

MARKET INTELLIGENCE

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The Industrial Renaissance: Impact on Cement Consumption

Introduction

Cement consumption is expected to weaken during the remainder of the year and into the first half of next year. This expected decline is predicated on a retreat in private sector construction brought on by the increase in interest rates and credit tightening. The expected improvement in public sector construction attributed to the Infrastructure, Inflation Jobs Act is expected to start slowly this year and not reach high enough spending levels to offset the expected declines in the private sector.

This reflects our national view. Regional expectations can differ significantly.

A key aspect that can shed a decidedly more optimistic outlook for a specific region is the presence of large-scale investments in manufacturing facilities. These large investments require considerable concrete and cement usage. This need for concrete and cement will likely be amplified by construction for infrastructure to support the plant. Residential and nonresidential construction will likely add further to cement consumption.

This report offers a survey of large-scale plant investments, their likely downstream public and private construction activity, and the potential impacts on cement consumption.

Origins of Globalization

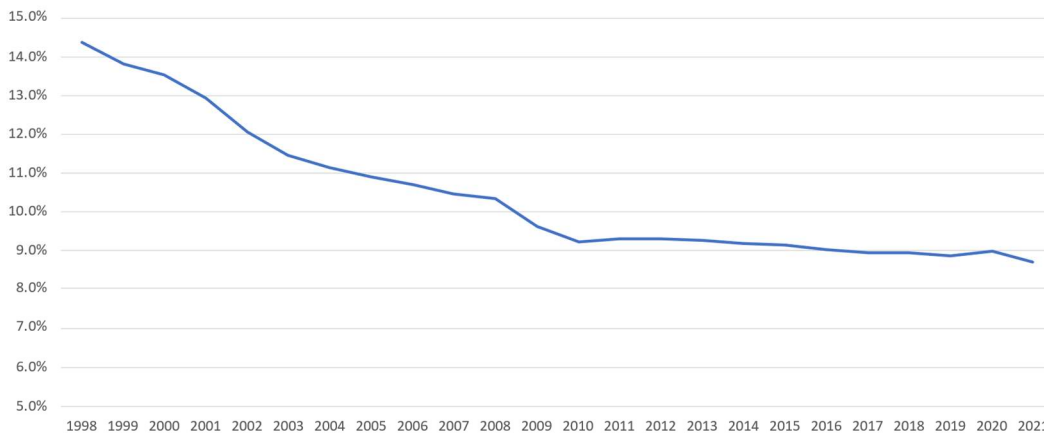
Decades ago, trade restraints were lowered. In this context, imports of manufactured goods increased their flow into the US. Often the imports came from countries with newer facilities, cheaper labor, and more efficient production practices. Many US industries lost significant market share of the domestic market to foreign manufacturers.

For US manufacturing assemblers to survive, such as the automotive industry, it was argued they had to lower costs to compete in the new age of international competition. Often this entailed sourcing products from newer factories operated by cheaper labor that was present in foreign lands.

US manufacturing as a share of total GDP has declined. With the lost volume to foreign competitors, many manufacturing plants were shuttered. The long-term decline in the manufacturing share of total employment has meant fewer jobs available at good wages for workers who lack advanced education. By itself, this slows economic growth. Lacking opportunities, younger workers often move to areas in the country with better growth prospects. A relocation in economic activity and population away from the traditional US industrial belt and toward the south and west has been an on-going phenomenon for decades.

Manufacturing Jobs as a Percent of Total Jobs

Percentage



The United States' trade policy supported this business model and accepted this decline in domestic manufacturing as well as the notion of globalization of manufacturing. This acceptance was based on the proposition that it increased global efficiencies, provided opportunities for lesser developed countries, and the lower costs emanating from this phenomenon directly translated into lower prices and enhanced consumer buying power and thereby consumer economic welfare.

Some have argued globalization of manufacturing provides the United States the opportunity to enhance overall *social welfare* by adding rigid environmental and safety regulations and inhibiting domestic industry's ability to compete on the global stage. Such regulatory policies accelerate the retreat in production among "dirty" industries. In this context, these policies essentially reduce domestic emissions by exporting them to foreign producing countries.

