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POLICY BRIEF

CHOICE-DEVELOPMENT PILOT INCENTIVE PROGRAM

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Executive Summary

The City of Goodyear is predicted to develop quickly in the next several years. However, the build-out water demand is expected to exceed the current water supplies of the city (Holmes, 2016). Furthermore, development can lead to urban heat island effects, which exacerbate the water-energy nexus and water consumption. Thus, the City of Goodyear seeks to develop a pilot incentive program to address these concerns.

The goal of this project is two-fold: to develop a pilot incentive program that (1) incentivizes developers to reduce water consumption in their developments and (2) provides choice to developers in what goals they meet and how they achieve these goals. The research began with an analysis of the root causes of the issue and potential solutions through a literature review. Next, a framework was developed to visualize the findings from the research. From this, a draft pilot incentive program was developed and shared with the City for feedback.

The main findings from the research are that water consumption, energy consumption, and urban heat island effects are interrelated in complex ways. Additionally, economic analysis found that certification of homes can lead to overestimate of the cost, but buyers were more likely to buy efficient homes than convert them. Based on the findings, incentives that pull people, rather than push behavioral change, and public engagement are recommend. Additionally, there are several technology options to help reduce water consumption, and the capture and use of rainwater can significantly reduce outdoor water use.

Our recommended pilot incentive program includes three tiers, each with a different number of criteria to be met and a different number of incentives. To monitor success, recording the number of participants, water consumption, energy consumption, urban temperatures, and developer cost and revenue of each new development is recommended.

Introduction

The City of Goodyear is predicted to develop quickly in the next several years. However, the build-out water demand is expected to exceed the current water supplies of the city, without accounting for the large droughts predicted to occur in the future. Furthermore, there is a significant water-energy nexus, in which increased water consumption typically leads to increased energy consumption and vice versa. New developments increase both energy and water consumption. Additionally, development can lead to urban heat island effects, which tend to compound the water-energy nexus and consumption. Thus, the City of Goodyear seeks to develop a pilot incentive program to incentivize developers to reduce water consumption, energy consumption, and urban heat island effects in their developments.

The goal of this project is twofold: to develop a pilot incentive program that (1) incentivizes developers to reduce water consumption in their developments and (2) provides choice to developers in what water savings goals they meet and how they achieve these goals. The research to develop a program achieving these goals began with an analysis of the causes of this sustainability challenge and potential solutions from five different perspectives: economic, social, political, environmental, and technological. This analysis was conducted with a thorough literature review of academic journals and professional publications. Next, a framework was developed to visually show the findings from the research in a unified way. Finally, a draft pilot program was developed based on this research and the framework. The draft program was shared

with Mark Holmes, Water Resources Manager at the City of Goodyear, for feedback on feasibility. The finalized pilot incentive program is summarized in this report.

Background

The City of Goodyear is experiencing an issue with unsustainable development as it relates to water consumption. The Phoenix Valley is currently running a deficit on renewable water resources and is projected to have a high increase in population over the next few years and experience more severe and longer droughts in the future (Bureau of Reclamation, 2011). The percentage of water used outdoors in the Phoenix Valley is between 60% and 70% (Holmes, 2016). Prices for sewage, water and electricity are projected to increase sharply for many years to come (Holmes, 2016). There is a significant positive correlation between higher energy use and higher water use. Goodyear is one of the fastest growing cities in the Phoenix Valley, and is consequently booming with development (Holmes, 2016). However, the development of the outdoor landscapes has been poorly planned, and has contributed to a phenomenon known as the "Urban Heat Island". The urban heat island causes the city to capture heat and retain it throughout the night, keeping the average 24-hour temperature of the city higher than the surrounding desert landscape (Holmes, 2016). This results in higher demands for water and electricity which are not sustainable for the projected development and growth in the area.

Problem Analysis

In efforts to create a pilot program that increases conservation in all four sectors of water consumption (residential, agricultural, commercial, industrial), an analysis of all contributing factors was performed. The goal of this analysis is to both highlight the key factors contributing to the issue and possible solutions. Developing a thorough analysis will limit the possibilities of negative externalities (unintended consequences) and help identify key elements of success for the pilot program. Because this research is targeting water conservation through sustainable practice, this analysis was organized by targeting five key elements of sustainability: economic, social, political, environmental, technology & infrastructure. The key findings of each sustainability category is summarized in the sections that follow.

