INFRASTRUCTURE NEEDS AND FUNDING ALTERNATIVES FOR ARIZONA: 2008-2032

WATER, ENERGY, COMMUNICATIONS AND TRANSPORTATION

ARIZONA INVESTMENT COUNCIL

Executive Summary

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prepared by:

L. William Seidman Research Institute
W.P. Carey School of Business
Arizona State University

with the assistance of Elliott D. Pollack & Company

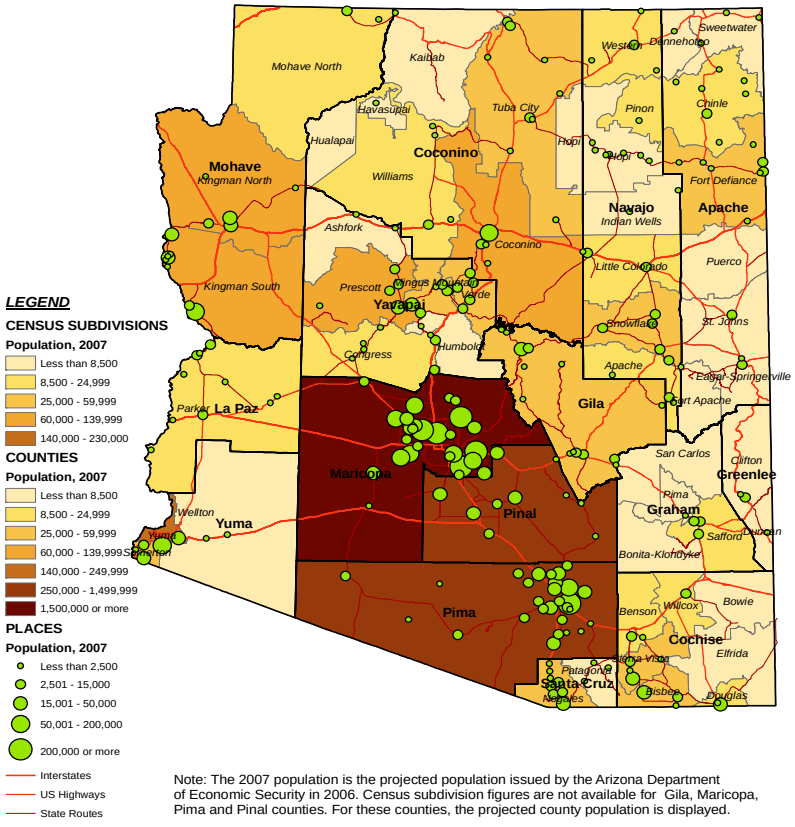
A Future of Growth in Arizona

Arizona has been among the Nation's leaders in population growth for decades. People continue to be attracted to the State for its climate, job opportunities, life style, and western spirit of independence. Between 1980 and 2007, the State's population rose by nearly 3.8 million (an increase of 137%).

Similarly, explosive population growth is in store for the State's next 25 years. Between 2008 and 2032, the projected change in population is even larger – at 4.2 million people (a 65% increase).

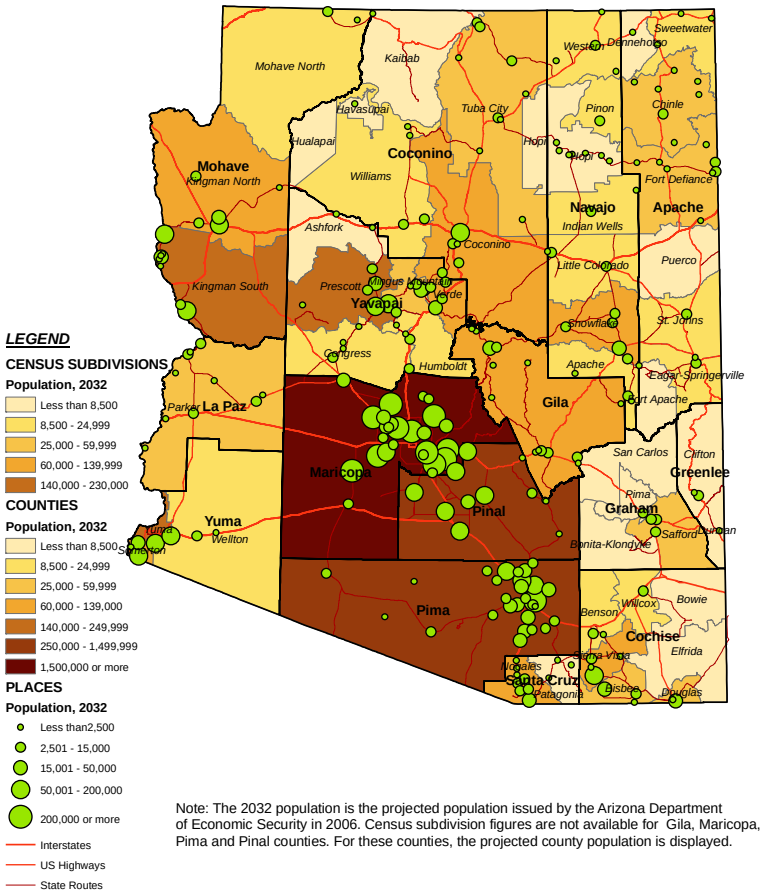
Neither the State's population growth nor its corresponding infrastructure needs will be evenly dispersed across the State. The map below highlights current population centers around the State, as of 2007. The map that follows highights expected growth patterns.

