FINAL

INDUSTRIAL WAREHOUSING

IN THE SCAG REGION

TASK 5. Developing a Policy Evaluation Framework and Assessing the Implications

APRIL 2018

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technical report

Southern California Association of Governments Industrial Warehousing Study

Task 5. Developing a Policy Evaluation Framework and Assessing the Implications

prepared for

Southern California Association of Governments

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April 2018

Table of Contents

List of Tables

List of Figures

Executive Summary

Task Goals and Outputs

This technical report (or the report) describes the primary work conducted under Task 5, which consisted of:

- Developing an evaluation framework for warehousing-related public scenario planning and policy-making. This includes:
  - A recap of the industry trends, as identified in the Task 3 report of this study;
  - A recap of the baseline scenario, as defined in the Task 4 report of this study;
  - Definitions of warehousing-related alternate scenarios that relate to industry trends, alternate freight forecasts, and state and local policies;
  - Identification of assumptions that implement the alternate scenarios in the warehouse space forecasting model; and
  - Approximate methodologies used for estimation of travel impacts and air quality impacts related to warehousing.
- Evaluates alternate scenarios in terms of future demand for warehouse space; and assesses their implications on travel, air quality, and warehouse-related policy and decision-making using the warehouse space forecasting model, which was improved as part of the Task 4 report of this study. This includes:
  - Results and findings of quantitative evaluation of alternate scenarios in terms of future occupied warehouse space at regional and submarket area level and at cargo market level;
  - Results and findings of quantitative assessment of future occupied warehouse space-related travel impacts and air quality impacts; and
  - Discussion of the implications of the alternate scenarios evaluation and impacts assessment on policy and decision-making of stakeholders.

Evaluation Framework

- Definitions of warehousing-related alternate scenarios, and differences in their inputs and calculations in the warehouse space forecasting model with respect to the baseline scenario are shown in Table ES.1.
- Using approximate methodologies for travel and air quality impacts estimation, the relative levels of impacts between alternate scenarios were compared.

Table ES.1 Alternate Scenario Definitions, and Inputs and Calculations in the Warehouse Space Forecasting Model

Alternate Number	Alternate Scenario Name	Definition	Changes to Existing User Controlled Inputs in Relation to Baseline Scenario	New User Controlled Inputs	Changes to Nonuser Controlled Calculations in Relation to Baseline Scenario
1	Baseline Scenario plus Efficiency Gain	This examines the effect of industry trends of growing use of information technology (IT) in cargo-handling facilities and increasing warehouse automation to gain operating efficiencies in existing and new developments	Modified Avison-Young (A-Y) equation-based efficiency parameters for all new developments	None	• Net efficiency gain calculation due to lowered footprint requirement for all cargo that are to be handled at new developments
2	Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings	In addition to effect of Alt 1 (baseline scenario plus efficiency gain), this examines the effect of a regional policy to support replacement of older, functionally obsolete warehouse buildings with newer and modern design warehouse buildings to gain operating efficiencies	Modified A-Y equation-based efficiency parameters for replaced developments and all new developments	Era definition of building that becomes obsolete by decade Percentage of obsolete inventory to be replaced by decade	• Net efficiency gain calculation due to lowered footprint requirement for some of the existing cargo and all added cargo • Added submarket area vacant space calculation due to lowered footprint requirement for some of the existing cargo

Alternate Number	Alternate Scenario Name	Definition	Changes to Existing User Controlled Inputs in Relation to Baseline Scenario	New User Controlled Inputs	Changes to Nonuser Controlled Calculations in Relation to Baseline Scenario
3	Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share	In addition to effect of Alt 1, this examines the effect of industry trend of increasing share of mega regional distribution centers (RDC) in new developments to gain operating efficiencies and economies of scale	Modified A-Y equation-based efficiency parameters for all new developments	Mega RDCs cargo loads percentage share of total cargo loads by 2040	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Mega RDCs cargo loads percentage share of total cargo loads for interim years interpolation • Reduced general purpose warehouse cargo and increased mega RDCs cargo
4	Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share	In addition to effect of Alt 1, this examines the effect of industry trend of increasing customer demand for transloading and policy of near-port municipalities to preserve existing warehousing land uses for crossdock transload purposes to reduce shipper costs of trucking, to improve port throughput, and to reduce storage space needed	Modified A-Y equation-based efficiency parameters for all new developments	Crossdock transload import cargo loads percentage share of total import cargo loads by 2040	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Crossdock transload import cargo loads percentage share of total import cargo loads for interim years interpolation • Reduced Import warehouse and port-related RDC cargo loads due to increased crossdock transload import cargo loads

Alternate Number	Alternate Scenario Name	Definition	Changes to Existing User Controlled Inputs in Relation to Baseline Scenario	New User Controlled Inputs	Changes to Nonuser Controlled Calculations in Relation to Baseline Scenario
5	Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share	In addition to effect of Alt 3 (baseline scenario plus efficiency gain plus increased mega RDCs), this examines the effect of industry trend of increasing demand for e-commerce and fulfillment centers (assumed to use mega RDCs) to reduce customer's cost of goods, while also reducing time for delivery (approaching a retail store purchase of same day or two days)	Modified A-Y equation-Obased efficiency parameters for all new developments	Mega RDCs cargo loads percentage share of total cargo loads by 2040 Fulfillment center type mega RDC space percentage share of total mega RDC space by 2040	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Mega RDCs cargo loads percentage share of total cargo loads for interim years interpolation • Fulfillment center type mega RDC space percentage share of total mega RDC space for interim years interpolation • Reduced general purpose warehouse cargo loads due to increased mega RDCs cargo loads
6	Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario	In addition to effect of Alt 1, this examines the effect of alternate border-crossing freight forecast as a result of many reasons, including industry's reduced use of near-shoring strategy and lower public and private investment in border-crossing infrastructure than the baseline scenario	Modified A-Y equation-based efficiency parameters for all new developments	Border-crossing-related "low-volume" scenario origin-destination freight flows data and forecasts	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Conversion of truck flows to loads and interim years interpolation • Adjustment of port-related flows to keep international freight flows a constant

Alternate Number	Alternate Scenario Name	Definition	Changes to Existing User Controlled Inputs in Relation to Baseline Scenario	New User Controlled Inputs	Changes to Nonuser Controlled Calculations in Relation to Baseline Scenario
7	Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario	In addition to effect of Alt 1, this examines the effect of alternate border-crossing freight forecast as a result of many reasons, including industry's increased use of near-shoring strategy and higher public and private investment in border-crossing infrastructure than the baseline scenario	Modified A-Y equation-based efficiency parameters for all new developments	Border-crossing-related "high-volume" scenario origin-destination freight flows data and forecasts	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Conversion of truck flows to loads and interim years interpolation • Adjustment of port-related flows to keep international freight flows a constant
8	Baseline Scenario plus Efficiency Gain plus Increased Developable Space	In addition to effect of Alt 1, this examines the effect of local land use policy changes by converting more land from nonindustrial to industrial use	Modified A-Y equation-based efficiency parameters for all new developments	Additional developable space in building area	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo

Source: Cambridge Systematics, Inc.

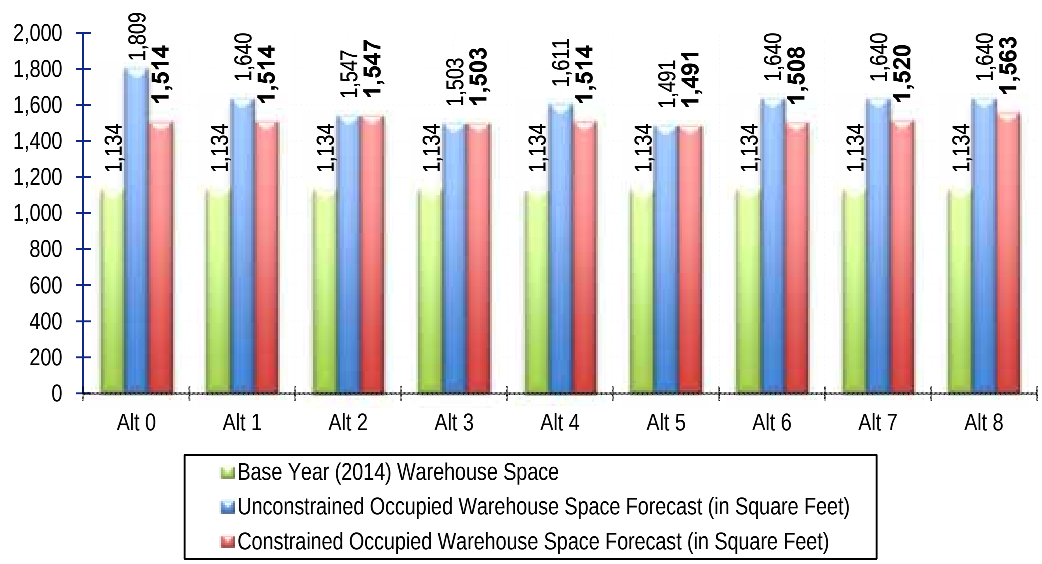
Note: Added cargo = forecast minus existing cargo; New development = New warehouse building constructed on planned industrial land or developable space for warehousing; and Replaced development = New warehouse building constructed on industrial land with existing obsolete warehouse building.
All" developments refer to warehouse buildings belonging to all cargo markets and functional uses; not just the cargo market or functional use that the alternate scenario is defined for.
Alternate scenarios Alt 2 to Alt 8 include the effects of Alt 1, which is efficiency gain for all new developments or added cargo; thus, Alt 1 scenario also can be considered as a modified baseline scenario.

Alternate Scenarios Future Occupied Warehouse Space Evaluation Results of the Model

Figure ES.1 and Table ES.2 show model results for region-level demand for warehouse space under unconstrained supply and constrained supply conditions in 2014 and 2040 scenarios, which was used to compare supply shortfall across the scenarios.

Table ES.3 and Table ES.4 show the model results for region-level demand for warehouse space under unconstrained supply and constrained supply conditions in 2014 and 2040 scenarios by cargo submarket type and by submarket area, respectively, which was used to compare cargo submarket type and submarket area shares of the total across the scenarios.

Figure ES.1 Alternate Scenarios Comparison of Southern California Association of Government (SCAG) Region-Level Warehousing Space Forecasts, 2014 versus 2040 Unconstrained versus 2040 Constrained
Millions of Square Feet



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario, Alt 1: Baseline Scenario plus Efficiency Gain, Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings, Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share, Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share, Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario, Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table ES.2 SCAG Region-Level Warehousing Space Forecasting Model Key Results, 2040

Millions of Square Feet

Alternate Number	Alternate Scenario Name	2040 Unconstrained Occupied Warehousing Space	2040 Constrained Occupied Warehousing Space	Shortfall in Occupied Warehousing Space	First Year of Shortfall >5 Million Square Feet
0	Baseline	1,809	1,514	295	2029
1	Baseline Scenario plus Efficiency Gain	1,640	1,514	126	2035
2	Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings	1,547	1,547	0	N/A[a]
3	Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share	1,503	1,503	0	N/A[a]
4	Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share	1,611	1,514	97	2036
5	Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share	1,491	1,491	0	N/A[a]
6	Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario	1,640	1,508	132	2035
7	Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario	1,640	1,520	120	2035
8	Baseline Scenario plus Efficiency Gain plus Increased Developable Space	1,640	1,563	77	2037

Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

[a] Indicates in this scenario that the region does not run out of warehousing space in the timeframe considered.

Table ES.3 Unconstrained Occupied Warehouse Space by Cargo Submarket, 2014 and 2040 by Alternate Scenario

Millions of Square Feet

Cargo Market	Cargo Submarket	2014 Occupied Warehouse Space	2040 Unconstrained Occupied Warehouse Space by Alternate Scenario								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
Port Related		126.6	226.2	219.8	212.9	197.0	211.6	231.8	219.0	226.2	226.2
1	Ports Import Loads to Crossdock Transload Facilities	4.0	8.2	8.1	8.2	11.9	8.2	8.3	8.2	8.2	8.2
2	Ports Import Loads to Small RDCs (<500,000 SF)	16.2	25.5	24.7	25.5	25.5	25.5	25.8	25.3	25.5	25.5
3	Ports Import Loads to Mega RDCs (>=500,000 SF)	11.7	17.0	16.6	22.3	17.0	21.0	17.1	16.8	17.0	17.0
4	Ports Import Loads to Import Warehouses	81.8	161.6	157.3	142.9	128.7	142.9	164.3	157.8	161.6	161.6
5	Ports Export Loads to Export Warehouses	12.8	13.9	13.2	13.9	13.9	13.9	16.2	10.9	13.9	13.9
Border-Crossing Related		14.4	31.2	31.1	30.9	31.2	30.9	25.2	38.2	31.2	31.2
6	Border-Crossing Import Loads to Crossdock Transload Facilities in Imperial County	0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.4	0.3	0.3
7	Border-Crossing Import Loads to Small RDCs (<500,000 SF)	0.8	1.3	1.3	1.3	1.3	1.3	1.1	1.5	1.3	1.3
8	Border-Crossing Import Loads to Mega RDCs (>=500,000 SF)	0.5	0.9	0.9	1.0	0.9	1.0	0.7	1.0	0.9	0.9
9	Border-Crossing Import Loads to Import Warehouses (Excl. Exports via Ports)	6.5	14.7	14.7	14.3	14.7	14.3	11.9	18.0	14.7	14.7
10	Border-Crossing Export Loads to Export Warehouses (Excl. Imports via Ports)	6.5	14.0	14.0	14.0	14.0	14.0	11.1	17.3	14.0	14.0

Cargo Market	Cargo Submarket	2014 Occupied Warehouse Space	2040 Unconstrained Occupied Warehouse Space by Alternate Scenario								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
Domestic		993.5	1,382.6	1,295.6	1,259.2	1,382.6	1,248.8	1,382.9	1,382.6	1,382.6	1,382.6
11	Domestic Loads to Small RDCs (<500,000 SF)	129.5	184.0	171.8	184.0	184.0	184.0	184.0	184.0	184.0	184.0
12	Domestic Loads to Mega RDCs (>= 500,000 SF)	93.2	124.4	119.9	178.5	124.4	168.2	124.4	124.4	124.4	124.4
13	Domestic Loads to General Purpose Warehouses	770.8	1,074.1	1,003.9	896.6	1,074.1	896.6	1,074.5	1,074.1	1,074.1	1,074.1
Total		1,134.4	1,640.0	1,546.6	1,502.9	1,610.8	1,491.3	1,639.8	1,639.8	1,640.0	1,640.0

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table ES.4 Constrained Occupied Warehousing Space by Submarket Area, 2014 and 2040 by Alternate Scenario

Millions of Square Feet

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space	2040 Occupied Warehouse Space by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
1	Long Beach Area Ind	15,431	22,845	22,845	25,566	22,845	22,845	22,845	22,845	22,845	22,845
2	Carson/Rancho Domingz Ind	58,063	67,715	67,723	78,109	67,773	67,758	67,773	67,623	67,879	67,723
3	Lynwood/Paramount Ind	8,213	8,228	8,228	9,320	8,228	8,228	8,228	8,228	8,229	8,228
4	Mid-Counties-LA Ind	58,491	62,376	62,376	71,320	62,376	62,376	62,377	62,376	62,379	62,376
5	Vernon Area Ind	47,418	59,179	59,189	58,570	59,203	59,208	59,203	59,156	59,245	59,189
6	Commerce Area Ind	52,349	54,952	54,952	63,199	54,952	54,953	54,952	54,949	54,957	54,952
7	Southwest SGV Ind	6,339	6,341	6,341	7,445	6,341	6,341	6,341	6,341	6,342	6,341
8	Lower SGV Ind	63,737	88,921	88,921	97,593	88,921	88,921	88,921	88,921	88,924	88,921
9	Eastern SGV Ind	18,764	18,919	18,919	21,428	18,919	18,919	18,919	18,919	18,920	18,919
10	West San Bernardino County Ind	41,460	43,857	43,857	46,666	43,857	43,857	43,857	43,857	43,859	43,857
11	Ontario Airport Area Ind	159,545	257,776	257,816	268,872	257,992	257,816	257,979	257,715	257,693	257,816
12	East San Bernardino County Ind	69,335	72,127	72,127	74,732	72,127	72,127	72,127	72,127	72,128	72,901
13	Gardena/110 Corridor Ind	20,659	24,580	24,591	25,180	24,590	24,599	24,590	24,573	24,611	24,591
14	Central LA Ind	54,367	68,519	68,552	65,525	68,551	68,618	68,551	68,479	68,637	68,552
15	El Segundo/Hawthorne Ind	9,895	11,067	11,155	12,280	11,152	11,357	11,152	10,959	11,373	11,155
16	North Orange County Ind	63,803	69,181	69,181	71,410	69,181	69,181	69,181	69,181	69,185	69,181
17	West Orange County Ind	20,847	21,250	21,250	23,443	21,250	21,250	21,250	21,250	21,251	21,250
18	Riverside Ind	72,430	121,786	121,767	124,535	121,850	121,767	121,880	121,711	121,685	170,728
19	North San Bernardino County Ind	11,208	38,143	38,065	28,187	38,120	38,065	38,113	38,053	38,078	38,029
20	Westside Ind	8,335	8,461	8,461	9,952	8,461	8,461	8,461	8,461	8,461	8,461
21	SFV East Ind	54,897	56,310	56,314	65,184	55,665	56,314	55,665	56,311	56,320	56,314
22	East LA Cnty Outlying Ind	17	22	22	22	22	22	22	22	22	22
23	Ventura County Ind	25,676	31,285	31,589	29,991	31,561	31,595	27,029	31,381	31,847	31,590
24	Coachella Valley Ind	6,742	31,512	31,464	7,601	31,557	31,464	31,506	31,457	31,474	31,464

