Concawe
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European downstream oil industry safety performance

Statistical summary of reported incidents - 2018

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European downstream oil industry safety performance

Statistical summary of reported incidents – 2018

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ABSTRACT

The 2018 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 98% of the European refining capacity. Total work hours reported (579 million) were around 3% lower in 2018 than in 2017. In 2018, there were ten fatalities reported by the industry, six of these as a result of a single incident. This is a significant increase since 2017 and 2016 when 2 fatalities were recorded each year. The number of Lost Workday Injuries recorded in 2018 (586) is slightly higher than those in 2017 (577). The combined number of Tier 1 and 2 process safety releases across Manufacturing and Marketing in 2018 declined 6% since 2017 (270 releases in 2018 and 287 in 2017). However, the number of Manufacturing Tier 1 events rose over 20% from 62 in 2017 to 75 in 2018.

Note that 2017 data in this report has been revised based on new member company information received in the 2018 data collection. This report therefore provides the most accurate and up to date details of both 2017 and 2018 data.

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

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EXECUTIVE SUMMARY

For 2018, information was received from forty-two Concawe Member Companies and Joint Ventures (comprised of member companies), together accounting for greater than 98% 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 2018 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	110	166	276	158	144	303	268	311	579
Fatalities	0	7	7	1	2	3	1	9	10
FAR - FA/100Mh	0.0	4.2	2.5	0.6	1.4	1.0	0.4	2.9	1.7
LWI	165	162	327	154	105	259	319	267	586
Lost time through LWI - Days	6,293	4,987	11,280	4,599	2,615	7,214	10,892	7,602	18,494
LWIF - LWI/Mh	1.5	1.0	1.2	1.0	0.7	0.9	1.2	0.9	1.0
LWIS - Lost days/LWI	42.0	36.7	39.4	30.9	27.8	29.7	36.4	33.1	35.0
AI	334	337	671	275	146	421	609	483	1092
AIF - AI/Mh	3.0	2.0	2.4	1.7	1.0	1.4	2.3	1.6	1.9
Distance travelled - million km							232	747	978
RA							157	150	307
RAR							0.7	0.2	0.3

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

There were 10 fatalities reported for 2018. Six of these were as a result of a single incident. Of the 10 fatalities, nine nine contractors (two in Marketing activities and seven in Manufacturing) and one member of staff engaged in Marketing activities. This represents a significant rise in annual number of fatalities following two consecutive years of the lowest number of annual fatalities recorded (two fatalities in both 2016 and 2017). The 2018 data indicate that continued efforts are essential 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 586 LWIs were reported in 2018 (577 in the previous year) and 549 of these were allocated to the agreed 16 incident categories within the membership company submissions. As in previous years, a relatively small number of categories contribute to most LWIs reported. Slips and Trips (same height), Struck by and Falls from Height together account for almost 54% of all LWIs reported in 2018 and this order holds true for both Manufacturing and Marketing.

For 2018, 40 companies submitted Process Safety Event (PSE) data for the Manufacturing operations and 18 submitted Marketing PSE data. The combined

number of Tier 1 and 2 process safety releases across Manufacturing and Marketing decreased in 2018 by approximately 6% since 2017 (270 releases in 2018 and 287 in 2017). However, the number of Manufacturing Tier 1 events rose over 20% from 62 in 2017 to 75 in 2018.

Note that 2017 data in this report has been revised based on new member company information received in the 2018 data collection. This report takes into account the following revisions in 2017 data:

- a reduction in originally reported work hours from 598.7 million in Concawe 2017 report [24] to 594.3 million in this report;
- an increase in kilometres driven from 925 million to 953 million
- new information regarding fatal incidents: There are two additional Manufacturing Explosion or burns fatalities in the period 2013-2017, not included in the 2017 report. A Manufacturing Falls from height fatality which had been erroneously assigned to Marketing is now corrected.

This report therefore provides the most accurate and up to date details of both 2017 and 2018 data.

1. INTRODUCTION TO 2018 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-fifth report on this topic (see references of past reports in the reference list [1-24]). This report covers data collected for 2018 as well as a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available. For 2018, information was received from forty-two Concawe Member Companies and Joint Ventures comprised of member companies, representing more than 98% 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 in to 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 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 2018 PSE data represents 40 out of 42 of the Manufacturing companies. Following concerted efforts from Concawe representatives and within the membership, the number of respondents has increased in 2018. The improvement in the completeness of the data will further improve the benchmark reliability. Also for the first time in the data collection for 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 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.

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 2018

No of Companies	Manufacturing			Marketing		
	Own Staff	Contractors	All Workers	Own Staff	Contractors	All Workers
Submission	42	41		24	21	
Including						
Lost Days	36	30		21	17	
All Injuries	34	35		15	17	
Road Accidents	30	24		18	14	
Distance Travelled	22	18		17	14	
Process Safety			40			18
Retail Operations						
No Retail						8
COCO						11
CODO						5
DOCO						2
DODO						6

[a]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. 2018 PERSONAL SAFETY PERFORMANCE RESULTS

The aggregated 2018 results for Manufacturing, Marketing and the combined downstream industry are shown in **Table 2**.

All reporting companies									
Sector	Manufacturing			Marketing			Both Sectors		
Workforce	OS	CT	AW	OS	CT	AW	OS	CT	AW
Hours worked Mh	110	166	276	158	144	303	268	311	579
Fatalities	0	7	7	1	2	3	1	9	10
FAR - FA/100Mh	0.0	4.2	2.5	0.6	1.4	1.0	0.4	2.9	1.7
LWI	165	162	327	154	105	259	319	267	586
Lost time through LWI - Days	6,293	4,987	11,280	4,599	2,615	7,214	10,892	7,602	18,494
LWIF - LWI/Mh	1.5	1.0	1.2	1.0	0.7	0.9	1.2	0.9	1.0
LWIS - Lost days/LWI	42.0	36.7	39.4	30.9	27.8	29.7	36.4	33.1	35.0
AI	334	337	671	275	146	421	609	483	1092
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Distance travelled - million km							232	747	978
RA							157	150	307
RAR							0.7	0.2	0.3

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

2.1. 2018 FATALITIES

There were ten fatalities reported for 2018. Six contractors died following a single explosion at a fuel loading terminal serving a refinery. A further three fatalities were recorded as a result of road accidents. All were engaged in Marketing activities. A tanker truck driver (own staff) was fatally injured when the vehicle left the motorway and overturned. Equipment reliability and human factors were identified as causal factors in this incident. One contractor died as a result of losing control of a vehicle on a straight road and another contractor died following collision with a stationary vehicle on a highway. Both incidents reported human factors as the sole causal factor.

A single Manufacturing contractor was also fatally injured in an incident categorised as Struck by - no further details of this incident have been provided.

This represents a significant rise in annual number of fatalities following two consecutive years of the lowest number of annual fatalities recorded (two fatalities in both 2016 and 2017). The 2018 data indicate that continued efforts are essential to achieve the target of zero fatalities in our industry.

Concawe membership study Lost Workday Injuries (LWI) in addition to fatalities, to identify further opportunities for continuous safety performance improvement.

2.2. 2018 LOST WORKDAY INJURIES

In 2018, there were a total of 586 Lost Workday Injuries, with 56% of these in Manufacturing and 44% in Marketing. Manufacturing LWI are split evenly across staff and contractors whereas Marketing LWI are more prominent among staff (59%), than contractors (41%).

There was an overall increase in Lost Workday Injury Frequency (LWIF) from 2017 performance. The LWIF went from 0.97 LWI/Mh in 2017 to 1.02 LWI/Mh in 2018 across all workers. Thirty-five companies reported LWI in both 2018 and 2017. Of these, 17 companies (49%) reported a lower overall LWIF in 2018 than in 2017, 4 companies had the same LWIF in 2017 and 2018 (11%) and 14 companies (40%) had a higher LWIF in 2018.

Manufacturing staff are the sector with the highest LWIF (1.50 in 2018, compared with 1.53 in 2017) and Marketing contractors have the lowest recorded LWIF of all sectors in 2018 and the largest improvement in LWIF since last year (0.73 in 2018, compared with 0.81 in 2017). Marketing staff LWIF rose modestly from 0.95 to 0.97 in 2018. Refer to **Table 3** and **Appendix 2** for the details.

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 2018

	LWIF	LTIF
All Workers	1.02	1.03
Manufacturing Staff	1.50	1.50
Manufacturing Contractors	0.99	1.02
Marketing Staff	0.97	0.98
Marketing Contractors	0.73	0.74

There is little difference between the two measures when the total number of fatalities is lower relative (10) to the number of LWI (586).

It has long been accepted that to achieve a sustainable zero-fatality safety performance a company must continually work to reduce lower level safety incidents (such as lost workday injuries, restricted workday injuries, medical treatment cases, first aid cases and near misses). Although lower level incidents such as slips and trips can result in relatively minor consequences, the actual root causes behind both minor and major incidents generally prove to be very similar.

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. Slips and Trips (same height), Struck by and Falls from Height together account for almost 54% of all LWIs reported in 2018 and this holds true for each sector, Manufacturing and Marketing, as detailed in **Table 5.** Other frequent categories include Explosion and Burns and Caught in, under or between in Manufacturing (9.8% and 8.9% of Manufacturing LWI) and Cut, Puncture, Scrape and Overexertion, Strain (9.0% and 6.7% of Marketing LWI). Slight differences between the sectors emerge between less frequent LWI categories.

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 Lost Workday Injuries in 2018

		LWI 2018			
Categories		**Manufacturing**	**Marketing**	**Combined**	**%**
Road Accident	Road accident	7	13	20	3.4
Height/Falls	Falls from height	32	24	56	9.6
	Staff hit by falling objects	5	10	15	2.6
	Slips & trips (same height)	98	94	192	33.0
Burn/ Electrical	Explosion or burns	32	6	38	6.5
	Exposure electrical	0	1	1	0.2
Confined Space	Confined space	2	0	2	0.3
Other Categories	Assault or violent act	1	10	11	1.9
	Water related, drowning	0	0	0	0.0
	Cut, puncture, scrape	27	23	50	8.6
	Struck by	35	32	67	11.5
	Exposure, noise, chemical, biological, vibration	16	2	18	3.1
	Caught in, under or between	29	13	42	7.2
	Overexertion, strain	15	17	32	5.5
	Pressure release	3	1	4	0.7
	Other	25	9	34	5.8
	Total	327	255*	582	100.0

*Four LWI for Marketing were not allocated to a cause.