Covid & Geopolitical Tensions

While few question the overall economic benefits of free trade and globalization, recently concerns have arisen over its extent and breadth. Covid brought to light the fragility of the US supply chain, particularly regarding semiconductor chips. Some of this fragility has materialized due to reliance on global manufacturers. Seeking to reduce risks associated with disruptions in long supply chains, some manufacturers have begun to re-think their sourcing strategies for the United States market. Accordingly, by shortening the supply chain, risks of supply disruption are believed to be reduced.

Some argue that the United States' must invest in high-profile research and development efforts to assure stronger long-term economic growth. By transferring the results of this research abroad, the economic gains (versus corporate gains) associated with outsourcing accrues to the foreign trading partner. This works to moderate United States economic growth.

Covid occurred at the same time as a rise in geopolitical tensions. Russia invaded Ukraine. The risks of a Chinese attack on Taiwan are elevated. US industry is largely dependent on sophisticated chips produced in Taiwan. As a result, arguments for localized production of key products, technologies, and materials has also been supported by national security arguments.

US Chips Act, Inflation Reduction Act

In response to concerns regarding long-term economic growth and national defense, the Biden Administration has pushed two programs, the CHIPS and Science Act and the Inflation Reduction Act.

CHIPS and Science Act: During the pandemic, the U.S. experienced slowdowns in domestic production in several sectors that relied on semiconductors from overseas. Logistical and labor issues abroad greatly reduced semiconductor output which hampered the U.S.' ability to produce important goods such as motor vehicles. The CHIPS and Science Act is a response to that crisis.

Demand for semiconductors is expected to continue to grow. The law intends to “re-shore” semiconductor manufacturing to decrease the country’s dependency on imports. Specifically, it distributes \$280 billion in new funding to increase research and manufacturing of semiconductors in the U.S. over the next ten years.

The CHIPS and Science Act contains several provisions and sizable funding for research and development of advanced semiconductor technologies. The act also includes \$39 billion in tax incentives aimed to increase domestic chip manufacturing facilities. An additional \$24 billion is allocated for semiconductor investment tax credits to encourage private investment over the next five years.

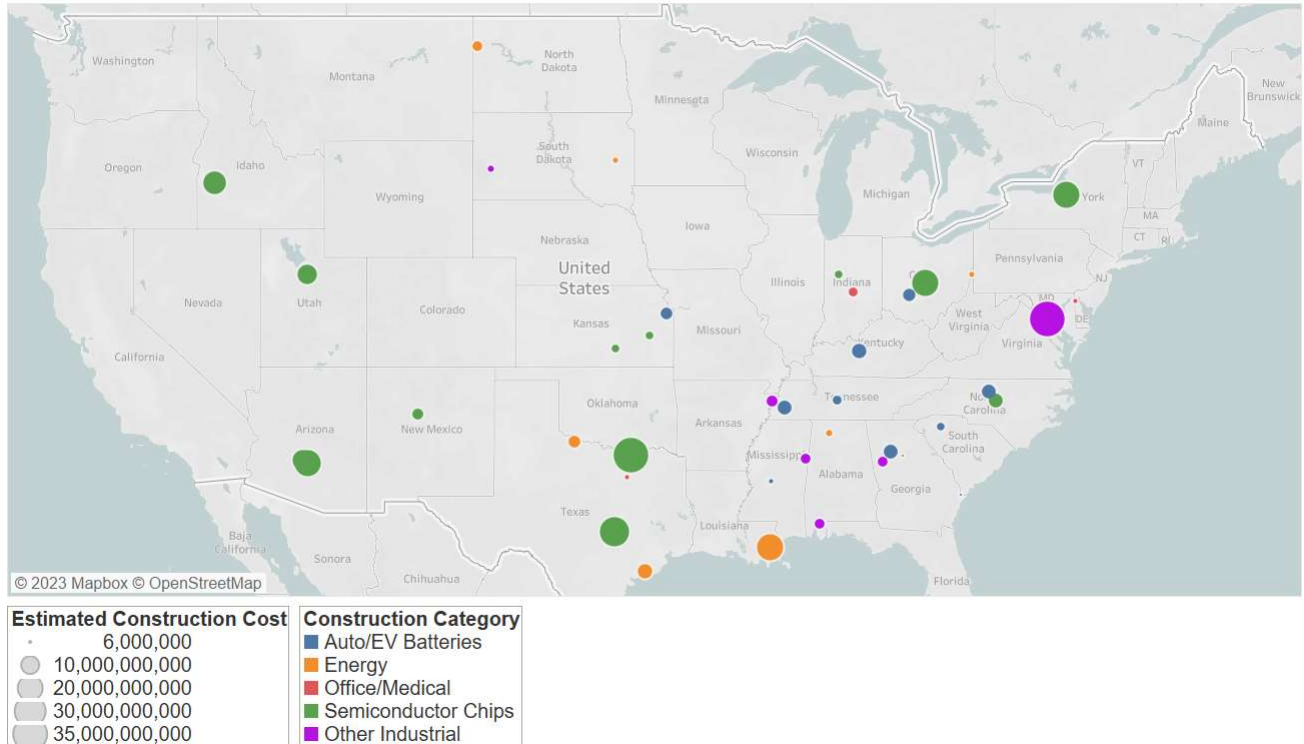
Inflation Reduction Act: The Inflation Reduction Act (IRA) was signed into law in August of 2022. The act contains a wide range of provisions including lowering healthcare costs, increased funding to the Internal Revenue Service, and considerable focus on clean energy initiatives. The Congressional Budget Office estimates the law will raise \$738 billion and reduce budget deficits by \$238 billion. The IRA authorizes nearly \$400 billion in funding related to clean energy. This investment reaches numerous industries to lower carbon emissions over the next decade.

