

Transitioning from Title 21 Protocol to the 6C Electronic Toll Collection Protocol

A Standardized Regulatory Impact Assessment

Caltrans
7/27/2016

A. Summary

The proposed regulatory change allows California's toll agencies the ability to transition from the Title 21 (T21) electronic toll collection (ETC) protocol to newer and cheaper International Standards Technology 18000-63 technology, also known as the 6C protocol. California toll agencies using electronic toll collection systems to collect fees from users of toll roads, bridges, and high-occupancy toll lanes would be affected.¹ If toll agencies are allowed to implement the 6C protocol, additional costs would be incurred to purchase 6C transponders and equipment. However, the initial costs to toll agencies are minimal when compared to the overall savings and benefits that would be gained. California industries and the state also stand to benefit from the adoption of this new technology.

Toll agencies will incur additional costs to retrofit their ETC systems to handle the 6C protocol and purchase higher volumes of transponders than under normal conditions to phase out the T21 protocol. As a result, shipping and disposal costs increase during the implementation period. However, the estimated reduction in spending from 6C transponder procurements offset these increased costs. Toll agencies would realize savings from transitioning to the cheaper 6C technology within the first year of implementing the regulation, as the savings range from \$10.00 to \$14.00 per unit. The incurred savings by toll agencies would be reallocated into the toll facilities, thus, further affecting industry demand in California that leads to additional benefits.

The direct costs (savings) and demand changes associated with 6C impact in-state industries, equipment purchases, and system operations and maintenance (O&M). Currently, two out-of-state companies manufacture T21 equipment, whereas, four 6C companies are capable of producing 6C equipment. One company's 6C manufacturing facility is located in California.

Consumers using the toll facilities are not impacted under this 6C regulatory change proposal, as neither costs nor savings are passed onto individuals or households (toll payers or subscribers of the toll facilities). The same established policies and charges to consumers would apply for this regulatory change. The regulations also require protection of personally-identifiable information.

Overall, this proposed regulatory change benefits toll agencies by allowing them to procure cheaper and modern transponder technology, while recognizing applicable intellectual property. California stands to gain from potential in-state 6C manufacturing, leading to additional employment and productivity. The following sections explain the regulatory change proposal, methodology used to determine state economic impacts, and alternative scenarios.

1. Statement of the Need for the Proposed Amendment

The adoption of this regulatory change allows toll agencies to modernize their ETC systems and purchase more reliable and cheaper 6C technology than compared to the current T21 technology.² Moreover, by allowing toll agencies the ability to procure 6C technology, there is potential for users to

¹ Pursuant to SB 1523 (1990) and AB 780 (1992), the California Department of Transportation (Caltrans) develops ETC specifications that statewide toll facility operators are required to use.

² California Toll Operation Committee. (2015). CTOC Plan for Transitioning from Title-21 Protocol to the 6C Protocol. Retrieved from http://www.dot.ca.gov/trafficops/tech/docs/CTOC-6C-TransitionPlan_v1.1-FinalWithAppendices.pdf

use their transponders in neighboring states that have already adopted this technology such as Washington, Colorado, and Utah.

2. Major Regulation Determination

After Caltrans' Economic Analysis Branch gathered, analyzed, and estimated the direct costs (savings) to toll agencies, representatives from the California Department of Finance (DOF) were consulted. While meeting with Caltrans, DOF determined that the proposed regulatory change resulted in over \$50 million worth of impacts occurring within a 12-month period during implementation. As required by Senate Bill 617 (2011), any regulatory change exceeding a \$50 million impact—whether results are positive or negative—requires a Standardized Regulatory Impact Assessment (SRIA). This economic impact analysis spans from January 2019 to January 2024 (implementation timeframe from 2019-2023, plus one year after) and is referred to as the proposed scenario in this analysis.

3. Baseline Information

A current condition scenario was developed to estimate the baseline economic impacts of the proposed regulatory change. The economic impact of the proposed regulatory change was evaluated against the current condition baseline scenario.

In the current condition baseline scenario, 4.5 million T21 transponders are actively being used by users in 2016. User demand was projected from 2019-2024 using an annual rate of 12% for growth and 13% for replacement. During the analysis period from 2019-2024, toll agencies are expected to purchase between 440,000 to 730,000 new T21 switchable transponders at \$20.00 per unit, and 850,000 to 1.4 million non-switchable transponders at \$15.00 per unit. Furthermore, toll agencies are expected to dispose an annual average of 520,000 T21 transponders at \$0.28 per unit annually, while shipping 1.3 to 2.2 million transponders at a cost of \$3.00 per unit during the analysis horizon. The average life of T21 transponders was assumed to be 8.6 years. See Appendix I for details on how the current condition baseline scenario was derived.

4. Outreach and Input

Members from the California Toll Operators Committee (CTOC) and their consultant provided data required to conduct this analysis, including the number of active transponders issued statewide, growth and replacement rates to calculate future demand, associated costs such as equipment, shipment, and disposal, and savings investment strategies. Caltrans coordinated with CTOC and their consultant formally and informally several times, spanning from January 2016 to July 2016. See Appendix II for details as to how the proposed scenario transponder demand was forecasted.

B. Benefits

The proposed regulatory change allows toll agencies to purchase less expensive technology. Transponder users and select California industries would indirectly benefit from this change as well.

