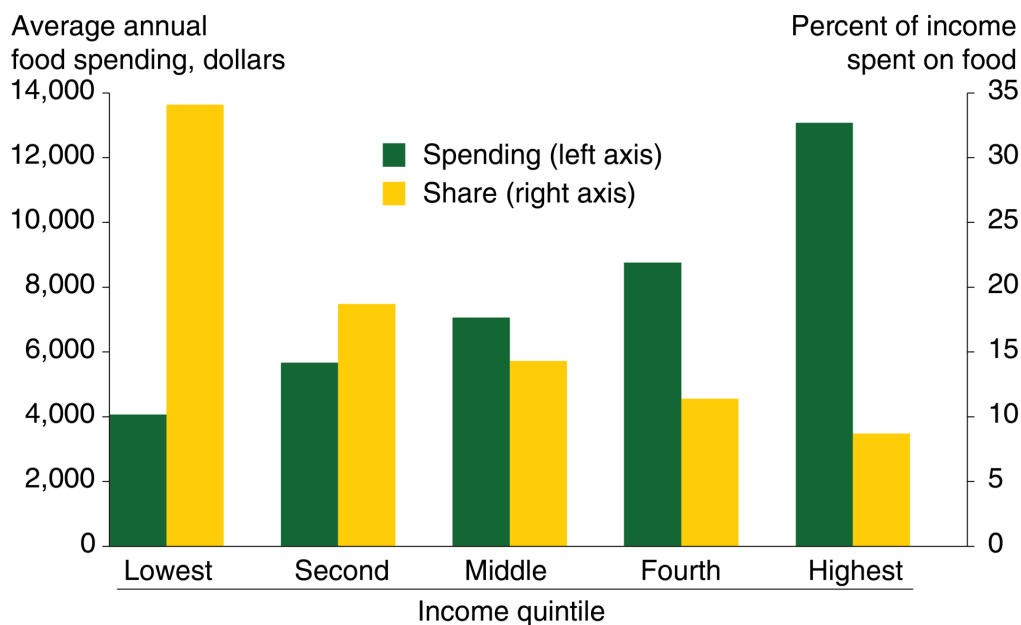
<sup>132</sup> PlanPHX 2015 General Plan. Retrieved on 10/7/18 from, [https://www.phoenix.gov/pddsites/Documents/PZ/pdd\\_pz\\_pdf\\_00451.pdf](https://www.phoenix.gov/pddsites/Documents/PZ/pdd_pz_pdf_00451.pdf)

<sup>133</sup> Healthy Food Policy Project Policy Database. Retrieved on 10/7/18 from, <http://healthyfoodpolicyproject.org/policy-database>

<sup>134</sup> For example, see Phoenix 2018-2019 Summary Budget. Retrieved on 10/7/18 from, <https://www.phoenix.gov/budget/annualbudget>

<sup>135</sup> <https://www.tempe.gov/home/showdocument?id=19206>

### Food spending and share of income spent on food across U.S. households, 2017



Source: USDA, Economic Research Service using data from U.S. Bureau of Labor Statistics, Consumer Expenditure Survey, 2017.

**Figure 1.** Food spending and share of income spent on food across U.S. Households in 2017.

### Hunger, Food Insecurity, and Food Access Benchmarks:

- 1) By 2025 ban low access census tracts for new development.
- 2) By 2030 facilitate the placing of a full-service grocery store in 100% of existing food deserts or require corner stores to stock a full section of healthy staples.
- 3) By 2030 reduce food insecurity to below 5% with very low food security below 1% in each municipality.
- 4) By 2030 restructure municipal revenue such that a majority of the funds come progressive taxes and other progressive redistribution funds.
- 5) By 2025 make the county's living wage \$20 (in 2018 dollars tagged to inflation).
- 6) By 2030 reduce the poverty rate in each municipality to below 5% of residents. (currently 17% for the county).<sup>136</sup>

<sup>136</sup> American Community Survey. U.S. Census Bureau. 2016.

## Diet-Related Health:

### Background

Diet and lifestyle choices are known to be the major driving factors in many of today's chronic diseases. These diseases, such as heart-disease, certain types of cancer, and diabetes are so directly influenced by diet that differences in morbidity and mortality rates from them can be explained by differences in diet.<sup>137</sup> Following the shift in the U.S. from an agrarian to an urban society, people began eating more and more away from home, letting corporations do the cooking.<sup>138</sup> In Maricopa County, there is a mentality that people do not have enough time to do everything that they need to in a day, so going out to eat has become an easy solution for those who want a convenient meal. In the mid-1990's Americans were getting one third of their calories away from home with more recent (2012) data indicating this has remained level at one-third.<sup>139</sup> These away from home meals have more calories, more fat, more cholesterol, and less dietary fiber.<sup>140</sup> In fact the USDA reports that in 2017, 53.8% of the money Americans spent on food was away from home, on average.<sup>141</sup>

Although this convenience factor has become very appealing to people, there are significant drawbacks to this fast-food lifestyle. The major drawback to eating out and eating fast-food is that these food items lack the nutrition that the body needs to be healthy. As more people have relied on unhealthy foods that are higher in fat, sugar and calorie content, the more diet-related health issues have become prominent in today's society. Due to the increased intake of these high-calorie and low nutritional density diets the diet-related health issues that are plaguing citizens include: heart disease, stroke, and type 2 diabetes. In Maricopa County alone, 28.3% of the population is considered to be obese.