Economic

Economic factors and incentives have been shown to be successful in a variety of cases. The first case is in the conversion of mesic to xeric landscaping. Mesic landscapes consist of grass turf and water reliant plants, while xeriscapes are typically rock yards with plants that require much less additional water. A case study of an incentive program implemented in Las Vegas with a "turf for cash" conversion goal showed great results. Homeowners were paid by the city for the amount of grass they converted into rock lawns, on a square foot basis. To receive the incentive, the house must have a 50% canopy coverage by the end of 5 years. The results showed that there was an average of a 30% reduction in water use from the converted homes, which equated to a 54% reduction in their water bill costs and was sustained for the next 5 years

(Sovocool et. al., 2006). The breakeven point of conversion costs for homeowners was reached in an average of under 2 years (Sovocool et. al., 2006). Economically speaking, this provides a huge incentive for members of the community to convert their lawns, and for developers to build subdivisions that have housing with xeriscapes in Goodyear. Developers would see a higher return on investment because they could provide more long term value to homeowners. In addition, water prices in Goodyear rose 13% from 2015 to 2016, which would provide an even stronger calling to do away with grass lawns (GoodyearAZ). An important factor in this study is the requirement for a 50% canopy coverage. Rock lawns heat up quickly when in the sun, which reflects heat towards the house resulting in higher use of air conditioning. Palo Verde and Mesquite trees grow very quickly, provide lots of shade, reduce energy costs and can actually provide a higher value to the properties themselves (Guhathakurta, Gober, 2007).

Another incentive to developers and homeowners would be to require developers to build LEED certified buildings. LEED certified buildings use less water and electricity than normal construction (USGBC). Many developers are beginning to realize how much utility these homes provide for homeowners, and how they can dramatically contribute to their own margins. Davis Langdon quotes “many projects are achieving LEED within their budgets, and in the same cost range as non-LEED projects” (Hoffman, Henn, 2008). Homeowners typically overestimate the cost of these homes by anywhere from 11% to 28%, with their average overestimation being about 17% (Hoffman, Henn, 2008). This could mean two things. Either homeowner estimation of the cost may be deterring homeowners from purchasing LEED homes, so advertising is needed to correct this perception, or there is a significant amount of room for developers to make

more money on their initial house sales while also providing brand new homes at costs that buyers would consider to be inexpensive.

Social

The social barriers affecting policy implementation in a city may arise due to three main reasons. The first is the general attitude of society, which currently views consumption as "good" and necessary in order to be comfortable. "Unsustainable behaviors result from a vicious cycle, where traditional market and state institutions reinforce disincentives for more sustainable behaviors..." (Fischer et. al, 2012). This idea of consumption leading to comfort is called "inconspicuous consumption", and commercial interests are exploiting this, thus reinforcing the belief of consumption being "good". Another social barrier is that since citizens are not directly facing the scarcity, they see no reason to change their attitudes and behaviors, or there is no incentive to change. A large part of this attitude stems from the lack of understanding of the problem at hand, so community involvement on the issues will prove to be crucial to get everyone on the same page. Finally, institutions also lack momentum to effectively promote fundamental reforms to help guide community attitudes towards sustainability, which increases the importance of approaching policy reform and education through a poly-centric governance format.

Political

There are various state policies the City of Goodyear must follow in regards to water consumption, conservation, and resource allocation. Of these policies, the 1980 Groundwater Management Act (GMA) continues to frame all current and future initiatives in the City through

required rules and regulations a city must meet when developing water policies (Water Planning Committee, 2015). This is because the City of Goodyear currently receives all physical water supplies from groundwater sources. The GMA was established as a result of consistent annual overdraft and targeted three major conservation goals (Water Planning Committee, 2015). The first goal, is targeted directly at reducing Arizona's consistent overdraft problem. Overdraft occurs when a state is pumping out available groundwater faster than the aquifer can naturally be replenished (City of Goodyear, 2008). When this occurs, the quality of water decreases while the costs of water increase. The second goal will organize water usage by targeting individual needs of water consumers and allocating appropriate resource amounts (City of Goodyear, 2008). The third goal of the Groundwater Management Act is to enable a water augmentation plan through supply development (City of Goodyear, Curtailment Plan Committee, 2008). An example of a current policy in Goodyear that helps meet these required rules is the Turf Related Facilities Program for industrial sites with water intensive landscapes. The program frames different criteria that limit groundwater usage and require constant city inspections and reports of consumption, methods, or future plans (GoodyearAZ.Gov).