1) Toll Agencies Save and Reinvest

Aside from the cost savings of purchasing a 6C transponder, the technology's lifespan is tied to the average life of a vehicle, as it is pasted onto the windshield in "sticker tag" form and cannot be

transferred. Given that the estimated national age of vehicles exceeds the analysis horizon,³ the replacement rate of 6C is assumed to be 1 percent for this analysis to account for replacement tags being issued because of cracked windshields. These transponders can be disposed as typical household waste. In comparison, the T21 transponder's average lifespan is 8.6 years due to an internal battery. Moreover, T21 transponders must be returned to toll agencies for proper battery disposal. Thus, the replacement rate and disposal cost of 6C transponders are lower than T21.

Shipment costs would decrease, as 6C non-switchable transponders are \$2 per unit cheaper to mail than T21 transponders and there are expected to be fewer replacement requests over time. A 6C transponder requires less packaging and postage to ship compared to a T21 transponder. T21 switchable and non-switchable and 6C switchable transponders were held constant at \$3 per unit to ship. It is possible that the cost per unit to ship 6C switchable transponders will be cheaper than \$3 per unit, but this was not considered since a value per unit could not be determined.

The savings achieved by adopting new technology allows toll agencies to allocate their savings toward other purposes such as maintaining and improving the toll facilities. For this analysis, toll agencies would reinvest all savings into the toll facilities by devoting 60 percent to toll facility maintenance and pavement rehabilitation and 40 percent to new facility construction and network expansion.

It can be assumed that toll agencies would use a portion of their savings to pay down debt service over time. However, this is difficult to generalize at a statewide level given each agency's differing financial structure. Due to the inability to estimate the statewide impact such as improved credit or bond ratings, paying down debt was not factored in this analysis. Even though this benefit cannot be quantified, the reduction of debt service may allow toll agencies to defer the need to raise tolls, while potentially making other revenues available for the toll agencies to allocate to the system.

2) User Benefits

Transponder users would not be directly impacted from this regulatory change. However, the reinvestment of savings from the change to 6C could indirectly benefit users by improving transportation infrastructure (smoother roads for example) which would lower vehicle operation costs and emissions and it could also defer toll increases. Users may also have the ability to use their sticker tags in other states that use the 6C technology. This would allow for convenient transactions to occur when traveling interstate. The regulations also require proper handling of personally-identifiable information.

3) Benefits to California Industries

Overall, the semiconductor, secondary, and indirect industries would benefit from switching from T21 to 6C technology. The regulations also require compliance with all intellectual-property laws.

a) Semiconductor Industry

Currently, toll agencies can purchase T21 transponders from two out-of-state manufacturers. This act results in money and resources "leaking" out of California to support out-of-state economic activity.

³ United States Department of Transportation. n.d. Table 1-26: Average Age of Automobiles and Trucks in Operation in the United States. Retrieved from http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_26.html_mfd

California's semiconductor industry could receive a boost in activity (depending on procurement contract negotiations) from the regulatory change, as a 6C manufacturing company already resides within the state. Moreover, the cost of a 6C transponder could decrease over time, as the open sourced technology is currently produced by four manufacturers and used by the retail, security, and airline industries.

b) Impacts to Secondary Industries

The regulatory change requires existing T21 transponders to be phased out. Thus, T21 transponders would need to be shipped back to toll agencies for proper disposal. As a result, the shipping and waste disposal industries would be required to handle a slight increase of transponders during regulatory implementation. A slight increase is expected, as the current condition baseline scenario useful life of T21 transponders (8.6 years) closely aligns to when toll agencies would stop issuing and phase out units (2017-2024, 8 years).

c) Indirect Benefits to Other Industries and California

As a result of allocating savings back into the tolling facilities, impacted industries in California can expect a positive impact during the regulation's implementation period. Primary industries impacted from this analysis include construction, manufacturing, wholesale trade, retail trade, transportation and warehousing. Moreover, reinvesting into the toll facilities can generate construction activity which would further stimulate local and state economies. Overall, this regulatory change would stimulate in-state economic growth.

Other potential benefits of improving the tolling facility infrastructure that are outside the scope of this analysis include travel efficiency gains for individuals or industries by improving access for labor and buyer-supplier markets. Thus, these efficiency gains indirectly improve California's national and global competitiveness.

C. Direct Costs and Cost Savings

This section identifies affected California entities and outlines the direct cost estimation methodology and assumptions. The inputs and outputs of the indirect cost estimation will be discussed, followed by an interpretation of regulatory impact results. See Appendix III for details on how direct costs (savings) were estimated for the proposed scenario.

1) Direct Costs to Individuals

T21 policies and charges to consumers and households would remain the same under 6C. No direct costs will be imposed onto individuals.

2) Direct Costs to Businesses

This regulatory change will not impact businesses, as no cost will be imposed onto them.

3) Direct Cost Estimation to Toll Agencies

Toll agencies and special-purpose districts operate California's toll facilities.⁴ The regulatory change in transponder technology would affect procurement costs (savings) and require toll agencies to retrofit

⁴ Impacted toll agencies: Transportation Corridor Agencies (TCA), Orange County Transportation Authority (OCTA), Riverside County Transportation Commission (RCTC), Los Angeles Metropolitan Transportation Authority (LA

T21 – 6C Annual Differences for California’s Economy

Category	2019	2020	2021	2022	2023	2024
Total Employment ¹⁰	217	247	276	303	166	375
Output ¹¹	\$34,483,000	\$40,017,000	\$45,455,000	\$50,406,000	\$32,388,000	\$63,775,000
GDP	\$20,619,000	\$23,928,000	\$27,261,000	\$30,324,000	\$20,392,000	\$38,341,000
Personal Income	\$14,392,000	\$18,009,000	\$21,487,000	\$24,790,000	\$16,295,000	\$32,118,000

b) Industry Impacts

Similar to the statewide economic outlook, construction, manufacturing, and real estate and rental and leasing industries would benefit the most from this regulatory change. Transportation and warehousing would be negatively impacted, which is likely due to the decrease in associated transponder shipping costs. The toll agencies transponder savings investment is a primary factor regarding which industry is most impacted.

