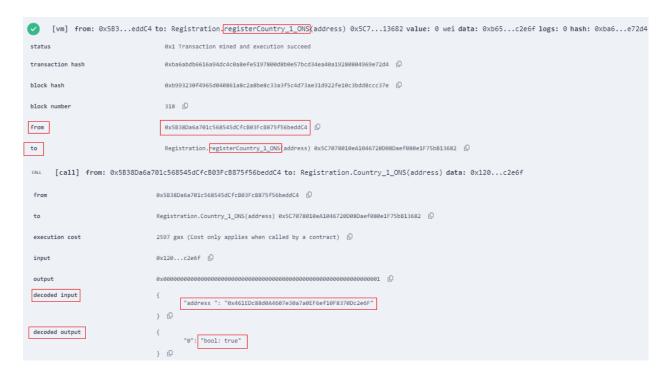
## <Supplemental material>

## Manuscript title: Blockchain-based multi-regional input-output (MRIO) framework for carbon accounting in global supply chains



Supplementary Figure 1: Log showing the successful Deployment of Registration Smart Contract



Supplementary Figure 2: Log showing the successful registration of Country 1 ONS

```
💟 [vm] from: 0x583...eddC4 to: Registration_registerCountry_2_ONS]address) 0x5C7...13682 value: 0 wei data: 0x1b1...47cb3 logs: 0 hash: 0x51d...ecd7d
 status
                                     0x1 Transaction mined and execution succeed
                                     0x51d06f20c21001d58dcf95bf22f111e6a5240516f5e94e6cdf50bff4f60ecd7d [Q
 transaction hash
 block hash
                                     0x5aa279430b7d3bc64265c244845367a1f18e4e948adf33df201d7d44c34a374f
 block number
                                    0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
from
                                     Registration registerCountry_2_ONS (address) 0x5C7078010eA1046720D08Daef080e1F75bB13682
to
      [call] from: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 to: Registration.Country_2_ONS(address) data: 0x486...47cb3
                                 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 [D
                                  Registration.Country_2_ONS(address) 0x5C7078010eA1046720D08Daef080e1F75bB13682
execution cost
                                 2596 gas (Cost only applies when called by a contract) [
                                  0x486...47cb3 [Q
input
output
decoded input
                                          "address ": "0x1520a9c6Dc3a55Dc7cD06e6E6e31Fa9072047cB3"
decoded output
                                         "0": "bool: true"
```

Supplementary Figure 3: Log showing the successful registration of all Country 2 ONS



Supplementary Figure 4: Log showing the successful registration of all Country 3 ONS

```
(vm) from: 0x5B3...eddC4 to: Registration registerCountry_4_ONS(address) 0x517...07455 value: 0 wei data: 0x014...5e7f2 logs: 0 hash: 0x8f6...858b7
 status
                                 0x1 Transaction mined and execution succeed
transaction hash
                                 0x8f6bcf072a29f0148d39a92dad0265054c1e10921725b3ed4f952d51bae858b7
block hash
                                 0x336106781bb9d0934f4bcce6efc3c46e757a4f8099ea4a972c66728b7404de25
                                 259 [
block number
                                 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 [D
from
                                 to
    [call] from: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 to: Registration.Country_4_ONS(address) data: 0xa7f...5e7f2
                              0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 []
from
                              Registration.Country_4_ONS(address) 0x876197308cAebE9E0DE88c703608D33598E2c058
                              2596 gas (Cost only applies when called by a contract) \mathbb{Q}
execution cost
input
output
decoded input
                                     "address ": "0x617F2E2fD72FD9D5503197092aC168c91465E7f2"
decoded output
                                    "0": "bool: true"
```

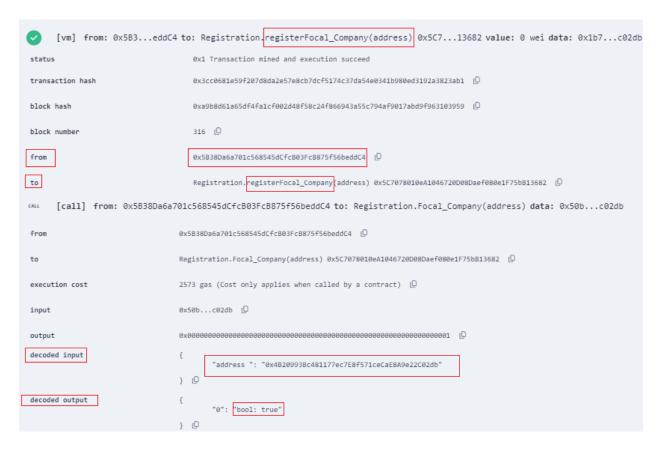
Supplementary Figure 5: Log showing the successful registration of Country 4 ONS