2007 Population of Census Subdivisions and Places in Arizona



Note: The 2007 population is the projected population issued by the Arizona Department of Economic Security in 2006. Census subdivision figures are not available for Gila, Maricopa, Pima and Pinal counties. For these counties, the projected county population is displayed.

2032 Population of Census Subdivisions and Places in Arizona



Note: The 2032 population is the projected population issued by the Arizona Department of Economic Security in 2006. Census subdivision figures are not available for Gila, Maricopa, Pima and Pinal counties. For these counties, the projected county population is displayed.

Population growth will continue to be concentrated in Central Arizona, in Maricopa, Pima, and, increasingly, Pinal counties. Maricopa County will see the largest numeric population increase with 2.5 million new residents (representing a 64% increase). While Pinal County's numeric increase is smaller, at 600,000, its percentage increase is the largest, at 207%. Pima County is forecast to gain 470,000 new residents (a 47% increase).

Growth's Opportunities

A growing population will allow the State to build its significance as an economic center in the Southwest. If Arizona takes the opportunity now to build cutting-edge telecommunication, energy, transportation, and water and wastewater infrastructure networks, the State will rival others in promoting economic growth and prosperity.

Growth gives Arizona the opportunity to:

- build cutting-edge telecommunications infrastructure that puts the State on par with world telecommunications leaders like Japan, Korea, and France;

- realize forward-thinking energy infrastructure that accounts for the new realities of the 21st century – like soaring oil and natural gas prices and an increasing desire to reduce our negative environmental impact;

- host growing populations well into the future by leading innovation on water conservation and supply augmentation solutions - as other states in the Southwest grow increasingly thirsty and competition over the region's limited water supplies intensifies;

- build an efficient and safe transportation infrastructure to carry the State's people and goods within, into, and out of the State.

Growth's Challenges

A growing population is forcing Arizonans to make tough decisions about planning for, and financing, needed infrastructure projects. The State's growth has already placed a heavy strain on existing public and private infrastructure. In the water and wastewater and transportation sectors, especially, significant investment is needed to replace and rehabilitate creaking infrastructure. Arizona's projected *future* growth will place even greater pressure on the State's infrastructure.

At this critical juncture, the State must decide if it is indeed willing to embrace the kind of growth forecast in this study. An unwillingness to confront the challenges posed by Arizona's forecast growth will not only limit the opportunity to become one of the region's leading economic centers, but may end up stifling growth itself.

Accommodating growth fully is going to be very, very costly. We estimate the cost of infrastructure in the transportation, telecommunications, water and wastewater and energy sectors ranges between $417 billion and $532 billion for the next 25 years.

ENERGY

Arizona faces important and difficult decisions about how to meet rapidly growing demands for energy.

Over the next 25 years, electricity demand from the growing population will increase by about 85 percent.

Demand for natural gas will nearly double over the forecast period, as will demand for petroleum products, requiring a 33 percent increase in product fuel delivery capacity and storage.

Overall, in the energy sector (including electricity, natural gas, petroleum and other fuels) the total capital investment in energy infrastructure required to serve Arizona's growing population to 2032 is between $74 billion and $86.5 billion depending upon the mix of generation technologies employed going forward.