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<sup>137</sup> Ford, E.S., Bergmann, M.M., Kröger, J., Schienkiewitz, A., Weikert, C.T., & Böing, H. (2009). Healthy living is the best revenge: findings from the European Prospective Investigation Into Cancer and Nutrition-Potsdam study. *Archives of internal medicine*, 169 15, 1355-62.

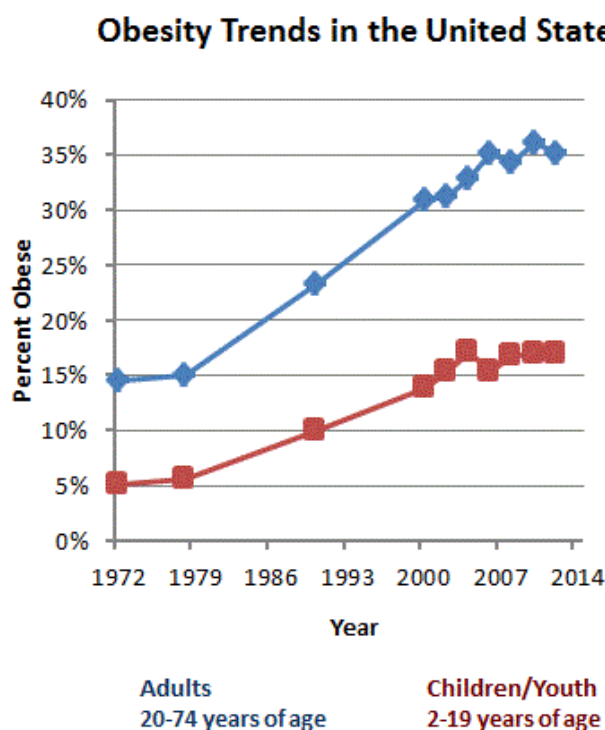
<sup>138</sup> Pollan, M. (2013). *Cooked: A Natural History of Transformation*. Penguin Press.

<sup>139</sup> Saksena, Michelle & Okrent, Abigail & D. Anekwe, Tobenna & Cho, Clare & Dicken, Chris & Elitzak, Howard & Guthrie, Joanne & Hamrick, Karen & Hyman, Jeffrey & Jo, Young & Lin, Biing-Hwan & Mancino, Lisa & W. McLaughlin, Patrick & Rahkovsky, Ilya & Ralston, Katherine & Smith, Travis & Stewart, Hayden & E. Todd, Jessica & Tuttle, Charlotte. (2018). America's Eating Habits: Food Away From Home.

<sup>140</sup> Guthrie, Joanne F., Frazao, Elizabeth & Lin, Biing-Hwan. Role of Food Prepared Away from Home in the American Diet, 1977-78 versus 1994-96: Changes and Consequences. *Journal of Nutrition Education and Behavior* 34(3). June 2002.

<https://www.sciencedirect.com/science/article/abs/pii/S1499404606600833>

<sup>141</sup> United States Department of Agriculture 2017. Food Prices and Spending. Retrieved from <https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-prices-and-spending/>



**Figure 2.** Obesity Trends in the United States <sup>142</sup>

### Comparable Cities:

Many cities and counties in the United States are facing similar diet-related health issues and are choosing to implement innovative initiatives to combat the problems. For example, in 2008 the City of Minneapolis passed its Staple Foods Ordinance which requires all corner stores (except those at small gas stations) to carry a minimum diversity of staple foods including five varieties of fruits and vegetables and other minimum stock requirements of staple foods such as meat, bread, and dairy. The Minnesota Department of Health followed up to evaluate the effects on this new ordinance which was passed in conjunction with a city run and funded 'Minneapolis Healthy Corner Store Program' that provided funds for produce displays and signage, technical assistance with procurement and storage, and community events like in-store cooking demos and tasting opportunities. The Minnesota Department of Health found that even after 5 years and all of the above mentioned assistance and funding from the city, *sales of fruits and vegetables averaged less than \$10 per store per week.*<sup>143</sup> We believe

<sup>142</sup> Simons-Morton, DG. National Heart, Lung and Blood Institute. Obesity Trends in the United States. National Heart, Lung and Blood Institute. July 2014. Retrieved from: <https://www.nhlbi.nih.gov/research/resources/obesity/index.htm>

<sup>143</sup> Minneapolis Department of Health and Family Support. *Minneapolis Healthy Corner Store Program*. February 2012.

that this provides first hand evidence that physical access to food is only a *minor* issue in the under consumption of fruits and vegetables (see Handbury et al. 2016).<sup>144</sup>

For a more local example, in 1994 Arizona citizens proposed and passed a ballot initiative, The Tobacco Tax and Healthcare Act, which raised the state tax on tobacco and earmarked the funds for healthcare, tobacco outreach, and research. This tax, and taxes like it, have been effective in reducing the consumption of unhealthy products. Soda taxes, like tobacco taxes, have been a demonstrably effective way to reduce the consumption of soda, which only causes health problems, in Mexico, Norway, and the United Kingdom, among many other countries and municipalities. **In the United States, Berkley California saw soda consumption in low income neighborhoods drop by 21% following the penny per ounce tax on sugar sweetened beverages.**<sup>145</sup> Additionally, 'junk food' taxes in Mexico and Hungary have proven to be effective at curbing consumption of such food.<sup>146</sup> Closer to home, in 2014 the Navajo Nation also instituted a 'junk food' tax, but research on its impacts has not yet been published.