T21 – 6C Annual Differences for California Industry Outputs

Category	2019	2020	2021	2022	2023	2024
	Millions of Fixed (2015) Dollars					
Construction (23)	15.9	18.6	21.2	23.8	9.3	31.4
Manufacturing (31-33)	4.8	5.2	5.5	5.8	6.1	6.6
Wholesale Trade (42)	1.1	1.3	1.4	1.6	0.9	2.1
Retail Trade (44-45)	1.3	1.5	1.7	1.9	1.1	2.5
Transportation and Warehousing (48-49)	(0.7)	(0.9)	(1.0)	(1.2)	2.5	(2.2)
Information (51)	0.9	1.0	1.1	1.1	0.6	1.4
Finance and Insurance (52)	1.8	1.9	2.1	2.3	1.2	2.9
Real Estate and Rental and Leasing (53)	2.3	2.7	3.2	3.6	2.2	4.6
Professional, Scientific, and Technical Services (54)	1.9	2.2	2.5	2.8	1.6	3.7
Administrative and Waste Management Services (56)	0.7	0.7	0.8	0.9	1.3	1.0
Health Care and Social Assistance (62)	1.3	1.4	1.7	1.8	1.1	2.4
Accommodation and Food Services (72)	0.5	0.6	0.7	0.8	0.5	1.1
Other Services, except Public Administration (81)	0.7	0.7	0.8	0.8	0.4	1.1

¹⁰ Employment comprises of the number of jobs, full-time and part-time, by place of work. Full-time and part-time jobs are equal in weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not accounted.

¹¹ Output is the amount of production, including all intermediate goods purchased and value added (compensation and profit). This can be thought of as sales or supply. The components of output are self-supply and exports (multi-regions, nation, and international).

4) Summary of Interpretation and Results of the Economic Impact Assessment

Overall, the regulatory change would result in cost savings for toll agencies and translate to positive impacts for California industries and the state. Even though these gains are positive, the impact would be minimal in comparison to the statewide economy. California's gross state product is about \$2.5 trillion with over 18 million people in its labor force today. The proposed scenario exceeds the \$50 million economic impact threshold on two occasions over the analysis horizon. See Appendix V for a detailed breakdown of estimated impacts to California's economy for the proposed scenario.

E. Alternatives

In addition to the proposed regulation change, two alternative scenarios were developed for consideration:

- Alternative 1 – current condition baseline scenario
- Alternative 2 – shorten regulation implementation horizon from 2019 to 2021

1) Alternative 1: Current Condition Baseline Scenario

a) Cost and Benefits

There would be no additional costs or benefits to toll agencies, the state, or industries. However, as signified in the regulation and alternative scenario analysis, a switch to 6C technology would result in transponder procurement savings for toll agencies. Therefore, this alternative leads to an opportunity cost to toll agencies.

b) Economic Impacts

No economic impacts would occur under the current condition baseline scenario. However, the actualized savings, as discussed, would be reinvested into the toll facilities, leading to overall benefits for the state and its industries. By requiring toll agencies to operate under the current condition baseline scenario, transponder costs are higher than the proposed regulation and potential savings reinvestment into the toll facilities would be forgone. Thus, the current condition baseline scenario results in opportunity costs for toll agencies, the state, and industries.

c) Cost-Effectiveness

Alternative 1 is less costly to the state and industries initially during the ETC system retrofit years (2017-2018). In addition, the transportation and warehousing industry would experience a minimal disbenefit due to lower volumes and associated shipping costs to mail transponders. However, the current condition baseline scenario is more costly to toll agencies, industries, and the state than other scenarios when reviewing the overall impacts.

d) Reason for Rejection

The current condition baseline scenario results in an overall disbenefit to toll agencies, the state, and industries. Toll agencies would continue to procure transponders at a higher cost; therefore, leading to a potential economic stimulation opportunity loss for the state and its industries.

2) Alternative 2: Shorten Regulation Implementation Horizon from 2019 to 2021

a) Costs and Benefits

The retirement of T21 transponders would be over two years as opposed to five years under this scenario. As a result, 6C transponders and associated disposal and shipping costs would be accrued at a faster rate than the regulation scenario. The useful life of T21 transponders of 8.6 years would not be actualized under this scenario as these transponders are retired earlier than normal. Below are direct costs assumptions that were used as inputs for REMI. See Appendix II and III for Alternative 2 breakdowns of the transponder forecast and costs (savings).

Direct Cost Estimation Inputs (2015\$) – Proposed 6C Alternative 2

		6C Proposed Regulation			T21 Baseline		
		Period	No. of Units Per Year (Millions)	Unit Price	Period	No. of Units Per Year (Million)	Unit Price
Equipment Purchases	System Retrofit	2017-18	Statewide Upgrades	\$2.4 million	-	-	-
	Transponder Purchases (Switchable)	2019-21	0.350- 1.3	\$10.00	2018-21	0.440 - 0.530	\$20.00
	Transponder Purchases (Non-switchable)	2019-21	0.690- 2.5	\$1.20	2018-21	0.850 - 1.0	\$15.00
O&M Costs	Transponder Disposal	2019-21	2.8- 2.9	\$0.28	2018-21	0.520	\$0.28
	Transponder Shipping	2019-21	2.8- 2.9	T21: \$3.00 6C switchable: \$3.00 6C non-switchable: \$1.00	2018-21	1.3 - 1.4	\$3.00

b) Economic Impacts

The state’s and industries’ benefits are minimized during the implementation period when accelerating the regulation horizon. See Appendix IV and V for detailed breakdowns of REMI inputs and economic impacts to California for Alternative 2.

