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European downstream oil industry safety performance

Statistical summary of reported incidents - 2020

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Statistical summary of reported incidents – 2020

C. Banner (Concawe)

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ABSTRACT

The 2020 annual report on European downstream oil industry safety performance presents work-related personal injuries for the industry's own employees and contractors and process safety performance indicators. Information was received from forty-two Concawe Member Companies and Joint Ventures comprised of member companies, together representing more than 97% of the European refining capacity. Total work hours reported (543 million) were around 12% lower in 2020 than in 2019, potentially associated with the reduction in staffing and fall in product demand due to the Covid-19 pandemic. In 2020, there were two fatalities reported by the industry, one Manufacturing staff and one Marketing contractor. The number of Lost Workday Injuries recorded in 2020 (476) is 20% lower than those in 2019 (595). The combined number of Tier 1 and 2 process safety events across Manufacturing and Marketing in 2020 declined by almost 17% since 2019 (197 releases in 2020 and 236 in 2019). The numbers of Tier 1 and Tier 2 events declined in both sectors, with the largest reduction in the number of Marketing Tier 1 events 50% from 8 in 2019 to 4 in 2020.

Note that 2019 data in this report has been revised based on new member company information received in the 2020 data collection. This report therefore provides the most accurate and up to date details of both 2019 and 2020 data.

This report is available as an Adobe pdf file on the Concawe website (www.Concawe.eu).

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EXECUTIVE SUMMARY

For 2020, information was received from forty-two Concawe Member Companies and Joint Ventures (comprised of member companies), together accounting for greater than 97% of the available refining capacity in the EU-28, Norway, and Switzerland. The purpose of collecting this data is to provide member companies with a benchmark against which to compare their performance, so that they can determine the efficacy of their safety management systems, identify shortcomings, and take corrective actions. Data also serve to demonstrate that the responsible management of safety in the downstream oil industry results in a low level of accidents despite the hazards intrinsic to its operations.

The aggregated 2020 results for Manufacturing, Marketing and the combined downstream oil industry are shown in the table below.

All reporting companies									
Sector	**Manufacturing**			**Marketing**			**Both Sectors**		
Workforce	**OS**	**CT**	**AW**	**OS**	**CT**	**AW**	**OS**	**CT**	**AW**
Hours worked Mh	111	142	253	139	150	289	251	292	543
Fatalities	1	0	1	0	1	1	1	1	2
FAR - FA/100Mh	0.90	0.00	0.39	0.00	0.67	0.35	0.40	0.34	0.37
LWI	153	139	292	112	72	184	265	211	476
Lost time through LWI - Days	5,752	3,685	9,437	2,991	1,987	4,978	8,743	5,672	14,415
LWIF - LWI/Mh	1.37	1.01	1.17	0.80	0.48	0.64	1.06	0.73	0.88
LWIS - Lost days/LWI	38.6	34.1	36.7	29.3	35.5	31.5	34.8	34.6	34.7
AI	249	268	517	198	109	307	447	377	824
AIF - AI/Mh	2.24	1.89	2.04	1.42	0.73	1.06	1.78	1.29	1.52
Distance travelled - million km							176	400	576
RA							83	161	244
RAR							0.47	0.39	0.41
T-1 PSE			62			4			66
T-2 PSE			120			11			131
T-1 PSER PSI/Mh reported			0.25			0.02			0.13
T-2 PSER PSI/Mh reported			0.49			0.04			0.26
Total PSER PSI/Mh reported			0.74			0.06			0.40

OS: Own staff; CT: Contractors; AW: All workers

* LWIS is calculated for those LWI where lost days are reported

+ RAR is calculated for those RA where distance is reported

There were two fatalities reported for 2020, one Manufacturing staff and one Marketing contractor. The Manufacturing staff fatality was as a result of a fire and a Marketing contractor died in a vehicle turnover (caught in, under or between). In comparison with 2018 and 2019 (10 and 3 fatalities, respectively), there is a decrease of number of recorded fatalities, however, continued efforts are needed to achieve the target of zero fatalities in our industry.

In addition to fatalities Lost Workday Injuries (LWI) are also studied to identify further opportunities for continuous safety performance improvement. A total of 476 LWIs were reported in 2020 (595 in the previous year) with a 2020 LWIF of 0.88, compared with 0.97 in 2019. As in previous years, a relatively small number of categories contribute to most LWIs reported. In order of frequency (highest first) Slips and Trips (same height), Struck by and Cut, puncture and scrape together account for over 51% of all LWIs reported in 2020 across Manufacturing and Marketing.

For 2020, 40 companies submitted Process Safety Event (PSE) data for the Manufacturing operations and 21 submitted Marketing PSE data. The combined number of Tier 1 and 2 process safety releases across Manufacturing and Marketing in 2020 declined by almost 17% since 2019 (197 releases in 2020 and 236 in 2019). The numbers of Tier 1 and Tier 2 releases declined in both sectors, with the largest reduction in the number of Marketing Tier 1 events 50% from 8 in 2019 to 4 in 2020. Five out of 476 LWIs (1%) in 2020 were related to Tier 1 process safety events, this is the same proportion as in 2019. This underlines the importance of high technical standards and strict procedures in process safety.

Note that 2019 data in this report has been revised based on new member company information received in the 2020 data collection, see **Appendix 5**. This report takes into account the following revisions in 2019 data:

- an increase in the originally reported work hours for Manufacturing staff from 118.1 million in Concawe 2019 report [26] to 118.4 million in this report;

- an increase in the originally reported work hours for Manufacturing contractor from 167 million in Concawe 2019 report [26] to 171 million in this report

This report therefore provides the most accurate and up to date details of both 2019 and 2020 data.

1. INTRODUCTION TO 2020 REPORT

The collection and analysis of incident data is widely recognised by the downstream oil refining industry as an essential element of an effective safety management system. Concawe started compiling statistical data for the European downstream oil industry in 1993 and this is the twenty-seventh report on this topic (see references of past reports in the reference list [1-26]). This report covers data collected for 2020 as well as a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available. For 2020, information was received from all forty Concawe Member Companies and two Joint Ventures comprised of member companies when the data is not submitted by the Member Company partners. These 42 submissions in 2020 represent more than 97% of the European Refining capacity. From the outset, most Concawe member companies have participated so that the report has always represented a large portion of the industry and by 1995 the report represented ~93% of European refining capacity (somewhat less for distribution and retail). Over the years, the level of representation has fluctuated in line with the structural changes and mergers occurring in the industry. In the last 10 years, the average representation was around 97% of the European Refining capacity.

The term "downstream" represents all activities of the Industry from receipt of crude oil to products sales, through refining, distribution, and retail. Not all companies operate in both the Manufacturing and Marketing areas and not all companies are able to supply all the requested data. All those who do, collect data separately for "Manufacturing" (i.e. refining) and "Marketing" (i.e. distribution, retail and "head office" staff) and this split has been applied in the report. The data is also split between company and contractor staff as contractor statistics are normally fully integrated into the companies' safety monitoring systems. Some companies do not record road accidents separately from other incidents. All companies record own staff injuries against the Manufacturing and/or Marketing categories, but this is not always the case for lost days. Contractor data is in general, less complete than company staff data. Where data are not available directly, Members are requested to present the best estimate possible.

The purpose of collecting this data is twofold.

- To provide member companies with a benchmark against which to compare their performance, so that they can determine the efficacy of their safety management systems, identify shortcomings, and take corrective actions.
- To demonstrate that the responsible management of safety in the downstream oil industry results in a low level of accidents despite the hazards intrinsic to its operations.

Several safety key performance indicators have been adopted by most oil companies operating in Europe as well as by other industries. Although there are differences in the way member companies collect base data these common indicators allow for an objective comparison at the industry level. The differences in precise definitions used and in local interpretation of metrics means that direct comparison of data from individual companies could lead to erroneous conclusions. For this reason, Concawe does not report individual company data but rather aggregates the data at the membership level.

In 2009, Concawe began to compile Process Safety Performance Indicator (PSPI) data. These describe the number of Process Safety Events (PSE) expressed as unintended Loss of Primary Containment (LOPC). The 2020 PSE data represents 40 out of 42 of the Manufacturing companies and 96% of European refining capacity.

In 2013, the Concawe membership agreed to adopt 16 incident categories to describe both fatalities and Lost Workday Injury (LWI) in an attempt to learn more from the actual incidents. These categories allow for better benchmarking and alignment with other industry organisations, particularly the IOGP that represents the upstream sector of the oil and gas industry. The Concawe categorization of fatalities and LWIs are further explained in **Appendix 1**.

In 2014, the members decided to commence collecting additional information in relation to the nature of Marketing retail operations. Companies have been asked to indicate if they have no retail activity and to describe their retail operations as either Company Owned Company Operated (COCO), Company Owned Dealer Operated (CODO), Dealer Owned Company Operated (DOCO) or Dealer Owned Dealer Operated (DODO). Concawe would like to improve the report in the data coverage for retail and transport contractors.

As from 2018, additional information was gathered regarding the causal factors of Lost Workday Injuries. This information is in line with the requirements of API RP754 (2016). This data is presented in table format in **Appendix 3**. Over time this will allow assessment of the main factors contributing to Lost Workday Injuries from which approaches to address incident prevention can be developed.

In 2019, the possibility to link reported Tier 1 Process Safety Events with Lost Workday Injuries was provided with the intention to build an understanding of the types of Process Safety Events and their causal factors that lead to direct injury.

In 2020, for the first time, the opportunity to record the number of RWIs and/or MTCs linked to each Tier 2 Event was provided.

Table 1 summarises the number of submissions and illustrates some key aspects of the data supplied by the companies.

Table 1 Number of companies submitting data for 2020

No. of Companies	Manufacturing			Marketing		
	Own Staff	Contractors	All Workers	Own Staff	Contractors	All Workers
Submission	42	42		24	21	
Including						
Lost Days	39	34		22	15	
All Injuries	34	38		12	13	
Road Accidents*	33	30		16	11	
Distance Travelled	25	24		15	11	
Process Safety			40			21
Retail Operations						
No Retail						4
COCO						14
CODO						13
DOCO						7
DODO						10

* Several companies do not report their Road Accidents and related exposure hours separately. These incidents are included in their overall statistics in cases where relevant criteria (LWI, AI) are met.

2. 2020 PERSONAL SAFETY PERFORMANCE RESULTS

The aggregated 2020 results for Manufacturing, Marketing and the combined downstream industry are shown in **Table 2.**

Table 2 Aggregated 2020 results for all reporting companies

All reporting companies									
Sector	**Manufacturing**			**Marketing**			**Both Sectors**		
Workforce	**OS**	**CT**	**AW**	**OS**	**CT**	**AW**	**OS**	**CT**	**AW**
Hours worked Mh	111	142	253	139	150	289	251	292	543
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LWIS - Lost days/LWI	38.60	34.12	36.72	29.32	35.48	31.51	34.83	34.59	34.73
AI	249	268	517	198	109	307	447	377	824
AIF - AI/Mh	2.24	1.89	2.04	1.42	0.73	1.06	1.78	1.29	1.52
Distance travelled - million km							176	400	576
RA							83	161	244
RAR							0.47	0.39	0.41

OS: Own staff; CT: Contractors; AW: All workers
* LWIS is calculated for those LWI where number of lost days are reported
⁺ RAR is calculated for those RA where distance is reported

2.1. 2020 FATALITIES

There were two fatalities reported for 2020, one Manufacturing staff and one Marketing contractor. The Manufacturing staff fatality was as a result of a fire and a Marketing contractor died in a vehicle turnover (caught in, under or between).

- A fire inside a building in a non-production area of the refinery (not a process safety event) injured 3 people and killed a member of Manufacturing staff. An incident investigation held by the Public Firefighting Service is ongoing.
- During road transport of crude oil, the truck left the road and rolled over, killing the driver (Caught in, under or between).

While this represents a reduction in annual number of fatalities since 2018 and 2019 (when 10 and 3 fatalities were reported respectively), it remains the same number recorded in 2016 and 2017 (two fatalities in both 2016 and 2017). The 2020 data indicate that continued efforts are essential to achieve the target of zero fatalities in our industry.

2.2. 2020 LOST WORKDAY INJURIES

In 2020, there were a total of 476 Lost Workday Injuries, with 61% of these in Manufacturing and 39% in Marketing. For both sectors, more LWI were recorded for staff than contractors. In Manufacturing the split between staff and contractor LWI is 52% versus 48%. In Marketing the split between staff and contractor LWI is 61% versus 39%.

There was an overall decrease in Lost Workday Injury Frequency (LWIF) compared with 2019. The LWIF went from 0.97 LWI/Mh in 2019 to 0.88 LWI/Mh in 2020 across all workers. Thirty-six companies reported LWI in both 2019 and 2020. Of these, 21 companies (58%) reported a lower overall LWIF in 2020 than in 2019, 3 companies had the same LWIF in 2019 and 2020 (8%) and 12 companies (33%) had a higher LWIF in 2020.

As in 2018 and 2019, Manufacturing staff is the sector with the highest LWIF (1.37 in 2020, compared with 1.54 in 2019 and 1.50 in 2018). Marketing contractors have the lowest recorded LWIF of all sectors in 2020 at 0.48.

For comparison purposes, the LTIF (frequency of LWIs + Fatalities) has been calculated for each category of workers, compared with the LWIF and presented in **Table 3** below.

Table 3 Comparison of LWIF and LTIF in 2020

	LWIF	LTIF
All Workers	0.88	0.88
Manufacturing Staff	1.37	1.38
Manufacturing Contractors	1.01	1.01
Marketing Staff	0.80	0.80
Marketing Contractors	0.48	0.49

Nearly no difference between the two reported measures is apparent as the number of fatalities (2) is small relative to the number of LWI (476).

The effective investigation of all incidents (near miss, minor and major) to obtain a full understanding of their root causes is therefore essential for the creation of a supportive safety culture and the fostering of the right organisational behaviours necessary to achieve zero incidents or accidents in operations.

