

## European downstream oil industry safety performance

Statistical summary of  
reported incidents – 2014



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# **European downstream oil industry safety performance**

## **Statistical summary of reported incidents – 2014**

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## ABSTRACT

In this twenty-first annual report on European downstream oil industry safety performance, 2014 statistics are presented on work-related personal injuries for the industry's own employees and contractors. Information was received from 38 Concaawe Member Companies representing approximately 98% of the European refining capacity. Trends over the last twenty-one years are also highlighted and the data are compared to similar statistics from related industries. This report also presents the sixth year of results for Process Safety Performance Indicators from Concaawe members.

## KEYWORDS

Accidents, AIF, Concaawe, FAR, fatality, incidents, injury, LWI, LWIF, marketing, oil industry, refining, RAR, RWI, safety statistics, Process Safety Performance Indicators, Process Safety Events

## INTERNET

This report is available as an Adobe pdf file on the Concaawe website ([www.concaawe.org](http://www.concaawe.org)).

## NOTE

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## SUMMARY

The collection and analysis of accident data are widely recognised by the oil industry as an essential element of an effective safety management system.

This report is the twenty first Concaawe review on safety, compiling statistical data for the European downstream oil industry. This latest version incorporates data for 2014 and gives a full historical perspective from 1993. It also includes comparative figures from other related industry sectors. For 2014, information was received from 38 Concaawe Member Companies, together accounting for more than 98% of the available refining capacity in the EU-28, Norway and Switzerland.

The results are reported mainly in the form of key performance indicators that have been adopted by the majority of oil companies operating in Europe as well as by other industry sectors.

Accident frequencies in the European downstream oil industry are generally at low levels and the 2014 performance continues this trend. Standing at 1.1, the Lost Work Incident Frequency (LWIF) indicator for 2014 is slightly lower than that achieved in 2013 (1.2), and is the lowest recorded since 1993, which maintains the positive trend of being less than 2.0 as has been the case since 2007. The responsible management of safety in the oil industry has resulted in a low level of accidents despite the intrinsic hazards of the materials handled and the operations carried out.

During the process of data collection and verification in 2015, an error was found in the hours reported by one company for the 2013 year (as reported in the 2014 report). The results for 2013 have been corrected where necessary within this report.

In 2014, the fatal accident rate (1.38 per hundred million hours worked) and the total number of fatalities (7) were marginally higher than in 2013 (6 fatalities, 1.11 Fatal Accident Rate (FAR)), but remain at a historical low level. Of the 7 fatalities, 6 were Contractors (5 Manufacturing and 1 Marketing): 3 (43%) resulted from “struck by”, 1 (14%) was caused by a “road accident”, 1 (14%) resulted from a fall from height, 1 (14%) was caused by “confined space” and 1 (14%) was categorised as “other”.

For the sixth consecutive year, Concaawe Member Companies were asked to provide Process Safety Performance Indicator (PSPI) data which describe the number of Process Safety Events (PSE) expressed as unintended Loss of Primary Containment (LOPC). Twenty-nine Companies provided data in 2014, three less than in 2013 (32 Companies) and four less than in 2012 (33 Companies). The 2014 data represents 76% of the respondents and 83% of the hours worked. Up until 2012 the number of respondents was increasing each year but it now seems to have plateaued. From the responses for 2014, a Process Safety Event Rate (PSER) indicator of 0.9 for all PSEs was recorded, a reduction from 1.1 recorded in 2013 and a continuation of the year by year reduction since the commencement of data collection in 2009.

## 1. INTRODUCTION

The collection and analysis of accident data are widely recognised by the oil industry as an essential element of an effective safety management system.

Concaawe started compiling statistical data for the European downstream oil industry twenty-two years ago and this is the twenty-first report on this topic (see references of past reports in the reference list [1-20]). This report covers data collected for 2014 and includes a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available.

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 but all those who do, collect data separately for “Manufacturing” (i.e. refining) and “Marketing” (i.e. distribution and retail, also including “head office” staff) and this split has also been applied in the Concaawe data. Additionally, the data are split between own personnel and contractors, the latter being fully integrated in all of the companies’ safety monitoring systems. The purpose of collecting this information is twofold:

- To provide member companies with a benchmark against which to compare their performance, so that they can determine the efficacy of their 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.

From the outset, a majority of Concaawe member companies have participated so that the sample has always represented a large portion of the industry. By 1995 virtually all Concaawe members participated, representing about 93% of the European refining capacity (somewhat less for distribution and retail). Over the years this level of participation has peaked to >97%, although the actual number of participating companies fluctuated in line with the structural changes and mergers occurring in the industry as did the percentage of the refining capacity represented. For 2014, 38 Member Companies responded with the submission of a completed questionnaire, however, not all companies could supply all the requested data. Therefore, the statistics presented represent more than 98% of the refining capacity.