From 2013-2014, the City of Goodyear was averaging an annual 8.0 million gallons of water per day and with a projected increase of 2.4 million gallons per day by 2020 (Water Planning Committee, 2015). Although the projected surge indicates growth in all sectors of water consumption, the city government is faced with finding a balance between staying within its annual water allocation and sustainable water consumption. The City's annual surface water allocation, based on an agreement with the Central Arizona Project (CAP), is 10,742 acre-ft of

water, with an additional 7000 acre-feet of CAP water leased from the Gila River Indian Community (GRIC) (City of Goodyear, 2014). During Goodyear's initial growth surge, policy makers were able to source additional water through the agreement with GRIC; however, with the Phoenix metropolitan area experiencing similar growth throughout the valley, additional water allocation is not an option. Instead, the city government has taken on the challenge of advocating water conservation through various initiatives and incentives programs. This is in effort to engage constituents in the various efforts of policy makers that are targeting city growth through water conservation. By incorporating local communities in municipal government work, the conservation efforts will generate public awareness and involvement among its constituents which will provide much needed help in meeting annual water-consumption goals.

Environmental

According to the 2014 census there were over 74,000 residents who call Goodyear Arizona their home, which is over a 13% increase from the 2010 census of 65,000 (Goodyear, 2016). It is not uncommon for fast growing cities to suffer challenges, and Goodyear is certainly no exception as it is currently running up against its own water availability and quality concerns. The water that feeds Goodyear is extracted from ancient water supplies that are stored in underground aquifers. Lowering water tables are a direct result of aquifer over-extraction and a particularly harrowing topic in the Sonoran Desert as endangered life forms depend on the security and habitat that the riparian ecosystems provide. These riparian ecosystems are in a delicate balance and depend on a healthy and complete water system.

In order for Goodyear to achieve their water stewardship goals, it is recommended that the city make more use of rainwater collection and irrigation. This seemingly large hurdle will go a long way towards water conservation as upwards of 60% of total household potable water is used to moisten dirt in the yard. Passive rain harvesting is the answer. Residents use an average of 6,000,000,000 gallons of municipal water annually. In the same span of a year Goodyear gets over 16,000,000,000 gallons of rainwater delivered free of charge within its 116.5 square miles with only 8 inches of rain (Lancaster, 2008). *Goodyear receives over twice the amount of rain than the residents use in municipal water in an average year*!! Thus, there is strong potential to greatly reduce municipal water use for outdoor landscaping through greater collection and use of rainwater.

Technological

Research of the technological and infrastructural challenges and potential solutions demonstrates a strong nexus between water, energy, and the urban heat island effect. The current urban surfaces used in developments tend to increase urban heat island effects and runoff (increasing pollutants and missing a water harvesting opportunity) (Ben-Horin, 2007; Coutts, Tapper, Beringer, Loughnan, & Demuzere, 2013; MacAdam, 2012; US Environmental Protection Agency (EPA), 2016). These raised urban temperatures tend to increase outdoor water consumption and energy consumption because plants require more water at higher temperatures and more energy is used for air conditioning (Ben-Horin, 2007; Crewe, 2013; Jo, Carlson, Golden, & Bryan, 2010; MacAdam, 2012; Nakayama & Fujita, 2010). Further, the desire to create an oasis in the desert, by installing lawns and pools, increases outdoor water use

(Guhathakurta & Gober, 2010; Wentz & Gober, 2007). However, these oases can be best at mitigating the urban heat island effect, reducing energy consumption (Gober et al., 2010; Shashua-Bar, Pearlmutter, & Erell, 2009). Reduced energy consumption tends to reduce water use (and vice versa), since most conventional power sources use a considerable amount of water in their energy producing processes (Ruddell & Dixon, 2013). Finally, lower density developments have been found to have higher water and energy consumption (Guhathakurta & Gober, 2010; Wentz & Gober, 2007). However, there are several potential technological solutions that can be implemented by developments to address these concerns.

The first set of solutions includes the use of water and energy saving devices and fixtures. These include energy efficient and water efficient appliances and fixtures, outdoor water saving devices that water plants based on soil moisture (rather than a timer), leak detection technology, and pressure management technology to reduce energy consumption by pumps in a distribution system (Bijoor, Pataki, Haver, & Famiglietti, 2014; Mutchek & Williams, 2014; Suzenet, Tal, & Boymanns, 2002; US Environmental Protection Agency (EPA), 2016). Another helpful technological solution is the design of "Green Infrastructure". This type of infrastructure makes use of bioswales, bioretention basins, green and cool roofs, and porous or water holding pavements to reduce urban runoff, make use of rainwater to water landscaping, and reduce urban heat island effects (Coutts et al., 2013; Crewe, 2013; Frias & Binney, 2009; Jo et al., 2010; MacAdam, 2012; Nakayama & Fujita, 2010; US Environmental Protection Agency (EPA), 2016). Additionally, green infrastructure can include rainwater harvesting to supplement, or even eliminate, use of potable water in outdoor watering (Ben-Horin, 2007; MacAdam, 2012). Other