Table 5 Categories of LWIs in 2018 split Manufacturing vs. Marketing

	LWI 2018				
Categories		**Manufacturing**	**%**	**Marketing**	**%**
Road Accident	Road accident	7	2.1	13	5.1
Height/Falls	Falls from height	32	9.8	24	9.4
	Staff hit by falling objects	5	1.5	10	3.9
	Slips & trips (same height)	98	30.0	94	36.9
Burn/ Electrical	Explosion or burns	32	9.8	6	2.4
	Exposure electrical	0	0.0	1	0.4
Confined Space	Confined space	2	0.6	0	0.0
Other Causes	Assault or violent act	1	0.3	10	3.9
	Water related, drowning	0	0.0	0	0.0
	Cut, puncture, scrape	27	8.3	23	9.0
	Struck by	35	10.7	32	12.5
	Exposure, noise, chemical, biological, vibration	16	4.9	2	0.8
	Caught in, under or between	29	8.9	13	5.1
	Overexertion, strain	15	4.6	17	6.7
	Pressure release	3	0.9	1	0.4
	Other	25	7.6	9	3.5
	Total	327	100.0	255*	100.0

*Four LWI for Marketing were not allocated to a cause.

For the first time in 2018, 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 23% of LWI (135 LWI incidents). In many cases, this reflects ongoing investigations and causal factors for such incidents may be recorded by Concawe in future.

The most commonly reported causal factors across all LWI are Human Factors (34% of causal factors reported), Safe Work Practices & Procedures (13%), Risk Assessment (10%), Procedures (7%) and Design (7%). There was little difference in the application of these factors in Manufacturing and Marketing related incidents with Human Factors and Work Practices & Procedures, consistently the first and second most frequently reported factor, respectively. Manufacturing incidents reported Risk Assessment and Equipment Reliability as third and fourth most frequent causal factors. Procedures and Risk Assessment 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, Falls from Height, Road Accident and Struck by LWI incidents in both Manufacturing and Marketing. Risk Assessment, Safe Work Practices & Procedures, Procedures and Design were also commonly reported causal factors in these incident types. Manufacturing Explosion and Burns LWI incidents most frequently reported Risk Assessment as a causal factor.

Figure 1 Frequency of causal factors assigned to Lost Workday Injury Incidents (note more than one causal factor may be assigned to an incident)

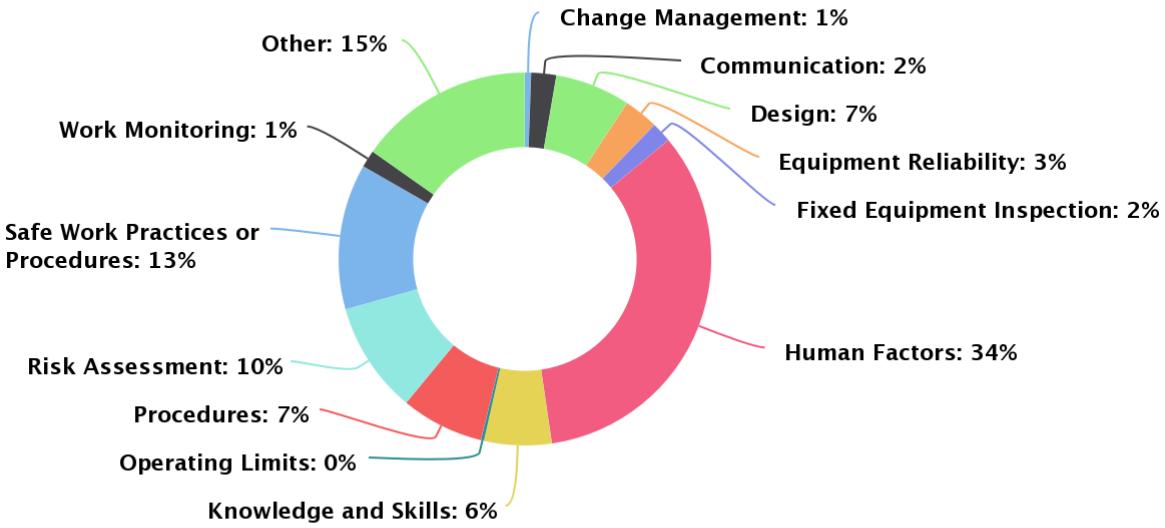


Table 6 shows the Lost Workday Injury frequency statistics broken down in to quartiles. This demonstrates a wide range of variability in performance between the top performing members (Quartile 1 – Q1) and the bottom performing members (Quartile 4 – Q4).

Table 6 2018 LWIF quartile distribution 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	0.47	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.12	0.00	0.40	0.16
Q2	0.49	1.48	0.92	0.00	0.67	0.31	0.00	0.98	0.44	0.40	1.18	0.69	0.46	1.30	0.86
Q3	1.58	3.23	2.25	0.69	2.13	1.32	1.09	3.70	2.08	1.26	2.36	1.64	1.33	2.75	2.00
Q4	4.30	15.09	6.84	2.21	5.70	3.20	3.79	15.09	6.46	2.56	20.39	8.05	3.23	15.09	6.39

The quartile distribution ranges and average values for each quartile for the 2018 All Injury Frequency (AIF) are shown in **Table 7**. The average performance indicator figures for the industry conceal a wide range of individual values between reporting companies.

Table 7 2018 AIF quartile distribution 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	1.15	0.61	0.17	0.68	0.39	0.00	0.53	0.13	0.00	1.18	0.41	0.00	1.11	0.61
Q2	1.17	2.39	1.84	0.76	1.48	1.10	0.62	1.79	1.19	1.19	2.07	1.63	1.39	2.58	1.91
Q3	2.58	4.31	3.32	2.58	3.56	3.06	2.24	4.91	3.68	2.07	7.12	3.25	2.72	5.35	3.89
Q4	4.53	21.37	9.86	5.05	14.77	7.89	6.00	30.19	12.48	8.16	36.90	18.95	5.39	30.19	13.94

2.3. PERFORMANCE TRENDS IN THE LAST 10 YEARS 2009 TO 2018

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 8 Fatalities by sector 2009-2018

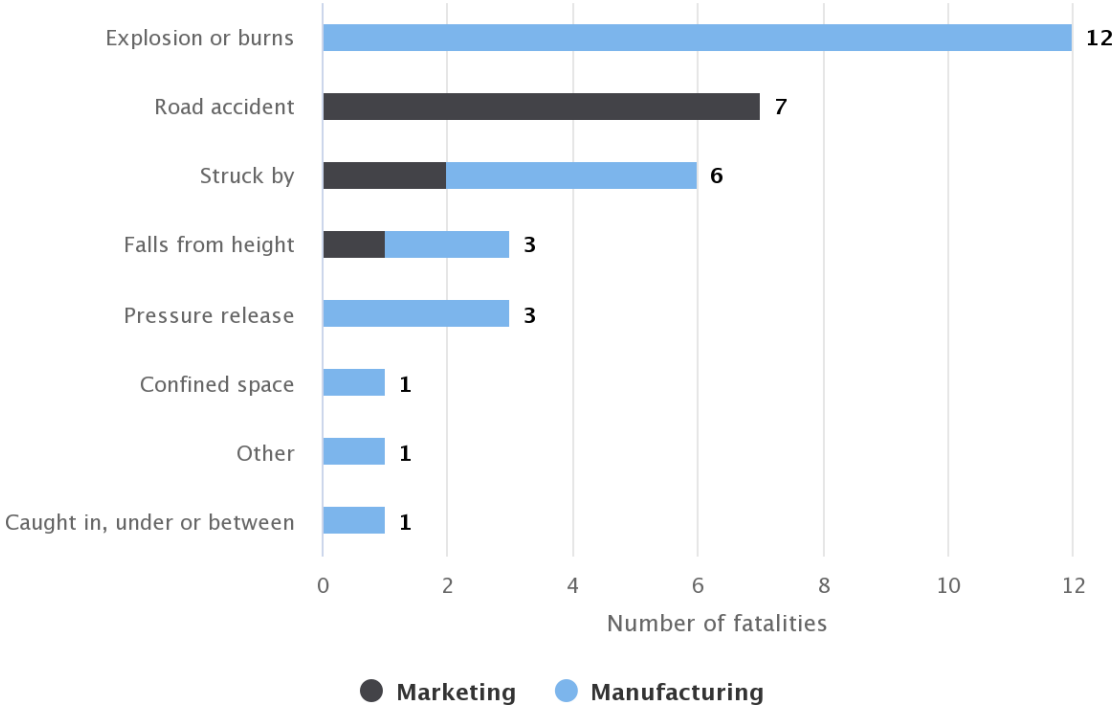
Fatalities over 10 years by sector			
Year	Manufacturing	Marketing	Total
2009	9	2	11
2010	11	3	14
2011	10	1	11
2012	4	6	10
2013	4	2	6
2014	6	1	7
2015	4	3	7
2016	2	0	2
2017	1	1	2
2018	7	3	10
Total	**58**	**22**	**80**

2018 has seen a severe reversal in the downward trend over recent years in numbers of fatalities in European downstream oil industry figures. Annual fatalities in 2018 are at the highest level since 2012 for Manufacturing and since 2016 for Marketing. Increased 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 2013, the membership agreed to adopt 15 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**.

Figure 2 summarizes the categories of all fatalities which were allocated by participating companies in the period 2013 to 2018. As new information regarding fatality categorisation for historic incidents has been provided to Concawe throughout 2018, **Figure 2** below does not compare directly with previously reported data in the Concawe 2017 report [24]. There are two additional Manufacturing Explosion or burns fatalities in the period 2013-2017, not included in the 2017 report. A Manufacturing Falls from height fatality which had been erroneously assigned to Marketing is now corrected.