## Diet-Related Health Benchmarks:

- 1) By 2025 the county will require all restaurants to provide food labeling that includes information that consumers need to make choices aligned with sustainable values including animal treatment, greenhouse gas emissions, labor conditions, and so on.
- 2) By 2025 there will be a ban on all schools selling junk food such as chips and soda to students.
- 3) By 2025 institute a countywide soda tax of at least 1 penny per ounce and a junk food tax of 8% (authors are aware of the 2018 preemption bill, see Title 42, Chapter 6, Article 1, Section 42-6015, of the Arizona Revised Statute. Municipalities should organize to amend this section).
- 4) By 2040 reduce prevalence of obesity to below 10% and (diagnosed) type II diabetes to below 3% in each municipality.

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<sup>144</sup> Handbury et al. (2016). Is the focus on food deserts fruitless? Retail access and food purchases across the socioeconomic spectrum. Becker Friedman Institute for Research in Economics. Working Paper Series Health Economics Series No. 2016-08.

<sup>145</sup> Falbe et al. (2016). Impact of the Berkeley excise tax on sugar-sweetened beverage consumption. American Journal of Public Health, 106(10), 1865–1871. <http://doi.org/10.2105/AJPH.2016.303362>

<sup>146</sup> Bíró, A. (2015). Did the junk food tax make the Hungarians eat healthier? Food Policy, 54, 107–115. <http://doi.org/10.1016/j.foodpol.2015.05.003> ; Batis et al. (2016). First-Year Evaluation of Mexico's Tax on Nonessential Energy-Dense Foods: An Observational Study. *PLoS Medicine*, 13(7), 1–14. <http://doi.org/10.1371/journal.pmed.1002057> ; Hernández-f, et al. (2018). Reduction in purchases of energy-dense nutrient-poor foods in Mexico associated with the introduction of a tax in 2014. *Preventive Medicine*, 118 (May 2018), 16–22. <http://doi.org/S0091743518302974>



## Food Waste:

### Background

We waste enough food in the United States to feed our food insecure population 4 times over. That is, the roughly 50 million people in the United States that self-identify as food insecure could have their choice of 8000 calories of food per day (Buzby et al. 2014). These estimates exclude food wasted on the farm and in transport to retail locations, so, these are conservative numbers. Furthermore, fully *four-fifths* (by monetary value), *two-thirds* (by weight), and *one-half* (by Caloric energy) of this wasted food is meat, poultry, fish, nuts, vegetables, fruits, and dairy products, not added sugars or added fats. This means that the food insecure, as well as those who are forced to eat poorly and suffer from the consequential diet related health diseases, could have access to a **dignified diet**, if we change the rules of the game. This is a moral problem, not a technical problem.

The way that food is wasted in the U.S. is uneven. 32-40% of food waste comes from commercial businesses like restaurants and supermarkets. Another 43-67% comes from the residential home (ReFed ;Buzby et al. 2014). From these summary statistics, one might think that tackling food waste should be aimed at these two sectors. However, the EPA Food Recovery Hierarchy suggests preventing food waste before it is produced because it has large multiplier effects for preventing adverse externalities (e.g. twice as much greenhouse gas emissions can be abated through prevention when compared with composting the wasted food) (CITATION). This does not make for clear cut solutions. Post production sectors landfill the majority of the wasted food, but the advantages of *preventing the production* of food destined for waste in the first place are strong motivators to focus higher upstream in the supply chain. Project Drawdown cites food waste as responsible for roughly 8 percent of global emissions. They found reducing food waste before it is produced to be the 3<sup>rd</sup> most effective (in terms of gross plausibly reducible emissions) solution for reducing greenhouse gas emissions globally (Project Drawdown 2018).

### Comparable Cities:

Cities across the country are stepping up to tackle food waste. The pace of this transformation is quickened by the lack of significant pushback from stakeholders. In other words, **nobody likes food waste**, and so everybody, including federal agencies are behind a more efficient food system. The goal set by the USDA and the Environmental Protection Agency (EPA) in 2015 is to reduce wasted food by 50% (by-weight) nationally by 2030. This is a goal we believe the County should and can meet. This goal is in line with United Nations Sustainable Development Goal Target 12.3, which many countries have adopted for themselves (Flanagan et al 2018). The State of Massachusetts is leading the charge towards this ambitious goal. In

2014 commercial food waste in excess of 1 ton per week was outlawed (Government of Massachusetts 2018). Similarly, Oregon's Metro Council (an elected government of the Portland metro area) has banned commercial food waste in excess of 1000 pounds per week (Metro website Citation). Local municipalities engage with local restaurants and supermarkets to ensure compliance with these bans and provide technical assistance. Broadly, governments can address food waste through prevention, recycling, recovery, and educational campaigns. Incentivizing recycling (or disincentivizing waste) can be a strong motivator for recycling businesses to start up or expand and will challenge retailers and consumers to prevent waste under their control.

