

State Purchasing Contract Environmental Impact Analysis

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Introduction

For most companies and organizations the majority of their environmental impact occurs not from their own operations but from the procurement of products and services.¹ Organizations already successful in improving the environmental performance of their own operations are increasingly looking to harness their purchasing power to reduce environmental impacts embodied in their supply chains. The Minnesota Pollution Control Agency (MPCA) through a grant from the Region 5 U.S. Environmental Protection Agency (EPA), is examining current State of Minnesota purchasing contracts to identify environmental improvement opportunities. The analysis conducted through this grant attempts to answer:

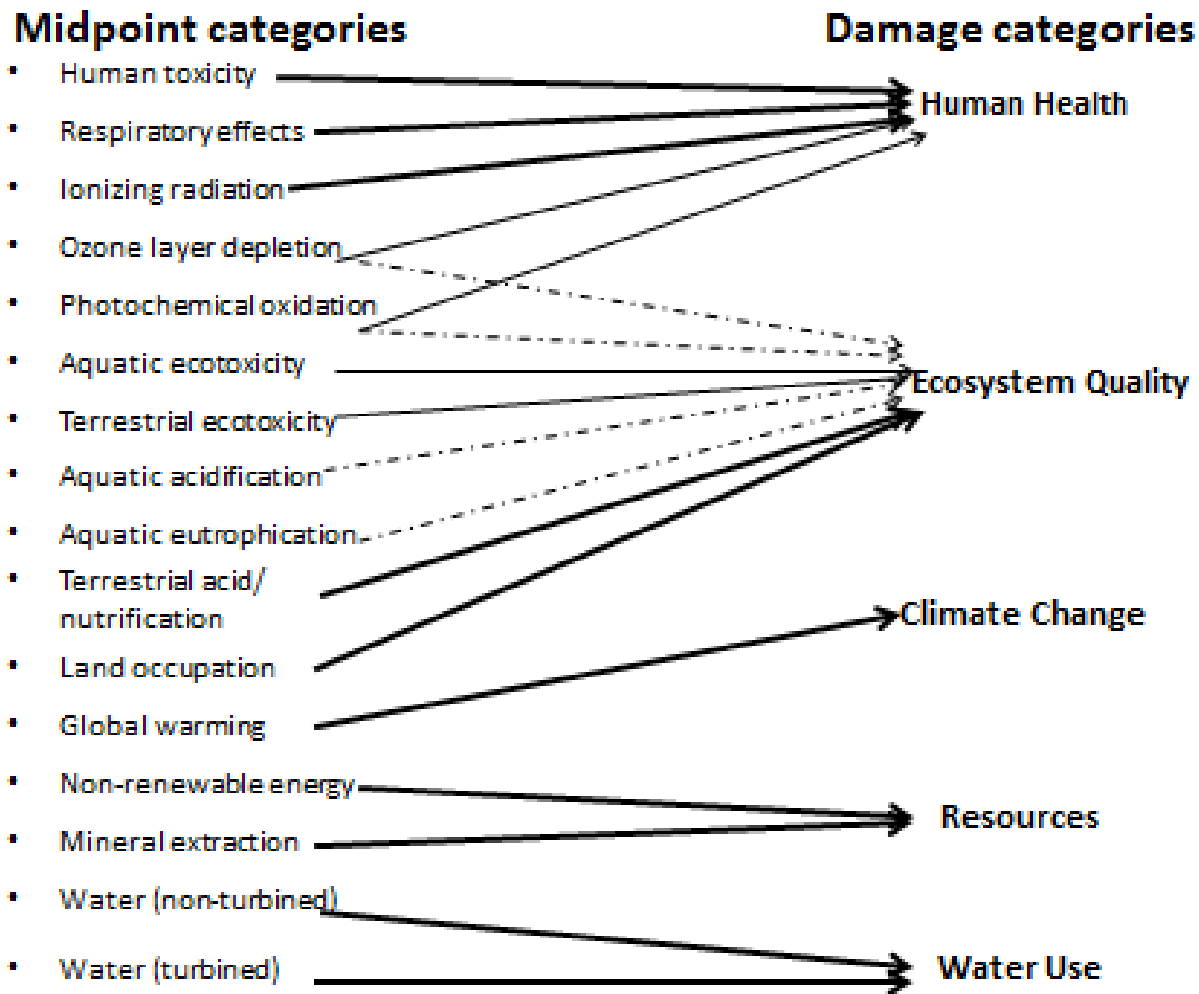
- which purchased product and service categories create the largest environmental impacts in the State of Minnesota's supply chain?
- which upstream sectors hold the largest potential for environmental improvements through the development of targeted procurement specifications?