Supplementary Figure 6: Log showing the successful registration of Rest-of-the-World ONS



Supplementary Figure 7: Log showing the successful registration of MRIO Data Aggregator



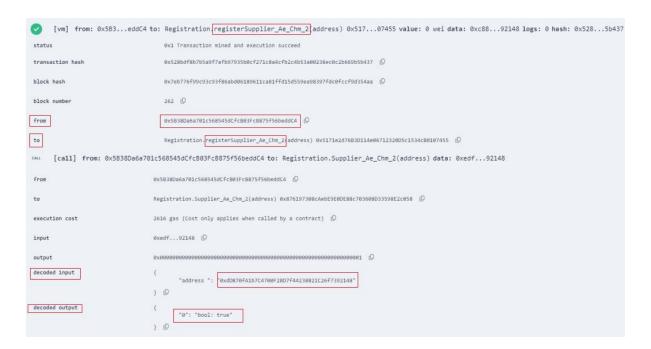
Supplementary Figure 8: Log showing the successful registration of Focal Company



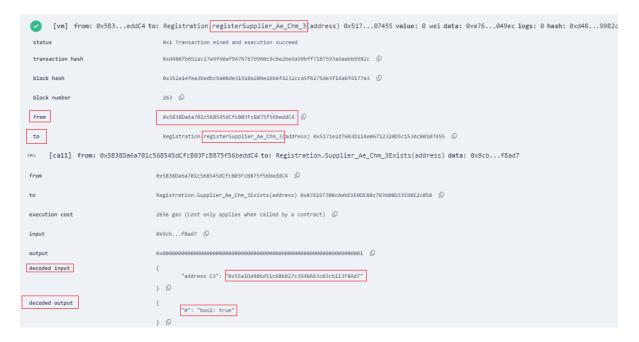
Supplementary Figure 9: Log showing the successful registration of Chemical Industry Supplier in Oman



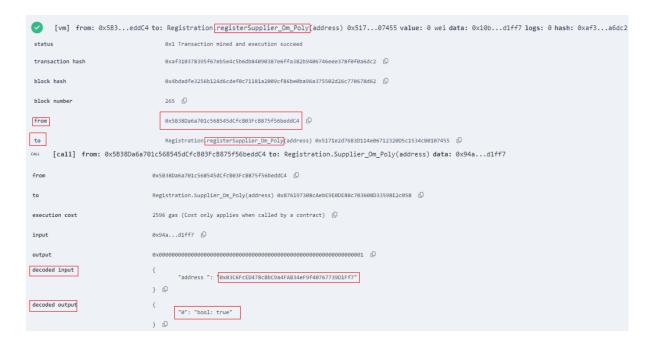
Supplementary Figure 10: Log showing the successful registration of Chemical Industry Supplier 1 in Oman



Supplementary Figure 11: Log showing the successful registration of Chemical Industry Supplier 2 in UAE



Supplementary Figure 12: Log showing the successful registration of Chemical Industry Supplier 3 in UAE



Supplementary Figure 13: Log showing the successful registration of Polymer Industry Supplier in Oman



Supplementary Figure 14: Log showing the successful registration of Polymer Industry Supplier in Kuwait



Supplementary Figure 15: Log showing the successful registration of Polymer Industry Supplier in Qatar



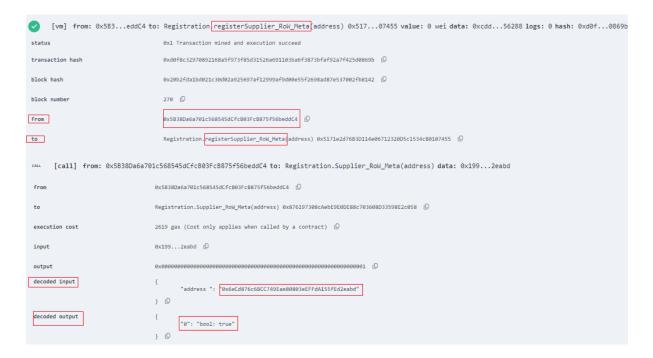
Supplementary Figure 16: Log showing the successful registration of Metal Industry Supplier in Kuwait