## Policy Recommendations:

A baseline waste stream analysis should be conducted to understand each municipality's food waste challenges. This will require a comprehensive original assessment. Audits and reevaluations must regularly occur to ensure progress towards the goal. Technical assistance for this assessment and for reducing food waste is offered by the EPA through their Food: Too Good to Waste Implementation Guide and Toolkit<sup>147</sup>. These types of analysis are necessary to show progress. The United Kingdom has employed these methods for household food waste since 2007 and was able to show a 12% reduction from that time to 2015 (Quested and Parry 2017). We believe that **a commercial ban on excessive food waste** is a necessary step towards meeting the food waste goal and believe businesses will rise to the challenge. Indeed, Sprouts Farmers Market, a local grocer, is leading the way. In 2017, Sprouts diverted 53 million pounds of its food waste stream towards donations (23 million pounds or 19 million meals), animal feed (25 million pounds), and compost (5 million pounds) (Sprouts Farmers Market 2017). Additionally, a consumer education and advocacy campaign is necessary to stem food wasted within the house. This will be discussed below as part of the Food Literacy Goal.

## Food Literacy:

### Background

Through its history, the United States has transitioned from an agrarian society where most people were farmers, to an urban society where less than 2% of us are farmers now.<sup>148</sup> What in 1977 Wendell Berry called, 'The Unsettling of America', has resulted in a definitive, though not permanent or inevitable, separation between people and their food production.<sup>149</sup>

<sup>147</sup> Food: Too Good to Waste Implementation Guide and Toolkit. Environmental Protection Agency. Retrieved from: <https://www.epa.gov/sustainable-management-food/food-too-good-waste-implementation-guide-and-toolkit#docs>

<sup>148</sup> United States Department of Agriculture (2014). 2012 Census of Agriculture. Retrieved on 10/1/18 from [https://www.nass.usda.gov/Publications/AgCensus/2012/Full\\_Report/Volume\\_1\\_Chapter\\_1\\_US/usv1.pdf](https://www.nass.usda.gov/Publications/AgCensus/2012/Full_Report/Volume_1_Chapter_1_US/usv1.pdf)

<sup>149</sup> Berry, W. (1977). *The Unsettling of America: Culture and Agriculture*. Sierra Club Books.

Along with that, county residents continue to be denied a meaningful connection to who grows their food and how it is grown and the process that it takes to get to them from the farm.

The majority of food eaten in the county is, and will likely continue to be, grown elsewhere, increasingly from all over the globe. As such, the impact that eaters have is mostly felt in other parts of the world. These impacts include deforestation, sea level rise, biodiversity loss, hunger, environmental contamination, and many others. Most directly, **eaters are responsible for ensuring the just livelihood of those that produce their food.** Fair and fully priced food is currently out of reach for most residents of the county and indeed much of the United States. Cheap food has several positive and negative benefits for consumers, many negative consequences for producers, and detrimental impacts for third parties and Nature.<sup>150</sup> Thus, implicit in the call for fair and fully priced food is a call for living wages so that everyone can realize their right to eat sustainably. We believe that a food literate population will not only know how to choose and prepare healthy meals for themselves and their families, but will know how to employ their diet in the struggle for a sustainable global environment, society, and economy. The charge of cities then, is two-fold; 1) Cities must ensure that barriers such as poverty and food deserts are removed to allow full participation in the sustainable food system, and 2) Cities must be partners, along with schools and lifelong learning programs, in propaganda campaigns to better inform eaters of their global impact.

### Comparable Cities:

In Sacramento California, the Food Literacy Center is working with youth through structured food education after-school programs.<sup>151</sup> This program's goal is to deeply connect youth with the food that they eat, while inspiring them to eat healthy food. This program works with schools that are located in areas with low income families who are forced to suffer the consequences of the multiple market and civic failures of the food system including the abusive and aggressive advertising of unhealthy food to youth and the bad-habit-forming school lunch programs. Food companies wage an all too powerful battle against the teachers and parents of these youth who are bombarded with advertisements for unhealthy and unsustainable food on a daily basis.<sup>152</sup> **Parents and teachers cannot fairly compete for the minds of the youth when companies spend millions of dollars pushing addictive and unhealthy food into communities across the world.**<sup>153</sup>

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<sup>150</sup> Patel, R. and Moore, J. (2017). *A history of the world in seven cheap things : A guide to capitalism, nature, and the future of the Planet*. University of California Press

<sup>151</sup> Food Literacy Center. Sacramento California 2018. Retrieved on 10/1/18 from, <https://www.foodliteracycenter.org>

<sup>152</sup> Nestle, M. (2013). *Food Politics: How the Food Industry Influences Nutrition and Health*. University of California Press.