Table 4 indicates a relatively small number of categories contribute to most LWIs reported. In order of frequency (highest first) Slips and Trips (same height), Struck by and Cut, puncture, scrape together account for over 51% of all LWIs reported in 2020. Other frequently reported incident categories in Manufacturing include Caught in, under or between, Overexertion, strain, Falls from Height, Exposure, noise, chemical, biological, vibration and Explosion or burns. Each category accounting for >5% of reported LWI in Manufacturing. The Marketing sector LWIs differed from Manufacturing sector in a higher incidence of reported Road Accidents and Overexertion, strain and a lower incidence of Falls from Height, Exposure, noise, chemical, biological, vibration and Caught in, under or between.

Concentrating on the most frequent categories of these incidents offers the opportunity to address prevention of Lost Workday Injury across both sectors.

Table 4 Categories of LWIs in 2020

	Manufacturing		Marketing		Combined	
	Number	%	Number	%	Number	%
Road Accident	6	2.1	10	5.4	16	3.4
Falls from height	20	6.8	6	3.3	26	5.5
Staff hit by falling objects	8	2.7	1	0.5	9	1.9
Slips & trips (same height)	79	27.1	60	32.6	139	29.2
Explosion or burns	18	6.2	11	6.0	29	6.1
Exposure electrical	2	0.7	0	0.0	2	0.4
Confined Space	1	0.3	1	0.5	2	0.4
Assault or violent act	0	0.0	5	2.7	5	1.1
Water related, drowning	0	0.0	0	0.0	0	0.0
Cut, puncture, scrape	24	8.2	20	10.9	44	9.2
Struck by	37	12.7	25	13.6	62	13.0
Exposure, noise, chemical, biological, vibration	20	6.8	3	1.6	23	4.8
Caught in, under or between	25	8.6	9	4.9	34	7.1
Overexertion, strain	22	7.5	17	9.2	39	8.2
Pressure release	6	2.1	2	1.1	8	1.7
Other	24	8.2	14	7.6	38	8.0
Total	**292**	**100**	**184**	100	**476**	**100**

As in 2019, Concawe collected causal factors where available for each LWI, see **Figure 1** and **Appendix 3**. Causal factors are described in alignment with API RP754 (2016) and multiple factors may be recorded per LWI. Causal factors were not available for 17% of LWI (79 LWI incidents) in 2020 (similar to 2019 when 16% of incidents had no causal factor available. In many cases, the absence of causal factors reflects ongoing investigations.

The most commonly reported causal factors across all LWI are Human Factors (31% of causal factors reported), Safe Work Practices & Procedures (12%), Risk Assessment (10%), Design (8%), Procedures (8%) and Knowledge and Skills (7%). Eight percent of LWI causal factors were reported as Other (used to specify where an incident cannot be logically classed under any other category). Start here Human Factors was the causal factor most frequently assigned to LWI in both Manufacturing and Marketing incidents. Safe Work Practices & Procedures and Risk Assessment were the second most frequently assigned causal factors in Manufacturing and Marketing, respectively. Manufacturing incidents reported Risk Assessment and Procedures as third and fourth most frequent causal factors. Safe Work Practices & Procedures and Design were the third and fourth most frequently reported causal factors in Marketing incidents.

There was little difference between the most frequently reported causal factors in some of the most commonly occurring incident categories. Human factors was the most commonly assigned causal factor in Slips and Trips, Struck by and Cut, puncture, scrape LWI incidents in both Manufacturing and Marketing. Safe Work Practices & Procedures Risk Assessment, Procedures and Design were also commonly reported causal factors in these incident types. Causal factors for Manufacturing Explosion and Burns LWI incidents were attributed primarily to Human Factors, then Design and Equipment Reliability.

Figure 1 Causal factors recorded for all Lost Workday Injuries in 2020

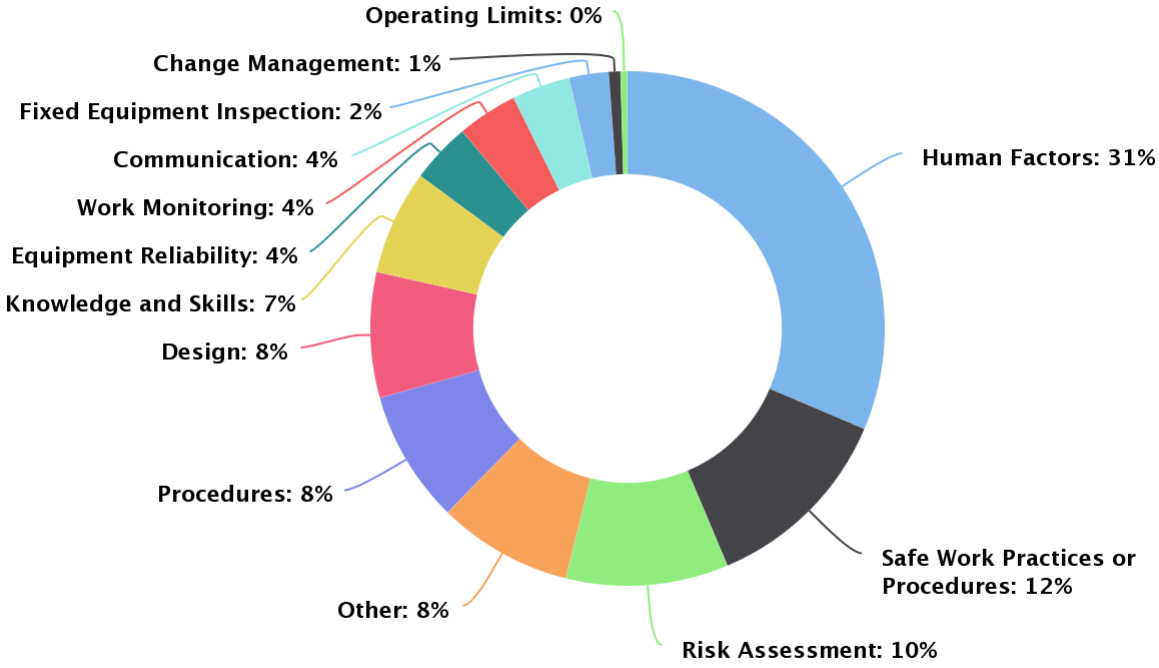


Table 5 shows the Lost Workday Injury frequency statistics broken down in to quartiles. This demonstrates a wide range of variability in performance between the top performing members (Quartile 1 – Q1) and the bottom performing members (Quartile 4 – Q4).

Table 5a 2020 LWIF quartile distribution by sector: ranges and average values for each quartile range

LWIF	Manufacturing			Marketing			Total Own Staff			Total Contractors			Total Downstream		
	low	high	average	low	high	average	low	high	average	low	high	average	low	high	average
Q1	0.00	0.46	0.20	0.00	0.00	0.00	0.00	0.08	0.01	0.00	0.36	0.09	0.00	0.44	0.17
Q2	0.52	1.16	0.80	0.00	0.38	0.12	0.24	1.27	0.62	0.36	0.96	0.64	0.51	1.02	0.73
Q3	1.21	3.68	2.32	0.44	0.81	0.63	1.41	3.13	2.14	1.07	3.04	1.82	1.03	3.17	1.99
Q4	3.78	16.80	7.94	0.90	1.82	1.30	3.41	38.74	8.83	3.13	24.86	10.50	3.78	16.80	7.83

Table 5b 2020 LWIF quartile distribution by staff type: ranges and average values for each quartile range

LWIF	Manufacturing Staff			Manufacturing Contractors			Marketing Staff			Marketing Contractors		
	low	high	average	low	high	average	low	high	average	low	high	average
Q1	0.00	0.00	0.00	0.00	0.38	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Q2	0.00	1.25	0.55	0.41	1.17	0.79	0.00	0.00	0.00	0.00	0.40	0.17
Q3	1.27	3.88	2.52	1.18	3.13	1.88	0.00	0.88	0.51	0.49	0.97	0.71
Q4	3.91	38.74	9.15	3.38	24.86	10.57	1.12	3.86	1.77	1.25	2.57	1.86

The quartile distribution ranges and average values for each quartile for the 2020 All Injury Frequency (AIF) are shown in **Table 6**. The average performance indicator figures for the industry conceal a wide range of individual values between reporting companies.

Table 6a 2020 AIF quartile distribution by sector: ranges and average values for each quartile range

AIF	Manufacturing			Marketing			Total Own Staff			Total Contractors			Total Downstream		
	low	high	average	low	high	average	low	high	average	low	high	average	low	high	average
Q1	0.00	1.03	0.56	0.00	0.00	0.00	0.00	0.62	0.16	0.00	0.85	0.31	0.00	0.84	0.47
Q2	1.10	2.48	1.58	0.00	0.56	0.30	0.62	1.71	1.26	0.99	1.84	1.40	0.99	2.48	1.47
Q3	2.63	5.73	4.11	0.61	1.04	0.80	1.86	5.02	3.32	1.88	9.31	3.94	2.63	4.88	3.69
Q4	6.19	18.66	10.58	1.16	3.99	2.45	5.82	38.74	11.31	9.38	24.86	13.97	5.67	18.66	10.43

Table 6b 2020 AIF quartile distribution by staff type: ranges and average values for each quartile range

AIF	Manufacturing Staff			Manufacturing Contractors			Marketing Staff			Marketing Contractors		
	low	high	average	low	high	average	low	high	average	low	high	average
Q1	0.00	0.54	0.13	0.00	0.95	0.38	0.00	0.00	0.00	0.00	0.00	0.00
Q2	0.62	2.03	1.40	1.08	1.77	1.42	0.00	0.19	0.03	0.17	0.82	0.49
Q3	2.06	5.21	3.60	1.84	9.38	4.67	0.57	1.16	0.87	0.94	1.79	1.45
Q4	5.79	38.74	11.56	9.40	24.86	14.00	1.19	8.00	3.30	2.27	3.31	2.68

2.3. PERFORMANCE TRENDS IN THE LAST 10 YEARS 2011 TO 2020

Performance indicators are particularly useful for identifying trends and patterns when considered over time. The historical trends for the European downstream oil industry over the past ten years are summarised in this section. Ten years has been chosen as a period reasonably representative of actual operating conditions and practices in place within the industry. For a full historical perspective, back to 1993, additional data tables are provided in **Appendix 2**.

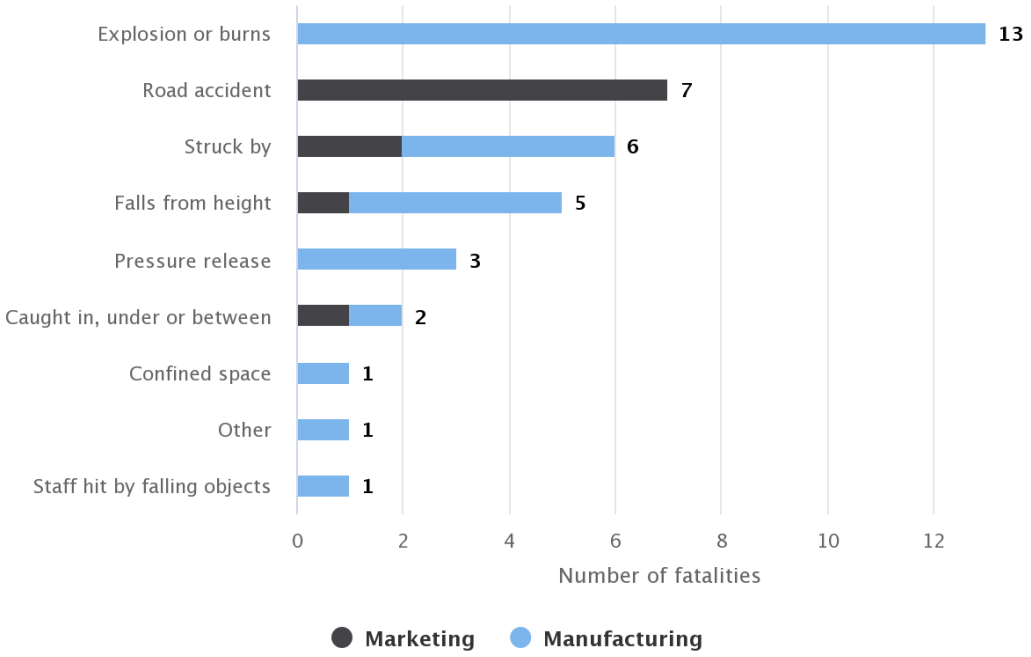
Table 7 Fatalities by sector 2011-2020

Fatalities over 10 years by sector			
Year	**Manufacturing**	**Marketing**	**Total**
2011	10	1	11
2012	7	6	13
2013	4	2	6
2014	6	1	7
2015	5	3	8
2016	2	0	2
2017	1	1	2
2018	7	3	10
2019	3	0	3
2020	1	1	2
Total	46	18	64

The total number of fatalities in 2020 (2) equals the lowest number of annual fatalities recorded in the sector in 2016 and 2017. Whilst this is below the 10 year average, continuous focus on understanding causal factors and putting in place clearly defined preventative actions are required to achieve and sustain our objective of zero fatalities in both Manufacturing and Marketing.

Figure 2 summarizes the categories of all fatalities which were allocated by participating companies in the period 2013 to 2020.

Figure 2 Number of fatalities by incident type 2013-2020



Since Concawe moved to reporting fatalities against the same 16 categories as Lost Workday Injury in 2013, 'Explosions or Burns' (13 fatalities), 'Road Accident' (7 fatalities) and 'Struck by' (6 fatalities) have been the largest contributors to fatalities in the industry. Together, the three categories account for approximately 65% of the fatalities experienced in the industry since 2013.

Until 2013, Concawe compiled fatality data against broad categories that could change year to year. Expanding this to 16 distinct categories provided for greater transparency of cause and better benchmarking, but risked losing information on longer-term trends. However, by revisiting pre-2013 data, a reasonably consistent pattern can be seen.