Current funding for electricity in Arizona is insufficient. The total funding gap for the energy sector, without any change in the current funding regime, is likely to be around $109 Billion.

The time to act is now. With construction lead times of eight years or more, now is the time to plan for new facilities and to think of new ways to finance infrastructure in a capital intensive sector.

Business as Usual?

In the last 10 years alone, electricity demand has increased about 41 percent. The state managed through this period of rapid growth by building a large number of gas-fired plants—enough to quadruple gas-fired capacity in the state.

Yet there are a number of reasons to believe that business as usual – a relative reliance on natural gas-fired plants – may not be the best strategy for meeting the challenge of future growth. For one, natural gas has become much more expensive since the 1990s, when relatively low natural gas prices drove a surge in natural gas plant construction. Given expected fuel market conditions, gas-fired generation may no longer be the low-cost method of producing electricity.

Secondly, as environmental concerns escalate and a collective willingness to take action to reduce carbon emissions emerges, both natural gas and coal generation methods are likely to be discouraged (without major technological breakthroughs, at least).

If coal or nuclear generation methods are to be preferred to gas – for either financial, economic or environmental reasons – the decision must be made within the next few years if the plants are going to be ready to meet the needs of Arizonans a decade from now.

The Bottom Line

Overall, in the electricity and natural gas, petroleum and other fuels sectors, the total capital investment in energy infrastructure required to serve Arizona's growing population to 2032 is likely to be between $74 billion and $86.5 billion.

Energy Infrastructure Costs, 2008-2032

The cost of new energy infrastructure has been rising rapidly in recent years and is likely to continue to do so over the next few decades. Inflation in materials and construction activity has been pushing up relative costs in all capital-intensive industries, including energy. And electricity generation is likely to become even more capital intensive than it is now. Consider that:

- capital costs per MW are much higher for coal and nuclear than they are for gas;
- a new renewables mandate has recently taken effect, and the cost per MW of solar and wind generation is especially high.

Forecast Total Energy Infrastructure Costs, 2008-2032 (Millions)

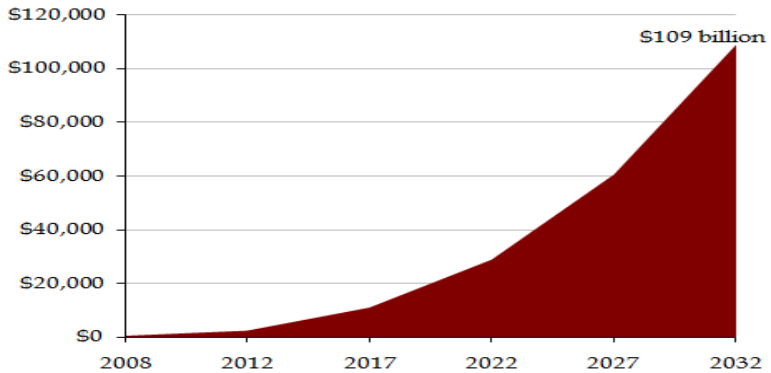
	Electricity	*Natural Gas, Petroleum, and Other Fuels*
Total Capital Costs	**$65,000-$77,400**	**$8,980-9,080**
Generation:		
Coal Scenario	$44,900	N/A
Gas Scenario	$36,100	N/A
Nuclear Scenario	$48,500	N/A
Refineries	N/A	$3,600
Transmission	$9,600	$2,780
Distribution	$19,300	$2,400
Storage	N/A	$200-300

Paying for Energy Infrastructure: Challenges Ahead

In the natural gas, petroleum, and other fuels sector, there is no immediately obvious funding gap for pipeline or storage provision. Demand will be met by the private sector, which has historically demonstrated an ability to quickly meet demand with supply. However, there is an obvious disconnect if power generators and gas distributors are not able to fully recover their costs sufficiently to enter into long-term supply contracts with pipeline operators.

In the electricity sector, the picture looks quite different. Assuming that the price of electricity is fixed at its 2006[1] level, there will be a cumulative funding gap over the entire forecast period of $109 billion.[2]

Cumulative Funding Gap in the Electricity Sector



[1] 2006 electricity rates (for all sectors) are the latest available from the EIA's profile of Arizona.
[2] The funding gap includes costs associated with operations and maintenance as well as fuel costs.