Figure 2 Number of fatalities by category 2013-2018



Since Concawe moved to reporting fatalities against the same 16 categories as Lost Workday Injury in 2013, 'Explosions or Burns' (twelve fatalities), 'Road Accident' (seven fatalities) and 'Struck by' (six fatalities) have been the largest contributors to fatalities in the industry. Together, the three categories account for approximately 74% of the fatalities experienced in the industry since 2013. Two of the 34 fatalities in this period have not been allocated to a category.

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.

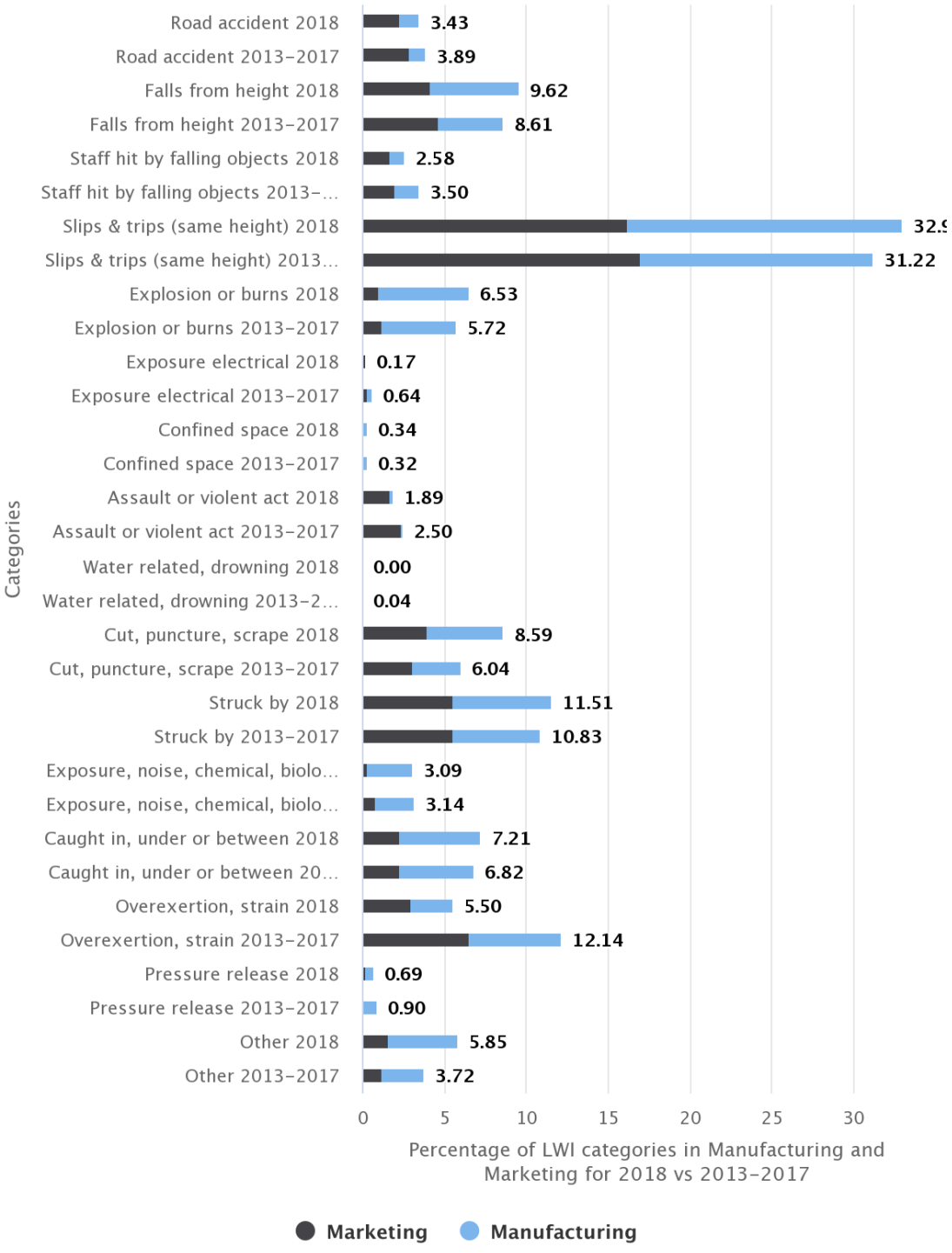
Explosion or burns and Road Accidents are the most prevalent fatal incident categories recorded in the period 2009-2018. Road accidents have declined as an overall percentage of all fatalities compared to 1998-2008 when they represented

almost half of all fatalities. No fatal road accidents were recorded in 2016 and 2017 but in 2018 three people were fatally injured in separate road accidents.

Falls from Height and Stuck by categorised incidents are the next most prevalent, the former category accounting for over 10% of fatalities over the last 10 years.

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 2018 compared with period 2013-2017



Since Concawe began collecting LWI data against the 16 categories in 2013 a pattern has been emerging in the data. As in fatalities, a limited number of causes contribute to most LWIs. In 2018, almost 70% of LWIs were caused by the following, Slips & Trips (same height) 33%, Struck by 11.5%, Falls from Height 9.6%, Cut, Puncture, Scrape 8.6% and Caught in under between 7.2%. The latter category was more prominent in 2018 than in 2017, while incidents related to Overexertion and strain were less frequent in 2018 (5.5% compared to 9.5% in 2017). However, the pattern of categories is broadly consistent year to year and similar across both Manufacturing and Marketing, see **Figure 3**.

For the first time in 2018, Concawe collected information about LWI incident categories split between staff and contractors. For the most frequent LWI incident category, Slips and Trips, the staff / contractor split is 65 / 35%. Other LWI incident categories provide a more equal split. The percentage staff / contractor split for Explosion or burns is 42 / 58, Struck by 52 / 48, Road Accident 50 / 50 and Falls 46 / 54.

While there is no direct correlation between categories of LWI and fatalities (**Figure 4**), the data suggest that focus on reducing LWI in three areas could have the potential to address the causes of the majority of fatal incidents reported in recent years.

These areas are:

- Process Safety to address Explosion, Burns and Pressure Release related incidents
- Operational safety focused on Struck by, Caught in under and between and Working at Height
- Road Safety

Figure 4 LWI and Fatalities category data for 2013-2018

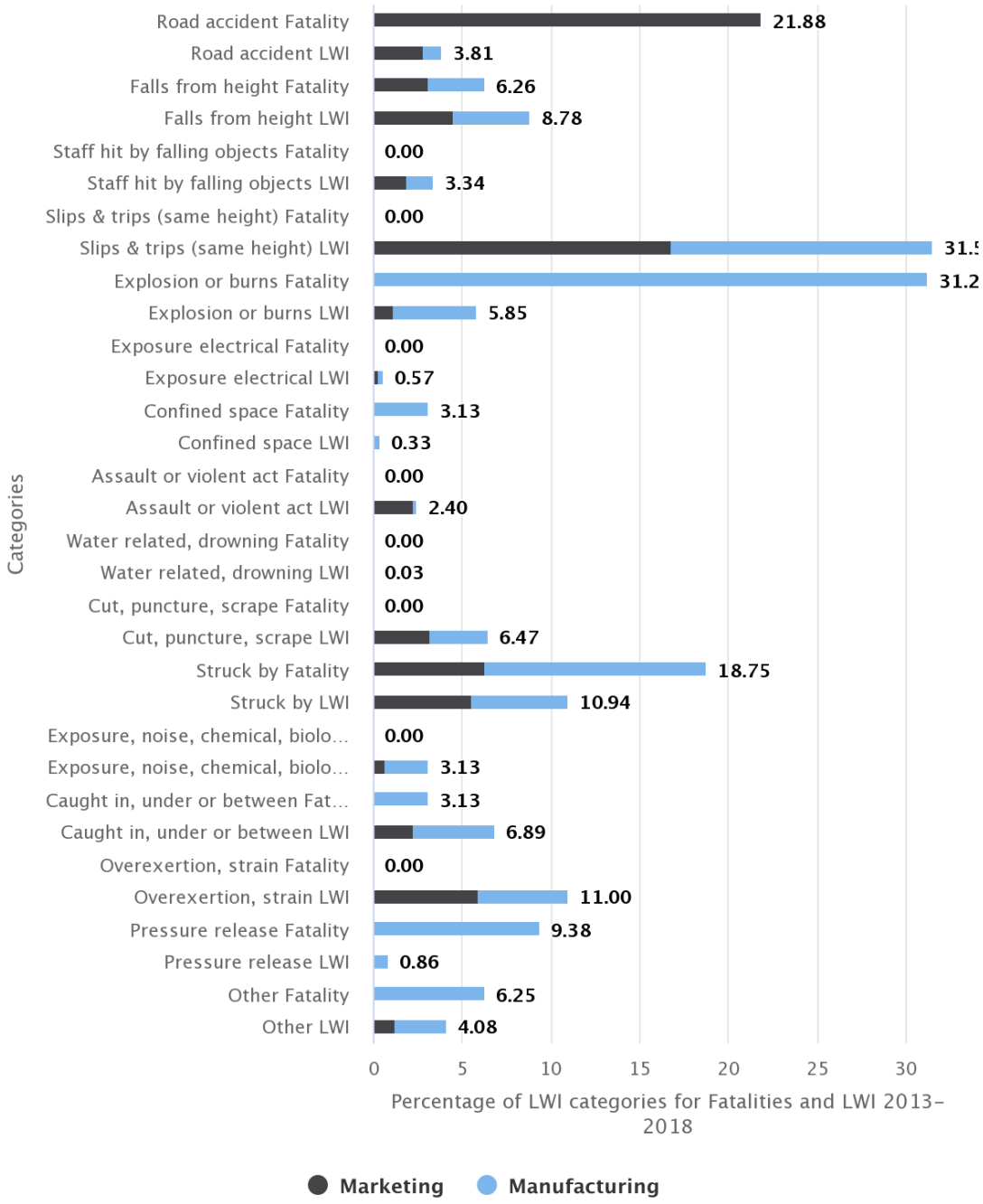
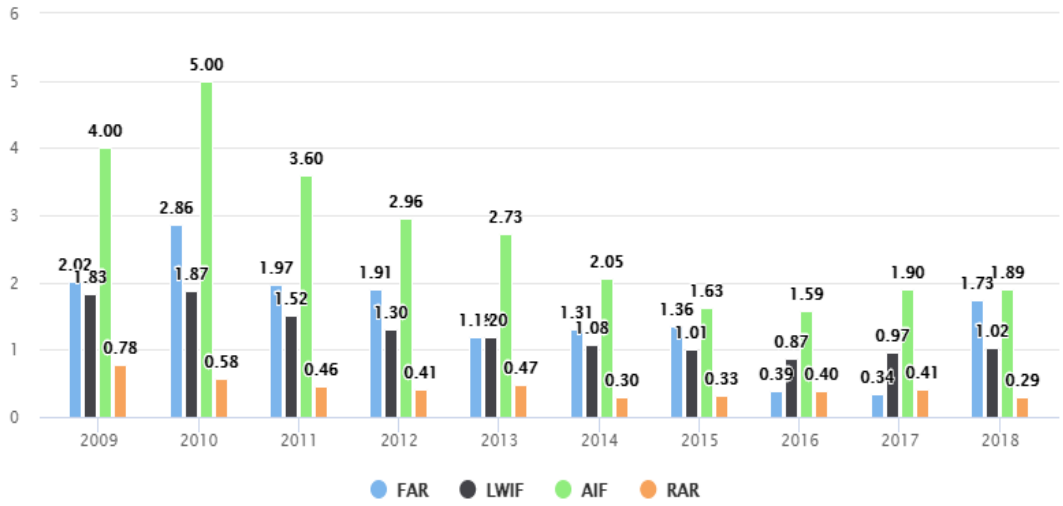