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space	2040 Occupied Warehouse Space by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
25	Corona Ind	15,899	16,732	16,732	17,235	15,994	16,732	15,994	16,732	16,733	16,732
26	Northwest SGV Ind	11,367	11,523	11,523	13,148	11,523	11,523	11,523	11,523	11,523	11,523
27	Orange County Outlying Ind	240	240	240	240	240	240	240	240	240	240
28	John Wayne Airport Area Ind	35,994	36,518	36,518	42,846	36,518	36,518	36,518	36,518	36,519	36,518
29	Santa Clarita Valley Ind	11,537	11,721	11,721	12,842	11,721	11,721	11,721	11,721	11,721	11,721
30	SFV West Ind	20,516	24,480	24,480	24,273	22,781	24,480	20,593	24,480	24,481	24,480
31	South Orange County Ind	14,323	18,266	18,372	14,917	14,743	18,375	14,743	18,283	18,483	18,372
32	South Riverside County Ind	22,015	34,129	34,078	23,762	34,078	34,078	29,183	34,072	34,085	34,078
33	Upper SGV Ind	15,988	16,078	16,078	18,255	16,078	16,078	16,078	16,078	16,078	16,078
34	Torrance/Beach Cities Ind	22,402	24,225	24,260	25,410	22,780	24,260	22,780	24,230	24,297	24,260
35	San Bernardino County Outlying Ind	106	115	115	127	115	115	115	115	115	115
36	Riverside County Outlying Ind	112	112	112	119	112	112	112	112	112	112
37	Conejo Valley Ind	9,209	11,737	11,737	10,722	9,579	11,737	9,579	11,737	11,738	11,737
38	NE LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
39	Antelope Valley Ind	5,166	46,970	46,942	47,081	46,841	46,942	46,839	46,894	46,994	46,834
40	NW LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
41	Ventura Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
42	Imperial County Ind	1,540	15,889	15,095	9,450	14,326	14,754	14,323	10,331	20,091	15,079
43	Catalina Island Ind	2	2	2	3	2	2	2	2	2	2
Total		1,134,435	1,514,091	1,513,711	1,546,557	1,502,926	1,513,710	1,491,266	1,507,963	1,519,559	1,563,286

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Travel and Air Quality Impacts Assessment Results of the Model

Table ES.5 and Table ES.6 show the model results for region-level truck trips generated by warehouses and the associated vehicle miles traveled (VMT) under constrained supply conditions in 2014 and 2040 scenarios by cargo market type, which are used to compare travel impacts across the scenarios.

Figure ES.2 and Figure ES.3 show the model results for region-level cargo market type distributions for truck trips generated by warehouses and the associated VMT under constrained supply conditions in 2014 and 2040 baseline scenario, which are used to compare cargo market type shares of the total trips with cargo market type shares of the total truck miles traveled in 2014 and 2040.

Table ES.7 shows the model results for region-level emissions due to truck trips generated by warehouses under constrained supply conditions in 2014 and 2040 scenarios by air pollutant type, which is used to compare air quality impacts across the scenarios.

Table ES.5 Constrained Occupied Warehousing Space-Related Daily Truck Trips Generated by Cargo Market Type, 2014 and 2040 by Alternate Scenario

Thousands

Cargo Market Type	2014 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type by Alternate Scenario Number								
		Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
Port Related	121	232	220	214	203	188	202	225	213	220
Border-Crossing Related	15	33	32	32	32	32	32	26	40	32
Domestic	948	1,171	1,195	1,236	1,161	1,224	1,155	1,190	1,200	1,243
Total	1,084	1,436	1,447	1,481	1,395	1,444	1,389	1,441	1,452	1,495

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

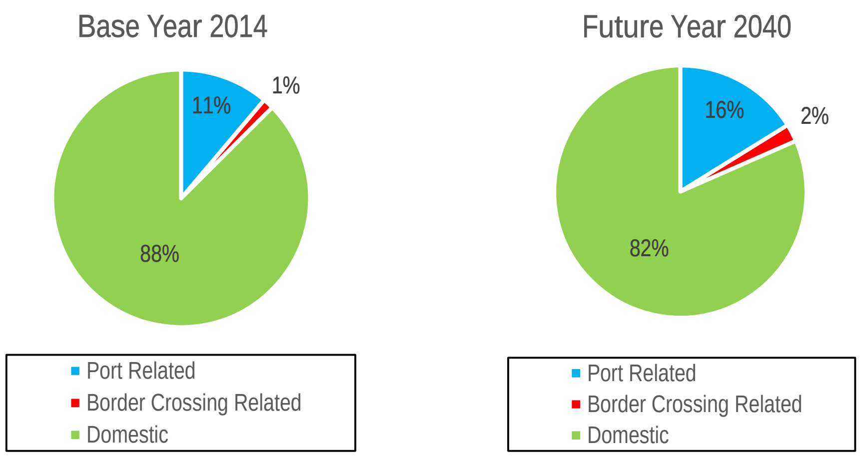
Table ES.6 Constrained Occupied Warehousing Space-Related Daily Truck VMT for Truck Trips Generated by Cargo Market Type, 2014 and 2040 by Alternate Scenario
Thousands

Cargo Market Type	2014 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type by Alternate Scenario Number								
		Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
Port Related	3,698	7,204	6,695	6,129	6,168	5,580	6,124	7,017	6,343	6,582
Border-Crossing Related	1,610	2,343	2,399	2,918	2,421	2,436	2,418	2,116	2,790	2,397
Domestic	47,396	58,567	59,753	61,776	58,031	61,177	57,742	59,479	59,981	62,163
Total	52,705	68,114	68,847	70,822	66,619	69,193	66,283	68,612	69,115	71,142

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

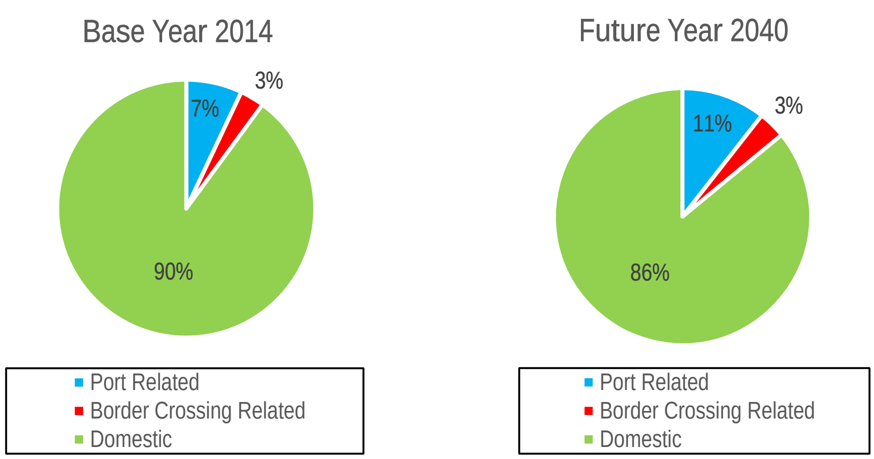
Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Figure ES.2 Regional Occupied Warehousing Space-Related Daily Truck Trips Distribution by Cargo Market Type under Baseline Scenario, 2014 and 2040 Constrained



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Figure ES.3 Regional Occupied Warehousing Space-Related Daily Truck VMT Distribution by Cargo Market Type under Baseline Scenario, 2014 and 2040 Constrained



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Table ES.7 Constrained Occupied Warehousing Space-Related Regional Total Emissions Due to Truck Trips in Tons per Day by Air Pollutant Type, 2014 and 2040 by Alternate Scenario

Tons per Day

Scenario Number	Air Pollutant Type	2014 Emissions	2040 Emissions								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
1	ROG	9.2	2.6	2.6	2.7	2.5	2.6	2.5	2.6	2.6	2.7
2	TOG	11.4	4.0	4.0	4.2	3.9	4.1	3.9	4.0	4.1	4.2
3	CO	75	25	25	26	25	26	25	25	26	26
4	NO_x	278	35	35	36	34	35	34	35	35	36
5	CO2	71,367	90,609	91,585	94,212	88,621	92,044	88,174	91,271	91,940	94,637
6	PM_{10}	4.08	0.34	0.35	0.36	0.33	0.35	0.33	0.34	0.35	0.36
7	$PM_{2.5}$	3.90	0.33	0.33	0.34	0.32	0.33	0.32	0.33	0.33	0.34

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Notes: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

ROG = Reactive Organic Gases; TOG = Total Organic Gases; CO = Carbon monoxide; NO_x = Oxides of Nitrogen; CO_2 = Carbon-dioxide; PM_{10} = Particular Matter with a diameter of 10 micrometers or less; and $PM_{2.5}$ = Particular Matter with a diameter of 2.5 micrometers or less.

Findings and Policy and Decision-Making Implications

The model results indicate that demand for warehousing space will likely outpace supply under six out of the nine scenarios (including the baseline scenario) over the planning horizon up to the year 2040, which could have an impact on the SCAG region's ability to facilitate efficient and effective logistics activities. Shortages in supply could start to appear as early as 2029, depending on the scenario. Even under the scenarios without a supply shortfall by 2040, significant private investment into new construction and operational improvements would be needed, and strong support for permitting would be needed from local jurisdictions.

The model results indicated that the biggest gains in warehouse square footage will be derived through replacing obsolete buildings with more efficient facilities and through construction of new warehouses and RDCs on currently undeveloped land. Based on the model results, these are the only two options for appreciably increasing the overall supply of warehousing in the region.

Upgrading warehouse operating efficiencies is important for improving productivity in the goods movement industry, and it will have the effect of reducing unconstrained demand in the region. However, this improvement in efficiencies and productivity will not be enough to avoid shortfalls in supply versus demand.

Some industry trends, alternate freight forecasts, and regional and local policies may serve as demand management strategies, which can further reduce the warehouse space needed in the future.

By 2040, the region overall would have an increase in truck VMT, although air quality impacts would reduce as a result of less polluting truck fleet in the future.

Table ES.8 shows the policy and decision-making implications of the model results to various public and private stakeholders.

Table ES.8 Policy and Decision-Making Implications to Stakeholders under Alternate Scenarios

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
0	Baseline Scenario	• A shortfall of 295 million SF of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. This is the worst case scenario. • Approximately 33% increase in truck trips and 29% increase in truck VMT over 2014 level under warehouse space forecasting model assumptions, however, substantial drop in truck emissions.	N/A	N/A	N/A	N/A
1	Baseline Scenario plus Efficiency Gain	• Efficiency improvements for new developments would increase regional economic competitiveness (see efficiency gains in Table 1.3). • A shortfall of 126 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 34% increase in truck trips and 31% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• In areas where new buildings are constructed, greater efficiencies imply more cargo handled per square foot of space consumed.	• BCOs would benefit from greater productivity in the new buildings meeting their physical configuration and operational characteristics requirements, and resulting in better customer service.	• There would be investment opportunities for developers to construct new buildings with modern design features and services in submarket areas with developable space.	• Warehouse operators would attract more customers to new developments with modern building features and services.
2	Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings	• Includes implications in Scenario 1 in terms of regional economic competitiveness • Efficiency improvements for replaced obsolete facilities would increase regional economic competitiveness (see efficiency gains in Table 1.3). • The existing supply is expected to fully meet the regional demand for warehouse space up to 2040 under warehouse space forecasting model assumptions. This is one of the possible best case scenarios. • Approximately 37% increase in truck trips and 34% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Local governments would see more renovation-related construction in areas where there are obsolete buildings. • Local governments decide to preserve the existing land use designation for warehouse parcels.	• Same implications as in Scenario 1.	• Same implications as in Scenario 1.	• Same implications as in Scenario 1.

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
3	Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • Mega RDCs would help BCOs achieve economies of scale, thus, would improve regional economic competitiveness (see Sections 1.1 and 1.3 and Task 3 Report). • The existing supply is expected to fully meet the regional demand for warehouse space up to 2040 under warehouse space forecasting model assumptions. This is one of the possible best case scenarios. • Approximately 29% increase in truck trips and 26% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • This would create economic development opportunities, but also concentrated local traffic impacts in municipalities in Inland Empire and northern reaches of Los Angeles County the most, as there are large amounts of developable space and contains large-sized parcels to accommodate building sizes of 500,000 square feet or more. • However, a few mega RDC developments also may occur in other submarket areas where there is developable space, compatible land uses, and local support. • Local governments develop policy and ordinances to support development of mega RDCs.	• Includes implications in Scenario 1. • Large BCOs would benefit from greater supply chain productivity with the use of larger, more modern facilities.	• Developers of large facilities would see more opportunities in submarket areas with developable space for mega RDCs.	• Operators of large facilities would see more opportunities in submarket areas with new mega RDC developments.

Table ES.8 Policy and Decision-Making Implications to Stakeholders under Alternate Scenarios (continued)

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
4	Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • Crossdock transloading facilities would support a growing segment of port-related transloading customers. Through a high cargo turnover rate, they would also reduce demand for port-related warehouse space (see Sections 1.1 and 1.3 and Task 3 Report). • A shortfall of 97 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 33% increase in truck trips and 31% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Local jurisdictions near the ports would see an increase in demand for crossdock transloading, and associated truck traffic. • Local jurisdictions near the ports decide to preserve the existing land use designation for crossdock transloading purposes.	• Includes implications in Scenario 1. • This scenario is primarily BCO driven as part of BCO's overall supply chain strategy. If more crossdock transloading is accommodated, it could make Southern California more attractive to BCOs using crossdock transloading as their supply chain strategy.	• Developers would have increased opportunities for crossdock transload facilities in submarket areas near the ports.	• Crossdock transload-related third-party logistics (3PL) operators would likely see more business in submarket areas near the ports.
5	Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • Fulfillment centers would support a growing segment of e-commerce customers who require same day or two-day delivery (see Sections 1.1, 1.3 and Task 3 Report). • The existing supply is expected to fully meet the regional demand for warehouse space up to 2040 under warehouse space forecasting model assumptions. This is one of the possible best case scenarios. • Approximately 28% increase in truck trips and 26% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions. This is the best case scenario.	• Includes implications in Scenarios 1 and 3. • In fulfillment centers that are highly specialized or automated, skilled workforce opportunities may benefit local jurisdictions.	• Includes implications in Scenarios 1 and 3 • By providing same day or two-day delivery service, BCOs would become more attractive to e-commerce customers.	• Includes implications in Scenarios 1 and 3	• Includes implications in Scenario 1. • Operators of large facilities, but workforce specialized in fulfillment center operations would see more opportunities in submarket areas with new mega RDC developments.

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
6	Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • This scenario reflects SCAG's alternate freight forecast for border-crossing cargo, which is lower than the baseline scenario. This would reduce demand for border-crossing-related warehouse space, but increase demand for port-related warehouse space (see Section 1.3 and SCAG Goods Movement Border Crossing Study and Analysis – Phase II Report). • A shortfall of 132 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 33% increase in truck trips and 30% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Cities in Imperial County would see less economic development opportunities than the baseline scenario. • Communities closer to the ports could see rise in traffic levels in the short term, but on the long term, the impacts would be similar to the baseline scenario. Communities along the Mexico-U.S. border would see an increase in traffic levels lower than the baseline scenario both in the short and long term.	• Includes implications in Scenario 1. • BCOs would have reduced benefits of the North American Free Trade Agreement (NAFTA) trade benefits, as the overall transportation cost will be higher than the baseline scenario.	• Includes implications in Scenario 1. • Developers might see a slower increase in demand for warehousing in Imperial County to attract cargo from Mexico.	• Includes implications in Scenario 1. • Although port-related warehouse operations near San Pedro Bay Ports would see a rise, the decline in demand for border-crossing-related warehouse operations would be replaced by domestic warehouse operations.

Table ES.8 Policy and Decision-Making Implications to Stakeholders under Alternate Scenarios (continued)

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
7	Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • This scenario reflects SCAG's alternate freight forecast for border-crossing cargo, which is higher than the baseline scenario. This would increase demand for border-crossing-related warehouse space, but reduce demand for port-related warehouse space (see Section 1.3 and SCAG Goods Movement Border Crossing Study and Analysis – Phase II Report). • A shortfall of 120 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 34% increase in truck trips and 31% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Cities in Imperial County would see more economic development opportunities than the baseline scenario. • Communities closer to the ports could see lower traffic levels in the short term, but on the long term, the impacts would be similar to the baseline scenario. Communities along the Mexico-U.S. border would see an increase in traffic levels higher than the baseline scenario both in the short and long term.	• Includes implications in Scenario 1 • BCOs would have increased benefits of NAFTA trade benefits as supply chain benefits (such as ease of quality control and lower overall transportation cost), will be higher than the baseline scenario.	• Includes implications in Scenario 1 • Developers might see a faster increase in demand for warehousing in Imperial County to attract cargo from Mexico.	• Includes implications in Scenario 1 • Although port-related warehouse operations near San Pedro Bay Ports would see a decline, the demand would be replaced with border crossing-related and domestic warehouse operations.
8	Baseline Scenario plus Efficiency Gain plus Increased Developable Space	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • This scenario reflects some of the local governments' recent approval of development proposals and tentative land use conversions. This would delay the projected year when the region would start experiencing a warehouse supply shortfall. • A shortfall of 77 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 38% increase in truck trips and 35% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions. This is the worst case scenario.	• Includes implications in Scenario 1. • The additional land for warehousing is assumed to be available in eastern part of Inland Empire. Travel impacts would increase due to added traffic from facilities that are anticipated to be built in this scenario. • This scenario may impose a number of policy considerations to local governments as it assumes land use type conversions, potential traffic increase, and transportation facility adequacy to handle increased traffic, etc.	• Includes implications in Scenario 1. • BCOs will have more choices and more warehouse capacity to work with.	• Includes implications in Scenario 1. • Real estate developers will benefit because of greater development opportunities.	• Includes implications in Scenario 1. • Warehouse operators will benefit because of greater growth opportunities.