Any of the funding mechanisms currently used to generate infrastructure funds for energy projects in Arizona could be modified to bridge the gap between funding under current mechanisms and costs in the next 25 years. For example, usage fees, hook-up fees or transmission fees could be increased.

Arizona's ability to bridge the $109 billion funding gap may be more limited. Arizona is in the precarious position of having major utilities with poor bond ratings and, at the same time, a sluggish regulatory process that results in periodic (typically large) rate changes rather than smooth rate ones. When market investors doubt the ability of a utility to recover costs in a timely fashion, ratepayers must absorb higher interest costs for the utility's debt financing.

The optimal portfolio of infrastructure investment is one that makes sense financially and environmentally. To make smart choices, the power industry and its stakeholders must develop more innovative ways of ensuring that necessary infrastructure is adequately funded. These might include:

- changes in the determination of usage fees – for example, establishing a process that allows for more frequent but smaller rate increases to minimize the effects of regulatory lag and reduce the impact of rate shock on Arizona businesses and consumers;
- establishment of specific capital recovery mechanisms to facilitate more timely recovery of required distribution, transmission and generation investment – to the extent that generation is provided by the market (via independent power producers), such a mechanism should be geared toward ensuring that utilities are of sufficient financial health to enter into long-term purchase contracts;
- the creation of a transmission infrastructure authority – to provide power providers with access to low cost loans in order to finance the construction of transmission infrastructure and/or generation;
- any other method that smooths out the pattern of expected price increases, improves the timeliness and predictability of capital investment recovery, and balances the costs of growth with who pays for growth.

A New Era of Electricity Prices

Driven by declining fuel prices, falling long-term interest rates and one-time benefits of over investment in generation, electricity prices have fallen substantially since the early 1980s, on an inflation-adjusted basis.

But the era of declining electricity prices is over; retail prices will have to rise to allow producers to recover the higher cost of fuels and more expensive methods of generation that are necessary if the industry is to support environmental initiatives. Specifically, the price of electricity will have to rise at or above the rate of inflation over the next 25 years in order to compensate producers and distributors for the full costs of meeting Arizona's electricity demand.[3]

[3] It is important to note here that changes in usage fees for the majority of providers in Arizona are large determined by the Arizona Corporation Commission. Therefore, as changes in usage fees require regulatory approval this affects the efficiency of usage fees being able to adjust to eliminate any funding gap.

TELECOMMUNICATIONS

In Arizona and the United States generally the thirst for access to high-speed data, voice, and video services is rapidly increasing among residential and commercial users. The system is increasingly failing to keep pace with the demands put upon it by Arizona's connected users.

Yet a significant minority of the State's population does not even have access to basic broadband internet.

To provide broadband connectivity to the currently un-served population of Arizona would cost between $1-2.2 billion.

Creation of a state-of-the-art statewide fiber to the home (FTTH) network would costs an *additional* $23 billion that would give Arizonans the same speed of access as the citizens of countries such as Japan, France and Korea.

The Motivation for Improving Telecommunications

Access to a high quality telecommunication infrastructure is vitally important for the economy in Arizona and its residents' quality of life.

Businesses increasingly rely on access to telecommunications infrastructure – particularly, access to high-speed data lines - to complete their business activities. Examples abound: from the lettuce farmer in Yuma who supplies Subway to the trauma specialist available to offer remote help to physicians in smaller hospitals across the state.

Serving Arizona's Unserved Population

Access to broadband connections is already widespread in Arizona, particularly in urbanized areas.

However, approximately 3 percent of Arizonans lack access to necessary "middle mile"[4] broadband connectivity. These "middle mile"-constrained communities are home to approximately 200,000 Arizonans.

We estimate the extension of "middle mile" lines to un-served areas of Arizona so that residents and businesses in those areas have access to broadband services would $1-2.2 billion for the 25 year period to 2032.

Providing the 'Gold Standard'

The world is becoming increasingly connected and markets more competitive due to increasing access to high-quality telecommunications.

[4] Middle mile fiber connects communities to the long haul (cross-country) fiber.

Not having a state-of-the-art telecommunications infrastructure is detractor for businesses and residents when deciding if they should locate in Arizona.

Put another way, a "gold standard" telecommunications infrastructure (which most commentators observe to be fiber to the home) would *attract* new businesses and more highly-skilled jobs to the state.