Alternative 2: T21 – 6C Annual Differences for California’s Economy

Column1	2019	2020	2021
Total Employment	91	116	299
Output	\$17,450,000	\$21,796,000	\$48,454,000
GDP	\$11,085,000	\$13,682,000	\$28,912,000
Personal Income	5,893,000	8,323,000	21,962,000

Similar to the statewide economic outlook for the proposed scenario, construction, manufacturing, and real estate and rental and leasing industries would benefit the most from this regulatory change. Transportation and warehousing would experience economic gains from 2019-2020 likely due to increased shipping demand and costs, before shipping expenses decrease and a loss is incurred in 2021.

Alternative 2: T21 – 6C Annual Differences for California Industry Outputs

Category	2019	2020	2021
	Millions of Fixed (2015) Dollars		
Construction - 23	3.5	5.5	23.7
Manufacturing - 31-33	4.8	5.3	5.7
Wholesale Trade - 42	0.5	0.7	1.6
Retail Trade - 44-45	0.6	0.7	1.9
Transportation and Warehousing - 48-49	2.2	2.1	(1.7)
Information - 51	0.4	0.5	1.2
Finance and Insurance - 52	0.8	1.0	2.4
Real Estate and Rental and Leasing - 53	1.0	1.3	3.4
Professional, Scientific, and Technical Services - 54	0.7	1.0	2.7
Administrative and Waste Management Services - 56	0.9	1.0	0.7
Health Care and Social Assistance - 62	0.5	0.7	1.8
Accommodation and Food Services - 72	0.2	0.3	0.8
Other Services, except Public Administration - 81	0.3	0.3	0.9

c) Cost-Effectiveness

By accelerating the regulation’s implementation period, the useful life (8.6 years) of issued T21 transponders would not be actualized. Moreover, shortening the implementation horizon would result in toll agencies incurring transitional costs at a faster rate instead of spreading out costs over five years.

d) Reason for Rejection

Toll agencies would incur costs at a faster rate than anticipated. Moreover, benefits to the state and its industries would be minimized under this alternative scenario.

Appendix I – Existing T21 Baseline Calculations

CTOC - 6C Economic Analysis Transponder Baseline Condition Statistics (3/10/16)	
Number of Active Tags (2016)	4,500,000
Annual Statewide Growth Rate	12%
Annual Statewide Replacement Rate	13%
Disposal Cost	\$0.28
Average Title-21 Lifecycle	8.6 years
6C Replacement Rate	1%
Estimated Statewide Shipping Cost per Unit:	
Title-21 technology & 6C switchable	\$3.00
6C non-switchable	\$1

Upfront Equipment Upgrade Costs	
Today's Estimate	\$ 4,800,000
FY15-16	\$ 2,400,000
FY16-17	\$ 2,400,000
Estimated Total Cost	\$ 4,800,000
Note: ETC system retrofit and upgrade work to be completed in two years.	

Estimated Title 21 Average Cost Per Unit		
	Switchable	Non-switchable
Statewide T21	\$20.00	\$ 15.00
Statewide 6C	\$10.00	\$1.20

Estimated Transponder Split Percentage by Type	
Switchable Rate:	34%
Non-switchable Rate:	66%

Appendix II – Transponder Inventory Estimate Calculations

Alternative #1 Baseline: Continue under current regulation.

Baseline Inventory Estimate - Title 21 Transponder (Thousands)									
	2016	2017	2018	2019	2020	2021	2022	2023	2024
Statewide Inventory	4,500	5,080	5,760	6,530	7,430	8,470	9,670	11,070	12,700
New Issue Trans.	-	588	675	777	896	1,036	1,202	1,398	1,631
Replacement Trans.	-	521	521	521	521	521	521	521	521
Total Annual Estimated Inventory	-	-	-	1,298	1,417	1,557	1,723	1,919	2,152

Total Title 21 Purchase Split	2016 - 18	2019	2020	2021	2022	2023	2024
Switchable	-	441	482	529	586	652	732
Non-Switchable	-	857	935	1,028	1,137	1,266	1,420
Total Check		1,298	1,417	1,557	1,723	1,919	2,152

Proposed Scenario: Replacement of Title 21 Transponders with 6C Transponders over a five (5) year period (Proposed)

Proposed Scenario Inventory Estimate - 6C Transponder (Thousands)									
	2016	2017	2018	2019	2020	2021	2022	2023	2024
Statewide Inventory	4,500	5,080	5,760	6,530	7,430	8,470	9,670	11,070	12,700
New Issued Trans.	-	588	675	777	896	1,036	1,202	1,398	1,631
Replacement Trans.	-	-	-	676	599	532	473	3,529	16
Total Annual Estimated Inventory	-	-	-	1,453	1,495	1,568	1,675	4,927	1,647

Note: 6C growth is assumed to be the same as Title 21. There is insufficient data to predict the impact of new transponder technology. The replacement calculation differs between Title 21 and 6C scenarios. Under the Title 21 current condition scenario, transponders are “naturally phased out” during the implementation horizon (2019-2023) by assuming their 8.6-year T21 battery lifespan. Under the 6C scenario, T21’s natural phase out is assumed on top of a 1% replacement rate for 6C transponders. Thus, replacement transponders are higher under the 6C scenario than the Title 21 current condition scenario.