The geographical area covered is the EU-28, Norway and Switzerland.

A number of key performance indicators have been adopted by the majority of oil companies operating in Europe as well as by other industries. Although there are differences in the way different companies collect basic data, these fairly straightforward parameters allow an objective comparison. There are differences noted between companies in their precise definitions or interpretation of metrics, meaning direct comparison of data from different companies could lead to erroneous conclusions. For this reason, Concaawe does not report individual company data but rather aggregates, averages and ranges of variation.

24 out of the 38 participating companies stated their willingness to share their data openly with other companies.

## 2. PERFORMANCE INDICATORS

A number of safety performance indicators have become “standard” in the oil industry and in many other industry sectors. They are mostly expressed in terms of event frequency - the number of hours worked being the common denominator representing the level of activity. Such parameters have the advantage of relying on a small number of straightforward inputs, which allows meaningful statistical analysis even when the data sets are incomplete. The performance indicators considered in this report are:

- The number of work-related fatalities and the associated Fatal Accident Rate (FAR) is expressed as the number of fatalities per 100 million hours worked.
- The All Injury Frequency (AIF) includes all recordable injuries and is expressed as the number of injuries per million hours worked.<sup>1</sup>
- The Lost Workday Injury Frequency (LWIF) is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
- Related to LWIF is the Lost Workday Injury Severity (LWIS) that expresses the average number of lost workdays per LWI.
- The Road Accident Rate (RAR) expressed in number of road accidents per million kilometres travelled.
- The Process Safety Performance Indicators (PSPI) [Appendix 2, 17, 18] measure the number of Process Safety Events (PSEs) expressed as the number of unplanned or uncontrolled releases of any material, including non-toxic and non-flammable materials from a process with the severity defined by the consequences experienced or released amount thresholds.

A more complete set of definitions is given in **Appendix 1** and the PSE criteria are further explained in **Appendix 2**.

There are, however, subtle differences in the way these parameters are used by different companies and how the data is collected and reported. The features, relevance and reliability of each indicator are further discussed below.

### ***Fatalities and Fatal Accident Rate (FAR)***

Because of their very low numbers, fatalities and, therefore, FAR are not 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. Indeed the well-known safety triangle suggests that for every fatality there have been many incidents with similar causes but less serious injury outcomes. These less severe incidents provide the opportunities to address equipment, standards, training, attitudes and practices that may prevent the near-misses, relatively minor incidents and, ultimately, the more serious accidents.

### ***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

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<sup>1</sup> AIF is often referred to as TRCF – Total Recordable Case Frequency. Refer **Appendix 1**.



industry. All companies without exception collect employee LWIF data for at least their own staff and this is, therefore, the most representative and reliable indicator of all.

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, these appear to reach a plateau and are prone to wider variations in relative terms. Companies that have achieved very low LWIF levels therefore need a more meaningful indicator to monitor trends and detect improvements or deterioration of performance. AIF provides 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.

### ***Road Accident Rate (RAR)***

It is no surprise that, since road accidents remain a cause of both fatalities and lost time injuries 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, Concaawe 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.

### 3. 2014 RESULTS

During the 2015 process of data collection for the 2014 year, there was an error identified in the data collected for the previous 2013 year. The error was in relation to the hours reported by one company. Consequently the results for 2013 have been corrected where necessary within this report.

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

**Table 1** Submission of results for 2014

No of companies	Manufacturing			Marketing		
	Own staff	Contractors	All workers	Own staff	Contractors	All workers
Submission	37	35		24	19	
Including						
Road accidents <sup>a</sup>	7	2		11	10	
Distance travelled	12	5		16	10	
Process Safety			28			15
Retail Operations						
COCO						10
CODO						4
DOCO						5
DODO						2

a) Several Companies do not report their Road accidents separately and these incidents are included in their overall statistics.

Most companies submitted data for their own Manufacturing and Marketing staff (several companies have no retail activity). This year there were 37 companies which reported Manufacturing statistics and one company which only reported Marketing data. This results in a total of 38 member companies reporting. Total own staff injuries are recorded by all companies, in the Manufacturing and/or Marketing categories, but this is not the case for lost days. A number of companies do not record road accidents separately. Contractor data are generally less complete.

In 2014 the members requested some additional information in relation to the nature of Marketing retail operations. As a result, companies were asked to describe their retail operations as either Company owned company operated, Company owned dealer operated, Dealer owned company operated or Dealer owned dealer operated. Answers were provided by only 10 companies and they are presented in **Table 1**.

The PSE data were requested for the sixth time in 2014 for all workers in both Manufacturing and Marketing sectors. In 2014, 28 companies submitted PSE data for the Manufacturing operations and 15 submitted Marketing PSE data. These numbers are lower than the number of respondents in 2013 as several companies did not report Process Safety data where they had done so in the past. The results are presented in Section 5.