Source: Cambridge Systematics, Inc.

1.0 Evaluation Framework

This section provides a recap of the identified industry trends and the defined baseline scenario in Tasks 3 and 4 reports of this study, respectively. It then continues to develop an evaluation framework for warehousing-related public scenario planning and policy-making. For this, alternate warehousing scenarios are defined not only based on the industry trends, but also alternate freight forecasts and state and local policies. Lastly, the parameters and calculations that implement these alternate warehousing scenarios are identified in this section.

1.1 A Recap of Warehousing-Related Industry Trends

In Task 3 report of this study, six historical and five emerging industry trends were discussed; all of which are meant to satisfy customer demand and increase operating efficiency of beneficial cargo owners (BCO). Some of the industry trends were evaluated in this report using warehouse space forecasting model.

The historical trends in Task 3 report included: 1) increasing share of mega regional distribution centers (RDC), 2) increasing share of transloading and crossdock transloading, 3) changes in RDC location strategy, 4) a growing trend in integration of value-added services into warehouse facility operation, 5) use of supply chain integration strategies such as vendor-managed inventory, and 6) growing use of information technology (IT) in cargo-handling facilities. The emerging trends in Task 3 report included: 1) development of multimodal logistics centers, 2) increasing near-shoring and re-shoring, 3) increasing warehouse automation, 4) a growing share of on-line or electronic retail order placement and fulfillment, and 5) growing potential for compressed time of order fulfillment enabled by alternate delivery systems. Some of these trends apply to only particular BCOs, and help them reduce total landed costs and increase market shares. Some of these trends also strongly relate to the needs of third-party logistics (3PL) firms that operate warehouse facilities on behalf of the BCOs, while others, such as changes in RDC location strategy, use of vendor-managed inventory, increasing near-shoring and re-shoring, weakly relate to 3PL needs.

The changes in BCO's business profile, as well as the changes in requirements of the 3PL's BCO customers, influence the location; physical configuration (facility type, layout, size, ceiling height, etc.); and operational characteristics (cargo turnover rate, stacking type, level of IT used in cargo handling and automation, etc.) of future warehouse facilities. Some of the industry trends were evaluated using the warehouse space forecasting model[1] over a planning horizon (up to the year 2040), as discussed in Section 1.3 of this report.

[1] This is a warehousing supply and demand model improved as part of the Task 4 report of this study.

Some of the industry trends were not evaluated or modified for evaluation purposes in this study for the following reasons:

1. Some of the industry trends are applicable to particular BCOs and 3PLs serving them. For example, according to a WSJ article[2]:

   > "The biggest shippers, including Wal-Mart Stores Inc., Home Depot Inc., and Target Corp., have employed for years what is known in the industry as a four-corner strategy, in which networks are expanded to include warehouses at northern and southern ports on both coasts and the Gulf of Mexico. Now even smaller companies are diversifying."

   The four-corner strategy and other such RDC location strategies are too firm specific and studying the firms' market shares and location preferences for warehousing within North America is beyond this study. Their impacts on physical configuration and operational characteristics would be difficult to represent in a public and macroscopic warehouse space forecasting model.

   However, this is an important industry trend for regional policy-makers to monitor and/or further study because the competition between ports and warehouse markets can have long-term economic effects, such as geographical shift in warehousing-related employment and change in cost of business, etc.

2. Certain industry trends do not result in substantial changes in occupied warehouse space. For example, integration of value-added services would result in a small increase in dwell times of cargo at warehouse facilities with such services, but no noticeable changes in regional-level occupied warehouse space over the planning horizon.

   However, this is an important industry trend for regional policy-makers to monitor and/or further study, because such operations can have short-term economic effects, such as workforce training, warehouse facilities reconfiguration/redevelopment, etc.

3. Understanding the implications of compressed time of order fulfillment, such as "Amazon Prime" offering same-day delivery on occupied warehouse space, requires an hourly or daily operational-level analysis of freight movements into/out of warehouses. This is beyond the capability of the warehouse space forecast model, which is an annual supply and demand model.

   However, this is an important industry trend for regional policy-makers to monitor and/or further study, because such operations can have short-term economic effects, such as additional traffic conflicts, prolonged hours of service, etc.

4. Lastly, the level of usage of IT in cargo handling and the level of warehouse automation could not be identified in the existing warehouse inventory.

   Noting that these industry trends tend to improve operational efficiency of warehouse facilities, a generalized efficiency gain scenario was developed in this study, as discussed later in Section 1.3 of this report.

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[2] Laura Stevens and Paul Ziobro, Ports Gridlock Reshapes the Supply Chain, Wall Street Journal Article, March 5 2015. Available at: http://www.wsj.com/articles/ports-gridlock-reshapes-the-supply-chain-1425567704 (last accessed on June 30, 2016).

1.2 A Recap of Baseline Scenario of Warehouse Space Forecasting Model

In Task 4 report, a spreadsheet-based warehouse space forecasting model was developed to estimate future supply and demand for warehouse space in 43 geographical submarket areas of the Southern California Association of Government (SCAG) region and three cargo markets; namely, "port-related," "border crossing-related" and "domestic." The three cargo markets were further broken down into 13 cargo submarkets to simultaneously also represent the functional use of warehouse building; namely, crossdock transloading, general purpose warehouse, small RDC or mega RDC.

The model consisted of a comprehensive warehouse space inventory for the year 2014 using a detailed warehouse facility location and type data. The inventory provided existing occupied and vacant space at regional and submarket area level by functional use of warehouse building. Based on local land use plan data, a baseline supply of developable space was estimated. Port-related baseline cargo forecasts[3] and border crossing-related baseline cargo forecasts[4] were combined with predictions of overall cargo forecasts[5] to estimate regional-level future unconstrained occupied warehouse space by cargo submarket under the baseline scenario. Under the baseline scenario, the warehouse stops distribution for port-related imported cargo was kept similar to existing conditions. Under the baseline scenario, the share of functional uses of building was kept similar to existing conditions. Future cargo loads were converted to future storage space under the baseline scenario using existing operational efficiency parameters of Avison-Young[6] formula; that is, no efficiency gain over time was assumed. The regional-level demand for warehouse space was allocated to 43 submarket areas, while taking into account the constraints of available vacant and developable space in each submarket area. Developable space over and above the existing developable space, that is new developable space, was added only in Imperial County and that too for border crossing-related freight purposes when the existing developable space runs out. No other new developable space was assumed under the baseline scenario.

In this report, the baseline scenario also is referred to as Alt zero (or Alt 0) for convenience.

1.3 Warehousing-Related Alternate Scenarios

This section defines warehousing-related alternate scenarios that could affect the supply and demand for warehousing space. These scenarios are developed not only based on

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[3] Based on the most recent and available San Pedro Bay Ports cargo forecasts.

[4] Based on SCAG Goods Movement Border Crossings Study and Analysis – Phase II cargo forecasts.

[5] Based on a relationship between historical occupied warehouse space in SCAG region and historical U.S. gross domestic product (GDP), applied on U.S. GDP forecasts from REMI PI+ Version 3.6.1 economic model for SCAG.

[6] Avison-Young is commercial real-estate services firm. They developed a formula to convert warehoused loads in twenty-foot equivalent units (TEU) to warehouse space in square feet using parameters, including container cargo capacity, container storage efficiency, warehouse cubic space utilization, capacity utilization, cargo turnover rate, and ceiling height of building.

some of the industry trends mentioned in Section 1.1 of this report, but also alternate freight forecasts and vehicle emission regulations by the State of California and local land use policies that were available.

Definitions of the alternate scenarios are provided below.

Alternate Scenario 1. Baseline Scenario plus Efficiency Gain (or Alt 1)

Alternate Scenario 1 is designed to test the industry trends of growing use of IT in cargo-handling facilities and increasing warehouse automation, which tend to increase operational efficiency of warehouse buildings through reduced manual operations, use of conveyors, sorters, robots, and other automated cargo-handling equipment, narrower spacing between aisles, tall storage racks, and higher stacking capability.

Additional operational efficiency gain also would come from locating new developments (that is, warehouse building developments in planned industrial lands for warehousing) with a higher allowable ceiling height than the average ceiling height for existing warehouse buildings.

For this scenario, it is assumed that the operational efficiency gains would be applicable only to added cargo (that is, forecast minus existing cargo), and existing cargo would continue to be handled at existing operational efficiency. This results in an increase in storage capacity utilization, and a reduction in unconstrained occupied warehouse space for added cargo compared to the baseline scenario.

All other alternate scenarios (Alt 2 to Alt 8) are assumed to include the effects of Alternate Scenario 1; thus, this scenario also can be considered as a modified baseline scenario.

Alternate Scenario 2. Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings (or Alt 2)

BCOs and 3PLs want distribution centers (DC) and warehouses that enable them to efficiently execute their supply chain strategies. However, a high percentage of facilities near the San Pedro Bay Ports can be considered functionally obsolete. Many of these older buildings are still in use because BCOs and 3PLs prefer to operate close to the ports, even though the building configuration and operational characteristics may not be optimal.

Alternate Scenario 2 is developed by superimposing the effects of Alternate Scenario 1 with a regional policy to support replacement of older, functionally obsolete warehouse buildings with those that have higher ceilings, modern design, and better interior layouts. The replacement developments result in preservation of warehousing land uses, an increase in storage capacity utilization, and a reduction in unconstrained occupied warehouse space for existing and added cargo compared to the baseline scenario.

Although there is a possibility for rezoning of the land on which warehouse buildings are torn down and used for purposes other than warehousing, this was not evaluated in this study. However, this scenario allows for regional policy-makers to consider what it takes to balance various land use types and interests, and their associated impacts.

Alternate Scenario 3. Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share (or Al 3)

Southern California is a large population center and retailers locate RDCs here to replenish inventories in stores that cater to consumers. An increasing number of large retailers is shifting to operating mega RDCs to gain operating efficiencies and economies of scale, and Southern California is a logical place to operate a mega RDC. The rise of e-commerce also is associated with greater use of mega RDCs, since they have high ceilings and more square footage to accommodate large pieces of automated cargo-handling equipment, as well as sizable yards for container and trailer storage. Historical trends in the CoStar® Property database also are evidence to a faster growth in number of mega RDCs, the new developments have mainly been in the Inland Empire and the northern reaches of Los Angeles County as opposed to near-port communities.

Alternate Scenario 3 is designed to test the industry trend of increasing share of mega RDCs, while also considering the effects of efficiency gains to all added cargo assumed in Alternate Scenario 1. Mega RDCs are defined in this study as RDCs with greater than or equal to 500,000 square feet of building area.[7] Under this scenario, mega RDCs form a higher share of total regional unconstrained occupied warehouse space than the baseline scenario, and as a result a higher share of developable space is allocated to new mega RDC developments than the baseline scenario. Much of the developable space in the SCAG region is located in Inland Empire and northern reaches of Los Angeles County, so the historical trend is expected to continue. Due to higher ceilings and better space utilization of mega RDCs over general purpose warehouses, overall square footage demand is likely to decrease.

Alternate Scenario 4. Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share (or Alt 4)

The 3PL interviews conducted for this study indicated that an increasing number of their customers are requesting transloading and, in particular, port-related crossdock transloading. These 3PL facilities are running close to capacity and operate 24/7. An increase in port-related cargo forecasts will likely increase this crossdock transload activity and cause 3PLs to seek additional warehouse space in municipalities close to the San Pedro Bay Ports in the near- to mid-term, either by relocating to larger facilities or operating multiple small facilities. Stand-alone crossdock transloading warehouses typically are not large, but nearly always are located in relative proximity to the San Pedro Bay Ports, because the nature of the activity is time-sensitive. Some 3PLs perform crossdock transloading in multipurpose warehouses, which usually are larger than the stand-alone facilities. With a day to two days' time for cargo turnover, there is very limited storage for cargo that is crossdock transloaded.

Increasing share of crossdock transloading has two important policy implications, which are: 1) it encourages further shift from "push" to "pull" logistics, which benefits San Pedro Bay Ports by faster removal of containers and better utilization of container storage area or

[7] Mega RDCs also can be defined in the warehouse space forecasting model using higher threshold values of building area, namely, 750,000 square feet or 1,000,000 square feet. The default threshold value of building area is 500,000 square feet; and this was used in the evaluation of all alternate scenarios.

a higher throughput; and 2) it emphasizes the need for near-port municipalities to preserve as much industrial land as possible for this purpose.

Alternate Scenario 4 is used to test increasing share of port-related crossdock transloading in near-port communities from both industry trend and local policy perspectives, while also considering the effects of efficiency gains to all added cargo assumed in Alternate Scenario 1. Due to a much higher cargo turnover rate of crossdock transloading facilities, overall square footage demand is likely to decrease. In the evaluation of this scenario, only existing vacant and developable space in near-port submarket areas was used; however, the near-port municipalities also can consider the possibility of redeveloping obsolete buildings of any existing land use type as crossdock transload facilities, if the size, layout, and existing conditions are suited for this purpose; and nearby land uses are compatible.

Alternate Scenario 5. Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share (or Alt 5)

E-commerce is growing as a share of overall retail sales, especially for large retailers. Rather than fulfilling Internet orders in multipurpose RDCs, retail giants, such as Amazon, Walmart, and Home Depot, have begun establishing stand-alone e-commerce and fulfillment centers. These facilities are highly automated in order to handle the multitude of consumer orders having one or only a few items, which is operationally somewhat different from a regular RDC that processes cartons to replenish store inventory.

Alternate Scenario 5 treats e-commerce and fulfillment centers as a type of mega RDCs, because they typically exceed 500,000 square feet of building area, but with a higher cargo turnover rate due to customer demand for quick order fulfillment. This scenario increases the share of e-commerce and fulfillment centers within all mega RDCs, while also considering the effects of efficiency gains to all added cargo assumed in Alternate Scenario 1, and the effects of increased share of mega RDCs assumed in Alternate Scenario 3. This scenario also would result in reduction in overall square footage demand.

Alternate Scenario 6. Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario (or Al 6)

and

Alternate Scenario 7. Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario (or Alt 7)

In concurrence with this study, SCAG conducted a goods movement study for border crossings along California-Mexico border to develop freight planning strategies that address long-term trade and transportation infrastructure needs. Although the border crossings study does not isolate the effects of the industry trend of near-shoring to Mexico, it provided two distinct scenarios, namely, "high-volume" and "low-volume" scenarios that can affect the amount of overall occupied warehouse space needed in the SCAG region.

Both scenarios are based on the projections of "macro" variables of the U.S. Index of Industrial Production and the U.S. Retail Sales. The "high-volume" scenario is based on optimistic projections of the "macro" variables, and the "low-volume" scenario is based on pessimistic projections of the "macro" variables. In comparison, the "baseline" scenario (which was used in the baseline scenario in this study) is based on most-likely projections of the "macro" variables.

In addition, an evolution of border-crossing "micro" events were assumed for each scenario to influence the border-crossing cargo forecasts. Table 1.1 shows the distinction of "micro" events between the low-volume and high-volume scenarios. While the policies are similar, the improvements relating to infrastructure, border-crossing operations and regional production capacity are more aggressive in the "high-volume" scenario than in the "low-volume" scenario. The improvements in the "baseline" scenario (which was used in the baseline scenario in this study) lie in between the "high-volume" and "low-volume" scenarios.

Table 1.1 Definitions of Border-Crossing-Related "High-Volume" and "Low-Volume" Growth Scenarios

Category	"Micro" Events in Scenario
High Volume Scenario	
Infrastructure	• Port of Ensenada expands (including El Sauzal) • Intermodal facility in Tijuana is built • Cold storage facilities are built in Imperial County • East-West railroad (Desert Line) begins operations • Modernization of railroad short-line between Tijuana and Tecate is completed (including expansion of freight yards in SY and Tijuana)
Border-Crossing Operations	• Pre-inspection and other technology-based operational improvements are introduced at local LPOEs
Regional Production Capacity	• Furniture companies relocate to Tijuana from China (higher quality) • Suppliers of large maquiladoras do not relocate to Tijuana and Mexicali • High value-added manufacturing activities in Tijuana and Mexicali increase
Policy	• BC State policy to retain and expand maquiladoras succeeds • BC State policy to promote relocation of supplier companies to maquiladoras fails • Mexican policy to promote domestic suppliers fails • Maquiladoras go back to IMMEX treatment (are not charged VAT)
Low-Volume Scenario	
Infrastructure	• LPOEs in SLRC expand capacity • Holtville air cargo project begins operations
Regional Production Capacity	• High value-added manufacturing activities in Tijuana and Mexicali do not increase

Policy	• BC State policy to retain and expand maquiladoras fails • BC State policy to promote relocation of supplier companies to maquiladoras succeeds • Mexican policy to promote domestic suppliers is successful • Maquiladoras are charged fully for VAT (no reimbursement)

Source: SCAG Goods Movement Border Crossing Study and Analysis – Phase II, HDR Analysis of Economic Trends Survey and Interviews with Companies.