Method

MPCA staff provided a list of 1,664 contracts for environmental supply chain analysis. Included with the contract name, state and cooperative purchasing venture (CPV) expenditure totals, and time period of expenditure data were United Nations Standard Products and Services Codes® (UNSPSC®). Since the environmental supply chain model used in this analysis, the Sustainability Consortium's OpenIO, is organized by *North American Industry Classification System (NAICS)* codes, the UNSPSC codes were matched with the corresponding NAICS code(s). NAICS codes that were more detailed than the 430 NAICS codes in the model were matched with EEIO model NAICS codes as closely as possible. OpenIO uses Impact2002+ life cycle assessment methodology to normalize different pollutants and environmental resources into single score life cycle assessment results.

¹ Huang, Y. A., Weber, C. L., & Matthews, H. S. (2009). Categorization of scope 3 emissions for streamlined enterprise carbon footprinting. *Environmental science & technology*, 43(22), 8509-8515.

Figure 1. Midpoint and Endpoint Life Cycle Assessment Impact Relationship



The five damage categories/endpoint LCA impact categories included in this analysis are climate change, ecosystem quality, human health, resource depletion, and water consumption. See table 1 for a description of these environmental impacts.

Table 1. Environmental Life Cycle Assessment Impact Categories

Environmental Impact Category	Description	Normalized Units
Climate Change	The impact methodology normalizes the heat-trapping potential of greenhouse gases, contributors to climate change.	Metric Tons of Carbon Dioxide Equivalent (mt CO ₂ e)
Ecosystem Quality	Damages of ecosystem quality include ecotoxicity, acidification, eutrophication and land use. They are expressed as a percentage of the species that are threatened or have disappeared in a certain area due to the environmental load during a year.	Potentially Disappeared Fraction of Species * area*year (PDF-m ² -yr) PDF = probability of the plants species to disappear from the area as a result of acidification and eutrophication.
Human Health	The Human Health damage category takes into account respiratory and carcinogenic effects, ozone layer depletion, greenhouse gas and ionizing radiation. Damage to human health is expressed in DALY (Disability Adjusted Life Years), which is the number of disability years caused by exposure to toxic material multiplied by the "disability factor", a number between 0 and 1 that describes severity of the damage.	Disability Adjusted Life Years (DALY)
Resource Depletion	Resource depletion category considers the use of non-renewable resources such as minerals and fossil fuels. It models the decrease of the concentration of the mineral resources in the Earth's crust and calculates the amount of energy needed to extract the mineral in a future in relation to the concentration.	GigaJoules (GJ)
Water Consumption	Quantity of water consumed in the production of one unit of economic activity by the procurement sector.	1,000 gallons (kGallons)

What is OPEN IO?

Open IO combines life cycle assessment with the economic input-output structure of the US economy developed by the Bureau of Economic Analysis. The input-output model encompasses 430 commodities based on the North American Industrial Classification System. Attached to each of these are environmental resource requirements for and emissions resulting from production for each industrial sector. The emission and resource requirements are associated with 15 midpoint and 5 endpoint environmental impacts based on the assessment methodology Impact 2002+. Open IO allows users to isolate impacts for each stage of the product's life cycle through the consumer stage.

Three levels of analysis were performed: individual contracts, contract categories, and cross sector contract category impacts. The top contracts by expenditure, with their corresponding environmental impact totals, are listed in table 2. Impacts for all 1,664 contracts are included in the accompanying excel workbook *MMD Acquisitions Contracts Environmental Impacts*.

The 1,664 individual contracts expenditures were aggregated into 39 categories using the NAICS taxonomy. Tables 4 through 6 show the expenditure and environmental impacts by these 39 categories in different formats.

For the cross sector impacts, the top 10 contracts by climate impact were chosen for cross sector impact analysis. The cross sector impact analysis examines which upstream sectors contribute to the top 10 purchasing categories impacts, and identifies which upstream sectors contribute to multiple top 10 purchasing categories impacts. This analysis answers the question: could reduction efforts in one or more upstream sectors reduce environmental impacts across multiple procurement categories? Tables 7 through 11 contain the cross sector results for the top contract categories for each of the 5 environmental impact categories.