The aggregated 2014 results per sector and for the whole of the European downstream oil industry are shown in **Table 2**. **Figure 1a** shows the average performance indicators and their range of variability amongst reporting companies. **Figures 1b** and **1c** show the results for all injuries and AIF and lost time injuries and

LWIF on a cumulative frequency basis, which allows individual companies to benchmark their own results against the group. For AIF and LWIF, which are the most universally used indicators, the distribution per quartile and average for each quartile are shown for the different sectors (**Figure 2a/b**).

**Table 2** Aggregated 2014 results for all reporting companies

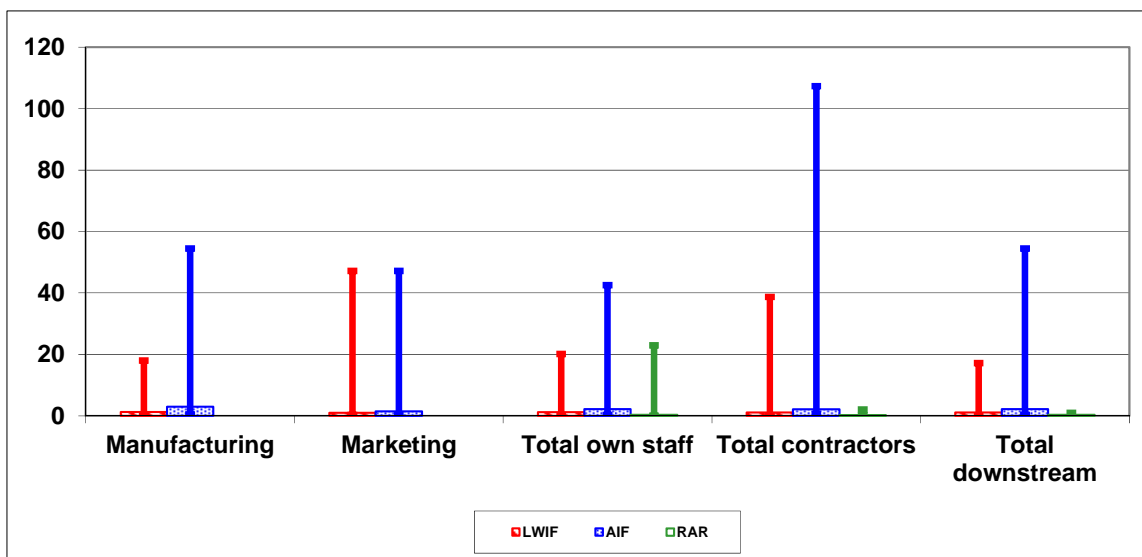
Sector		Manufacturing			Marketing			Both Sectors		
		OS	CT	AW	OS	CT	AW	OS	CT	AW
Work Force										
Hours worked	Mh	107	132	239	159	110	269	266	241	508
Fatalities		1	5	6	0	1	1	1	6	7
Fatal Accident Rate	F/100 Mh	0.9	3.8	2.5	0.0	0.9	0.4	0.4	2.5	1.4
Lost work incidents	LWI	147	144	291	166	112	278	313	256	569
Lost time through LWI	days	6,281	5,481	11,762	6,093	3,103	9,196	12,374	8,584	20,958
LWI frequency	LWI/Mh	1.4	1.1	1.2	1.0	1.0	1.0	1.2	1.1	1.1
LWI severity	lost days/LWI	43.9	46.1	44.9	42.3	38.3	40.9	43.1	42.9	43.0
All recordable incidents	AI	325	385	710	257	130	387	582	515	1,097
All incidents frequency	AI/Mh	3.0	2.9	3.0	1.6	1.2	1.4	2.2	2.1	2.2
Distance travelled	million km							550	718	1269
Road Accidents	RA							182	191	373
Road Accident Rate <sup>+</sup>	RA/million km							0.33	0.26	0.29