The border-crossing improvements enable BCOs to adopt the near-shoring strategy in their supply chains; that is, the BCOs are able to move manufacturing activities to Mexico rather than keep them overseas in countries like China. Due to relative levels of border-crossing improvements, the "high-volume" scenario is expected to support more near-shored cargo volumes than the baseline scenario, while the "low-volume" scenario is expected to support less near-shored cargo volumes than the baseline scenario. As per an ongoing SCAG Goods Movement Border Crossing Study and Analysis – Phase II, the annualized growth rate in border-crossing cargo flows between 2015 and 2040 in the baseline scenario is about 2.9 percent. In comparison to this, the low-volume growth scenario and the high-volume growth scenario have annualized growth rates of 2.1 percent and 3.7 percent, respectively. The origin-destination cargo flow pattern also is different among these scenarios.

Alternate Scenarios 6 and 7 evaluate the effects of the increase and decrease in border-crossing-related freight flows on demand for warehouse space over the planning horizon, while also considering the effects of efficiency gains to all added cargo assumed in Alternate Scenario 1. These scenarios assume that, as a result of the port-related import volume moving through the San Pedro Bay Ports, would decrease/increase commensurate with the increase/decrease in volume of border-crossing-related cargo moving via truck or rail across the Mexico-California border.

However, near-shoring also may result in some portion of goods produced in Mexico to be transported from Mexico through border crossings in Arizona and Texas destined to markets other than California. The border-crossing cargo forecasts for Tijuana and Mexicali border crossings were assumed to include such effects.

Alternate Scenario 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space (or Alt 8)

Over time, as urban in-fill development occurs in the core SCAG region and land supply for warehouses and RDCs is depleted, RDC and warehouse construction will be pushed further to the outskirts of the region. In the Inland Empire and in the northern reaches of Los Angeles County, there are large parcels that currently are not zoned for industrial warehousing.

Alternate Scenario 8 tests the impacts of an increase in the supply of warehousing space due to more buildings being approved and permitted, while also considering the effects of efficiency gains to all added cargo assumed in Alternate Scenario 1.

While this is a policy choice for municipalities to consider, this scenario allows for examining potential implications of having increased amount of developable land available to meet future demand for warehousing as a result of changes in zoning of certain parcels from nonindustrial to industrial use. Some recently industrially zoned land for warehouse projects in cities and, therefore, the submarket areas were added to the available supply.

1.4 Using the Warehouse Space Forecasting Model for Alternate Scenario Analysis

This section describes the identification of assumptions that implement the alternate scenarios in the warehouse space forecasting model. It also describes approximate methodologies used for estimation of travel impacts and air quality impacts related to warehousing.

Alternate Scenario-Specific Assumptions

The warehousing space forecasting model (as described in Task 4 report of this study) cannot capture the complete real-world complexity of policy-based alternate scenarios. Hence, some simplifying assumptions were made to mathematically define alternate scenarios and quantitatively evaluate them. These include the following:

- Alternate freight forecasts. Alternate freight forecasts were collected for port-related and border-crossing-related cargo markets only, and applied to particular port-related scenario (Alt 4) and border-crossing-related scenarios (Alt 6 and Alt 7). Predicted overall cargo forecast was not changed under any of the alternate scenarios.
- Decisions made by cargo owners and operators of warehouses. Macroscopic variables, representing physical configuration and average operational characteristics of warehouse facilities by cargo submarket, were used for all alternate scenarios. Variations were introduced in the shares of functional use type of warehouse buildings to represent particular alternate scenarios (Alt 3, Alt 4, and Alt 5). Operational efficiency gains were assumed in percentage warehouse building cubic space utilization for storage, percentage storage capacity utilization, and cargo turnover rate under all alternate scenarios.
- Condition of Buildings. The year of construction or the year of last renovation, whichever is later, was used to represent the condition of the buildings in all submarket areas. The condition information is used in only one of the alternate scenarios (Alt 2).
- Local Government Land Use Policies and Ordinances. Developable space identified from land use plan data was used for all alternate scenarios. Additional developable space based on newly approved lands by cities for warehousing was considered in one of the alternate scenarios (Alt 8). In addition, average ceiling height for new developments was assumed to be higher than existing warehouse buildings under all alternate scenarios. Similar assumption also was made for replacement developments under Alt 2. On the other hand, floor area ratios by submarket area was not changed under any alternate scenario.
- Access to Transportation and Travel Conditions. Average truck trip generation rates for high-cube warehouse and light warehouse, and average miles traveled per truck based on regional travel demand model runs, conducted as part of the 2013 SCAG

Comprehensive Regional Goods Movement Plan and Implementation Strategy (2013 SCAG CRGMPIS), were used to approximate in the evaluation of travel impacts under all alternate scenarios.

- State and Regional Air Quality Policies. California Air Resources Board's (CARB) 2014 truck-related emission factors for South California Air Basin (SCAB) over the planning horizon were used in the evaluation of air quality impacts under all alternate scenarios.[8]

In addition, a comparison of transportation-related impacts for alternate scenarios was performed. Impacts were measured in terms of warehouse-related truck vehicle miles traveled and criteria pollutant emissions. The methodologies for impacts estimation are approximate and is intended only as an indicator of the relative levels of impacts between alternate scenarios. More data collection and rigorous methods would be required in future studies.

Table 1.2 shows the alternate scenario-specific assumptions, including model inputs (existing and new) that are user controlled and changes to model calculations made with respect to the baseline scenario that are not user controlled.

Particular Input Values for Testing Alternate Scenarios

For comparing alternate scenarios using warehousing space forecasting model runs, particular values were selected for various user-controlled inputs as follows:

Modified Avison-Young (A-Y) Equation-Based Efficiency Parameters

Under the baseline scenario, for 2014 and all forecast years, the efficiency-related parameters were assumed as follows:

- u_1, u_2 are assumed to be 0.225 (or 22.5 percent) and 0.75 (or 75 percent), respectively.
- t is assumed to be 300 for crossdock transload facilities, 36 for general purpose warehouses in Imperial County,[9] 24 for fulfillment center type mega RDCs, and 12 for all other functional use types and locations of warehouse buildings.
- Roughly based on the average height in the 2014 CoStar® Property data inventory, h is assumed to vary for different functional use types of warehouse building as follows: 1) crossdock transload facility – 8 feet; 2) general purpose warehouse – 22 feet; 3) small RDC – 27 feet; and 4) mega RDC – 30 feet.

[8] http://www.arb.ca.gov/emfac/2014/ (last accessed on June 30, 2016).

[9] A higher assumption was used for Imperial County in order to balance existing supply (inventory of total existing warehouse building area) and existing demand (cargo flows converted to occupied warehouse building area).

Table 1.2 Alternate Scenario-Specific Inputs and Calculations in the Warehouse Space Forecasting Model

Alternate Number	Alternate Scenario Name	Changes to Existing Use-Controlled Inputs in Relation to Baseline Scenario	New User-Controlled Inputs	Changes to Nonuser-Controlled Calculations in Relation to Baseline Scenario
1	Baseline Scenario plus Efficiency Gain	• Modified A-Y equation-based efficiency parameters for all new developments	None	• Net efficiency gain calculation due to lowered footprint requirement for all cargo that are to be handled at new developments
2	Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings	• Modified A-Y equation-based efficiency parameters for replaced developments and all new developments	• Era definition of building that becomes obsolete by decade • Percentage of obsolete inventory to be replaced by decade	• Net efficiency gain calculation due to lowered footprint requirement for some of the existing cargo and all added cargo • Added submarket area vacant space calculation due to lowered footprint requirement for some of the existing cargo
3	Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share	• Modified A-Y equation-based efficiency parameters for all new developments	• Mega RDCs cargo loads percentage share of total cargo loads by 2040	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Mega RDCs cargo loads percentage share of total cargo loads for interim years interpolation • Reduced general purpose warehouse cargo and increased mega RDCs cargo
4	Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share	• Modified A-Y equation-based efficiency parameters for all new developments	• Crossdock transload import cargo loads percentage share of total import cargo loads by 2040	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Crossdock transload import cargo loads percentage share of total import cargo loads for interim years interpolation • Reduced Import warehouse and port-related RDC cargo loads due to increased crossdock transload import cargo loads

Alternate Number	Alternate Scenario Name	Changes to Existing Use-Controlled Inputs in Relation to Baseline Scenario	New User-Controlled Inputs	Changes to Nonuser-Controlled Calculations in Relation to Baseline Scenario
5	Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share	• Modified A-Y equation-based efficiency parameters for all new developments	• Mega RDCs cargo loads percentage share of total cargo loads by 2040 • Fulfillment center type mega RDC space percentage share of total mega RDC space by 2040	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Mega RDCs cargo loads percentage share of total cargo loads for interim years interpolation • Fulfillment center type mega RDC space percentage share of total mega RDC space for interim years interpolation • Reduced general purpose warehouse cargo loads due to increased mega RDCs cargo loads
6	Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario	• Modified A-Y equation-based efficiency parameters for all new developments	• Border-crossing-related "low-volume" scenario origin-destination freight flows data and forecasts	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Conversion of truck flows to loads and interim years interpolation • Adjustment of port-related flows to keep international freight flows a constant
7	Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario	• Modified A-Y equation-based efficiency parameters for all new developments	• Border crossing-related "high-volume" scenario origin-destination freight flows data and forecasts	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo • Conversion of truck flows to loads and interim years interpolation • Adjustment of port-related flows to keep international freight flows a constant
8	Baseline Scenario plus Efficiency Gain plus Increased Developable Space	• Modified A-Y equation-based efficiency parameters for all new developments	• Additional developable space in building area	• Net efficiency gain calculation due to lowered footprint requirement for all added cargo

Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Note: Added cargo = forecast minus existing cargo; New development = New warehouse building constructed on planned industrial land or developable space for warehousing; and Replaced development = New warehouse building constructed on industrial land with existing obsolete warehouse building.

"All" developments refer to warehouse buildings belonging to all cargo markets and functional uses, not just the cargo market or functional use that the alternate scenario is defined for.

Alternate scenarios Alt 2 to Alt 8 include the effects of Alt 1, which is efficiency gain for all new developments or added cargo; thus, Alt 1 scenario also can be considered as a modified baseline scenario.

In all alternate scenarios (Alt 1 to Alt 8), the above values are replaced for all new developments with the values shown below. In addition, under Alternate Scenario 2, the above values also are replaced for all replaced developments with the values shown below. The resulting efficiency gains by cargo submarket also are shown in Table 1.3.

- u_1 is raised from 0.225 (or 22.5 percent) to 0.25 (or 25.0 percent) for all new warehouse developments and u_2 is raised from 0.75 (or 75 percent) to 0.8 (or 80 percent) for crossdock transload facilities and fulfillment center type mega RDCs.
- h is raised from 22 feet to 25 feet for warehouses, from 27 feet to 35 feet for small RDCs, from 30 feet to 45 feet for mega RDCs.

Table 1.3 Modified A-Y Equation-Based Efficiency Parameters under All Alternate Scenarios for Warehousing

Cargo Submarket	u_1	u_2	t	h	Efficiency Gain over Baseline[a]
Import Loads to Crossdock Transload Facilities	0.25	0.80	300	8	19%
Import Loads to Import Warehouses	0.25	0.75	12	25	26%
Import Loads to Small RDCs (<500,000 SF)	0.25	0.75	12	35	44%
Import Loads to General Purpose Mega RDCs (>=500,000 SF)	0.25	0.75	12	45	67%
Import Loads to Fulfillment Center Type Mega RDCs (>=500,000 SF)	0.25	0.80	24	45	78%
Export Loads to Export Warehouses	0.25	0.75	12	25	26%
Border-Crossing-Related Loads to Warehouses (Imperial County)	0.25	0.75	36	25	26%
Domestic Loads to Warehouses	0.25	0.75	12	25	26%
Domestic Loads to Small RDCs (<500,000 sq. ft.)	0.25	0.75	12	35	44%
Domestic Loads to General Purpose Mega RDCs (>= 500,000 sq. ft.)	0.25	0.75	12	45	67%
Domestic Loads to Fulfillment Center Type Mega RDCs (>= 500,000 sq. ft.)	0.25	0.80	24	45	78%

[a] Efficiency gain is measured by multiplying the four parameters together, and then computing the percentage difference between the products for the Baseline Scenario and the alternate scenarios.

Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Note: A-Y parameters shown above are defined as follows: u1 = Warehouse cubic space utilization ratio and used for cargo at full capacity; u2 = Average percentage capacity utilization annually; t = Turnover of cargo in warehouse per year for particular cargo submarket type (e.g., t = 12 means 12 times per year); and h = Ceiling height (in feet) used for cargo storage for particular cargo submarket type.

Definition and Percentage of Buildings that Become Obsolete by Decade

Under Alternate Scenario 2, for each decade in the forecast period (current year to 2020, 2021-2030, and 2031-2040), warehouse buildings are assumed to become obsolete based on when they were originally built or last renovated. Three options are available for each forecast period decade to define obsolescence. The options for current year to 2020, obsolete warehouse building can be one of the following: Pre-World War, Pre-1970, or Pre-1980 built or last renovated. Similar options are there for the other forecast period decades. The particular definitions for obsolescence were selected as follows: 1) for the current year to 2020 forecast period, warehouse buildings built or last renovated prior to 1970 are deemed obsolete; 2) for the 2021-2030 forecast period, warehouse buildings built or last renovated prior to 1980 are deemed obsolete; and 3) for the 2031-2040 forecast period, warehouse buildings built or last renovated prior to 1990 are deemed obsolete.

It was assumed that only a portion of the obsolete inventory in a forecast period decade would be replaced with newer buildings with more efficient use of floor space. The particular assumptions for modeling Alternate Scenario 1 are as follows: 1) for the current year to 2020 forecast period, 75 percent of the warehouse buildings built or last renovated prior to 1970 would be replaced; 2) for the 2021-2030 forecast period, the remaining 25 percent of pre-1970 built or last renovated warehouse buildings and 75 percent of pre-1980 built or last renovated warehouse buildings would be replaced; and 3) for the 2031-2040 forecast period, the remaining 25 percent of pre-1980 built or last renovated warehouse buildings and 100 percent of pre-1990 built or last renovated warehouse buildings would be replaced.

Mega RDC Cargo Loads Percentage Share of Total Cargo Loads by 2040

Under Alternate Scenarios 3 and 5, mega RDCs cargo loads, consisting of 18 percent of total cargo loads in 2014, are assumed to increase to 30 percent of total cargo loads by 2040. As mega RDCs are assumed to have higher ceiling heights than other facilities, they are considered more efficient with respect to square footage utilization.

Fulfillment Center Type Mega RDC Space Percentage Share of Total Mega RDC Space by 2040

Under Alternate Scenario 5, fulfillment center type mega RDC space, consisting of 71 percent of total mega RDC space in 2014, is assumed to increase to 100 percent of total mega RDC space by 2040.

Port-Related Crossdock Transload Import Cargo Loads Percentage Share of Total Import Cargo Loads by 2040

Under Alternate Scenario 4, port-related crossdock transload import cargo loads, consisting of 17 percent of total import cargo loads in 2014, are assumed to increase to 30 percent of total import cargo loads by 2040.

Low- and High-Growth Rates for Border-Crossing Cargo Flows

Under Alternate Scenarios 6 and 7, low-volume and high-volume growth in border-crossing cargo flows were used, respectively, along with the origin-destination cargo flows pattern. These are based on the ongoing SCAG border crossing study.

Additional Developable Space in Building Area

Under Alternate Scenario 8, it was assumed that 50 million square feet of additional warehouse development would be completed in certain submarket areas. The development proposals consist of Heartland Specific Plan in City of Beaumont, World Logistics Center in Moreno Valley, March Business Center in Moreno Valley, Banning Business Park in City of Banning, and Redlands Logistics Center in City of Redlands. Around 98 percent of the space are added to Riverside Ind submarket area, and the remaining space is added to East San Bernardino County Ind submarket area.

Impacts Estimation Methodologies

This study did not collect any traffic counts or other travel-related data for warehouse buildings. Instead, the model estimates travel-related impacts by combining the model outputs of occupied warehousing space forecasts with external inputs from SCAG and CARB to estimate warehousing-related truck miles traveled and criteria pollutant emissions related to truck movements to/from warehouses. The estimation is intended only as a rough indicator of the relative levels of impacts among alternate scenarios. More travel-related data would be required to validate the estimates, and more rigorous methods for calculating truck trip generation would be needed in future studies. This section describes the impacts estimation methodology.

