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

THE ECONOMIC IMPACT OF THE CENTRAL ARIZONA PROJECT TO THE STATE OF ARIZONA

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

October 22, 2019

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

The L. William Seidman Research Institute serves as a link between the local, national, and international business communities and the W. P. Carey School of Business at Arizona State University (ASU).

First established in 1985 to serve as a center for applied business research and a consultancy resource for the Arizona business community, Seidman collects, analyzes and disseminates information about local economies, benchmarks industry practices, and identifies emerging business research issues that affect productivity and competitiveness.

Using tools that support sophisticated statistical modeling and planning, supplemented by an extensive understanding of the local, state and national economies, Seidman today offers a host of economic research and consulting services, including economic impact analyses, economic forecasting, general survey research, attitudinal and qualitative studies, and strategic analyses of economic development opportunities.

Working on behalf of government agencies, regulatory bodies, public or privately-owned firms, academic institutions, and non-profit organizations, Seidman specializes in studies at the city, county or state-wide level. Recent and current clients include:

- Alliance of Arizona Nonprofits
- Arizona Commerce Authority (ACA)
- Arizona Corporation Commission (ACC)
- Arizona Community Foundation
- Arizona Dept. Mines and Mineral Resources
- Arizona Diamondbacks
- Arizona Investment Council (AIC)
- Arizona Public Service Corporation (APS)
- Arizona School Boards Association
- Arizona Technology Council
- BHP Billiton
- The Boeing Company
- Business for Water Stewardship
- The Cactus League Association
- The Central Arizona Project
- City of Phoenix
- City of Scottsdale
- Curis Resources (Arizona)
- EDF
- Epic Rides/The City of Prescott
- EPCOR
- Excelsior Mining
- Executive Budget Office - State of Arizona
- First Things First
- Freeport McMoRan
- Glendale Community College
- Greater Phoenix Economic Council
- Intel Corporation
- iState Inc.
- Navajo Nation Division Economic Development
- The NFL
- Phoenix Convention Center
- Phoenix Sky Harbor International Airport
- Plexus
- Public Service New Mexico (PNM)
- Raytheon
- Republic Services, Inc.
- Rosemont Copper
- Science Foundation Arizona (SFAZ)
- Salt River Project (SRP)
- Turf Paradise
- Valley METRO Light Rail
- Vote Solar Initiative
- Waste Management, Inc.

EXECUTIVE SUMMARY

- This study estimates the economic impact of the Central Arizona Project (CAP) to the State of Arizona in three aspects:
    - The construction of CAP, 1973-1993;
    - The impact of CAP's water supply delivery operations, 1986-2017; and
    - The impact of CAP's inhouse operations, 2011-2017.

- A modified IMPLAN input-output model for the State of Arizona is used to implement the analysis.[1]

- The economic impacts are assessed in terms of Gross Domestic Product (GDP) by State and employment.

CONSTRUCTION PHASE, 1973-1993

- The total annual field project costs by year of completion for the construction phase, as supplied by CAP, are:

Total Construction Costs by Year of Completion, 1973-1993

	TOTAL FIELD PROJECT COSTS (Millions Nominal $)
1973	$1.2
1976	$223.7
1977	$33.5
1978	$85.5
1979	$28.4
1980	$115.9
1981	$22.4
1982	$111.1
1983	$69.5
1984	$261.3
1985	$230.8
1986	$73.3
1987	$406.1
1988	$39.1
1989	$137.1
1990	$79.9
1991	$784.6
1992	$423.9
1993	$190.9

Source: CAP/R.W. Beck [2]

[1] Input-output models like IMPLAN are a little imprecise when dealing with large-scale changes to economic variables. That is, they provide ballpark rather than definitive estimates of economic impact for something like the Central Arizona Project.
[2] Data supplied as part of private correspondence with CAP representatives.

- If CAP was built today, it would cost $6.6 billion (2018 $).
- The estimated statewide economic impacts of the construction of CAP are summarized in the table below.

Statewide Economic Impacts for the Construction of CAP, 1973-1993

	TIME HORIZON	DIRECT IMPACTS	INDIRECT IMPACTS	INDUCED IMPACTS	TOTAL IMPACTS
GDP[3] (Millions 2018 $)	1973-1993	$1,080.91	$708.58	$776.71	$2,566.20
Employment[4] (Job Years)[5]	1985[6]	1,486	559	736	2,780
	1991[7]	5,030	1,892	2,490	9,412
	1993[8]	1,359	511	673	2,543

Source: Authors' Calculations

- The construction of CAP, 1973-1993, is cumulatively estimated to generate approximately $2.6 billion GDP (2018 $) in the State of Arizona.

- The statewide GDP contribution resulting from the construction of CAP is equivalent to 0.13% of Arizona's cumulative GDP, 1973 – 1993.

- CAP's construction is also estimated to generate annual employment impacts of up to 9,412 job years, dependent on the year in question.

- In 1973, the construction of CAP is estimated to generate 18 jobs in the State of Arizona.

- In 1985 - the first year that CAP delivered water to customers - the construction of the aqueduct system is estimated to generate 2,780 direct, indirect and induced jobs.

- In 1991, the construction of CAP is estimated to generate 9,412 direct, indirect and induced jobs.

- In 1993, the construction of CAP is estimated to generate 2,543 direct, indirect and induced jobs.

[3] Gross Domestic Product by State can be defined as the sum of employee compensation (wages, salaries and benefits, including employer contributions to health insurance and retirement pensions), proprietor income, property income, and indirect business taxes.
[4] Employment is a count of full- and part-time jobs. It includes both wage and salary workers, and the self-employed.
[5] A job year is equivalent to one person having a full-time job for exactly one year. This means, for example, that one person working on the construction of CAP, 1973-1993, accounted for 21 job years, but only represented 1 job. A cumulative total employment impact for the entire 21 year period is therefore not appropriate.
[6] These are the full-time (or equivalent) jobs associated with the construction of CAP only in 1985.
[7] These are the full-time (or equivalent) jobs associated with the construction of CAP only in 1991.
[8] These are the full-time (or equivalent) jobs associated with the construction of CAP only in 1993.

WATER SUPPLY DELIVERY OPERATIONS, 1986 - 2017

- The study also assesses the statewide economic impact of 19.9 million acre-feet of water delivered by CAP to municipal, industrial and agricultural customers in Phoenix, Pinal, and Tucson AMAs between 1986 and 2017.[9]

- Assuming that CAP's annual water deliveries would not have been sourced elsewhere, the second analysis estimates the economic impacts of CAP's water supply for 22 sectors.

- The statewide estimated economic impact of CAP's supply of water, 1986-2017, are summarized in the table below.

Statewide Economic Impacts of CAP's Supply of Water, 1986-2010

	TIME HORIZON	TOTAL IMPACTS
Gross Domestic Product by State[10] (Billions 2018 $)	1986-2017	**$2,048.5**
Employment[11] (Job Years)[12]	1993[13] 2017[14]	252,72 1,578,059

Source: Authors' Calculations

- CAP's supply of water, 1986-2017, is cumulatively estimated to account for more than $2.0 trillion GDP by State (2018 $).

- This GDP by State contribution accounts for approximately 28.2% of cumulative statewide GDP throughout the 32-year study period.

- The top five sectors estimated to decline the most in terms of contribution to GDP if CAP's water supply had been unavailable to customers during the 1986-2017 study period are: Government ($335.2 billion), Healthcare ($302.1 billion), Real Estate & Travel ($286.6 billion), Retail ($187.9 billion), and Construction ($187.0 billion).

- CAP's supply of water to municipal, industrial, and agricultural customers in the three AMAs in 1993 is estimated to account for annual employment of 252,772 jobs.

[9] An AMA is an Active Management Area. There are five AMAs in the State of Arizona, established by the 1980 Arizona Groundwater Code. However, two AMAs (Prescott and Santa Cruz) do not receive any water from CAP.
[10] Gross Domestic Product by State can be defined as the sum of employee compensation (wages, salaries and benefits, including employer contributions to health insurance and retirement pensions), proprietor income, property income, and indirect business taxes.
[11] Employment is a count of full- and part-time jobs. It includes both wage and salary workers, and the self-employed.
[12] A job year is equivalent to one person having a full-time job for exactly one year. This means, for example, that one person working on the construction of CAP, 1973-1993, accounted for 21 job years, but only represented 1 job. A cumulative total employment impact for the entire 21 year period is therefore not appropriate.
[13] These are the full-time (or equivalent) jobs associated with CAP's three AMA water supply only in 1993.
[14] These are the full-time (or equivalent) jobs associated with CAP's three AMA water supply only in 2017.

- CAP's supply of water to municipal, industrial, and agricultural customers in the three AMAs in 2000 is estimated to account for annual employment of 540,349 jobs.

- CAP's supply of water to municipal, industrial, and agricultural customers in the three AMAs in 2010 is estimated to account for annual employment of approximately 1.3 million jobs.

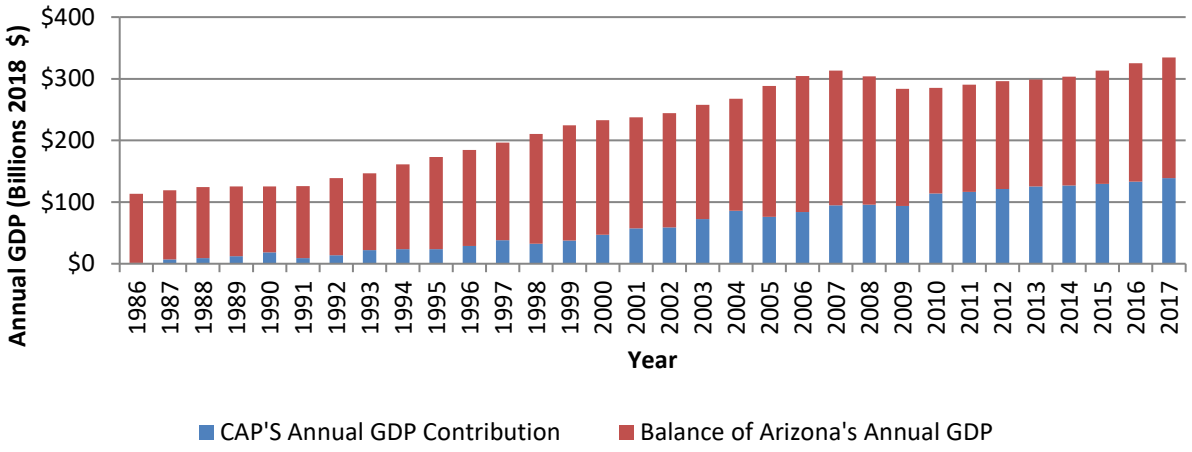
- CAP's supply of water to municipal, industrial, and agricultural customers in the three AMAs in 2017 is estimated to account for annual employment of approximately 1.6 million jobs.