Figure 5 shows the historical evolution of the main performance indicators over the past 10 years across all workers. Fatal accident rate FAR is 1.73 in 2018, the highest since 2012. The Lost Workday Injury Frequency LWIF of 1.02 is the highest since 2014 when it was 1.08. Similarly, the All Incident Frequency AIF of 2018 is 1.89, similar to that in 2017 (1.90) and higher than the best performance of 1.59 in 2016. The Road Accident Rate has decreased from 0.41 in 2017 to 0.29 in 2018, the lowest rate ever recorded. This is accompanied by an approximate 9% rise in km driven since 2017. (see **Table A2-1**). It is not clear to what extent this observation is impacted by changes in reporting activities.

Figure 5 Performance indicators over the last 10 years 2009-2018
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. Own staff have in general a lower FAR than contractors with one recorded fatality in the last three years in either sector. Further effort is required to reduce both contractor and staff fatalities.

Figure 6a Fatal Accident Rate (number of fatalities per million hours worked) – Manufacturing in the last 10 years 2009-2018

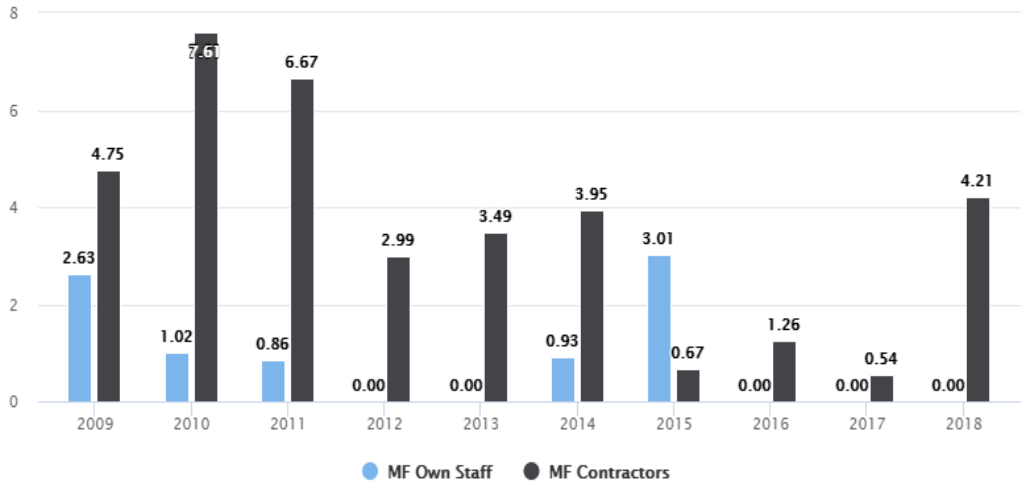


Figure 6b Fatal Accident Rate (number of fatalities per million hours worked) – Marketing in the last 10 years 2009-2018

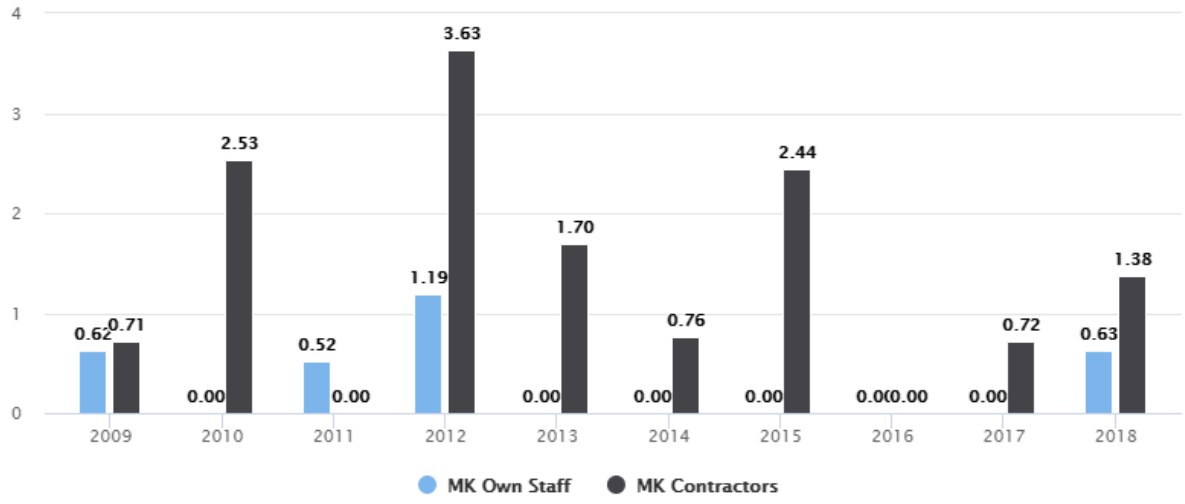
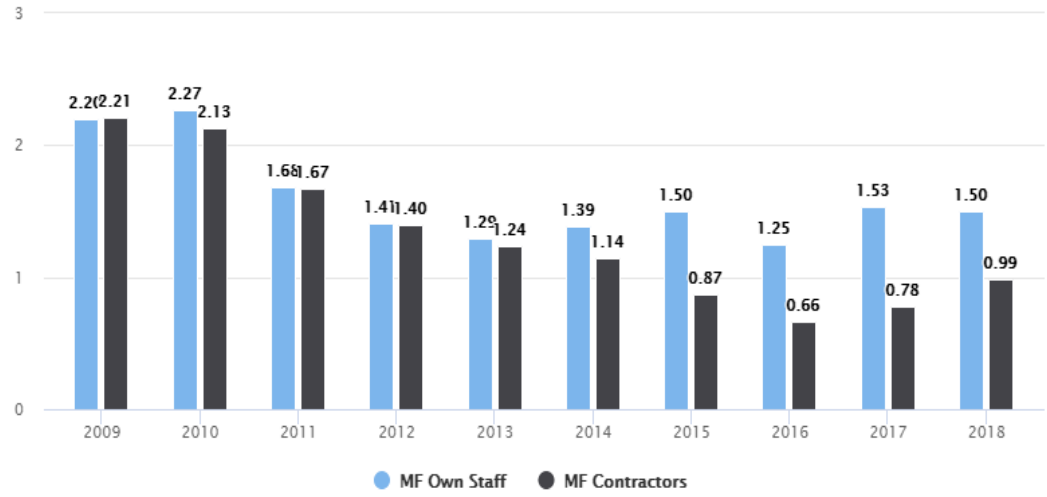


Figure 7a shows Manufacturing own staff LWIF in 2018 at 1.50, similar to rates recorded in 2015 and 2017. By contrast Manufacturing contractor LWIF continues to rise over the last 2 years and is now at 0.99.

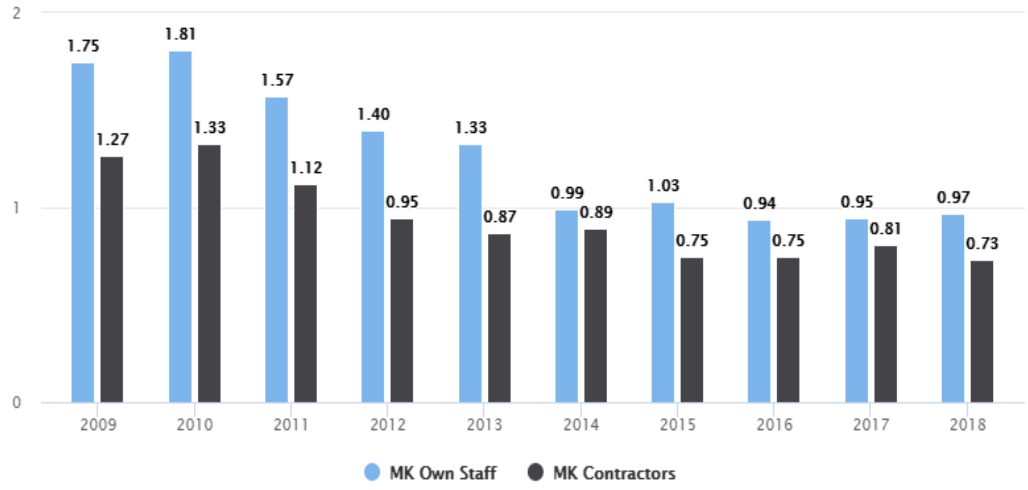
Figure 7a Lost Workday Injury Frequency (number of lost workday injuries per million hours worked) – Manufacturing in the last 10 years 2009-2018



Marketing contractors LWIF of 0.73 in 2018 is the lowest ever recorded, while Marketing staff LWIF has risen very slightly year on year since 2016 and is now at 0.97 (see **Figure 7b**).

Refer to **Appendix 2** for the details.

Figure 7b Lost Workday Injury Frequency (number of lost workday injuries per million hours worked) – Marketing in the last 10 years 2009-2018



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 3.04 and 2.03, respectively in 2018.