Warehousing Truck Miles Traveled

The outputs of the warehousing space forecasting model are regional total occupied warehousing space forecasts and their geographical distribution over 43 submarket areas. Every square foot of warehouse space was assumed to generate a fixed number of truck trips. The daily truck trip generation rates were assumed for the warehouses as shown in Table 1.4. For the purposes of this estimation, RDCs are assumed to represent high cube warehouses, and non-RDC warehouses are assumed to represent general warehouses.[10]

Table 1.4 Daily Heavy-Duty Truck Trip Generation Rate by Warehouse Type

Warehouse Type	Assumed Equivalent Warehouse Type	Heavy-Duty Truck Trip Generation Rate (Daily Trucks per Thousand Square Feet)
General Warehouses	Non-RDC	1.068
High Cube Warehouses	RDC	0.560

[10] Sean McAtee, Cambridge Systematics' Memorandum to SCAG, "Warehouse Allocation Model – Adjustments to Travel Model Data," dated June 28, 2016.

Source: Cambridge Systematics' memorandum to Mike Ainsworth, Guoxiong Huang, SCAG, "Trip Generation and Trip Distribution Updates for Warehousing in the SCAG Region," revised September 24, 2013.

Depending on the cargo market type, average distance traveled per truck trip generated in a submarket area was assumed. For port-related and border-crossing-related cargo markets, the distance traveled per truck trip was measured[11] as multiples of 25 miles from the centroid of submarket area to San Pedro Bay Ports and nearest border crossing, respectively. For domestic cargo market, a uniform value of 50 miles was used as average distance traveled per truck trip in any submarket area. Table 1.5 shows the various miles per truck trip assumptions used.

For each submarket area, multiplying occupied warehousing space forecasts, the truck trip generation rate and the truck miles per truck trip, regional total warehousing truck vehicle-miles traveled (VMT) was estimated.

Warehousing Truck Movement-Related Air Pollutant Emissions

The estimated warehousing truck VMT was combined with two external inputs to estimate warehousing truck-related air pollutant emissions. The two inputs are as follows: a) regional truck VMT distribution by speed bin from the latest model runs of SCAG travel demand model for 2012 (as a model run for 2014 is not available) and 2035; and b) 2014 California Air Resources Board emission factors by speed bin for trucks in South Coast Air Basin (SCAB) region.[12] The VMT distribution for the years 2036-2040 was kept the same as that in the year 2035. Since the warehousing truck miles estimation is approximate, the emission estimates are also approximate.

[11] Only geometric distance between point locations, and not the distance over the road network.

[12] http://www.arb.ca.gov/emfac/2014/ (last accessed on June 30, 2016)

Table 1.5 Assumptions on Average Distance Traveled per Truck Trip by Cargo Market Type and Submarket Area
Miles

Submarket Area ID	Submarket Area	County	Assumed Average Distance Traveled per Port Truck Trip	Assumed Average Distance Traveled per Border-Crossing Truck Trip	Assumed Average Distance Traveled per Domestic Truck Trip
1	Long Beach Area Ind	Los Angeles	25	125	50
2	Carson/Rancho Domingz Ind	Los Angeles	25	125	50
3	Lynwood/Paramount Ind	Los Angeles	25	125	50
4	Mid Counties-LA Ind	Los Angeles	25	125	50
5	Vernon Area Ind	Los Angeles	25	125	50
6	Commerce Area Ind	Los Angeles	25	125	50
7	Southwest SGV Ind	Los Angeles	25	125	50
8	Lower SGV Ind	Los Angeles	25	125	50
9	Eastern SGV Ind	Los Angeles	50	125	50
10	West San Bernardino County Ind	San Bernardino	50	100	50
11	Ontario Airport Area Ind	San Bernardino	50	125	50
12	East San Bernardino County Ind	San Bernardino	75	100	50
13	Gardena/110 Corridor Ind	Los Angeles	25	125	50
14	Central LA Ind	Los Angeles	25	125	50
15	El Segundo/Hawthorne Ind	Los Angeles	25	125	50
16	North Orange County Ind	Orange	25	100	50
17	West Orange County Ind	Orange	25	100	50
18	Riverside Ind	Riverside	50	100	50
19	North San Bernardino County Ind	San Bernardino	75	125	50
20	Westside Ind	Los Angeles	25	125	50
21	SFV East Ind	Los Angeles	25	125	50

Submarket Area ID	Submarket Area	County	Assumed Average Distance Traveled per Port Truck Trip	Assumed Average Distance Traveled per Border-Crossing Truck Trip	Assumed Average Distance Traveled per Domestic Truck Trip
22	East LA Cnty Outlying Ind	Los Angeles	50	150	50
23	Ventura County Ind	Ventura	50	175	50
24	Coachella Valley Ind	Riverside	100	75	50
25	Corona Ind	Riverside	50	150	50
26	Northwest SGV Ind	Los Angeles	25	125	50
27	Orange County Outlying Ind	Orange	50	75	50
28	John Wayne Airport Area Ind	Orange	25	100	50
29	SCV/Lancaster/Palmdale Ind	Los Angeles	50	150	50
30	SFV West Ind	Los Angeles	25	150	50
31	South Orange County Ind	Orange	50	75	50
32	South Riverside County Ind	Riverside	50	100	50
33	Upper SGV Ind	Los Angeles	50	125	50
34	Torrance/Beach Cities Ind	Los Angeles	25	125	50
35	San Bernardino County Outlying Ind	San Bernardino	100	100	50
36	Riverside County Outlying Ind	Riverside	100	50	50
37	Conejo Valley Ind	Los Angeles	50	150	50
38	NE LA Cnty Outlying Ind	Los Angeles	75	150	50
39	Antelope Valley Ind	Los Angeles	50	150	50
40	NW LA Cnty Outlying Ind	Los Angeles	75	175	50
41	Ventura Cnty Outlying Ind	Ventura	75	175	50
42	Imperial County Ind	Imperial	150	25	50
43	Catalina Island Ind	Los Angeles	N/A	N/A	10

Source: Cambridge Systematics, Inc.'s GIS Analysis.

2.0 Alternate Scenarios Evaluation, Impacts Assessment, and Policy Implications

This section discusses the results and findings of quantitative evaluation of alternate scenarios in terms of future occupied warehouse space at regional and submarket area level and at cargo market level. This also discusses the results and findings of quantitative assessment of future occupied warehouse space-related travel impacts in truck VMT and air quality impacts in tons of emissions of CO_2, CO, NO_X, ROG, PM_{10}, and $PM_{2.5}$. Lastly, this section discusses the implications of the alternate scenarios evaluation and impacts assessment on policy and decision-making for stakeholders, including SCAG, local governments, BCOs, real-estate developers, and warehouse operators.

2.1 Evaluation of Alternate Scenarios

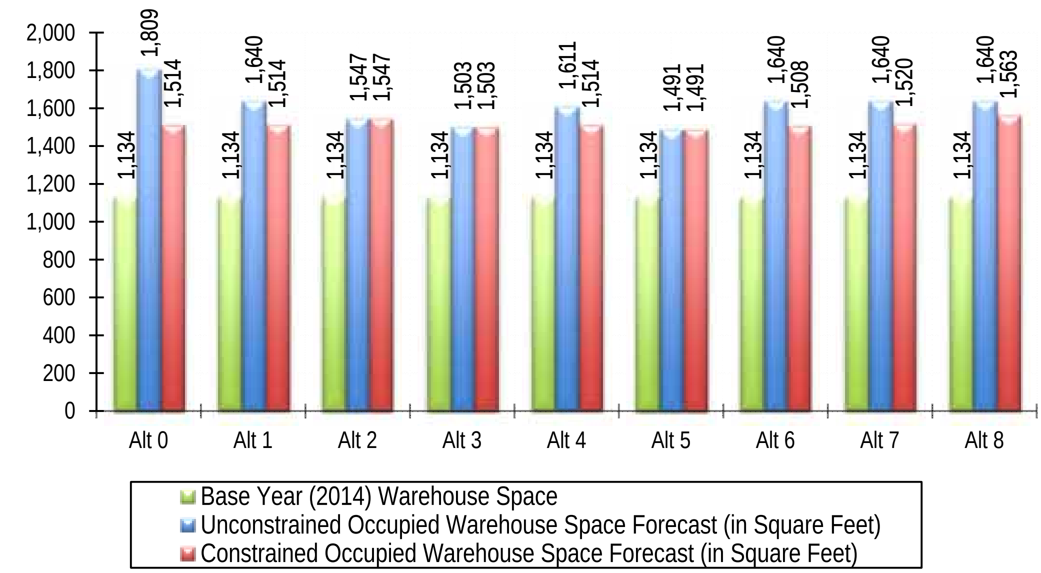
Alternate Scenarios Comparison of Region-Level Unconstrained and Constrained Total Demand and Shortfall

Figure 2.1 and Table 2.1 shows an overall summary of the warehousing square footage forecasts to 2040 by scenario. For each alternate scenario, Figure 2.1 includes the 2040 regional unconstrained occupied warehouse space and the 2040 regional constrained occupied warehouse space estimated using the warehouse space forecasting model; and comparisons to the 2014 regional occupied warehouse space, which is 1,134 million square feet. In addition, Table 2.1 shows the estimated shortfall (that is, unconstrained minus constrained demand) and the expected first year of shortfall at regional level by alternate scenario.

2040 Region-Level Unconstrained Total Demand

Under the baseline scenario (Alt 0), the unconstrained regional occupied warehouse space is expected to reach 1,809 million square feet in 2040, which is about 60 percent increase over the demand in 2014 or an annualized growth rate of 1.8 percent.

Figure 2.1 Alternate Scenarios Comparison of SCAG Region-Level Warehousing Space Forecasts, 2014 versus 2040 Unconstrained versus 2040 Constrained
Millions of Square Feet



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table 2.1 SCAG Region-Level Warehousing Space Forecasting Model Key Results, 2040
Millions of Square Feet

Alternate Number	Alternate Scenario Name	2040 Unconstrained Occupied Warehousing Space	2040 Constrained Occupied Warehousing Space	Shortfall in Occupied Warehousing Space	First Year of Shortfall >5 Million Square Feet
0	Baseline	1,809	1,514	295	2029
1	Baseline Scenario plus Efficiency Gain	1,640	1,514	126	2035
2	Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings	1,547	1,547	0	N/A
3	Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share	1,503	1,503	0	N/A
4	Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share	1,611	1,514	97	2036
5	Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share	1,491	1,491	0	N/A
6	Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario	1,640	1,508	132	2035
7	Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario	1,640	1,520	120	2035
8	Baseline Scenario plus Efficiency Gain plus Increased Developable Space	1,640	1,563	77	2037

Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

All alternate scenarios have a drop in unconstrained demand compared to Alt 0. The minimum drop in unconstrained demand is 169 million square feet (equals 1,809 million square feet minus 1,640 million square feet). This indicates that there is a significant advantage in terms of space utilization to constructing and operating new warehouse developments with higher ceiling heights, better layouts that are compatible with use of modern equipment, and higher automation for improved overall operational efficiency.

Since the alternate scenario of baseline scenario plus efficiency gain (Alt 1) also acts as a modified baseline for the other alternate scenarios, comparisons also can be made between Alt 2 to Alt 8 against Alt 1. Based on this comparison, baseline scenario plus efficiency gain plus lower border crossing growth scenario (Alt 6), baseline scenario plus efficiency gain plus higher border crossing growth scenario (Alt 7), and baseline scenario plus efficiency gain plus increased developable space (Alt 8) have the nearly the same unconstrained demand as Alt 1. Alt 6 and Alt 7 only result in a shift in cargo between the port-related and border-crossing-related cargo markets; and although the two cargo markets have different warehouse stop assumptions, the change in overall unconstrained demand is too small to notice. Under Alt 8, only the regional supply of warehouse space is modified, and no changes take place in the regional unconstrained demand for warehouse space.

The other scenarios where there is a noticeable drop in unconstrained demand compared to Alt 1 and the reasons for the same are explained below.

- Baseline scenario plus efficiency gain plus replacement of obsolete buildings (Alt 2). The replacement buildings have higher ceilings than the obsolete buildings, so within the same square footage they can store more cargo. So the overall cargo forecasts remaining the same, this alternate scenario results in lowered unconstrained demand for warehouse space.
- Baseline scenario plus efficiency gain plus increased mega RDCs share (Alt 3). Mega RDCs have higher ceilings than general purpose warehouses, so within the same square footage they can store more cargo. So the overall cargo forecasts remaining the same, this alternate scenario results in lowered unconstrained demand for warehouse space.
- Baseline scenario plus efficiency gain plus increased crossdock transloading share (Alt 4). Crossdock transload facilities have a high cargo turnover rate, so they reduce the need for storage of cargo substantially, while providing trucking-related cost savings. So the overall cargo forecasts remaining the same, this alternate scenario results in lowered unconstrained demand for warehouse space. The drop in regional unconstrained demand for warehouse space is much smaller compared to Alt 4, as the crossdock transload cargo market forms a very small part of the overall cargo.
- Baseline scenario plus efficiency gain plus increased e-commerce and fulfillment centers share (Alt 5). For the same reasons as Alt 3, this alternate scenario results in lowered unconstrained demand for warehouse space. It is even lower than Alt 3 because fulfillment centers are assumed to have a higher cargo turnover rate compared to general use of mega RDCs space.

These additional drops in unconstrained demand indicate regional storage demand management opportunities that can be supported by appropriate regional and local policies.

Under the best case demand management scenario, namely, Alt 5, the regional occupied warehouse space is expected to reach 1,491 million square feet in 2040, which is about 31 percent increase over the demand in 2014 or an annualized growth rate of 1.1 percent.

2040 Region-Level Constrained Total Demand and Shortfall

Existing vacant and developable space act as constraints to allocation of the unconstrained total demand for warehouse space in most submarket areas. Under the baseline and all alternate scenarios, the developable space in Imperial County, as an exception, is allowed to increase in response to the growth in demand in border-crossing-related cargo, and that too when the existing developable space in the SCAG region is depleted. Only under Alt 8, the supply for existing developable space is increased by 50 million square feet, in particular, submarket areas, as explained earlier in Section 1.4 of this report) to meet the demand for warehouse space for all cargo markets.

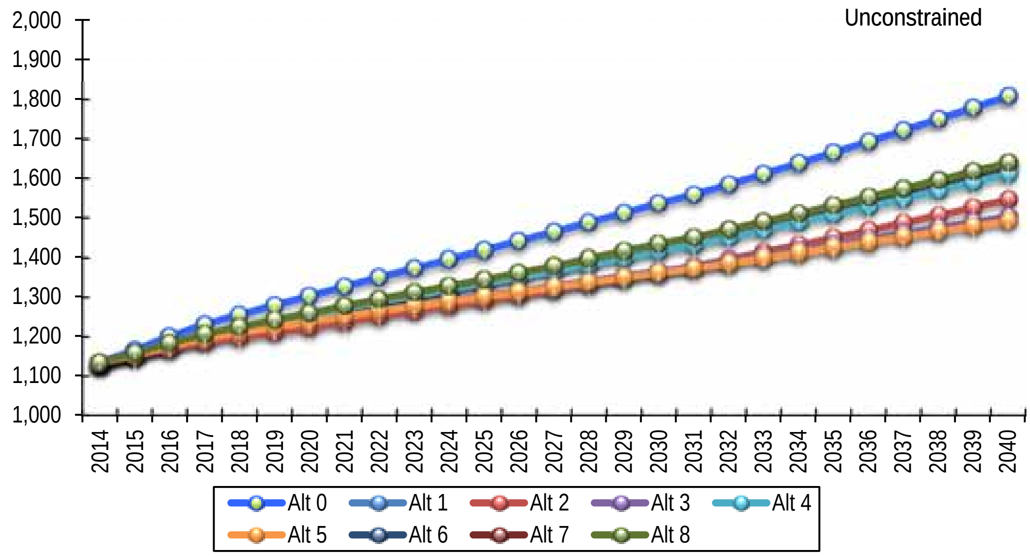
The shortfall by alternate scenario was estimated as the difference between the estimate of regional unconstrained demand for warehouse space and the regional total allocated occupied warehouse space, and adjustments in Imperial County (or the regional constrained demand for warehouse space). Under Alt 2, Alt 3, and Alt 5, there are no shortages in warehouse space at the end of the forecast year 2040. This means that within the model, the unconstrained demand is fully met by the available supply. While these represent the best case scenario to meet the future warehouse space demand up to the year 2040, because the supply and demand are at the equilibrium, the demand beyond the year 2040 might exceed the supply.

On the other hand, there are varying levels of shortages under Alt 0, Alt 1, Alt 4, Alt 6, Alt 7, and Alt 8, as shown in Table 2.1. Under the worst case supply shortage scenario, namely, Alt 0, the shortage in warehouse space is expected to start in 2029 and increase gradually to 295 million by 2040.

2014-2040 Region-Level Constrained and Unconstrained Total Demand

Figure 2.2 and Figure 2.3 show alternate scenarios comparisons of the rates of change between 2014 and 2040 in unconstrained and constrained demand for warehouse space. Alt 0 has the fastest rate of change, while Alt 5 has the slowest rate of change.