<sup>153</sup> Jacobs, A., Richtel, M.. How Big Business Got Brazil Hooked on Junk Food. (2017). New York Times. Retrieved from: <https://www.nytimes.com/interactive/2017/09/16/health/brazil-obesity-nestle.html>

Several countries and municipalities, including the United Kingdom, Quebec Canada, and Brazil, have instituted bans on advertising to children, many specifically for unhealthy food. These bans have been demonstrably effective at reducing the amount of exploitative advertising children see and reducing the consumption of unhealthy foods.<sup>154</sup> Benefits to the environment and to society abound from such bans including reduced materialism, consumerism, and therefore ecological impact, as well as reduced impetus for eating disorders, reduced family arguments between pestering children and their parents, and of course the consequential improved physical health and reduced spending on healthcare associated with avoiding the consumption of unhealthy foods.<sup>155</sup>

In San Francisco California, Code of Ordinance 471.1 – 471.9 established that a toy could not be given with meals that do not meet healthy nutritional standards. Santa Clara County California passed a similar law. Also, in San Francisco California, Health Code art. 42 established that any advertisement for a sugar sweetened beverage on billboards, transport, or buildings must carry a conspicuous warning that states, “WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay.” We believe that these laws should be passed here in the county as well.

“Sustainable University” is a life-long learning program offered by the City of Peoria that engages citizens on various aspects of sustainability that they can incorporate into their life such as gardening, composting, and water conservation.<sup>156</sup> Sustainable University includes materials for teachers to use in their classrooms. This program has the potential to include more information on nutrition, health, urban farming, and the global impacts of food for county residents. Larger efforts are needed though.

In the United Kingdom, a public campaign called “Love Food Hate Waste” has been educating citizens on household food waste since 2007.<sup>157</sup> This campaign has measured impacts that point to initial success. From 2007-2015 United Kingdom households reduced their food waste by 12%.<sup>158</sup> Canada has a robust food literacy campaign backed by extensive research and adaptive management.<sup>159</sup> Canada’s efforts focus on personal/household skills such as cooking, reading food labels, and food storage and handling. We believe that this could be implemented and expanded to include topics such as food waste and environmental impacts.

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<sup>154</sup> Humphreys et al. 2017. The impacts of banning advertising directed at children in Brazil. The Economist Intelligence Unit.

<sup>155</sup> Ibid.

<sup>156</sup> Sustainable University. Government of Peoria 2018. Retrieved from: <https://www.peoriaaz.gov/residents/about-peoria/sustainability/sustainability-university>

<sup>157</sup> Love Food Hate Waste. Retrieved from: <https://www.lovefoodhatewaste.com>

<sup>158</sup> Quested, T., & Parry, A. (2017). *Household Food Waste in the UK, 2015*. WRAP. Retrieved on 10/1/18 from, [http://www.wrap.org.uk/sites/files/wrap/Household\\_food\\_waste\\_in\\_the\\_UK\\_2015\\_Report.pdf](http://www.wrap.org.uk/sites/files/wrap/Household_food_waste_in_the_UK_2015_Report.pdf)

<sup>159</sup> Howard, A., & Brichta, J. (2013). What’s to eat? Improving food literacy in Canada: The Conference Board of Canada.

## Food Literacy Benchmarks:

1. Food literacy programs, as part of Arizona curriculum standards, will be implemented in the public school system by 2025.
2. A county-wide ban on the advertising of unhealthy food to children by 2025.
3. Require **prominent** labeling in food retailers that provides information relevant to ethical consumption by 2025.

## Policy Recommendations:

In order to improve food literacy within Maricopa County, municipalities should partner with their public schools to foster robust food education programs. Multiple implementation methods can be employed such as an elective course on food literacy, school gardens, and after-school snack and learn opportunities. The main goals of this program will be to create a foundation for children so that they will have knowledge about the history of the food system, experiential hands-on interactions with growing food, knowledge about where their food comes from, and the nutritional benefits of certain foods and diets.

Additionally, a county wide ban on the advertising of unhealthy food to children should be instituted. It should include billboards, street, business, public transport, and building signs as well as local radio and television stations. The City of São Paulo in Brazil, as with many other cities, has banned billboard advertising altogether within city limits.<sup>160</sup>

Lastly, food labeling should include information that consumers need to make choices aligned with sustainable values including animal treatment, greenhouse gas emissions, labor conditions, and so on. Cities can require such information to be available to consumers at local restaurants and supermarkets, if not on the menus and products themselves, then shown prominently on signs, or at the very least available upon request. Indeed, new federal regulations have gone into effect in 2018 that require chain restaurants (20 or more locations) to post caloric information for each item on their menu in addition to a statement that reads "2,000 calories a day is used for general nutrition advice, but calorie needs vary." Research on such caloric labeling over the past 10 years has shown that consumers eat consistently less calories at such restaurants when compared with those that do not label their menu items.<sup>161</sup>

<sup>160</sup> Madawi, Arwa. Can cities kick ads? inside the global movement to ban urban billboards. (2015). The Guardian. Retrieved from: <https://www.theguardian.com/cities/2015/aug/11/can-cities-kick-ads-ban-urban-billboards>