Figure 8a All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) – Manufacturing in the last 10 years 2009-2018

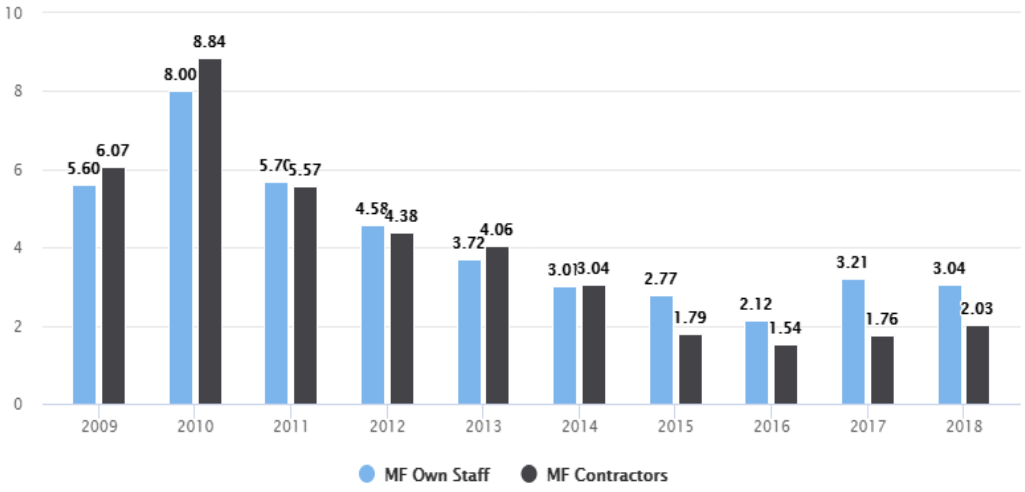
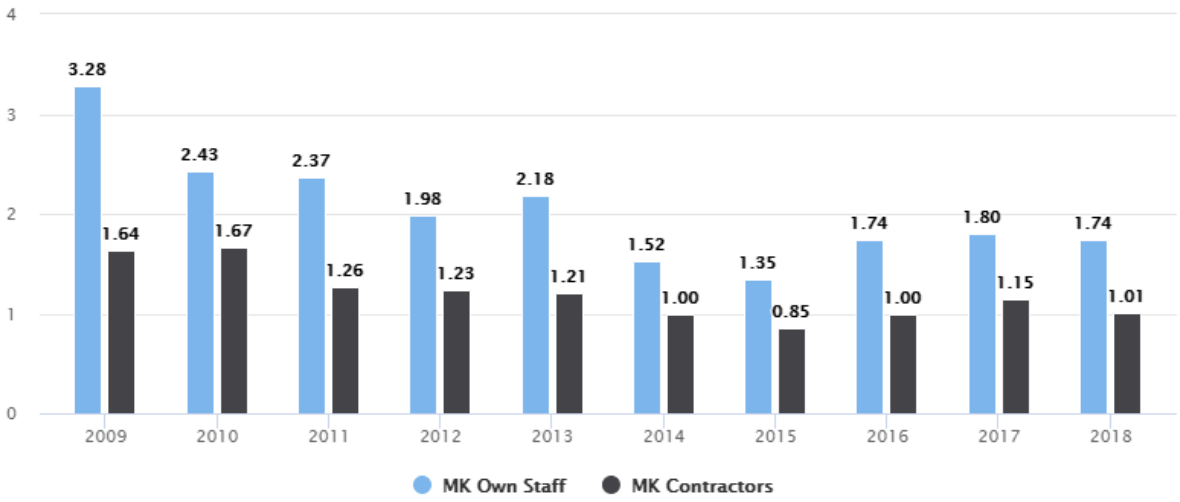


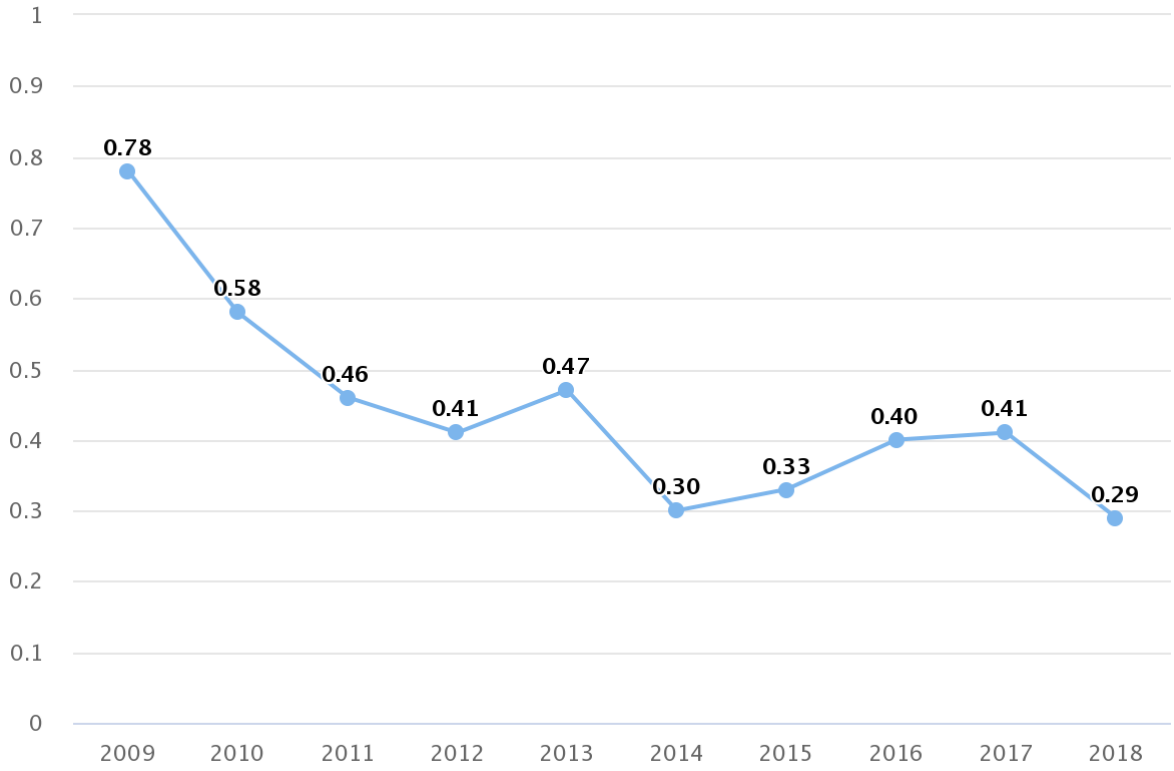
Figure 8b All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) – Marketing in the last 10 years 2009-2018



Marketing own staff AIF has plateaued over the last 3 years at around 1.74-1.80, higher than the lowest recorded in 2015 of 1.35. Similarly, Marketing contractor AIF has plateaued at around 1.00 -1.15, higher than the lowest recorded, 0.85 in 2015.

Three fatal road accidents in 2018 ended a short period in 2016 and 2017 of no fatal road accidents. In contrast, the Road Accident Rate dropped from 0.41 in 2017 to 0.29 in 2018, the lowest rate recorded. Road safety has been a major focus for the industry and a sustained effort is required in order to improve performance. These accidents mainly occur in the Marketing activity where the bulk of the driving takes place. See **Figure 9**.

Figure 9 Road Accident Rate (number of road accidents per million km driven) last 10 years 2009-2018 - 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 [24, 25]. 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 [25] and as further refined in the ANSI/API recommended practice that was published in 2010 [26]. 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 [27] 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). [31]

In 2018, 40 companies submitted PSE data for the Manufacturing operations, 2 more than in 2017 and 18 submitted Marketing PSE data, the same number as last year.

The aggregated 2018 results per sector and for the whole of the European downstream oil industry are shown in **Table 9**.

Table 9 Aggregated 2018 Process Safety results for all reporting companies

Sector	Manufacturing	Marketing	Both Sectors
Companies - Total	42	24	24
- PS Reporting	40	18	17
- %	95	75	71
Hours worked - Total Mh	276.4	302.7	579.1
- PS Reporting	270.3(270.3)	215.5(215.5)	485.8(485.8)
- %	95	75	71
T-1 PSE	75	3	78
T-2 PSE	175	17	192
T-1 PSER PSI/Mh reported	0.28	0.01	0.16
T-2 PSER PSI/Mh reported	0.65	0.08	0.40
Total PSER PSI/Mh reported	0.92	0.09	0.56

The total number of Tier 1 and Tier 2 process safety events reported at Manufacturing sites where the higher process safety risks exist remained largely constant (249 in 2017 and 250 in 2018).

The 2018 ratio of Tier 1 to Tier 2 process safety events was 0.41 (78 Tier 1 and 192 Tier 2), up from 0.32 in 2017 (70 Tier 1 and 217 Tier 2).