- A cumulative employment impact for the 1986-2017 study period is not appropriate as the unit of measurement is job years.

- The Healthcare, Government, Retail, Construction, and Real Estate & Travel sectors benefited from approximately 60 percent of the job year impacts, all of which could have been lost if CAP's water supply had been unavailable to customers during the 1986-2017 study period.

- CAP's establishment and subsequent delivery of water to municipal, industrial, and agricultural customers in the three AMAs has therefore had a crucial impact on the economic development of the State of Arizona.

CAP's Contribution to Statewide GDP, 1986-2017



Source: Authors' Calculations

- Without the availability of water from CAP, Arizona's economic development would have followed a radically different trajectory.

- If CAP's leisure benefits are added to the water supply analysis, the statewide economic impacts would be even greater.

INHOUSE OPERATIONS, 2011 - 2017

- Between 2011 and 2017, annual inhouse employment at CAP ranges from 461 to 484 people, dependent on the year in question.

- The total annual employment contribution of CAP's operations is estimated to range from 786 jobs in 2014,[15] to 1,778 jobs in 2017.[16]

- The cumulative GDP contribution of CAP's inhouse operations for the same seven-year time horizon is estimated at $829.4 million (2018 $).

- The inclusion of CAP's inhouse staff and supplier purchases since the agency's inception would also increase the estimated economic value of CAP's water delivery in the State of Arizona.

[15] These are the direct, indirect and induced jobs associated with CAP's inhouse operations and supplier purchases only in 2014.
[16] These are the direct, indirect and induced jobs associated with CAP's inhouse operations and supplier purchases only in 2017.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The Central Arizona Project (CAP) supplies approximately 1.5 million acre-feet of Colorado River water per year to businesses and residents in Pima, Pinal and Maricopa counties. A 336-mile aqueduct with 14 pumping plants, 1 hydroelectric pump, 8 inverted siphons, 39 radial gate structures, over 50 turnouts, and 3 tunnels, the entire system is operated 24/7 from a control center in north Phoenix. As the largest single resource of renewable water supplies in the State of Arizona, CAP carries water from Lake Havasu to the southern boundary of the San Xavier Indian Reservation.

Approved by Congress in 1968, construction began at Lake Havasu in 1973, and was declared "…substantially complete" 20 years later southwest of Tucson. The largest and most expensive aqueduct system ever constructed in the United States, CAP cost over $3.3 billion to build (nominal $), and is currently managed and operated by the Central Arizona Water Conservation District (CAWCD).

In summer 2013, CAWCD commissioned the Seidman Research Institute to estimate the economic impact of CAP for the State of Arizona. The primary objective of this request was to quantify the direct, indirect and induced effects of CAP's construction, and to also estimate the economic impact of CAP's water deliveries to the economic development of the State of Arizona. Seidman estimated that the construction of CAP, 1973-1993, cumulatively generated approximately $2.4 billion GDP (2013 $). That is, the cumulative GDP by State contribution resulting from the construction of CAP was equivalent to 0.13% of Arizona's cumulative GDP, 1973 – 1993. Seidman also estimated that CAP's supply of water, 1986-2010, generated $1,090 billion GDP by State (2013 $). That is, the cumulative GDP by State contribution resulting from CAP's water deliveries accounted for approximately 23.3% of cumulative statewide GDP, 1986-2010.

The purpose of the current study is to update the key findings up to and including 2017.

Section 2 offers a brief history of CAP. Section 3 describes water availability in Arizona, and Section 4 outlines CAP's current customer base and operations. The direct, indirect and induced economic impacts of the construction of CAP are quantified in Section 5, followed by an estimate of statewide economic losses likely if CAP had not been built to supply water to Phoenix, Pinal, and Tucson AMAs in Section 6. An estimate of the impact of CAP's inhouse operations, 2011-2017, is offered in Section 7. Conclusions and recommendations are provided in Section 8.

2. BRIEF HISTORY AND BUILD-OUT

Authorized by Congress and signed by President Johnson as part of the September 1968 Colorado River Basin Project Act, the Bureau of Land Reclamation began the construction of CAP at Lake Havasu on May 6, 1973. The first CAP water was delivered through the early segments of the aqueduct to the Harquahala Valley Irrigation District in 1985, with CAP water reaching the Phoenix Metropolitan Area by November of that year. Tucson customers received their first CAP water in 1992; and in 1993, Reclamation declared the CAP water supply system "…substantially complete", although several ancillary Indian distribution systems took another 10 to 20 years to construct. Figure 1 presents a historical chronology of events.

The largest and most expensive aqueduct system ever constructed in the United States, CAP cost over $3.3 billion to build (nominal $). Currently managed and operated by CAWCD, this latter organization was first established in 1971 in Maricopa, Pinal and Pima Counties to repay the state's share of the construction costs.

Since 1993, CAP has also developed and operated seven recharge facilities, one of which (Avra Valley) was sold to Metro Water in 2010.[17] Two of the recharge facilities are in the Tucson Active Management Area (AMA) and have a cumulative recharge capacity of 80,000 acre-feet per year. The other four recharge facilities are in Phoenix AMA and have a combined annual permitted capacity of 310,000 acre-feet per year.

[17] Recharge is a long-established and effective water management tool that allows renewable surface water supplies to be stored underground now for recovery later during periods of reduced water supply.

Figure 1: CAP - A Historical Timeline, 1967-2017

1967:	*U.S. Senate introduces bill S.1004 to authorize CAP*
1968:	*President Johnson signs S.1004, thereby authorizing the creation of CAP*
1970:	*Construction begins on NGS, which will supply 24.3% of CAP's electricity*
1971:	*Formation of CAWCD*
1972:	*CAWCD agrees $1.2 billion master repayment limit for CAP*
1973:	*CAP construction begins at Lake Havasu*
1974:	*NGS opens and concrete laid at Granite Reef Aqueduct Reach 11*
1977:	*Municipal and industrial allocations finalized*
1980:	*Indian allocations finalized*
1981:	*Control system specifications completed*
1984:	*Construction of Tucson Aqueduct begins*
1985:	*Granite-Reef Aqueduct completed, and first delivery to Harquahala Valley Irrigation District*
1987:	*Construction starts on New Waddell Dam; Santa Rosa Canal receives first delivery*
1988:	*CAWCD signs an amended $1.78 billion repayment contract*
1989:	*Revegetation of Avra Valley*
1992:	*Tucson receives first CAP delivery; work completed on New Waddell Dam*
1993:	*CAP's water delivery system is completed and CAGRD established*
1994:	*CAP produces hydroelectric power, and a record 785,000 acre-feet of water*
1996:	*CAP delivers 1 million acre-feet (MAF) of water*
1997:	*Avra Valley recharge facility completed*
1998:	*Pima Mina Road recharge facility completed*
2000:	*$1.65 Billion repayment refixed; CAP delivers 1.5 MAF water; Lower Santa Cruz recharge facility completed*
2001:	*Agua Fria recharge facility completed*
2002:	*Hieroglyphic Mountains recharge facility completed*
2003:	*New CAP maintenance excellence program launched*
2006:	*Tonopah recharge facility completed*
2007:	*New shortage sharing rules for Lakes Powell and Mead*
2011:	*Superstition Mountain recharge facility completed*
2017:	*Liberty Aquifer Replenishment Facility (AZ's first public-private reclaimed water recharge facility) opens in Goodyear*

3. WATER AVAILABILITY IN ARIZONA

Four categories of water supply are available in the State of Arizona. These are surface water, Colorado River water, groundwater, and effluent.

Surface water comes from lakes, rivers, and streams, stored in reservoirs or delivery systems. The availability of surface water can vary dramatically by year or location.

The State of Arizona has the right to use 2.8 million acre feet of water from the Colorado River each year, over half of which is delivered by CAP to Maricopa, Pinal, and Pima Counties. Mohave, La Paz, and Yuma Counties also rely on the Colorado River as their principal water supply.[18]

Groundwater is found beneath the earth's surface in natural reservoirs called aquifers. The Arizona Department of Water Resources estimates that up to 43% of the state's water comes from groundwater sources; and this category of supply is carefully managed by an Arizona Groundwater Management Code first launched in 1980.

Effluent is reclaimed water, used by agriculture, on golf courses, in parks, for industrial cooling, and to maintain wildlife areas.

Figure 2: Arizona's Water Supplies, 2018

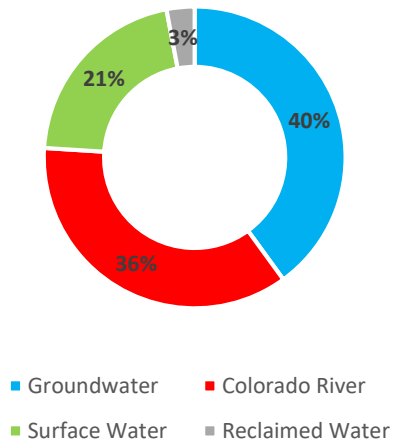


Figure 2 shows the distribution of Arizona's water supply by type in 2018. Approximately 40% of the state's water supply is groundwater. The Colorado River supplies 36% and surface water (or in-state rivers) 21%. Reclaimed water (or effluent) accounts for 3% of the state's total water supply.

Source: ADWR, (2018)[19]

[18] Source: Arizona Department of Water Resources, (date unknown). *Securing Arizona's Water Future*, available at: http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/supplydemand.pdf

[19] Source: Arizona Department of Water Resources, (2018). Arizona Water Facts, available at: arizonawaterfacts.com/water-your-facts

4. CAP'S CUSTOMER BASE AND OPERATIONS

Table 1 illustrates the volume of water delivered each year by CAP, up to and including 2017. The table shows how from an initial lowly base of 11,783 acre-feet in 1985, CAP's water deliveries quickly grew to over one million acre-feet of water in 1996 and hit a record 1.7 million acre-feet in 2007. In 2018, CAP delivered approximately 1.5 million acre-feet of water.

The total annual acre feet data displayed in Table 1 excludes Maricopa Water District Lake Exchange and Nevada II(b)(6) deliveries. Both CAP and Maricopa Water District hold storage rights in Lake Pleasant – Maricopa Water District for Agua Fria water and CAP for Colorado River water. The first exclusion refers to CAP indirectly delivering to Maricopa Water District via an exchange of water in their respective accounts. This occurs every year, 2001-2017, and ranges from 9,261 acre-feet in 2003 to 41,329 acre-feet in 2011. The Nevada II(b)(6) excluded delivery only occurs in 2018. The Arizona Water Banking Authority has also recharged 600,000 acre-feet on behalf of the Southern Nevada Water Authority for future usage. Most of the water stored for Nevada is sourced from Arizona's annual entitlement, but a small portion originates from Nevada's 300,000 acre-feet Colorado River entitlement. Nevada II(b)(6) refers to the legal mechanism under which that interstate transaction is permissible.