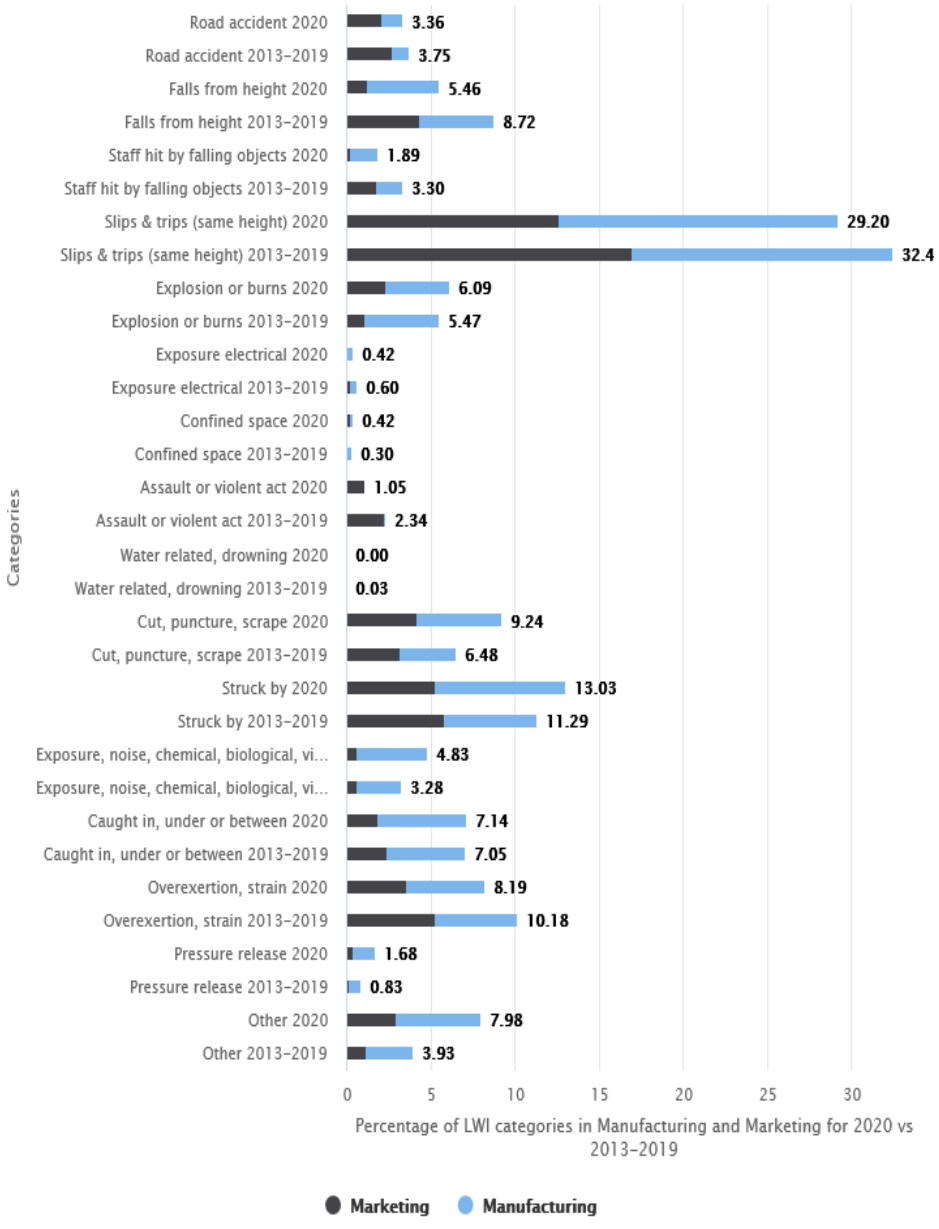
Explosion or burns and Road Accidents are the most prevalent fatal incident categories recorded in the period 2009-2018. Road Accidents have declined as an overall percentage of all fatalities compared to 1998-2008 when they represented almost half of all fatalities. This could be because of an increase in focus on Road Safety and the introduction of in-vehicle technology to help drivers. A fatal vehicle accident occurred in 2020 and as this was as a result of a truck rollover, the incident was recorded as Caught in, under or between. A single burns fatality (without explosion) was recorded in 2020.

Struck by and Falls from Height categorised incidents are the next most prevalent, accounting for more than a quarter of fatalities since 2013.

The 2013- 2020 reported fatalities is each of the sectors (**Appendix Tables A2-2 to A2-5**), indicate the higher prevalence of Contractor fatalities (25 fatalities in Manufacturing and 10 in Marketing) than own Staff (5 fatalities in Manufacturing and 1 in Marketing).

LWI category data has been available since 2013; a summary is shown in **Table A2-6 (Appendix 2)** and in **Figure 3**.

Figure 3: LWI categories in Manufacturing and Marketing in 2020 compared with period 2013-2019



Since Concawe began collecting LWI data against the 16 categories in 2013 a pattern has been emerging. As in fatalities, a limited number of categories contribute to most LWIs. In 2020, almost 73% of LWIs were as a result of the following, Slips & Trips (same height) 29.2% (cf. 32.4% in 2013-2019), Struck by 13.0% (cf. 11.3% in 2013-2019), Cut, Puncture, Scrape 9.2% (cf. 6.5% in 2013-2019), Overexertion, strain 8.2% (cf. 10.2% in 2013-2019) and Caught in, under or between 7.1% (also 7.1% in 2013-2019). 2020 saw the largest increases in LWI for the categories of Cut, puncture, scrape (increase of 2.8% cf. 2013-2019 average reported annual figures) and Struck by (1.7% increase). Fall from height and Slips and Trips (same height) in 2020 were reported at levels 3.3 and 3.2% less,

respectively than 2013-2019 average annual reported figures, see **Figure 3**. It is possible that the slight decrease in the proportion of these incidents is related to an increased situational awareness associated with COVID-19 risk management measures. The proportion of recorded LWI is generally similar for Manufacturing and Marketing sectors. The largest change in the proportion of LWI attribution is a 4.4% decrease in the proportion of Marketing sector Slips and Trips in 2020 compared with 2013-2019.

Concawe started collecting information about LWI incident categories split between staff and contractors for the first time in 2018. For the most frequent LWI incident category, Slips and Trips, the staff / contractor split in 2020 remains 64 / 36%, as in 2019). The main causal factor attributed to 553 Slips and Trips incidents in 2018 (192 incidents), 2019 (222 incidents) and 2020 (139) was Human Factors (50%), followed by Safe working practices or Procedures (9%) and Design (9%) then Risk Assessment (8%). The next most frequent LWI incident category is Struck by with a staff / contractor split of 56 / 44% in 2020 (cf. 45 / 55% in 2019) and Cut, puncture, scrape 43 / 57% (cf. 34 / 66% in 2019). The LWI incident category with the greatest difference between staff and contractors in 2020 is Assault or violent act (20 / 80%). Contractors LWI related to Hit by falling objects, Cut, puncture, scrape and Caught in under or between were greater in 2020 than those related to staff.

No direct correlation is observed between categories of LWI and fatalities in the period 2013 – 2020 (**Figure 4**). However, a focus on reducing LWI in the following areas may have the potential to address the causes of the majority of 15 fatalities recorded in the last three years. These areas are:

- Process Safety to address Explosion, Burns related incidents
- Operational safety focused on Working at Height
- Road Accidents

Figure 4 LWI and Fatalities causal data for 2013-2020

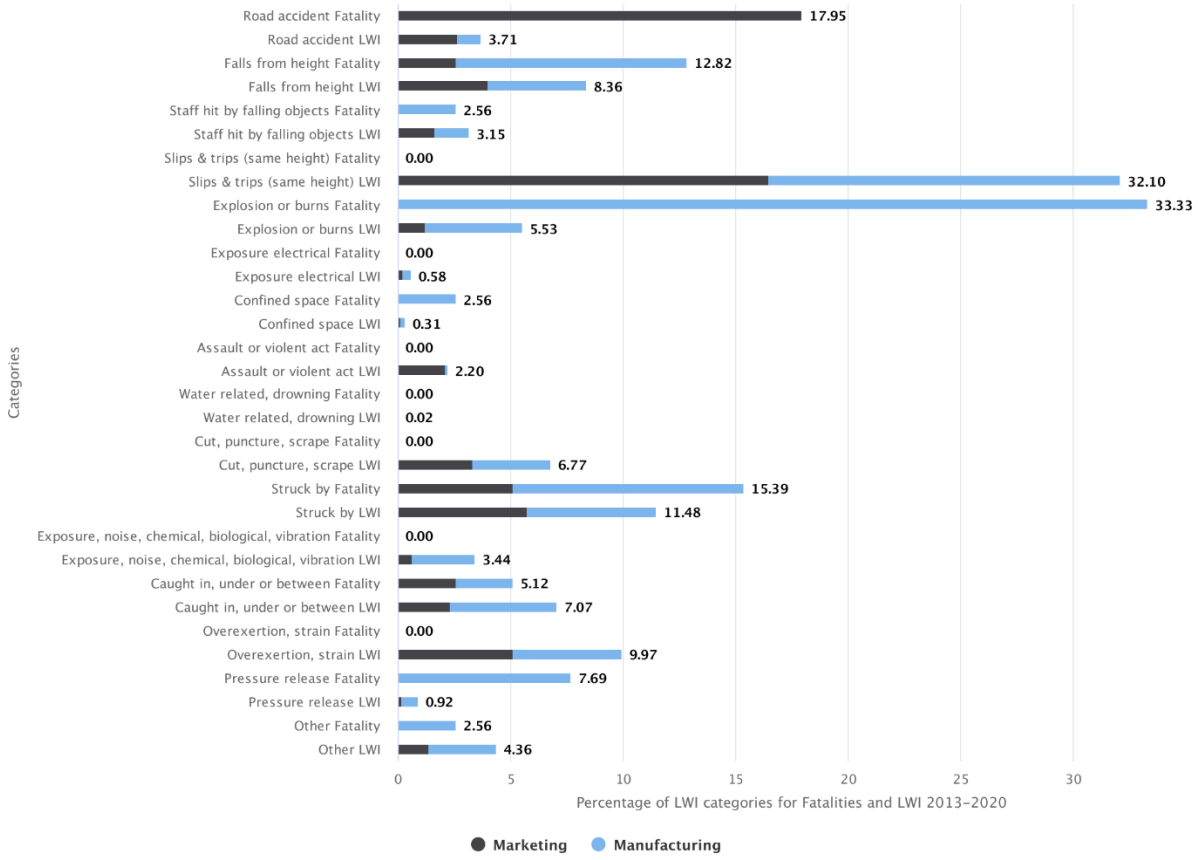
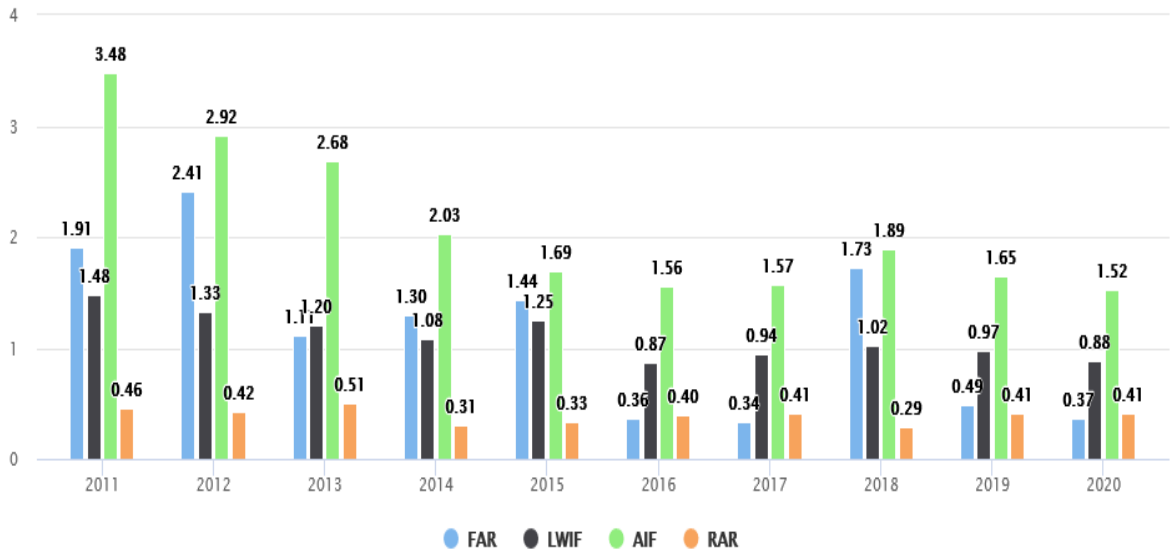


Figure 5 shows the historical evolution of the main performance indicators over the past 10 years across all workers. While work practises were impacted by the Covid-19 pandemic for much of 2020, no important changes in incident rates were recorded compared with previous years. With two fatal incidents in 2020, the Fatal Accident Rate (FAR) across all sectors is 0.37 in 2020, the lowest rate recorded since 2017 (0.34). The Lost Workday Injury Frequency LWIF of 0.88 in 2020 is lower than the three preceding years. Similarly, the All Incident Frequency AIF of 2020 at 1.52 is the lowest ever recorded. The Road Accident Rate RAR in 2020 is 0.41 and remains in line with rates recorded in 2016, 2017 and 2019. However, the total recorded distance driven in 2020 (576 million km) was 30% lower than in 2019 and the shortest distance recorded for more than 10 years (see **Table A2-1**).

Figure 5 Performance indicators over the last 10 years 2011-2020 European downstream oil industry



Figures 6a and 6b show the Fatal Accident Rate FAR for company versus contract staff split for Manufacturing **6a** and Marketing **6b**. While FAR are in general higher in Manufacturing than in the Marketing, both sectors display a high degree of variability over the last 10 years. Further effort is required to reduce contractor and maintain staff fatalities at zero.