We estimate the provision of fiber to the home (FTTH) – the "gold standard" level of service – to all households in Arizona would cost approximately an *additional* $23billion.

The Bottom Line

Costs to Connect Households, 2008-2032 (Millions)

	"Middle Mile" Connectivity[5]	Fiber-to-the-Home[6]
Capital Costs	$744-1,613	$9,087
Ongoing Costs	$258-548	$14,001
Total	**$1,002-2,161**	**$23,088**

Ensuring Access

The un-served areas of Arizona are those communities that are small in population with low population densities and/or are a significant distance away from any telecommunication infrastructure. Private sector providers have been reluctant to make substantial investments in remote areas where subscriber density is low and the cost of providing service is high.

The costs of investing in universal FTTH are also currently commercially prohibitive. We may well need the public and private sectors to act in concert to ensure our social and business well-being.

The State might well try one or a combination of the following to enhance the State's infrastructure:

- anchor tenancy – the State and local governments purchase all their bandwidth needs from a single concern and in return the company provides infrastructure to areas that otherwise would not receive service.
- public-sector provision of infrastructure - municipalities build, operate and maintain their own telecommunications infrastructure.
- creation of a telecommunication infrastructure bank - this provides municipalities and private companies access to low cost loans in order to finance telecommunication infrastructure.

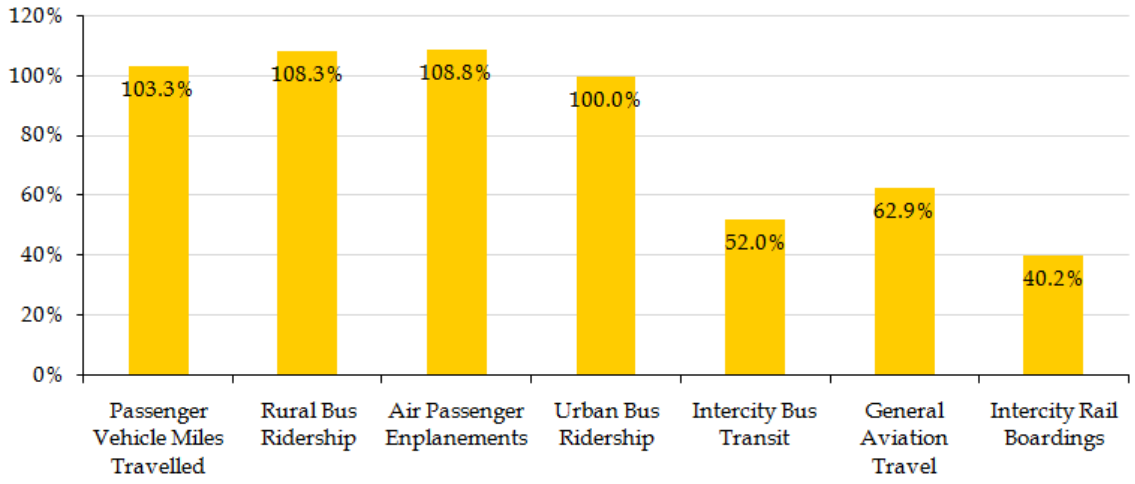
[5] Costs vary depending on whether the telecommunication line is deployed aerially (typically less expensive) or is buried (more expensive).
[6] These costs are in *addition* to the "middle mile" connectivity costs that must also be spent to provide FTTH.

- establishment of a *broadband* universal service fund - allows telecommunication providers access to a source of funds they can utilize when providing broadband services to above normal cost of provision communities.
- reduction of right-of-way (ROW) costs - streamlining or limiting ROW costs reduces the overall burden on telecommunications providers.
- alteration of building codes - require new buildings or re-models to be wired to provide fiber to the home.
- re-alignment of tax incentives - level the playing field for telecommunications so that it receives the same tax treatment as other sectors on its infrastructure investments
- offering grants to the private sector for areas that are not commercially viable without support.