solutions include planning higher density developments, using renewable energy sources that do not require a lot of water in energy production, and the expansion of water reuse (Crewe, 2013; Guhathakurta & Gober, 2010; Nanninga et al., 2012; US Environmental Protection Agency (EPA), 2016). However, since the problem and solution is complex, it is recommended to use performance-based incentives rather than dictating a specific set of solutions (Guhathakurta & Gober, 2010).

Recommendations for Pilot Program

With the data acquired during the problem analysis stage, key contributing factors to the issue and potential solutions were identified and used to help develop an effective pilot program. One of those factors is that many current initiatives implemented by the city are met with a low constituent participation. Although it is not a definitive explanation, the lack of prior community involvement in city initiatives, mentioned in the social analysis, is a possible explanation for low participation. Further, the complexity of the interactions between water, energy, and urban heat island effects may make the problem seem difficult and overwhelming, creating barriers to change. Another possible barrier to participation in an incentive program are rewards that are misaligned with the real motivators of desired participants. However, the economic analysis demonstrated that a major incentive for participants is consistent savings.

This leads to the first recommended course of action when developing the pilot program. By creating an incentive program that will reward participants with recurring, monthly incentives, such as special utility rates, it will motivate participants to continue meeting water

conservation goals monthly in order to receive the rewards. In addition to consistent rewards, it is recommended to use incentives that give the City of Goodyear a competitive advantage for developers to want to come to Goodyear for their projects, combined with criteria that help developers become more successful in their projects. For example, if developers meeting certain criteria of the incentive program lead to developments with lower utility rates, it may create a positive feedback loop: as more homeowners and companies move to Goodyear for the lower utilities, more developers will want to come to Goodyear when they see others' success.

With a successful acquisition of both recommendations, this pilot program will be able to perpetuate and build upon itself, in terms of both current and future residents/developers, and with the least amount of city intervention. Another important aspect learned through the problem analysis stage, is to create a program that is both simple and easy to understand and will eliminate the risk of low participation due to program confusion. For this reason, the recommended structure of this program will be organized through a tiered approach based off simple ranking system. As a result of program structure, all participants will have the option of *choice* and *flexibility* which will emphasize individual or community action without the need of city enforcement or regulation.

Proposed Pilot Program

In order to help shift community attitudes towards conservation and align developer's actions with the city's goals, our team developed an incentive program consisting of 15 criteria to pull developers into adopting conservative attitudes when it comes to water use. This program

can be used for residential, commercial, or industrial developments, and can also be modified to target individual residents or businesses. It consists of three tiers (Platinum, Gold, and Silver) in which developers and residents can achieve certain incentives by following a number of set criteria for each tier (Table 1). These incentives come in the forms of tax breaks, special utility rates, city marketing endorsements (developers only), and impact fee incentives (developers only). The Platinum tier is the highest tier which receives all incentives if a resident or developer follows at least 12 of the 15 criteria given by the city. The Gold tier residents and developers receive all of the incentives except the tax breaks if they follow 10 of the 15 criteria, and the Silver tier only receive special utility rates and city marketing endorsements if 6 of the 15 are achieved.

Table 1: Pilot Incentive Program

Tier Rank	**Tier Name**	**Incentives**	**Number of Criteria to meet:**
1	Platinum	● Tax breaks ● Special Utility Rates ● City Marketing Endorsements ● Impact Fee Incentives	12
2	Gold	● Special Utility Rates ● City Marketing Endorsements ● Impact Fee Incentives	10
3	Silver	● Special Utility Rates ● City Marketing Endorsements	6

The criteria chosen were based on the technological and environmental analysis of possible solutions for water conservation. The possible criteria to choose from consist of the following:

1. Ratio of impermeable to permeable surface area
2. Quantity of mesic landscaping versus xeriscaping
3. Use of renewable energy with low water consumption
4. Meet certain LEED Development rating level
5. Use of Energy Star certified appliances and fixtures
6. Use of low flow fixtures
7. Use of leak detection technology
8. Use of "smart meters" for landscaping (watering based on soil moisture content or weather)
9. Indoor water recycling set up within facility
10. Use of rainwater to supplement landscape watering and/or having a set up for rainwater harvesting on the property(ies)
11. Use of green roofs or cool roofs
12. Amount of bioswales and bioretention
13. Meet certain density (higher density better for water use)
14. Percentage of properties with a pool
15. Use of tank-less or solar water heaters