Figure 6a Fatal Accident Rate (number of fatalities per 100 million hours worked) – Manufacturing in the last 10 years 2010-2020

Figure 6b Fatal Accident Rate (number of fatalities per 100 million hours worked) – Marketing in the last 10 years 2010-2020

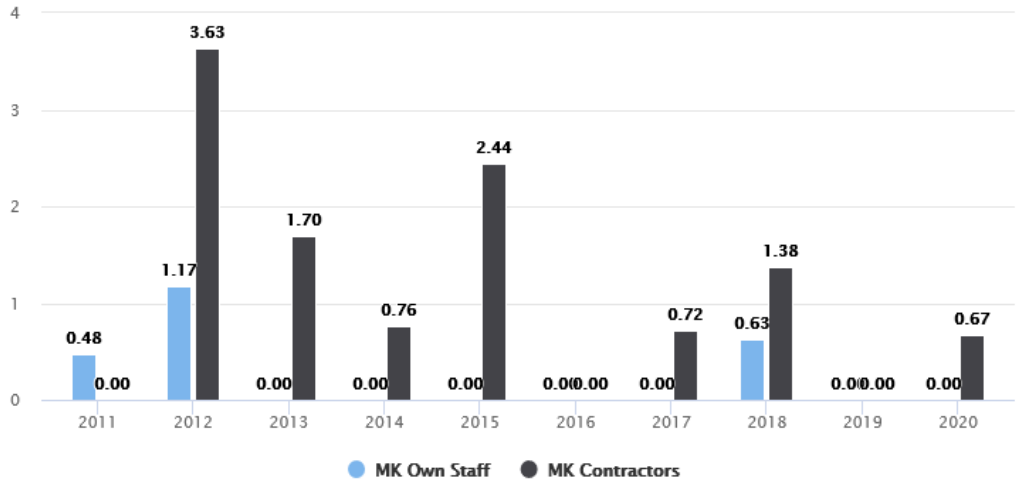
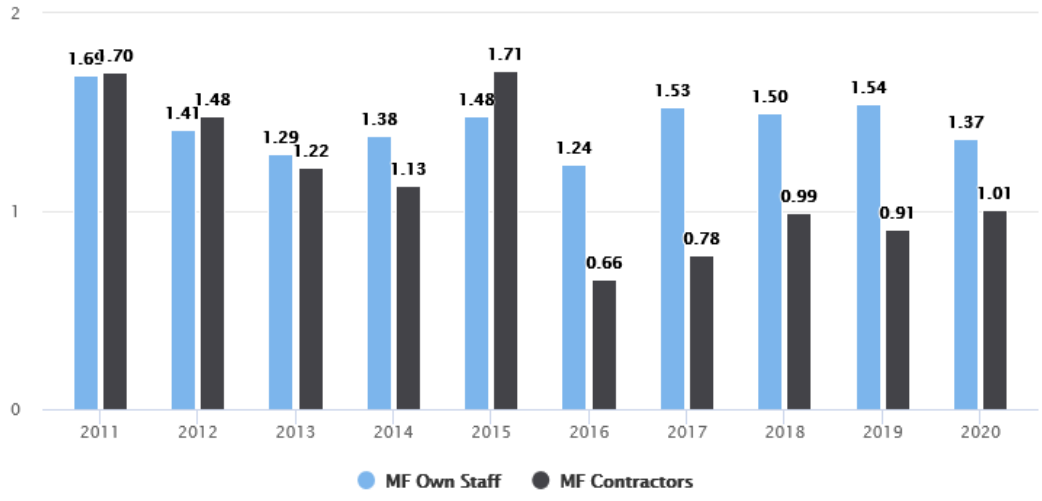


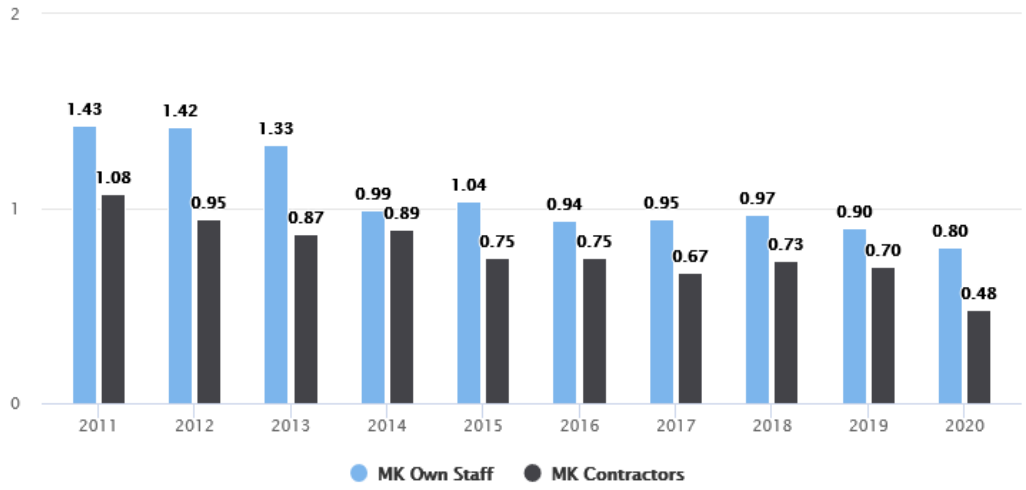
Figure 7a shows Manufacturing own staff LWIF in 2020 at 1.37, lower than rates recorded in the period 2017 to 2019. Manufacturing contractor LWIF is consistently lower than Manufacturing staff over the last five years, however the 2020 value at 1.01 is the highest over the same period.

Figure 7a Lost Workday Injury Frequency – Manufacturing in the last 10 years 2011-2020



Marketing own staff and contractors had the lowest LWIF ever recorded in 2020 at 0.80 and 0.48 respectively (see **Figure 7b**). Refer to **Appendix 2** for the details.

Figure 7b Lost Workday Injury Frequency – Marketing in the last 10 years 2011-2020

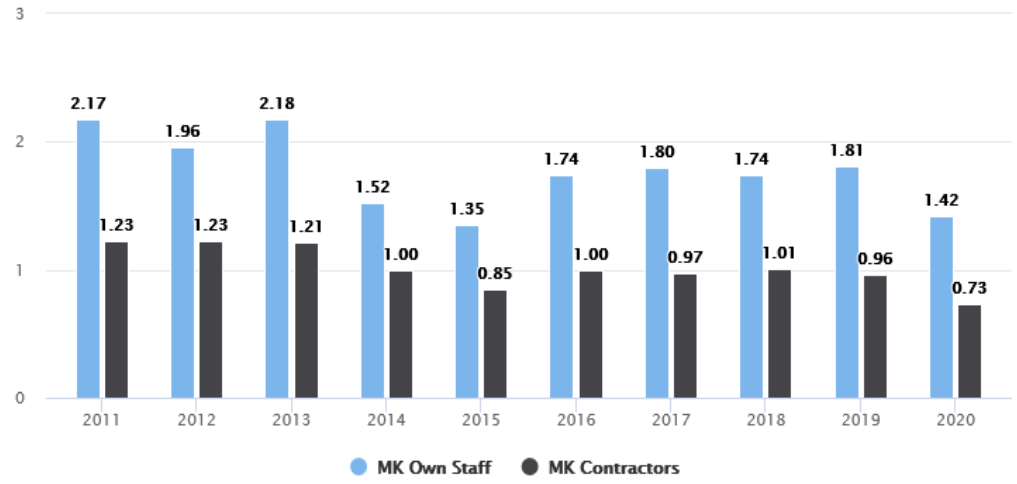


Historical figures (see **Appendix 2**) suggest that AIF peaked around 1996-97 but this was considered at the time likely the result of improved reporting standards. The downward trend in recorded Manufacturing AIF since 2010 ended in 2016. Since then own staff and contractor AIF have increased to 2.24 and 1.89, respectively in 2020 (**Figure 8a**).

Figure 8a All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) – Manufacturing in the last 10 years 2011-2020

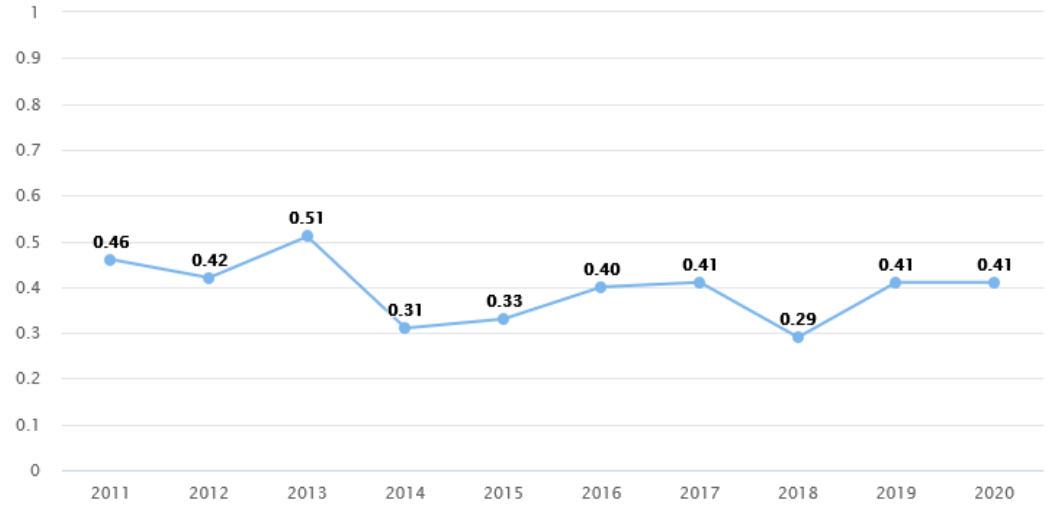
Marketing AIF in 2020 at 1.42 for own staff and 0.73 for contractors is lower than the plateau seen 2016 to 2019 (**Figure 8b**).

Figure 8b All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) – Marketing in the last 10 years 2011-2020



Despite a 30% reduction in kilometres driven in 2020 (576 million km) versus 2019 (818 million km), potentially related to the Covid-19 pandemic, the Road Accident Rate in 2020 remained at the 2019 rate of 0.41, a rate similar to those recorded in 2016 and 2017. Road safety has been a major focus for the industry and a sustained effort is required in order to improve performance to below the lowest rates recorded in 2014, 2015 and 2018, see **Figure 9**. These accidents mainly occur in the Marketing activity where the bulk of the driving takes place.

Figure 9 Road Accident Rate last 10 years 2011-2020 - European downstream oil industry



3. PROCESS SAFETY

The American Petroleum Institute (API) has recommended the adoption of Process Safety Performance Indicators (PSPI) in addition to personal safety performance indicators such as those contained in this report. This is intended to better address the potential causes of major process safety incidents, which can have catastrophic effects in the petroleum industry. As from the 2009 Concawe report, the Safety Management Group of Concawe expanded the scope of industry wide safety performance indicators to address process safety, following the reporting guidelines that were developed by the API [27, 28]. The expectation is that expanding the focus to include process safety in conjunction with the personal safety will contribute to a further reduction in serious injury rates in the industry.

The Concawe Membership was requested to report their PSPI as defined by the API in 2008 [27] and as further refined in the ANSI/API recommended practice that was published in 2010 [28]. The PSPI-data that were requested are the number of Tier 1 and 2 Process Safety Events (PSE). The Concawe definitions slightly differ from those in the 2010 ANSI/API guideline to allow for the use of SI-metric units (kg/m/sec) and for the inclusion of the European Classification and Labelling definitions [29] as an alternative for classifying the PSE. In 2017, Concawe moved to reporting against the revised definitions in the 2nd edition of the API Recommended practice 754 (2016) [32].

In 2020, 40 companies and joint ventures submitted PSE data for the Manufacturing operations, one less than in 2019 and 21 submitted Marketing PSE data, two more than last year.

The aggregated 2019 results per sector and for the whole of the European downstream oil industry are shown in **Table 8**.

Table 8 Aggregated 2020 Process Safety (PS) results for all reporting companies

Sector	Manufacturing	Marketing	Both Sectors
Companies - Total	42	24	24
- PS Reporting	40	21	21
- %	95	88	88
Hours worked - Total Mh	253.3	289.2	542.5
- PS Reporting	246.7	250.5	497.2
- %	95	88	88
T-1 PSE	62	4	66
T-2 PSE	120	11	131
T-1 PSER PSI/Mh reported	0.25	0.02	0.13
T-2 PSER PSI/Mh reported	0.49	0.04	0.26
Total PSER PSI/Mh reported	0.74	0.06	0.40

Of the 21 companies that reported Process Safety Events across both Manufacturing and Marketing, 3 companies reported zero Tier 1 events, 3 different companies reported zero Tier 2 events and 4 companies reported zero Tier 1 and Tier 2 events.

The total number of Tier 1 and Tier 2 process safety events reported at Manufacturing sites where the higher process safety risks exist has decreased in 2020 to 182 from 215 in 2019.

The ratio of Tier 1 to Tier 2 Manufacturing process safety events in 2020 is 0.52 (62 Tier 1 and 120 Tier 2). This is lower than the 2019 ratio of 0.64 (92 Tier 1 and 144 Tier 2), but remains higher than the same ratios recoded in 2018 (0.41) and 2017 (0.32).