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Table 2. Environmental Impacts of Contracts (sorted by largest expenditure totals)

Contract Release	Contract #	NAICS CATEGORY	Title	Annualized Contract Expenditure	Human Health	EcoSystem Quality	Climate Change (mt CO2e)	Resource Depletion (Gj)	Water Consumption (KGal)
C753(5)	17478	Electronic computer manufacturing	Mainframe & Midrange Hardware, Software & Maintenance	74,760,951	1,004	427,708,454	71,292	778,076	292,544
R651(5)	18128	Broadcast and wireless communications equipment	Radio Communication Equipment – 800 MHZ APCO 25 and UHF/VHF	39,095,096	652	354,917,343	68,991	741,448	290,403
F529(5)	442612	Petroleum Refineries	Fuel program: Fixed and Spot Price	32,475,912	266	106,376,107	54,488	6,009,724	682,948
C-712(5)	22666		Fleet Services Fuel Cards	28,781,388	236	94,274,550	48,290	5,326,046	605,254
R-651(5)	40071	Broadcast and wireless communications equipment	Radio Communication Equipment	26,839,109	447	243,653,710	47,363	509,010	199,364
C-816(5)	24099	Electronic computer manufacturing	Computer Hardware, Software, and Maintenance	24,494,040	329	140,130,750	23,358	254,922	95,847
T-535(5)	47762	Broadcast and wireless communications equipment	Wireless services and devices	15,019,839	250	136,354,729	26,505	284,855	111,569
T-535(5)	28173		Cellular Telephones and Service	14,897,103	248	135,240,492	26,289	282,527	110,657
F-369(5)	17900	Other Animal Food Manufacturing	Fresh, Frozen, Dry, Canned Food - Delivered	14,621,688	118	66,725,940	12,990	161,745	585,197
T-653(5)	41729	Broadcast and wireless communications equipment	Networking Equipment, Software and Maintenance	14,062,280	234	127,661,713	24,816	266,694	104,457
T-653(5)	41910				12,419,634	207	112,749,269	21,917	235,541
A-174(5)	37669	Automobile manufacturing	2013 Model Year Ford Patrol Type Interceptor – Sedan and Utility	12,170,315	360	93,117,427	7,461	88,195	39,470
S-803(5)	445154	All other chemical product manufacturing	Regular Road Salt for CPV Only	9,867,376	220	109,928,219	10,038	197,416	68,626
O-86(5)	16436	Office supplies (except paper) manufacturing	Office Supplies	9,701,891	159	55,137,568	10,272	127,030	53,169
P-720(5)	14381	Other concrete product mfg	Piers and Docks	9,292,656	105	37,320,624	17,865	117,814	52,892
S-863(5)	39250	Construction machinery manufacturing	Snow Plow Truck Components and Accessories	9,148,380	123	55,513,640	7,670	95,057	26,546
B-347(5)	15427	Heavy duty truck manufacturing	Transit Buses – 2011 Model Year	8,902,490	207	67,847,444	5,779	63,686	22,149
B-347(5)	15203					8,789,084	205	66,983,156	5,705
S-803(5)	445156	All other chemical product manufacturing	Regular Road Salt for CPV Only	7,712,368	172	85,920,196	7,845	154,301	53,638
C-815(5)	24006	Electronic computer manufacturing	Computer Hardware, Software, and Maintenance	7,002,985	94	40,064,174	6,678	72,884	27,403

Table 3. Top Contracts Across Impacts

Contract Release	Contract #	NAICS Category	Title	Top 10 by:					
				Expenditure	Health Impact	Ecosystem Impact	Climate Impact	Resource Depletion	Water Consumption
C-684(5)	15734	Not Applicable	Cards: Purchasing Payment Services	X					
C-753(5)	17478	Electronic computer manufacturing	Mainframe & Midrange H/W, S/W & Maint	X	X	X	X	X	X
F-369(5)	17900	Other Animal Food Manufacturing	Fresh, Frozen, Dry, Canned Food - Delivered	X					X
R-651(5)	18128	Broadcast and wireless communications equipment	Radio Communication Equipment – 800MHZ APCO 25 and UHF/VHF	X	X	X	X	X	X
C-712(5)	22666	Petroleum refineries	Fleet Services Fuel Cards	X			X	X	X
C-816(5)	24099	Electronic computer manufacturing	Computer Hardware, Software, and Maintenance	X	X	X	X	X	
T-535(5)	28173	Broadcast and wireless communications equipment	Cellular Telephones and Service	X		X	X	X	X
R-651(5)	40071		Radio Communication Equipment	X	X	X	X	X	X
T-535(5)	47762		Wireless services and devices	X	X	X	X	X	X
F-529(5)	442612	Petroleum Refineries	Fuel program: Fixed and Spot Price	X	X		X	X	X
C-456(5)	13084	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	Corrugated Pipe		X	X			
C-456(5)	13112				X				
D-212(5)	17331	Dental equipment and supplies manufacturing	Dental Supplies and Equipment		X	X			
A-174(5)	37669	Automobile manufacturing	2013 Model Year Ford Patrol Type Interceptor – Sedan and Utility		X				
T-653(5)	41729	Broadcast and wireless communications equipment	Networking Equipment, Software and Maintenance			X	X	X	X
T-653(5)	41910	Broadcast and wireless communications equipment	Networking Equipment, Software and Maintenance			X	X		
F-531(5)	13160	Petroleum refineries	Fuel program: Fixed and Spot Price					X	X