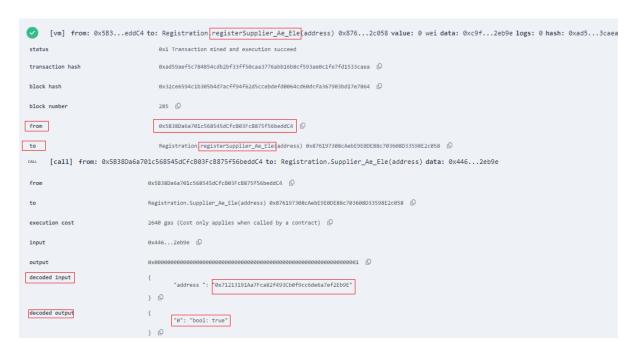
Supplementary Figure 17: Log showing the successful registration of Metal Industry Supplier 1 in Qatar



Supplementary Figure 18: Log showing the successful registration of Metal Industry Supplier 2 in Qatar



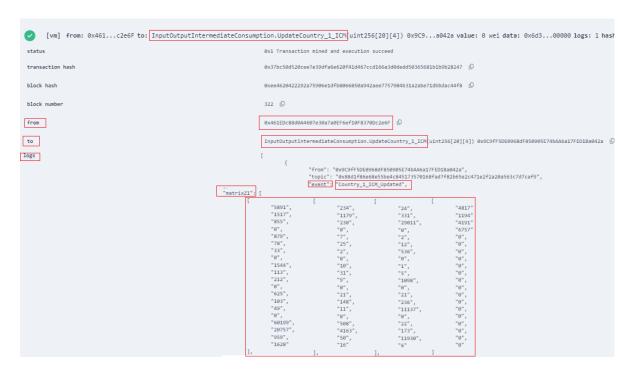
Supplementary Figure 19: Log showing the successful registration of Metal Industry Supplier in Rest-of-the-World region



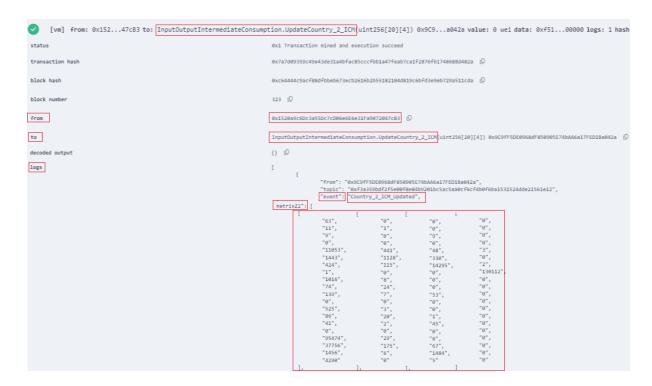
Supplementary Figure 20: Log showing the successful registration of Electricity Supplier in UAE



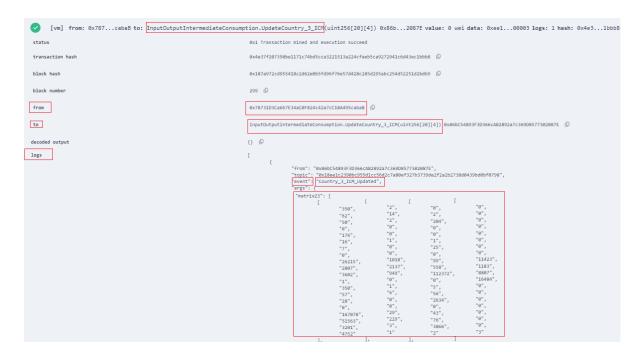
Supplementary Figure 21: Log showing the successful deployment of InputOutputIntermedicateConsumption Contract



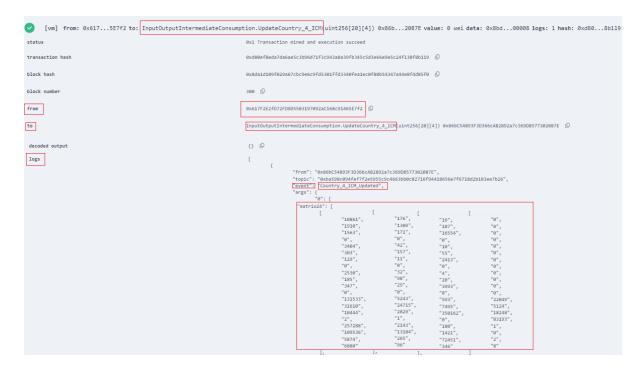
Supplementary Figure 22: Log showing the successful updating of Country 1 Intermediate Consumption Matrix (ICM)