CAP's customers include 52 long-term municipal and industrial contractors, 12 Arizona Indian Tribes, and 20 excess water contractors including the Agricultural Settlement Pool.[20] Figure 3 illustrates the principal recipients by type of CAP's water delivery in select years, up to and including 2017, excluding Maricopa Water District Lake Exchange and Nevada II(b)(6).

CAP also provides flood control, power, recreation, and fish and wildlife benefits. Daily operations are managed by approximately 475 employees in areas such as operations and maintenance, repayment obligations, public education and policy, and water resource management.

As the biggest user of electricity in the state, CAP requires around 2.8 billion kWh of electricity each year to pump water essentially uphill for 336 miles between Lake Havasu and the end of the CAP system south of Tucson. CAP self-generates some of this electricity at Lake Pleasant. Historically, almost a quarter of Navajo Generating Station's (NGS) generating capacity has also been dedicated to the operation of the aqueduct system each year. With NGS due to close at the end of 2019, CAP has signed power purchase agreements with SRP (35 MW from any source) and

[20] Source: McCann, Thomas W., (2013). *Central Arizona Project – A Brief History*, unpublished PowerPoint, available at: http://www.cpwac.org/presentationfiles/SPR_CAP_history_4_26_2013.pdf

a solar company (30 MW from solar). It also has a hydropower contract with Hoover Dam, and will additionally purchase blocks of energy on the open market.[21]

Table 1: CAP's Annual Volume of Water Delivered, 1985-2018

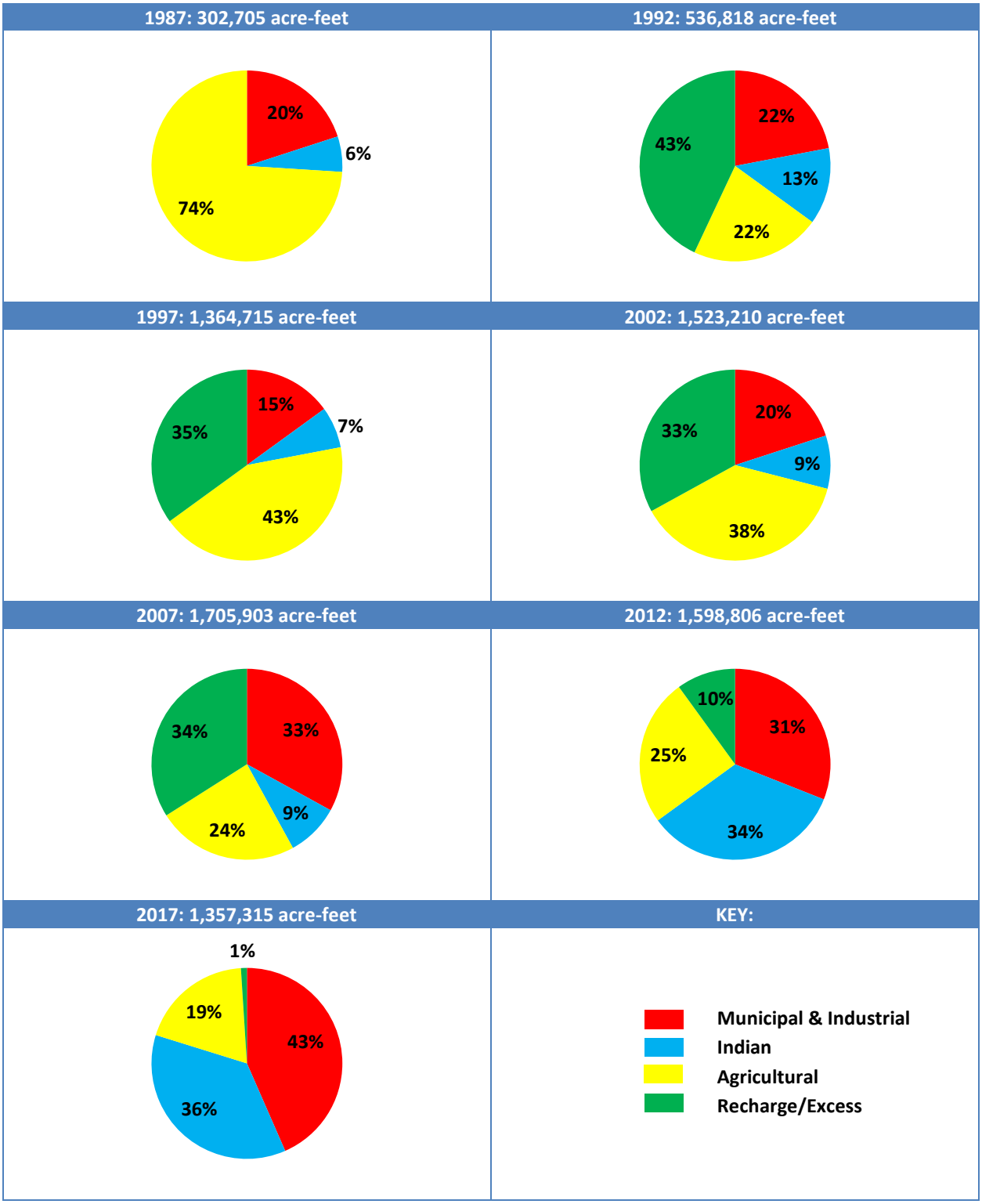
	VOLUME OF WATER (Acre-Feet)
1985	11,783
1986	92,123
1987	302,705
1988	468,392
1989	715,365
1990	744,506
1991	420,980
1992	536,818
1993	669,686
1994	808,037
1995	952,903
1996	1,115,839
1997	1,364,715
1998	1,026,832
1999	1,252,870
2000	1,540,312
2001	1,321,305
2002	1,523,210
2003	1,553,491
2004	1,597,631
2005	1,276,924
2006	1,492,692
2007	1,705,903
2008	1,549,023
2009	1,610,233
2010	1,599,057
2011	1,619,713
2012	1,598,806
2013	1,520,004
2014	1,525,960
2015	1,449,209
2016	1,430,910
2017	1,357,315
2018	1,465,730

Source: CAP [22]

[21] Source: CAP, (2019). *Packaging a New Power Portfolio*, June 12, 2019, available at: http://cap-az.com/public/blog/1024-packaging-a-new-power-portfolio

[22] Data supplied as part of private correspondence with CAP representatives.

Figure 3: CAP's Water Delivery by Customer Type, 1987-2017



Source: CAP [23]

[23] Data supplied as part of private correspondence with CAP representatives.

5. STATEWIDE ECONOMIC IMPACTS RESULTING FROM THE CONSTRUCTION OF CAP, 1973-1993[24]

5.1 Method

Economic impact analysis traces the full impact - direct, indirect and induced - of an economic activity on jobs and incomes in a defined economy. The construction of CAP has directly affected the State of Arizona's economy through the direct jobs provided to construction workers. Indirect effects have arisen through the purchase of construction materials from suppliers to support the build-out. Induced effects have occurred when workers either directly or indirectly associated with the construction of CAP spent their incomes in the local economy, when suppliers placed upstream demands on other producers, and when governments spent new tax revenues. The cumulative changes in jobs and incomes associated with the construction of CAP are a multiple of the initial direct effects.

To estimate the economic impacts of the construction of CAP, the Seidman Research Institute has used a modified version of an IMPLAN input-output model for the State of Arizona.

Originally developed by the University of Minnesota, IMPLAN is widely used for economic assessment and can provide detailed estimates of secondary expenditures and income generated as a result of a business investment or operation for a finite period of time (typically one full calendar year). The research team has calculated impacts for each year of CAP's construction, and summed the results to arrive at cumulative multi-year (1973-1993) estimate of impacts.

Two variables are used to quantify the economic impacts of CAP's construction phase in Seidman's analysis. These are:

- ***Gross Domestic Product (GDP) by State***: this is synonymous with value added. It represents the dollar value of all goods and services produced for final demand in the state. It excludes the value of intermediate goods and services purchased as inputs to final production. It can also be defined as the sum of employee compensation (wages, salaries and benefits, including employer contributions to health insurance and retirement pensions), proprietor income, property income, and indirect business taxes.
- ***Employment***: this is a count of full- and part-time jobs. It includes both wage and salary workers, and the self-employed.

[24] Section 5 in the current report differs from the 2014 report in one aspect. That is, all monetary amounts (unless otherwise stated) are expressed in 2018 dollars rather than 2013 dollars.

Table 2 summarizes the inputs used by Seidman to estimate the annual and cumulative statewide economic impacts of the construction of CAP, 1973 to 1993.[25] The table displays R. W. Beck's estimated total field project costs by the year of completion, supplied by CAP's management team. The annual field project costs are displayed in nominal dollars; and Seidman's analysis assumes that each annual cost is spent in full in the year identified in Table 2.

The total field project costs for the construction of CAP, 1973-1993, used by Seidman in the economic impact analysis are therefore just over $3.3 billion (nominal $). If CAP was built today, it would cost $6.6 billion (2018 $).

Table 2: Total Construction Costs by Year of Completion, 1973-1993[26]

	TOTAL FIELD PROJECT COSTS (Millions Nominal $)
1973	$1.2
1976	$223.7
1977	$33.5
1978	$85.5
1979	$28.4
1980	$115.9
1981	$22.4
1982	$111.1
1983	$69.5
1984	$261.3
1985	$230.8
1986	$73.3
1987	$406.1
1988	$39.1
1989	$137.1
1990	$79.9
1991	$784.6
1992	$423.9
1993	$190.9

Source: CAP/R.W. Beck [27]

5.2 Annual and Cumulative Economic Impacts, 1973-1993

The estimated Gross Domestic Product (GDP) impacts associated with the construction phase are summarized in Table 3. All GDP impacts are expressed in millions 2018 $.

Table 3 illustrates that in the first year of construction (1973), CAP is estimated to contribute more than $1.1 million (2018 $) GDP to the State of Arizona economy.

[25] CAP was declared "…substantially complete" in 1993. Seidman's analysis therefore assumes that all project costs after this date are primarily for operations and maintenance, and therefore excluded from the construction impacts analysis.
[26] Numbers may not tally exactly due to rounding-up.
[27] Data supplied as part of private correspondence with CAP representatives.

In 1985 - the first year that CAP delivered water to customers - an estimated $174.4 million (2018 $) is added to the state's GDP.

In 1993 - the year in which CAP was declared "…substantially complete" - an estimated $159.5 million (2018 $) is added to the state's GDP.

For the entire construction phase, an estimated cumulative total of almost $2.6 billion GDP (2018 $) is added to the State of Arizona economy. This represents 0.13% of the state's GDP throughout the construction of CAP. An estimated 42.1% of the $2.6 billion GDP is from direct impacts, 27.6% from indirect impacts, and 30.3% from induced impacts.