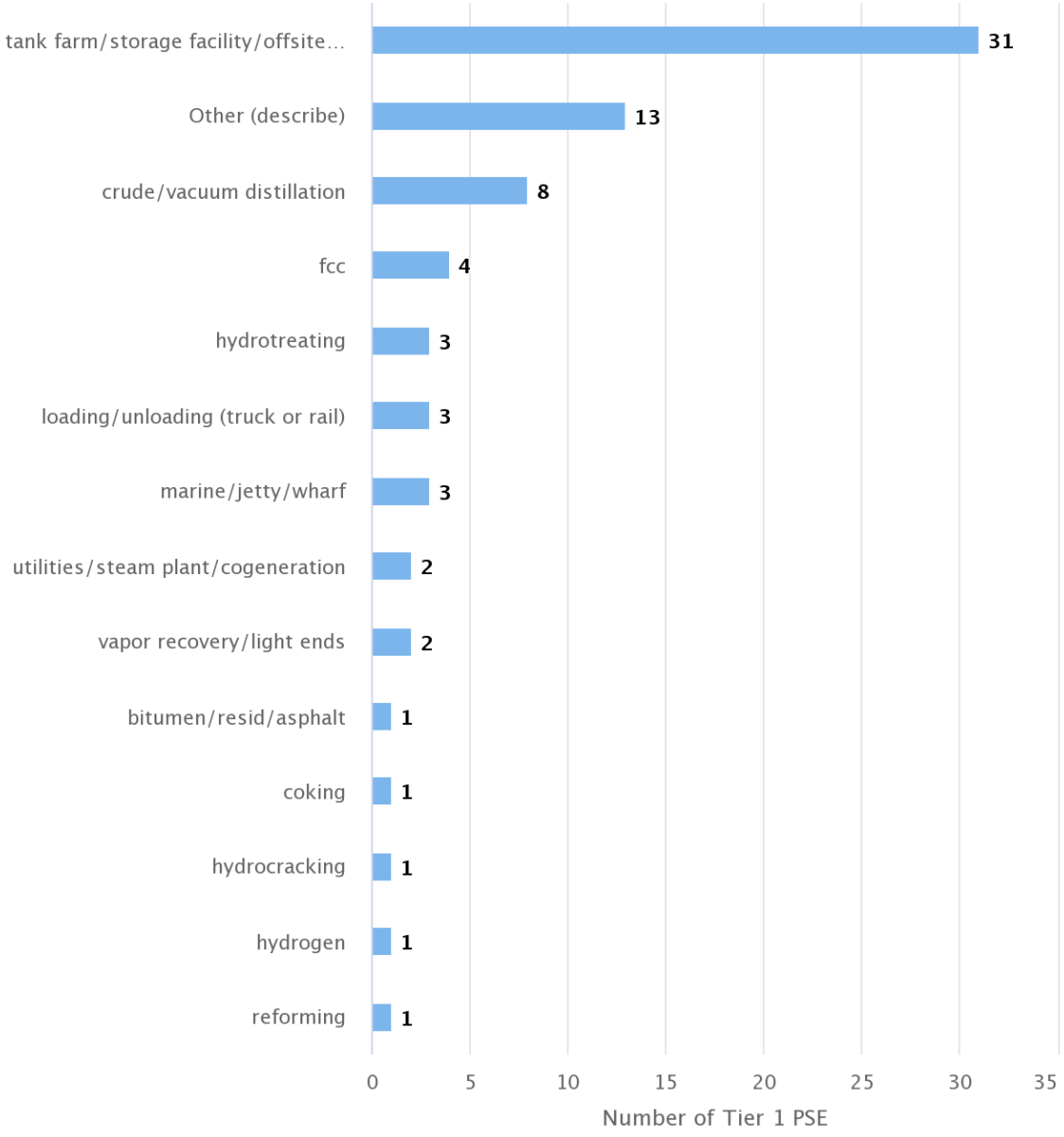
The Tier 1 PSER in 2018 was 0.16 compared with 0.14 in 2017. The Tier 2 PSER was 0.40 in 2018, down from 0.48 in 2017.

The number of LWIs resulting from the PSEs is not established, as this information is not currently available.

Since 2017 Concawe has been collecting additional information regarding the circumstances of Tier 1 Process Safety Events. This information for the 78 Tier 1 PSE in 2018 are provided in table form in **Appendix 4**. The following comments relate to the notable responses within each category:

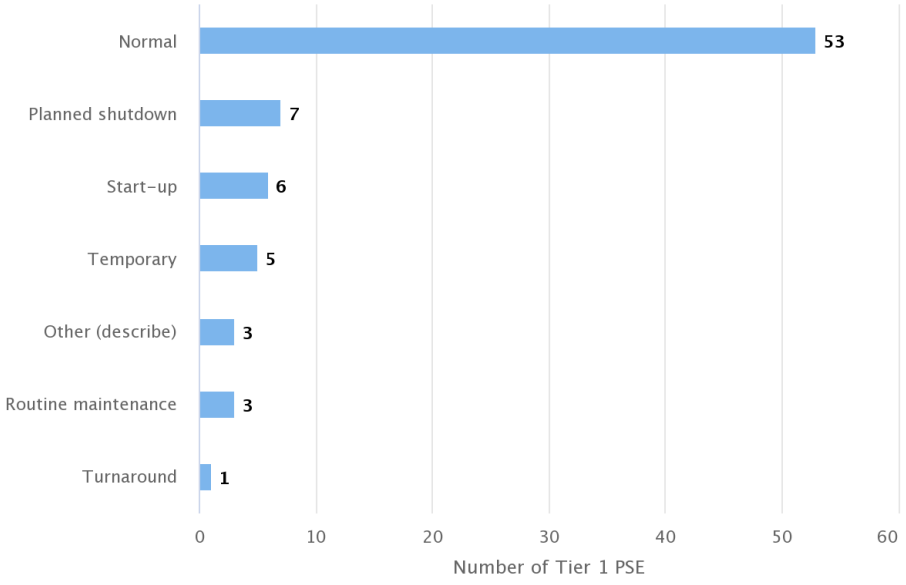
Type of Process: Tier 1 Process Safety Events in 2018 most frequently occurred in storage facilities or transfer piping (40% of all Tier 1 events), see **Figure 10** and **Table A4-1**. This finding is in alignment with 2017 data. Note that four PSE Tier 1 attributed to petrochemical processes are not included in Figure 10.

Figure 10 Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2018 by Refining Process



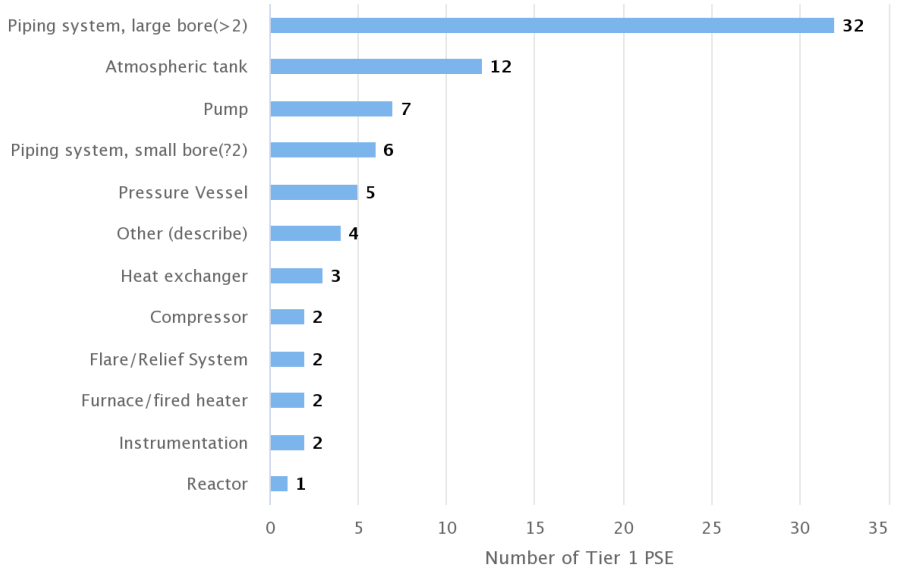
Mode of Operation: Sixty-nine percent of Tier 1 incidents occurred during normal operation, see **Figure 11**. This is alignment with 2017 Tier 1 data.

Figure 11 Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2018 by mode of operation



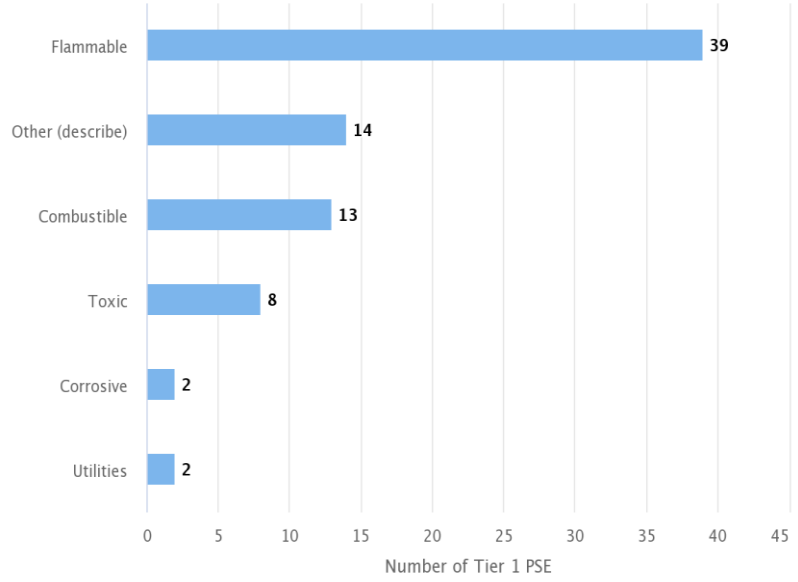
Point of Release: As in 2017, large bore piping remained the main point of release for Tier 1 events (41% of events in 2018), see **Figure 12**.

Figure 12 Number of Tier 1 Process Safety Events **(Manufacturing and Marketing)** reported in 2018 by point of release



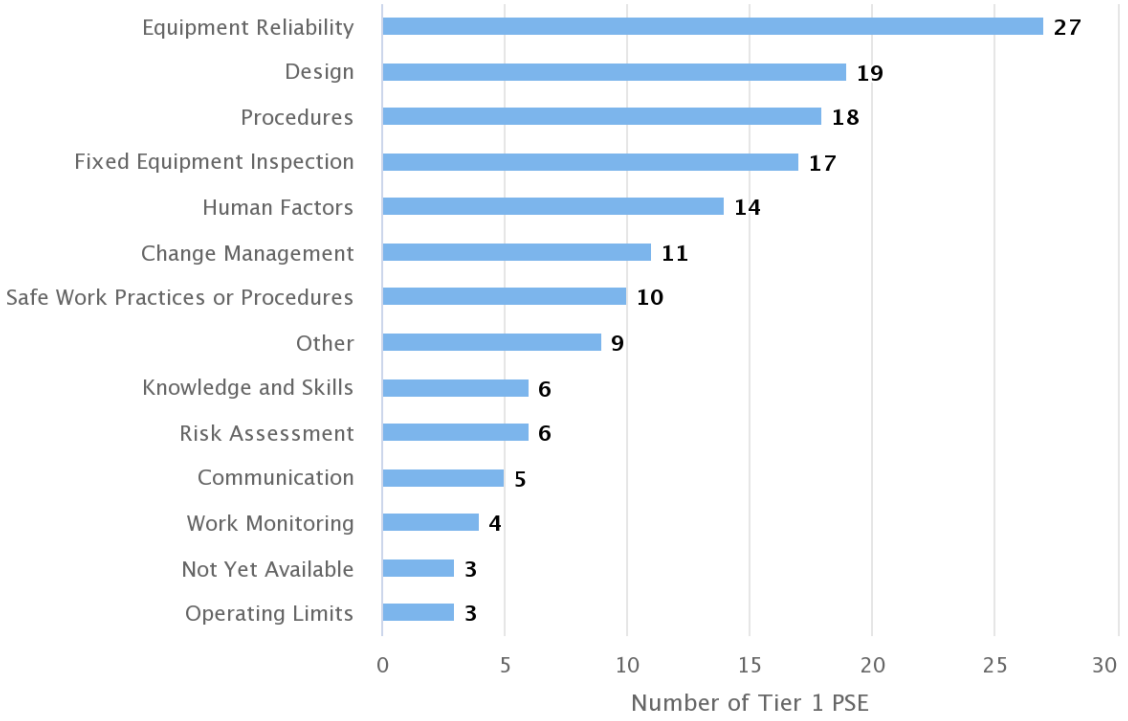
Type of material: Fig 13 indicates that flammable material was most frequently released in Tier 1 events in 2018 (50% of events). Again, this aligns with data from 2017.