Figure 2.2 Alternate Scenarios Comparison of SCAG Region-Level Unconstrained Warehousing Space Forecasts, 2014-2040
Millions of Square Feet

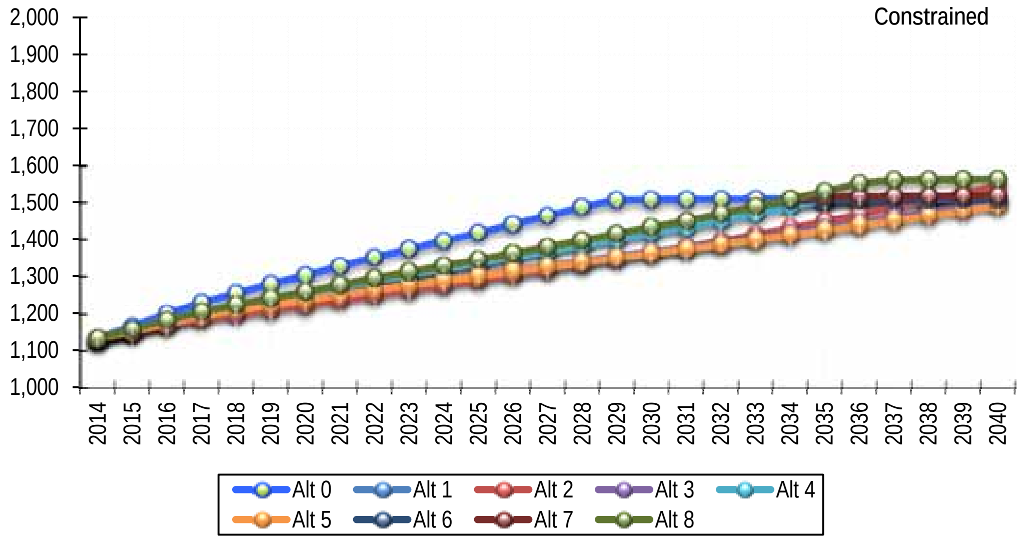


Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Figure 2.3 Alternate Scenarios Comparison of SCAG Region-Level Constrained Warehousing Space Forecasts, 2014-2040

Millions of Square Feet



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Alternate Scenarios Comparison of Region-Level Unconstrained Demand by Cargo Submarket Type

Table 2.2 and Table 2.3 show alternate scenarios comparison of estimated 2040 unconstrained warehoused loads and 2040 unconstrained occupied warehouse space by cargo submarket type, and the corresponding 2014 estimates.

Table 2.2 shows that the overall warehoused loads in 2040 are the same for all alternate scenarios. Under Alt 6, a shift of warehoused loads from border-crossing-related cargo market to port-related and domestic cargo markets was assumed. This is equivalent to reduction in border trade activities at California-Mexico border. On the other hand, under Alt 7, a shift of warehoused loads to border-crossing-related cargo market from port-related and domestic cargo markets was assumed. This is equivalent to increasing border trade activities.

Table 2.2 Unconstrained Warehoused Loads by Cargo Submarket, 2014 and 2040 by Alternate Scenario
Millions of TEUs

Cargo Market	Cargo Submarket	2014 Warehouse Loads	2040 Unconstrained Warehouse Loads by Alternate Scenario								
			0	1	2	3	4	5	6	7	8
Port Related		6.6	13.7	13.7	13.7	13.7	13.7	13.7	14.0	13.4	13.7
1	Ports Import Loads to Crossdock Transload Facilities	1.4	3.1	3.1	3.1	3.1	4.6	3.1	3.1	3.0	3.1
2	Ports Import Loads to Small RDCs (<500,000 SF)	0.7	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
3	Ports Import Loads to Mega RDCs (>=500,000 SF)	1.0	1.9	1.9	1.9	2.7	1.9	2.7	1.9	1.9	1.9
4	Ports Import Loads to Import Warehouses	3.0	6.8	6.8	6.8	6.0	5.4	6.0	7.0	6.7	6.8
5	Ports Export Loads to Export Warehouses	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.4	0.5
Border-Crossing Related		0.7	1.5	1.5	1.5	1.5	1.5	1.5	1.2	1.9	1.5
6	Border Crossing Import Loads to Crossdock Transload Facilities in Imperial County	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7	Border Crossing Import Loads to Small RDCs (<500,000 SF)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
8	Border Crossing Import Loads to Mega RDCs (>=500,000 SF)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
9	Border Crossing Import Loads to Import Warehouses (Excl. Exports via Ports)	0.3	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.9	0.7
10	Border Crossing Export Loads to Export Warehouses (Excl. Imports via Ports)	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.7	0.5
Domestic		42.7	65.8	65.8	65.8	65.8	65.8	65.8	65.9	65.8	65.8
11	Domestic Loads to Small RDCs (<500,000 SF)	5.9	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
12	Domestic Loads to Mega RDCs (>= 500,000 SF)	8.1	13.1	13.1	13.1	21.5	13.1	21.5	13.1	13.1	13.1
13	Domestic Loads to General Purpose Warehouses	28.7	43.1	43.1	43.1	34.8	43.1	34.8	43.1	43.1	43.1
Total		50.1	81.1	81.1	81.1	81.1	81.1	81.1	81.1	81.1	81.1

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table 2.3 Unconstrained Occupied Warehouse Space by Cargo Submarket, 2014 and 2040 by Alternate Scenario *Millions of Square Feet*

Cargo Market	Cargo Submarket	2014 Occupied Warehouse Space	2040 Unconstrained Occupied Warehouse Space by Alternate Scenario								
			0	1	2	3	4	5	6	7	8
Port Related		126.6	226.2	219.8	212.9	197.0	211.6	231.8	219.0	226.2	226.2
1	Ports Import Loads to Crossdock Transload Facilities	4.0	8.2	8.1	8.2	11.9	8.2	8.3	8.2	8.2	8.2
2	Ports Import Loads to Small RDCs (<500,000 SF)	16.2	25.5	24.7	25.5	25.5	25.5	25.8	25.3	25.5	25.5
3	Ports Import Loads to Mega RDCs (>=500,000 SF)	11.7	17.0	16.6	22.3	17.0	21.0	17.1	16.8	17.0	17.0
4	Ports Import Loads to Import Warehouses	81.8	161.6	157.3	142.9	128.7	142.9	164.3	157.8	161.6	161.6
5	Ports Export Loads to Export Warehouses	12.8	13.9	13.2	13.9	13.9	13.9	16.2	10.9	13.9	13.9
Border-Crossing Related		14.4	31.2	31.1	30.9	31.2	30.9	25.2	38.2	31.2	31.2
6	Border Crossing Import Loads to Crossdock Transload Facilities in Imperial County	0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.4	0.3	0.3
7	Border Crossing Import Loads to Small RDCs (<500,000 SF)	0.8	1.3	1.3	1.3	1.3	1.3	1.1	1.5	1.3	1.3
8	Border Crossing Import Loads to Mega RDCs (>=500,000 SF)	0.5	0.9	0.9	1.0	0.9	1.0	0.7	1.0	0.9	0.9
9	Border Crossing Import Loads to Import Warehouses (Excl. Exports via Ports)	6.5	14.7	14.7	14.3	14.7	14.3	11.9	18.0	14.7	14.7
10	Border Crossing Export Loads to Export Warehouses (Excl. Imports via Ports)	6.5	14.0	14.0	14.0	14.0	14.0	11.1	17.3	14.0	14.0

Cargo Market	Cargo Submarket	2014 Occupied Warehouse Space	2040 Unconstrained Occupied Warehouse Space by Alternate Scenario								
			0	1	2	3	4	5	6	7	8
Domestic		993.5	1,382.6	1,295.6	1,259.2	1,382.6	1,248.8	1,382.9	1,382.6	1,382.6	1,382.6
11	Domestic Loads to Small RDCs (<500,000 SF)	129.5	184.0	171.8	184.0	184.0	184.0	184.0	184.0	184.0	184.0
12	Domestic Loads to Mega RDCs (>= 500,000 SF)	93.2	124.4	119.9	178.5	124.4	168.2	124.4	124.4	124.4	124.4
13	Domestic Loads to General Purpose Warehouses	770.8	1,074.1	1,003.9	896.6	1,074.1	896.6	1,074.5	1,074.1	1,074.1	1,074.1
Total		1,134.4	1,640.0	1,546.6	1,502.9	1,610.8	1,491.3	1,639.8	1,639.8	1,640.0	1,640.0

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table 2.3 shows that the overall occupied warehouse space are not the same, although overall warehoused loads are the same for all alternate scenarios because the warehouse facilities handling the cargo submarket types have varying operational efficiencies. The minimum and maximum growth percentages and annualized growth rates for unconstrained demand for warehouse space by cargo market across alternate scenarios are shown in Table 2.4.

Table 2.4 2014-2040 Minimum and Maximum Growth in Unconstrained Occupied Warehouse Space by Cargo Market across Alternate Scenarios

	Growth Percentage Range		Annualized Growth Rate Range	
Cargo Market	**Min.**	**Max.**	**Min.**	**Max.**
Port-related market	56%	83%	1.7%	2.4%
Border Crossing-related market	75%	165%	2.2%	3.8%
Domestic market	26%	39%	0.9%	1.3%
Total	31%	45%	1.1%	1.4%

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Alternate Scenarios Comparison of Region-Level Percentage Demand Met by Cargo Submarket Type

Table 2.5 show alternate scenarios comparison of 2040 percentage demand met in occupied warehouse space by cargo submarket type. The percentage demand met was computed by dividing constrained occupied warehouse space by unconstrained occupied warehouse space.

In 2014, 100 percent of the demand in all cargo markets were met by existing inventory of warehouse buildings.

Under the baseline scenario or Alt 0, border-crossing-related demand for warehouse space is fully met, while 93 percent of port-related demand for warehouse space are met, and only 82 percent of domestic-related demand for warehouse space are met.

Under all alternate scenarios, port-related and border-crossing-related demand for warehouse space are nearly met. The reason for meeting border-crossing-related demand for warehouse space was due to allowing Imperial County's developable space to expand to meet added demand. The percentage demand met is high for port-related cargo market type, because the port forecasts indicate that the port reaches its highest terminals throughput (cargo volumes) in 2035, and the demand remains constant between 2035 and 2040. As the first year of shortage of warehouse space is mostly on or after 2035, the port-related demand for warehouse space is fully met. On the other hand, due to continued growth in domestic cargo beyond the first year of shortage, its demand for warehouse space is not fully met under alternate scenarios, except Alt 2, Alt 3, and Alt 5.

Table 2.5 Percentage Demand in Occupied Warehouse Space Met by Cargo Submarket, 2014 and 2040 by Alternate Scenario

Percentage

Cargo Market	Cargo Submarket	2014 Demand in Warehouse Space Met	2040 Demand in Warehouse Space Met by Alternate Scenario								
			0	1	2	3	4	5	6	7	8
Port Related		100.0%	92.8%	99.9%	100.0 %	100.0 %	99.8%	100.0 %	99.9%	100.0 %	99.9%
1	Ports Import Loads to Crossdock Transload Facilities	100.0%	88.7%	97.1%	100.0%	100.0%	96.6%	100.0%	97.1%	100.0%	97.1%
2	Ports Import Loads to Small RDCs (<500,000 SF)	100.0%	93.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3	Ports Import Loads to Mega RDCs (>=500,000 SF)	100.0%	93.5%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
4	Ports Import Loads to Import Warehouses	100.0%	92.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
5	Ports Export Loads to Export Warehouses	100.0%	93.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Border-Crossing Related		100.0%	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
6	Border Crossing Import Loads to Crossdock Transload Facilities in Imperial County	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
7	Border Crossing Import Loads to Small RDCs (<500,000 SF)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
8	Border Crossing Import Loads to Mega RDCs (>=500,000 SF)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
9	Border Crossing Import Loads to Import Warehouses (Excl. Exports via Ports)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Cargo Market	Cargo Submarket	2014 Demand in Warehouse Space Met	2040 Demand in Warehouse Space Met by Alternate Scenario								
			0	1	2	3	4	5	6	7	8
10	Border Crossing Export Loads to Export Warehouses (Excl. Imports via Ports)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Domestic		100.0%	81.8%	90.9%	100.0%	100.0%	93.0%	100.0%	90.5%	91.3%	94.5%
11	Domestic Loads to Small RDCs (<500,000 SF)	100.0%	85.0%	93.5%	100.0%	100.0%	95.5%	100.0%	93.4%	94.6%	96.6%
12	Domestic Loads to Mega RDCs (>= 500,000 SF)	100.0%	84.2%	94.1%	100.0%	100.0%	95.6%	100.0%	94.1%	95.0%	97.0%
13	Domestic Loads to General Purpose Warehouses	100.0%	80.9%	90.1%	100.0%	100.0%	92.3%	100.0%	89.6%	90.3%	93.8%
Total		100.0%	83.7%	92.3%	100.0%	100.0%	94.0%	100.0%	92.0%	92.7%	95.3%

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Alternate Scenarios Comparison of Submarket Area-Level Constrained Demand

Table 2.6 shows alternate scenarios comparison for projected constrained demand for warehouse space by submarket area.

The only scenarios showing a total increase in constrained demand are Alt 2 (replacement of obsolete facilities) and Alt 8 (more development). With respect to Alt 8, the only two submarkets with an increase in constrained demand are Submarket Area ID 18 (Riverside Industrial) and Submarket Area ID 12 (East San Bernardino County Industrial). The largest increase in assumed supply is projected to be in Submarket Area ID 18, largely because of the proposed World Logistics Center in Moreno Valley.

Aside the increase in the total, Imperial County's allocated demand could vary between 10 million and 20 million square feet, depending on the low growth or the high growth of border-crossing cargo flows (Alt 6 or Alt 7, respectively).

Table 2.6 Constrained Occupied Warehousing Space by Submarket Area, 2014 and 2040 by Alternate Scenario
Thousands of Square Feet

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space	2040 Occupied Warehouse Space by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
1	Long Beach Area Ind	15,431	22,845	22,845	25,566	22,845	22,845	22,845	22,845	22,845	22,845
2	Carson/Rancho Domingz Ind	58,063	67,715	67,723	78,109	67,773	67,758	67,773	67,623	67,879	67,723
3	Lynwood/Paramount Ind	8,213	8,228	8,228	9,320	8,228	8,228	8,228	8,228	8,229	8,228
4	Mid Counties-LA Ind	58,491	62,376	62,376	71,320	62,376	62,376	62,377	62,376	62,379	62,376
5	Vernon Area Ind	47,418	59,179	59,189	58,570	59,203	59,208	59,203	59,156	59,245	59,189
6	Commerce Area Ind	52,349	54,952	54,952	63,199	54,952	54,953	54,952	54,949	54,957	54,952
7	Southwest SGV Ind	6,339	6,341	6,341	7,445	6,341	6,341	6,341	6,341	6,342	6,341
8	Lower SGV Ind	63,737	88,921	88,921	97,593	88,921	88,921	88,921	88,921	88,924	88,921
9	Eastern SGV Ind	18,764	18,919	18,919	21,428	18,919	18,919	18,919	18,919	18,920	18,919
10	West San Bernardino County Ind	41,460	43,857	43,857	46,666	43,857	43,857	43,857	43,857	43,859	43,857
11	Ontario Airport Area Ind	159,545	257,776	257,816	268,872	257,992	257,816	257,979	257,715	257,693	257,816
12	East San Bernardino County Ind	69,335	72,127	72,127	74,732	72,127	72,127	72,127	72,127	72,128	72,901
13	Gardena/110 Corridor Ind	20,659	24,580	24,591	25,180	24,590	24,599	24,590	24,573	24,611	24,591
14	Central LA Ind	54,367	68,519	68,552	65,525	68,551	68,618	68,551	68,479	68,637	68,552
15	El Segundo/Hawthorne Ind	9,895	11,067	11,155	12,280	11,152	11,357	11,152	10,959	11,373	11,155

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space	2040 Occupied Warehouse Space by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
16	North Orange County Ind	63,803	69,181	69,181	71,410	69,181	69,181	69,181	69,181	69,185	69,181
17	West Orange County Ind	20,847	21,250	21,250	23,443	21,250	21,250	21,250	21,250	21,251	21,250
18	Riverside Ind	72,430	121,786	121,767	124,535	121,850	121,767	121,880	121,711	121,685	170,728
19	North San Bernardino County Ind	11,208	38,143	38,065	28,187	38,120	38,065	38,113	38,053	38,078	38,029
20	Westside Ind	8,335	8,461	8,461	9,952	8,461	8,461	8,461	8,461	8,461	8,461
21	SFV East Ind	54,897	56,310	56,314	65,184	55,665	56,314	55,665	56,311	56,320	56,314
22	East LA Cnty Outlying Ind	17	22	22	22	22	22	22	22	22	22
23	Ventura County Ind	25,676	31,285	31,589	29,991	31,561	31,595	27,029	31,381	31,847	31,590
24	Coachella Valley Ind	6,742	31,512	31,464	7,601	31,557	31,464	31,506	31,457	31,474	31,464
25	Corona Ind	15,899	16,732	16,732	17,235	15,994	16,732	15,994	16,732	16,733	16,732
26	Northwest SGV Ind	11,367	11,523	11,523	13,148	11,523	11,523	11,523	11,523	11,523	11,523
27	Orange County Outlying Ind	240	240	240	240	240	240	240	240	240	240
28	John Wayne Airport Area Ind	35,994	36,518	36,518	42,846	36,518	36,518	36,518	36,518	36,519	36,518
29	Santa Clarita Valley Ind	11,537	11,721	11,721	12,842	11,721	11,721	11,721	11,721	11,721	11,721
30	SFV West Ind	20,516	24,480	24,480	24,273	22,781	24,480	20,593	24,480	24,481	24,480
31	South Orange County Ind	14,323	18,266	18,372	14,917	14,743	18,375	14,743	18,283	18,483	18,372
32	South Riverside County Ind	22,015	34,129	34,078	23,762	34,078	34,078	29,183	34,072	34,085	34,078

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space	2040 Occupied Warehouse Space by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
33	Upper SGV Ind	15,988	16,078	16,078	18,255	16,078	16,078	16,078	16,078	16,078	16,078
34	Torrance/Beach Cities Ind	22,402	24,225	24,260	25,410	22,780	24,260	22,780	24,230	24,297	24,260
35	San Bernardino County Outlying Ind	106	115	115	127	115	115	115	115	115	115
36	Riverside County Outlying Ind	112	112	112	119	112	112	112	112	112	112
37	Conejo Valley Ind	9,209	11,737	11,737	10,722	9,579	11,737	9,579	11,737	11,738	11,737
38	NE LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
39	Antelope Valley Ind	5,166	46,970	46,942	47,081	46,841	46,942	46,839	46,894	46,994	46,834
40	NW LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
41	Ventura Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
42	Imperial County Ind	1,540	15,889	15,095	9,450	14,326	14,754	14,323	10,331	20,091	15,079
43	Catalina Island Ind	2	2	2	3	2	2	2	2	2	2
Total		1,134,435	1,514,091	1,513,711	1,546,557	1,502,926	1,513,710	1,491,266	1,507,963	1,519,559	1,563,286

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

2.2 TRAVEL IMPACTS AND AIR QUALITY IMPACTS ASSESSMENT

The SCAG region's truck trips and associated VMT for this study were calculated based on the total warehouse space inventory from the CoStar® Property data November 2014 downloaded data and the forecasts produced by the warehouse space forecasting model. As described in Section 1.4 of this report, truck trip generations were calculated based on RDC- and non-RDC-related truck trip generation rates; rough estimates of submarket area's average distances to port and border crossing; and assumed an average travel mileage of 50 miles for trips relating to domestic market.[13] The VMT for warehouse-related truck trips generated at a submarket area are not restricted within the submarket area. The submarket area level truck VMT related to warehouses was added to generate the regional total truck VMT related to warehouses in the SCAG region.