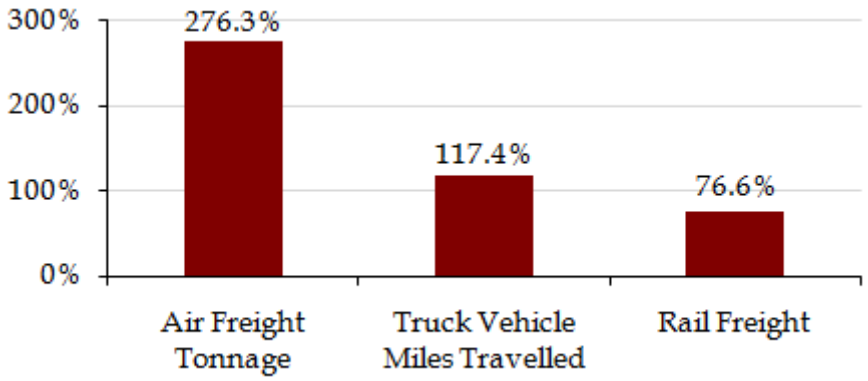
TRANSPORTATION

Transportation demand is set to increase dramatically over the next 25 years as Arizona's population grows. The following two figures illustrate.

Forecast Passenger Transportation Demand Increases, 2008-2032



Forecast Freight Transportation Demand Increases, 2008-2032



Passenger road usage is set to more than double. Truck freight tonnages will also more than double. Air freight tonnages will almost treble.

Meeting Arizona's Growing Transportation Demands

The State, as well as its counties and cities currently have (limited) plans to improve transportation infrastructure in the coming years. Yet even with these planned improvements in place, burgeoning demand will cause performance levels to *decrease* on the State's roads, railways, and in the airports.

Without significant infrastructure investment, the percent of road passenger travel at an acceptable level of service will fall from 77 percent statewide in 2002 to 38 percent in 2025. Average delay per trip statewide will increase nearly six-fold over the same period.

The Infrastructure Bill: What Enhancements Will Cost

The bill for improving Arizona's transportation network so that the roadways and highways, transit system, airways, and railways meet the rapidly growing demand for them is huge. The total capital bill over our 25-year study period is approximately $253-311 billion.[7] Roadways and highways make up the largest share of that bill – 79-83 percent – though paying for infrastructure improvements in the other sectors will be critical, too.

[7] Though it could well top $561 Billion if road construction inflation of 8.6% of the recent past continues over the 25 years.

Estimated Costs of Arizona's Needed Transportation Infrastructure Projects, 2008-2032

	25-Year Capital Costs (Billions)
Roadways and Highways	**$198.8[8]-$257[9]**
Transit	**$35.8**
Railways	**$5.9**
Airways	**$12.1**

The $253-311 billion cost estimates include costs to complete the transportation infrastructure improvements that are already in the works as well as those projects that will be necessary to maintain system performance at an acceptable level to 2032.

One factor that could potentially drive these costs even higher is the rising cost of construction. Over the last two decades, construction cost inflation has averaged 4 percent – well above consumer price inflation. In the last five years, though, construction costs have risen an average of *8.6 percent* each year.

Paying for Transportation Infrastructure

There is a huge gap between the money that current funding mechanisms can generate and this $253-311 billion infrastructure bill. The Arizona Department of Transportation estimates that within seven years Arizona will be in a "preservation only" mode,[10] meaning that incoming revenues will be sufficient only to support operations and maintenance costs; there will be no money available to fund new capital projects from current mechanisms.[11]

Assuming current funding mechanisms fund only operations and maintenance costs, then, the State is heading toward a funding chasm.

Some of the major current funding mechanisms include:

- the Highway User Revenue Fund (HURF) – which includes the State gasoline tax, and the Vehicle license tax (VLT) amongst other things;
- the Maricopa County Transportation Excise Tax- which includes the Regional Area Road Fund and the Public Transport: Public Transportation Fund (PTF);
- Federal funds from the Safe, Accountable, Flexible, Efficient Transportation Equity Act: a Legacy for Users (SAFETEA -LU) bill;
- the Highway Expansion and Extension Loan Program (HELP) – the "State Infrastructure Bank (SIB)"- allows agencies to begin construction of highways before funding is received;
- tax credits;
- the Airport Improvement Program (AIP)- which is administered by ADOT;
- the aviation Passenger Facility Charge (PFC)- a fee that is applied to every enplanement.

[8] Using 2.2 percent inflation.
[9] Using road construction inflation of 4% - its level of the last 15 years.
[10] For all regions that have not voted to collect additional transportation taxes.
[11] http://www.azdot.gov/Index_Docs/Headlines/index.asp

These are a mixture of usage fees, taxes, federal funding and indirect taxation that are used for transportation infrastructure and services. There may be some possibility for the extension and manipulation of these to squeeze out a little more money for enhancements but this is probably somewhat limited.