Figure 13 Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2018 by type of material



Causal Factors: Equipment Reliability (allocated to 35% of events), Design (24%) Procedures (23%) and Fixed Equipment Inspection (22%), are the most frequently cited causal factors for Tier 1 events in 2018, see **Figure 14** below. Interestingly Human Factors which was the most frequently assigned causal factor for 2017 Tier 1 events, in 2018 was the fifth most assigned factor (18%).

Figure 14 Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2018 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 10, 11, 12 and 13 show the quartile ranges for PSE and PSER.

Table 10 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**	**2.1**
Q3	**4**	**10**	**7.9**
Q4	**13**	**46**	**19.9**

Table 11 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**	**2.1**
Q3	**3**	**10**	**7.0**
Q4	**11**	**43**	**18.6**

Table 12 Total PSER quartile distribution ranges and average values for each quartile range

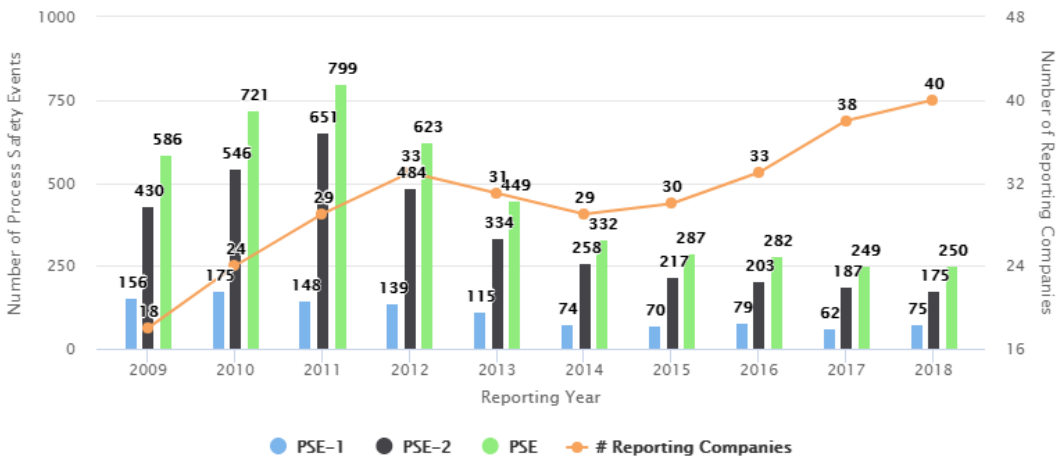
Manufacturing and Marketing PSER			
PSER	**Low**	**High**	**Average**
Q1	**0.00**	**0.08**	**0.01**
Q2	**0.15**	**0.49**	**0.33**
Q3	**0.61**	**1.79**	**1.12**
Q4	**2.06**	**6.89**	**3.86**

Table 13 Manufacturing PSER quartile distribution ranges and average values for each quartile range

Manufacturing PSER			
PSER	Low	High	Average
Q1	0.00	0.22	0.02
Q2	0.23	0.57	0.38
Q3	0.61	2.06	1.28
Q4	2.09	6.89	3.66

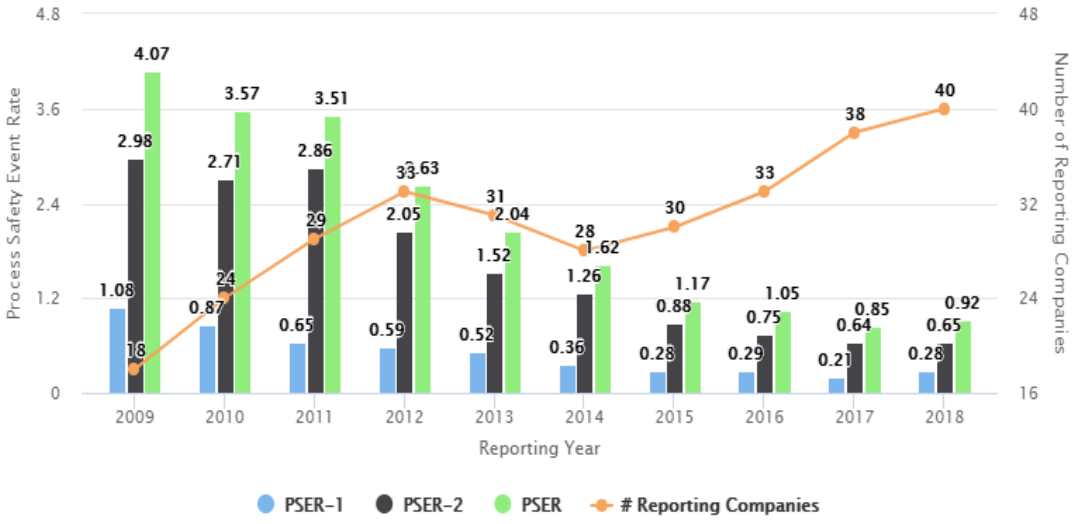
Figure 15 shows counts of the total Manufacturing PSE for the period 2009 to 2018 for which Concawe has data. **Figure 16** shows the same data expressed as rates. The data given are for Manufacturing, as only that data is sufficiently robust to allow the analysis provided in these presentations.

Figure 15 Process Safety Events last 10 years 2009-2018 - Manufacturing Staff and Contractors



As the number of reporting companies has risen over the past four years the number of total number of PSE in Manufacturing has plateaued in the last two years and in 2018 is at 250 annual PSE. The lowest number of Manufacturing Tier 2 PSE was recorded in 2018 (175) and the annual number of Manufacturing Tier 1 has plateaued between 62 and 79 annual events over the last five years.

Figure 16 Process Safety Event Rate last 10 years 2009-2018 - Manufacturing Staff and Contractors



The year on year decline in total Manufacturing PSER was reversed in 2018 with an increase from 0.85 in 2017 to 0.92 in 2018. This is largely driven by an increase in PSER Tier 1 (0.21 in 2017 and 0.28 in 2018). All Manufacturing PSER rates in 2018 remain below those in 2016.

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 14**. The IOGP statistics concern the upstream oil industry covering oil and gas exploration and production activities [28]. In comparison with IOGP statistics for European onshore, Concawe recorded higher fatalities, LWIF and AIF.

Table 14 Comparison of oil industry safety performance (own staff and contractors)

	Concawe 2018	International Association of Oil & Gas Producers IOGP 2018 Europe	
		Onshore	Onshore and Offshore
FAR	1.73	0.00	0.00
LTIF	1.03	0.46	0.70
AIF (TRIR)	1.89	1.18	2.17

The American Petroleum Institute (API) reports that the rate of injuries and illnesses for the US Petroleum Refining sector increased from 0.6 (job-related nonfatal injuries and illnesses) per 100 full-time workers in 2016 to 0.7 in 2017 [29]. 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 2018 LTIF expressed per 200,000 hours is 0.21.

The US Refining Tier 1 and 2 PSER recorded by API in 2018 are 0.0578 and 0.1722, respectively [32]. These values are comparable with 0.032 and 0.08 recorded by Concawe when expressed per 200,000 work hours.

A Lost Time Injury Rate (LTIR) for employees of 7.0 was recorded by the European Chemical Industry Association (Cefic) for Responsible Care companies in 2016 [30]. As a measure of number of lost time incidents per million working hours, this value is comparable with the Concawe LWIF, which in 2016 was 0.87. LTIR recorded by Cefic had previously decreased from 7.9 in 2011 to 6.6 in 2015.

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32. API 2018 Process Safety Event Public Reporting 2014-2018

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) [25,26]. 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

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.
COCO	Company owned and operated sites.
CODO	Company owned, Dealer operated sites.
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.
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.
DOCO	Dealer owned, Company operated sites.
DODO	Dealer owned and operated sites.
FAR	Fatal Accident rate is calculated from the number of fatalities divided by the number of hours worked expressed in hundred million.
Fatality	This is a death resulting from a work-related injury where the injured person dies within twelve months of the injury.
Hours worked	Hours worked by employees and contractors. Estimates should be used where contractor data is not available.
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 CO2, or compressed air).

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.
LWIF	Lost Workday Injury Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
LWIS	Lost Workday Injury Severity is the total number of days lost as a result of LWIs divided by the number of LWIs.
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.
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.
RAR	Road Accident Rate is calculated from the number of accidents divided by the kilometres travelled expressed in millions.
PSE	A Process Safety Event is an unplanned or uncontrolled LOPC. The severity of the PSE is defined by the consequences of the LOPC.
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.
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.
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.

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 [26]. Note Concawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concawe safety reports [18-24] for further details.
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 [26]. Note Concawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concawe safety reports [18-24] for further details.

Total days lost	The number of calendar days lost through LWIs counting from the day after the injury occurred.

Concawe 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.

Previous Category	Current Concawe Incident Category	Description
	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[1] 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.