The estimated regional total truck VMT related to warehouses was then distributed into speed bins using the 2012 SCAG Regional Transportation Plan's (RTP) base year (2012) and future year (2035) model run results for regional total truck VMT for all purposes by speed bin. The 2016 SCAG RTP would update the regional total truck VMT by speed bin distribution, but the information is not available at this time.

Also, as described in Section 1.4, the emission factors for the SCAG region were calculated using emission factors projections for 2014-2040 from the on-line EMFAC tool[14] for the SCAG region at five-year intervals, by speed bin, by air pollutant, and by truck vehicle category. The results were aggregated to trucks and interpolated linearly between the five-year intervals, providing daily tons of emissions by air pollutant type.

However, the above impacts calculations DO NOT CAPTURE the full complexity of the scenario definitions at this time due to limitations that exist in the SCAG's Regional Travel Demand Model. For example, both crossdock transload facility and import warehouse are treated as non-RDCs within the structure of the SCAG TDM – their trip generation rates are the same. The truck VMT estimates are still usable as percentage of warehouse space relating to crossdock transload facility is very small (around 1 percent of the total warehouse space), the error in VMT estimates by generalizing to non-RDC is small compared to total truck VMT.

Till further improvements are made to SCAG's TDM model, particularly adjusting the total warehouse space by transportation analysis zone (TAZ), expanding trip generation rates to more detailed warehouse types, and establishing truck trip length distributions for domestic cargo market based on Cal-VIUS or similar studies to make them more submarket area specific similar to the port- and border-crossing-related distance estimates, there will be some limitations of the impacts calculations. As such, the current results should serve as preliminary.

More importantly, interpretations based on this study's travel and air quality impact estimates should be recognized not as strong as those made based on the warehouse space forecasts.

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[13] 50 miles for domestic market is an arbitrary test value. To calibrate more refined average trip length, TDM related or California Vehicle Inventory and Use Survey (Cal-VIUS) study should be used in the future.

[14] http://www.dot.ca.gov/hq/env/air/pages/emfac.htm (last accessed on June 30, 2016).

Alternate Scenarios Comparison of Occupied Warehouse Space-Related Truck Trips and Truck VMT Impacts by Cargo Market Type

Table 2.7 shows alternate scenarios comparison of constrained occupied warehouse space-related truck trips generated by cargo market type, while Table 2.8 shows the truck VMT associated with them.

This indicates that under the baseline scenario, warehousing-related truck trips in the SCAG region are expected to grow from 1.08 million trucks per day to 1.43 million trucks per day, which is by 33 percent or 1.1 percent annually, while warehousing-related truck VMT in the SCAG region is expected to grow from 52.7 million trucks per day to 68.1 million trucks per day, which is by 29 percent or 1.0 percent annually.

Under alternate scenarios:

- Alt 4 (increased crossdock transloading) scenario results in the lowest port-related truck trips and truck VMT due to the lowering warehouse space needed for storage. Alt 6, on the other hand, increases port-related truck trips and truck VMT.
- Alt 6 also results in the lowest border-crossing-related truck trips and truck VMT, while Alt 7 results in the highest border-crossing-related truck trips and truck VMT.
- Alt 8 results in the highest domestic truck trips and truck VMT, while Alt 5 results in the lowest domestic truck trips and truck VMT.

Table 2.7 Constrained Occupied Warehousing Space-Related Daily Truck Trips Generated by Cargo Market Type, 2014 and 2040 by Alternate Scenario

Thousands

Cargo Market Type	2014 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type by Alternate Scenario Number								
		Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
Port Related	121	232	220	214	203	188	202	225	213	220
Border-Crossing Related	15	33	32	32	32	32	32	26	40	32
Domestic	948	1,171	1,195	1,236	1,161	1,224	1,155	1,190	1,200	1,243
Total	1,084	1,436	1,447	1,481	1,395	1,444	1,389	1,441	1,452	1,495

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table 2.8 Constrained Occupied Warehousing Space-Related Daily Truck VMT for Truck Trips Generated by Cargo Market Type, 2014 and 2040 by Alternate Scenario

Thousands

Cargo Market Type	2014 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type by Alternate Scenario Number								
		Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
Port Related	3,698	7,204	6,695	6,129	6,168	5,580	6,124	7,017	6,343	6,582
Border-Crossing Related	1,610	2,343	2,399	2,918	2,421	2,436	2,418	2,116	2,790	2,397
Domestic	47,396	58,567	59,753	61,776	58,031	61,177	57,742	59,479	59,981	62,163
Total	52,705	68,114	68,847	70,822	66,619	69,193	66,283	68,612	69,115	71,142

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Figures 2.4 and 2.5 show the distributions of warehousing-related truck trips and truck VMT for the SCAG region by cargo market type under the baseline scenario.

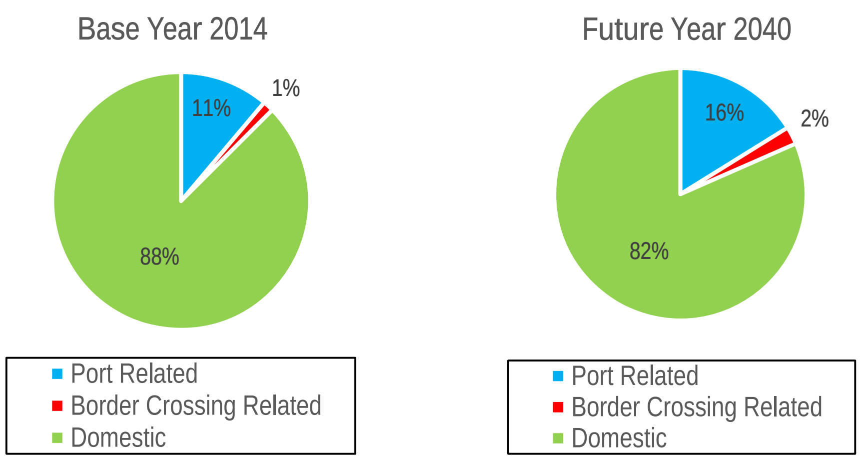
Although port-related truck trips make up 11 percent of the total truck trips in 2014, they form a smaller share of 7 percent of the total truck VMT. On the other hand, the truck VMT associated with border-crossing and domestic demand for warehouse space has a lower share of total truck trips but higher share of total truck VMT.

Truck trips for all cargo market types will grow between 2014 and 2040 baseline scenario (see Table 2.7). As shown in Figure 2.4, the port-related truck trips will increase from 11 percent to 16 percent, and the border crossing truck trips will increase from 1 percent to 2 percent, while the domestic truck trips will decrease from 88 percent to 82 percent.

Truck VMT for all cargo market types will grow between 2014 and 2040 baseline scenario (see Table 2.8). As shown in Figure 2.5, the port-related truck VMT will increase from 7 percent to 11 percent, the border-crossing truck VMT will remain about the same (3 percent both in 2014 and 2040), while the domestic truck VMT will decrease from 90 percent to 86 percent.

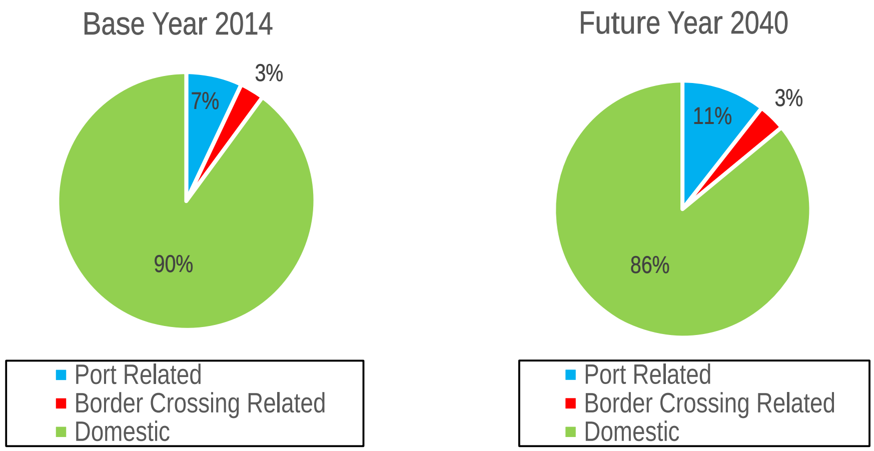
Although the magnitudes may differ slightly, the direction of share changes between 2014 and 2040 in the pie charts are similar under the alternate scenarios.

Figure 2.4 Regional Occupied Warehousing Space-Related Daily Truck Trips Distribution by Cargo Market Type under Baseline Scenario, 2014 and 2040 Constrained



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Figure 2.5 Regional Occupied Warehousing Space-Related Daily Truck VMT Distribution by Cargo Market Type under Baseline Scenario, 2014 and 2040 Constrained



Source: SCAG Warehousing Space Forecasting Model, Draft Version 1.0, June 30, 2016.

Alternate Scenarios Comparison of Occupied Warehouse Space-Related Truck Trips and Truck VMT Impacts by Submarket Area

Table 2.9 shows the alternate scenarios comparison of constrained occupied warehouse space-related truck trips by submarket area, while Table 2.10 shows the comparison in terms of truck VMT. In comparison to the baseline scenario, Alt 3 and Alt 5 result in reduction in total truck trips and truck VMT, with the most benefits going to Ontario Airport Ind area and Riverside Ind area. All other scenarios result in an increase in total truck trips and truck VMT. The highest increase in truck trips of 59,000 trucks per day and truck VMT of 3.0 million truck miles per day are seen under Alt 8. Alt 2 is estimated to have the second largest increase in truck trips of 46,000 trucks per day and truck VMT of 2.7 million truck miles per day, the submarket areas near the port will see a rise in truck trips, while the submarket areas away from ports will see a decline in truck VMT. This is due to the geographical distribution of older and functionally obsolete buildings. Alt 6 and Alt 7 have very little impact on the truck trips and truck miles. Increasing crossdock transloading (Alt 4) has the highest impact on miles per truck basis.

Table 2.9 Constrained Occupied Warehousing Space-Related Daily Truck Trips Generated by Submarket Area, 2014 and 2040 by Alternate Scenario

Thousands

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
1	Long Beach Area Ind	16	24	24	27	24	24	24	24	24	24
2	Carson/Rancho Domingz Ind	55	65	65	75	64	65	64	65	64	65
3	Lynwood/Paramount Ind	8	8	8	9	8	8	8	8	8	8
4	Mid Counties-LA Ind	56	61	61	67	61	61	61	61	61	61
5	Vernon Area Ind	49	62	62	61	62	62	62	62	62	62
6	Commerce Area Ind	50	53	53	62	53	53	53	53	53	53
7	Southwest SGV Ind	7	7	7	8	7	7	7	7	7	7
8	Lower SGV Ind	61	88	88	93	88	88	88	88	88	88
9	Eastern SGV Ind	19	19	19	21	19	19	19	19	19	19
10	West San Bernardino County Ind	39	42	42	44	42	42	42	42	42	42
11	Ontario Airport Area Ind	145	235	235	242	218	235	218	235	235	235
12	East San Bernardino County Ind	53	54	54	56	54	54	54	54	54	55
13	Gardena/110 Corridor Ind	21	25	25	26	25	25	25	25	25	25
14	Central LA Ind	56	71	71	67	71	71	71	71	71	71
15	El Segundo/Hawthorne Ind	10	11	12	13	11	11	11	11	12	12
16	North Orange County Ind	64	69	70	71	70	70	70	70	70	70
17	West Orange County Ind	21	21	21	23	21	21	21	21	21	21
18	Riverside Ind	61	103	105	114	92	105	94	104	105	147
19	North San Bernardino County Ind	10	34	35	28	32	35	33	35	35	37
20	Westside Ind	9	9	9	10	9	9	9	9	9	9

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck Trips by Cargo Market Type by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
21	SFV East Ind	57	58	58	64	57	57	57	58	58	58
22	East LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
23	Ventura County Ind	26	32	33	31	33	31	28	31	33	33
24	Coachella Valley Ind	7	28	32	8	27	32	28	32	32	31
25	Corona Ind	16	17	17	18	16	17	16	17	17	17
26	Northwest SGV Ind	11	12	12	13	12	12	12	12	12	12
27	Orange County Outlying Ind	0	0	0	0	0	0	0	0	0	0
28	John Wayne Airport Area Ind	37	38	38	45	38	38	38	38	38	38
29	Santa Clarita Valley Ind	11	12	12	13	11	12	11	12	12	12
30	SFV West Ind	21	25	25	25	23	25	21	25	25	25
31	South Orange County Ind	14	18	18	15	15	18	15	18	19	17
32	South Riverside County Ind	19	29	31	20	29	31	27	32	31	31
33	Upper SGV Ind	17	17	17	19	17	17	17	17	17	17
34	Torrance/Beach Cities Ind	21	22	23	24	21	23	21	23	22	23
35	San Bernardino County Outlying Ind	0	0	0	0	0	0	0	0	0	0
36	Riverside County Outlying Ind	0	0	0	0	0	0	0	0	0	0
37	Conejo Valley Ind	9	12	12	11	10	11	10	12	11	12
38	NE LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
39	Antelope Valley Ind	5	39	40	50	40	40	40	40	41	45
40	NW LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
41	Ventura Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
42	Imperial County Ind	1	17	16	10	15	16	15	11	21	16
43	Catalina Island Ind	0	0	0	0	0	0	0	0	0	0
Total		1,084	1,436	1,447	1,481	1,395	1,444	1,389	1,441	1,452	1,495

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Table 2.10 Constrained Occupied Warehousing Space-Related Daily Truck VMT for Truck Trips Generated by Submarket Area, 2014 and 2040 by Alternate Scenario

