

# Report

Report no. 9/24

## European downstream oil industry safety performance

Statistical summary of reported incidents -  
2023



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This report was prepared by C. Banner and C. Davidson (Anything Hosted) at the request of Concawe Safety Management Group (SMG).

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## ABSTRACT

The 2023 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 Concawe Member Companies and two Joint Ventures (comprised of member companies) reported separately, together representing 96% of the European refining capacity. Total work hours reported (593 million) were almost 9% higher in 2023 than in 2022. In 2023, there were seven fatalities reported by the industry, four Manufacturing staff, two Manufacturing contractors and one Marketing contractor. The number of Lost Workday Injuries recorded in 2023 (655) is 15% higher than those in 2022 (568). The combined number of Tier 1 and 2 process safety events across Manufacturing and Marketing in 2023 remains the same as in 2022 (224), however there were more Tier 1 events in 2023 (79) than in 2022 (61).

This report is available as an Adobe pdf file on the Concawe website ([www.concawe.eu](http://www.concawe.eu)).

### NOTE

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## EXECUTIVE SUMMARY

For 2023, information was received from 40 Concawe Member Companies and 2 Joint Ventures (comprised of Member Companies) reported separately, together accounting for greater than 96% of the available refining capacity in the EU-27, UK, Norway and Switzerland. The purpose of collecting this data is to provide fuel manufacturers and distributors 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 assess the efficiency of the responsible management of safety implemented in the downstream oil industry and whether it results in a low level of accidents despite the hazards intrinsic to its operations.

The aggregated 2023 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	106	168	274	140	179	319	246	347	593
Fatalities	4	2	6	0	1	1	4	3	7
FAR - FA/100Mh	3.77	1.19	2.19	0.00	0.56	0.31	1.63	0.86	1.18
LWI	202	207	409	117	129	246	319	336	655
Lost time through LWI - Days	7,340	8,095	15,435	3,727	3,359	7,086	11,067	11,454	22,521
LWIF - LWI/Mh	1.90	1.23	1.49	0.84	0.72	0.77	1.30	0.97	1.10
LWIS - Lost days/LWI	39.04	47.62	43.11	37.65	30.26	33.74	38.56	40.76	39.65
AI	389	453	842	162	157	319	551	610	1,161
AIF - AI/Mh	3.67	2.70	3.07	1.16	0.88	1.00	2.24	1.76	1.96
Distance travelled - million km	22	48	70	271	499	770	293	546	840
RA	23	6	29	64	104	168	87	110	197
RAR – RA/Mkm	0.85	0.10	0.34	0.24	0.19	0.21	0.28	0.18	0.22
Hours worked Mh (PS reporting)			273.3			282.7			556.0
T-1 PSE			74			5			79
T-2 PSE			126			19			145
T-1 PSER PSI/Mh reported			0.27			0.02			0.14
T-2 PSER PSI/Mh reported			0.46			0.07			0.26
Total PSER PSI/Mh reported			0.73			0.08			0.40

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

\*Total hours recorded in millions, rounded to whole number (rates below use data before rounding for hours associated with those companies/sectors reporting incidents)

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

\*\*\* RAR is calculated only when both Road accidents and Distance travelled are reported

There were seven fatalities reported for 2023, four Manufacturing staff, two Manufacturing contractors and one Marketing contractor. Two Manufacturing staff fatalities were as a result of hydrogen sulphide inhalation. Another two Manufacturing staff died because of exposure to nitrogen (in the same incident). One Manufacturing contractor also died as a result of nitrogen exposure in a separate incident and the other as a result of burns. The Marketing contractor was fatally struck. In comparison with 2021 and 2022 (six and eleven fatalities, respectively), 2023 again represents a large and unwelcome number of recorded fatalities.

In addition to fatalities Lost Workday Injuries (LWI) are also studied to identify further opportunities for continuous safety performance improvement. A total of 655 LWI were reported in 2023 (568 in the previous year) with a 2023 LWIF of 1.10, compared with 1.05 in 2022. As in previous years, a relatively small number of categories contribute to most LWI reported. In order of frequency (highest first) Slips & trips (same height), Struck by, Caught in under or between, Falls from Height and Explosion and burns together account for 69% of all LWI reported in 2023 across Manufacturing and Marketing.

For 2023, 41 companies submitted Process Safety Event (PSE) data for the Manufacturing operations and 23 submitted Marketing PSE data. The combined number of Tier 1 and 2 process safety events across Manufacturing and Marketing in 2023 (224) remained around the same as in 2022. Tier 1 Manufacturing process safety events (74 in 2023) increased by more than 21% compared with 2022 (61) and Tier 2 Manufacturing process safety events (126 in 2023) decreased by 14% since 2022 (147). The number of Marketing Tier 1 events in 2023 (5) remained the same as those in 2022 and Marketing Tier 2 events increased from 13 to 19 events in 2023. Three out of seven fatalities (43%) and 14 out of 655 LWI (2%) in 2023 were related to Tier 1 process safety events, the same percentage of LWI as in 2022. This underlines the importance of high technical standards and strict procedures in process safety.

## 1. INTRODUCTION TO 2023 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 thirtieth report on this topic (see references of past reports in the reference list [1-29]). This report covers data collected for 2023 as well as a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available. For 2023, information was received from all forty Concawe Member Companies and two Joint Ventures comprised of Member Companies when information has not been submitted by the Member Company partners. These submissions in 2023 represent 96% 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 ten 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 assess the efficiency of the responsible management of safety implemented in the downstream oil industry and whether it 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 2023 Manufacturing PSE data represents 41 out of 42 of the Manufacturing companies and more than 96% of European refining capacity.

In 2013, the Concawe membership agreed to adopt sixteen 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 LWI are further explained in Appendix 1.

In 2014, Concawe 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 2021, the opportunity to record the number of RWIs and/or MTCs linked to each Tier 2 Event was provided.

In 2022, it was possible to record for each LWI and fatality, the type of permit to work (PTW) issued at the time of the incident and for each LWI, the number of days absent from work. This information may help Member Companies build a strong management system in conjunction with their PTW procedure.

In 2023, Concawe introduced mandatory reporting of more detailed Tier 1 process safety event information to enable focus on Tier 1 events in 5 categories: Fire with damage greater than or equal to \$100,000 of direct cost; Explosion with damage greater than or equal to \$100,000 of direct cost; An officially declared community evacuation or community shelter-in-place, (including precautionary); Engineered pressure relief that results in one or more of four consequences (rainout, discharge to a potentially unsafe location, on-site shelter-in-place or on-site non- precautionary evacuation and/or public measures (including precautionary)) and Upset Emission from a Permitted or Regulated Source that results in one or more of the same four consequences.

A restructuring of causal factors including the removal of the generic causal factor "human factors" was introduced in 2023 in an attempt to extract more meaningful information from reported incidents, see Appendix 1 for definitions of the Concawe causal factors.

**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 2023

No. Companies	Manufacturing			Marketing		
	Own Staff	Contractors	All Workers	Own Staff	Contractors	All Workers
Submission	42	41		27	24	
Including:						
Lost Days	37	35		22	17	
All Injuries	38	37		12	16	
Road Accidents	37	35		18	16	
Distance Travelled	25	23		15	13	
Process Safety			41			23
Retail Operations:						
No Retail						6
COCO						14
CODO						14
DOCO						10
DODO						11

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. 2023 PERSONAL SAFETY PERFORMANCE

The aggregated 2023 results for Manufacturing, Marketing and the combined downstream industry are shown in Table 2.

**Table 2** Aggregated 2023 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	106	168	274	140	179	319	246	347	593
Fatalities	4	2	6	0	1	1	4	3	7
FAR - FA/100Mh	3.77	1.19	2.19	0.00	0.56	0.31	1.63	0.86	1.18
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AI	389	453	842	162	157	319	551	610	1,161
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RA	23	6	29	64	104	168	87	110	197
RAR	0.85	0.10	0.34	0.24	0.19	0.21	0.28	0.18	0.22

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

\*Total hours recorded in millions, rounded to whole number (rates below use data before rounding for hours associated with those companies/sectors reporting incidents)

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

\*\*\* RAR is calculated only when both Road accidents and Distance travelled are reported

### 2.1. FATALITIES

There were seven fatalities reported for 2023, four Manufacturing staff, two Manufacturing contractors and one Marketing contractor.

- Two Manufacturing staff were killed as a result of exposure to hydrogen sulphide in separate incidents both reported as category Exposure, noise, chemical, biological, vibration.
  - One Manufacturing staff member died as a result of hydrogen sulphide inhalation
  - Hydrogen sulphide release at a valve inspection resulted in a further fatality of a Manufacturing staff member
- Two Manufacturing staff were killed as a result of exposure to nitrogen in the same incident reported as category Confined space
  - An operator went in a confined space with nitrogen to remove objects and was intoxicated with nitrogen vapour
  - A further operator entered the same space to rescue the first operator and was also intoxicated.
- One Manufacturing contractor died during a nitrogen dive, reported as category Confined space
- A further Manufacturing contractor died as a result of burns following ignition of a sudden release of hydrocarbons while removing a pipe plug after a flange had been welded on a cut pipeline (reported as category Explosion or burns).

- A Marketing contractor was fatally injured during excavation pit lining work at a service station, reported as category Struck by.

While the number of fatalities in 2023 is lower than that recorded in 2022 (11), the number of deaths remains unacceptably high and continued efforts are essential to achieve the target of zero fatalities in our industry.

## 2.2. LOST WORKDAY INJURIES

In 2023, there were a total of 655 Lost Workday Injuries (LWI), with 62% of these in Manufacturing and 38% in Marketing. The number of Manufacturing LWI were almost equally split between own staff and contractors (202 and 207 LWI, respectively). A similarly even split was reported in Marketing LWI, with 52% of LWI associated with contractors (129 contractor LWI out of 246 total Marketing LWI).

There was an increase in Lost Workday Injury Frequency (LWIF) compared with 2022. The LWIF went from 1.05 LWI/Mh in 2022 to 1.10 LWI/Mh in 2023 across all workers. Thirty-nine companies reported LWI in 2022 and 37 of these reporting companies also reported LWI in 2023. Of these 37 companies, 16 (43%) reported a lower overall LWIF in 2023 than in 2022, 2 companies had the same LWIF in 2022 and 2023 (5%) and 19 companies (51%) had a higher LWIF in 2023. With regard to All Injury Frequency (AIF), of these 37 companies, 15 (41%) reported a lower overall AIF in 2023 than in 2022, and 22 companies (59%) had a higher AIF in 2023.

As in 2022, Manufacturing staff in 2023 is the sector with the highest LWIF (1.90 in 2023 and 1.41 in 2022). Marketing contractors have the lowest recorded LWIF of all sectors in 2023 at 0.72.

For comparison purposes, the LTIF (frequency of LWI + 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 2023

	LWIF	LTIF
All Workers	1.10	1.12
Manufacturing Staff	1.90	1.94
Manufacturing Contractors	1.23	1.24
Manufacturing All	1.49	1.51
Marketing Staff	0.84	0.84
Marketing Contractors	0.72	0.73
Marketing All	0.77	0.77

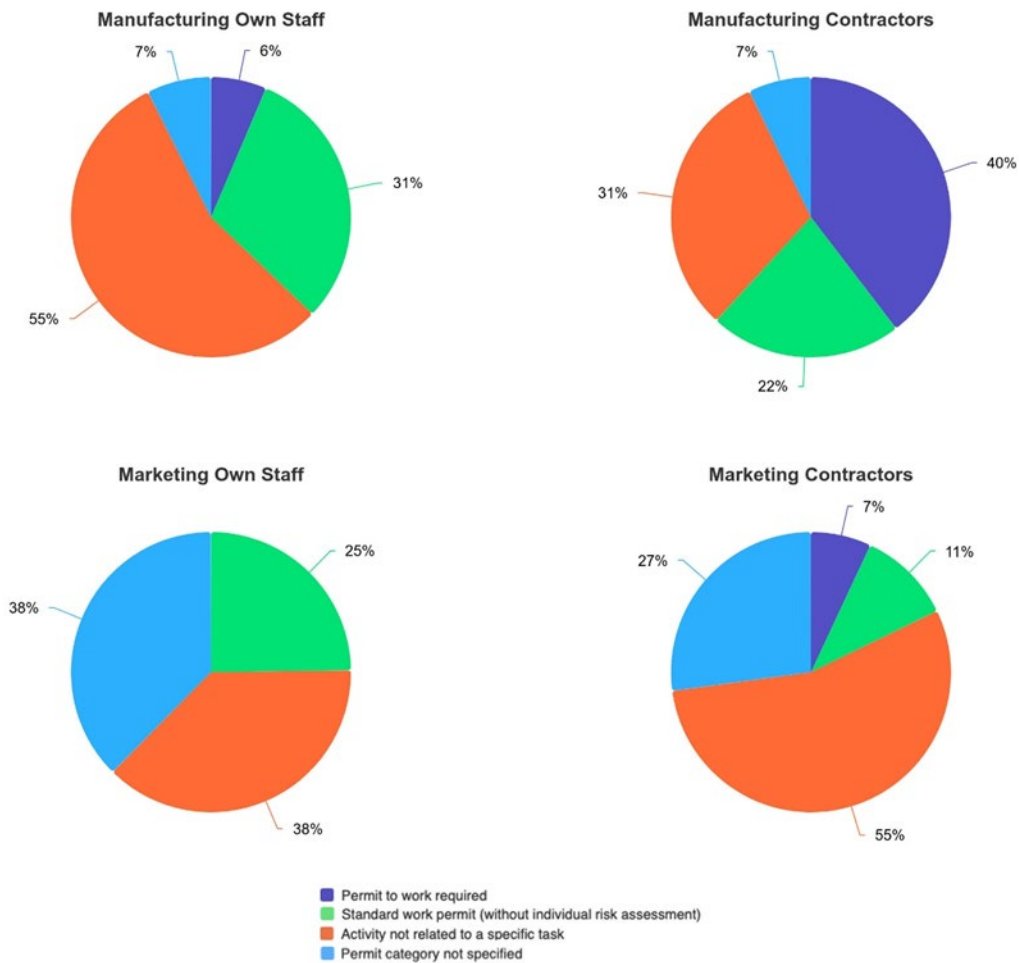
**Table 4** LWI by Incident Category in 2023

Category		MF & MK Combined		Manufacturing (MF)						Marketing (MF)					
		All	%	OS	%	CT	%	AW	%	OS	%	CT	%	AW	%
Road Accident	Road Accident	23	3.5	6	3.0	8	3.9	14	3.4	4	3.4	5	3.9	9	3.7
Height/Falls	Falls from height	53	8.1	9	4.5	20	9.7	29	7.1	15	12.8	9	7.0	24	9.8
	Staff hit by falling objects	18	2.7	0	0.0	9	4.3	9	2.2	2	1.7	7	5.4	9	3.7
	Slips & trips (same height)	216	33.0	73	36.1	56	27.1	129	31.5	49	41.9	38	29.5	87	35.4
Burn/ Electrical	Explosion or burns	45	6.9	22	10.9	18	8.7	40	9.8	4	3.4	1	0.8	5	2.0
	Exposure electrical	8	1.2	2	1.0	4	1.9	6	1.5	0	0.0	2	1.6	2	0.8
Confined Space	Confined Space	1	0.2	1	0.5	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
Other Causes	Assault or violent act	10	1.5	0	0.0	0	0.0	0	0.0	3	2.6	7	5.4	10	4.1
	Water related, drowning	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Cut, puncture, scrape	43	6.6	11	5.4	15	7.2	26	6.4	7	6.0	10	7.8	17	6.9
	Struck by	71	10.8	21	10.4	27	13.0	48	11.7	6	5.1	17	13.2	23	9.3
	Exposure, noise, chemical, biological, vibration	11	1.7	5	2.5	6	2.9	11	2.7	0	0.0	0	0.0	0	0.0
	Caught in, under or between	67	10.2	24	11.9	19	9.2	43	10.5	11	9.4	13	10.1	24	9.8
	Overexertion, strain	44	6.7	15	7.4	12	5.8	27	6.6	5	4.3	12	9.3	17	6.9
Pressure release	4	0.6	2	1.0	2	1.0	4	1.0	0	0.0	0	0.0	0	0.0	

OS: Own staff; CT: Contractors; AW: All workers MF: Manufacturing; MK: Marketing

For the third year in 2023, Concawe collected information to link the event leading to the LWI to the type of Permit to Work (PTW) required to execute the task, if any. The assignment of type of PTW (Permit to work required, e.g., for confined space or hot work; Standard work permit (without individual risk assessment), e.g., for sampling and driving; work without PTW not related to a specific task, e.g., cycling or walking) for each of the sectors is set out in Figure 1A, below.