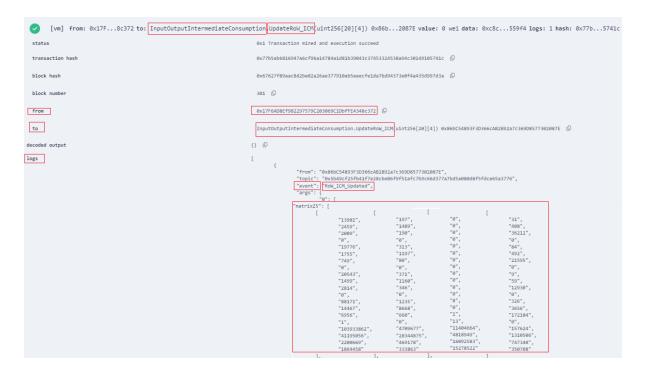
Supplementary Figure 23: Log showing the successful updating of Country 2 Intermediate Consumption Matrix (ICM)



Supplementary Figure 24: Log showing the successful updating of Country 3 Intermediate Consumption Matrix (ICM)



Supplementary Figure 25: Log showing the successful updating of Country 4 Intermediate Consumption Matrix (ICM)



Supplementary Figure 26: Log showing the successful updating of Rest-of-the-World Intermediate Consumption Matrix (ICM)

```
[vm] from: 0x712...2Eb9E to: InputOutputIntermediateConsumption.Input_Ae_EleDemand uint256) 0x86b...2087E value: 0 wei data: 0x1c7...04a38 logs: 1 hash: 0x9
 status
                                       0x1 Transaction mined and execution succeed
                                       0x97b2fb7af7b425e169f366c606bd75b1ea526feffeef1b2401e16128f5772069
 transaction hash
 block hash
                                       0xb1313fd432b35f2996b6699817e91dd5a7f397f3bbfb15f0c11c7976d9f22593
 block number
                                      0x71213191Aa7Fca82f493Cb0f9cc6de6a7ef2Eb9E
from
to
                                      InputOutputIntermediateConsumption.Input_Ae_EleDemand uint256) 0x86bC54893F3D366cAB2892a7c369D8577302087E
decoded input
                                            "uint256 Y11": "19000"
decoded output
                                      () (D
logs
```

Supplementary Figure 27: Log showing the successful updating of Electricity Demand in UAE



Supplementary Figure 28: Log showing the successful updating of Chemical Products Demand by Supplier 1 in UAE

```
(vm] from: 0xdD8...92148 to: InputOutputIntermediateConsumption | Input_Chm_2Demand(uint256) 0x86b...2087E value: 0 wei data: 0x2d5...02ee0 logs: 1 hash: 0xea2...6f58E
 status
                                       0x1 Transaction mined and execution succeed
  transaction hash
                                       0xea2f3a7b57c377644ea4ccd4cf1e9192a52ba0b3ca17f0a5c2cbb703c9c6f588
                                       0x550c9f5d8487f6598e69bbaac609d20740f1d59020791842a196acd04fc33591 [D
 block number
                                     0xdD870fA1b7C4700F2BD7f44238821C26f7392148
 from
to
                                       InputOutputIntermediateConsumption Input_Chm_2Demand(uint256) 0x86bC54893F3D366cAB2892a7c369D8577302087E
decoded input
                                            "uint256 Y9": "12000"
                                      } (D
                                      {} O
```

Supplementary Figure 29: Log showing the successful updating of Chemical Products Demand by Supplier 2 in UAE