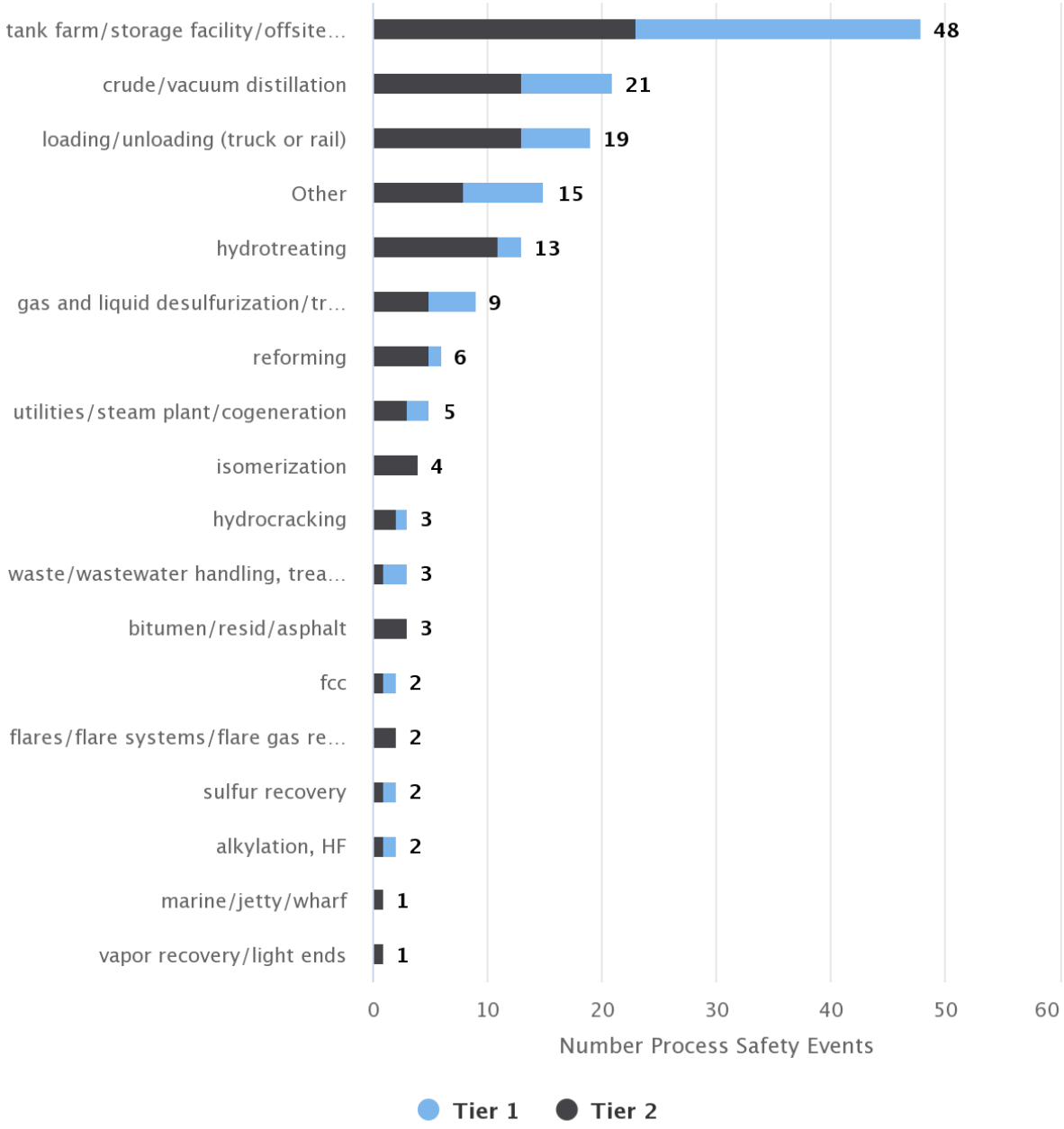
The Manufacturing Tier 1 PSER in 2020 was higher at 0.25 compared with 0.19 in 2019, 0.16 in 2018 and 0.14 in 2017. The Manufacturing Tier 2 PSER was also higher in 2020 at 0.49, compared with 0.30 in 2019, 0.40 in 2018 and 0.48 in 2017.

The number of Tier 1 PSEs resulting in LWIs was reported for the first time in 2019. In 2020, Five Tier 1 PSE (7.6% of Tier 1 PSE) resulted in LWI. The low proportion of total LWI related to Tier 1 events (1% of LWI), is encouraging and underlines the importance of high technical standards and strict procedures in process safety, which should never be viewed as a routine job. Of these five cases, two LWI were categorized as “Explosion or burns” (direct contact with hot released material), two were categorized as “Exposure, noise, chemical, biological, vibration” (direct contact with released material) and one as “Slips & Trips” (moving away from release). “Procedures” was cited as a causal factor in three of these incidents. The causal factors of Work Monitoring, Design, Risk Assessment and Human Factors, were also each cited.

Since 2017 Concawe has been collecting additional information regarding the circumstances of Tier 1 Process Safety Events. For the first time in 2020, Concawe collected additional information also for Tier 2 PSE. This information for the combined 197 Tier 1 and Tier 2 PSE across Manufacturing and Marketing in 2020 are provided in table form in **Appendix 4**. The following comments relate to the notable responses within each category:

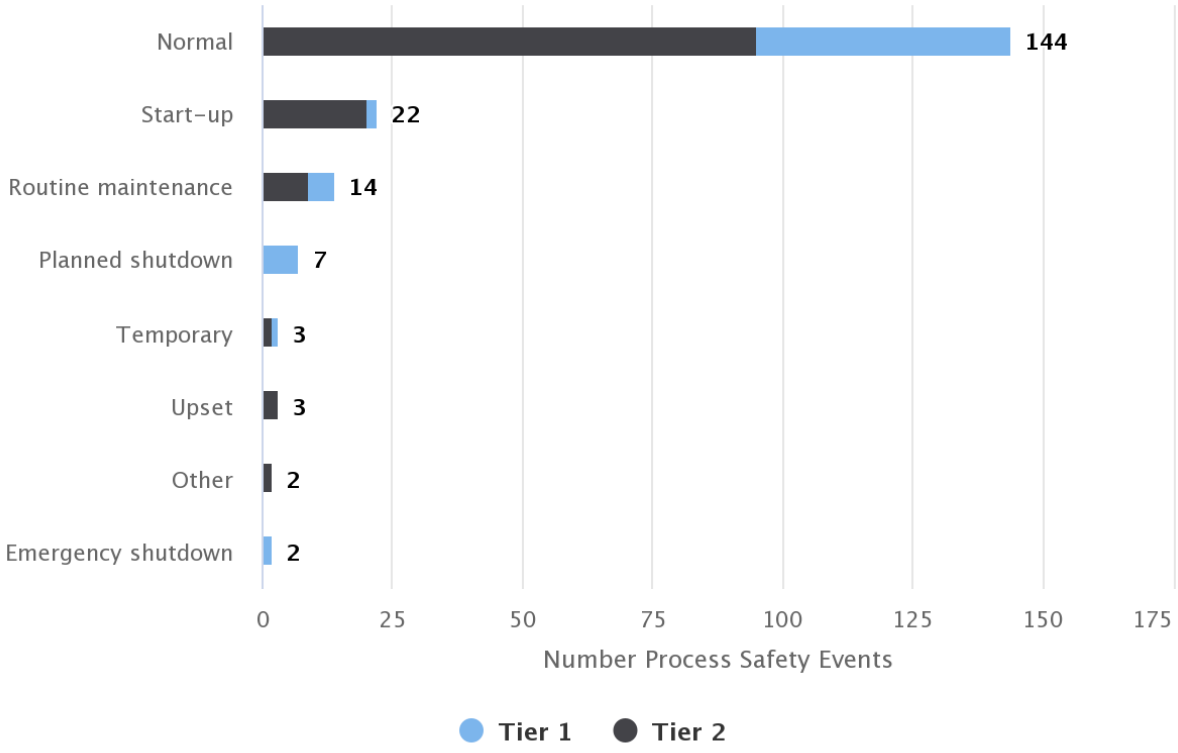
Type of Process: Process Safety Events in 2020 most frequently occurred in storage facilities or transfer piping (24% of all Process Safety Events, 38% of Tier 1 PSE and 18% of Tier 2 PSE), see **Figure 10** and **Table A4-1**. This finding is in alignment with 2019, 2018 and 2017 data. Note that 5 PSE Tier 1 and 33 Tier 2 PSE attributed to petrochemical processes are not included in **Figure 10**.

Figure 10 Number of Tier 1 and 2 Process Safety Events (Manufacturing and Marketing) reported in 2020 by Refining Process



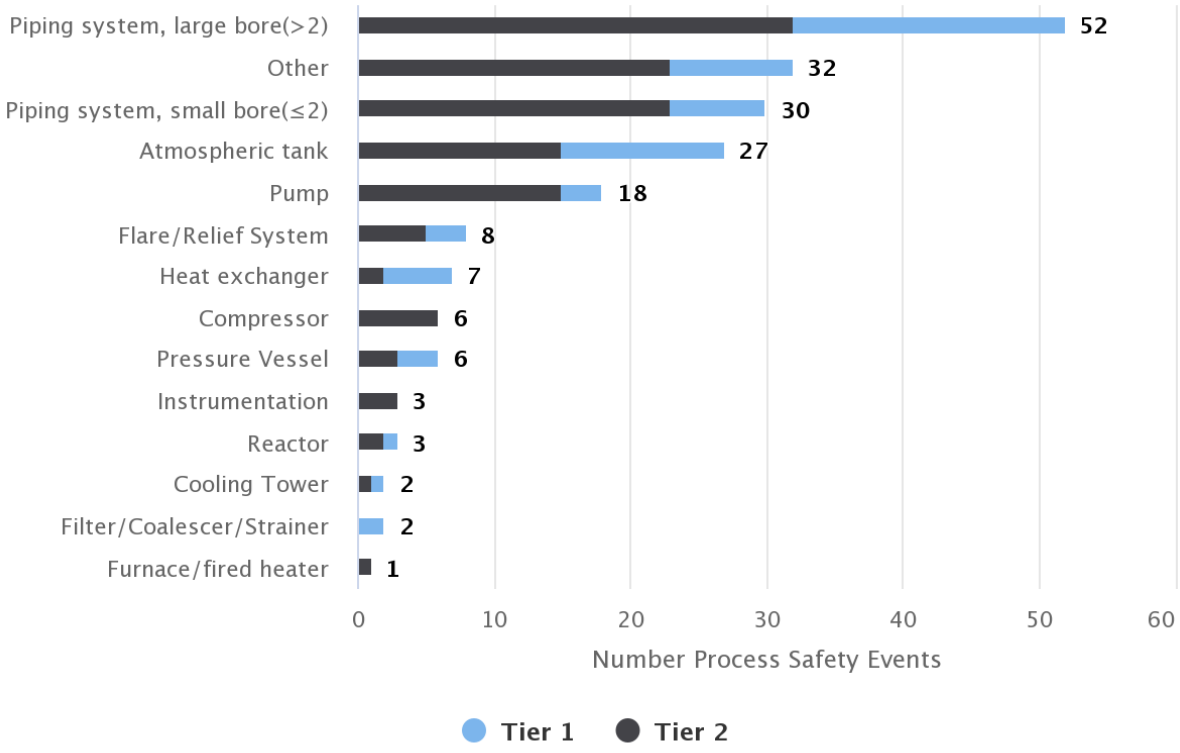
Mode of Operation: Seventy-three percent of Process Safety Events occurred during normal operation, see **Figure 11** and **Table A4-3**. This percentage also applies for the individual count of Tier 1 and Tier 2 PSE and is in alignment with 2018 and 2017 Tier 1 data.

Figure 11 Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2020 by mode of operation



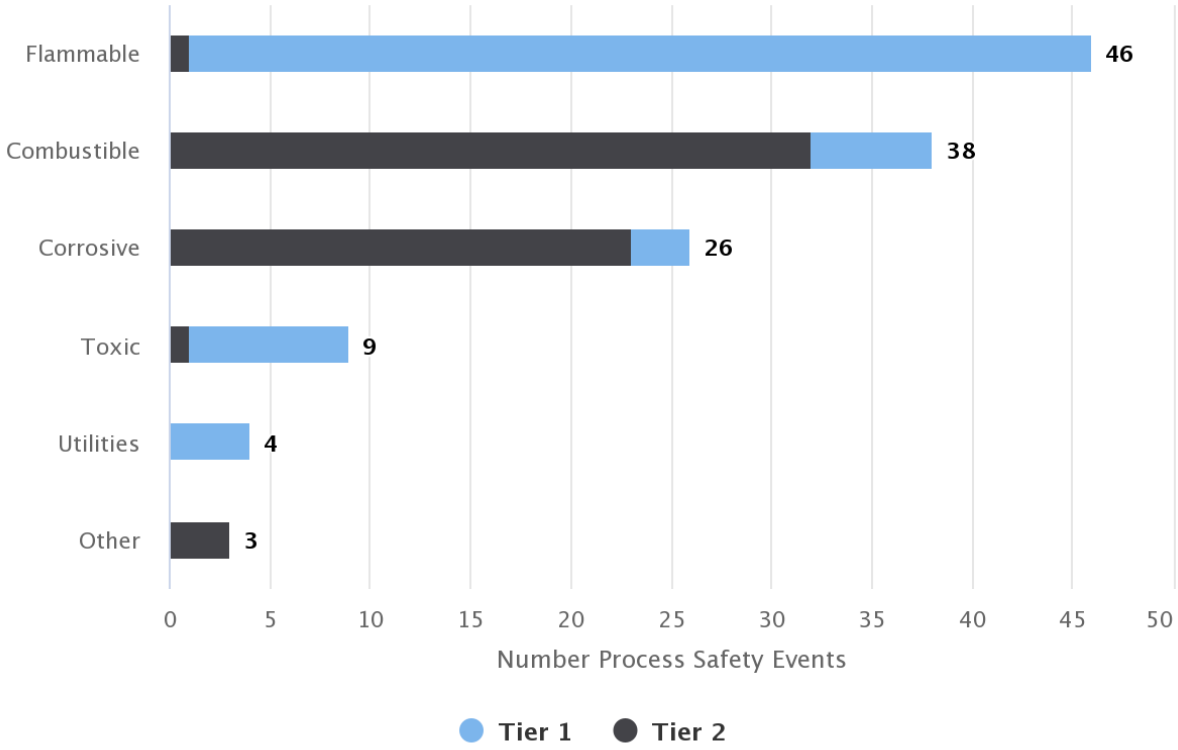
Point of Release: As in previous years, large bore piping remained the main point of release for Process Safety Events (26% of all PSE in 2020, 30% of Tier 1 and 24% of Tier 2 events), see **Figure 12** and **Table A4-4**.