There are a number of alternative funding mechanisms that could be used to bridge the cost/funding gap, including:

- local options to levy fuel taxes - allow municipalities to set their own gas tax rates;
- additional regional sales taxes - increase the sales tax at the regional or State level;
- regional or State impact fees – when new developments are build impose an impact fee to support transportation projects;
- public private partnerships (P3s) - have the private sector build, maintain and operate transportation infrastructure;
- charges based on roadway use- these would include congestion pricing, mileage-based fees, and/or toll facilities.

Whichever funding method, or combination of funding methods, is chosen, the bottom line is clear: the costs for securing adequate transportation infrastructure to serve the Arizona's increasing passenger and freight transportation demands, which will clearly grow dramatically in the next 25 years, are unprecedented and certainly far greater than the costs Arizonans have become accustomed to.

WATER AND WASTEWATER

The era of "cheap water" in Arizona has passed: water delivery and wastewater services are going to have to become much more expensive.

Arizona needs to spend in excess of $109 billion over the next 25 years on its water and wastewater infrastructure. Current funding sources will fall some $30 billion short of what is necessary.

The requirement for and ability to fund infrastructure needs varies quite dramatically across the State. In Cochise, Coconino, Gila, and Yavapai counties the funding gap will be much larger comparatively, and the communities' ability to overcome that gap much more limited.

Challenges in the Water and Wastewater Sectors

Arizona is at a crossroads. The infrastructure built several decades ago – principally the SRP and CAP systems – will not meet the demands of a rapidly growing population. Significant new capital investments – in Central Arizona and in other parts of the state – are required to provide a sustainable water supply to future populations.

In addition, the water delivery and treatment systems built decades ago are now due for replacement – what the American Water Works Association calls the "dawn of the replacement

era" is upon us in Arizona.[12] Furthermore, easy supply augmentation options are no longer available.

As we look to water reclamation and even desalination to augment our existing water supplies, outlays for capital and O&M will increase. Climate change will also have unknown, though potentially adverse, effects on Arizona's water resources.

Planning for future populations is critical. In some cases effective planning involves securing new water supplies – which can be legally, institutionally, and financially very complex. In other cases it involves large-scale capital projects, which take time to finance and build.

Meeting Arizonans' Water and Wastewater Needs to 2032

The water and wastewater infrastructure built several decades ago in Arizona will not meet the demands of a rapidly growing population. Significant infrastructure investments will be required in the next 25 years to:

- rehabilitate and replace aging drinking water delivery and wastewater treatment systems;
- build new drinking water delivery and wastewater treatment systems to support future populations; and
- augment existing water supplies in counties with current or impending water supply/demand gaps to provide sustainable sources of water for future populations.

The total infrastructure bill, including capital outlays, operations and maintenance, and debt service costs, to meet the water and wastewater needs of current and future Arizonans over the next 25 years is just over $109 billion.

[12]American Water Works Association, *Dawn of the Replacement Era: Reinvesting in Drinking Water Infrastructure*, May 2001, <http://www.win-water.org/reports/infrastructure.pdf>.

Estimated Total Water and Wastewater Costs, 2008-2032 (Nominal Millions)

	Water	Wastewater
Total Capital Costs	**$30,716**	**$14,162**[13]
Drinking Water Infrastructure[14]	$29,121	
Coconino County Supply Augmentation[15]	$652	
Cochise County Supply Augmentation	$217	
Yavapai County Supply Augmentation	$197	
Gila County Supply Augmentation	$31	
Dam Renovation and Replacement	$336	
SRP Well Rehabilitation and Replacement	$161	
Total Ongoing Costs	**$42,088**	**$22,139**
Total: All Costs	**$72,804**	**$36,301**

The Bottom Line: Paying for Water and Wastewater Infrastructure

Examining current funding mechanisms through our 25-year study period, monies available to cover capital outlays, operations and maintenance, and debt service total $79.3 billion – approximately 73 percent of the total $109.1 billion infrastructure bill. That makes for a total 25-year funding gap of approximately $30 billion.