This funding will be delivered through tax credits, grants, and loan authorizations flowing through several federal agencies. The loan program is intended to provide funding for upgrading older energy infrastructure with newer, cleaner alternatives. But the bulk of the funding will arrive via tax credits. Corporations will be the largest beneficiary, receiving an estimated \$216 billion in incentives to generate private investment towards cleaner energy and manufacturing. At the consumer level, \$43 billion of incentives are aimed in several fields including electric vehicles and home improvement tax credits.

Survey of Direct Investments

The first step in assessing the impact of an industrial renaissance on United States cement consumption is to identify the magnitude of investment activity. To this end, PCA conducted a thorough review of recent major plans to build large manufacturing plants in the United States. Our review is constrained to all plants with an investment of \$500 million or greater that have

Large-Scale Investment Across the United States



been undertaken since 2021. *To the extent that facility investments less than \$500 million materialize, upside risk to these estimates exists.*

Based on this survey, PCA identified 42 projects, totaling roughly \$300 billion in direct investment. For most of these investments, construction start date and end dates have been identified. Where square footage is not specified, PCA estimates. All totaled, including PCA estimates, more than 825 million square feet of industrial space is planned to come on-line during the forecast horizon. If facilities with less than a \$500 million price tag are included, total square feet could exceed 1 billion square feet.

PCA apportions total construction spending over the life of the build based on stated construction start and end dates. These apportionments are weighted based on rough historical patterns that have been observed for large private construction projects. Generally, construction is divided into four stages including; 1) site prep, 2) foundations construction, 3) vertical construction, and 4) finishing. Most spending and cement consumption occurs in stages two and three.

According to this protocol, and adjusted for inflation, roughly \$38 billion of “Made In America” was spent during 2021-2022. Going forward and stated in real dollars (deflated for inflation), \$67 billion is expected in 2023, \$62 billion in 2024, \$42 billion in 2025, \$19 billion in 2026 and \$8 billion in 2026.

Economic & Construction impacts

Each large investment is unique. Each will have differing impacts on overall local economic stimulus and job creation. PCA makes general assumptions regarding the; 1) size investment required to build the plant, 2) square feet of space, and 3) projected employment of the plant of the plant. These assumptions are used to infer the potential cement consumption for building the plant as well as downstream commercial and infrastructure cement consumption.

PCA estimates that more than 100,000 jobs will be created in 2023 and 2024 due to the construction of these new facilities. This includes downstream impacts of indirect and induced employment. The estimated employment in subsequent years represents roughly 72,000 jobs in 2025, 33,000 jobs in 2026, and 14,000 jobs in 2027.

These are considered temporary jobs, generally lasting up to four years. Because they are temporary, long-term investments in housing and commercial properties are not likely to be impacted. As a result, PCA excludes these employment impacts in our downstream impacts on construction activity associated with the construction of these plants.