Supplementary Figure 30: Log showing the successful updating of Chemical Products Demand by Supplier 3 in UAE

```
[vm] from: 0x0A0...C70DC to: InputOutputIntermediateConsumption Input_Ku_MetaDemand(uint256) 0x86b...2087E value: 0 wei data: 0xb0e...0364c logs
 status
                                  0x1 Transaction mined and execution succeed
 transaction hash
                                  0x4de7618237529f5c2e9855f956f50dfc10d37d5d17aa8dc91cd3f415b3635b31
                                  0x5b5874a435c286b10e0a23088119f889e3664df99b7bcc389d37526cefd7d276
 block hash
 block number
                                  0x0A098Eda01Ce92ff4A4CCb7A4fFFb5A43EBC70DC
from
                                  to
decoded input
                                       "uint256 Y4": "13900"
                                 } (Q
decoded output
                                 {} @
logs
                                           "0": "13900",
"Y4": "13900"
```

Supplementary Figure 31: Log showing the successful updating of Metal Products Demand by Supplier in Kuwait



Supplementary Figure 32: Log showing the successful updating of Polymer Products Demand by Supplier in Kuwait



Supplementary Figure 33: Log showing the successful updating of Chemical Products Demand by Supplier in Oman



Supplementary Figure 34: Log showing the successful updating of Polymer Products Demand by Supplier in Oman

```
[vm] from: 0x6eC...2eabd to: InputOutputIntermediateConsumption.Input_RoW_MetaDemand(uint256) 0x86b...2087E value: 0 wei data: 0x536...03e80
   status
  transaction hash
                                                      0xf66f9151fda328583175c467a28a5fa86694145820981ff6492863ee244c0963
                                                      0xfd60d55ab766a6311d02cba7461ae75a8bfe76d2f9fbfe5fabcaaa6fd29e95db
  block hash
  block number
 from
                                                    0x6eCd876c6BCC749Eae80803eEFFdA155fEd2eabd
 to
                                                    InputOutputIntermediateConsumption.Input_RoW_MetaDemand uint256) 0x86bC54893F3D366cAB2892a7c369D8577302087E []
decoded input
                                                            "uint256 Y12": "16000"
                                                   } (D
                                                   {} ©
decoded output
logs
                                                                    "from": "0x86bC54893F3D366cAB2892a7c369D8577302087E",
"topic": "0xa55b194c1a3adc691b76553b6c2b2b6a24a69e992ed7ce42faca0098f8fd091d",
"event": | "RoW_MetaDemandUpdated",
"args": |
```

Supplementary Figure 35: Log showing the successful updating of Metal Products Demand by Supplier in Rest-of-the-World

```
[vm] from: 0xCA3...a733c to: InputOutputIntermediateConsumption.Input_Qa_PolyDemand(uint256) 0x86b...2087E value: 0 wei data: 0xb0a...03e80
 status
                                          0x1 Transaction mined and execution succeed
 transaction hash
                                          0x4acf40c37335e79d407f809b5972127c8c25d68d9cc66c4b9478d210b70760ff
 block hash
                                          0x5b333e016e4d19a881c83ce9b643d6e7bbb343fdcb9eda60cd486b659deea791 [Q
 block number
from
                                          0xCA35b7d915458EF540aDe6068dFe2F44E8fa733c
to
                                          InputOutputIntermediateConsumption.Input_Qa_PolyDemand(uint256) 0x86bC54893F3D366cAB2892a7c369D8577302087E (Q
decoded input
                                                 "uint256 Y5": "16000"
                                          } @
                                         {} ()
logs
                                                      evenc.
"args": {
    "0": "16000",
    "Y5": "16000"
```

Supplementary Figure 36: Log showing the successful updating of Polymer Products Demand by Supplier in Qatar