**Figure 1A** Type of Permit to work for LWI recorded by sector

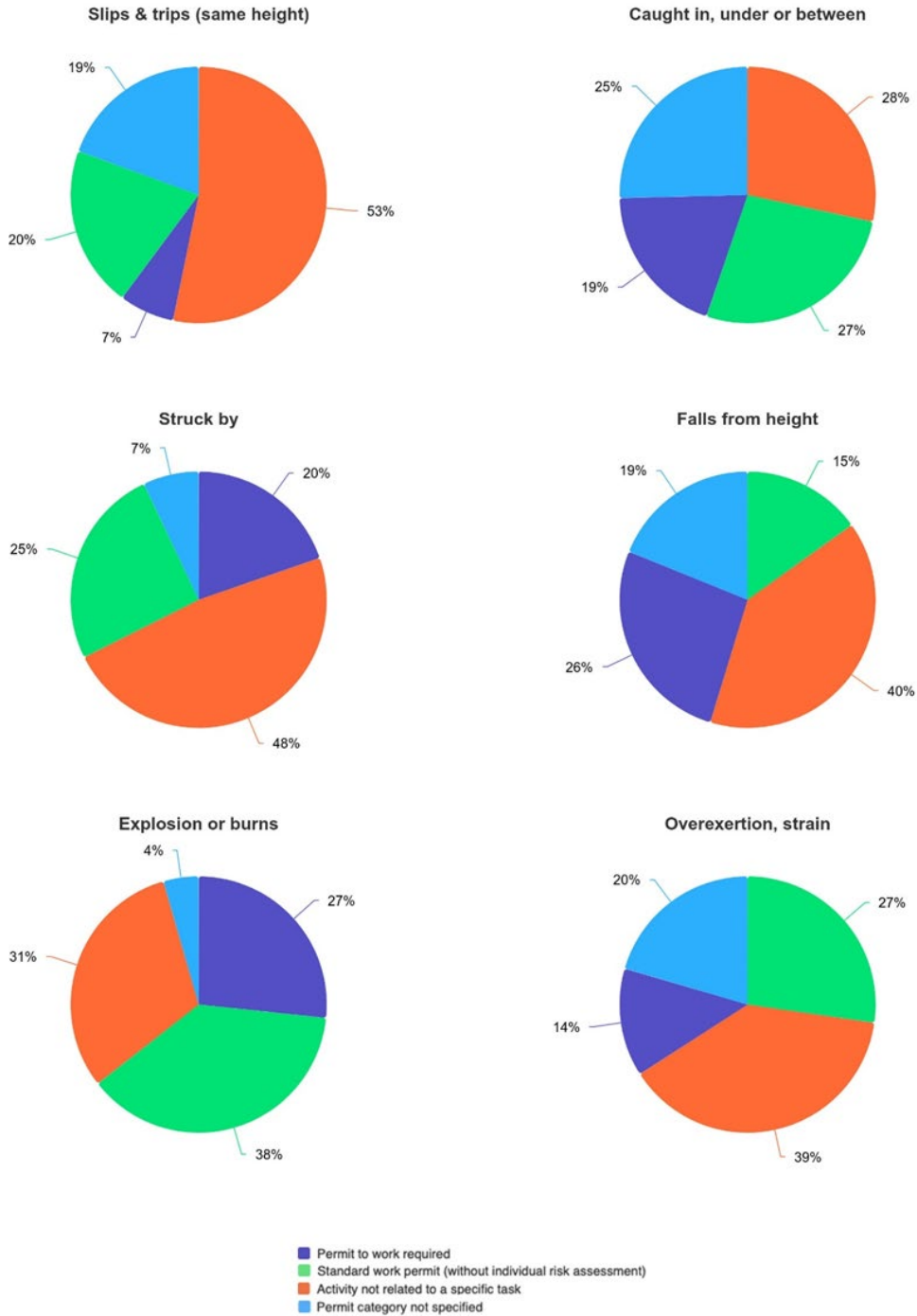


The specification of whether a permit to work was required for work at the time of a LWI varies across the sectors between 93% specification across both Manufacturing sectors down to 62% amongst Marketing own staff. In all sectors except Manufacturing contractors, where most LWI occur during work which requires a permit, most LWI occur during work that is not related to a specific task. In Manufacturing, LWI occur in work that is not related to a specific task more often for own staff (55% of sector LWI) than for contractors (31% of sector LWI). However, the opposite is seen in Marketing where LWI occur in work that is not related to a specific task more often for contractors (55% of sector LWI) than for own staff (38% of sector LWI).

The sector that reported the most LWI during work subject to a specific permit is Manufacturing contractors (40% of sector LWI). No LWI for Marketing own staff were recorded during work subject to a specific permit. The proportion of LWI associated with work that requires a permit increased on Manufacturing contractors from 27% of sector LWI in 2022 to 40% in 2023. Marketing own staff LWI associated with work not related to a specific task fell from 75% of sector LWI in 2022 to 38% in 2023.

For the most frequently reported LWI, the type of PTW in place at the time of the event is presented in Figure 1B. The proportion of the types of PTW specified varies between the LWI categories. A full PTW was more likely to be in place at the time of events leading to LWI associated with explosion or burns (27% of incident category LWI) and falls from height (26% of incident category LWI) type incidents than for LWI associated with slips and trips (7% of incident category LWI). The proportion of all falls from height in 2023 while working under a full PTW is considerably higher than in 2022 (7%). As in 2022, slips & trips reported the largest proportion of no PTW (activity not related to a specific task) and caught in under or between the smallest proportion.

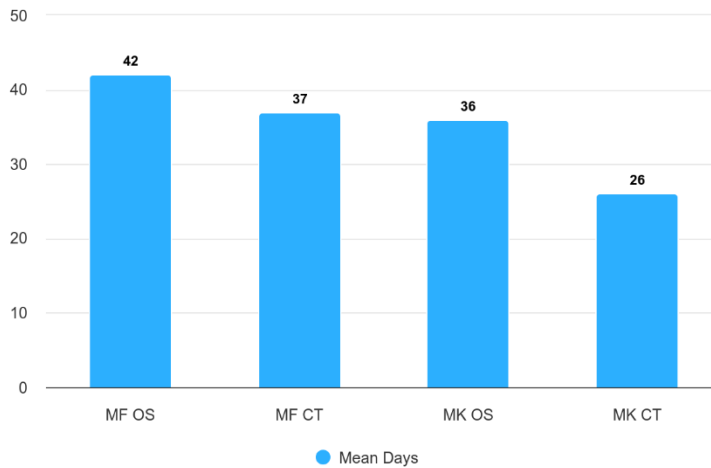
**Figure 1B** Type of Permit to Work in place at time of Lost Work Injury event for most frequently reported Incident Categories



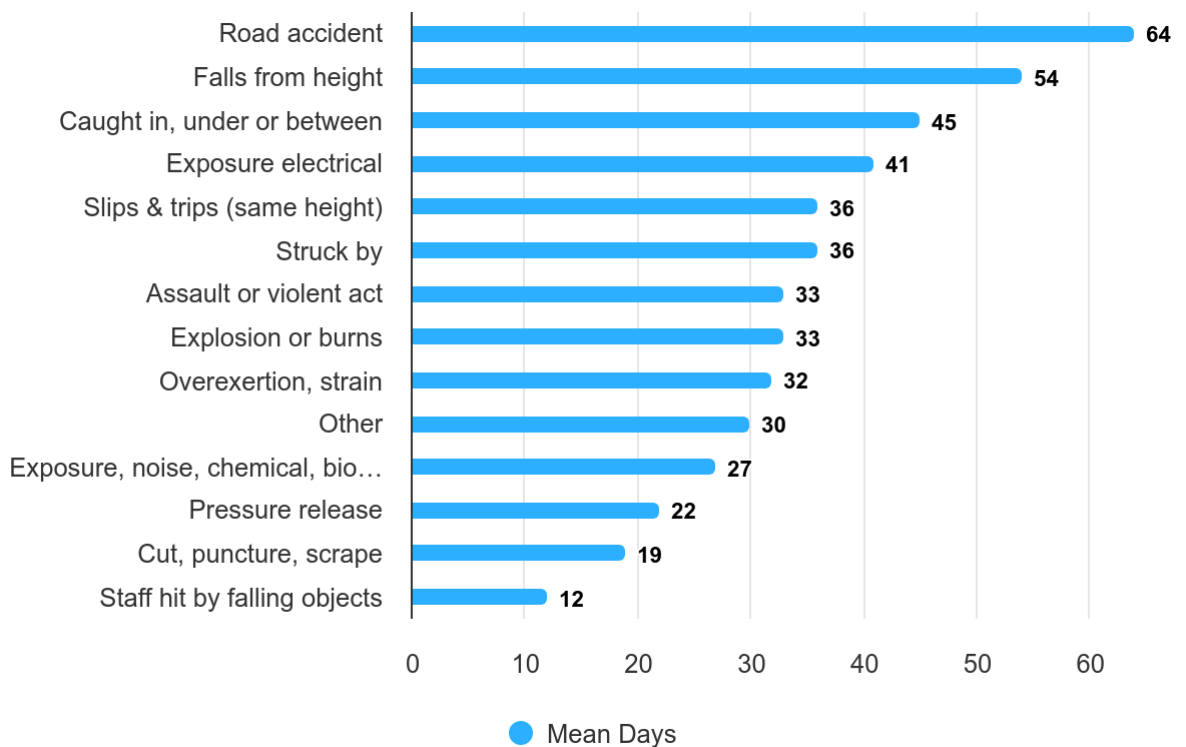


The number of days absent from work per LWI was reported in 2023 for 85 % of LWI (559 LWI) compared with 74% of LWI in 2022. The total number of days absence recorded for individual LWI in 2023 was 20,203 (the total number of days absence for all LWI reported, 22,521). The mean absence per LWI is 36 days with Manufacturing Own Staff and Contractors above this mean at 42 and 37 days lost per LWI, respectively and Marketing Contractors below the mean at 26 days per LWI, see **Figure 1C**.

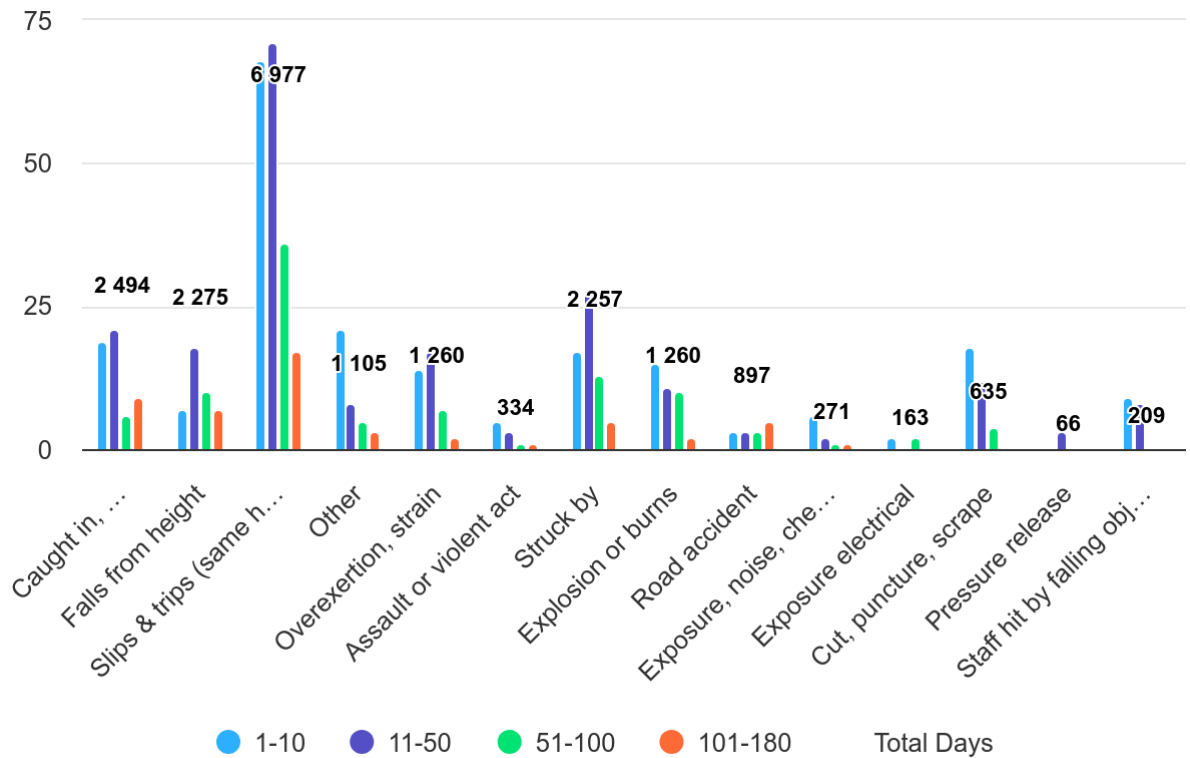
**Figure 1C** Mean number of days absent from work per LWI by sector (MF = Manufacturing; MK = Marketing; OS = Own Staff; CT = Contractors)



**Figure 1D** Mean number of days absent from work per LWI by incident category



**Figure 1E** Distribution of number of days absent from work per LWI by Incident Category (days absence grouped 1-10 days, 11-50 day, 51-100 days and 101-180 days per LWI). Values above bars indicate total number of days absence reported for all incidents in each incident category



Concawe collected causal factors where available for each LWI, see Figure 1f and Appendix 3. A new set of causal factors with revised definitions was introduced in 2023 (see Appendix 1) in an attempt to understand more about the causes of incidents. The causal factor "human factors" has been widely reported, but this rarely informs the root cause of the incident and it is possible that Member Companies have different definitions of human factors. Causal factors are still described in alignment with API RP 754 (2021) and multiple factors may be recorded per LWI.