Figure 12 Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2020 by point of release



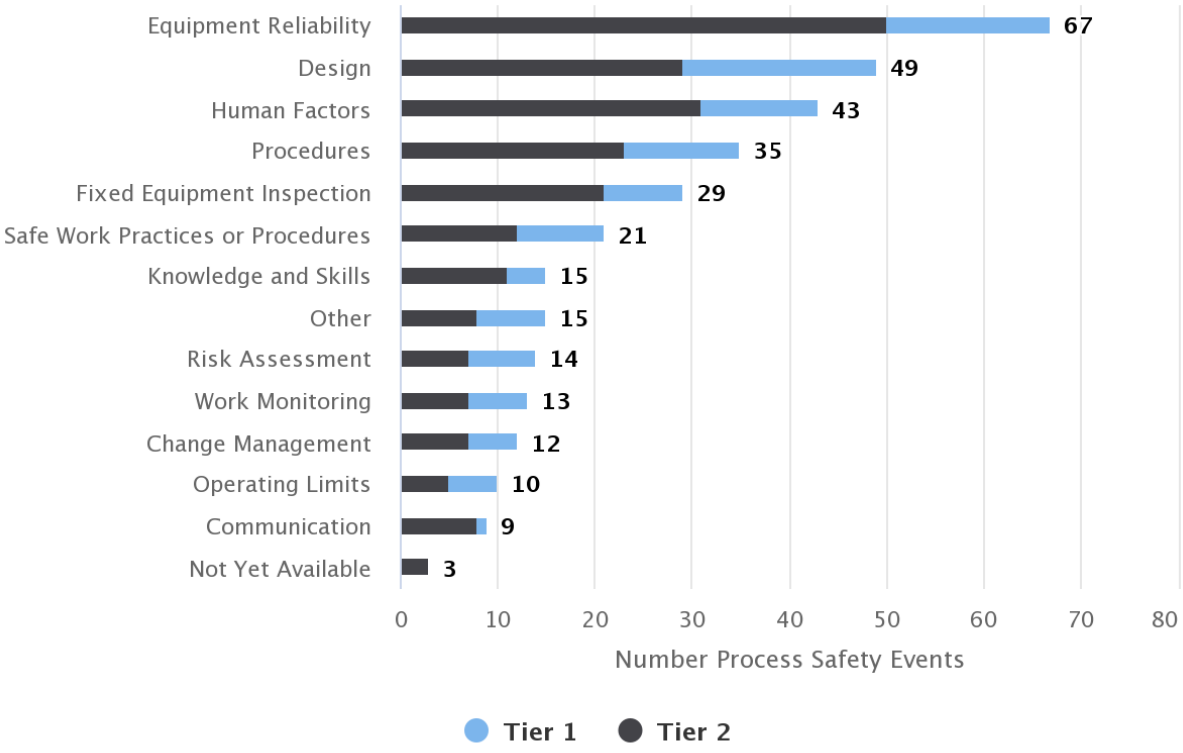
Type of material: Figure 13 and **Table A4-5** indicate that flammable material was most frequently released in Process Safety Events in 2020 (65% of all PSE in 2020, 68% of Tier 1 and 1.6% of Tier 2 events). Again, this aligns with data from the previous three years.

Figure 13 Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2020 by type of material



Causal Factors: Equipment Reliability (allocated to 34% of events), Design (25%) and Human Factors (22%), are the most frequently cited causal factors across all Process Safety Events in 2020, see **Figure 14** and **Table A4-6**. For Tier 1 PSE the most frequently cited causal factors are Design (30%), Equipment Reliability 26%, Human Factors 18% and Procedures 18%. Equipment Reliability was cited most frequently as a causal factor of Tier 2 PSE (allocated to 38% of Tier 2 PSE), Design (22%), Human Factors (24%) and Procedures (18%) were also cited. Interestingly the attribution of Design as a causal factor for Tier 1 events is the highest it has been over the last three years. The attribution of Fixed Equipment Inspection as a causal factor in Tier 1 events has progressively fallen from 22% in 2018, to 17% in 2019 and 12 % in 2020.

Figure 14 Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2020 by Causal Factor (note that more than one causal factor may be assigned to an event)



Over time, the collection of this information across the industry is expected to result in an evaluation of the main factors contributing to process safety incidents, which will facilitate the development of approaches to address incident prevention.

Tier 1 and 2 process safety incidents are investigated in detail within member companies and considerable effort is expended in identifying root causes and responding accordingly. As with Fatalities and Lost Workday Injury cases in personal safety, such events are now relatively infrequent occurrences at each site so establishing trends on a site by site basis and across the industry is a challenge. To overcome this, many members now look to Tier 3 process safety events for their site based improvement activity. The definition of a Tier 3 incident is often asset specific and therefore trending such events across the Industry is not practicable at this time.

Tables 9, 10, 11 and 12 show the quartile ranges for PSE and PSER.

Table 9 Total PSE quartile distribution ranges and average values for each quartile range

Manufacturing and Marketing PSE			
PSE	Low	High	Average
Q1	0	1	0.1
Q2	1	3	2.0
Q3	3	7	4.7
Q4	7	29	12.9

Table 10 Manufacturing PSE quartile distribution ranges and average values for each quartile range

Manufacturing PSE			
PSE	Low	High	Average
Q1	0	1	0.1
Q2	1	3	2.0
Q3	3	6	4.1
Q4	6	27	12.0

Table 11 Total PSER quartile distribution ranges and average values for each quartile range

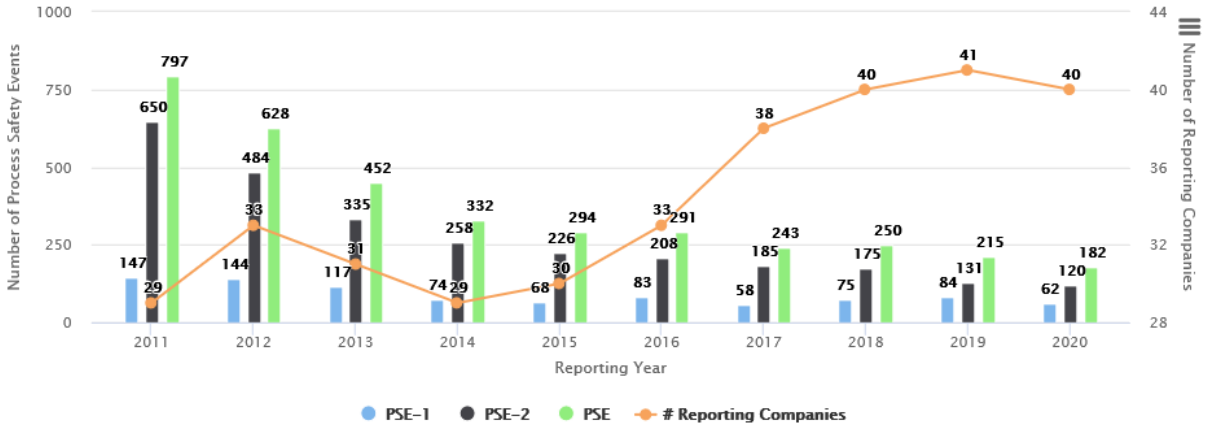
Manufacturing and Marketing PSER			
PSE	Low	High	Average
Q1	0.00	0.10	0.01
Q2	0.14	0.51	0.31
Q3	0.53	1.21	0.81
Q4	1.25	5.78	3.63

Table 12 Manufacturing PSER quartile distribution ranges and average values for each quartile

Manufacturing PSER			
PSE	Low	High	Average
Q1	0.00	0.17	0.02
Q2	0.22	0.70	0.47
Q3	0.75	1.30	1.05
Q4	1.31	6.19	3.81

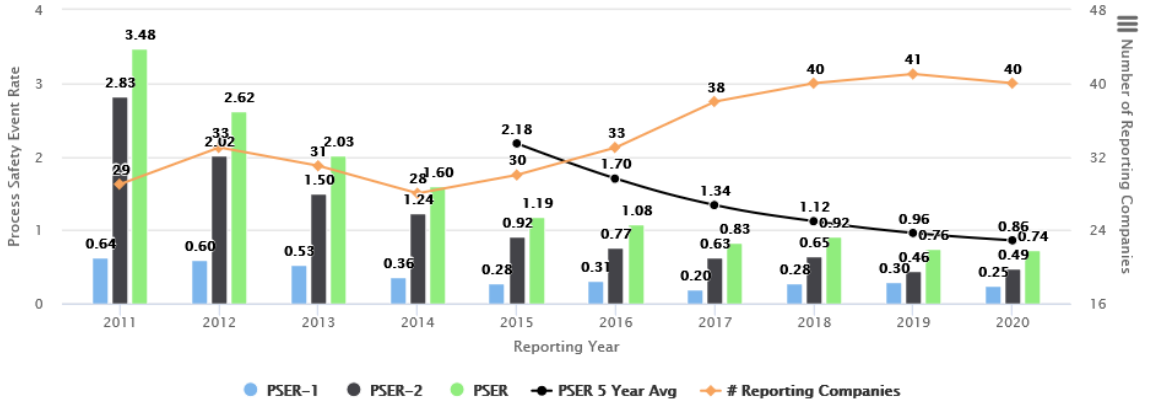
Figure 15 shows counts of the total Manufacturing PSE for the period 2011 to 2020 for which Concawe has data. **Figure 16** shows the same data expressed as rates. The data given are for Manufacturing, as only that data is sufficiently robust to allow the analysis provided in these presentations.

Figure 15 Process Safety Events last 10 years 2011-2020 - Manufacturing Staff and Contractors



The number of companies reporting Manufacturing PSE has decreased in 2020 since 2019 and this reduction is apparent in both Tier 1 and Tier 2 events. The overall number of reported Manufacturing PSE has reduced over the last 10 years. The lowest number of Manufacturing Tier 2 PSE was recorded in 2020 (120), an average of 3 Tier 2 PSE per company, compared with an average of 3.2 Tier 2 PSE per company in 2019.

Figure 16 Process Safety Event Rate last 10 years 2011-2020 - Manufacturing Staff and Contractors



The year 2020 saw a continuation of the decline in Manufacturing PSER, with the lowest rate recorded in 2020 at 0.74. This is largely driven by the decrease in PSER Tier 1 (0.30 in 2019 and 0.25 in 2020), with Tier 2 PSER slightly increased in 2020 at 0.49 cf. 0.46 in 2019.

4. COMPARISON WITH OTHER SECTORS

Most of the safety performance indicators used in the oil industry, and particularly LWIF, have also been adopted in many other sectors so that meaningful comparisons are possible, see **Table 13**. The IOGP statistics concern the upstream oil industry covering oil and gas exploration and production activities [30]. In comparison with IOGP statistics for European onshore, Concawe recorded a 0.37 fatality rate, a 0.88 lost workday injury frequency and 1.52 all injury frequency.

Table 13 Comparison of oil industry safety performance (own staff and contractors)

	Concawe 2020	International Association of Oil & Gas Producers - IOGP Europe 2020	
		Onshore	Onshore and Offshore
FAR	0.37	0	0
LWIF	0.88	0.54*	0.73*
AIF	1.52	1.15	1.83

FAR is per 100 million work hours
LWIF and AIF per million work hours
*IOGP values are quoted as Lost Time Injury Rate (LTIR), the number of lost time injuries (fatalities + lost work day cases) incidents per 1,000,000 hours worked. As no fatalities were recorded in 2020, LTIR is equivalent to LWIF.

The American Petroleum Institute (API) reports that the rate of job-related nonfatal injuries and illnesses for the US Petroleum Refining sector remained at 0.4 per 100 full-time workers from 2018 to 2019 [31]. Note this figure does not refer to lost workdays. Note also that this figure is based upon 200,000 work hours as a denominator compared with 1,000,000 work hours used by Concawe. The Concawe 2019 LTIF expressed per 200,000 work hours is 0.19.

The US Refining Tier 1 and 2 PSE Rates recorded by API for 2020 are 0.0612 and 0.1311, respectively [33]. These values are comparable with 0.026 and 0.052 recorded by Concawe when expressed per 200,000 work hours.

The European Chemical Industry Association (Cefic) reports for Responsible Care companies a total number of incidents in 2019 of 2838 compared with 2498 in 2018. The total number of work hours in 2019 was 1055 Mio compared with 1034 Mio in 2018. PSER (for Tier 1 and Tier 2 process safety rates combined) in 2019 increased from 0.48 (in 2018) to 0.54 (PSER based on events per 200000 hrs). When normalised to 200000 hrs, the Concawe 2018 and 2019 PSER across manufacturing and marketing activities are 0.11 in 2018 and 0.10 in 2019.

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APPENDIX 1 EUROPEAN OIL INDUSTRY STATISTICS DEFINITIONS AND GUIDING NOTES

Several safety performance indicators have become “standard” in the oil industry and in many other industry sectors. They are mostly expressed in terms of frequency of the incident with the number of hours worked being the common denominator. This taken to be representative of the overall level of activity. Such parameters have the advantage of relying on a small number of straightforward inputs allowing meaningful statistical analysis even when the data sets are incomplete. The “standard” performance indicators considered in this report are FAR, LWIF, LWIS, RAR, AIF, and PSE(R) [27, 28]. There are subtle differences in the way these parameters are used, collected, and reported by different companies. The features, relevance and reliability of each indicator are therefore discussed below in the guidance section.

Abbreviations and Definitions

1.	AIF (TRCF)	All Injury Frequency (Total Recordable Case Frequency) which is calculated from the sum of fatalities, LWIs, RWIs and MTCs divided by number of hours worked expressed in millions of hours.
2.	COCO	Company owned and operated sites.
3.	CODO	Company owned, Dealer operated sites.
4.	Contractor	A company or an individual engaged to carry out specified work under a contract on company premises (incl. retail stations and office buildings). Off-site contractor activities are considered only for transportation and loading/unloading of hydrocarbons and other products performed on behalf of the company.
5.	Distance travelled	This is the distance, expressed in millions of kilometres, covered by company owned delivery vehicles, contractor delivery vehicles and company cars whether leased or owned. It should also include kilometres travelled in employee’s cars when on company business.
6.	DOCO	Dealer owned, Company operated sites.
7.	DODO	Dealer owned and operated sites.
8.	FAR	Fatal Accident Rate is calculated from the number of fatalities divided by the number of hours worked expressed in hundred million.
9.	Fatality	This is a death resulting from a work-related injury where the injured person dies within twelve months of the injury.
10.	Hours worked	Hours worked by employees and contractors. Estimates should be used where contractor data is not available.