The estimated employment impacts associated with the construction phase are summarized in Table 4. The data is expressed in job years. The label "job year" is important and should not be simplified or abbreviated to "job". A "job year" is defined as one person having a full-time job for exactly one year. This means, for example, that one person working on the construction of CAP from 1973 to 1993 accounts for 21 job years, but only represents 1 job. A cumulative total employment impact for the entire 21 year period is therefore not appropriate.

Table 4 illustrates that in 1973 - the first year of construction – CAP is estimated to generate a total of 18 jobs in the State of Arizona.

In 1985 - the first year that CAP delivered water to customers - the construction of the aqueduct system is estimated to generate 2,780 direct, indirect and induced jobs in the State of Arizona.

In 1993 - the year in which CAP was declared "…substantially complete" - the construction of the aqueduct system is estimated to generate 2,543 direct, indirect and induced jobs in the State of Arizona.

Table 3: The Construction of CAP - Statewide GDP Impacts, 1973-1993[28]

	DIRECT GDP IMPACTS (Millions 2018 $)	INDIRECT GDP IMPACTS (Millions 2018 $)	INDUCED GDP IMPACTS (Millions 2018 $)	TOTAL ANNUAL GDP IMPACTS (Millions 2018 $)
1973	$0.48	$0.31	$0.34	$1.13
1974	$0.00	$0.00	$0.00	$0.00
1975	$0.00	$0.00	$0.00	$0.00
1976	$71.35	$46.77	$51.26	$169.38
1977	$10.94	$7.17	$7.86	$25.97
1978	$28.96	$18.99	$20.81	$68.77
1979	$9.71	$6.36	$6.98	$23.05
1980	$37.22	$24.41	$26.75	$88.38
1981	$6.71	$4.39	$4.82	$15.92
1982	$30.81	$20.19	$22.14	$73.13
1983	$19.83	$13.00	$14.25	$47.07
1984	$80.59	$52.84	$57.91	$191.35
1985	$73.44	$48.15	$52.77	$174.37
1986	$24.70	$16.19	$17.74	$58.63
1987	$139.85	$91.67	$100.50	$332.03
1988	$13.59	$8.91	$9.77	$32.26
1989	$46.17	$30.26	$33.18	$109.62
1990	$26.03	$17.07	$18.71	$61.80
1991	$248.63	$162.98	$178.66	$590.27
1992	$144.73	$94.88	$104.00	$343.60
1993	$67.17	$44.04	$48.27	$159.47
CUMULATIVE IMPACTS, 1973-1993 (Millions 2018 $)	**$1,080.91**	**$708.58**	**$776.71**	**$2,566.20**

Source: Authors' Calculations

[28] Numbers may not tally exactly due to rounding-up.

Table 4: The Construction of CAP - Statewide Employment Impacts, 1973-1993[29]

	DIRECT EMPLOYMENT (Job Years)	INDIRECT EMPLOYMENT (Job Years)	INDUCED EMPLOYMENT (Job Years)	TOTAL ANNUAL EMPLOYMENT (Job Years)[30]
1973	10	4	5	18
1974	0	0	0	0
1975	0	0	0	0
1976	1,443	543	715	2,701
1977	221	83	110	414
1978	586	220	290	1,097
1979	196	74	97	368
1980	753	283	373	1,409
1981	136	51	67	254
1982	623	234	308	1,166
1983	401	151	199	751
1984	1,630	613	807	3,051
1985	1,486	559	736	2,780
1986	500	188	247	935
1987	2,829	1,064	1,401	5,294
1988	275	103	136	514
1989	934	351	462	1,748
1990	527	198	261	985
1991	5,030	1,892	2,490	9,412
1992	2,928	1,102	1,449	5,479
1993	1,359	511	673	2,543

Source: Authors' Calculations

[29] Numbers may not tally exactly due to rounding-up.
[30] A "job year" is defined as one person having a full-time job for exactly one year.

6. STATEWIDE ECONOMIC IMPACT OF CAP'S WATER SUPPLIES, 1986-2017

The previous section estimates the direct, indirect and induced impacts associated with the construction of CAP in terms of GDP and employment. However, CAP's significance for the State of Arizona economy extends far beyond these construction phase impacts. Water availability is a critical component in the economic development of a state. In the absence of CAP to deliver a significant proportion of total water supply to Phoenix, Pinal and Tucson AMAs since 1985, the State of Arizona's economic development would almost certainly have followed a different trajectory.

The purpose of this section is to estimate the extent to which the State of Arizona economy would have been smaller, 1986-2017, without the annual availability and supply of water from CAP. This is an update of the 2014 report. Consistent with the prior report, the analysis assumes the non-substitutability of CAP's annual water deliveries in the State.[31] However, fundamental changes in the IMPLAN model, an enhanced method focused on the three AMAs, and the reporting of results in 2018 dollars all have significant impacts on the estimates of the GDP and employment losses.[32]

6.1 Method

A series of customized input-output models for the three central AMAs (Phoenix, Pinal, and Tucson) have been used to estimate annual and cumulative statewide economic impact of CAP's annual water deliveries, 1986-2017.[33]

Seidman's method for estimating these economic impacts consists of five fundamental steps:

1. **Prepare a baseline forecast for a three-AMA economy:** This Business As Usual (BAU) case consists of a historical input-output table for each year, in which the intermediate demand and final demand of a 22 sector version of the local economy is described, and a distinction made between the use of water as a primary input to the production process of each industry or sector, and other water supplies that are directly consumed.
2. **Develop a policy scenario:** This policy scenario reduces the annual availability of water in the three central AMAs by the historical amount of water supplied by CAP for the 22 sectors in the input-output tables.
3. **Compare the baseline and policy scenario forecasts.**

[31] The ADWR suggested that without CAP, the state would have been forced to draw more heavily from groundwater supplies, thereby undermining the availability of water for future generations living and working in Arizona.
[32] Changes to the IMPLAN model are explained in an Appendix to this report.
[33] Phoenix, Pinal, and Tucson AMAs are the primary recipients of CAP water. Prescott and Santa Cruz AMAs do not receive any CAP water.

4. **Produce the "delta" results**: Differences between the values for each sector estimate the potential economic impact of the non-availability of water supplied by CAP on the local economy, relative to the baseline, for each year of study.
5. **Run an IMPLAN analysis on each series of delta results**: This produces annual and cumulative estimates of the importance of CAP's water deliveries for GDP and employment.

Table 5 estimates the annual extent to which municipal, industrial, and agricultural water availability in the three central AMAs (Phoenix, Pinal, and Tucson) would have declined if CAP had not been established, based on AMA data supplied by the ADWR, and an assumption that other sources of water are not available to compensate for the loss of CAP's water deliveries.

The table estimates, for example, that the non-availability of CAP water in 1986 would have resulted in a 1.6% total decline in water availability for municipal users in the three AMAs, and a 0.4% decline in water availability for agricultural users.

In 1993, the table estimates that the non-availability of CAP water would have resulted in a 17.6% decline in water availability for municipal users in the three AMAs, a 0.5% decline in water availability for industrial users in the three AMAs, and a 5.0% decline in water availability for agricultural users.

In 2010, the table estimates that the non-availability of CAP water would have resulted in a 38.5% decline in water availability for municipal users in the three AMAs, a 0.6% decline in water availability for industrial users in the three AMAs, and a 21.0% decline in water availability for agricultural users.

In 2017, the table estimates that the non-availability of CAP water would have resulted in a 40.8% decline in water availability for municipal users in the three AMAs, a 0.8% decline in water availability for industrial users in the three AMAs, and a 16.1% decline in water availability for agricultural users.

Table 5: Percent Decline in Water Availability in the Central AMAs by Customer Type in the Absence of CAP, 1986-2017

	TOTAL ESTIMATED SHORTFALL IN PHOENIX, PINAL & TUCSON AMAS		
	Municipal	Industrial	Agricultural
1986	1.6%	0.0%	0.4%
1987	7.1%	0.5%	4.8%
1988	8.7%	0.5%	11.4%
1989	11.7%	0.6%	16.9%
1990	17.6%	0.5%	19.9%
1991	8.5%	0.5%	13.1%
1992	11.8%	0.4%	7.2%
1993	17.6%	0.5%	5.0%
1994	17.2%	0.5%	21.0%
1995	16.3%	0.4%	18.7%
1996	16.4%	0.8%	19.1%
1997	18.9%	1.1%	18.6%
1998	17.0%	1.0%	18.3%
1999	17.2%	1.0%	19.1%
2000	22.6%	1.3%	20.5%
2001	25.6%	1.6%	18.9%
2002	26.8%	1.0%	22.6%
2003	31.0%	1.1%	26.5%
2004	34.8%	3.5%	24.2%
2005	31.4%	1.2%	20.0%
2006	30.9%	1.4%	19.9%
2007	35.3%	1.5%	18.8%
2008	36.8%	1.6%	20.0%
2009	37.7%	1.0%	21.3%
2010	38.5%	0.6%	21.0%
2011	38.8%	0.9%	20.4%
2012	37.8%	3.9%	22.3%
2013	39.0%	4.5%	23.0%
2014	39.2%	4.0%	22.4%
2015	39.2%	2.8%	19.5%
2016	38.2%	3.3%	19.4%
2017	40.8%	0.8%	16.1%

Source: ADWR and Authors' Calculations

6.2 Sectoral Economic impact by Year, 1986-2017

Tables 6 through 9 illustrate the annual importance of CAP's water deliveries by sector for the State of Arizona economy if there was a shortfall in water availability caused by the non-existence of CAP. Tables 6 and 7 focus on changes in total GDP by State. Tables 8 and 9 examines changes in total employment.

Table 6 estimates the GDP by State losses by year and sector without the availability of CAP's water supply, 1986-2001.

The table estimates that in 1986, Arizona's GDP across all sectors would have been lower by almost $1.6 billion (2018 $). The top five sectors estimated to decline the most in terms of contribution to GDP in 1986 are: Government ($327.0 million), Healthcare ($280.2 million), Real Estate & Travel ($239.7 million), Retail ($166.8 million), and Finance and Insurance ($101.9 million).

In 1993 - the year that CAP was declared "…substantially complete" - Arizona's GDP across all sectors would have been lower by $22.0 billion (2018 $). The top five sectors estimated to decline the most in terms of contribution to GDP in 1993 are: Government ($4.5 billion), Healthcare ($3.9 billion), Real Estate & Travel ($3.3 billion), Retail ($2.3 billion), and Finance and Insurance ($1.4 billion).

In 2001, Arizona's GDP across all sectors would have been lower by $57.2 billion (2018 $). The top five sectors estimated to decline the most in terms of contribution to GDP in 2001 are: Government ($11.5 billion), Healthcare ($9.8 billion), Real Estate & Travel ($8.7 billion), Retail ($5.9 billion), and Finance and Insurance ($3.9 billion).