Total 6C Purchase Split	2016 - 18	2019	2020	2021	2022	2023	2024
Switchable	-	494	508	533	570	1,675	560
Non-Switchable	-	959	987	1,035	1,106	3,252	1,087
Total Check	-	1,453	1,495	1,568	1,675	4,927	1,647

Alternative #2: Expedited replacement of Title 21 Transponders with 6C Transponders over a two (2) year period

Alternative #2 Inventory Estimate - 6C Transponder				
	2016	2019	2020	2021
Statewide Inventory	4,500	6,530	7,430	8,470
New Issued Transponders	-	777	896	1,036
Replacement Transponders	-	2,886	2,887	10
Total Annual Estimated Inventory	-	3,663	3,783	1,046

Total 6C Purchase Split	2016 - 18	2019	2020	2021
Switchable	-	1,245	1,286	356
Non-Switchable	-	2,418	2,497	690
Total Check	-	3,663	3,783	1,046

Appendix III – Estimated Direct Cost (Saving) Impacts

Alternative 1 - Statewide Baseline Cost Estimates (Thousands)									
	2017	2018	2019	2020	2021	2022	2023	2024	Total
Switchable	-	-	\$8,820	\$9,630	\$10,580	\$11,710	\$13,040	\$14,630	\$68,410
Non-switchable	-	-	\$12,850	\$14,020	\$15,410	\$17,050	\$18,990	\$21,300	\$99,620
Disposal Cost	-	-	\$145	\$145	\$145	\$145	\$145	\$145	\$870
Shipping Cost	-	-	\$3,890	\$4,250	\$4,670	\$5,160	\$5,750	\$6,450	\$30,170
Total	-	-	\$25,705	\$28,045	\$30,805	\$34,065	\$37,925	\$42,525	\$199,070

Proposed Scenario Cost Estimates (Thousands)									
	2017	2018	2019	2020	2021	2022	2023	2024	Total
6C Transition Cost	\$2,400	\$2,400	-	-	-	-	-	-	\$4,800
Switchable	-	-	\$4,940	\$5,080	\$5,330	\$5,690	\$16,750	\$5,590	\$43,380
Non-switchable	-	-	\$1,150	\$1,180	\$1,240	\$1,320	\$3,900	\$1,300	\$10,090
Disposal Cost	-	-	\$186	\$165	\$146	\$129	\$984	\$-	\$1,610
Shipping Cost	-	-	\$2,440	\$2,510	\$2,630	\$2,810	\$8,270	\$2,760	\$21,420
Total	\$2,400	\$2,400	\$8,716	\$8,935	\$9,346	\$9,949	\$29,904	\$9,650	\$81,300

Summary of Net Savings for Proposed Scenario (Thousands)									
	6C ETC System Transition/Retrofit Cost		Regulation Implementation Horizon					One-year after Implementation	Total
	2017	2018	2019	2020	2021	2022	2023	2024	
ALT 1 - Baseline Cost Total	-	-	\$25,705	\$28,045	\$30,805	\$34,065	\$37,925	\$42,525	\$199,070
Proposed Scenario Cost Total	\$2,400	\$2,400	\$8,716	\$8,935	\$9,346	\$9,949	\$29,904	\$9,650	\$81,300
Net Savings	\$(2,400)	\$(2,400)	\$16,989	\$19,110	\$21,459	\$24,116	\$8,021	\$32,875	\$117,770

Alternative 1 - Statewide Baseline Cost Estimates (Thousands)						
	2017	2018	2019	2020	2021	Total
Switchable	-	-	\$8,820	\$9,630	\$10,580	\$29,030
Non-switchable	-	-	\$12,850	\$14,020	\$ 15,410	\$42,280
Disposal Cost	-	-	\$145	\$145,000	\$145	\$435
Shipping Cost	-	-	\$3,890	\$4,250	\$4,670	\$12,810
Total	-	-	\$25,705	\$28,045	\$30,805	\$84,555

Statewide Alternative #2 Cost Estimates (Thousands)						
	2017	2018	2019	2020	2021	Total
6C Transition Cost	\$2,400	\$2,400	-	-	-	\$4,800
Switchable	-	-	\$12,450	\$12,860	\$3,550	\$28,860
Non-switchable	-	-	\$2,900	\$2,990	\$820	\$6,710
Disposal Cost	-	-	\$805	\$805	-	\$1,610
Shipping Cost	-	-	\$6,150	\$6,350	\$1,750	\$14,250
Total	\$2,400	\$2,400	\$22,305	\$23,005	\$4,120	\$56,230

Summary of Net Savings from Alternative #2 (Thousands)						
	2017	2018	2019	2020	2021	Total
Baseline Cost Total	-	-	\$25,705	\$28,045	\$30,805	\$84,555
Alternative #2 Cost Total	\$2,400	\$22,305	\$23,005	\$4,120	\$56,230	\$22,305
Net Savings	\$(2,400)	\$(2,400)	\$3,400	\$5,040	\$24,685	\$28,325