11. LOPC	Loss of Primary Containment (LOPC) is an unplanned or uncontrolled release of any material from primary containment, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed table, or compressed air).
12. LTIF	Lost Time Injury Frequency is calculated from the sum of fatalities and LWI divided by the number of hours worked expressed in millions
13. LWI	Lost Workday Injury is a work-related injury that causes the injured person to be away from work for at least one normal shift because he is unfit to perform any duties.
14. LWIF	Lost Workday Injury Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
15. LWIS	Lost Workday Injury Severity is the total number of days lost as a result of LWIs divided by the number of LWIs.
16. Marketing	Marketing includes all non-Manufacturing activities including Retail Operation which comprises the selling of products to the public at Company owned and operated sites (COCO), Company owned, Dealer operated sites (CODO), Dealer owned, Company operated sites (DOCO) and Dealer owned and operated sites (DODO) as well as "Head Office" personnel and other Marketing activities. COCO and DOCO retail operations are likely to be operated by staff and/or contractors while CODO are likely to be operated by contractors. DODO retail operations are not usually operated by Company staff or contractors and hence their hours are not usually included.
17. MTC	Medical Treatment Case is a work-related personal injury which requires treatment by a medical professional and does not result in time away from work or restriction in duties. It excludes all cases involving first aid treatments as specified in OSHA 1904.7(b) (5) even if these treatments are performed by a medical professional.
18. RAR	Road Accident Rate is calculated from the number of accidents divided by the kilometres travelled expressed in millions.
19. PSE	A Process Safety Event is an unplanned or uncontrolled LOPC. The severity of the PSE is defined by the consequences of the LOPC.
20. PSER	Process Safety Event Rate (PSER) is calculated as the number of PSE (Tier 1, Tier 2 or Total) divided by the total number of hours worked (including contractor hours) expressed in millions.
21. RA Road Accidents	Any incident involving any of the vehicles described above that occurs on or off-road resulting in a recordable injury (fatality, LTI, MTI, RWI), asset damage greater than EUR 2.500 or loss of containment greater than a Tier 2 Process Safety incident. It excludes all accidents where the vehicle was legally parked, the journey to or from the driver's home and normal place of work, minor wear and tear, vandalism, or theft. On-site incidents involving cars or trucks should be covered in the site statistics.

22. RWI	Restricted Workday Injury is a work-related injury which causes the injured person to be assigned to other work on a temporary basis or to work his normal job less than full time or to work at his normal job without undertaking all the normal duties.
23. Tier 1 PSE	A Tier 1 Process Safety Event (T-1 PSE) is a loss of primary containment (LOPC) with the greatest consequence. Refer to the definitions in API (2010) ANSI/API Recommended practice 754 for further details. Note Concawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concawe safety reports [18-25] for further details
24. Tier 2 PSE	A Tier 2 Process Safety Event (T-2 PSE) is a LOPC with lesser consequence. Refer to the definitions in API (2010) ANSI/API Recommended practice 754 for further details. Note Concawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concawe safety reports [18-25] for further details
25. Total days lost	The number of calendar days lost through LWIs counting from the day after the injury occurred.

Concawe Categorization of causes for Fatalities and LWIs

Previous Category	Current Concawe Incident Category	Description
Road accident	Road accident	Incidents involving motorised vehicles designed for transporting people and goods over land e.g. cars, buses, and trucks. Pedestrians struck by a vehicle are classes as road accidents. Fatal incidents from a mobile crane would only be road accidents if the crane were being moved between locations.
Height/Falls	Falls from height	A person falls from one level to another.
	Staff hit by falling objects	Incidents where injury results from being hit by flying or falling objects.
	Slips & trips (same height)	Slips, trips, and falls caused by falling over or onto something at the same height.
Burn/electrical	Explosion or burns	Burns or other effects of fires, explosions, and extremes of temperature. "Explosion" means a rapid combustion not an overpressure.
	Exposure electrical	Exposure to electrical shock or electrical burns etc.
Confined space entry	Confined Space	Incidents which occur within a confined space. Spaces are considered "confined" because their configurations hinder the activities of employees who must enter, work in, and exit them. Confined spaces include, but are not limited to underground vaults, tanks, storage bins, manholes, pits, silos, process vessels and pipelines.
Construction / Maintenance & Other	Assault or violent act	Intentional attempt, threat, or act of bodily injury by a person or persons or by violent harmful actions of unknown intent, includes intentional acts of damage to property.
	Water related, drowning	Incidents/events in which water played a significant role including drowning.
	Cut, puncture, scrape	Abrasions, scratches, and wounds that penetrate the skin.
	Struck by	Incidents/events where injury results from being hit by moving equipment or machinery, or by moving objects. Also includes vehicle incidents where the vehicle is struck by or struck against another object.
	Exposure, noise, chemical, biological, vibration	Exposure to noise, chemical substances (including asphyxiation due to lack of oxygen not associated with a confined space), hazardous biological material, vibration, or radiation.
	Caught in, under or between	Injury where injured person is crushed or similarly injured between machinery moving parts or other objects, caught between rolling tubulars or objects being moved, crushed between a ship and a dock, or similar incidents. Also includes vehicle incidents involving a rollover.
	Overexertion, strain	Physical overexertion, e.g. muscle strain.

Previous Category	Current Concawe Incident Category	Description
	Pressure release	Failure of or release of gas, liquid or object from a pressurised system.
	Other	Used to specify where an incident cannot be logically classed under any other category.

Guidance

Fatalities and Fatal Accident Rate (FAR)	Because of their very low numbers, fatalities and, therefore, FAR are not necessarily reliable indicators of the safety performance of a Company or Industry. A single accident can produce several fatalities and cause an abnormally high result in the indicator for a certain year. Conversely, the lack of fatalities is certainly no guarantee of a safe operation. The safety pyramid of H.W. Heinrich[2] implies that for every fatality there have been many other incidents with less serious injury outcomes. These less severe incidents provide the opportunities to address equipment, standards, training, attitudes, and practices that may prevent both the less, and the more serious incidents.
Lost Workday Injury Frequency (LWIF) and Lost Workday Injury Severity (LWIS)	The LWIF is the most common indicator in the oil and other industries and has been in use for many years. It is now common practice to include not only a company's own staff but also contractors in the statistics and this is done almost universally in the oil industry. All companies without exception collect employee LWIF data for at least their own staff and this is, therefore, the most frequently used and reliable indicator. Not all companies keep track of the number of lost days and, in some cases, the numbers are skewed by local interpretation. The overall LWIS reported is calculated taking account only of those companies that report the data. It should also be noted that the difference in interpretation of days lost results in a wide variation in the results and hence trends are difficult to identify.
All Injury Frequency (AIF)	As LWIF figures become progressively lower they appear to reach a plateau. Companies that have achieved very low LWIF levels may need a more meaningful indicator to monitor trends and detect improvements or deterioration of performance. AIF would provide such an indicator, since it records fatalities, Restricted Work Injuries (RWI) and Medical Treatment Cases (MTC) in addition to LWIs. Although it is still less widely used than LWIF, reporting improves year by year with more companies including this indicator into their performance reporting. It should also be noted that not all companies operate a restricted work system and also restricted working is not allowed in some countries. As the total number of injuries is not reported by all companies, only the worked hours for which this number is available are taken into account in the calculation of the overall AIF figure.

[2] Industrial Accident Prevention. H.W. Heinrich, 1931.

Road Accident Rate (RAR)

It is no surprise that, since road accidents remain a cause of both fatalities and Lost Workday Injury in the oil industry, a number of companies have chosen to calculate and monitor these separately outside of their impact on the overall statistics. This allows some extra focus on this key area of concern. The separate road accident data is still incomplete and the overall figures should therefore be considered as indicative only. For this reason, Concawe only reports RAR data for the whole downstream industry and all personnel involved (own staff and contractors), since the level of reporting is insufficient for the segmented data to be analysed. It must be noted, however, that the vast majority of road accidents occur in distribution and retail activities where both sales employees and truck drivers travel longer distances.

APPENDIX 2 HISTORICAL DATA 1993 TO 2020

Table A2-1 Performance indicators - All sectors

Year	Fatalities	FAR	AIF	LWIF	LWIS	RAR	Million Hours Reported	Distance Travelled Million km
1993	18	5.04	7.88	4.66	27	3.8	357.0	252
1994	19	5.36	7.42	3.96	25	3.1	354.8	227
1995	13	3.55	11.15	4.64	24	2.6	366.4	627
1996	14	3.33	10.72	4.71	19	2.0	420.6	705
1997	15	3.39	11.40	4.57	23	1.9	442.0	720
1998	12	2.55	9.91	4.48	22	1.5	469.7	369
1999	8	1.78	9.45	4.27	21	0.9	448.5	474
2000	13	2.74	8.78	4.25	25	0.9	475.1	1084
2001	14	2.83	9.53	4.28	24	0.8	495.5	1112
2002	16	3.33	6.92	3.91	23	1.1	480.0	1123
2003	22	4.14	6.34	3.22	30	1.0	531.6	1459
2004	12	2.34	6.28	3.17	33	1.0	513.3	1016
2005	11	1.89	4.47	2.57	35	0.9	581.7	1364
2006	7	1.47	4.62	2.48	30	1.6	477.5	557
2007	15	2.79	4.00	1.88	35	0.9	538.2	1069
2008	11	1.98	3.69	1.71	28	0.9	555.5	1004
2009	11	2.02	4.00	1.83	30	0.8	545.3	1036
2010	14	2.68	5.00	1.87	30	0.6	522.2	1011
2011	11	1.91	3.48	1.48	42	0.5	577.2	1084
2012	13	2.41	2.92	1.33	29	0.4	538.9	1164
2013	6	1.11	2.68	1.20	34	0.5	540.5	1178
2014	7	1.30	2.03	1.08	43	0.3	539.3	1271
2015	8	1.44	1.69	1.25	29	0.3	554.7	1111
2016	2	0.36	1.56	0.87	34	0.4	559.6	833
2017	2	0.34	1.57	0.94	34	0.4	594.3	953
2018	10	1.73	1.89	1.02	35	0.3	579.1	978
2019*	3	0.49	1.65*	0.97*	35	0.4	617.6*	818
2020	**2**	**0.37**	**1.52**	**0.88**	**35**	**0.4**	**542.5**	**576**

*2019 data provided in this table have been revised since publication of the Concawe 2019 report [26]. This includes an increase in the originally reported work hours for 2019 from 613.2 million to 617.6 million in this report which impacts certain calculated rates.

Table A2-2 Performance indicators – Manufacturing Staff

Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	2	2.67	12.71	3.84	50
1994	3	3.98	10.24	2.93	29
1995	1	1.08	12.23	3.58	29
1996	0	0.00	14.83	3.94	28
1997	2	1.76	15.09	4.78	24
1998	1	0.92	10.76	4.70	20
1999	0	0.00	12.46	4.45	16
2000	0	0.00	13.89	3.14	30
2001	5	5.56	9.91	3.35	27
2002	4	5.44	9.67	2.95	28
2003	2	2.50	8.38	2.90	38
2004	3	3.30	6.63	1.87	51
2005	0	0.00	5.11	1.83	44
2006	0	0.00	5.06	1.98	28
2007	0	0.00	3.93	1.78	33
2008	1	0.83	3.69	1.51	32
2009	3	2.63	5.60	2.20	34
2010	1	1.02	8.00	2.27	28
2011	1	0.86	5.70	1.69	76
2012	0	0.00	4.51	1.41	32
2013	0	0.00	3.65	1.29	33
2014	1	0.92	2.96	1.38	44
2015	3	3.00	2.92	1.48	41
2016	0	0.00	2.05	1.24	34
2017	0	0.00	2.26	1.53	35
2018	0	0.00	3.04	1.50	42
2019*	0	0.00	2.36	1.54	32
2020	**1**	**0.90**	**2.24**	**1.37**	**39**

*2019 data have been revised to those reported previously [26] (see **Appendix 5**). The small increase in number of Manufacturing staff hours, did not result in any change of the above indicators.

Table A2-3 Performance indicators – Manufacturing Contractors

Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	8	20.68	13.11	5.35	20
1994	1	2.63	12.73	4.57	36
1995	0	0.00	12.57	7.39	24
1996	3	5.03	18.66	8.26	19
1997	1	1.78	28.45	8.84	23
1998	0	0.00	25.08	9.32	24
1999	2	3.53	24.47	8.14	19
2000	2	3.07	20.96	8.00	23
2001	3	4.09	18.13	6.89	24
2002	6	9.89	14.34	6.31	23
2003	6	8.41	12.78	4.55	42
2004	5	6.16	10.23	3.54	30
2005	3	3.36	8.02	3.07	33
2006	2	2.07	6.82	2.88	31
2007	8	7.01	6.20	2.30	25
2008	4	3.09	5.28	1.81	26
2009	6	4.75	6.07	2.21	33
2010	10	7.61	8.84	2.13	32
2011	9	6.59	5.51	1.70	34
2012	7	5.17	4.30	1.48	26
2013	4	3.46	3.92	1.22	32
2014	5	3.91	2.97	1.13	46
2015	2	1.34	1.89	1.71	18
2016	2	1.26	1.48	0.66	42
2017	1	0.54	1.42	0.78	36
2018	7	4.21	2.03	0.99	37
2019*	3	1.75*	1.69*	0.91*	40
2020	**0**	**0.00**	**1.89**	**1.01**	**34**

*2019 data provided in this table have been revised since publication of the Concawe 2019 report [26]. This includes an increase in the originally reported work hours for Manufacturing contractors which impacts the calculated rates.