Causal factors were not available for 11% of LWI (70 LWI) in 2023 (higher than in 2022 when 8% 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 risk assessment and associated action management (20% of causal factors reported), knowledge and skills (17%), procedures (11%), design (8%) and safe system of work (8%). Twenty-two percent of LWI causal factors were reported as other (used to specify where an incident cannot be logically classed under any other category).

In both Manufacturing and Marketing, reporting of causal factors was very similar. Both sectors reported most frequently risk assessment and associated action management, followed by knowledge and skills, procedures and design.

There was also little difference between the most frequently reported causal factors in some of the most commonly occurring incident categories. Risk assessment and associated action management was the most commonly assigned causal factor in slips & trips; struck by; falls from height and explosion or burns type LWI across Manufacturing and Marketing. Knowledge and skills causal factor was reported most frequently for caught in under and between type incidents. Knowledge and skills; procedures and design were the next most frequently assigned causal factors for the above-mentioned incident categories.

**Figure 1F** Causal factors recorded for all LWI in 2023

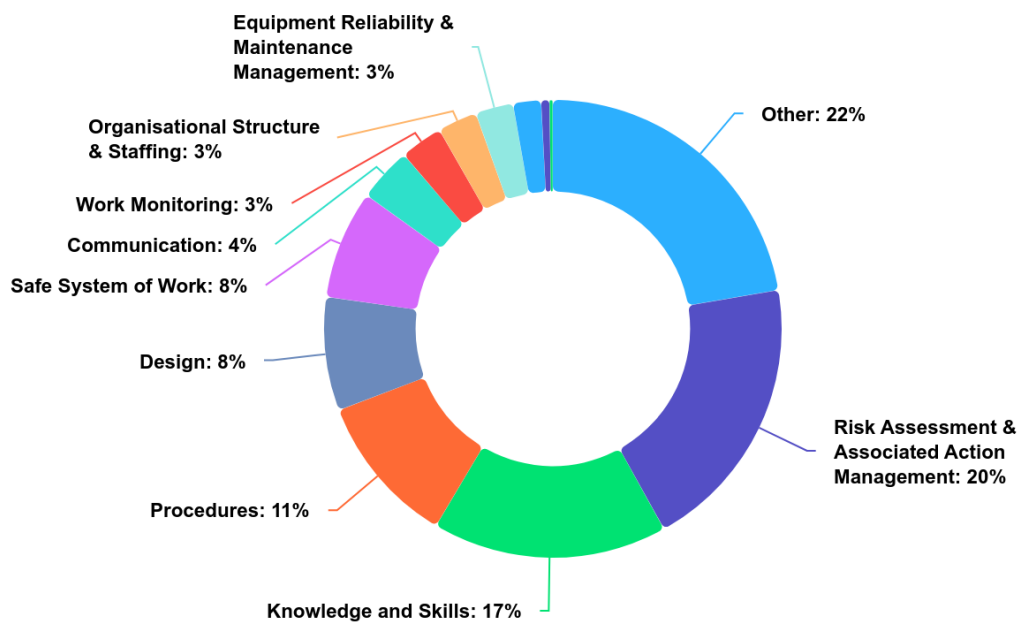


Table 5 shows the LWI frequency statistics broken down into quartiles. This demonstrates a wide range of variability in performance between the top performing Member Companies (Quartile 1 - Q1) and the bottom performing Member Companies (Quartile 4 - Q4).

**Table 5A** 2023 LWIF quartile distribution ranges and average values for each quartile range

LWIF	Quartiles														
	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	0.60	0.20	0.00	0.00	0.00	0.00	0.58	0.15	0.00	0.38	0.09	0.00	0.63	0.31
Q2	0.61	1.39	0.99	0.19	0.73	0.54	0.59	1.33	0.92	0.41	0.95	0.68	0.66	1.22	0.95
Q3	1.75	3.55	2.46	0.80	1.09	0.92	1.33	4.09	2.43	0.99	3.98	1.94	1.30	3.39	1.95
Q4	3.94	11.13	5.68	1.19	12.05	4.25	4.65	14.06	6.91	4.72	10.49	0.09	3.94	11.13	5.66

**Table 5B** 2023 LWIF quartile distribution by staff type: ranges and average values for each quartile range

LWIF	Quartiles											
	Manufacturing Staff			Manufacturing Contractors			Marketing Staff			Marketing Contractors		
	Low	High	Average	Low	High	Average	Low	High	Average	Low	High	Average
Q1	0.00	0.15	0.01	0.00	0.28	0.05	0.00	0.00	0.00	0.00	0.37	0.11
Q2	0.55	1.54	1.09	0.34	1.11	0.65	0.00	0.23	0.04	0.58	1.02	0.74
Q3	1.75	4.65	2.70	1.14	3.98	1.89	0.28	0.85	0.58	1.13	1.53	1.34
Q4	4.68	14.06	7.21	4.72	10.49	6.75	0.87	3.47	1.64	2.48	32.26	12.47

The quartile distribution ranges and average values for each quartile for the 2023 All Injury Frequency (AIF) are shown in Table 6. The average performance indicator figures for the industry represent a wide range of individual values between reporting companies.

**Table 6A** 2023 AIF quartile distribution by sector: ranges and average values for each quartile range

AIF	Quartiles														
	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	1.50	0.76	0.00	0.00	0.00	0.00	1.00	0.51	0.00	0.95	0.48	0.00	1.20	0.71
Q2	1.84	3.39	2.35	0.25	0.87	0.61	1.06	2.32	1.64	1.07	2.87	1.74	1.20	2.71	2.01
Q3	3.58	6.50	5.01	0.92	1.54	1.16	3.02	5.88	4.74	3.07	7.36	4.94	2.81	6.13	4.29
Q4	6.52	25.30	12.25	1.59	12.05	4.52	6.47	35.67	13.91	7.46	27.64	0.48	6.24	25.30	12.23

**Table 6B** 2023 AIF quartile distribution by staff type: ranges and average values for each quartile range

AIF	Quartiles											
	Manufacturing Staff			Manufacturing Contractors			Marketing Staff			Marketing Contractors		
	Low	High	Average	Low	High	Average	Low	High	Average	Low	High	Average
Q1	0.00	1.16	0.48	0.00	1.38	0.55	0.00	0.00	0.00	0.00	0.37	0.13
Q2	1.38	3.02	2.00	1.40	3.07	1.98	0.00	0.28	0.05	0.66	1.02	0.82
Q3	3.66	7.15	5.06	3.21	7.56	5.15	0.30	1.11	0.68	1.42	2.10	1.77
Q4	7.24	35.67	14.58	8.51	27.64	13.89	1.12	5.83	2.35	2.48	32.26	12.47

### 2.3. PERFORMANCE TRENDS IN THE LAST 10 YEARS - 2014 TO 2023

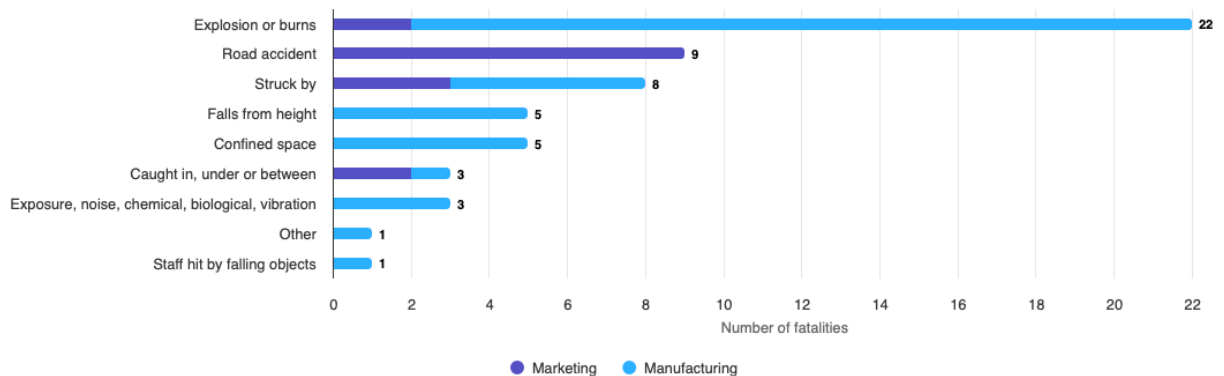
Performance indicators are particularly useful for identifying trends and patterns when considered over time. The historical trends for the European downstream oil industry over the past ten years are summarised in this section. Ten years has been chosen as a period reasonably representative of actual 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 2014-2023

Fatalities over 10 years by sector			
Year	Manufacturing	Marketing	Total
2014	6	1	7
2015	4	3	7
2016	2	0	2
2017	1	1	2
2018	7	3	10
2019	3	0	3
2020	1	1	2
2021	5	1	6
2022	6	5	11
2023	6	1	7
<b>Total</b>	<b>41</b>	<b>16</b>	<b>57</b>

The total number of fatalities in 2023 (seven) is the second highest number of annual fatalities recorded in the last 5 years. Continuous focus on understanding causal factors and putting in place clearly defined preventative actions and mitigative are required to achieve and sustain our objective of zero fatalities in both Manufacturing and Marketing.

**Figure 2** Number of fatalities by category 2014-2023



In the last 10 years there have been 57 fatalities, of which 22 ‘explosions or burns’ type fatalities, 9 road accident fatalities and 8 fatalities following ‘struck by’ incidents have been the largest contributors to fatalities in the industry. Together, these three categories account for 68% of the fatalities experienced in the industry since 2014.

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.

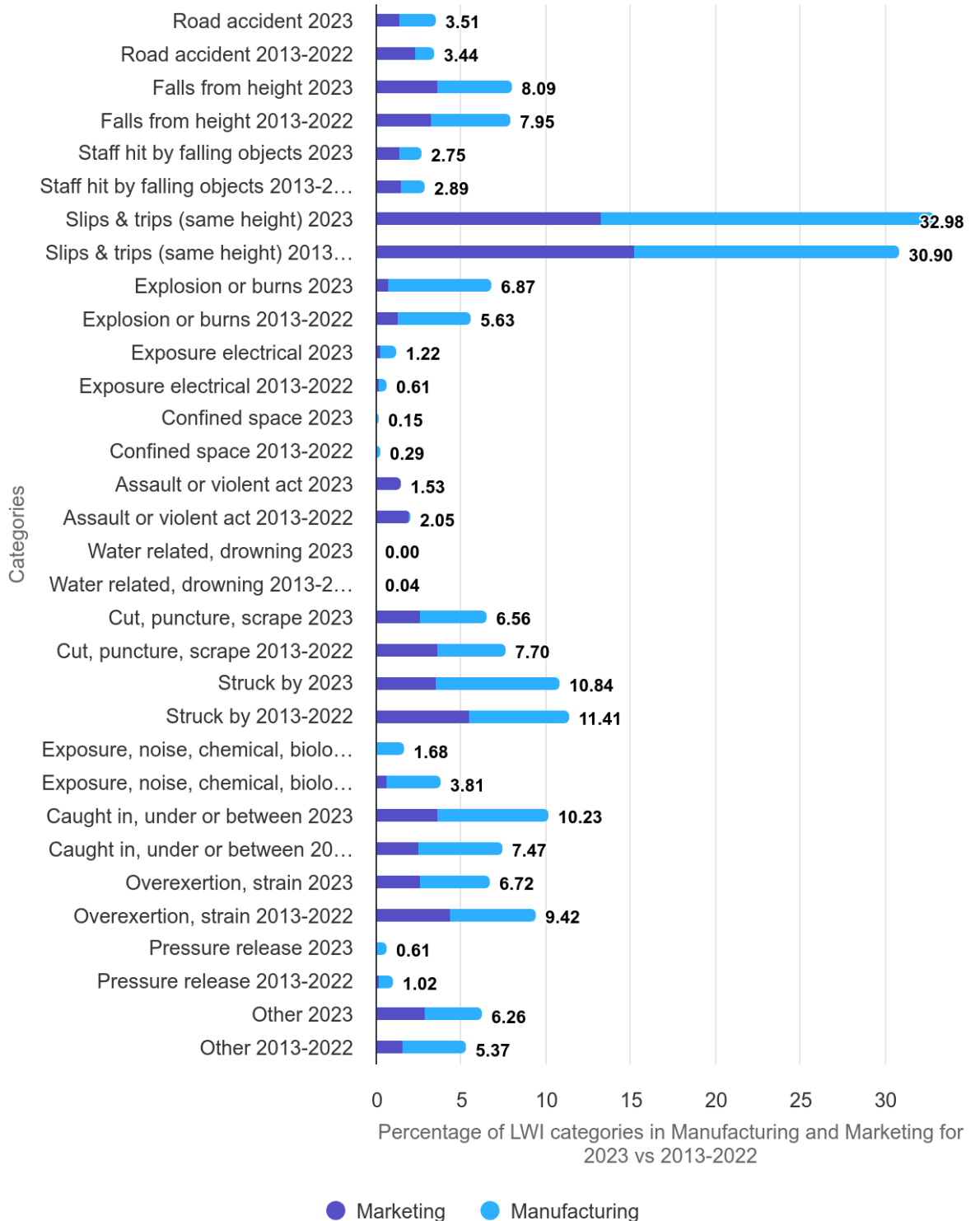
Explosion or burns and road accidents are the most prevalent fatal incident categories recorded in the period 2009-2018. Road accidents have declined as an overall percentage of all fatalities compared to 1998-2008 when they represented almost half of all fatalities. This could be because of an increase in focus on Road Safety and the introduction of in-vehicle technology to help drivers.

Falls from height, confined space, caught in, under or between and exposure noise, chemical, biological, vibration categorised incidents are the next most prevalent, accounting for more than one quarter of fatalities since 2014.

The 2014-2023 reported fatalities in each of the sectors (**Appendix Tables A2-2 to A2-5**), indicate the higher prevalence of Contractor fatalities (27 fatalities in Manufacturing and 15 in Marketing) than own Staff (14 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** Percentage of LWI by incident category in Manufacturing and Marketing in 2023 compared with period 2013-2022



Since Concawe began collecting LWI data against the 16 categories in 2013 a pattern has been emerging. As in fatalities, a limited number of incident categories contribute to most LWI.