Appendix IV – REMI Inputs Proposed Scenario - REMI Inputs

Alternative 1 - FINAL REMI INPUTS:		REMI Inputs 2015\$ (Units)								
Affected Ind. NAICS	Transfer Category	PV	2017	2018	2019	2020	2021	2022	2023	2024
562(211) - Waste management and remediation services	Exogenous Final Demand	X6530	0	0	40590	19800	990	-15840	830610	-143550
492 - Couriers and Messengers	Exogenous Final Demand	X6494	0	0	-1435500	-1722600	-2019600	-2326500	2494800	-3653100
3344 - Semiconductors, electronic components, and computer related devices	Exogenous Final Demand	X6444	0	0	3014550	3098700	3252150	3469950	10221750	3410550
Local Government	Local Government Spending	65	-2376000	-2376000	0	0	0	0	0	0
23(7310) - Construction	Exogenous Final Demand	X6412	0	0	10091466	11351340	12746646	14324904	4764474	19527750
23(7310) - Construction	Exogenous Final Demand	X6412	0	0	6727644	7567560	8497764	9549936	3176316	13018500

REMI Workbook Flow Chart (with DOF Calibration):

```

graph LR
    A[Standard National Control] --> B[Standard Regional Control]
    A --> C[Calibration Change]
    C --> D[US GDP Update]
    D --> E[Calibration Change]
    E --> F[CA Population Update]
    F --> G[Policy Change]
    G --> H[CTOC Reg]
    G --> I[REMI Inputs 2015$ (Units) Table]
  
```

Note: Inputs for semiconductors, electronic components industry (NAICS 3344) was scaled down further, on top of the model's assumptions, to account for the actual impacts that 6C may have on California since only one company resides in-state to date. All T21 manufacturers are located outside of California to date.

Toll Agency Reinvestment Strategy

Categories	
Operation and Maintenance of the facility (e.g., maintain toll system, pavement rehab, etc.)	60%
New construction, expansion of tolling network	40%
Total reinvested into the toll facilities	100%

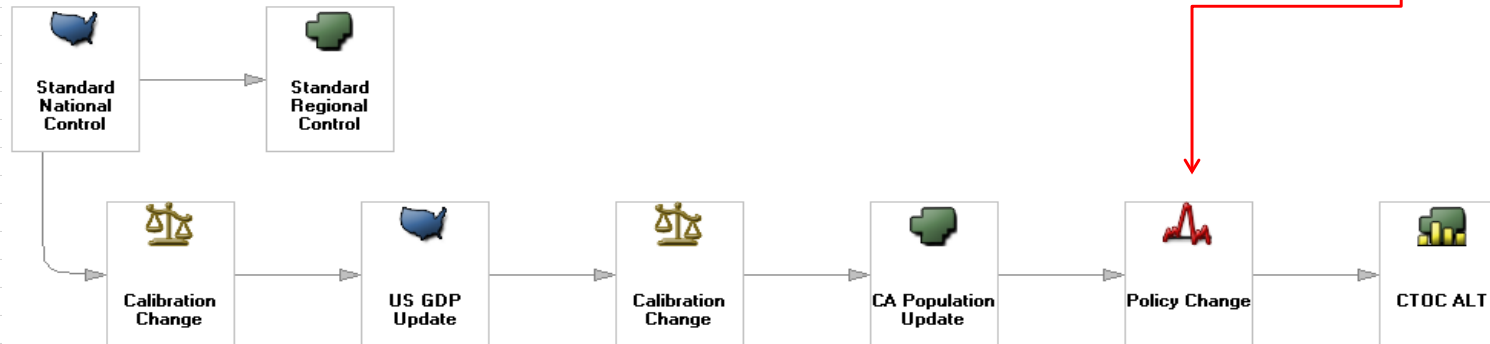
Proposed Scenario - Reinvestment Allocation for REMI (Thousands)

Savings Estimate	2017	2018	2019	2020	2021	2022	2023	2024	Total
6C Savings	\$(2,400)	\$(2,400)	\$16,989	\$19,110	\$21,459	\$24,116	\$8,021	\$32,875	\$117,770
Reinvestment Calcs									
Reinvest - OM			\$10,193	\$11,466	\$12,875	\$14,470	\$4,813	\$19,725	\$70,662
Capital Purchase			\$6,796	\$7,644	\$8,584	\$9,646	\$3,208	\$13,150	\$47,108

Alternative 2 - REMI Inputs

FINAL REMI INPUTS:		REMI Inputs 2015\$ (Units)								
Affected Ind. NAICS	Transfer Category	PV	2017	2018	2019	2020	2021	2022	2023	2024
562(211) - Waste management and remediation services	Exogenous Final Demand	X6530	0	0	653400	653400	-143550	0	0	0
492 - Couriers and Messengers	Exogenous Final Demand	X6494	0	0	2237400	2079000	-2890800	0	0	0
3344 - Semiconductors, electronic and other electronic components	Exogenous Final Demand	X6444	0	0	7598250	7845750	2163150	0	0	0
Local Government	Local Government Spending	65	-2376000	-2376000	0	0	0	0	0	0
23(7310) - Construction	Exogenous Final Demand	X6412	0	0	2019600	2993760	14662890	0	0	0
23(7310) - Construction	Exogenous Final Demand	X6412	0	0	1346400	1995840	9775260	0	0	0

REMI Workbook Flow Chart (with DOF Calibration):



Alternative 2 Reinvestment Allocation for REMI (Thousands)

Alternative 2 - Savings Estimate	2017	2018	2019	2020	2021	Total
6C Savings	\$(2,400)	\$(2,400)	\$3,400	\$5,040	\$24,685	\$28,325
Reinvestment Calcs						
Reinvest - OM			\$2,040	\$3,024	\$14,811	\$16,995
Capital Purchase			\$1,360	\$2,016	\$9,874	\$11,330