Table 4. State Purchasing Category Impact Rankings

Purchasing Category	Annualized Contract Category Expenditure	Human Health	Ecosystem Quality	Climate Change	Resource Depletion	Water Consumption
Computer and Electronic Product Manufacturing	1	1	1	1	2	1
Transportation Equipment Manufacturing	2	2	2	4	4	4
Machinery Manufacturing	3	4	3	3	3	5
Petroleum and Coal Products Manufacturing	4	8	8	2	1	2
Chemical Manufacturing	5	5	5	5	5	6
Electrical Equipment, Appliance, and Component Mfg	6	6	6	6	6	7
Miscellaneous Manufacturing	7	7	7	8	7	9
Metal Product Manufacturing	8	3	4	7	8	10
Telecommunications	9	15	13	18	18	20
Food Manufacturing	10	9	9	10	9	3
Professional, Scientific, and Technical Services	11	19	18	23	22	17
Construction	12	12	11	15	12	16
Publishing Industries (except Internet)	13	16	15	17	20	18
Waste Management and Remediation Services	14	11	16	9	19	21
Furniture and Related Product Manufacturing	15	10	10	11	11	11
Administrative and Support Services	16	22	17	20	17	19
Printing and Related Support Activities	17	13	14	13	13	14
Food Services and Drinking Places	18	21	19	22	23	12
Postal and Courier Services	19	27	27	12	14	22
Paper Manufacturing	20	14	12	14	15	15
Radio, Television, and Cable broadcasting	21	29	21	28	29	28
Textiles and Apparel	22	18	20	21	21	13
Accommodation	23	30	29	24	24	25
Fishing	24	26	25	16	16	23
Other Services (except Public Administration)	25	24	22	30	31	27
Repair and Maintenance	26	20	24	29	30	26
Rental and Leasing Services	27	33	30	33	33	31
Data Processing, Hosting, and Related Services	28	31	23	34	32	33
Mining	29	17	26	19	10	24
Transportation and Warehousing Services	30	25	33	25	26	29
Greenhouse and Nursery Production	31	23	31	27	25	8
Credit Intermediation and Related Activities	32	36	37	37	36	36
Utilities	33	32	32	26	28	32
Plastics and Rubber Products Manufacturing	34	28	28	31	27	30
Used goods	35	34	36	35	34	35
Ambulatory Health Care Services	36	35	34	36	35	34
State Enterprises and Utilities	37	39	39	32	39	39
Wholesale Trade	38	38	38	38	37	38
Social Assistance	39	37	35	39	38	37

Table 5. Environmental Impacts of Contracts by Contract Category (sorted by top expenditure totals)