## Supplementary Table 1: Intermediate Consumption Matrix (Z)

			Country 1	(Oman)			Country 2	(Kuwait)			Country 3	(Qatar)			Country	4 (UAE)			Rest-of-t	he-World	
		Chemical	Polymer	Metal	Electricity	Chemical	Polymer	Metal	Electricity	Chemical	Polymer	Metal	Electricity	Chemical	Polymer	Metal	Electricity	Chemical	Polymer	Metal	Electrici
Country 1 (Oman)	Chemical	58.91	15.17	8.55	0	8.79	0.78	0.33	0	15.44	1.13	2.12	0	6.25	1.03	0.49	0	601.99	207.57	9.59	16.28
	Polymer	2.34	11.79	2.3	0	0.07	0.25	0.02	0	0.1	0.31	0.09	0	0.21	1.48	0.11	0	5.08	41.63	0.5	0.16
	Metal	0.24	3.31	290.11	0	0.02	0.12	5.36	0	0.01	0.05	10.98	0	0.21	2.36	111.37	0	0.22	1.73	119.3	0.06
	Electricity	48.17	11.94	41.91	67.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Country 2 (Kuwait)	Chemical	0.63	0.11	0.09	0	110.53	14.43	4.24	0.01	10.16	0.74	1.39	0	5.25	0.86	0.41	0	954.74	377.56	14.56	42.9
	Polymer	0	0.01	0	0	4.41	11.28	1.15	0	0.08	0.24	0.07	0	0.03	0.2	0.02	0	0.29	1.75	0.06	0
	Metal	0	0	0.09	0	0.48	3.3	142.95	0	0	0	0.53	0	0	0.01	0.45	0	0.08	0.67	14.84	0.05
	Electricity	0	0	0	0	0.03	0	0.02	1301.12	0	0	0	0	0	0	0	0	0	0	0	0
Country 3 (Qatar)	Chemical	3.5	0.62	0.5	0	1.76	0.16	0.07	0	262.15	28.07	36.02	0.01	3.5	0.57	0.28	0	1670.78	515.63	32.01	47.52
	Polymer	0.02	0.14	0.02	0	0	0.01	0	0	10.18	21.37	9.49	0	0.01	0.06	0	0	0.29	2.29	0.03	0.01
	Metal	0	0.02	2.04	0	0	0.01	0.25	0	0.99	5.58	1123.72	0	0.05	0.56	26.34	0	0.43	0.76	38.66	0.02
	Electricity	0	0	0	0	0	0	0	0	114.23	11.83	88.07	164.84	0	0	0	0	0	0	0	0.03
Country 4 (UAE)	Chemical	108.61	19.1	15.63	0	34.04	3.03	1.29	0	25.3	1.85	3.47	0	1315.33	316.1	104.44	0.02	2572.88	1095.36	58.74	68.8
	Polymer	1.76	13.09	1.71	0	0.42	1.57	0.11	0	0.32	0.98	0.29	0	52.43	247.15	28.29	0.01	21.43	131.84	2.65	0.96
	Metal	0.16	1.87	165.54	0	0.1	0.55	24.13	0	0.04	0.2	39.93	0	5.93	74.95	3501.62	0	1.8	14.21	724.51	3.46
	Electricity	0	0	0	0	0	0	0	0	0	0	0	0	220.49	51.24	182.48	831.93	0.01	0	0.02	0.08
Rest-of-the-World	Chemical	139.81	24.59	20.09	0	197.76	17.55	7.49	0	205.43	14.99	28.14	0	881.71	144.67	69.56	0.01	1039339	411950.6	22006.69	18644.58
	Polymer	1.97	14.89	1.9	0	3.13	11.97	0.8	0	3.71	11.6	3.46	0	12.35	86.68	6.6	0	47096.77	283448.8	4691.78	3338.63
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0.01	0.13	114046.6	48189.49	160925.8	152785.2
	Electricity	0.31	4.08	362.12	0	0.84	4.92	215.95	0	0.09	0.59	129.3	0	3.26	36.56	1721.04	0	1576.24	13105.06	747339.7	3507.08
	Output	2891.28	780.74	2367.92	2223.09	4446.65	516.74	1050.53	9890.04	7373.43	1013.14	5519.18	2343.05	27403.06	9248.05	19278.08	12063.02	3732402	2035283	2623273	3 28747
	Carbon emissions	3.895275	1.193152	2.843123	14.53232	5.946167	0.931505	0.68661	40,74667	8.685134	1.030444	1.374334	18.54859	15.52457	4.525441	6,936519	43.81777	660,1689	91.60576	1102.881	1 12560.8

Supplementary Table 2: Final Demand and Number of Suppliers

Regions	Industries	Final Demand (Y)	No. of Suppliers	Supplier by Product
	Chemical	14600		1
0	Polymer	9500	1	1
Oman	Metal	0	1	0
	Electricity	0		0
	Chemical	0		0
Kuwait	Polymer	8800	2	1
Kuwait	Metal	13900		1
	Electricity	0		0
	Chemical	0		0
Qatar	Polymer	16000	3	1
Qatai	Metal	12000		2
	Electricity	0		0
	Chemical	32000		3
UAE	Polymer	0	6	0
U/IL	Metal	0		0
	Electricity	19000		1
	Chemical	0		0
Rest-of-	Polymer	0		0
the-World	Metal	16000		1
	Electricity	0		0