Table 7 estimates the GDP by State losses by year and sector without the availability of CAP's water supply, 2002-2017.

The table estimates that in 2002, total GDP across all sectors would have been lower by $59.1 billion (2018 $). The top five sectors estimated to decline the most in terms of contribution to GDP in 2002 are: Government ($12.0 billion), Healthcare ($10.3 billion), Real Estate & Travel ($9.0 billion), Retail ($6.1 billion), and Finance and Insurance ($4.0 billion).

In 2010, total GDP across all sectors would have been lower by almost $113.8 billion (2018 $). The top five sectors estimated to decline the most in terms of contribution to GDP in 2010 are: Construction ($21.3 billion), Real Estate & Travel ($14.5 billion), Government ($14.2 billion), Healthcare ($13.9 billion), and Professional and Technical Services ($11.4 billion).

Table 6: Estimated GDP Losses by Year & Sector without the Availability of CAP Water, 1986-2001[34]

	GROSS DOMESTIC PRODUCT (GDP) STATE LOSSES (Millions 2018 $)															
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Government	-327.0	-1,450.9	-1,853.1	-2,514.0	-3,810.2	-1,849.8	-2,831.5	-4,508.2	-4,817.0	-4,858.5	-5,889.9	-7,776.4	-6,507.5	-7,526.0	-9,457.7	-11,468.5
Other Services	-57.8	-263.6	-334.0	-452.5	-680.6	-333.5	-507.1	-805.1	-860.4	-867.1	-1,057.5	-1,400.4	-1,184.4	-1,370.8	-1,724.6	-2,097.2
Accommodation & Food	-67.3	-302.1	-384.5	-521.2	-787.3	-383.8	-585.7	-931.4	-995.3	-1,003.4	-1,219.7	-1,612.4	-1,355.8	-1,568.4	-1,972.1	-2,394.4
Arts	-21.6	-97.3	-123.8	-167.9	-253.5	-123.6	-188.6	-299.9	-320.4	-323.2	-392.8	-519.5	-437.1	-505.7	-635.8	-772.1
Healthcare	-280.2	-1,242.5	-1,587.4	-2,153.5	-3,264.7	-1,584.4	-2,426.0	-3,862.7	-4,127.4	-4,162.9	-5,045.8	-6,661.3	-5,572.5	-6,444.5	-8,098.3	-9,819.1
Education	-43.2	-191.7	-244.9	-332.4	-503.6	-244.5	-374.4	-596.0	-636.8	-642.3	-778.6	-1,028.1	-860.1	-994.8	-1,250.1	-1,515.5
Administrative & Waste	-22.9	-120.1	-146.3	-196.6	-284.4	-146.3	-214.8	-336.0	-359.5	-360.8	-453.7	-610.0	-543.4	-631.0	-798.7	-984.2
Management of Companies	0.0	-7.8	-6.8	-8.6	-7.3	-6.9	-6.8	-8.4	-9.2	-8.5	-17.1	-27.1	-36.6	-43.3	-56.9	-75.6
Professional & Technical Services	-46.6	-238.4	-292.3	-393.7	-573.3	-292.3	-432.0	-677.4	-724.8	-728.1	-910.6	-1,221.1	-1,078.3	-1,251.4	-1,582.0	-1,944.6
Real Estate & Travel	-239.7	-1,087.7	-1,382.6	-1,874.9	-2,822.1	-1,381.1	-2,104.0	-3,339.2	-3,569.2	-3,600.0	-4,384.1	-5,803.7	-4,897.4	-5,669.1	-7,127.8	-8,655.0
Finance & Insurance	-101.9	-484.8	-607.9	-822.3	-1,221.3	-607.6	-914.8	-1,444.6	-1,544.7	-1,556.1	-1,914.6	-2,547.8	-2,189.4	-2,537.4	-3,197.0	-3,900.0
Information	-38.7	-180.0	-226.8	-306.9	-459.3	-226.5	-342.8	-543.2	-580.7	-584.9	-716.1	-950.2	-809.5	-937.2	-1,180.3	-1,438.0
Transportation	-26.2	-124.7	-156.5	-211.9	-314.3	-156.5	-235.7	-371.9	-397.7	-400.9	-493.3	-656.7	-564.5	-654.5	-824.3	-1,004.7
Retail	-166.8	-742.0	-947.2	-1,284.8	-1,946.0	-945.5	-1,446.5	-2,302.4	-2,460.3	-2,481.2	-3,009.5	-3,974.4	-3,328.9	-3,850.1	-4,838.8	-5,869.0
Wholesale	-71.6	-325.1	-413.2	-560.4	-843.2	-412.8	-628.6	-997.7	-1,066.4	-1,075.6	-1,310.1	-1,734.6	-1,464.3	-1,695.1	-2,131.4	-2,588.2
Manufacturing	-24.4	-115.9	-146.0	-197.8	-293.8	-146.1	-220.4	-347.7	-371.9	-375.1	-460.9	-613.3	-525.8	-609.6	-767.3	-934.0
Construction	-4.7	-26.4	-31.7	-42.6	-60.3	-31.8	-46.0	-71.3	-76.4	-76.7	-97.8	-132.5	-120.8	-140.5	-178.1	-220.0
Water	-7.9	-35.8	-45.8	-62.1	-93.6	-45.7	-69.8	-110.8	-118.5	-119.6	-145.3	-192.3	-161.7	-187.2	-235.3	-285.2
Natural Gas	-3.8	-17.7	-22.4	-30.3	-45.5	-22.4	-34.0	-53.7	-57.4	-57.9	-70.8	-93.9	-79.7	-92.2	-116.1	-141.2
Electric	-24.2	-112.3	-142.2	-192.6	-287.9	-142.0	-215.4	-340.7	-364.3	-367.5	-449.6	-596.6	-507.6	-588.0	-739.8	-899.5
Mining	0.0	-4.1	-3.8	-4.8	-4.3	-3.9	-3.9	-5.0	-5.4	-5.2	-9.8	-15.2	-19.7	-23.3	-30.6	-40.4
Agriculture	-2.4	-13.2	-18.7	-26.7	-36.5	-19.3	-30.1	-44.2	-47.7	-50.4	-62.0	-84.6	-73.4	-87.1	-106.7	-123.1
Annual Total	**-1,578.9**	**-7,184.8**	**-9,118.6**	**-12,358.8**	**-18,593.1**	**-9,106.6**	**-13,858.5**	**-21,997.2**	**-23,511.0**	**-23,706.3**	**-28,890.1**	**-38,252.8**	**-32,318.1**	**-37,407.5**	**-47,049.1**	**-57,169.2**

Source: Authors' Calculations

[34] Annual totals may not tally exactly due to rounding-up.

Table 7: Estimated GDP Losses by Year & Sector without the Availability of CAP Water, 2002-2017[35]

	GROSS DOMESTIC PRODUCT (GDP) STATE LOSSES (Millions 2018 $)															
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Government	-11,989.2	-14,720.1	-17,216.8	-15,475.5	-17,044.4	-19,142.4	-19,265.5	-18,985.7	-14,195.2	-14,577.5	-14,608.7	-15,239.0	-15,533.0	-15,961.4	-16,198.3	-17,619.4
Other Services	-2,165.1	-2,652.8	-3,155.5	-2,778.2	-3,065.7	-3,481.9	-3,511.9	-3,430.5	-2,853.0	-2,937.7	-3,006.6	-3,154.4	-3,205.0	-3,263.1	-3,320.4	-3,559.3
Accommodation & Food	-2,489.2	-3,053.4	-3,598.4	-3,204.7	-3,532.5	-3,987.3	-4,016.8	-3,943.0	-5,263.3	-5,407.9	-5,443.0	-5,684.0	-5,789.8	-5,938.4	-6,030.1	-6,538.9
Arts	-802.0	-983.7	-1,160.4	-1,032.2	-1,137.9	-1,285.3	-1,294.9	-1,270.5	-1,382.5	-1,421.5	-1,452.1	-1,516.7	-1,541.3	-1,572.7	-1,603.1	-1,713.4
Healthcare	-10,269.2	-12,609.1	-14,739.7	-13,257.7	-14,600.9	-16,392.3	-16,496.6	-16,261.5	-13,945.4	-14,311.1	-14,215.1	-14,814.7	-15,122.0	-15,592.1	-15,793.5	-17,313.0
Education	-1,584.8	-1,945.6	-2,274.8	-2,045.5	-2,252.8	-2,529.6	-2,545.7	-2,509.0	-1,763.5	-1,810.1	-1,801.4	-1,877.9	-1,916.3	-1,974.3	-2,000.5	-2,189.6
Administrative & Waste	-957.1	-1,161.0	-1,497.2	-1,192.4	-1,328.6	-1,595.0	-1,625.1	-1,521.7	-757.5	-807.6	-1,133.5	-1,234.6	-1,204.0	-1,095.7	-1,179.6	-961.7
Management of Companies	-48.9	-54.3	-122.0	-45.3	-56.2	-106.3	-115.5	-80.3	-31.8	-48.2	-218.9	-255.7	-231.9	-164.0	-202.1	-50.5
Professional & Technical Services	-1,910.2	-2,320.5	-2,951.3	-2,391.4	-2,659.8	-3,162.5	-3,216.7	-3,033.6	-11,350.4	-11,630.9	-12,524.7	-12,817.4	-12,908.3	-13,024.3	-13,603.9	-13,463.0
Real Estate & Travel	-8,960.6	-10,975.9	-13,003.2	-11,504.4	-12,688.8	-14,372.5	-14,488.2	-14,177.6	-14,472.6	-14,888.4	-15,401.0	-16,077.4	-16,305.0	-16,567.5	-16,948.1	-17,877.6
Finance & Insurance	-3,952.9	-4,824.6	-5,881.5	-5,023.2	-5,558.6	-6,418.8	-6,494.1	-6,260.3	-3,865.1	-4,014.8	-4,531.3	-4,805.4	-4,812.7	-4,724.5	-4,902.2	-4,824.3
Information	-1,472.1	-1,801.4	-2,167.3	-1,881.6	-2,078.9	-2,379.5	-2,403.5	-2,334.0	-1,834.2	-1,887.5	-2,006.4	-2,087.1	-2,107.4	-2,124.2	-2,192.6	-2,241.2
Transportation	-1,018.1	-1,241.5	-1,513.8	-1,292.5	-1,430.3	-1,651.7	-1,671.0	-1,610.2	-1,636.9	-1,697.2	-1,909.5	-2,015.5	-2,019.0	-1,986.7	-2,064.9	-2,026.4
Retail	-6,129.0	-7,523.6	-8,812.2	-7,907.2	-8,710.2	-9,791.6	-9,856.4	-9,706.0	-9,128.4	-9,368.3	-9,417.7	-9,796.9	-9,980.2	-10,254.1	-10,429.2	-11,276.4
Wholesale	-2,678.3	-3,280.3	-3,888.8	-3,437.8	-3,792.0	-4,297.0	-4,331.9	-4,237.5	-4,431.7	-4,558.1	-4,827.7	-5,017.8	-5,069.2	-5,115.6	-5,277.3	-5,407.7
Manufacturing	-949.4	-1,157.6	-1,405.1	-1,206.3	-1,334.2	-1,535.9	-1,553.0	-1,499.5	-3,936.7	-4,046.2	-4,298.0	-4,454.0	-4,497.1	-4,538.8	-4,693.0	-4,779.0
Construction	-208.7	-251.3	-335.0	-255.9	-286.3	-351.8	-359.8	-330.8	-21,270.1	-21,669.4	-22,243.9	-22,468.3	-22,790.9	-23,483.7	-24,376.5	-24,990.6
Water	-296.4	-363.1	-427.8	-381.0	-420.0	-474.0	-477.5	-468.5	-373.6	-384.5	-394.5	-413.1	-419.5	-426.9	-435.0	-464.1
Natural Gas	-145.1	-177.5	-212.3	-185.7	-205.0	-233.6	-235.8	-229.6	-104.4	-107.9	-115.8	-122.0	-123.1	-123.1	-126.5	-130.1
Electric	-922.5	-1,127.4	-1,352.4	-1,178.2	-1,301.3	-1,486.3	-1,500.7	-1,458.4	-729.7	-764.4	-929.4	-996.0	-987.7	-943.5	-991.5	-916.6
Mining	-26.9	-30.0	-64.8	-25.5	-31.4	-57.2	-61.7	-43.8	-329.6	-340.9	-405.2	-420.4	-417.5	-405.7	-431.6	-391.2
Agriculture	-124.0	-142.9	-172.2	-148.0	-163.5	-186.8	-188.2	-177.4	-101.6	-105.6	-123.8	-131.8	-131.1	-125.8	-131.4	-123.6
Annual Total	**-59,099.7**	**-72,398.3**	**-85,951.9**	**-75,850.2**	**-83,679.6**	**-94,918.6**	**-95,710.7**	**-93,569.7**	**-113,757.3**	**-116,785.7**	**-121,008.1**	**-125,400.1**	**-127,112.2**	**-129,406.4**	**-132,931.3**	**-138,857.5**