Category	Annualized Contract Category Expenditure	Human Health (Disability Adjusted Life Years)	EcoSystem Quality (Potentially Disappeared Fraction of species per square meter per year)	Climate Change (mt CO ₂ e)	Resource Depletion (GJs)	Water Consumption (kGals)
Computer and Electronic Product Manufacturing	\$ 287,572,777	4,216	2,096,735,715	385,181	4,184,702	1,618,154
Transportation Equipment Manufacturing	\$ 141,734,613	3,853	1,130,580,673	93,065	1,065,327	413,184
Machinery Manufacturing	\$ 93,273,196	1,362	650,133,915	106,140	1,284,629	409,100
Petroleum and Coal Products Manufacturing	\$ 70,944,361	586	235,623,990	118,808	13,025,016	1,485,045
Chemical Manufacturing	\$ 45,633,835	1,272	506,715,958	51,217	933,724	308,841
Electrical Equipment, Appliance, and Component Manufacturing	\$ 36,522,310	1,083	279,467,379	38,121	427,210	169,660
Miscellaneous Manufacturing	\$ 30,640,667	842	250,454,708	25,936	302,607	132,126
Metal Product Manufacturing	\$ 23,065,595	1,593	550,494,440	32,617	261,560	106,747
Telecommunications	\$ 20,605,665	46	33,554,933	3,750	47,816	17,305
Food Manufacturing	\$ 19,191,575	155	87,580,577	17,050	212,297	768,095
Professional, Scientific, and Technical Services	\$ 17,961,853	22	14,849,078	2,461	30,761	23,321
Construction	\$ 12,574,899	66	44,187,898	5,638	76,253	28,235
Publishing Industries (except Internet)	\$ 11,429,993	34	24,744,366	3,773	42,701	20,837
Waste Management and Remediation Services	\$ 10,326,324	81	20,389,058	20,172	42,957	16,197
Furniture and Related Product Manufacturing	\$ 9,368,667	117	60,452,520	9,934	108,499	42,232
Administrative and Support Services	\$ 8,263,119	16	16,373,594	3,012	52,270	18,876
Printing and Related Support Activities	\$ 8,042,835	55	26,111,359	6,695	74,760	33,966
Food Services and Drinking Places	\$ 5,968,091	17	13,399,044	2,575	30,071	40,282
Postal and Courier Services	\$ 5,350,984	9	4,070,683	6,837	72,480	14,803
Paper Manufacturing	\$ 5,262,739	49	33,714,822	5,822	68,824	28,958
Radio, Television, and Cable broadcasting	\$ 4,806,640	7	8,081,758	752	9,274	4,540
Textiles and Apparel	\$ 3,631,180	26	10,902,632	2,942	35,654	34,482

Category	Annualized Contract Category Expenditure	Human Health (Disability Adjusted Life Years)	Ecosystem Quality (Potentially Disappeared Fraction of species per square meter per year)	Climate Change (mt CO₂e)	Resource Depletion (GJs)	Water Consumption (kGals)
Accommodation	\$ 3,434,711	5	3,209,031	1,600	19,211	11,663
Fishing	\$ 3,253,945	13	5,396,583	4,099	62,640	13,785
Other Services (except Public Administration)	\$ 2,924,063	13	7,512,180	604	7,108	6,377
Repair and Maintenance	\$ 2,110,563	20	5,510,567	609	7,507	8,697
Rental and Leasing Services	\$ 2,089,766	3	2,923,576	304	3,482	2,214
Data Processing, Hosting, and Related Services	\$ 1,865,533	4	5,691,369	259	3,573	1,588
Mining	\$ 1,059,667	32	4,085,038	3,289	128,438	13,451
Transportation and Warehousing Services	\$ 1,043,416	13	1,572,942	1,334	12,212	3,618
Greenhouse and Nursery Production	\$ 838,259	14	2,439,754	1,008	12,956	154,512
Credit Intermediation and Related Activities	\$ 749,686	0	270,182	75	893	546
Utilities	\$ 682,166	4	1,721,518	1,042	10,155	1,618
Plastics and Rubber Products Manufacturing	\$ 632,097	8	3,279,329	603	11,458	3,270
Used goods	\$ 599,929	1	314,381	169	1,760	757
Ambulatory Health Care Services	\$ 446,689	1	1,292,092	88	1,224	841
State Enterprises and Utilities	\$ 67,254	0	737	457	3.3	1
Wholesale Trade	\$ 55,158	0	39,158	10	127	46
Social Assistance	\$ 34,601	0	314,790	9	113	155

Table 6. Top Contract Categories Across Impacts

Category	Top 10 by:					
	Expenditure	Health Impact	Ecosystem Impact	Climate Impact	Resource Depletion	Water Consumption
Computer and Electronic Product Manufacturing	X	X	X	X	X	X
Transportation Equipment Manufacturing	X	X	X	X	X	X
Machinery Manufacturing	X	X	X	X	X	X
Petroleum and Coal Products Manufacturing	X	X	X	X	X	X
Chemical Manufacturing	X	X	X	X	X	X
Electrical Equipment, Appliance, and Component Manufacturing	X	X	X	X	X	X
Miscellaneous Manufacturing	X	X	X	X	X	X
Metal Product Manufacturing	X	X	X	X	X	X
Telecommunications	X					
Food Manufacturing	X	X	X	X	X	X
Furniture and Related Product Manufacturing		X	X			
Waste Management and Remediation Services				X		
Mining					X	
Greenhouse and Nursery Production						X

Table 7. Cross Sector GHG Contribution Analysis of Top 10 Contract Categories (mt CO2e)