Based on company announcements, once these facilities are up and running they are expected to directly employ roughly 80,000 workers annually. These are considered permanent jobs of which long-term investments in housing and commercial properties are determined.

PCA totals the “planned employment” announced by each plant investment. After this totaling, labor multipliers are applied. Labor multipliers that help calculate total employment impacts by including direct, indirect, and induced employment, these investments could exceed 300,000 workers.¹ It should be noted that not all these investments will be up and running by the end of the forecast horizon (2027).

This approach suggests that no significant permanent employment from these investments materializes until 2025. PCA estimates, including the multiplier effects, 55,000 net new jobs in 2025, 246,000 in 2026, and 373,000 in 2027. These are the employment increases that will create secondary impacts for new housing demand, new retail and other commercial investments.

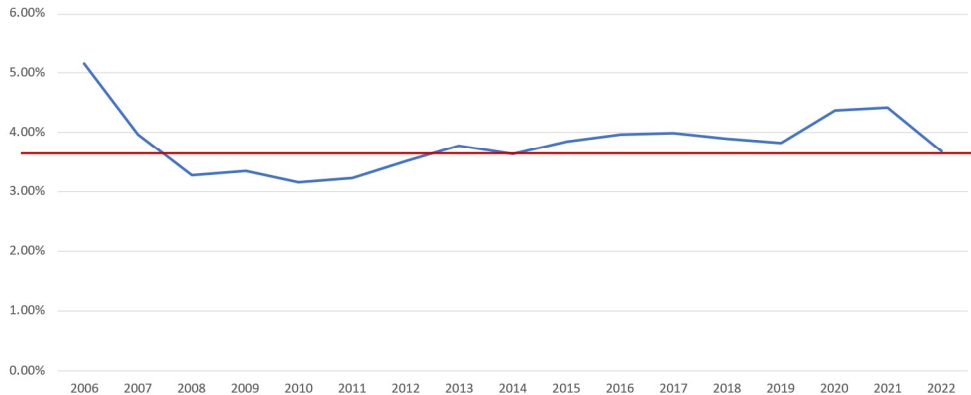
Residential Impacts: On average, for every 4 new jobs created one new start materializes based on the long-term ratio between employment and starts. This implies an additional 1,530 housing starts in 2023, 9,660 in 2024, 22,000 in 2025, 5,600 in 2026, and 5900 in 2027.

Historically, composition of housing starts is roughly two-thirds single-family and one third multifamily. Since these are largely manufacturing jobs, albeit high paid, PCA skews the composition of housing starts to 60% single-family and 40% multifamily.

PCA assumes 21 metric tons per single family start and 8,5 metric tons per multifamily start to arrive at downstream residential impacts associated with the construction of these manufacturing facilities. According to this process, nearly 25,000 metric tons of residential cement consumption are attributed the manufacturing revival in 2023, 150,000 metric tons 2024, 350,000 metric tons in 2025, and roughly 90,000 metric tons in 2026 and 2027.

¹ PCA's multipliers are based off Josh Bivens estimates. Oxford Economics multiplier is more than twice the size used by PCA and as a result arrive at much higher labor multipliers.

Employment to Housing Starts Ratio



Nonresidential Impacts: With increased employment, housing stock, and population, commercial properties are likely to achieve higher net operating income (NOI). This suggests the openings of new businesses will occur to take advantage of these opportunities. Nonresidential construction, as a result, is expected to increase.

Using specific case studies of large manufacturing plant investments, PCA identified the correlation between large plant investments and the resulting impact on nonresidential construction post plant construction². Nonresidential activity increased at a rate of roughly 50% of the value of housing's increase. This increase occurred with a lag of up to three years.

Based on this estimate, the nonresidential construction increases in real dollars by roughly \$1 billion in 2025, \$4.5 billion in 2026, and \$8.6 billion in 2027. Using nonresidential cement intensities suggests an incremental increase of 15,000 metric tons of cement consumption in 2023, 94,000 metric tons in 2024, 214,000 metric tons in 2025, and an average of more than 100,000 metric tons annually during 2026-2027. Further increases in nonresidential construction and cement consumption resulting from the construction of these manufacturing plants occurs in 2028 and beyond.

Infrastructure Impact: Often, the large size of these facilities requires additional investments in surrounding infrastructure such as road access. Secondary infrastructure investments may also be required to facilitate increases in the local population. Not only does plant size and employment matter, but the complexity of assembly, and location also contributes to infrastructure requirements.