<sup>161</sup> Restrepo, B., Minor, T.. New National Menu Labeling Provides Information Consumers Can Use To Help Manage Their Calorie Intake. (2018). United States Department of Agriculture. Retrieved from: <https://www.ers.usda.gov/amber-waves/2018/october/new-national-menu-labeling-provides-information-consumers-can-use-to-help-manage-their-calorie-intake/>

## Agriculture Goals

### Background

Agriculture in Maricopa County has deep historical roots that predate the colonization of Indigenous Peoples' land by of Spanish and later Americans. This land was farmed first by the Hohokam and is now farmed by the Akimel O'odham and Pee Posh.<sup>162</sup> American colonizers began usurping water and land to farm this area in the mid-1800's.<sup>163</sup> Public data, from the United States Census of Agriculture, dating back to the year 1890 shows that American farmland in the county grew from an initial 62,000 acres to a peak of 2.7 million acres (about half the county's land) in 1954. Since that time, agricultural land has been in a steady decline due to suburban style development, especially since the passing of the 1980 Groundwater Management Act, which ensures that irrigated agriculture will only decline in the future (Citation). Currently, in 2018, there are approximately 400,000 acres of farmland in the county with about half devoted to grazing pasture and half to irrigated crops. Of the crops grown, about half go to feed livestock.<sup>164</sup>

A capitalist agricultural system has a unique signature with regard to the distribution of goods. Farmland ownership is a prime example. A few farmers own the majority of the farmland while the majority hold a small piece of the pie. In 2012, the top 2% of farmers (that's roughly 50 farmers) controlled *two-thirds* of all the agricultural land in the county on farms larger than 2000 acres each (see **Figure 1** below). This is not a new pattern. In 1925, the top 1% of county farmers (roughly 40 farmers) held *two-thirds* of all the farmland on farms larger than 1000 acres.<sup>165</sup> This pattern is not unique to the county. Indeed, the entire United States has a similar distribution of agricultural land and equipment.<sup>166</sup>

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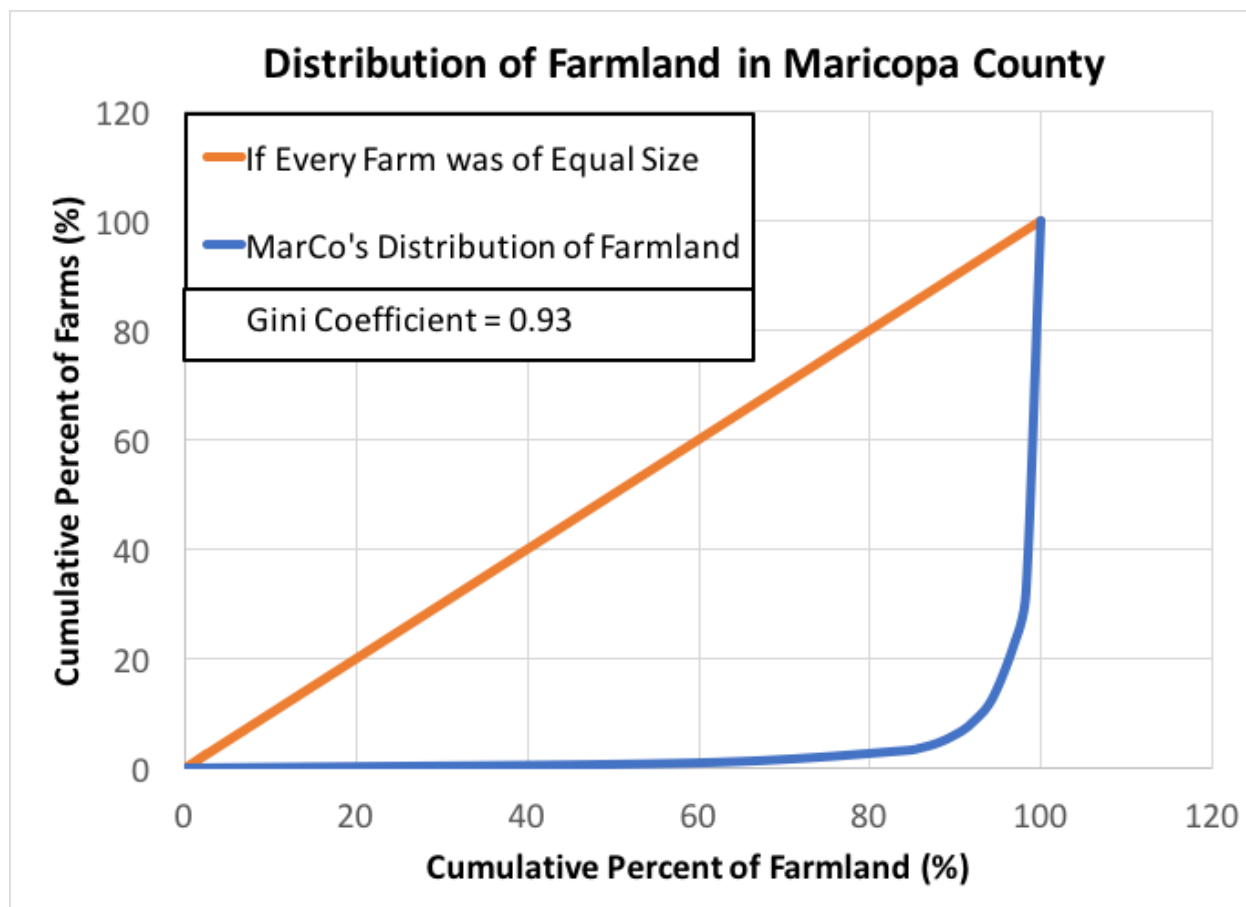
<sup>162</sup>The Hohokam: The Land and The People. Pueblo Grande Museum. Retrieved from: <https://artsandculture.google.com/exhibit/the-hohokam-the-land-the-people/wRnHM1ZB>