In 2023, 82% of LWI across Manufacturing and Marketing were as a result of the following:

- slips & trips (same height) 33.0% (30.9% in 2013-2022)
- struck by 10.8% (11.4% in 2013-2022)
- caught in, under or between 10.2% (7.5% in 2013-2022)
- falls from height 8.1% (8.0% in 2013-2022)
- explosion and burns 6.9% (5.6 % in 2013-2022)
- cut, puncture, scrape 6.6% (7.7% in 2013-2022)
- overexertion, strain 6.7% (9.4% in 2013-2022)

2023 saw the largest increases in LWI across Manufacturing and Marketing together for the categories of slips and trips (difference of 2.1% compared with 2013-2022 average reported annual figures) and caught in, under or between (2.8% difference) see Figure 3. The proportion of recorded LWI is generally similar in 2023 and 2013-2022 for Manufacturing and Marketing sectors. The largest change in the proportion of LWI attribution in Manufacturing is a 4.0% difference (increase) in the proportion of slips and trips category incidents in 2023 compared with 2013-2022. In Marketing the largest shift in LWI attribution is a 2.0% difference (reduction) in the proportion of struck by incidents.

Concawe started collecting information about LWI categories split between staff and contractors for the first time in 2018.

For the most frequent LWI category, slips & trips, the staff / contractor split in 2023 is 56 / 44 %, slightly less evenly distributed than in 2022 (54 / 46%)

The main causal factor attributed to 216 slips & trips incidents in 2023 was Risk Assessment & Associated Action Management (attributed to 27% of LWI%). For own staff slips and trips, Risk Assessment & Associated Action Management was associated with 22% of incidents and for contractors this figure is 33%.

The next most frequent LWI category is struck by with a staff / contractor split of 38 / 62% (37 / 63% in 2022) and caught in, under or between with a staff / contractor split of 52 / 48% in 2023 (33 / 67 % in 2022)

The LWI categories with the greatest difference between staff and contractors in 2023 are staff hit by falling object (11 / 89%) and exposure electrical (25 / 75%).

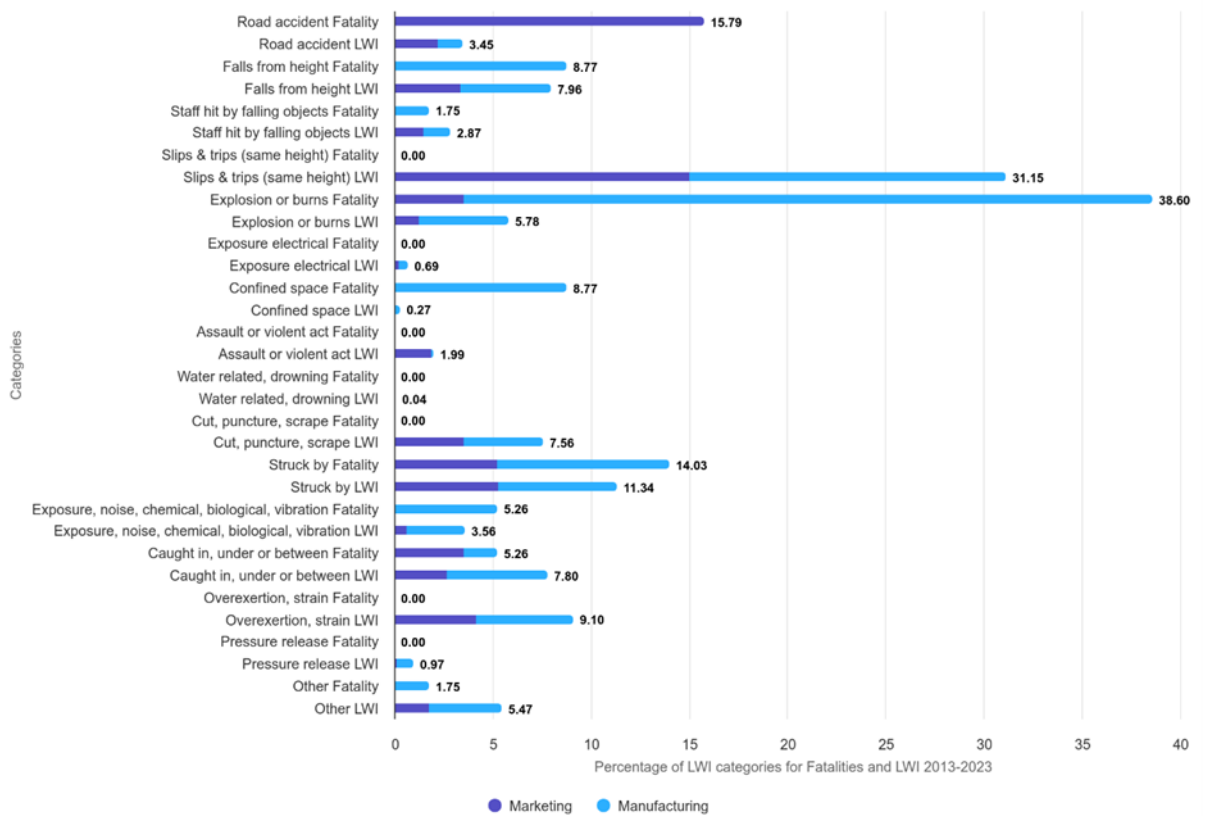
There were more reported contractors LWI than own staff LWI in 2023 for the following incident categories: road accident, falls from height, staff hit by falling object, exposure electrical, assault or violent act, cut, puncture, scrape, struck by, exposure, noise, chemical, biological, vibration and overexertion, strain.

No direct correlation is observed between categories of LWI and fatalities in the period 2014 - 2023 (Figure 4a and Figure 4b). Incidents in the categories explosion or burns, road accident and confined space incidents have a high potential to result in a fatality. Focus on reducing LWI in the following areas may have the potential to address the causes of 57 fatalities recorded since 2014.



- Process Safety to address explosion or burns related incidents
- Operational safety focused on working at height
- Actions to prevent incidents in the category struck by road accidents

**Figure 4a** LWI and Fatalities 2014-2023 by Incident Category (percentage)



**Figure 4b** Total number of LWI and Fatalities 2014-2023 by Common Incident Category

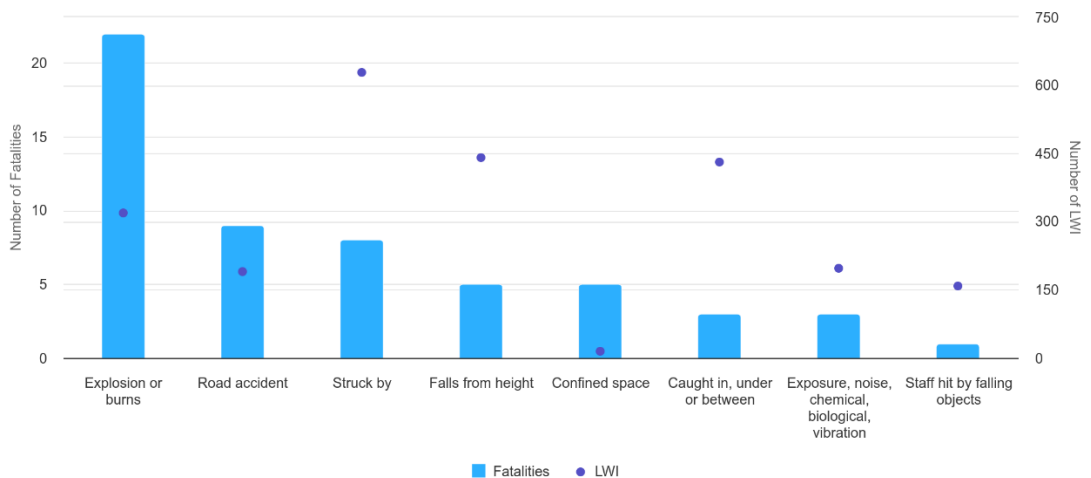
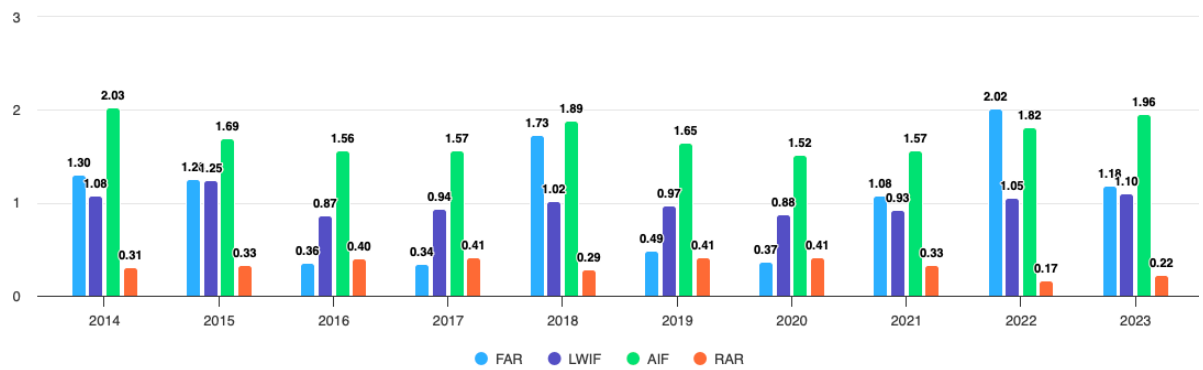


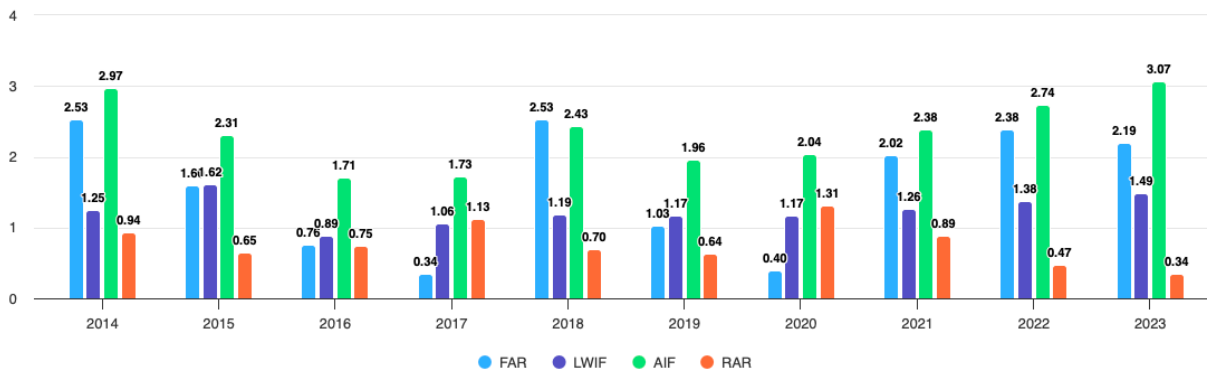
Figure 5A shows the historical evolution of the main personal safety performance indicators over the past ten years across all workers. With five fatal incidents (with 7 casualties) in 2023, the Fatal Accident Rate (FAR) across all sectors is 1.18 in 2023, lower than 2.02 recorded in

2022. The LWIF of 1.10 in 2023 is the highest since 2015 (when it was 1.25) and represents a steady rise in LWIF since 2020. Similarly, the All Injury Frequency AIF of 2023 at 1.96 is the highest since 2014 (when it was 2.03). The Road Accident Rate RAR in 2023 is 0.22, slightly higher than the lowest recorded (0.17 in 2022). The total recorded distance driven in 2023 (840 million km) is 54% higher than in 2022 (see Table A2-1). Figures 5B and 5C show the same data split for Manufacturing and Marketing, respectively.

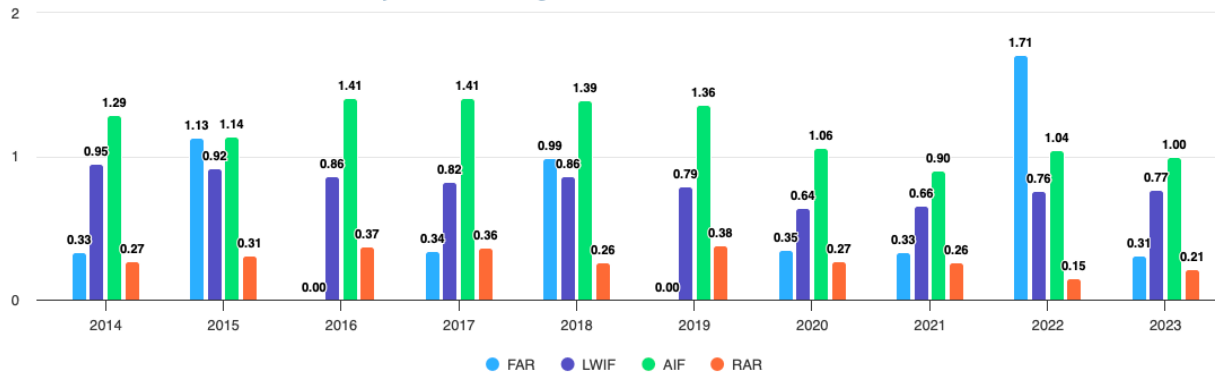
**Figure 5A** Performance indicators over the last ten years for the European downstream oil industry (FAR fatalities per 100 million hours; LWIF and AIF incidents per 1 million hours; RAR road accidents per 1 million km)



**Figure 5B** Performance indicators over the last ten years for Manufacturing (FAR fatalities per 100 million hours; LWIF and AIF incidents per 1 million hours; RAR road accidents per 1 million km)

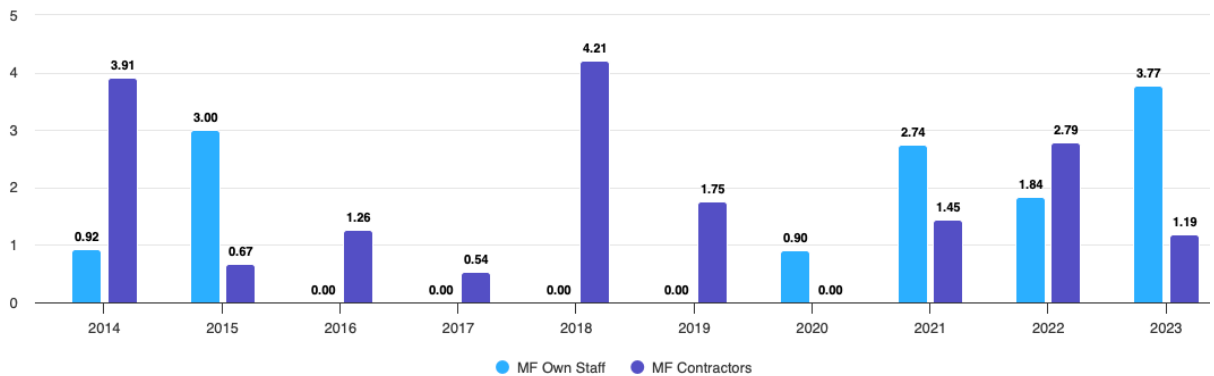


**Figure 5C** Performance indicators over the last ten years for Marketing. (FAR fatalities per 100 million hours; LWIF and AIF incidents per 1 million hours; RAR road accidents per 1 million km)



Figures 6A and 6B show the Fatal Accident Rate FAR for own staff versus contractors 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 ten years. In particular, Marketing FAR in 2022 (1.71) associated with five contractor fatalities (three road accidents and two explosion or burns categorised incidents) was the highest recorded in this period. (Further effort is required to reduce staff and contractor fatalities to zero.)

