

ENVIRONMENTAL PERFORMANCE SUMMARY (EXCLUDED UHV : UPSTREAM PROJECT OF HYGENE AND VALUE ADDED PRODUCT PLANT)

To ensure that environmental performance in 2016-2017 are comparable with historical data, the data in 2016-2017 in these below table are excluded new plant (UHV) that started commercial operation date in July 2016. Typically, newly acquired business or recently established plants are required to comply with IRPC management system within 24 months or soon.

PRODUCTION

GRI Standard	Data	Unit	2014	2015	2016	2017
N/A	Annual production	Tonne	9,965,199	10,518,179	10,665,380	10,038,254

ENVIRONMENTAL

Materials Consumption

GRI Standard	Data	Unit	2014	2015	2016	2017
301-1	Crude oil	Tonne	8,233,754	8,737,143	8,863,305	8,592,344
	Naphtha	Tonne	745,450	787,527	682,215	700,113

Energy Consumption ⁽¹⁾

GRI Standard	Data	Unit	2014	2015	2016	2017
302-1	Total energy consumption ^{(2), (3)}	GJ	41,438,061	45,015,597	44,333,170	41,675,400
	Total direct energy consumption	GJ	46,802,327	49,427,071	48,721,421	45,651,996
	Total indirect energy consumption	GJ	18,636	889,249	937,873	472,087
	Total electricity sold	GJ	2,161,886	2,108,913	2,200,936	1,963,211
	Total steam sold	GJ	3,221,016	3,191,809	3,125,188	2,485,472
302-3	Energy intensity ⁽⁴⁾	GJ/tonne of production	4.16	4.28	4.16	4.15
302-4	Energy saved due to conservation and efficiency improvements	GJ	372,357	1,611,884	756,750	1,914,021
N/A	Total diesel consumed by IRPC owned marine vessels	Litre	726,146	852,094	615,199	620,054

Remark:

- (1) Standards and methodologies used to calculate are based on relevant laws and regulations.
- (2) Energy use increased between 2014 to 2015 due to increase in production, unplanned shutdown, and production of special grade HDPE and Polyol.
- (3) Electricity use of the Bangkok office purchased from the Metropolitan Electricity Authority since 2015.
- (4) Energy intensity not including energy used during major turnaround period.

Flared and Vented Hydrocarbon ^{(1), (2), (3)}

GRI Standard	Data	Unit	2014	2015	2016	2017
G4-OG6	Volume of flared hydrocarbon	Million M ³	38.67	36.19	22.30	39.17
	Volume of continuously flared hydrocarbon	Million M ³	N/A	N/A	19.02	34.88
	Volume flared hydrocarbon for oil & gas production in relation to volume produced	M ³ / ton of production	3.88	3.44	2.09	3.90
N/A	Methane Emission of flared	Ton	50.16	31.39	28.93	50.81

Remark:

- (1) The amount of flared hydrocarbon is calculated accordingly to IRPC's hydrocarbon management manual, in reference to HM31: Guide to HC Management in Petroleum Refinery Operation and HM32: Guide to Product HC Management at Petroleum Product Marketing and Distribution.
- (2) Hydrocarbons released from production processes gathered from ACB data (calculated HC from the differences of feed to products as stored in SAP) and EPS data (calculated from Feed going into the reactor in each batch 7.5% and products contain Pentane 6.6% each month)
- (3) Hydrocarbons released from storage tanks and product and raw material handling, gathered from ton VOCs of Tank calculation and Marketing & Terminal as Nm³ in the VOCs inventory.