1 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 2018

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	2.86	5.00	1.87	30	0.6	522.2	1011
2011	11	1.97	3.60	1.52	41	0.5	559.8	1085
2012	10	1.91	2.96	1.30	29	0.4	534.3	1161
2013	6	1.18	2.73	1.20	34	0.5	536.5	1175
2014	7	1.31	2.05	1.08	43	0.3	535.1	1269
2015	7	1.36	1.63	1.01	37	0.3	553	1109
2016	2	0.39	1.59	0.87	34	0.4	558.4	831
2017	2	0.34*	1.90*	0.97*	34	0.4*	594.3*	953*
2018	**10**	**1.73**	**1.89**	**1.02**	**35**	**0.3**	**579.1**	**978**

*2017 data provided in this table has been revised on the basis of new information received from participating companies since publication of the Concawe 2017 report [24]. This includes:
A reduction in originally reported work hours from 598.7 million in Concawe 2017 report [24] to 594.3 million in this report
An increase in kilometres driven from 925 million in Concawe 2017 report [24] to 953 million in this report.
These new data impact 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	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	1.68	77
2012	0	0.00	4.58	1.41	32
2013	0	0.00	3.72	1.29	33
2014	1	0.93	3.01	1.39	44
2015	3	3.01	2.77	1.50	41
2016	0	0.00	2.12	1.25	34
2017*	0	0.00	3.21*	1.53*	35
2018	**0**	**0.00**	**3.04**	**1.50**	**42**

*2017 data provided in this table have been revised since publication of the Concawe 2017 report [24]. This includes a reduction in originally reported work hours for 2017 from 598.7 million to 594.3 million in this report which impacts calculated rates.

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	6.67	5.57	1.67	31
2012	4	2.99	4.38	1.40	28
2013	4	3.49	4.06	1.24	34
2014	5	3.95	3.04	1.14	46
2015	1	0.67	1.79	0.87	36
2016	2	1.26	1.54	0.66	42
2017	1	0.54*	1.76*	0.78*	36
2018	**7**	**4.21**	**2.03**	**0.99**	**37**

*2017 data provided in this table have been revised since publication of the Concawe 2017 report [24]. This includes a reduction in originally reported work hours for 2017 from 598.7 million to 594.3 million in this report which impacts calculated rates

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	0.52	2.37	1.57	32
2012	2	1.19	1.98	1.40	28
2013	0	0.00	2.18	1.33	33
2014	0	0.00	1.52	0.99	42
2015	0	0.00	1.35	1.03	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

*2017 data provided in this table have been revised since publication of the Concawe 2017 report [24]. This includes a reduction in originally reported work hours for 2017 from 598.7 million to 594.3 million in this report which impacts calculated rates.

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	1.26	1.12	21
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	1.15	0.81	28
2018	2	1.38	1.01	0.73	28

Table A2-6 Lost Workday Injury categories 2014-2018 – Staff and Contractors in both Manufacturing and Marketing

	LWI 2018					2017	2016	2015	2014
Categories		**Manufacturing**	**Marketing**	**Combined**	**%**	**%**	**%**	**%**	**%**
Road Accident	Road accident	7	13	20	3.4	2.9	4.1	4.2	3.9
Height/Falls	Falls from height	32	24	56	9.6	7.8	7.3	8.6	8.6
	Staff hit by falling objects	5	10	15	2.6	3.1	3.0	3.1	4.6
	Slips & trips (same height)	98	94	192	33.0	36.5	30.1	29.5	27.1
Burn/ Electrical	Explosion or burns	32	6	38	6.5	4.5	7.3	6.0	6.2
	Exposure electrical	0	1	1	0.2	0.9	0.4	0.7	0.5
Confined Space	Confined space	2	0	2	0.3	0.2	0.2	0.2	0.2
Other Causes	Assault or violent act	1	10	11	1.9	2.0	3.0	3.1	2.8
	Water related, drowning	0	0	0	0.0	0.0	0.0	0.0	0.0
	Cut, puncture, scrape	27	23	50	8.6	6.4	5.7	4.6	8.6
	Struck by	35	32	67	11.5	13.3	8.3	11.9	10.9
	Exposure, noise, chemical, biological, vibration	16	2	18	3.1	4.7	3.5	2.6	2.5
	Caught in, under or between	29	13	42	7.2	3.8	6.1	9.0	7.7
	Overexertion, strain	15	17	32	5.5	9.5	15.2	13.9	10.0
	Pressure release	3	1	4	0.7	0.7	1.2	0.7	0.9
	Other	25	9	34	5.8	3.6	4.5	1.8	5.6
	Total	327	255	582	100.0	100.0	100.0	100.0	100.0

APPENDIX 3 LOST WORKDAY INJURIES 2018 - CAUSAL FACTORS

MF Manufacturing; MK Marketing		Number of Incidents													
Sector	**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	1	0	0	0	0	0	0	0
MK	Assault or violent act	0	0	0	0	0	0	0	0	1	0	0	0	8	1
MF	Caught in, under or between	1	2	3	1	0	14	4	0	3	4	6	2	1	10
MK	Caught in, under or between	0	1	1	0	0	9	0	0	1	3	1	0	1	2
MF	Confined space	0	0	0	0	1	0	0	0	0	0	0	0	0	1
MK	Confined space	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Cut, puncture, scrape	0	1	2	1	0	7	1	0	1	5	10	1	3	9
MK	Cut, puncture, scrape	0	1	1	0	0	13	2	0	4	2	4	0	4	5
MF	Explosion or burns	0	4	6	2	2	10	5	1	10	13	12	1	2	4
MK	Explosion or burns	0	0	0	1	0	4	0	0	1	0	2	0	1	0
MF	Exposure electrical	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK	Exposure electrical	0	0	0	1	1	0	0	0	0	0	0	0	0	0
MF	Exposure, noise, chemical, biological, vibration	1	1	3	4	0	5	1	0	4	1	3	0	6	2
MK	Exposure, noise, chemical, biological, vibration	0	0	0	0	0	1	0	0	0	1	1	0	0	0
MF	Falls from height	1	0	3	1	1	10	2	0	2	9	7	1	5	12
MK	Falls from height	0	1	2	0	1	14	3	0	1	2	4	1	5	3
MF	Other	0	1	0	0	0	3	2	0	1	1	5	2	3	16
MK	Other	0	0	0	0	0	5	0	0	1	1	1	0	4	0
MF	Overexertion, strain	0	0	1	1	0	6	1	0	2	1	3	0	5	1
MK	Overexertion, strain	0	0	1	0	1	9	2	0	2	5	4	1	5	1
MF	Pressure release	0	0	1	0	1	0	1	0	0	1	0	0	0	1
MK	Pressure release	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MF	Road accident	0	0	0	0	0	3	0	0	0	0	0	0	0	4
MK	Road accident	0	0	0	0	0	7	0	0	0	0	0	0	2	4
MF	Slips & trips (same height)	0	0	10	4	2	48	7	0	4	9	14	2	23	18
MK	Slips & trips (same height)	1	2	4	0	0	50	4	0	6	6	2	0	26	17
MF	Staff hit by falling objects	0	0	0	0	1	2	0	1	1	1	2	0	0	1
MK	Staff hit by falling objects	0	1	2	1	2	3	1	0	2	1	3	0	0	3
MF	Struck by	0	0	4	3	0	11	3	0	2	3	6	0	2	11
MK	Struck by	0	1	4	2	0	14	3	0	4	2	3	0	6	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	**4**	**16**	**48**	**22**	**13**	**248**	**43**	**2**	**53**	**71**	**93**	**11**	**112**	**135**

APPENDIX 4 PROCESS SAFETY EVENTS 2018

Table A4-1 Type of Process (Refining)

Type of Process: Refining	
1. active warehouse	
2. alkylation, HF	
3. alkylation, sulfuric	
4. bitumen/resid/asphalt	1
5. calcining	
6. coking	1
7. crude/vacuum distillation	8
8. fcc	4
9. flares/flare systems/flare gas recovery	
10. gas and liquid desulfurization/treating (H2S absorbers, amine systems, Merox)	
11. hydrocracking	1
12. hydrogen	1
13. hydrotreating	3
14. isomerization	
15. loading/unloading (truck or rail)	3
16. marine/jetty/wharf	3
17. Other (describe)	13
18. pilot plant	
19. reforming	1
20. sulfur recovery	
21. tank farm/storage facility/offsites/storage and transfer piping	31
22. utilities/steam plant/cogeneration	2
23. vapor recovery/light ends	2
24. waste/wastewater handling, treatment or disposal	
Total	**74**

Table A4-2 Type of Process (Petrochemical & other process)

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

Table A4-3 Mode of Operation

Mode of Operation	
1. Emergency shutdown	
2. Normal	53
3. Other (describe)	3
4. Planned shutdown	7
5. Routine maintenance	3
6. Start-up	6
7. Temporary	5
8. Turnaround	1
9. Upset	
Total	**78**

Table A4-4 Point of release

Point of Release	
1. Atmospheric tank	12
2. Blower/Fan	
3. Compressor	2
4. Cooling Tower	
5. Filter/Coalescer/Strainer	
6. Fired Boiler	
7. Flare/Relief System	2
8. Furnace/fired heater	2
9. Heat exchanger	3
10. Instrumentation	2
11. Other (describe)	4
12. Piping system, large bore(>2)	32
13. Piping system, small bore(?2)	6
14. Pressure Vessel	5
15. Pump	7
16. Reactor	1
Total	**78**

Table A4- Type of Material

Type of Material	
1. Emergency shutdown	13
2. Normal	2
3. Other (describe)	39
4. Planned shutdown	14
5. Routine maintenance	8
6. Start-up	
7. Temporary	2
Total	**78**

Table A4-6 Causal Factors

Causal Factors	
1. Change Management	11
2. Communication	5
3. Design	19
4. Equipment Reliability	27
5. Fixed Equipment Inspection	17
6. Human Factors	14
7. Knowledge and Skills	6
8. Operating Limits	3
9. Procedures	18
10. Risk Assessment	6
11. Safe Work Practices or Procedures	10
12. Work Monitoring	4
13. Other	9
14. Not Yet Available	4
Total	**153**

APPENDIX 5 CONCAWE MEMBER COMPANIES THAT SUBMITTED DATA

The following member companies provided the data upon which this report is based.

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
Total	Valero	VaroEnergy	VPR Energy

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