**Figure 6A** Manufacturing Fatal Accident Rate (number of fatalities per 100 million hours worked) in the last ten years



**Figure 6B** Marketing Fatal Accident Rate (number of fatalities per 100 million hours worked) in the last 10 years

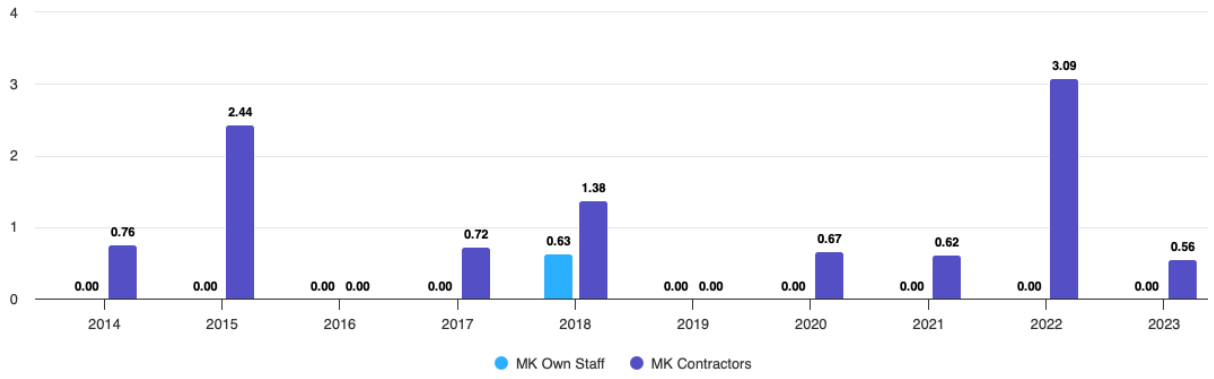
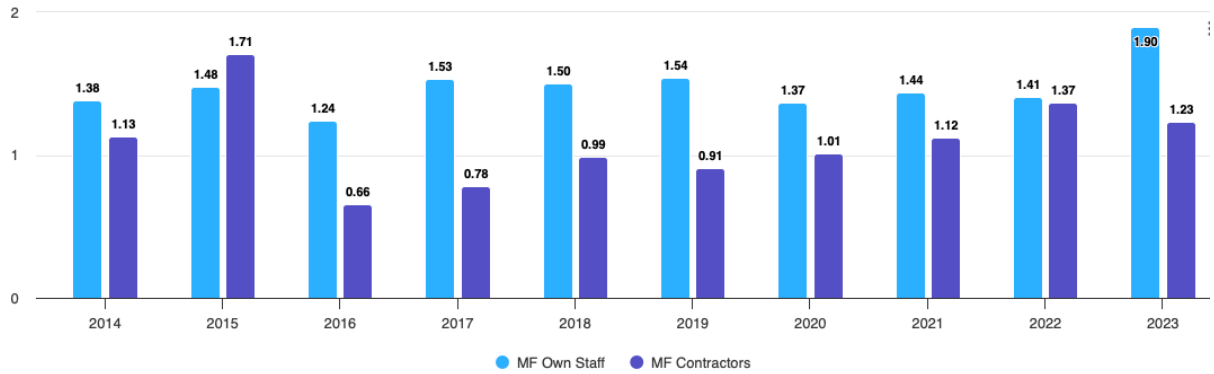


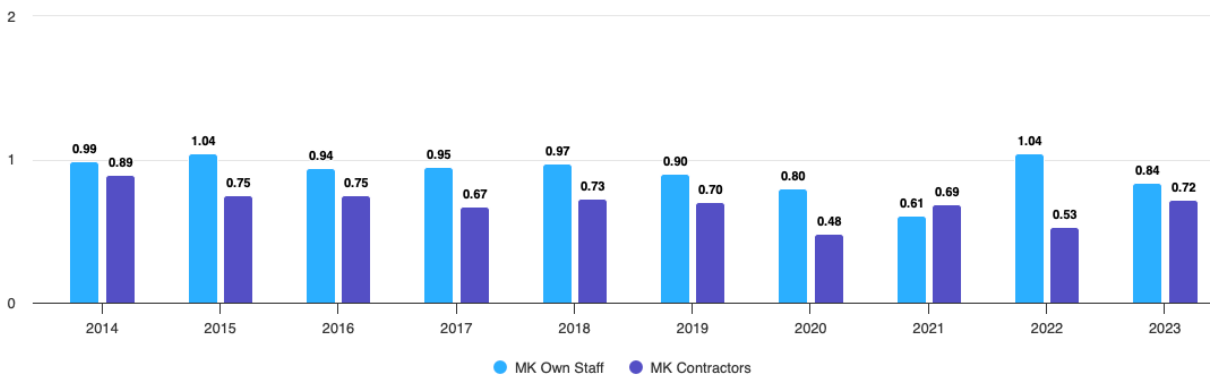
Figure 7A shows Manufacturing own staff LWIF in 2023 at 1.90, the highest recorded in the last ten years. Manufacturing contractor LWIF has been lower than of Manufacturing own staff since 2016.

Figure 7A Manufacturing LWIF in the last ten years



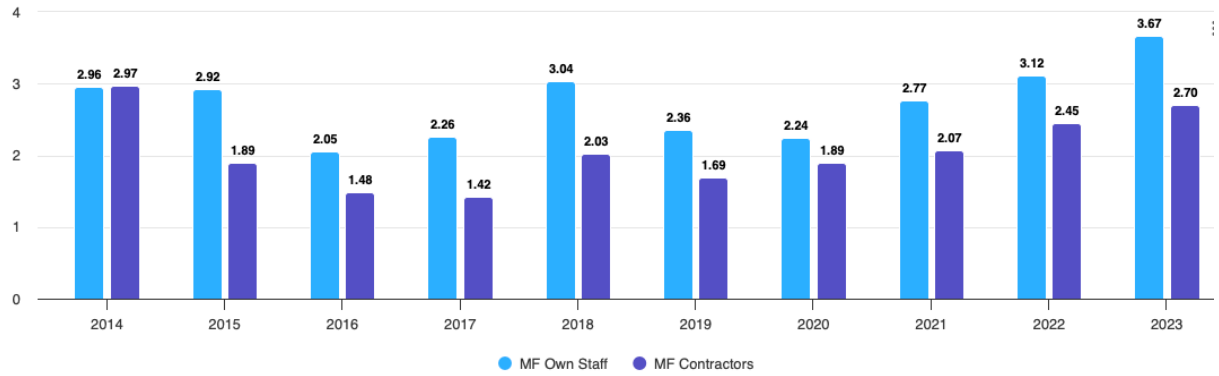
In 2023, Marketing own staff had an LWIF of 0.84 a reduction from 1.04 in 2022. Marketing contractors LWIF increased in 2023 to 0.72 from 0.53 in 2022 and is currently the highest since 2018 (see Figure 7B and Appendix 2 Table A2-4).

Figure 7B Marketing LWIF in the last ten years



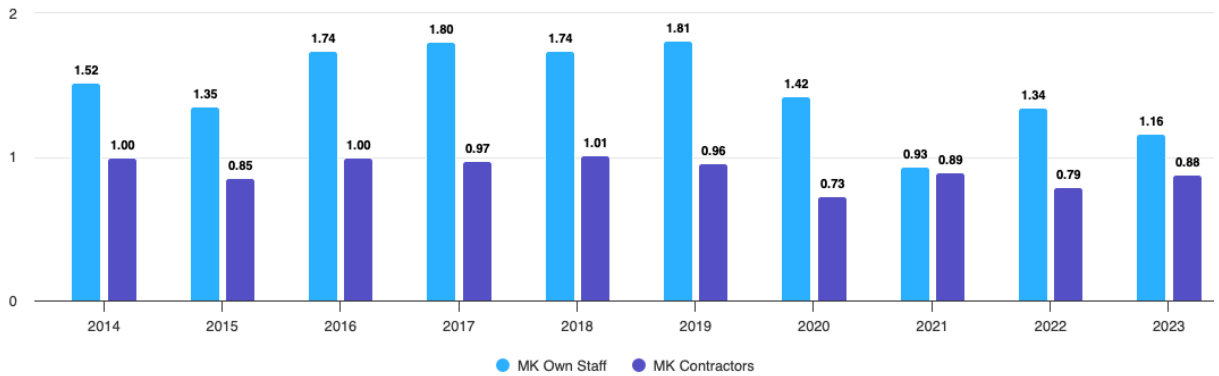
Historical figures (see Appendix 2) suggest that AIF peaked around 1995-97 but this was considered at the time likely the result of improved reporting standards. The downward trend in recorded Manufacturing AIF since 2010 ended in 2016 for staff and in 2017 for contractors. Since then, own staff and contractor AIF in Manufacturing have steadily increased in recent years to 3.67 (the highest in the last 10 years) and 2.70 (the highest in the last 10 years), respectively in 2023 (Figure 8A).

**Figure 8A** Manufacturing All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) in the last ten years



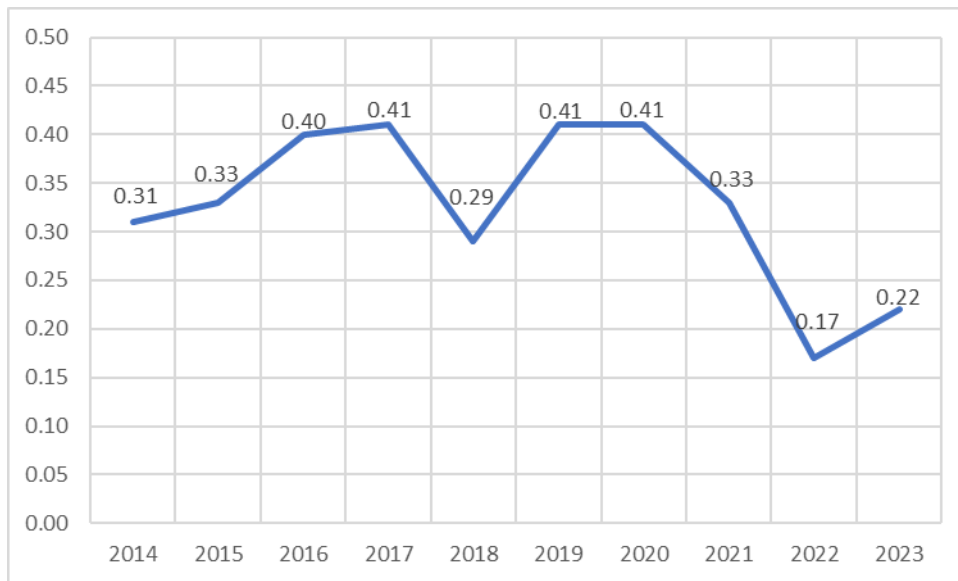
Marketing own staff AIF in 2023 at 1.16 represents a decrease since 2022 but is still within the range recorded in the last 10 years. For Marketing contractors with an AIF at 0.88 in 2023, this is a slight increase since 2022 (0.79) and within the range of the past 10 years (0.73-1.01), see Figure 8B and Appendix 2 Tables A2-4 and A2-5.

**Figure 8B** Marketing All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) in the last ten years



There was a slight reduction in the number of road accidents (197 in 2023 compared with 205 in 2022) and a 54% increase in kilometres driven in 2023 (840 million km in 2023 compared with 546 million km in 2022), the Road Accident Rate in 2023 increased from 0.17 in 2022 to 0.22 in 2023. Road safety has been a major focus for the industry and a sustained effort is required in order to improve performance. Road accidents mainly occur in the Marketing activity where the bulk of the driving takes place (Manufacturing 8% and Marketing 92% of total driving distance reported in 2023).

**Figure 9** Road Accident Rate (RAR) in the last ten years - European downstream oil industry (RAR number of road accidents per 1 million km)



### 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 [30, 31]. 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 754 in 2008 [30] and as further refined in the ANSI/API recommended practice that was published in 2010 [31] and the third edition released in 2022 [37]. The PSPI-data that were requested are the number of Tier 1 and 2 Process Safety Events (PSE). Concawe does not explicitly instruct Member Companies as to which material hazard classification option should be used when determining PSE Tier 1/2. The Concawe definitions slightly differ from those in the 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 [32] as an alternative for classifying the PSE. In 2017, Concawe moved to reporting in line with the revised definitions of the second edition of the API Recommended Practice 754 (2016) [35] that was followed by the third edition in 2022 [37].

More detailed consequence related Tier 1 data was collected for the first time in 2023 based on the API 754 consequence classifications.

In 2023, 41 companies and joint ventures submitted PSE data for the Manufacturing operations, two more than in 2022 and 23 companies submitted Marketing PSE data, one more than last year.

The aggregated 2023 results per sector and for the whole of the European downstream oil industry are shown in Table 8.

**Table 8** Aggregated 2023 Process Safety (PS) results for all reporting companies

Sector	Manufacturing	Marketing	Both Sectors
Companies - Total	42	27	27
- PS Reporting	41	23	23
- % of companies	98	85	85
Hours worked Mh	274.1	318.8	592.9
- PS Reporting	273.3	282.7	556.0
- %	100	89	94
T-1 PSE	74	5	79
T-2 PSE	126	19	145
T-1 PSER PSI/Mh reported	0.27	0.02	0.14
T-2 PSER PSI/Mh reported	0.46	0.07	0.26
Total PSER PSI/Mh reported	0.73	0.08	0.40

Of the 23 companies that reported Process Safety Events across both Manufacturing and Marketing in 2023, six companies reported zero Tier 1 events, 6 companies reported zero Tier 2 events and four 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 by just under 4% in 2023 from 208 in 2022 to 200 in 2023, see Figure 15. The ratio of Tier 1 to Tier 2 Manufacturing process safety events in 2023 is 0.59 (74 Tier 1 and 126 Tier 2). This is higher than the 2022 ratio of 0.41 (61 Tier 1 and 147 Tier 2) but remains in the range of ratios recorded since 2017 (0.29-0.64). The Manufacturing Tier 1 PSE



