

APPENDIX E
ENERGY RESOURCES

Regional Connector - Supplemental Environmental Impact Study (SEIS)

Supporting Energy Calculations

Prepared May 2014

Regional Connector SEIS - Construction Energy Impacts (Indirect)									
Construction Description	Construction Cost, Engineer's Estimate (2013\$)			Conversion Factors		Construction Energy Factor	Construction Energy Consumption		
	Construction Cost Summary (\$)¹ (thousands)			Dollar-to-Energy Factor²	2013 Price Escalation³		Units		
	Direct	Indirect*	Total	(Btu/1973\$)	1973\$/2013\$	Btu/2013\$	Btu	MMBtu	Billion Btu
Baseline/LPA									
Earth Pressure Balance Tunnel Boring Machine (EPBM) Bored Tunnels, Cut-and-Cover	\$63,162	\$21,475	\$84,637	24,600	0.204	5,017	316,869,876	316,870	317
Alternative 1									
EPBM Bored Tunnels on Low Alignment, Cut-and-Cover	\$45,798	\$15,571	\$61,369	24,600	0.204	5,017	229,758,802	229,759	230
Alternative 2									
EPBM bored tunnels on LPA alignment; Cut-and-Cover	\$65,657	\$22,324	\$87,981	24,600	0.204	5,017	329,389,588	329,390	329
Alternative 3									
EPBM Bored Tunnels on LPA Alignment; Open Face Shield Tunnel Excavation; Sequential Excavation Method (SEM) Tunnel Construction; and Mucking	\$64,359	\$50,502	\$114,861	24,600	0.204	5,017	322,875,529	322,876	323
Alternative 4									
EPBM Bored Tunnels on Deep Alignment; Remove EPBMs through Tunnel Portal, SEM Tunnel Construction; and Mucking	\$58,726	\$39,047	\$97,773	24,600	0.204	5,017	294,618,122	294,618	295

Notes

* = Indirect costs include contractor mark-up fees and project schedule delay costs and are not included in the energy consumption analysis.

Methodology:

Construction Energy Consumption

Input/Output Approach for Urban Conventional Highway Construction (CalTrans' Energy and Transportation Systems, July 1983)

Construction Energy Formula

$$E = C \times EF \times DC$$

E = Energy consumed (Btu)

C = Cost of a particular construction activity (2007\$)

DEF = Dollar-to-Energy Factor for Urban Freeway Widen (Btu/1973\$)

DC = Dollar Conversion (1973\$/2013\$)

Conversion Factors

2013 Price Escalation

$$1973\$/2013\$ = 19.8/97.09 = 0.203934494$$

References and Source:

¹ Construction Cost Estimate obtained from Metro, dated 4/12/13

² Caltrans Construction Activity, Energy and Transportation Systems, 1983, State of California Department of Transportation

³ Price Index for Selected Construction Items, Caltrans. Obtained from http://www.dot.ca.gov/hq/esc/oe/cost_index/historical_reports/CCI_4QTR_2013.pdf. Accessed May 23, 2014.