	334220 - Broadcast and wireless comm. equipment	324110 - Petroleum refineries	334111 - Electronic computer mfg	336120 - Heavy duty truck mfg	333120 - Construction machinery mfg	3259A0 - All other chemical product and preparation mfg	333319 - Other commercial and service industry machinery	327390 - Other concrete product mfg	562000 - Waste managemen t and remediation services	336111 - Automobile mfg	Cross Sector Totals	Cross Sector %
Use Phase	172,256	-	67,086	-	11,091	-	24,185	1,687	-	-	276,304	39.3%
Warehousing & Retailing	35,950	21,216	15,093	-	-	7,014	1,974	2,579	-	2,824	86,650	12.3%
Direct Operations	680	22,741	457	9,996	5,521	796	700	10,272	16,450	508	68,120	9.7%
211000 - Oil and gas extraction	0	41,656	-	2	1	29	0	0	1	0	41,689	5.9%
336300 - Motor vehicle parts mfg	466	28	138	13,356	1,764	20	34	32	74	9,538	25,451	3.6%
Final Transportation	2,261	8,329	1,739	-	-	2,101	-	1,442	-	1,300	17,173	2.4%
Electricity Inputs to Commodity	3,724	4,543	1,067	1,321	1,868	2,540	301	662	312	526	16,863	2.4%
334413 - Semiconductor and related device manufacturing	7,401	13	5,541	313	137	78	49	47	0	266	13,847	2.0%
Transportation of Inputs to Commodity	1,692	4,250	1,268	1,141	1,046	860	165	401	210	564	11,598	1.7%
331110 - Iron and steel mills and ferroalloy manufacturing	1,033	53	72	1,725	6,680	66	666	408	15	81	10,798	1.5%
324110 - Petroleum refineries	12	6,203	57	57	622	1,125	113	8	102	4	8,304	1.2%
333618 - Other engine equipment manufacturing	0	1	-	5,864	1,937	0	3	-	2	211	8,019	1.1%
420000 - Wholesale trade	2,022	320	2,231	876	618	262	81	63	19	323	6,815	1.0%
TOTAL	252,700	117,060	115,053	46,684	44,464	33,797	30,649	22,600	20,172	19,629	702,808	88%
Top 10 Category Impact Contribution %	36%	17%	16%	7%	6%	5%	4%	3%	3%	3%		

Table 8. Cross Sector Ecosystem Quality Impact Contribution Analysis of Top 10 Contract Categories (1,000 PDF-m²-yr)

	334220 - Broadcast and wireless comm. equipment	324110 - Petroleum refineries	334111 - Electronic computer mfg	336120 - Heavy duty truck mfg	333120 - Construction machinery mfg	3259A0 - chemical product and preparation mfg	333319 - commercial and service industry machinery	327390 - Other concrete product mfg	562000 - Waste mgmt and remediation services	336111 - Automobile mfg	Cross Sector Totals	Cross Sector %
334413 - Semiconductor and related device manufacturing	340,024	585	254,562	14,395	6,316	3,591	2,273	2,174	2	12,222	636,145	16.5%
336300 - Motor vehicle parts mfg	8,399	505	2,489	240,596	31,775	357	618	580	1,341	171,813	458,472	11.9%
Warehousing & Retailing	98,060	72,365	44,502	-	-	20,677	5,612	7,062	-	8,361	256,639	6.7%
325188 - All other chemical mfg	1,183	41,601	2,822	150	15	199,689	306	76	1,069	7	246,918	6.4%
334418 - Printed circuit assembly (electronic assembly) mfg	29,305	184	106,546	2,565	2,190	1,788	540	725	0	200	144,044	3.7%
334220 - Broadcast and wireless communications equipment	142,145	6	1,659	-	4	3	76	1	5	0	143,901	3.7%
331420 - Copper rolling, drawing, extruding and alloying	122,419	-	11,315	1,255	958	3,052	3,573	23	-	56	142,651	3.7%
331411 - Primary smelting and refining of copper	130,928	-	-	1,681	50	9,418	27	20	-	15	142,139	3.7%
333618 - engine equipment mfg	7	9	-	98,439	32,515	1	58	-	28	3,549	134,606	3.5%
Use Phase	70,632	-	27,508	-	4,548	-	9,917	692	-	-	113,296	2.9%
334419 -electronic component mfg	84,968	229	9,123	412	2,579	155	991	35	2	105	98,600	2.6%
334417 - Electronic connector mfg	73,173	-	3,066	-	113	21	1,040	1	1	-	77,414	2.0%
335920 - Communication and energy wire and cable mfg	27,570	-	6,156	18,464	629	435	16,583	2	9	11	69,857	1.8%
334112 - Computer storage device manufacturing	665	-	66,277	3	9	2	0	-	5	0	66,960	1.7%
211000 - Oil and gas extraction	0	57,301	-	3	1	40	0	0	2	0	57,347	1.5%
33291A - Valve and fittings other than plumbing	658	1,091	131	7,078	33,598	2,262	4,767	16	476	1,812	51,891	1.3%
335911 - Storage battery mfg	0	-	48	13,366	25,676	0	221	-	1,275	4,344	44,931	1.2%
331110 - Iron and steel mills and ferroalloy manufacturing	4,216	215	292	7,043	27,269	270	2,721	1,664	62	329	44,081	1.1%
334412 - Bare printed circuit board manufacturing	29,264	6	8,168	634	845	393	132	190	0	4	39,637	1.0%
TOTAL	1,299,999	228,535	690,245	548,110	321,841	370,132	79,317	47,213	20,389	244,987	3.8E7	
Top 10 Category Impact %	33.8%	5.9%	17.9%	14.2%	8.4%	9.6%	2.1%	1.2%	0.5%	6.4%		