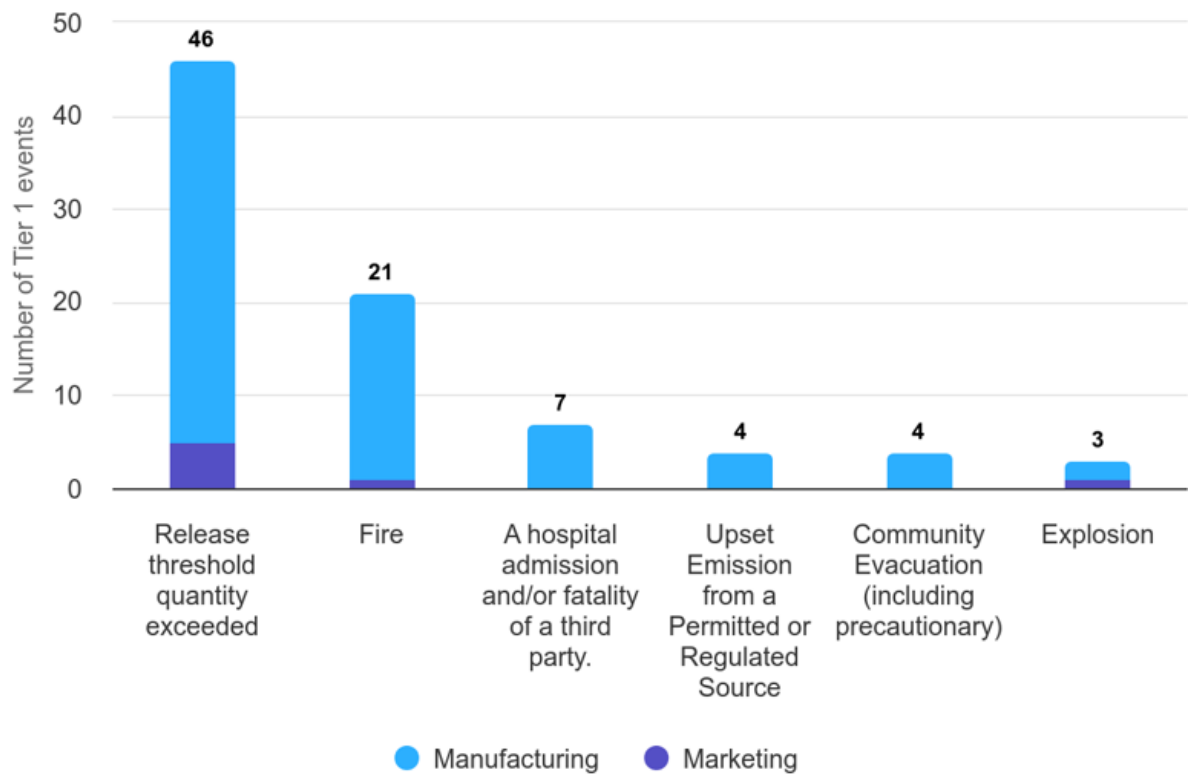
rate (PSER - number of Tier 1 process safety events per million hours reported) in 2023 was 0.27. This is slightly higher than that recorded in 2022 (0.24) but well within the range recorded over the last 10 years, see Figure 17. The Manufacturing Tier 2 PSER was lower in 2023 at 0.46, compared with 0.58 in 2022. Lower Manufacturing Tier 2 PSER have been recorded (0.30 in 2019 and 0.40 in 2018).

The number of Tier 1 PSEs resulting in LWI or fatality was reported for the first time in 2019. In 2023, 16 Manufacturing Tier 1 events (and zero Marketing Tier 1 events) equal to 20% of Tier 1 events, were associated with three Manufacturing fatalities in the incident categories of exposure, noise, chemical, biological, vibration (2), and explosion or burns (1) and 14 LWI. This is an increase in number of Tier 1 PSE related-injuries compared with 2022 when 12 Manufacturing Tier 1 events were associated with 12 LWI and two fatalities.

The Tier 1 incident leading to the multiple injured persons (one fatality and one LWI, both manufacturing contractors) was reported as an explosion and burn categorized incident (still under investigation). Of the remaining 13 LWI associated with Manufacturing Tier 1 events, most were explosion or burns categorised incidents (seven manufacturing staff and 3 manufacturing contractors). Two LWI were categorised as slips or trips and one as explosion or burns. “Procedures” was the most commonly assigned causal factor (11 assignments) for these Tier 1 events leading to LWI. “Risk assessment” (assigned to 7 Tier 1 events), “design” (6 events), “knowledge and skills” (6 events), “communication” (5 events) and “safe system of work” (5 events) were the next most frequently assigned causal factors. As in previous years, no Tier 2 PSE were reported to be associated with RWI or MTC in 2023.

For the first time in 2023, Concawe collected information about the consequences of the 74 Manufacturing and 5 Marketing Tier 1 process safety events. No consequence was recorded for 10 Manufacturing and 0 Marketing Tier 1 PSE. The most commonly recorded consequence of Manufacturing Tier 1 was release threshold quantity released (46 Tier 1 PSE), see Figure 10.

**Figure 10.** Consequences of Tier 1 process safety events

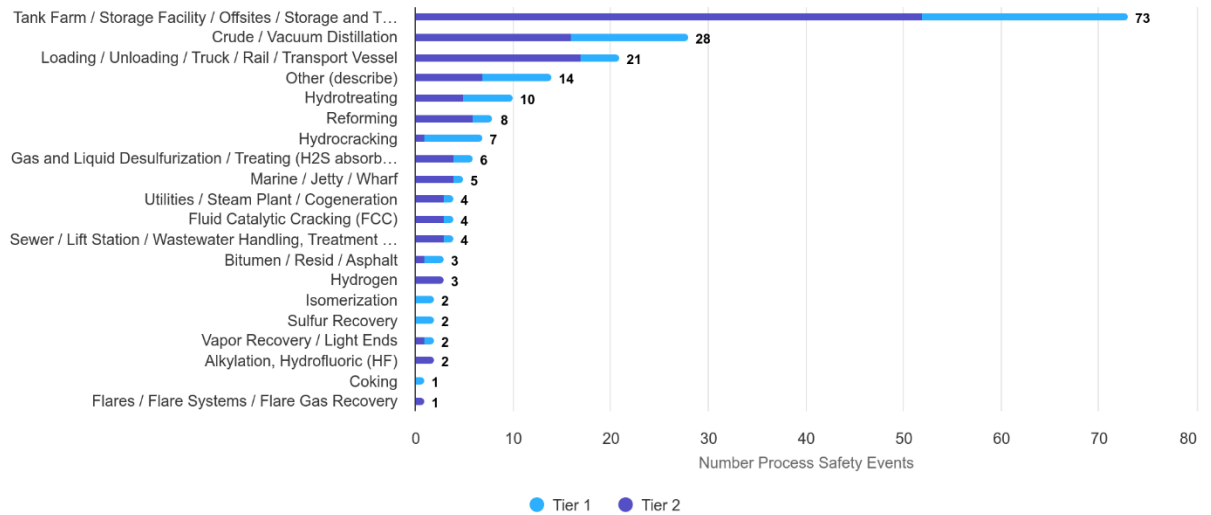


Of the four Tier 1 process safety events recorded as “upset emission from a permitted or regulated source” two events had the further consequence of “on-site shelter-in-place or on-site non-precautionary evacuation”, one had the further consequence of “Public measures (including precautionary)” and one had no further consequence reported.

Information for the combined Tier 1 and Tier 2 PSE across Manufacturing and Marketing in 2023 are provided in table form in Appendix 4. The following comments relate to the notable responses within each category.

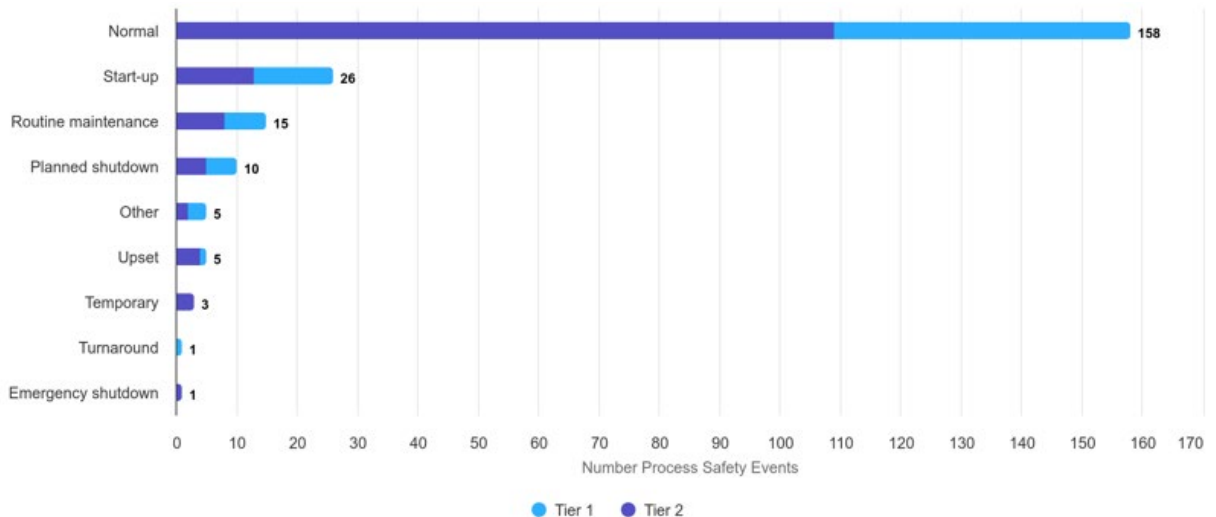
Type of Process: Process Safety Events in 2023 most frequently occurred in storage facilities or transfer piping (37% of all Process Safety Events, 30% of Tier 1 PSE and 40% of Tier 2 PSE), see Figure 11 and Table A4-1. This finding is in alignment with recorded PSE since 2017. Note that 10 PSE Tier 1 and 16 Tier 2 PSE attributed to petrochemical processes are not included in Figure 11 as this refers to refining processes only.

**Figure 11** Number of Tier 1 and 2 Process Safety Events (Manufacturing and Marketing) reported in 2023 by Refining Process



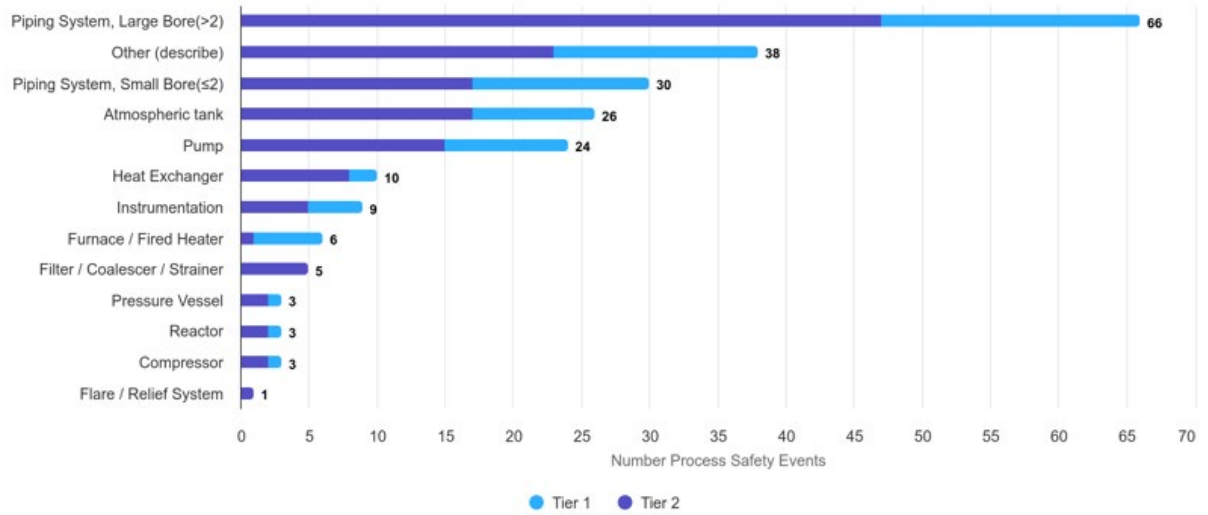
Mode of Operation: Seventy-one percent of Process Safety Events occurred during normal operation, see Figure 12 and Table A4-3. For Tier 1 events, 62% occurred during normal operation and 75% of Tier 2 events occurred during normal operation. The overall percentage is within the range recorded since 2017 (66-78%).

**Figure 12** Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2023 by mode of operation



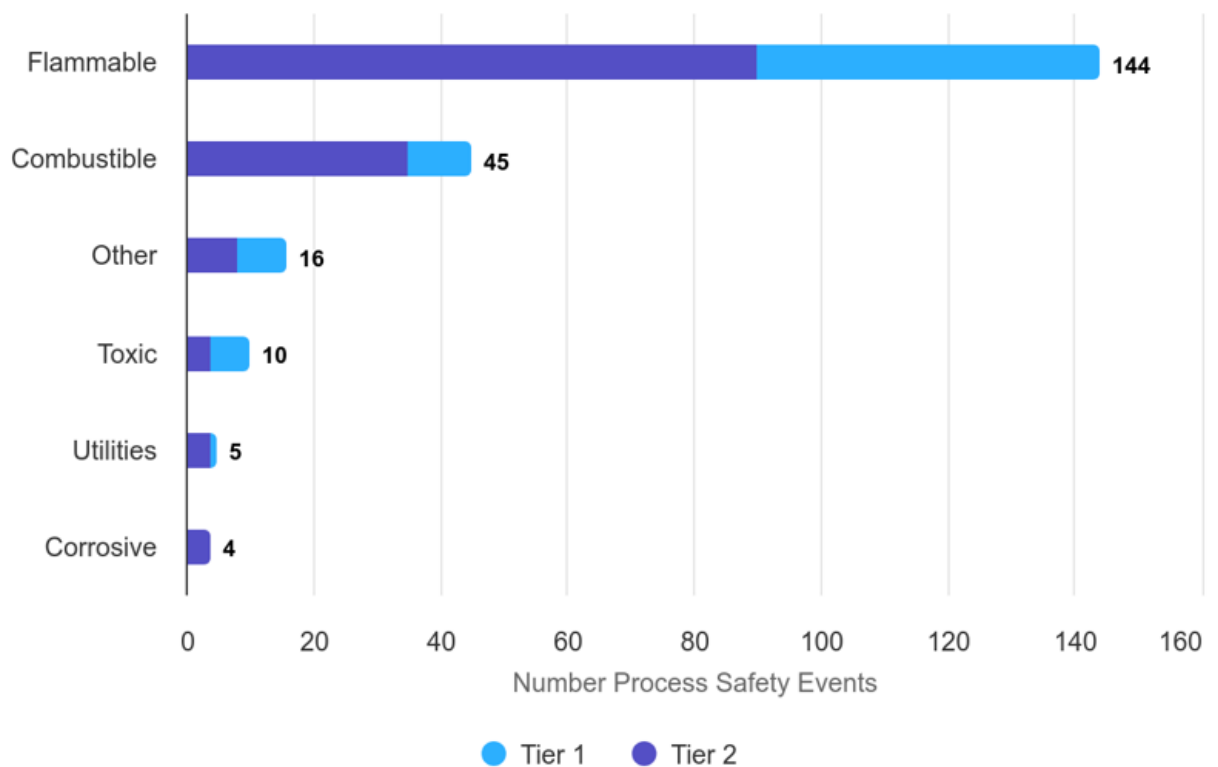
Point of Release: As in previous years, large bore piping remained the main point of release for Process Safety Events (29% of all PSE in 2023, 24% of Tier 1 and 32% of Tier 2 events), see Figure 13 and Table A4-4.

**Figure 13** Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2023 by point of release



Type of material: Figure 14 and Table A4-5 indicate that flammable material was most frequently released in Process Safety Events in 2023 (64% of all PSE, 68% of Tier 1 and 62% of Tier 2 events). Again, this aligns with data from previous years. The proportion of total PSE that are reported as flammable material released has been 64% each year since 2020.