² These investments include the North Dakota oil boom, Tesla's Gigafactory in Austin, Texas, FoxCom in Wisconsin, Tesla's factory in Nevada, and the North Dakota fracking boom.

	Cement Consumption					
	Thousand MT					
	2022	2023	2024	2025	2026	2027
Plant Construction	150	399	533	416	198	89
Residential Construction	14	25	155	354	90	95
- SF	11	19	122	278	70	74
- MF	3	5	34	77	19	21
Nonresidential Construction	9	15	94	214	108	160
Public Infrastructure	221	695	1,094	1,117	732	195
- Road & Bridge	212	667	1,050	1,072	703	188
- Other	9	28	44	45	29	8
Total	394	1,134	1,875	2,101	1,128	539
Share of Total Cement Consumption						
Plant Construction	38%	35%	28%	20%	18%	16%
Residential Construction	4%	2%	8%	17%	8%	18%
Nonresidential Construction	2%	1%	5%	10%	10%	30%
Public Construction	56%	61%	58%	53%	65%	36%

Identifying the infrastructure impact of these large manufacturing facilities is difficult. Based on a survey of plans for these plants, rough guidelines are established to estimate infrastructure spending. PCA estimates spending on road and bridge work per planned direct job created. In addition, PCA estimates spending on all other infrastructure. We use these estimates and combine them with the stated plant's job creation. This yields the total infrastructure spending associated with the new manufacturing facilities. These spending totals are dispersed across the time of the plant's construction.

Based on this approach total infrastructure spending is expected to add roughly 700,000 metric tons to cement consumption in 2023, roughly 1.1 million metric tons in 2024 and 2025, and gradually ease as the number of plants under construction that have been identified declines.

Summary

The manufacturing renaissance ushered in by covid supply chain disruptions, heightened national defense concerns and propelled by incentives contained in the US CHIPS and Inflation Reduction Acts may result in significant cement consumption during the remainder of the forecast horizon.

These additions to cement consumption go beyond the direct effects of building the manufacturing facility. Concurrent with the construction of the plant, infrastructure construction

will also materialize. Once these plants are operating, and providing jobs, secondary private construction will likely materialize.

All totaled, PCA estimates that these direct impacts of these new manufacturing facilities will account for nearly 2 million tons to cement consumption annually during 2024-2025. These estimates are based on announced intentions to build plants whose construction spending is valued at \$500 million or higher. Smaller plants will add further to cement consumption. Keep in mind, as the building of more plants are announced, the decline in consumption in the outyears of the forecast will lessen.

It is important to note that these volumes are not necessarily additive to the forecast. Infrastructure investments, for example, will likely entail state spending sterilization – thereby reducing the overall net contribution to total cement consumption compared to the current forecast.

Finally, it should be noted that the timing of the elevated volumes coincides with significant volumes associated with the long-awaited infrastructure program. Expected decline in interest rates later in the forecast horizon could add further to cement consumption in the latter years of the forecast.