Appendix V – Economic Results

Proposed Scenario - California Economic Impact from 6C

Differences									
Category	Units	2017	2018	2019	2020	2021	2022	2023	2024
Total Employment	Individuals (Jobs)	-48.415	-49.739	216.989	247.291	276.393	302.531	166.009	375.14
Private Non-Farm Employment	Individuals (Jobs)	-29.485	-30.363	211.575	237.467	263.27	286.769	151.835	356.4
Residence Adjusted Employment	Individuals	-45.746	-46.607	205.349	232.114	260.399	285.666	157.16	356.293
Population	Individuals	-9.189	-15.89	30.599	69.561	108.991	148.21	155.266	207.34
Labor Force	Individuals	-9.879	-15.376	36.188	69.657	99.715	126.705	117.789	162.55
Gross Domestic Product	Millions of Fixed (2015) Dollars	-4.767	-4.962	20.619	23.928	27.261	30.324	20.392	38.341
Output	Millions of Fixed (2015) Dollars	-7.934	-8.272	34.483	40.017	45.455	50.406	32.388	63.775
Value Added	Millions of Fixed (2015) Dollars	-4.843	-5.043	20.609	23.951	27.308	30.391	20.319	38.437
Personal Income	Millions of Fixed (2015) Dollars	-3.408	-3.804	14.392	18.009	21.487	24.79	16.295	32.118
Disposable Personal Income	Millions of Fixed (2015) Dollars	-2.799	-3.128	11.797	14.774	17.633	20.354	13.441	26.341
Real Disposable Personal Income	Millions of Fixed (2015) Dollars	-2.683	-2.726	11.571	12.943	15.078	17.073	10.026	22.734

Proposed Scenario - California Industry Output Impact from 6C

Category	Units	2019	2020	2021	2022	2023	2024
Forestry, Fishing, and Related Activities - 113-	Millions of Fixed (2015)	0.0178	0.0196	0.0211	0.0225	0.0067	0.0275
Mining - 21	Millions of Fixed (2015)	0.2695	0.3164	0.3484	0.3689	0.2363	0.4306
Utilities - 22	Millions of Fixed (2015)	0.2118	0.2378	0.2710	0.3000	0.1772	0.3859
Construction - 23	Millions of Fixed (2015)	15.8623	18.6194	21.2164	23.8293	9.2648	31.4469
Manufacturing - 31-33	Millions of Fixed (2015)	4.8470	5.2077	5.5159	5.7736	6.1489	6.5535
Wholesale Trade - 42	Millions of Fixed (2015)	1.1334	1.2850	1.4471	1.5889	0.9319	2.0623
Retail Trade - 44-45	Millions of Fixed (2015)	1.3226	1.4969	1.7079	1.8918	1.0738	2.4837
Transportation and Warehousing - 48-49	Millions of Fixed (2015)	-0.6804	-0.8507	-1.0334	-1.2346	2.5356	-2.2084
Information - 51	Millions of Fixed (2015)	0.8716	0.9501	1.0524	1.1362	0.6051	1.4440
Finance and Insurance - 52	Millions of Fixed (2015)	1.7860	1.9421	2.1418	2.2922	1.1632	2.8893
Real Estate and Rental and Leasing - 53	Millions of Fixed (2015)	2.2999	2.6731	3.1868	3.5919	2.2476	4.5940
Professional, Scientific, and Technical Services -	Millions of Fixed (2015)	1.8557	2.1844	2.4999	2.7924	1.5546	3.6504
Management of Companies and Enterprises -	Millions of Fixed (2015)	0.2342	0.2539	0.2715	0.2837	0.2499	0.3332
Administrative and Waste Management Services	Millions of Fixed (2015)	0.6554	0.7374	0.8221	0.8960	1.3053	1.0266
Educational Services - 61	Millions of Fixed (2015)	0.1728	0.1998	0.2303	0.2566	0.1550	0.3271
Health Care and Social Assistance - 62	Millions of Fixed (2015)	1.2586	1.4415	1.6529	1.8479	1.0883	2.4175
Arts, Entertainment, and Recreation - 71	Millions of Fixed (2015)	0.2298	0.2453	0.2675	0.2850	0.1421	0.3568
Accommodation and Food Services - 72	Millions of Fixed (2015)	0.5401	0.6330	0.7438	0.8449	0.5495	1.1065
Other Services, except Public Administration -	Millions of Fixed (2015)	0.6546	0.7029	0.7723	0.8301	0.4045	1.0511

Proposed Scenario - California Employment Impact from 6C

Category	Units	2019	2020	2021	2022	2023	2024
Private Non-Farm	Individuals (Jobs)	211.6	237.5	263.3	286.8	151.8	356.4
Government	Individuals (Jobs)	5.4	9.8	13.1	15.8	14.2	18.7
Farm	Individuals (Jobs)	0.0	0.0	0.0	0.0	0.0	0.0
Category	Units	2019	2020	2021	2022	2023	2024
Private Non-Farm Employment	Individuals (Jobs)	211.6	237.5	263.3	286.8	151.8	356.4
Intermediate Demand Employment	Individuals (Jobs)	42.3	47.4	52.1	56.1	31.8	68.6
Local Consumption Demand Employment	Individuals (Jobs)	56.9	61.5	68.5	74.5	40.8	93.7
Government Demand Employment	Individuals (Jobs)	0.5	0.8	1.0	1.1	0.8	1.1
Investment Activity Demand Employment	Individuals (Jobs)	10.5	17.3	21.2	23.0	16.3	22.7
Exports to Multiregions Employment	Individuals (Jobs)	0.0	0.0	0.0	0.0	0.0	0.0
Exports to Rest of Nation Employment	Individuals (Jobs)	-2.1	-2.7	-3.5	-4.2	-4.3	-5.5
Exports to Rest of World Employment	Individuals (Jobs)	0.0	-0.3	-0.7	-1.1	-1.3	-1.6
Exogenous Industry Sales Employment	Individuals (Jobs)	0.0	0.0	0.0	0.0	0.0	0.0
Exogenous Industry Demand Employment	Individuals (Jobs)	103.6	113.5	124.6	137.4	67.6	177.4