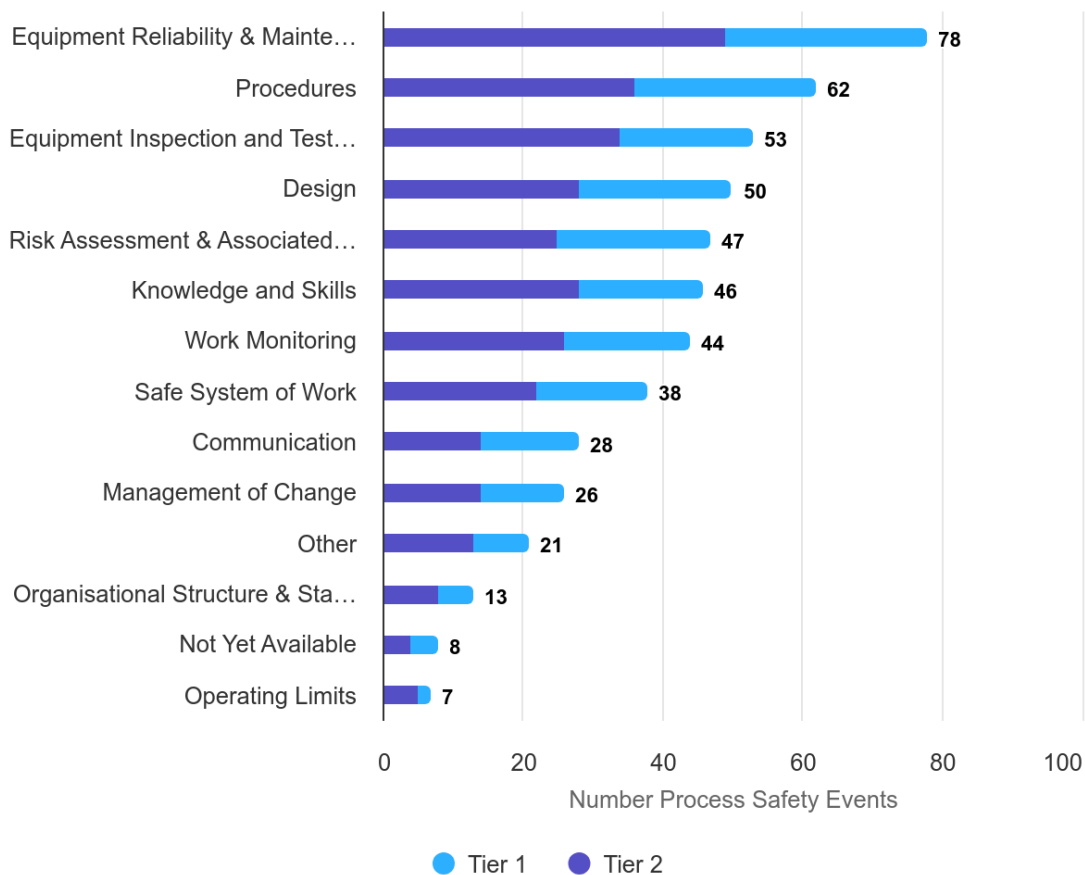
**Figure 14** Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2023 by type of material released



Causal Factors: Equipment Reliability & Maintenance Management (allocated to 35% of events), Procedures (28%) and Equipment Inspection and Testing (23%) are the most frequently cited causal factors across all Process Safety Events in 2023, see Figure 15 and Table A4-6. For

Tier 1 PSE the most frequently cited causal factors are Equipment Reliability & Maintenance Management (37%), Procedures (33%) and Risk Assessment & Associated Action Management (28%). Equipment Reliability was cited most frequently as a causal factor of Tier 2 PSE (allocated to 34% of Tier 2 PSE), Procedures (25%) and Equipment Inspection and Testing (23%) were also cited.

**Figure 15** Number of Tier 1 and Tier 2 Process Safety Events (Manufacturing and Marketing) reported in 2023 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 events are investigated in detail within Member Companies and considerable effort is expended in identifying root causes and responding accordingly. As with fatalities and LWI 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 Member Companies now look to Tier 3 process safety events for their site-based improvement activity. The definition of a Tier 3 event 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

Total PSE			
PSE	Low	High	Average
Q1	0	1	0.2
Q2	1	4	2.2
Q3	4	11	6.6
Q4	12	22	15.8

**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	4	2.2
Q3	4	10	6.0
Q4	10	19	13.6

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

Total PSER			
PSE	Low	High	Average
Q1	0.00	0.15	0.02
Q2	0.17	0.37	0.28
Q3	0.56	1.13	0.79
Q4	1.20	3.06	2.13

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

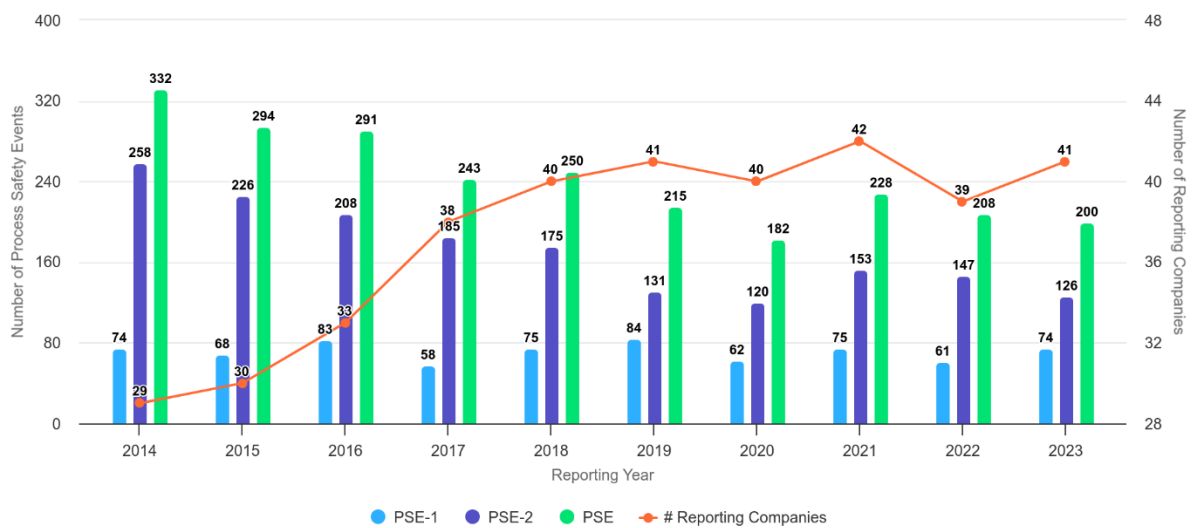
Manufacturing PSER			
PSE	Low	High	Average
Q1	0.00	0.20	0.02
Q2	0.26	0.64	0.46
Q3	0.71	1.22	0.93
Q4	1.66	3.06	2.42

**Table 12B** Marketing PSER quartile distribution ranges and average values for each quartile range

Marketing PSER			
PSE	Low	High	Average
Q1	0.00	0.00	0.00
Q2	0.00	0.00	0.00
Q3	0.00	0.14	0.07
Q4	0.16	0.60	0.29

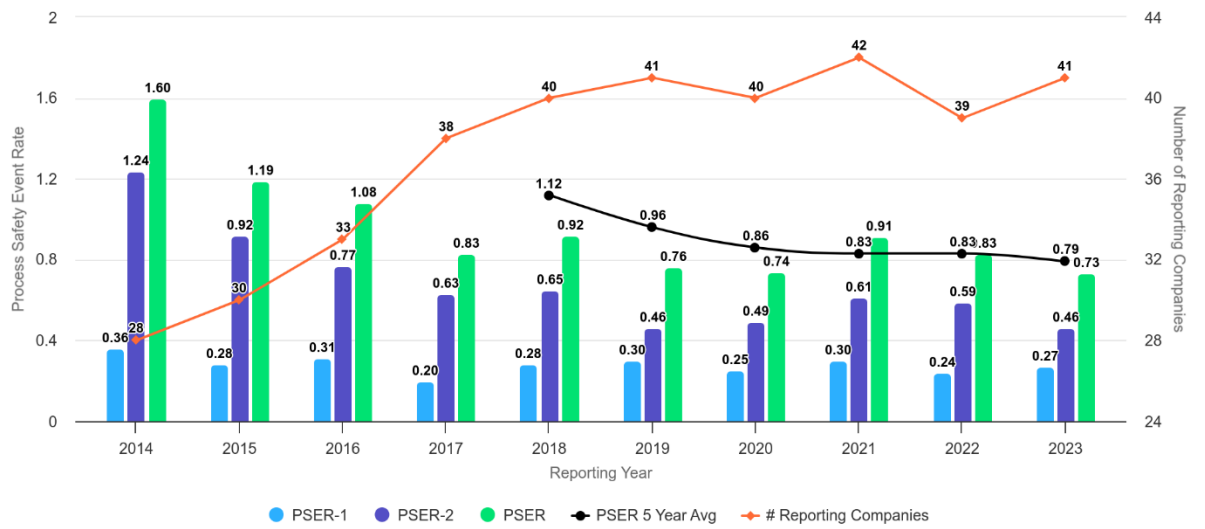
Figure 16 shows counts of the total reported Manufacturing PSE for the period 2014 to 2023. Figure 17 shows the same data expressed as rates. The data given are for Manufacturing, as only that data is sufficiently robust to allow the analysis provided in these presentations.

**Figure 16** Manufacturing Process Safety Events in the last ten years



The number of companies reporting Manufacturing PSE (41) is higher than in 2022 (39). The total number of Manufacturing Tier 1 and Tier 2 events has decreased over the last two years and in 2023 is now 200.

**Figure 17** Manufacturing Process Safety Event Rate in the last ten years



2023 saw a slight reduction in the 5-year rolling average of Manufacturing PSER and in 2023 it stands at the lowest value of 0.73.



#### 4. COMPARISON WITH OTHER SECTORS

Most of the safety performance indicators used in the oil industry have also been adopted in many other sectors so that meaningful comparisons are possible, see **Table 13**. The IOGP statistics cover the oil and gas exploration and production activities of participating IOGP Member Companies [32]. In comparison with IOGP statistics for European onshore, Concawe recorded a 1.18 fatality rate, a 1.12 LTIF and 1.96 AIF. These Concawe rates include marketing activities, which are typically not represented in the IOGP data.

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

	Concawe 2023			International Association of Oil & Gas Producers IOGP 2023	
	Overall	Own staff	Contractors	Europe Onshore	Europe Onshore & Offshore
FAR	1.18	1.63	0.86	0	0
LTIF	1.12	1.31	0.98	0.50	0.68
AIF*	1.96	2.24	1.76	1.00	1.67

FAR is per 100 million work hours

LTIF and AIF per million work hours

\*AIF reported as Total Recordable Injury Rate (TRIR) by IOGP (number of recordable injuries (fatalities + LWI + RWI + MTC) per million hours worked

The American Petroleum Institute (API) reports that the rate of job-related nonfatal injuries and illnesses for the US Petroleum Refining sector was 0.6 per 100 full-time workers in 2022 [34]. 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 2022 AIF expressed per 200,000 work hours is 0.39.

The US Refining Tier 1 and 2 PSE rates recorded by API for 2023 are 0.0604 and 0.1500, respectively [36]. The Concawe rates are 0.030 and 0.052 when expressed per 200,000 work hours.

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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) [30, 31]. 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 CO<sub>2</sub>, 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 LWI Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
15. LWIS LWI 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 [18-29] 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 [18-29] for further details
25. Total days lost The number of calendar days lost through LWIs counting from the day after the injury occurred.

### Concawe Incident Categorization 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.
	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<sup>2</sup> 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.

### LWI Frequency (LWIF) and LWI 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, RWI and 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.

<sup>2</sup> 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 LWI 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.

## Concawe causal factors 2023: definitions

### Management of Change

Issues related to the management of change (MOC) process including: identification of a change; identification and risk assessment of hazards associated with the change; timely execution; action item follow-up; stakeholder engagement and review team composition. Includes changes to plant, equipment and processes as well as organisational changes. Includes management of temporary MOCs and their extensions.

### Communication

Issues related to verbal, written or other forms of communication between different parties for example shift handover, maintenance handback, or critical communications related to key controls. Not included in this category are documents such as policies, permanent procedures, standards, or specifications.

### Design

Incorrect or lack of application of codes and standards. Specification, purchase, fabrication, materials, construction or installation not consistent with design. Includes design deficiencies that make operations, maintenance, inspection or emergency response tasks more difficult to complete e.g., poor ergonomic design, poor accessibility, Human-Machine Interface (HMI) Less Than Adequate (LTA), poor layout, signage and labelling LTA.

### Equipment Reliability & Maintenance Management

Maintenance, repair and testing issues including program requirements, program execution and standards applied. This could include: Maintenance Less Than Adequate (LTA), Repair LTA, Testing LTA, Premature Failure due to Defective Parts or Vibration, etc. Includes cases where equipment condition or unavailability influenced the performance of critical tasks.

### Equipment Inspection and Testing

Issues related to equipment inspection and maintenance programs to detect or monitor failure mechanisms, including Safety Critical Equipment (SCE). Includes cases where inspections are not performed in a timely manner (or at all), incorrect technique or location, inadequate frequency, poor record keeping. If no inspection or testing was in place, chose Equipment Reliability.

### Organisational Structure & Staffing

Issues related to the way a facility is staffed in terms of numbers of personnel, team organisation, reporting lines, shift system, roles and responsibilities. Includes issues related to workload, pressure, duty rotas, worker fatigue and impairment due to illness. Note that pressure can be caused by the individual themselves, by a peer or group of peers, a leader, or the organisation.

### Knowledge and Skills

Issues related to personnel not having sufficient understanding of a process, equipment or hazard to manage the risk. Some of the programs included in this category include: worker recruitment/selection, worker training, worker qualification, testing and skill verification. Includes knowledge, skills and experience. This factor also includes extensive knowledge, skills and experience resulting in risk blindness (missing hazards), a lack of focus, autopilot behaviour or disrespect of risk.

### **Operating Limits**

Issues related to the process for establishing, monitoring and deviating from operating limits established to adhere to design requirements, control metallurgical degradation and ensure safe operation. Includes limits not being specified or applied correctly, and lack of process alarms.

### **Procedures**

Issues related to appropriate procedures/documents not being utilized, available, complete, accurate or correctly executed. Procedures included in this category may include operating procedures, maintenance procedures, emergency procedures, security procedures and procedures related to shutdowns, commissioning, start-ups, etc. Includes contractor procedures where appropriate. Not included in this category are safe work procedures such as hot work permitting, confined space entry, hazardous energy isolation, etc. which should be classified under Safe System of Work.

### **Risk Assessment & Associated Action Management**

Issues related to a failure to adequately choose a risk assessment methodology, perform a risk assessment, identify hazards, investigate incidents, apply risk criteria or close action items. Some of the risk assessment processes in this category include: process hazards analysis, reliability-centred maintenance assessments, risk-based inspection analysis, incident investigation, quantitative risk analysis, critical task analysis and safety inspections.