Appendix: List of Plant's Surveyed

Plant Name	Product	\$ Amount Invested	SQ FT (Millions)	Planned Employment	Construction Start	On-Line	City/State/County
Middle Atlantic							
Micron	Semiconductor	\$20.0	61	3000	2024	2030	Clay, New York, Onondaga County
Subtotal		\$20.0		3000			
South Atlantic							
WUXI AppTec	Medicine	\$0.5	8.3	500	2022	2025	Middletown, Delaware, New Castle County
Amazon Data	Web Services	\$35.0	TBD	1000	TBD	2040	Alexandria, Virginia, Fairfax County
Form	Energy	\$0.8	2.4	750	2023	2024	Weirton, West Virginia, Hancock County
Toyota	EV Batteries	\$5.6	78.4	350	2023	2025	Greensboro, North Carolina, Guilford County
Wolfspeed Inc	Semiconductor	\$5.0	19.4	1800	2022	2026	Siler City, North Carolina, Chatham County
BMW	Auto	\$1.7	7	300	TBD	TBD	Woodruff, South Carolina, Spartanburg County
Hyundai	EV Batteries	\$5.5	17	8100	2022	2025	Savannah, Georgia, Bryan County
Absolics	Semiconductor	\$0.6	0.012	400	2021	2024	Covington, Georgia, Newton County
Rivian	EV Batteries	\$5.0	87.1	7500	2022	2024	Atlanta, Georgia, Morgan County
Freyr	Battery Cells	\$2.6	16	720	2023	2029	Newnan, Georgia, Coweta County
Subtotal		\$62.3		21420			
East South Central							
Novelis Corp	Aluminum	\$2.5	130.7	1000	2022	2025	Bay Minette, Alabama, Baldwin County
Enel	Energy (Solar)	\$1.1	TBD	1500	2022	2025	Moulton, Alabama, Lawrence County
Nissan	EV Batteries	\$0.5	4.7	2000	2022	2025	Canton, Mississippi, Madison County
Steel Dynamics	Steel	\$2.5	87.1	850	2023	2025	Columbus, Mississippi, Lowndes County
GM & LG	EV Batteries	\$2.3	2.8	1700	2021	2023	Spring Hill, Tennessee, Williamson County
Ford: Blueova	EV Batteries	\$5.6	156.8	6000	2023	2025	Stanton, Tennessee, Haywood County
Ford: Blueova	EV Batteries	\$5.8	65.3	5000	2023	2025	Glendale, Kentucky, Hardin County
Subtotal		\$20.3		18050			
West South Central							
Latham & Walsh	LNG	\$21.0	TBD	TBD	TBD	TBD	Louisiana
U.S. Steel	Steel	\$3.0	TBD	900	2022	2024	Osceola, Arkansas, Mississippi County
AES Corp	Energy (Green)	\$4.0	217.8	115	2024	2027	Vernon, Texas, Wilbarger County
Samsung	Semiconductor	\$25.0	6	2000	2022	2024	Taylor, Texas, Williamson County
GlobiTech	Semiconductor	\$5.0	3.2	1500	2022	2025	Sherman, Texas, Grayson County
HIF Global	Energy (Hydro)	\$6.0	23.5	125	2023	2026	Bay City, Texas, Matagorda County
TXI	Semiconductor	\$30.0	1.4	3000	2023	2025	Sherman, Texas, Grayson County
Goldman Sachs	Regional Office	\$0.5	0.8	5000	2023	2027	Dallas, Texas, Dallas County
Subtotal		\$94.5		12640			
East North Central							
Intel	Semiconductor	\$20.0	43.6	3000	2022	2025	New Albany, Ohio, Licking County
Honda/LG	EV Batteries	\$4.4	2	2200	2023	2025	Jeffersonville, Ohio, Fayette County
SkyWater	Semiconductor	\$1.8	17.4	750	2023	2026	Lafayette, Indiana, Tippecanoe County
Eli Lilly & Co	Medicine	\$2.1	TBD	500	2023	2026/2027	Indianapolis, Indiana, Boone County
Subtotal		\$28.3		6450			
West North Central							
Panasonic	EV Batteries	\$4.0	2.7	4000	2023	2025	DeSoto, Kansas, Johnson County
Integra	Semiconductor	\$1.8	1	2000	2023	TBD	Wichita, Kansas, Sedgwick County
EMP Shield	Semiconductor	\$1.9	13	1200	2023	TBD	Burlington, Kansas, Coffey County
Cerilon	Energy (GTL)	\$2.8	TBD	80	2023	2026	Trenton, North Dakota, Williams County
Gevo	Biofuel	\$1.0	11.1	90	2022	2025	Lake Preston, South Dakota, Kingsbury County
Meat Process	Beef	\$1.1	1	2500	2023	2026	Rapid City, South Dakota, Pennington County
Subtotal		\$12.6		9870			
Mountain							
Intel	Semiconductor	\$3.5	0.2	700	2021	2024	Rio Rancho, New Mexico, Sandoval County
TSMC	Semiconductor	\$12.0	3.8	1600	2022	2024	Phoenix, Arizona, Maricopa County
Intel	Semiconductor	\$20.0	30.5	3000	2021	2024	Chandler, Arizona, Maricopa County
TXI	Semiconductor	\$11.0	2	800	2023	2026	Lehi, Utah, Utah County
Micron	Semiconductor	\$15.0	0.6	2000	2023	2025	Boise, Idaho, Ada County
Subtotal		\$61.5		8100			
National Total		\$299.5		79530			