Table 9. Cross Sector Human Health Impact Contribution Analysis of Top 10 Contract Categories (DALY)

	334220 - Broadcast and wireless comm. equipment	324110 - Petroleum refineries	334111 - Electronic computer mfg	336120 - Heavy duty truck mfg	333120 - Construction machinery mfg	3259A0 - chemical product and preparation mfg	333319 - commercial and service industry machinery	327390 - Other concrete product mfg	562000 - Waste mgmt and remediation services	336111 - Automobile mfg	Cross Sector Totals	Cross Sector %
336300 - Motor vehicle parts mfg	38	2	11	1,077	142	2	3	3	6	769	2,053	22.8%
334413 - Semiconductor and related device mfg	827	1	619	35	15	9	6	5	0	30	1,547	17.2%
Warehousing & Retailing	218	149	96	-	-	45	12	16	-	18	554	6.2%
325188 - All other basic inorganic chemical mfg	2	58	4	0	0	277	0	0	1	0	342	3.8%
Use Phase	196	-	76	-	13	-	27	2	-	-	314	3.5%
334418 - Printed circuit assembly (electronic assembly) mfg	63	0	231	6	5	4	1	2	0	0	312	3.5%
334220 - Broadcast and wireless communications equipment	246	0	3	-	0	0	0	0	0	0	249	2.8%
333618 - Other engine equipment mfg	0	0	-	182	60	0	0	-	0	7	248	2.8%
2122A0 - Gold, silver, and other metal ore mining	60	76	53	-	4	54	0	-	-	2	248	2.8%
334419 - Other electronic component mfg	135	0	15	1	4	0	2	0	0	0	157	1.7%
334112 - Computer storage device mfg	1	-	141	0	0	0	0	-	0	0	143	1.6%
Final Transportation	20	59	14	-	-	13	-	18	-	14	137	1.5%
335911 - Storage battery mfg	0	-	0	38	73	0	1	-	4	12	128	1.4%
334417 - Electronic connector mfg	115	-	5	-	0	0	2	0	0	-	122	1.4%
211000 - Oil and gas extraction	0	116	-	0	0	0	0	0	0	0	116	1.3%
325130 - Synthetic dye and pigment mfg	0	0	-	0	5	99	0	0	0	0	105	1.2%
331110 - Iron and steel mills and ferroalloy mfg	10	0	1	16	63	1	6	4	0	1	102	1.1%
TOTAL	2,387	571	1,620	1,675	714	741	141	132	81	947	9,008	
Top 10 Category Impact Contribution %	26%	6%	18%	19%	8%	8%	2%	1%	1%	11%		76.3%

Table 10. Cross Sector Resource Depletion Contribution Analysis of Top 10 Contract Categories (GJ)