### **Safe System of Work**

Issues related to safe work practices or procedures such as permit to work, hot work permitting, confined space entry, hazardous energy isolation, breaking containment, job safety analysis, blinding practices, lock out/tag out (LOTO) protocols, override management, etc.

### **Work Monitoring**

Issues related to supervision of personnel such as oversight of work and auditing to ensure quality, effective scheduling, establishing priorities or correcting behaviours/enforcing rules. Includes housekeeping.

### **Other**

Causal factor known but not described by any of the above.

### **Not Yet Available**

Investigation not yet complete therefore no known causal factors.

## APPENDIX 2 HISTORICAL DATA 1993 TO 2023

**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	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	420.6	705
1997	15	3.39	11.4	4.57	23	1.9	442	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	1123
2003	22	4.14	6.34	3.22	30	1	531.6	1459
2004	12	2.34	6.28	3.17	33	1	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	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	7	1.26	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
2021	6	1.08	1.57	0.93	36	0.3	556.4	593
2022	11	2.02	1.82	1.05	31	0.2	544.9	1164
<b>2023</b>	<b>7</b>	<b>1.18</b>	<b>1.96</b>	<b>1.10</b>	<b>40</b>	<b>0.2</b>	<b>592.9</b>	<b>840</b>

**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	14.83	3.94	28
1997	2	1.76	15.09	4.78	24
1998	1	0.92	10.76	4.7	20
1999	0	0	12.46	4.45	16
2000	0	0	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	2.5	8.38	2.9	38
2004	3	3.3	6.63	1.87	51
2005	0	0	5.11	1.83	44
2006	0	0	5.06	1.98	28
2007	0	0	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
2021	3	2.74	2.77	1.44	39
2022	2	1.84	3.12	1.41	36
<b>2023</b>	<b>4</b>	<b>3.77</b>	<b>3.67</b>	<b>1.90</b>	<b>39</b>

**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	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	25.08	9.32	24
1999	2	3.53	24.47	8.14	19
2000	2	3.07	20.96	8	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	6.2	2.3	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	1	0.67	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
2021	2	1.45	2.07	1.12	38
2022	4	2.79	2.45	1.37	29
<b>2023</b>	<b>2</b>	<b>1.19</b>	<b>2.70</b>	<b>1.23</b>	<b>48</b>

**Table A2-4** Performance indicators - Marketing Staff

Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	2	1.2	6.07	5.68	23
1994	13	8.07	5.95	5.16	21
1995	1	0.62	12	4.93	22
1996	2	1.11	8.64	4.89	18
1997	4	2.4	8.62	4.61	23
1998	3	1.64	7.73	3.41	21
1999	2	1.12	6.5	3.67	23
2000	0	0	4.71	3.68	29
2001	3	1.42	6.68	3.63	27
2002	4	2.1	5.66	3.61	22
2003	2	0.98	5.73	3.33	19
2004	0	0	6.62	3.9	25
2005	3	1.4	4.17	2.98	36
2006	0	0	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
2021	0	0.00	0.93	0.61	41
2022	0	0.00	1.34	1.04	26
<b>2023</b>	<b>0</b>	<b>0.00</b>	<b>1.16</b>	<b>0.84</b>	<b>38</b>



**Table A2-5** Performance indicators - Marketing Contractors

Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	6	7.83	3.66	2.9	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	7.6	3.37	2.01	20
1998	8	6.79	5.87	3.5	19
1999	4	3.3	5.6	3.23	18
2000	11	9.66	2.86	4.06	17
2001	3	2.48	8.2	4.52	17
2002	2	1.29	4.41	3.79	20
2003	12	6.82	3.4	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
2021	1	0.62	0.89	0.69	24
2022	5	3.09	0.79	0.53	33
<b>2023</b>	<b>1</b>	<b>0.56</b>	<b>0.88</b>	<b>0.72</b>	<b>30</b>

**Table A2-6** LWI causes 2018-2023 - Staff and Contractors in both Manufacturing and Marketing

		LWI 2023				2022	2021	2020	2019
Categories		Manufacturing	Marketing	Combined	%	%	%	%	
Road Accident	Road Accident	14	9	23	4	2.6	3.1	3.4	3.4
Height/Falls	Falls from height	29	24	53	8.1	7.4	7.8	5.5	8.3
	Staff hit by falling objects	9	9	18	2.7	2.3	2.1	1.9	3.1
	Slips & trips (same height)	129	87	216	33.0	27.1	26.9	29.2	37.8
Burn/ Electrical	Explosion or burns	40	5	45	6.9	5.1	6.0	6.1	3.2
	Exposure electrical	6	2	8	1.2	0.5	1.0	0.4	0.9
Confined Space	Confined Space	1	0	1	0.2	0.2	0.8	0.4	0.2
Other Causes	Assault or violent act	0	10	10	1.5	0.9	1.6	1.1	2.0
	Water related, drowning	0	0	0	0.0	0.2	0.2	0.0	0.0
	Cut, puncture, scrape	26	17	43	6.6	10.4	9.4	9.2	6.5
	Struck by	48	23	71	10.8	9.7	10.5	13.0	13.3
	Exposure, noise, chemical, biological, vibration	11	0	11	1.7	4.4	4.9	4.8	4.1
	Caught in, under or between	43	24	67	10.2	10.2	7.8	7.1	8.0
	Overexertion, strain	27	17	44	6.7	8.5	9.6	8.2	5.5
	Pressure release	4	0	4	0.6	1.2	1.6	1.7	0.7
	Other	22	19	41	6.3	9.3	6.8	8.0	3.1
<b>Total</b>		<b>409</b>	<b>246</b>	<b>655</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

### APPENDIX 3 LWI 2023 - CAUSAL FACTORS

Sector	Incident Category	Number of Causal Factors assigned to Lost Workday Injuries (more than one causal factor can be assigned to a single LWI)													Not Yet Available
		Management of Change	Communication	Design	Equipment Reliability & Maintenance Management	Equipment Inspection and Testing	Organisational Structure & Staffing	Knowledge and Skills	Operating Limits	Procedures	Risk Assessment & Associated Action Management	Safe System of Work	Work Monitoring	Other	
Manufacturing	Assault or violent act	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marketing	Assault or violent act	0	0	0	0	0	0	0	0	1	1	0	0	8	1
Manufacturing	Caught in, under or between	0	5	8	4	1	1	10	0	10	12	9	1	8	2
Marketing	Caught in, under or between	1	1	6	1	1	0	5	0	4	2	1	1	5	9
Manufacturing	Confined space	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Marketing	Confined space	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing	Cut, puncture, scrape	0	1	2	2	0	0	15	0	4	7	4	0	4	2
Marketing	Cut, puncture, scrape	0	0	0	0	0	2	3	0	2	2	1	0	2	7
Manufacturing	Explosion or burns	0	3	5	4	3	1	7	0	12	15	5	2	6	1
Marketing	Explosion or burns	0	0	0	0	0	0	3	0	2	0	1	0	1	0
Manufacturing	Exposure electrical	0	0	0	0	0	1	3	1	0	2	0	1	0	0
Marketing	Exposure electrical	0	0	0	0	1	1	0	0	0	1	0	0	0	0
Manufacturing	Exposure, noise, chemical, biological, vibration	0	0	3	0	1	0	0	0	3	5	1	0	0	0
Marketing	Exposure, noise, chemical, biological, vibration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing	Falls from height	1	3	3	1	0	3	9	0	7	14	7	2	5	0
Marketing	Falls from height	0	0	1	2	0	0	7	0	5	3	1	1	5	6
Manufacturing	Other	0	0	2	2	0	2	5	0	2	5	2	1	8	1
Marketing	Other	0	0	0	0	1	1	6	0	1	1	0	1	8	3
Manufacturing	Overexertion, strain	0	2	5	0	1	2	6	0	6	4	4	0	7	2
Marketing	Overexertion, strain	0	1	2	0	1	0	3	0	3	2	3	0	5	4
Manufacturing	Pressure release	0	1	2	1	0	0	1	1	0	2	1	0	0	0
Marketing	Pressure release	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing	Road accident	0	0	1	0	0	0	3	0	1	4	0	2	8	1
Marketing	Road accident	0	0	0	0	0	0	3	0	1	0	0	0	4	1
Manufacturing	Slips & trips (same height)	2	3	21	2	3	2	25	0	8	32	10	6	52	11
Marketing	Slips & trips (same height)	0	1	5	1	1	3	10	0	5	26	5	1	30	13
Manufacturing	Staff hit by falling objects	0	3	0	0	0	2	3	0	2	4	2	2	0	0
Marketing	Staff hit by falling objects	0	0	0	0	0	0	1	0	0	2	0	0	4	2
Manufacturing	Struck by	0	8	3	2	3	2	14	0	10	17	8	5	12	1
Marketing	Struck by	1	1	0	1	0	1	1	0	3	6	1	0	9	3
Manufacturing	Water related, drowning	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marketing	Water related, drowning	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<b>Total</b>	<b>5</b>	<b>33</b>	<b>69</b>	<b>23</b>	<b>17</b>	<b>24</b>	<b>143</b>	<b>2</b>	<b>92</b>	<b>169</b>	<b>66</b>	<b>26</b>	<b>192</b>	<b>70</b>

## APPENDIX 4 PROCESS SAFETY EVENTS 2023

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

Type of Process: Refining	Tier 1	Tier 2
1. Active Warehouse	0	0
2. Alkylation, Hydrofluoric (HF)	0	2
3. Alkylation, Sulfuric	0	0
4. Bitumen / Resid / Asphalt	2	1
5. Calcining	0	0
6. Coking	1	0
7. Crude / Vacuum Distillation	12	16
8. Flares / Flare Systems / Flare Gas Recovery	0	1
9. Fluid Catalytic Cracking (FCC)	1	3
10. Gas and Liquid Desulfurization / Treating (H2S absorbers, amine systems, Merox)	2	4
11. Hydrocracking	6	1
12. Hydrogen	0	3
13. Hydrotreating	5	5
14. Isomerization	2	0
15. Loading / Unloading / Truck / Rail / Transport Vessel	4	17
16. Marine / Jetty / Wharf	1	4
17. Other (describe)	7	7
18. Pilot Plant	0	0
19. Polymerization	0	0
20. Reforming	2	6
21. Sewer / Lift Station / Wastewater Handling, Treatment or Disposal	1	3
22. Sulfur Recovery	2	0
23. Tank Farm / Storage Facility / Offsites / Storage and Transfer Piping	21	52
24. Utilities / Steam Plant / Cogeneration	1	3
25. Vapor Recovery / Light Ends	1	1
<b>Total</b>	<b>71</b>	<b>129</b>

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

Type of Process: Petrochemical & other process	Tier 1	Tier 2
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	0
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	3
15. Ethylene and Derivatives	0	1

16. Ethylene Dichloride and Derivatives	0	0
17. Ethylene Oxide	0	0
18. Flares / Flare Systems / Flare Gas Recovery	0	0
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	0
25. Isocyanates	0	0
26. Isopropanol	0	0
27. LNG	0	0
28. Loading / Unloading / Truck / Rail / Transport Vessel	5	9
29. Methane	0	1
30. Methanol	0	0
31. Methyl Mercaptan	0	0
32. MTBE	0	0
33. NGL Fractionation	0	0
34. Other (describe)	0	1
35. Paraxylene	0	1
36. Pentane	0	0
37. Phenol	0	0
38. Pilot Plant	0	0
39. Polyethylene	0	0
40. Polypropylene	1	0
41. Polystyrene	0	0
42. Propane	0	0
43. Propylene	0	0
44. Propylene Oxide and Derivatives	0	0
45. Sewer / Lift Station / Wastewater Handling, Treatment or Disposal	0	0
46. Specialty Chemicals	0	0
47. Styrene-Butadiene	0	0
48. Synthesis Gas (CO, H <sub>2</sub> )	0	0
49. Tank Farm / Storage Facility / Offsites / Storage and Transfer Piping	1	0
50. Toluene	0	0
51. Utilities / Steam Plant / Cogeneration	1	0
52. Xylene	0	0
<b>Total</b>	<b>8</b>	<b>16</b>

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

Mode of Operation	Tier 1	Tier 2
1. Emergency shutdown	0	1
2. Normal	49	109
3. Other	3	2
4. Planned shutdown	5	5
5. Routine maintenance	7	8
6. Start-up	13	13
7. Temporary	0	3
8. Turnaround	1	0
9. Upset	1	4
<b>Total</b>	<b>79</b>	<b>145</b>

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

Point of release	Tier 1	Tier 2
1. Atmospheric tank	9	17
2. Blower / Fan	0	0
3. Compressor	1	2
4. Cooling Tower	0	0
5. Filter / Coalescer / Strainer	0	5
6. Fired Boiler	0	0
7. Flare / Relief System	0	1
8. Furnace / Fired Heater	5	1
9. Heat Exchanger	2	8
10. Instrumentation	4	5
11. Other (describe)	15	23
12. Piping System, Large Bore(>2)	19	47
13. Piping System, Small Bore( $\leq 2$ )	13	17
14. Pressure Vessel	1	2
15. Pump	9	15
16. Reactor	1	2
<b>Total</b>	<b>79</b>	<b>145</b>

**Table A4-5** Tier 1 and 2 Process Safety events by Type of Material released

Type of Material released	Tier 1	Tier 2
1. Combustible	10	35
2. Corrosive	0	4
3. Flammable	54	90
4. Other	8	8
5. Toxic	6	4
6. UNDG Class 2	0	0
7. Utilities	1	4
<b>Total</b>	<b>79</b>	<b>145</b>

**Table A4-6** Tier 1 and 2 Process Safety events by Causal Factor\*

Causal Factors	Tier 1	Tier 2
1. Management of Change	12	14
2. Communication	14	14
3. Design	22	28
4. Equipment Reliability & Maintenance Management	29	49
5. Equipment Inspection and Testing	19	34
15. Organisational Structure & Staffing	5	8
7. Knowledge and Skills	18	28
8. Operating Limits	2	5
9. Procedures	26	36
10. Risk Assessment & Associated Action Management	22	25
11. Safe System of Work	16	22
12. Work Monitoring	28	26
13. Other	8	13
14. Not Yet Available	4	4
<b>Total</b>	<b>215</b>	<b>306</b>

\*More than one causal factor may be assigned to a single Tier 1/2 event

## APPENDIX 5 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 Joint Ventures when these are not provided in the Member Company submissions.

ALMA Petroli	GALP Energia	MOL Group	Rompetrol
Gruppo API	Gunvor	Motor Oil (Hellas)	Sara
BP	H&R	Neste	Saras
CEPSA	Helleniq Energy	Nynas	Shell
Crossbridge	Ineos	OMV	St1
ENI	IPLOM	Phillips 66	Tamoil
Equinor	Irving	PKN Orlen	TotalEnergies
ESSAR	ISAB	Preem	Valero
ExxonMobil	Klesch	Q8	Varo
FNA Trusteeship of Rosneft Germany Assets	LUKOIL	Repsol	Vitol



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