Source: Authors' Calculations

[35] Annual totals may not tally exactly due to rounding-up.

Table 8: Estimated Employment Losses by Year & Sector without the Availability of CAP Water, 1986-2001[36]

	ESTIMATED EMPLOYMENT LOSSES (Job Years)															
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Government	-3,503	-15,544	-19,854	-26,934	-40,821	-19,818	-30,336	-48,299	-51,609	-52,052	-63,103	-83,315	-69,720	-80,631	-101,327	-122,870
Other Services	-867	-3,955	-5,012	-6,789	-10,211	-5,004	-7,608	-12,078	-12,909	-13,011	-15,866	-21,010	-17,770	-20,566	-25,876	-31,465
Accommodation & Food	-1,165	-5,234	-6,661	-9,030	-13,640	-6,649	-10,148	-16,137	-17,244	-17,386	-21,132	-27,938	-23,490	-27,175	-34,169	-41,487
Arts	-416	-1,872	-2,382	-3,229	-4,875	-2,378	-3,628	-5,767	-6,163	-6,214	-7,555	-9,990	-8,405	-9,724	-12,228	-14,848
Healthcare	-3,558	-15,778	-20,158	-27,347	-41,457	-20,120	-30,806	-49,052	-52,412	-52,864	-64,075	-84,590	-70,764	-81,837	-102,838	-124,691
Education	-680	-3,016	-3,854	-5,228	-7,924	-3,847	-5,889	-9,376	-10,018	-10,106	-12,250	-16,173	-13,532	-15,650	-19,666	-23,843
Administrative & Waste	-375	-1,970	-2,397	-3,223	-4,662	-2,397	-3,520	-5,506	-5,892	-5,914	-7,436	-9,998	-8,907	-10,341	-13,090	-16,131
Management of Companies	0	-85	-75	-94	-80	-76	-75	-92	-101	-93	-188	-298	-402	-476	-625	-831
Professional & Technical Services	-542	-2,773	-3,401	-4,580	-6,669	-3,401	-5,026	-7,880	-8,431	-8,471	-10,592	-14,205	-12,543	-14,557	-18,404	-22,620
Real Estate & Travel	-1,769	-8,027	-10,205	-13,838	-20,828	-10,193	-15,528	-24,645	-26,343	-26,570	-32,357	-42,835	-36,145	-41,840	-52,607	-63,878
Finance & Insurance	-1,112	-5,293	-6,636	-8,977	-13,332	-6,633	-9,986	-15,769	-16,862	-16,986	-20,900	-27,812	-23,900	-27,698	-34,898	-42,572
Information	-363	-1,684	-2,122	-2,871	-4,297	-2,119	-3,207	-5,081	-5,432	-5,471	-6,699	-8,889	-7,572	-8,767	-11,041	-13,452
Transportation	-310	-1,480	-1,858	-2,515	-3,730	-1,858	-2,798	-4,413	-4,720	-4,758	-5,855	-7,794	-6,700	-7,768	-9,783	-11,925
Retail	-2,297	-10,218	-13,043	-17,692	-26,796	-13,019	-19,918	-31,704	-33,877	-34,166	-41,440	-54,727	-45,838	-53,016	-66,630	-80,814
Wholesale	-638	-2,897	-3,682	-4,993	-7,512	-3,678	-5,602	-8,889	-9,501	-9,583	-11,673	-15,455	-13,047	-15,103	-18,990	-23,061
Manufacturing	-227	-1,074	-1,354	-1,834	-2,724	-1,354	-2,044	-3,223	-3,448	-3,478	-4,273	-5,686	-4,874	-5,652	-7,113	-8,658
Construction	-60	-337	-406	-545	-771	-406	-589	-911	-976	-980	-1,250	-1,694	-1,543	-1,796	-2,276	-2,811
Water	-72	-322	-411	-558	-841	-411	-627	-995	-1,064	-1,074	-1,305	-1,727	-1,453	-1,682	-2,113	-2,561
Natural Gas	-29	-136	-172	-233	-349	-172	-261	-413	-441	-445	-544	-721	-612	-709	-892	-1,084
Electric	-138	-642	-812	-1,101	-1,646	-812	-1,231	-1,947	-2,082	-2,100	-2,569	-3,410	-2,901	-3,361	-4,228	-5,141
Mining	0	-28	-25	-32	-29	-26	-27	-34	-37	-35	-65	-102	-132	-157	-205	-271
Agriculture	-30	-168	-237	-338	-462	-245	-380	-559	-604	-637	-785	-1,071	-928	-1,103	-1,351	-1,557
Annual Total	**-18,151**	**-82,535**	**-104,755**	**-141,978**	**-213,656**	**-104,615**	**-159,232**	**-252,772**	**-270,166**	**-272,394**	**-331,913**	**-439,440**	**-371,180**	**-429,610**	**-540,349**	**-656,573**

Source: Authors' Calculations

[36] Annual totals may not tally exactly due to rounding-up.

Table 9: Estimated Employment Losses by Year & Sector without the Availability of CAP Water, 2002-2017[37]

	ESTIMATED EMPLOYMENT LOSSES (Job Years)															
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Government	-128,450	-157,708	-184,456	-165,801	-182,610	-205,087	-206,407	-203,409	-152,696	-156,808	-157,144	-163,923	-167,086	-171,695	-174,243	-189,529
Other Services	-32,485	-39,801	-47,344	-41,683	-45,996	-52,242	-52,691	-51,471	-45,015	-46,351	-47,439	-49,770	-50,568	-51,486	-52,389	-56,158
Accommodation & Food	-43,129	-52,905	-62,346	-55,525	-61,205	-69,085	-69,597	-68,317	-92,188	-94,720	-95,334	-99,556	-101,410	-104,012	-105,618	-114,530
Arts	-15,425	-18,919	-22,316	-19,851	-21,884	-24,718	-24,904	-24,433	-21,725	-22,339	-22,820	-23,835	-24,221	-24,715	-25,192	-26,926
Healthcare	-130,405	-160,118	-187,175	-168,355	-185,412	-208,160	-209,486	-206,500	-177,133	-181,778	-180,559	-188,175	-192,078	-198,049	-200,607	-219,908
Education	-24,931	-30,608	-35,788	-32,180	-35,442	-39,795	-40,050	-39,473	-29,749	-30,534	-30,387	-31,678	-32,325	-33,304	-33,746	-36,935
Administrative & Waste	-15,685	-19,028	-24,537	-19,542	-21,774	-26,140	-26,635	-24,940	-11,475	-12,234	-17,170	-18,703	-18,239	-16,599	-17,869	-14,568
Management of Companies	-538	-596	-1,340	-497	-618	-1,169	-1,268	-882	-322	-488	-2,215	-2,587	-2,347	-1,660	-2,045	-511
Professional & Technical Services	-22,221	-26,993	-34,332	-27,818	-30,941	-36,788	-37,419	-35,288	-131,377	-134,624	-144,969	-148,357	-149,409	-150,752	-157,461	-155,829
Real Estate & Travel	-66,134	-81,008	-95,970	-84,908	-93,650	-106,076	-106,930	-104,638	-105,227	-108,250	-111,977	-116,895	-118,550	-120,459	-123,226	-129,984
Finance & Insurance	-43,150	-52,665	-64,203	-54,833	-60,678	-70,068	-70,889	-68,337	-41,174	-42,768	-48,271	-51,191	-51,268	-50,329	-52,222	-51,392
Information	-13,772	-16,851	-20,274	-17,602	-19,448	-22,259	-22,484	-21,833	-16,646	-17,130	-18,209	-18,941	-19,126	-19,278	-19,899	-20,340
Transportation	-12,083	-14,736	-17,966	-15,340	-16,975	-19,603	-19,833	-19,110	-19,083	-19,787	-22,262	-23,498	-23,539	-23,162	-24,073	-23,625
Retail	-84,395	-103,600	-121,343	-108,881	-119,938	-134,829	-135,721	-133,650	-120,278	-123,439	-124,089	-129,086	-131,501	-135,111	-137,418	-148,581
Wholesale	-23,864	-29,228	-34,648	-30,630	-33,786	-38,286	-38,597	-37,756	-37,300	-38,364	-40,633	-42,233	-42,665	-43,056	-44,417	-45,515
Manufacturing	-8,801	-10,732	-13,026	-11,183	-12,369	-14,239	-14,397	-13,901	-35,173	-36,151	-38,401	-39,795	-40,181	-40,553	-41,930	-42,699
Construction	-2,667	-3,212	-4,281	-3,270	-3,659	-4,495	-4,599	-4,226	-243,310	-247,877	-254,450	-257,016	-260,706	-268,632	-278,844	-285,869
Water	-2,662	-3,261	-3,843	-3,422	-3,772	-4,257	-4,288	-4,207	-2,953	-3,039	-3,118	-3,265	-3,316	-3,374	-3,438	-3,668
Natural Gas	-1,115	-1,363	-1,630	-1,426	-1,574	-1,794	-1,811	-1,763	-916	-947	-1,015	-1,070	-1,080	-1,080	-1,110	-1,141
Electric	-5,272	-6,443	-7,729	-6,734	-7,437	-8,495	-8,576	-8,335	-4,222	-4,422	-5,377	-5,762	-5,715	-5,459	-5,736	-5,303
Mining	-180	-201	-434	-171	-210	-383	-414	-294	-2,776	-2,871	-3,413	-3,541	-3,517	-3,417	-3,635	-3,295
Agriculture	-1,571	-1,809	-2,180	-1,874	-2,071	-2,365	-2,383	-2,247	-1,443	-1,498	-1,757	-1,870	-1,861	-1,786	-1,865	-1,754
Annual Total	**-678,934**	**-831,787**	**-987,163**	**-871,524**	**-961,449**	**-1,090,333**	**-1,099,379**	**-1,075,010**	**-1,292,179**	**-1,326,420**	**-1,371,008**	**-1,420,747**	**-1,440,707**	**-1,467,964**	**-1,506,983**	**-1,578,059**