<sup>163</sup> Rogers, P & Edmiston, S. 2013. The Gila River Indian Community Water Rights Settlement and its impact on water resource management. Water International. Vol. 38, No. 3, 250–262, <http://dx.doi.org/10.1080/02508060.2013.793571>

<sup>164</sup> United States Department of Agriculture. 2012 ; 1954 ; 1890 Maricopa County Census of Agriculture.

<sup>165</sup> United States Department of Agriculture. 2012 ; 1925 Maricopa County Census of Agriculture.

<sup>166</sup> Peterson, N and Brooks, N. 1993. The Changing Concentration of U.S. Agricultural Production During the 20th Century: 14th Annual Report to the Congress. Agriculture and Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Agriculture Information Bulletin No. 671.



**Figure 1.** A Lorenz Curve showing the distribution of farmland amongst farmers in Maricopa County in 2012. The orange line represents a hypothetical scenario where every farm is the same size (perfect equality) and a right triangle would represent a scenario where one farm owned all the farmland (perfect inequality). The blue line shows how Maricopa County's distribution is skewed towards inequality as indicated by the large Gini coefficient.

This same pattern is evident in the distribution of all agricultural goods in the county from vegetable production, to farm labor, to cattle, and others. No deliberate redistribution system exists as it does with, for example, personal income, where taxes redistribute the wealth earned by individuals that year to the community. Due to this dearth of redistributive policies in agriculture, extreme concentration towards the top is the tendency. Concentration of land and other equipment has many consequences for a society. To take a local example, large farms conspired together and crafted what is today Arizona's Agricultural Employment Relations law (see Arizona Revised Statutes Title 23, Chapter 8, Article 5). Farmworkers and small farmers were united against this effort but their power was inferior due to the concentration of the means of production.<sup>167</sup>

<sup>167</sup> Tempe History Museum. Oral Histories Collection. Gustavo Gutierrez 2012. Interview # OH-395 Retrieved from <https://www.tempe.gov/government/community-services/tempe-history-museum/tempe-history/oral-history>. ; Phoenix Historic Property Surveys. Community Expansion and the Struggle for



In 1972, Cesar Chavez came to Maricopa County to organize farmworkers against this law which criminalizes many of the effective organizing tactics employed by farmworkers and their unions including storefront boycotting and union organizing on the farm while protecting the “management rights” of farmers to determine how much farmworkers get paid, what crops to plant, who does what work, and what to do with the profits, among others.<sup>168</sup> These measures all but ensure that a corrosively unequal power structure will persist between farmers and farmworkers. Indeed, this led to farmworkers being forced to sleep in beneath the trees in citrus orchards here in the county in makeshift housing made of orange crates where they were paid less than the federal minimum wage.<sup>169</sup> These sorts of abuses continue here in the county right up to the present. In 2017 farmworkers picking watermelons, onions, and potatoes in at an El Mirage farm were forced to live in makeshift housing made of converted school buses and semi-trailers during the hot summer months (azcentral).<sup>170</sup> Agrarian reform has, historically, been the solution to these problems.

### Comparable Cities:

Agrarian reform has been attempted and carried out in the United States in various forms and with varying degrees of success and failure (e.g. ‘40 acres and a mule’ and The Dawes Act of 1887). Other countries have been more successful at fostering a sustainable, healthy, and equitable food system through agrarian reform. Among the best examples are Cuba and Ecuador. Article 282 from Ecuador’s constitution explicitly states that, “Large estate farming and land concentration is forbidden...” while Article 15 of Cuba’s constitution states that, “the land that does not belong to small farmers or cooperatives comprised of them...” shall be the property of the State (Constitution Project 2018). Here, we take the example of Cuba, where agrarian reform, in tandem with other key developments, has taken the country from the same level of concentration we have today in the county, towards a local, healthy, equitable, and sustainable food system.

During Cuba’s “Special Period” (1991-Present) following the collapse of their main trading partners, the Soviet Bloc countries, and during the longstanding trade embargo imposed by the United States, renewed intensity in Cuban agriculture enabled largely self-sufficient

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production of staples of the Cuban diet like roots and tubers, vegetables, fruits, and beans using largely organic and sustainable methods (Altieri and Funes-Monzote 2012). After the fall of the Soviet Union, imports of tractors, fuel, fertilizers, pesticides, and other hallmarks of industrial agriculture were drastically reduced (Wright 2008; Willot 2013). In the place of industrial agriculture, labor-intensive urban agriculture has flourished to such a degree that resident/farmers in cities across the country have been able to produce the majority of the fruit, vegetables, and leafy greens that city residents require (Altieri and Funes-Monzote 2012; Wright 2008; Sinclair and Thompson 2001). Additional merits of this system include farmer incomes that *surpass* the national average and levels of social capital that facilitate the sharing of farm equipment, seeds, fertilizers and other inputs, and normalize the provisioning of 10-30% of their crops to schools, hospitals, and childcare centers (See Willot 2013 p 51).