Alternative 2: California Economic Impact from 6C

Differences						
Category	Units	2017	2018	2019	2020	2021
Total Employment	Individuals (Jobs)	-48.415	-49.739	91.265	115.77	299.438
Private Non-Farm Employment	Individuals (Jobs)	-29.485	-30.363	88.976	110.833	288.435
Residence Adjusted Employment	Individuals	-45.746	-46.607	86.516	108.605	282.537
Population	Individuals	-9.189	-15.89	5.63	25.11	78.104
Labor Force	Individuals	-9.879	-15.376	9.752	27.602	78.705
Gross Domestic Product	Millions of Fixed (2015) Dollars	-4.767	-4.962	11.085	13.682	28.912
Output	Millions of Fixed (2015) Dollars	-7.934	-8.272	17.45	21.796	48.454
Value Added	Millions of Fixed (2015) Dollars	-4.843	-5.043	10.953	13.569	28.957
Personal Income	Millions of Fixed (2015) Dollars	-3.408	-3.804	5.893	8.323	21.962
Disposable Personal Income	Millions of Fixed (2015) Dollars	-2.799	-3.128	4.824	6.82	17.987
Real Disposable Personal Income	Millions of Fixed (2015) Dollars	-2.683	-2.726	4.971	6.145	16.406

Alternative 2: California Industry Output Impact from 6C

Category	Units	2017	2018	2019	2020	2021
Forestry, Fishing, and Related Activities - 113-115	Millions of Fixed (2015)	-0.0026	-0.0025	0.0053	0.0071	0.0248
Mining - 21	Millions of Fixed (2015)	-0.0864	-0.0896	0.1487	0.1918	0.3754
Utilities - 22	Millions of Fixed (2015)	-0.0595	-0.0605	0.0969	0.1198	0.2950
Construction - 23	Millions of Fixed (2015)	-0.6492	-0.8023	3.4699	5.4820	23.7126
Manufacturing - 31-33	Millions of Fixed (2015)	-0.6080	-0.5985	4.8490	5.2583	5.7047
Wholesale Trade - 42	Millions of Fixed (2015)	-0.2487	-0.2576	0.5329	0.6562	1.5781
Retail Trade - 44-45	Millions of Fixed (2015)	-0.3039	-0.3144	0.5656	0.7137	1.8700
Transportation and Warehousing - 48-49	Millions of Fixed (2015)	-0.1225	-0.1243	2.1568	2.0709	-1.7329
Information - 51	Millions of Fixed (2015)	-0.2516	-0.2494	0.4084	0.4918	1.1861
Finance and Insurance - 52	Millions of Fixed (2015)	-0.4296	-0.4279	0.8029	0.9657	2.4183
Real Estate and Rental and Leasing - 53	Millions of Fixed (2015)	-0.5911	-0.6188	0.9930	1.2887	3.3510
Professional, Scientific, and Technical Services - 54	Millions of Fixed (2015)	-0.3671	-0.3905	0.7153	0.9695	2.7058
Management of Companies and Enterprises - 55	Millions of Fixed (2015)	-0.0433	-0.0430	0.1954	0.2175	0.2900
Administrative and Waste Management Services - 56	Millions of Fixed (2015)	-0.2084	-0.2152	0.8829	0.9588	0.7458
Educational Services - 61	Millions of Fixed (2015)	-0.0416	-0.0430	0.0742	0.0951	0.2451
Health Care and Social Assistance - 62	Millions of Fixed (2015)	-0.3293	-0.3374	0.5401	0.6867	1.7839
Arts, Entertainment, and Recreation - 71	Millions of Fixed (2015)	-0.0569	-0.0552	0.1044	0.1230	0.3039
Accommodation and Food Services - 72	Millions of Fixed (2015)	-0.1472	-0.1545	0.2379	0.3074	0.7788
Other Services, except Public Administration - 81	Millions of Fixed (2015)	-0.1525	-0.1485	0.2725	0.3264	0.8729

Alternative 2: California Employment Impact from 6C

Category	Units	2019	2020	2021
Private Non-Farm	Individuals (Jobs)	89.0	110.8	288.4
Government	Individuals (Jobs)	2.3	4.9	11.0
Farm	Individuals (Jobs)	0	0	0
Category	Units	2019	2020	2021
Private Non-Farm	Individuals (Jobs)	89.0	110.8	288.4
Intermediate Demand	Individuals (Jobs)	19.5	23.9	56.5
Local Consumption	Individuals (Jobs)	24.7	29.4	75.6
Government Demand	Individuals (Jobs)	0.2	0.5	0.9
Investment Activity	Individuals (Jobs)	4.5	9.1	19.8
Exports to	Individuals (Jobs)	0.0	0.0	0.0
Exports to Rest of	Individuals (Jobs)	-1.6	-2.0	-3.1
Exports to Rest of	Individuals (Jobs)	0.0	-0.1	-0.4
Exogenous Industry	Individuals (Jobs)	0.0	0.0	0.0
Exogenous Industry	Individuals (Jobs)	41.7	50.0	139.1