Thousands

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
1	Long Beach Area Ind	440	772	763	853	1,164	1,062	1,164	715	799	763
2	Carson/Rancho Domingz Ind	2,171	2,470	2,470	2,941	2,491	2,474	2,490	2,446	2,583	2,470
3	Lynwood/Paramount Ind	464	464	464	523	464	464	464	466	462	464
4	Mid Counties-LA Ind	2,615	2,719	2,719	2,927	2,719	2,719	2,719	2,719	2,719	2,719
5	Vernon Area Ind	2,315	2,636	2,638	2,645	2,640	2,640	2,640	2,635	2,643	2,638
6	Commerce Area Ind	2,352	2,422	2,422	2,753	2,422	2,422	2,422	2,422	2,422	2,422
7	Southwest SGV Ind	311	311	311	352	311	311	311	311	311	311
8	Lower SGV Ind	2,859	3,534	3,554	4,394	3,554	3,554	3,554	3,554	3,553	3,554
9	Eastern SGV Ind	931	939	939	1,074	939	939	939	939	939	939
10	West San Bernardino County Ind	1,976	2,104	2,104	2,185	2,104	2,104	2,104	2,104	2,104	2,104
11	Ontario Airport Area Ind	7,287	11,788	11,812	12,166	10,968	11,812	10,970	11,802	11,809	11,812
12	East San Bernardino County Ind	2,737	2,820	2,814	2,856	2,827	2,814	2,827	2,812	2,816	2,876
13	Gardena/110 Corridor Ind	980	1,104	1,105	1,166	1,105	1,106	1,105	1,103	1,108	1,105
14	Central LA Ind	2,635	3,029	3,034	2,972	3,034	3,235	3,034	3,024	3,045	3,034
15	El Segundo/Hawthorne Ind	593	672	684	771	678	711	678	657	713	684
16	North Orange County Ind	2,987	3,121	3,128	3,195	3,128	3,235	3,128	3,129	3,128	3,128
17	West Orange County Ind	1,032	1,044	1,044	1,125	1,044	1,044	1,044	1,044	1,044	1,044
18	Riverside Ind	3,068	5,146	5,239	5,711	4,638	5,239	4,698	5,234	5,239	7,380
19	North San Bernardino County Ind	504	1,736	1,947	1,411	1,632	1,781	1,662	2,039	1,871	1,907
20	Westside Ind	513	523	523	607	523	523	523	521	526	523
21	SFV East Ind	2,825	2,854	2,872	3,095	2,837	2,855	2,837	2,871	2,872	2,872

Submarket Area ID	Submarket Area	2014 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type	2040 Occupied Warehouse Space-Related Truck VMT by Cargo Market Type by Alternate Scenario Number								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
22	East LA Cnty Outlying Ind	1	1	1	1	1	1	1	1	1	1
23	Ventura County Ind	1,414	1,764	1,821	1,747	1,818	1,759	1,576	1,706	1,876	1,824
24	Coachella Valley Ind	348	1,551	1,595	396	1,361	1,585	1,414	1,588	1,602	1,568
25	Corona Ind	818	862	862	889	823	862	823	862	861	862
26	Northwest SGV Ind	570	574	574	617	574	574	574	574	574	574
27	Orange County Outlying Ind	13	13	13	13	13	13	13	13	13	13
28	John Wayne Airport Area Ind	2,087	2,115	2,115	2,477	2,127	2,115	2,127	2,114	2,115	2,115
29	Santa Clarita Valley Ind	566	576	576	632	571	576	571	576	576	576
30	SFV West Ind	1,045	1,153	1,257	1,190	1,164	1,257	1,047	1,257	1,257	1,256
31	South Orange County Ind	715	922	940	757	746	940	746	932	949	858
32	South Riverside County Ind	956	1,439	1,531	1,008	1,453	1,539	1,340	1,601	1,533	1,547
33	Upper SGV Ind	830	835	835	951	835	835	835	835	835	835
34	Torrance/Beach Cities Ind	975	1,067	1,082	1,108	997	1,082	997	1,078	1,050	1,082
35	San Bernardino County Outlying Ind	6	7	7	8	7	7	7	7	7	7
36	Riverside County Outlying Ind	6	6	6	7	6	6	6	6	6	6
37	Conejo Valley Ind	464	599	599	545	484	558	484	599	567	599
38	NE LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
39	Antelope Valley Ind	249	1,985	2,032	2,488	2,022	2,032	2,013	2,026	2,037	2,254
40	NW LA Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
41	Ventura Cnty Outlying Ind	0	0	0	0	0	0	0	0	0	0
42	Imperial County Ind	47	438	418	269	398	409	398	292	552	418
43	Catalina Island Ind	0	0	0	0	0	0	0	0	0	0
Total		52,705	68,114	68,847	70,822	66,619	69,193	66,283	68,612	69,115	71,142

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Note: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

Alternate Scenarios Comparison of Regional Occupied Warehouse Space-Related Air Quality Impacts

Table 2.11 shows the regional occupied warehouse space-related estimates of daily emissions by air pollutant type in 2014 and 2040 by alternate scenario. Except for carbon dioxide emissions, there is not much distinction between the alternate scenarios. Although the regional truck trips increase by 33 percent and truck VMT increase by 29 percent between 2014 and 2040 under the baseline scenario and travel speeds would be lowered, the emissions reduce due to implementation of state air quality policy, truck emission reduction measures and truck-related regulations. The results are as follows: 1) ROG reduces by 72 percent; 2) TOG reduces by 65 percent; 3) CO reduces by 66 percent; 4) NO_x reduces by 87 percent; 5) CO_2 increases by 27 percent; and 6) PM_{10} and $PM_{2.5}$ reduce by 92 percent each.

Table 2.11 Constrained Occupied Warehousing Space-Related Regional Total Emissions Due to Truck Trips in Tons per Day by Air Pollutant Type, 2014 and 2040 by Alternate Scenario

Scenario Number	Air Pollutant Type	2014 Emissions	2040 Emissions								
			Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
1	ROG	9.2	2.6	2.6	2.7	2.5	2.6	2.5	2.6	2.6	2.7
2	TOG	11.4	4.0	4.0	4.2	3.9	4.1	3.9	4.0	4.1	4.2
3	CO	75	25	25	26	25	26	25	25	26	26
4	NO_x	278	35	35	36	34	35	34	35	35	36
5	CO2	71,367	90,609	91,585	94,212	88,621	92,044	88,174	91,271	91,940	94,637
6	PM_{10}	4.08	0.34	0.35	0.36	0.33	0.35	0.33	0.34	0.35	0.36
7	$PM_{2.5}$	3.90	0.33	0.33	0.34	0.32	0.33	0.32	0.33	0.33	0.34

Source: SCAG Warehouse Space Forecasting Model, Version 1.0, developed in June 30, 2016.

Notes: The Alternate Scenario are as follows: Alt 0: Baseline Scenario; Alt 1: Baseline Scenario plus Efficiency Gain; Alt 2: Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings; Alt 3: Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share; Alt 4: Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share; Alt 5: Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share; Alt 6: Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario; Alt 7: Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario; and Alt 8: Baseline Scenario plus Efficiency Gain plus Increased Developable Space.

ROG = Reactive Organic Gases; TOG = Total Organic Gases; CO = Carbon monoxide; NO_x = Oxides of Nitrogen; CO_2 = Carbon-dioxide; PM_{10} = Particular Matter with a diameter of 10 micrometers or less; and $PM_{2.5}$ = Particular Matter with a diameter of 2.5 micrometers or less.

2.3 FINDINGS, AND POLICY AND DECISION-MAKING IMPLICATIONS

Findings

The analysis of the model results indicate that, in the future, the biggest gains in warehouse square footage will be derived through replacing obsolete buildings with more efficient facilities, and through construction of new warehouses and RDCs on currently undeveloped land. These are the only two options for appreciably increasing the overall supply of warehousing capacity in the region. However, beyond the forecast year of 2040, it is unknown whether the region would be able to continue accommodating warehousing space demand even with an increase in efficiencies and construction of new facilities.

Gains in warehouse operating efficiencies are important for improving productivity in the goods movement industry, and they will have the effect of reducing unconstrained demand in the region. However, these improvements in efficiencies and productivity will not be enough to avoid shortfalls in supply versus demand.

Some industry trends, alternate freight forecasts, and regional and local policies may serve as demand management strategies, which can further reduce the warehouse space needed in the future.

Under all future scenarios, the SCAG region will face challenging situations, including, but not limited to, the following:

1. Potential risks of running out of vacant space to accommodate growth in warehousing space demand;
2. Balancing economic, social, and environmental objectives when approving development proposals for industrial lands and redevelopment proposals to upgrade existing facilities;
3. Addressing traffic impacts associated with increased amount of logistics facilities and regional transportation system capacity to handle the increased truck volume;
4. Preservation of existing industrial parcels and vacant parcels designated for warehousing purposes; and
5. Potentially changing land use designation to increase developable space for warehousing.

This study showed that demand for warehousing will likely outpace supply under six out of the nine scenarios (including the baseline scenario) over the planning horizon up to the year 2040, which could have an impact on the SCAG region's ability to accommodate logistics activities and its economic competiveness. Shortages in supply could start to appear as early as 2029, and depend on the scenario. Even under the scenarios without a supply shortfall by 2040, significant private investment into new construction and operational improvements would be needed, and significant approval and permitting would be needed from the cities and counties. By 2040, the region overall would have an increase in truck VMT, although air quality impacts would reduce as a result of less polluting truck fleet in the future.

Policy and Decision-Making Implications

The policy and decision-making implications of the model results to various public and private stakeholders are shown in Table 2.12 below.

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Table 2.12 Policy and Decision-Making Implications to Stakeholders under Alternate Scenarios

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
0	Baseline Scenario	• A shortfall of 295 million SF of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. This is the worst case scenario. • Approximately 33% increase in truck trips and 29% increase in truck VMT over 2014 level under warehouse space forecasting model assumptions, however, substantial drop in truck emissions.	N/A	N/A	N/A	N/A
1	Baseline Scenario plus Efficiency Gain	• Efficiency improvements for new developments would increase regional economic competitiveness (see efficiency gains in Table 1.3). • A shortfall of 126 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 34% increase in truck trips and 31% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• In areas where new buildings are constructed, greater efficiencies imply more cargo handled per square foot of space consumed.	• BCOs would benefit from greater productivity in the new buildings meeting their physical configuration and operational characteristics requirements, and resulting in better customer service.	• There would be investment opportunities for developers to construct new buildings with modern design features and services in submarket areas with developable space.	• Warehouse operators would attract more customers to new developments with modern building features and services.
2	Baseline Scenario plus Efficiency Gain plus Replacement of Obsolete Buildings	• Includes implications in Scenario 1 in terms of regional economic competitiveness • Efficiency improvements for replaced obsolete facilities would increase regional economic competitiveness (see efficiency gains in Table 1.3). • The existing supply is expected to fully meet the regional demand for warehouse space up to 2040 under warehouse space forecasting model assumptions. This is one of the possible best case scenarios. • Approximately 37% increase in truck trips and 34% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Local governments would see more renovation-related construction in areas where there are obsolete buildings. • Local governments decide to preserve the existing land use designation for warehouse parcels.	• Same implications as in Scenario 1.	• Same implications as in Scenario 1.	• Same implications as in Scenario 1.

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
3	Baseline Scenario plus Efficiency Gain plus Increased Mega RDCs Share	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • Mega RDCs would help BCOs achieve economies of scale, thus, would improve regional economic competitiveness (see Sections 1.1 and 1.3 and Task 3 Report). • The existing supply is expected to fully meet the regional demand for warehouse space up to 2040 under warehouse space forecasting model assumptions. This is one of the possible best case scenarios. • Approximately 29% increase in truck trips and 26% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • This would create economic development opportunities, but also concentrated local traffic impacts in municipalities in Inland Empire and northern reaches of Los Angeles County the most, as there are large amounts of developable space and contains large-sized parcels to accommodate building sizes of 500,000 square feet or more. • However, a few mega RDC developments also may occur in other submarket areas where there is developable space, compatible land uses, and local support. • Local governments develop policy and ordinances to support development of mega RDCs.	• Includes implications in Scenario 1. • Large BCOs would benefit from greater supply chain productivity with the use of larger, more modern facilities.	• Developers of large facilities would see more opportunities in submarket areas with developable space for mega RDCs.	• Operators of large facilities would see more opportunities in submarket areas with new mega RDC developments.

Table 2.12 Policy and Decision-Making Implications to Stakeholders under Alternate Scenarios (continued)

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
4	Baseline Scenario plus Efficiency Gain plus Increased Crossdock Transloading Share	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • Crossdock transloading facilities would support a growing segment of port-related transloading customers. Through a high cargo turnover rate, they would also reduce demand for port-related warehouse space (see Sections 1.1 and 1.3 and Task 3 Report). • A shortfall of 97 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 33% increase in truck trips and 31% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Local jurisdictions near the ports would see an increase in demand for crossdock transloading, and associated truck traffic. • Local jurisdictions near the ports decide to preserve the existing land use designation for crossdock transloading purposes.	• Includes implications in Scenario 1. • This scenario is primarily BCO driven as part of BCO's overall supply chain strategy. If more crossdock transloading is accommodated, it could make Southern California more attractive to BCOs using crossdock transloading as their supply chain strategy.	• Developers would have increased opportunities for crossdock transload facilities in submarket areas near the ports.	• Crossdock transload-related third-party logistics (3PL) operators would likely see more business in submarket areas near the ports.
5	Baseline Scenario plus Efficiency Gain plus Increased E-commerce and Fulfillment Centers Share	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • Fulfillment centers would support a growing segment of e-commerce customers who require same day or two-day delivery (see Sections 1.1, 1.3 and Task 3 Report). • The existing supply is expected to fully meet the regional demand for warehouse space up to 2040 under warehouse space forecasting model assumptions. This is one of the possible best case scenarios. • Approximately 28% increase in truck trips and 26% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions. This is the best case scenario.	• Includes implications in Scenarios 1 and 3. • In fulfillment centers that are highly specialized or automated, skilled workforce opportunities may benefit local jurisdictions.	• Includes implications in Scenarios 1 and 3 • By providing same day or two-day delivery service, BCOs would become more attractive to e-commerce customers.	• Includes implications in Scenarios 1 and 3	• Includes implications in Scenario 1. • Operators of large facilities, but workforce specialized in fulfillment center operations would see more opportunities in submarket areas with new mega RDC developments.

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
6	Baseline Scenario plus Efficiency Gain plus Lower Border Crossing Growth Scenario	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • This scenario reflects SCAG's alternate freight forecast for border-crossing cargo, which is lower than the baseline scenario. This would reduce demand for border-crossing-related warehouse space, but increase demand for port-related warehouse space (see Section 1.3 and SCAG Goods Movement Border Crossing Study and Analysis – Phase II Report). • A shortfall of 132 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 33% increase in truck trips and 30% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Cities in Imperial County would see less economic development opportunities than the baseline scenario. • Communities closer to the ports could see rise in traffic levels in the short term, but on the long term, the impacts would be similar to the baseline scenario. Communities along the Mexico-U.S. border would see an increase in traffic levels lower than the baseline scenario both in the short and long term.	• Includes implications in Scenario 1. • BCOs would have reduced benefits of the North American Free Trade Agreement (NAFTA) trade benefits, as the overall transportation cost will be higher than the baseline scenario.	• Includes implications in Scenario 1. • Developers might see a slower increase in demand for warehousing in Imperial County to attract cargo from Mexico.	• Includes implications in Scenario 1. • Although port-related warehouse operations near San Pedro Bay Ports would see a rise, the decline in demand for border-crossing-related warehouse operations would be replaced by domestic warehouse operations.

Table 2.12 Policy and Decision-Making Implications to Stakeholders under Alternate Scenarios (continued)

Alternate Number	Alternate Scenario Name	SCAG Region	Local Governments	Beneficial Cargo Owners (BCO)	Real Estate Developers	Warehouse Operators
7	Baseline Scenario plus Efficiency Gain plus Higher Border Crossing Growth Scenario	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • This scenario reflects SCAG's alternate freight forecast for border-crossing cargo, which is higher than the baseline scenario. This would increase demand for border-crossing-related warehouse space, but reduce demand for port-related warehouse space (see Section 1.3 and SCAG Goods Movement Border Crossing Study and Analysis – Phase II Report). • A shortfall of 120 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 34% increase in truck trips and 31% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions.	• Includes implications in Scenario 1. • Cities in Imperial County would see more economic development opportunities than the baseline scenario. • Communities closer to the ports could see lower traffic levels in the short term, but on the long term, the impacts would be similar to the baseline scenario. Communities along the Mexico-U.S. border would see an increase in traffic levels higher than the baseline scenario both in the short and long term.	• Includes implications in Scenario 1 • BCOs would have increased benefits of NAFTA trade benefits as supply chain benefits (such as ease of quality control and lower overall transportation cost), will be higher than the baseline scenario.	• Includes implications in Scenario 1 • Developers might see a faster increase in demand for warehousing in Imperial County to attract cargo from Mexico.	• Includes implications in Scenario 1 • Although port-related warehouse operations near San Pedro Bay Ports would see a decline, the demand would be replaced with border crossing-related and domestic warehouse operations.
8	Baseline Scenario plus Efficiency Gain plus Increased Developable Space	• Includes implications in Scenario 1 in terms of regional economic competitiveness. • This scenario reflects some of the local governments' recent approval of development proposals and tentative land use conversions. This would delay the projected year when the region would start experiencing a warehouse supply shortfall. • A shortfall of 77 million square feet of warehouse space is expected by 2040 under warehouse space forecasting model assumptions. • Approximately 38% increase in truck trips and 35% increase in truck VMT over 2014 level, however, substantial drop in truck emissions under warehouse space forecasting model assumptions. This is the worst case scenario.	• Includes implications in Scenario 1. • The additional land for warehousing is assumed to be available in eastern part of Inland Empire. Travel impacts would increase due to added traffic from facilities that are anticipated to be built in this scenario. • This scenario may impose a number of policy considerations to local governments as it assumes land use type conversions, potential traffic increase, and transportation facility adequacy to handle increased traffic, etc.	• Includes implications in Scenario 1. • BCOs will have more choices and more warehouse capacity to work with.	• Includes implications in Scenario 1. • Real estate developers will benefit because of greater development opportunities.	• Includes implications in Scenario 1. • Warehouse operators will benefit because of greater growth opportunities.

Source: Cambridge Systematics, Inc.

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