By allowing developers and residents to choose which criteria they will meet, they are able to determine what is feasible for their development/property and business needs. Alternatively, if the City of Goodyear would like to provide more choice to developers and residents in how they meet the criteria for each level, the criteria could be based on a single

performance goal. For example, the criteria of each tier for developers could be to meet a certain level of water consumption per land area or less (e.g. Platinum must use 200 acre-feet of water per acre of land or less). If this method is pursued, it is still recommended to show developers the above list of 15 criteria as a list of recommendations, or ideas, to help them get started.

However, for either of these tactics, more research is needed to determine reasonable quantities and/or ratios for the criteria. Research needs to be performed to determine what levels push the boundaries or limits on current development and residential practices without being so out of reach that they become unachievable.

Proposed Monitoring Program

In order to determine the success of the pilot program, and to identify where improvements can be made, proper monitoring procedures are required. With the proper planning in place, data can be used to measure the level of success achieved via a comparison analysis. To determine the success of this program, it is proposed that Goodyear measure (1) the water consumption, energy consumption, and urban temperatures of each development, (2) number of developers electing to participate in the program, (3) cost and revenue of developments, (4) watershed runoff analysis, and (5) utility bills of properties in each development. These measurements can also be modified to apply to individual properties, if the incentive program is also modified to target individual residents and business, but will be discussed here in terms of developers.

First and foremost, since the goal is to reduce water consumption, and related concerns of energy and urban temperatures, measuring water consumption, energy consumption, and urban temperatures of each new development will greatly help assess the success of the program. Additionally, it would be helpful to measure each of these parameters in existing developments as well. This way, the performance of new developments can be compared to the performance of existing developments. Additionally, these parameters should be compared between new developments both participating in and not participating in the incentive program, and between developments at each of the different tiers of the program. This will help determine how much of an impact participation in the program has on reducing each of these parameters. These measurements will be the most direct assessment of program success.

Second, the number of developers choosing to participate in the program, compared to those electing not to participate, should be monitored because participation is such an important part of the success of this program. If participation is lower than intended, more investigation on how to increase participation should be pursued before fully implementing the program.

Third, assessing the costs and revenues of developers participating in and not participating in the program can help in several ways. This will help demonstrate how participation in the program affects financial success of developers. If the data shows that participation improves financial success, this can be used to advertise to other developers to convince more to participate. If it shows a financial burden, research can be performed to determine the cause and how to modify the program so as not to be a burden on developers financially.

Fourth, watershed analysis of the new development can help show how some of the green infrastructure initiatives may help in reducing the amount of runoff and drainage planning required. This, again, can be used for advertising to other developers how participation in the program benefits them, or demonstrate pitfalls of the program that need to be addressed.

Fifth, and finally, utility bills of each of the properties within a development can be monitored to see if the program helps reduce water and energy bills of businesses, residents, and industries. The goal should be to show a comparison of utility bills in a development not participating in the program and one that is participating in the program. Again, this can be used as an advertising tool to persuade businesses and homeowners to want to purchase property in Goodyear, which further incentivizes developers to want to develop in Goodyear. Alternatively, it can alert Goodyear to any concerns in the program that may need to be modified or address before a full-scale implementation. Finally, this data can also help new residents and business want to continue the water stewardship set out by the development, deterring them from making changes that increase water consumption after purchasing a property designed for conservation (such as adding lawns or pools).

Conclusion

The issue of development under limited water supply conditions is certainly a difficult challenge to overcome, with no one panacea. However, taking steps to detangle and address the problem will help set Goodyear on the path to water sustainability. Having the opportunity to tackle the challenge from the ground up, by incentivizing developers, is a unique and possibly

very impactful way to move towards a water sustainable future. Through the use of incentives, the goal is that developers both buy-in to the program buy choosing to participate, rather than reluctantly following an imperative. Further, by providing choice, developers can be creative in the solutions they pursue and can determine what levels of sustainability they can achieve given their financial or logistical constraints. The next steps are to perform more research to determine the exact criteria that developers should meet so as to have a real impact without being unattainable. Then, the pilot program can be implemented, with the monitoring program in place to determine effectiveness and where, if any, improvements can be made. However, it is recommended that this program be implemented as one part of a multi-pronged and diverse solution strategy in order to achieve a resilient and water sustainable city.

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Appendices

Appendix A: Solution Framework