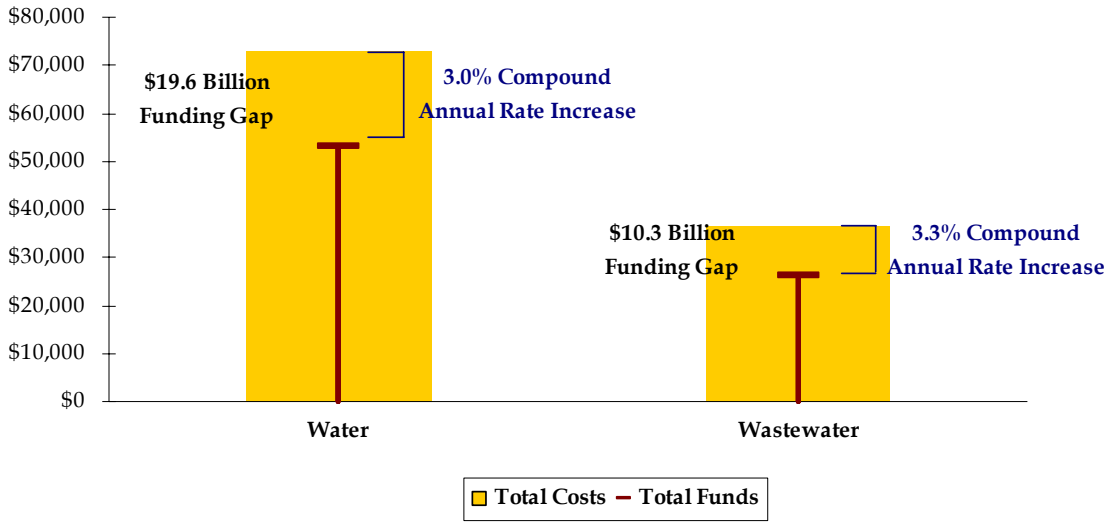
If user fees alone were used to close the funding gap, the required one-time price increase is about 55 percent in the water sector and 62 percent in the wastewater sector. These one-time increases translate to annual rate increases of 3.0 percent and 3.3 percent, respectively, across the entire 25-year period.

[13] Wastewater capital costs include the rehabilitation and replacement of wastewater and stormwater systems to serve existing populations as well as the construction of new systems to serve future populations.

[14] Drinking water infrastructure costs include the rehabilitation and replacement of drinking water systems to serve existing populations as well as the construction of new systems to serve future populations.

[15] Supply augmentation includes projects to provide sustainable sources of water for future populations.

Water and Wastewater Funding Gap and Required Rate Increase



In addition to increasing usage fees, other mechanisms for bridging the funding gap might include:

- increasing providers' ability to issue bonds – the advantage of financing capital projects via bonding is that it enables providers to distribute the costs of a capital project over the useful life of the project;
- increasing capital contributions – increasing development/impact fees or requiring developers to secure larger amounts of infrastructure to be handed over to the public sector.

Per Capita Infrastructure Costs and Geographic Disparities

We've estimated a funding gap across the entire state. Yet the requirement for and ability to fund infrastructure needs varies quite dramatically across the State. In the areas with impending supply augmentation needs (Cochise, Coconino, Gila, and Yavapai counties) funding gap will be much larger, and the communities' ability to overcome that gap more limited. The table below highlights the per-capita costs of the supply augmentation projects that will be necessary to support existing and future populations in the counties with supply/demand gaps in the next 25 years.

Per Capita Supply Augmentation Costs by County

	Total Supply Augmentation Capital Costs	Per Capita Costs
Coconino County	$652 million	$4,752
Cochise County	$217 million	$1,547
Yavapai County	$197 million	$817
Gila County	$31 million	$543

While infrastructure costs in Arizona's other counties are not as dramatic as in the four counties noted above, they are not insignificant. On average across the state, the total annual per capita bill for water and wastewater infrastructure (capital and ongoing costs) – not including the costs borne by residents of the four counties (noted above) – is about $465.

It's important to remember, too, that our analysis ends in 2032. The water supply surplus in Central Arizona (including Maricopa, Pima, and Pinal counties) shrinks dramatically between 2008 and 2032. Water managers will be tasked with securing additional water supplies for Central Arizona well before 2050. And there's no reason to believe that supply augmentation options for Central Arizona will be any less expensive than the options we've discussed for Coconino, Cochise, Yavapai, and Gila counties.