Source: Authors' Calculations

[37] Annual totals may not tally exactly due to rounding-up.

In 2017, Arizona's total GDP across all sectors would have been lower by almost $138.9 billion (2018 $). The top five sectors estimated to decline the most in terms of contribution to GDP in 2017 are: Construction ($25.0 billion), Real Estate & Travel ($17.9 billion), Government ($17.6 billion), Healthcare ($17.3 billion), and Professional and Technical Services ($13.5 billion).

Table 8 estimates total employment losses by year and sector without the availability of CAP's water supply, 1986-2001.

The table estimates that in 1986 alone, employment across all sectors would have been lower by 18,151 jobs. The top five sectors estimated to experience the most job losses due to the absence of CAP's water exclusively in 1986 are: Healthcare (3,558 jobs), Government (3,503 jobs), Retail (2,297 jobs), Real Estate & Travel (1,769 jobs), and Accommodation & Food (1,165 jobs).

In 1993 - the year that CAP was declared "…substantially complete" - Arizona's employment across all sectors would have been lower by 252,772 jobs in that year alone. The top five sectors estimated to experience the most job losses due to the absence of CAP's water exclusively in 1993 are: Healthcare (49,052 jobs), Government (48,299 jobs), Retail (31,704 jobs), Real Estate & Travel (24,645 jobs), and Accommodation & Food (16,137 jobs).

In 2001, total employment across all sectors would have been lower by 656,573 jobs. The top five sectors estimated to experience the most job losses due to the absence of CAP's water exclusively in 2001 are: Healthcare (124,691 jobs), Government (122,870 jobs), Retail (80,814 jobs), Real Estate & Travel (63,878 jobs), and Finance & Insurance (42,572 jobs).

Table 9 estimates total employment losses by year and sector without the availability of CAP's water supply, 2002-2017.

The table estimates that in 2002 alone, employment across all sectors would have been lower by 678,934 jobs. The top five sectors estimated to experience the most job losses due to the absence of CAP's water exclusively in 2002 are: Healthcare (130,405 jobs), Government (128,450 jobs), Retail (84,395 jobs), Real Estate & Travel (66,134 jobs), and Finance & Insurance (43,150 jobs).

In 2010, Arizona's employment across all sectors would have been lower by almost 1.3 million jobs. The top five sectors estimated to experience the most job losses due to the absence of CAP's water exclusively in 2010 are: Construction (243,310 jobs), Healthcare (177,133 jobs), Government (152,696 jobs), Professional and Technical Services (131,377 jobs), and Retail (120,278 jobs).

In 2017, Arizona's employment across all sectors would have been lower by almost 1.6 million jobs. The top five sectors estimated to experience the most job losses due to the absence of CAP's water exclusively in 2017 are: Construction (285,869 jobs), Healthcare (219,908 jobs), Government (189,529 jobs), Professional and Technical Services (155,829 jobs), and Retail (148,581 jobs).

6.3 Annual and Cumulative Statewide Economic Impact, 1986-2017

Table 10 displays the importance of CAP's water delivery across all sectors by year, based on the assumption that municipal, industrial and agricultural customers in Phoenix, Pinal and Tucson AMAs would have experienced a shortfall in water availability, 1986-2017, in the absence of CAP.

Table 10 estimates that the State of Arizona would have cumulatively lost more than $2.0 trillion (2018 $) between 1986 and 2017 if CAP had not been established and the availability of water for municipal, industrial, and agricultural customers had declined accordingly. This accounts for 28.2% of cumulative statewide GDP for the total study period. The contribution made by CAP to statewide GDP has increased annually from an estimated 20.2% in 2000 to almost half of Arizona's GDP (41.5%) in 2017. A graphical representation of the annual impact of CAP's water supply to statewide GDP is shown in Figure 4.

Table 10 also estimates that the State of Arizona would have lost 18,151 jobs in 1986, 540,349 jobs in 2000, and almost 1.6 million jobs in 2017. A cumulative figure for the entire study period is not appropriate as the unit of measurement for employment is job years, rather than jobs.[38]

[38] A "job year" is defined as one person having a full-time job for exactly one year.

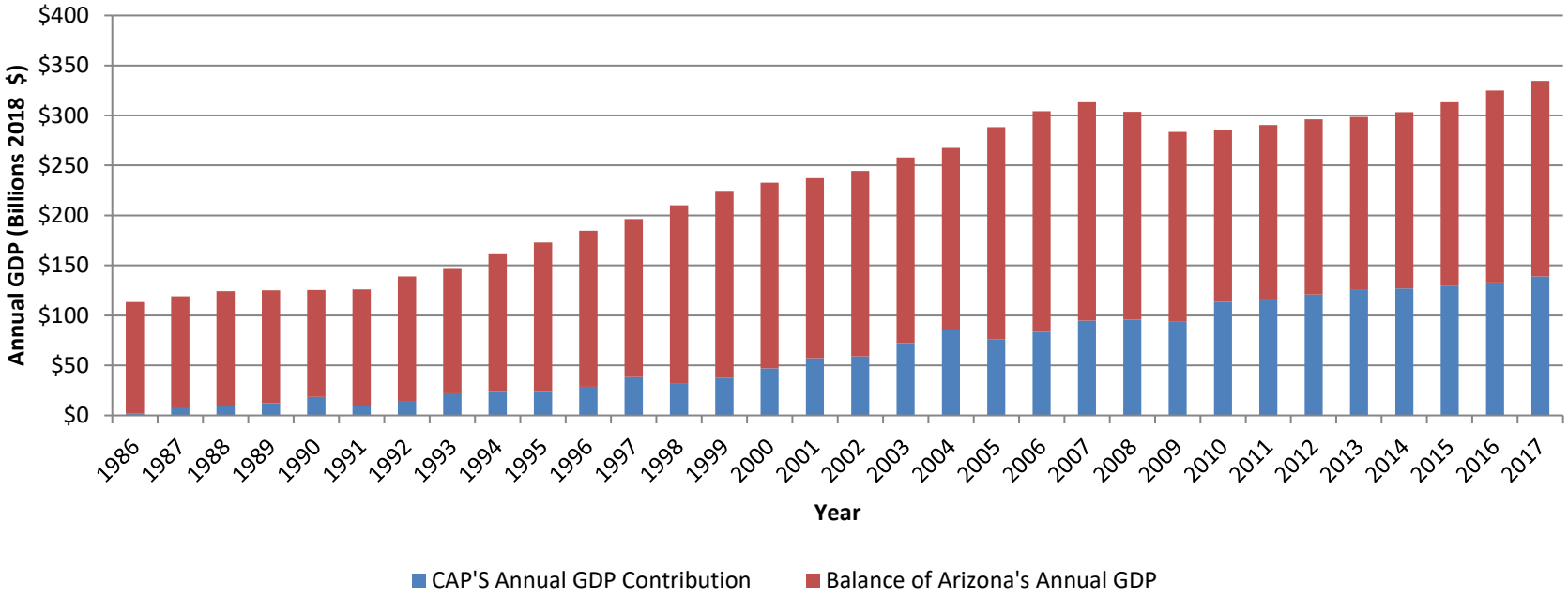
Table 10: Estimated Statewide Economic Losses, 1986-2017[39]

	GDP (Millions 2018 $)	CAP'S GDP CONTRIBUTION AS A PERCENT OF STATEWIDE GDP	EMPLOYMENT (Job Years)
1986	-$1,578.9	-1.4%	-18,151
1987	-$7,184.8	-6.0%	-82,535
1988	-$9,118.6	-7.3%	-104,755
1989	-$12,358.8	-9.9%	-141,978
1990	-$18,593.1	-14.8%	-213,656
1991	-$9,106.6	-7.2%	-104,615
1992	-$13,858.5	-10.0%	-159,232
1993	-$21,997.2	-15.0%	-252,772
1994	-$23,511.0	-14.6%	-270,166
1995	-$23,706.3	-13.7%	-272,394
1996	-$28,890.1	-15.6%	-331,913
1997	-$38,252.8	-19.5%	-439,440
1998	-$32,318.1	-15.4%	-371,180
1999	-$37,407.5	-16.7%	-429,610
2000	-$47,049.1	-20.2%	-540,349
2001	-$57,169.2	-24.1%	-656,573
2002	-$59,099.7	-24.2%	-678,934
2003	-$72,398.3	-28.1%	-831,787
2004	-$85,951.9	-32.1%	-987,163
2005	-$75,850.2	-26.3%	-871,524
2006	-$83,679.6	-39.4%	-961,449
2007	-$94,918.6	-30.3%	-1,090,333
2008	-$95,710.7	-31.5%	-1,099,379
2009	-$93,569.7	-33.0%	-1,075,010
2010	-$113,757.3	-39.9%	-1,292,179
2011	-$116,785.7	-40.2%	-1,326,420
2012	-$121,008.1	-40.8%	-1,371,008
2013	-$125,400.1	-42.0%	-1,420,747
2014	-$127,112.2	-41.9%	-1,440,707
2015	-$129,406.4	-41.3%	-1,467,964
2016	-$132,931.3	-40.9%	-1,506,983
2017	-$138,857.5	-41.5%	-1,578,059
Total	**-$2,048,538.0**	**-28.2%**	**-**

Source: Authors' Calculations

[39] Totals may not tally exactly due to rounding-up.