Table A2-4 Performance indicators – Marketing Staff

Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	2	1.20	6.07	5.68	23
1994	13	8.07	5.95	5.16	21
1995	1	0.62	12.00	4.93	22
1996	2	1.11	8.64	4.89	18
1997	4	2.40	8.62	4.61	23
1998	3	1.64	7.73	3.41	21
1999	2	1.12	6.50	3.67	23
2000	0	0.00	4.71	3.68	29
2001	3	1.42	6.68	3.63	27
2002	4	2.10	5.66	3.61	22
2003	2	0.98	5.73	3.33	19
2004	0	0.00	6.62	3.90	25
2005	3	1.40	4.17	2.98	36
2006	0	0.00	3.73	2.63	23
2007	2	1.18	3.98	2.12	31
2008	1	0.62	4.04	2.13	27
2009	1	0.62	3.28	1.75	22
2010	0	0.00	2.43	1.81	26
2011	1	0.48	2.17	1.43	32
2012	2	1.17	1.96	1.42	29
2013	0	0.00	2.18	1.33	34
2014	0	0.00	1.52	0.99	43
2015	0	0.00	1.35	1.04	40
2016	0	0.00	1.74	0.94	25
2017	0	0.00	1.80	0.95	36
2018	1	0.63	1.74	0.97	31
2019	0	0.00	1.81	0.90	42
2020	**0**	**0.00**	**1.42**	**0.80**	**29**

Table A2-5 Performance indicators – Marketing Contractors

Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	6	7.83	3.66	2.90	21
1994	2	2.49	4.34	2.21	25
1995	11	18.16	7.03	3.09	21
1996	9	11.85	3.54	2.57	11
1997	8	7.60	3.37	2.01	20
1998	8	6.79	5.87	3.50	19
1999	4	3.30	5.60	3.23	18
2000	11	9.66	2.86	4.06	17
2001	3	2.48	8.20	4.52	17
2002	2	1.29	4.41	3.79	20
2003	12	6.82	3.40	2.68	31
2004	4	2.77	3.33	2.79	43
2005	5	2.73	2.61	2.28	28
2006	5	4.58	3.79	2.32	19
2007	5	3.94	2.35	1.39	22
2008	5	3.46	1.88	1.31	20
2009	1	0.71	1.64	1.27	28
2010	3	2.53	1.67	1.33	36
2011	0	0.00	1.23	1.08	19
2012	4	3.63	1.23	0.95	29
2013	2	1.70	1.21	0.87	37
2014	1	0.76	1.00	0.89	37
2015	3	2.44	0.85	0.75	25
2016	0	0.00	1.00	0.75	37
2017	1	0.72	0.97	0.67	28
2018	2	1.38	1.01	0.73	28
2019	0	0.00	0.96	0.70	25
2020	**1**	**0.67**	**0.73**	**0.48**	**35**

Table A2-6 Lost Workday Injury causes 2016-2020 – Staff and Contractors in both Manufacturing and Marketing

		LWI 2020				2019	2018	2017	2016
Causes		**Manufacturing**	**Marketing**	**Combined**	**%**	**%**	**%**	**%**	**%**
Road Accident	Road Accident	6	10	16	3.4	3.4	3.4	2.9	4.1
Heights/Falls	Falls from height	20	6	26	5.5	8.3	9.6	7.8	7.3
	Staff hit by falling objects	8	1	9	1.9	3.1	2.6	3.1	3.0
	Slips & trips (same height)	79	60	139	29.2	37.8	33.0	36.5	30.1
Burn/Electrical	Explosion or burns	18	11	29	6.1	3.2	6.5	4.5	7.3
	Exposure electrical	2	0	2	0.4	0.9	0.2	0.9	0.4
Confined Space	Confined Space	1	1	2	0.4	0.2	0.3	0.2	0.2
Other Causes	Assault or violent act	0	5	5	1.1	2.0	1.9	2.0	3.0
	Water related, drowning	0	0	0	0.0	0.0	0.0	0.0	0.0
	Cut, puncture, scrape	24	20	44	9.2	6.5	8.6	6.4	5.7
	Struck by	37	25	62	13.0	13.3	11.5	13.3	8.3
	Exposure, noise, chemical, biological, vibration	20	3	23	4.8	4.1	3.1	4.7	3.5
	Caught in, under or between	25	9	34	7.1	8.0	7.2	3.8	6.1
	Overexertion, strain	22	17	39	8.2	5.5	5.5	9.5	15.2
	Pressure release	6	2	8	1.7	0.7	0.7	0.7	1.2
	Other	24	14	38	8.0	3.1	5.8	3.6	4.5
	Total	292	184	476	100	100	100	100	100

APPENDIX 3 LOST WORKDAY INJURIES 2020 - CAUSAL FACTORS

		Number of Incidents													
MF/MK	Incident Category	Change Management	Communication	Design	Equipment Reliability	Fixed Equipment Inspection	Human Factors	Knowledge and Skills	Operating Limits	Procedures	Risk Assessment	Safe Work Practices or Procedures	Work Monitoring	Other	Not Yet Available
MF	Assault or violent act	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK	Assault or violent act	0	1	0	0	0	1	0	0	0	1	1	0	2	1
MF	Caught in, under or between	0	0	3	0	1	15	6	0	2	2	6	0	0	3
MK	Caught in, under or between	0	1	2	0	0	3	0	0	0	3	0	0	0	1
MF	Confined space	0	0	0	0	0	0	0	0	1	0	0	0	0	1
MK	Confined space	0	0	0	0	0	1	0	0	0	1	1	0	0	0
MF	Cut, puncture, scrape	0	1	1	4	0	14	3	0	2	1	11	2	1	3
MK	Cut, puncture, scrape	0	0	2	0	0	6	1	0	3	2	3	0	3	4
MF	Explosion or burns	0	2	4	4	1	6	3	1	3	3	1	2	0	5
MK	Explosion or burns	0	0	0	2	0	5	3	0	2	3	3	4	0	1
MF	Exposure electrical	0	1	0	0	0	1	0	0	1	1	1	1	0	2
MK	Exposure electrical	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Exposure, noise, chemical, biological, vibration	0	1	2	0	0	7	4	0	5	6	9	4	0	1
MK	Exposure, noise, chemical, biological, vibration	0	0	1	0	1	2	1	1	1	1	1	1	0	0
MF	Falls from height	1	1	4	2	2	10	3	0	3	4	5	2	2	3
MK	Falls from height	0	0	0	1	0	3	1	0	0	0	0	0	3	0
MF	Other	1	1	1	1	2	11	3	1	6	3	4	2	7	3
MK	Other	0	0	0	0	2	6	1	0	2	0	0	0	4	1
MF	Overexertion, strain	0	1	8	1	0	18	1	0	1	4	3	1	1	2
MK	Overexertion, strain	0	0	1	1	2	7	0	0	0	1	1	0	0	6
MF	Pressure release	0	1	1	0	0	1	2	0	1	2	1	0	1	1
MK	Pressure release	0	0	0	0	0	1	0	0	0	0	0	0	1	0
MF	Road accident	0	1	0	0	0	2	0	0	1	0	1	0	2	0
MK	Road accident	0	1	0	0	0	4	1	0	0	2	2	0	4	0
MF	Slips & trips (same height)	2	3	11	2	2	39	4	0	7	10	10	1	16	14
MK	Slips & trips (same height)	0	2	5	1	3	30	1	0	3	5	5	0	6	15
MF	Staff hit by falling objects	1	1	1	2	0	3	0	0	3	4	4	3	0	1
MK	Staff hit by falling objects	0	0	0	0	0	0	1	0	0	0	0	0	1	0
MF	Struck by	0	5	3	4	1	12	4	0	8	7	10	0	1	3
MK	Struck by	0	1	4	1	0	7	2	0	2	4	1	3	3	8
MF	Water related, drowning	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK	Water related, drowning	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	5	25	54	26	17	215	45	3	57	70	84	26	58	79

APPENDIX 4 PROCESS SAFETY EVENTS 2020

Table A4-1 Tier 1 and 2 Process Safety incidents by Type of Process (Refining)

Type of Process: Refining	Number of Tier 1 events	Number of Tier 2 events
1. active warehouse	0	0
2. alkylation, HF	1	1
3. alkylation, sulfuric	0	0
4. bitumen/resid/asphalt	0	3
5. calcining	0	0
6. coking	0	0
7. crude/vacuum distillation	8	13
8. fcc	1	1
9. flares/flare systems/flare gas recovery	0	2
10. gas and liquid desulfurization/treating (H2S absorbers, amine systems, Merox)	4	5
11. hydrocracking	1	2
12. hydrogen	0	0
13. hydrotreating	2	11
14. isomerization	0	4
15. loading/unloading (truck or rail)	6	13
16. marine/jetty/wharf	0	1
17. Other (describe)	7	8
18. pilot plant	0	0
19. reforming	1	5
20. sulfur recovery	1	1
21. tank farm/storage facility/offsites/storage and transfer piping	25	23
22. utilities/steam plant/cogeneration	2	3
23. vapor recovery/light ends	0	1
24. waste/wastewater handling, treatment or disposal	2	1
Total	**61**	**98**

Table A4-2 Tier 1 and 2Process Safety incidents by Type of Process (Petrochemical & other process)

Type of Process: Petrochemical	Number of Tier 1 events	Number of Tier 2 events
1. acetic acid and derivatives	0	0
2. active warehouse	0	0
3. amines derivatives	0	0
4. aromatics derivatives (cumene, dis-proportionation, aromatic isomerization, linear alkylbenzene)	0	0
5. benzene	0	0
6. butadiene	0	0
7. butane	0	0
8. cyclohexane	0	0
9. dehydrogenation (propylene, butylenes)	0	1
10. diisocyanates (TDA, MDA, IPDA, etc.)	0	0
11. ETBE	0	0
12. ethane	0	0
13. ethanol	0	0
14. ethyl benzene and derivatives	0	1
15. ethylene and derivatives	1	2
16. ethylene dichloride and derivatives	0	0
17. ethylene oxide	0	0
18. flares/flare systems/flare gas recovery	0	1
19. formaldehyde and derivatives	0	0
20. glycols (ethylene, propylene)	0	0
21. hexane	0	0
22. hexanol	0	0
23. isobutane	0	0
24. isobutene	0	1
25. isocyanates	0	0
26. isopropanol	0	0
27. LNG	0	0
28. loading/unloading (truck or rail)	0	0
29. methane	0	0
30. methanol	0	0
31. methyl mercaptan	0	0
32. MTBE	0	0
33. NGL fractionation	0	0
34. Other (describe)	2	11
35. paraxylene	0	0
36. pentane	0	0
37. phenol	0	0
38. pilot plant	0	0
39. polyethylene	0	0
40. polypropylene	0	0
41. polystyrene	0	0
42. propane	0	0
43. propylene	0	2
44. propylene oxide and derivatives	0	0
45. specialty chemicals	0	0
46. styrene-butadiene	0	0
47. synthesis gas (CO, H2),	0	1
48. tank farm/storage facility/offsite/storage & transfer piping	2	12
49. toluene	0	0
50. utilities/steam plant/cogeneration	0	1
51. waste/wastewater handling, treatment or disposal	0	0
52. xylene	0	0
Total	**5**	**33**

Table A4-3 Tier 1 and 2 Process Safety incidents by Mode of Operation

Mode of Operation	Number of Tier 1 events	Number of Tier 2 events
1. Emergency shutdown	2	0
2. Normal	49	95
3. Other (describe)	0	2
4. Planned shutdown	7	0
5. Routine maintenance	5	9
6. Start-up	2	20
7. Temporary	1	2
8. Turnaround	0	0
9. Upset	0	3
Total	**66**	**131**

Table A4-4 Tier 1 and 2 Process Safety incidents by Point of release

Point of Release	Number of Tier 1 events	Number of Tier 2 events
1. Atmospheric tank	12	15
2. Blower/Fan	0	0
3. Compressor	0	6
4. Cooling Tower	1	1
5. Filter/Coalescer/Strainer	2	0
6. Fired Boiler	0	0
7. Flare/Relief System	3	5
8. Furnace/fired heater	0	1
9. Heat exchanger	5	2
10. Instrumentation	0	3
11. Other (describe)	9	23
12. Piping system, large bore(>2)	20	32
13. Piping system, small bore(?2)	7	23
14. Pressure Vessel	3	3
15. Pump	3	15
16. Reactor	1	2
Total	**66**	**131**

Table A4-5 Tier 1 and 2 Process Safety incidents by Type of Material

Type of Material	Number of Tier 1 events	Number of Tier 2 events
1. Combustible	6	27
2. Corrosive	3	3
3. Flammable	45	82
4. Other	0	11
5. Toxic	8	8
6. UNDG Class 2	0	0
7. Utilities	4	2
Total	**66**	**131**

Table A4-6 Tier 1 and 2 Process Safety incidents by Causal Factor

Causal Factors	Number times Causal Factor assigned* **Tier 1**	Number times Causal Factor assigned* **Tier 2**
1. Change Management	5	7
2. Communication	1	8
3. Design	20	29
4. Equipment Reliability	17	50
5. Fixed Equipment Inspection	8	21
6. Human Factors	12	31
7. Knowledge and Skills	4	11
8. Operating Limits	5	5
9. Procedures	12	23
10. Risk Assessment	7	7
11. Safe Work Practices or Procedures	9	12
12. Work Monitoring	6	7
13. Other	7	8
14. Not Yet Available	7	4
Total	**120**	**223**

*More than one causal factor may be assigned to a single Tier one event

APPENDIX 5 CORRECTIONS TO PREVIOUS REPORTS

Data corrections have been made to previously reported data for 2019 [26]. This has been aggregated below by area and staff/contractor.

Year	Person	Area	Data Point	Previously Reported	Revised Value
2019	Contractor	Manufacturing	Total hours worked	167356290	171491780
2019	Staff	Manufacturing	Total hours worked	118109106	118405446

APPENDIX 6 CONCAWE MEMBER COMPANIES THAT SUBMITTED DATA

The following member companies provided the data upon which this report is based. The report includes additional data from two member company joint ventures when these are not provided in the member company submissions.

ALMA Petroli	Gruppo API	ATCP	BP
CEPSA	ENI	Equinor	ESSAR
ExxonMobil	GALP Energia	Gunvor	H&R
Hellenic Petroleum	IPLOM	Irving	Rompetrol
Q8	Gruppa Lotos	LUKOIL	MOL Group
Motor Oil (Hellas)	Neste	Nynas	OMV
Petroineos	Phillips 66	PKN Orlen	Preem
Raffinerie Heide	Repsol	Rosneft	Sara
Saras	Shell	St1	Tamoil
TotalEnergies	Valero	VaroEnergy	VPR Energy

Concawe
Environmental Science
for European Refining

Concawe
Boulevard du Souverain 165
B-1160 Brussels
Belgium

Tel: +32-2-566 91 60
Fax: +32-2-566 91 81
e-mail: info@Concawe.eu
http://www.Concawe.eu

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