Greenhouse Gas ⁽¹⁾

GRI Standard	Data	Unit	2014	2015	2016	2017					
305-1	Operational control										
305-2	Direct emissions of greenhouse gas (Scope 1) ⁽²⁾	Million tCO ₂ e	3.121	3.223	3.146	2.949					
305-3							Indirect emissions of greenhouse gas (Scope 2)	0.004	0.070	0.013	0.003
							Other indirect emissions of greenhouse gas (Scope 3) ^{(3), (4)}	N/A	7.662	7.495	15.005
	Equity Basin ⁽⁵⁾										
	Direct emissions of greenhouse gas (Scope 1)	Million tCO ₂ e	3.124	3.307	3.992	3.172					
	Indirect emissions of greenhouse gas (Scope 2)	Million tCO ₂ e	0.004	0.070	0.280	0.003					
305-4	GHG emission intensity ⁽⁶⁾	tCO ₂ e/ton of production	0.314	0.313	0.296	0.294					

Remark:

- (1) Greenhouse gas (GHG) emissions calculation is based on API 2009, IPCC 2006, ISO14064-1, and The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition). GWP used is IPCC Fourth Assessment Report (AR4-100year).
- (2) This does not include GHG emission released from process vents.
- (3) Scope 3 GHG emissions come from employee transportation, and use of B5, E10, and E20 products.

- (4) Scope 3 GHG emissions increased from 2016 to 2017 as a result of an expansion in scope of reporting, i.e. inclusion of sales and transport data, electricity loss data (PTT tool).
- (5) GHG emissions from the group's subsidiaries include those from IRPC Pcl., IRPC Oil Co.Ltd., IRPC Polyol Co.Ltd., UBE Chemical Co.Ltd. and IRPC Clean Power Co.Ltd.
- (6) GHG emission intensity was calculated from Scope 1 and Scope 2 GHG emissions.

Air Emissions ⁽¹⁾

GRI Standard	Data	Unit	2014	2015	2016	2017
305-7	Total NOx	Tonne	2,700	1,778	1,714	1,383
	NOx intensity	Ton/thousand ton of production	0.271	0.169	0.161	0.138
	Total SOx ^{(2), (3)}	Tonne	1,430	1,491	1,987	1,929
	SOx intensity	Ton/thousand ton of production	0.143	0.142	0.186	0.192
	Total suspended particulate (TSP)	Tonne	325	298	293	189
	TSP intensify	Ton/thousand ton of production	0.033	0.028	0.027	0.019
	Total VOCs ⁽⁴⁾	Tonne	1,603	1,690	2,142	1,809
	VOCs intensity	Ton/thousand ton of production	0.161	0.161	0.201	0.180

Remark:

- (1) This comes from direct measurements and relevant standards and regulations
- (2) Sulfur oxide in the form of sulfur dioxide.
- (3) Total SO_x has been increased since 2015 as there was an increase in use of fuel oil which has a larger sulfur content.
- (4) The calculation method for flare VOCs is refer to US.EPA 2015 and tank VOCs

Water Consumption and Wastewater

GRI Standard	Data	Unit	2014	2015	2016	2017
303-1	Water withdrawn by source ⁽¹⁾	M ³	37,635,997	38,938,454	38,561,720	32,961,313
	Surface water	M ³	19,298,917	19,607,178	18,491,128	18,779,726
	Rain water	M ³	817,080	1,111,159	1,935,557	2,461,860
	Municipal water supply	M ³	N/A	21,625	16,208	14,599
	Ground water	M ³	N/A	769	7,715	7,589
	Salt / brackish water	M ³	17,520,000	18,197,723	18,111,112	11,697,539
	Fresh water withdrawal intensity ⁽²⁾	M ³ /Tonne of production	2.02	1.91	1.92	1.87
303-3	Total volume of recycled/reused water	M ³	450,775	1,007,400	979,477	3,110,723
		% of total water withdrawal	1.20	2.59	2.68	9.44
306-1	Total volume of water discharge ⁽³⁾	Million M ³	19.73	20.41	20.67	14.93

GRI Standard	Data	Unit	2014	2015	2016	2017
	Chemical oxygen demand (COD) in treated wastewater discharged ⁽⁴⁾	Tonne	179	172	186	194
	Biochemical oxygen demand (BOD) in treated wastewater discharged ⁽⁴⁾	Tonne	17	23	12	18
	Total suspended solid (TSS) in treated wastewater discharged ⁽⁴⁾	Tonne	47	40	31	53