Figure 4: CAP's Contribution to Statewide GDP, 1986-2017



Source: Authors' Calculations

7. ECONOMIC IMPACT OF INHOUSE OPERATIONS, 2011-2017

Table 11 summarizes the direct employment, wages, and operating costs of CAP, 2011 through 2017, expressed in nominal dollars. The table states that CAP's annual full-time equivalent (FTE) employment ranges from 460.6 people to 483.9 people, depending on the year in question. The total salaries and wages (including benefits) ranges from $48.2 million in 2011 to $56.3 million in 2017 (all nominal dollars). Payroll taxes ranges from $3.0 million in 2011 to $3.6 million in 2017 (all nominal dollars). Other operating costs ranges from $17.0 million in 2011 to $104.8 million in 2017 (all nominal dollars). All of the data in Table 11 is supplied by CAP.

Table 11: CAP's Inhouse Operations, 2011-2017[40]

	INHOUSE OPERATIONS BY YEAR (NOMINAL DOLLARS)						
	2011	2012	2013	2014	2015	2016	2017
Employment (FTE)	468.6	460.6	470.6	476.7	471.1	475.3	483.9
Salaries and Wages (Millions $)	$35.1	$35.4	$37.0	$37.6	$36.9	$39.4	$40.4
Benefits (Millions $)	$13.1	$14.2	$15.0	$15.3	$15.0	$16.5	$15.9
Payroll Taxes (Millions $)	$3.0	$3.1	$3.2	$3.3	$3.3	$3.4	$3.6
Other Operating Costs (Millions $)	$17.0	$21.7	$24.2	$24.7	$23.4	$82.5	$104.8
Total Operations (Millions $)	**$68.1**	**$74.3**	**$79.4**	**$81.0**	**$78.6**	**$141.9**	**$164.7**

Source: CAP

Table 12 summarizes the annual total GDP impact of CAP's inhouse operations in the State of Arizona. All monetary amounts in Table 12 are expressed in 2018 dollars (2018 $). The table shows that the total GDP contribution of CAP's operations ranges from $86.0 million to $169.14 million, dependent on the year in question. The cumulative total GDP of CAP's operations, 2011 through 2017, is estimated at $829.4 million.

Table 13 summarizes the annual total employment impact of CAP's inhouse operations in the State of Arizona. The annual data in Table 13 is expressed in job years. The label "job year" is important and should not be simplified or abbreviated to "job". A "job year" is defined as one person having a full-time job for exactly one year. This means, for example, that one person working for CAP throughout the seven-year time horizon accounts for 7 job years of

[40] Columns may not tally exactly due to rounding-up.

employment, but only one 1 job. A cumulative total employment impact for the entire seven-year period is therefore not appropriate. Table 13 shows that the total annual employment contribution of CAP's operations ranges from 786 jobs in 2014,[41] to 1,778 jobs in 2017.[42] In 2016 and 2017, for every job year of employment at CAP, 2.2 or 2.7 job years of employment is created elsewhere in the State of Arizona in the corresponding year.

Table 12: CAP's Inhouse Operations – Statewide GDP Impacts, 2011-2017[43]

	DIRECT GDP IMPACTS FROM INHOUSE OPERATIONS (Millions 2018 $)	DIRECT GDP IMPACTS FROM SUPPLIER PURCHASES (Millions 2018 $)	INDIRECT & INDUCED GDP IMPACTS (Millions 2018 $)	TOTAL ANNUAL GDP IMPACTS (Millions 2018 $)
2011	$57,550,790	$8,982,936	$33,544,949	$100,078,674
2012	$58,097,483	$10,227,239	$34,970,842	$103,295,564
2013	$59,934,225	$11,814,032	$36,854,264	$108,602,520
2014	$59,932,027	$9,807,772	$16,281,017	$86,020,817
2015	$58,212,578	$13,105,094	$35,173,375	$106,491,047
2016	$61,949,418	$36,938,430	$56,908,827	$155,796,675
2017	$61,356,168	$41,606,949	$66,180,136	$169,143,252
CUMULATIVE IMPACTS, 2011-2017 (Millions 2018 $)	**$417,032,688**	**$132,482,452**	**$279,913,410**	**$829,428,549**

Source: Authors' Calculations

Table 13: CAP's Inhouse Operations – Statewide Employment Impacts, 2011-2017[44]

	DIRECT ANNUAL EMPLOYMENT CAP OPERATIONS	DIRECT ANNUAL EMPLOYMENT IN-STATE SUPPLIERS	INDIRECT & INDUCED ANNUAL EMPLOYMENT	TOTAL ANNUAL EMPLOYMENT
2011	469	113	396	978
2012	461	128	416	1,004
2013	471	151	436	1,058
2014	477	116	193	786
2015	471	131	415	1,017
2016	475	378	678	1,531
2017	484	517	776	1,778

Source: Authors' Calculations

[41] These are the direct, indirect and induced jobs associated with CAP's inhouse operations and supplier purchases only in 2014.
[42] These are the direct, indirect and induced jobs associated with CAP's inhouse operations and supplier purchases only in 2017.
[43] Totals may not tally exactly due to rounding-up.
[44] Totals may not tally exactly due to rounding-up.

8. CONCLUSIONS

The purpose of this study has been to calculate the economic impact of CAP for the State of Arizona, assessed in terms of GDP by State and employment, in three aspects:

- The construction of CAP, 1973-1993;
- The impact of CAP's water supply delivery operations, 1986-2017; and
- The impact of CAP's inhouse operations, 2011-2017.

The total field project costs used in the construction analysis are $3.3 billion (nominal $).

Seidman estimates that the construction of CAP cumulatively generates approximately $2.6 billion GDP between 1973 and 1993 (2018 $). It also estimates annual employment impacts of up to 9,412 job years, dependent on the year in question.

The statewide GDP contribution resulting from the construction of CAP is equivalent to 0.13% of Arizona's cumulative GDP, 1973-1993.

The construction sector is the primary direct beneficiary during the construction of CAP.

Seidman also estimates the impact of the loss of 19.9 million acre-feet of water delivered by CAP to municipal, industrial and agricultural customers in Phoenix, Pima, and Tucson AMAs, 1986-2017.

Central to this analysis is an assumption that CAP's annual water deliveries would not have been sourced elsewhere.

The water supply analysis estimates that the State of Arizona's GDP would have been cumulatively lower by approximately $2.0 trillion (2018 $) between 1986 and 2017, if CAP had not been established, and the availability of water for municipal, industrial, and agricultural customers had declined accordingly. This represents a loss of approximately 28.2% of cumulative statewide GDP throughout the study period.

Seidman also estimates that the annual importance of CAP's water supply to statewide GDP is greater than 40% from 2011 onwards.

The top five sectors estimated to decline the most in terms of contribution to GDP if CAP's water supply had been unavailable to customers during the 1986-2017 study period are: Government ($335.2 billion), Healthcare ($302.1 billion), Real Estate & Travel ($286.6 billion), Retail ($187.9 billion), and Construction ($187.0 billion).

Annual employment losses of 18,151 to approximately 1.6 million jobs, dependent on the year in question, would also have occurred if CAP's water supply had been unavailable during the 1986-2017 study period. Over 60 percent of these job losses would have occurred in the Healthcare, Government, Retail, Construction, and Real Estate & Travel sectors.

Seidman's water supply analysis therefore demonstrates the growing importance of CAP for the State of Arizona economy. CAP's establishment and subsequent delivery of water to municipal, industrial, and agricultural customers in the three central AMAs has had a crucial impact on the economic development of the state.

Without the availability of water from CAP, the economic development of the State would almost certainly have followed a different trajectory.

It is important to note that Seidman's estimated economic value of CAP's water delivery has not taken into account any leisure benefits associated with CAP, such as the 10,000-acre Lake Pleasant Park, the Reach 11 recreation area in Phoenix, or the TPC golf course and Westworld in Scottsdale. The inclusion of leisure would in all probability increase the estimated economic value of CAP's water delivery in the State of Arizona, 1986 through 2017.

The direct, indirect and induced effects of the staff and suppliers needed to operate and maintain CAP are also excluded from Seidman's estimated economic value of water delivery. Between 2011 and 2017, annual inhouse employment at CAP ranges from 461 to 484 people, dependent on the year in question. The total annual employment contribution of CAP's operations ranges from 786 jobs in 2014,[45] to 1,778 jobs in 2017.[46] The cumulative GDP contribution of CAP's inhouse operations for the same seven-year time horizon is $829.4 million. The inclusion of CAP's inhouse staff and supplier purchases will therefore also increase the estimated economic value of water delivery in the State of Arizona.

[45] These are the direct, indirect and induced jobs associated with CAP's inhouse operations and supplier purchases only in 2014.
[46] These are the direct, indirect and induced jobs associated with CAP's inhouse operations and supplier purchases only in 2017.

APPENDIX - IMPLAN

IMPLAN is a commercially-licensed input-output model that combines a set of extensive databases, economic factors, multipliers, and demographic statistics with a highly refined and customizable modeling system.

IMPLAN's sectoring scheme is based largely on the U.S. Bureau of Economic Analysis' (BEA's) sectoring scheme. The BEA updates these sectors every five years, and this is usually reflected in major changes to the IMPLAN model.

Seidman's original 2014 CAP study used a 2011 version of IMPLAN, which primarily drew from the BEA's 2002 sectoring scheme.

The current updated version of the CAP study uses a 2018 version of IMPLAN, which primarily draws from the BEA's 2012 sectoring scheme, supplemented by BEA insights in 2007, 2002, and 1997.

The BEA only identifies 405 sectors. However, the latest version of IMPLAN has 546 sectors (compared to 440 sectors in the original CAP study). Using input from industry experts, IMPLAN therefore provides production functions for sectors not included in any BEA benchmark. IMPLAN also uses earlier BEA benchmarks to split the absorption coefficients, byproduct coefficients, and institutional spending into greater levels of disaggregation.

It is usually possible to compare data across time using IMPLAN. However, the significant changes made to the IMPLAN model between 2011 and 2018 reduce the efficacy of sectoral comparisons over time in the current report. This is of particular significance for the sectoral distribution of impacts shown in Tables 6-9 in this report. The sectoral splits for 1986-2009 are based on the original 2011 version of IMPLAN, which draws from the BEA's 2002 national census of production. The sectoral splits for 2010-2017 are based on the updated 2018 version of IMPLAN, which draws from the BEA's 2012 national census of production.

660 S MILL AVENUE, SUITE 300
TEMPE
AZ 85281

Tel: (480) 965 5362
Fax: (480) 965 5458

www.seidmaninstitute.com

@SeidmanResearch