This was achieved in large part by an active government that adapted policies to the changing times. A series of sweeping reforms in agricultural land began when the revolution seized power in 1959 and continued most recently in 2008. Land ownership was concentrated at this time much like it is today in Maricopa County. That is, Maricopa County land distribution today is much like that of Cuba 60 years ago. In 1959, 8% of all farmers controlled 70% of the land while *foreign U.S.* owners controlled 25% of all Cuban land (Kost 1998; Sinclair and Thompson 2001). Over this time period, the maximum amount of land one could own was ratcheted down from 1000 acres in 1959 to 166 acres in 1963. Land that was expropriated from foreign and domestic capitalists was, in small part, given to small farmers and their cooperatives, so much so that the number of small farmers *tripled* during this short period of 4 years (Sinclair and Thompson 2001). However, much of the land went to the formation of state farms that over the next three decades, proved inefficient and not sufficiently productive.

This led to a third sweeping reform that came during the Special Period in 1993 where most of the state farms were devolved into a new form of socialist production called Basic Units of Cooperative Production (UBPCs) which became the largest productive sector of the agricultural economy (Sinclair and Thompson 2001). These cooperatives are worker managed. Members decide what to produce, how to produce it, who to sell it to, and what to do with the profits. Most employ a salary that is tied to individual productivity as well as a share of the overall profits which is tied to the productivity of the whole. The UBPCs, as well as small individual and family owned farms, are models of production that have led to the successful transition towards locally oriented sustainable and healthy food production in Cuba.

### **Goals for Maricopa County:**

- 1) By 2028, increase number organic operations to 130 and 50% of cropland acreage. (currently 13 and unknown acreage).
- 2) By 2028, increase number of Community Supported Agriculture (CSA) farms to 1 per 5,000 households (currently 1 per 71,000 households).

- 3) By 2028, increase direct to retailer sales for human consumption to at least 200,000,000 dollars (in 2012 dollars) and 20% of total sales. (currently 2,000,000 dollars and 0.2% of total sales).
- 4) By 2028, increase proportion of female principal operators to 50% (currently 30%) and the proportion of acres principally operated by females to 50% (currently 6.4%) Females are 8 times more likely than males to principally operate a farm with direct to retail for human consumption sales.
- 5) By 2028, increase the number of principal operators under 45 years old to 2,300 and decrease the average age to 45 years old (Currently 231 and 60).
- 6) By 2028, increase proportion of farmland held in farms smaller than 450 acres to 100% (currently 12%).

### **Policy Recommendations:**

We believe that reorganizing production towards fruits, vegetables, and leafy greens within the county through small scale distributed agroecological production will aid in alleviating many of the ills of our current food system including local food insecurity, diet related health issues, contributions to global climate change, local air pollution, etc. We recommend strong policies of agrarian reform that will disallow the concentration of the productive resources (i.e. farmland) and incentivize and support the growth of a new cohort of small farmers keen on producing for the local market. Reforming farmland ownership entails restricting the maximum allowable acreage of a farm to a size of, at most, the current national average, about 450 acres. This will create a surplus of expropriated land that can be held in trust until full ownership is ultimately given to the new cohort of small farmers.

Cuba ensured the success of their reforms by outlawing the private sale of farmland. There, farmers could only sell to the state or deed the land to a relative. Thus, Cuba preempted the concentration tendency that runs rampant in a more-free market of land (Sinclair and Thompson 2001). The authors are aware that this style of agrarian reform is currently unconstitutional and illegal in Arizona (see Section 2 Article 17 of Arizona's Constitution and Title 12 Chapter 8 Article 2.1 of the Arizona Revised Statutes). Cities should work to amend/overturn these legal barriers to redistribution. However, innovative and legal solutions can be pursued in the meantime (e.g. [Sustainable Iowa Land Trust](#)).

In order to ensure that this new cohort of farmers feels secure and comfortable with taking up the profession, several factors must be in place. The University of Arizona Cooperative Extension system, which already does work to foster and provide technical assistance to new and young farmers, will need to be strengthened and partnered with. Additionally, organic inputs must be made readily available and economically viable. Municipalities can engage in the production of compost, which the City of Phoenix and the City of Tempe are already doing, and provide it to farmers at the appropriate price. The production of this compost synergizes well with the food waste recommendations described below. Once grown, this new produce will

need to be adequately distributed to those who need it. It is beyond the scope of this report to recommend market reforms and strategies. However, a combination of institutional purchasing (i.e. schools, hospitals), traditional retail (i.e. supermarkets, corner stores) and distributed retail (i.e. farm gate sales, farmers markets) will need to be prepared and adapted to accommodate the new local distributed production.

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