Remark:

- (1) Water use from various sources of all IRPC Group businesses.
- (2) Fresh water use intensity does not included water from UHV plant, seawater, water use of customers, and water use during major turnaround activities.
- (3) All wastewater, including seawater used as sulfur scrubber which is treated before release to the ocean. The amount of total effluent is measured from the amount of wastewater sent to WWT system (except seawater, which uses water in is water out as in process design).
- (4) Data of COD, BOD and TSS is from direct measurement or calculation in reference to standard and related regulations.

Solid Waste

GRI Standard	Data	Unit	2014	2015	2016	2017
306-2	Total waste disposal ^{(1) (2) (3)}	Ton	27,411	34,405	30,387	41,007
	Total Non-hazardous waste	Ton	23,184	28,859	25,932	27,164
	Total Non-hazardous waste disposed ⁽⁴⁾	Ton	6,831	8,174	3,656	3,620
	Non-hazardous waste from routine operations	Ton	22,848	28,843	25,932	27,128
	Incineration	Ton	41	0	0	276
	Landfill	Ton	4,620	6,302	3,335	2,665
	Waste water treatment	Ton	1,719	0	293	0
	On-site storage	Ton	359	1,856	28	643
	Recovery	Ton	144	48	15	590
	Recycling	Ton	15,812	20,548	22,261	21,414
	Reuse	Ton	0	0	0	0
	Composition	Ton	153	0	0	1,540
	Export	Ton	0	89	0	0
	Non-hazardous waste from non-routine operations	Ton	336	16	0	36
	Incineration	Ton	0	0	0	0
	Landfill	Ton	92	16	0	36
	Recovery	Ton	244	0	0	0
	Recycling	Ton	0	0	0	0
	Total Hazardous waste	Ton	4,226	5,545	4,455	13,843

GRI Standard	Data	Unit	2014	2015	2016	2017
	Total Hazardous waste disposed⁽⁴⁾	Ton	1,229	1,791	1,171	5,494
	Hazardous waste from routine operations	Ton	4,111	5,507	4,336	13,410
	Incineration	Ton	860	813	712	5,155
	Landfill	Ton	311	766	402	258
	Waste water treatment	Ton	0	0	23	0
	On-site storage	Ton	57	189	34	79
	Recovery	Ton	2,234	3,255	2,264	5,535
	Recycling	Ton	441	452	838	2,023
	Reuse	Ton	42	32	62	35
	Composition	Ton	0	0	0	0
	Export	Ton	165	0	0	324
	Hazardous waste from non-routine operations	Ton	115	38	119	433
	Incineration	Ton	0	21	0	0
	Landfill	Ton	1	2	0	2
	Recovery	Ton	114	14	119	428
	Recycling	Ton	0	0	0	3
306-4	Hazardous waste transportation	Ton	4,169	5,356	4,454	13,750
	Hazardous waste import to IRPC	Ton	0	0	0	0
	Hazardous waste export from IRPC	Ton	4,169	5,356	4,454	13,750
	Hazardous waste treated	Ton	0	0	0	0
	Hazardous waste shipped internationally	Ton	165	89	23	324

Remark:

- (1) Total waste disposal in 2015 was increased from 2014 due to changing source of coal resulting in an increase in non-combusted waste, furnace refractor at Ethylene Plant, and inspection and cleaning of 6 crude oil tanks.
- (2) Total waste disposal in 2017 higher from previous year due to increase of hazardous waste during turnaround such as chemical cleaning water, used Amine, spent caustic polymer and refractory, etc.
- (3) Information of waste disposal method is provided by waste disposal contractor as approved by DIW.
- (4) Total non-hazardous and Total hazardous waste disposed are only included waste from incineration, landfill, wastewater treatment, and onsite storage.