	334220 - Broadcast and wireless comm. equipment	324110 - Petroleum refineries	334111 - Electronic computer mfg	336120 - Heavy duty truck mfg	333120 - Construction machinery mfg	3259A0 - chemical product and preparation mfg	333319 - commercial and service industry machinery	327390 - Other concrete product mfg	562000 - Waste mgmt and remediation services	336111 - Automobile mfg	Cross Sector Totals	Cross Sector %
211000 - Oil and gas extraction	2	11,268,926	-	514	237	7,889	68	1	300	38	11,277,974	58%
Use Phase	1,801,249	-	701,505	-	115,978	-	252,894	17,643	-	-	2,889,269	15%
324110 - Petroleum refineries	1,762	889,603	8,168	8,246	89,239	161,360	16,165	1,119	14,698	567	1,190,928	6%
Warehousing & Retailing	427,779	265,512	182,597	-	-	84,851	23,694	30,714	-	34,193	1,049,340	5%
Other Energy Inputs to Commodity	8,747	168,600	6,639	68,767	15,165	16,125	1,409	13,872	2,693	4,711	306,729	2%
336300 - Motor vehicle parts manufacturing	5,568	335	1,650	159,515	21,067	237	410	384	889	113,912	303,967	2%
Electricity Inputs to Commodity	38,943	47,504	11,155	13,810	19,531	26,564	3,147	6,919	3,260	5,503	176,337	1%
Final Transportation	19,358	94,074	14,883	-	-	18,035	-	12,371	-	11,474	170,194	1%
331110 - Iron and steel mills and ferroalloy manufacturing	12,630	645	875	21,100	81,693	808	8,151	4,985	186	985	132,060	1%
Transportation of Inputs to Commodity	14,492	61,369	10,898	9,855	9,289	7,823	1,459	3,460	1,828	4,883	125,357	1%
334413 - Semiconductor and related device manufacturing	62,702	108	46,943	2,655	1,165	662	419	401	0	2,254	117,308	1%
TOTAL	2,715,789	12,911,081	1,255,675	514,490	551,092	664,705	342,459	149,042	42,957	232,036	19,379,325	100%
Top 10 Category Impact Contribution %	14%	67%	6%	3%	3%	3%	2%	1%	0%	1%		92%

Table 11. Cross Sector Water Consumption Contribution Analysis of Top 10 Contract Categories (kGallons)

	334220 - Broadcast and wireless comm. equipment	324110 - Petroleum refineries	334111 - Electronic computer mfg	336120 - Heavy duty truck mfg	333120 - Construction machinery mfg	3259A0 - chemical product and preparation mfg	333319 - commercial and service industry machinery	327390 - Other concrete product mfg	562000 - Waste mgmt and remediation services	336111 - Automobile mfg	Cross Sector Totals	Cross Sector %
211000 - Oil and gas extraction	0	1,089,830	-	50	23	763	7	0	29	4	1,090,705	28%
Use Phase	591,910	-	230,522	-	38,112	-	83,104	5,798	-	-	949,446	25%
Warehousing & Retailing	234,290	117,559	93,600	-	-	43,500	12,539	16,770	-	17,461	535,719	14%
Direct Operations	33,015	79,283	2,693	7,067	6,401	50,500	1,210	19,179	2,214	2,666	204,227	5%
324110 - Petroleum refineries	187	94,537	868	876	9,483	17,148	1,718	119	1,562	60	126,559	3%
336300 - Motor vehicle parts mfg	2,223	134	659	63,674	8,409	94	164	153	355	45,471	121,336	3%
550000 - Management of companies and enterprises	20,295	2,781	14,056	4,559	5,181	7,171	736	1,111	410	1,707	58,008	1%
Electricity Inputs to Commodity	12,797	15,610	3,666	4,538	6,418	8,729	1,034	2,274	1,071	1,808	57,946	1%
334413 - Semiconductor and related device manufacturing	23,693	41	17,738	1,003	440	250	158	152	0	852	44,328	1%
333618 - Other engine equipment manufacturing	2	2	-	24,499	8,092	0	14	-	7	883	33,501	1%
420000 - Wholesale trade	9,458	1,497	10,436	4,097	2,889	1,228	380	296	87	1,512	31,880	1%
Final Transportation	3,840	15,828	2,913	-	-	3,319	-	2,694	-	2,399	30,992	1%
334220 - Broadcast and wireless communications equipment	29,400	1	343	-	1	1	16	0	1	0	29,763	1%
Other Energy Inputs to Commodity	832	13,685	650	6,350	1,461	1,305	129	756	253	435	25,857	1%
334418 - Printed circuit assembly (electronic assembly) mfg	5,049	32	18,357	442	377	308	93	125	0	35	24,818	1%
325190 - Other basic organic chemical manufacturing	588	4,477	289	259	652	17,648	141	112	275	84	24,525	1%
334112 - Computer storage device manufacturing	236	-	23,534	1	3	1	0	-	2	0	23,777	1%
Transportation of Inputs to Commodity	2,822	8,483	2,189	2,046	1,877	1,522	290	715	328	1,022	21,293	1%
TOTAL	1,063,693	1,467,220	472,113	178,932	153,902	231,066	114,362	66,912	16,197	103,843	3,868,241	
Top 10 Category Impact Contribution %	27%	38%	12%	5%	4%	6%	3%	2%	0%	3%		