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

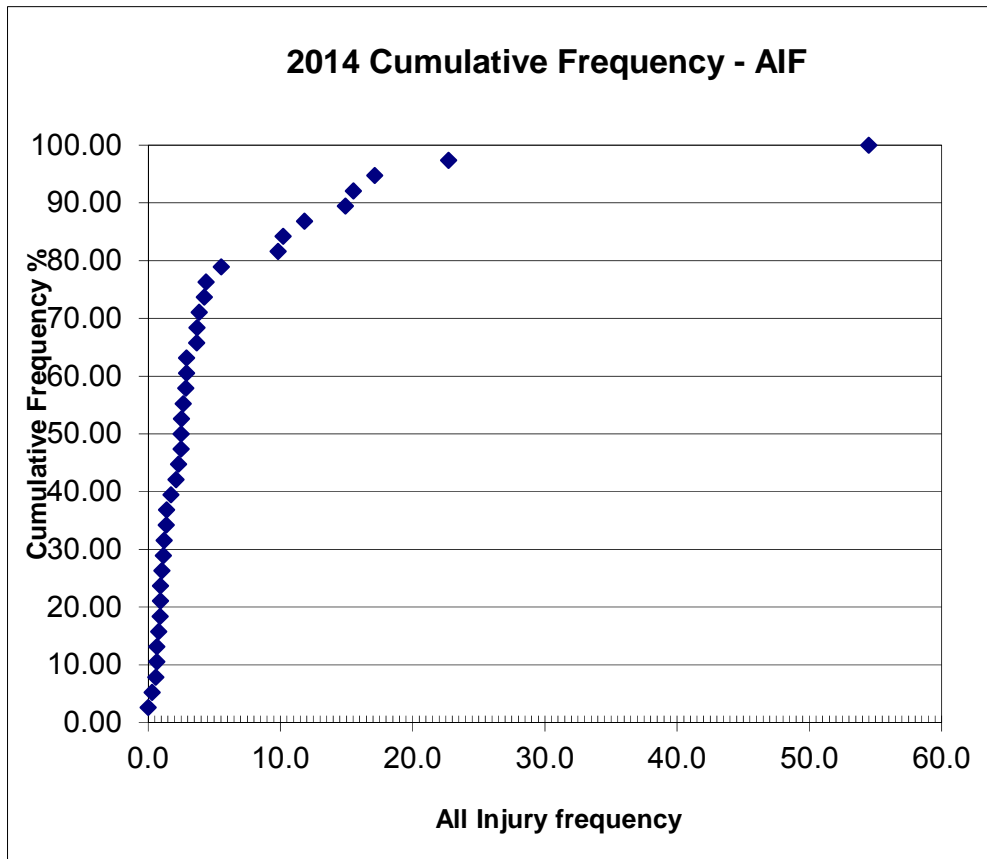
\*) RAR is calculated for those RA where distance is reported

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

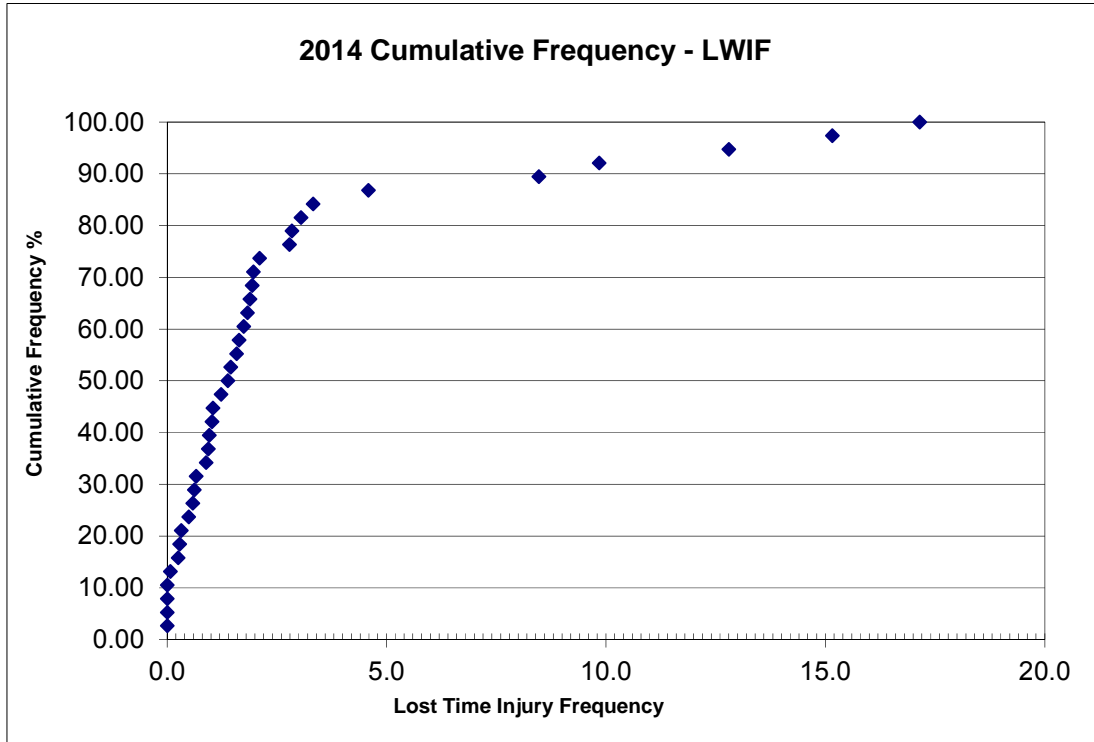
**Figure 1a** Average 2014 performance indicators with range of variability



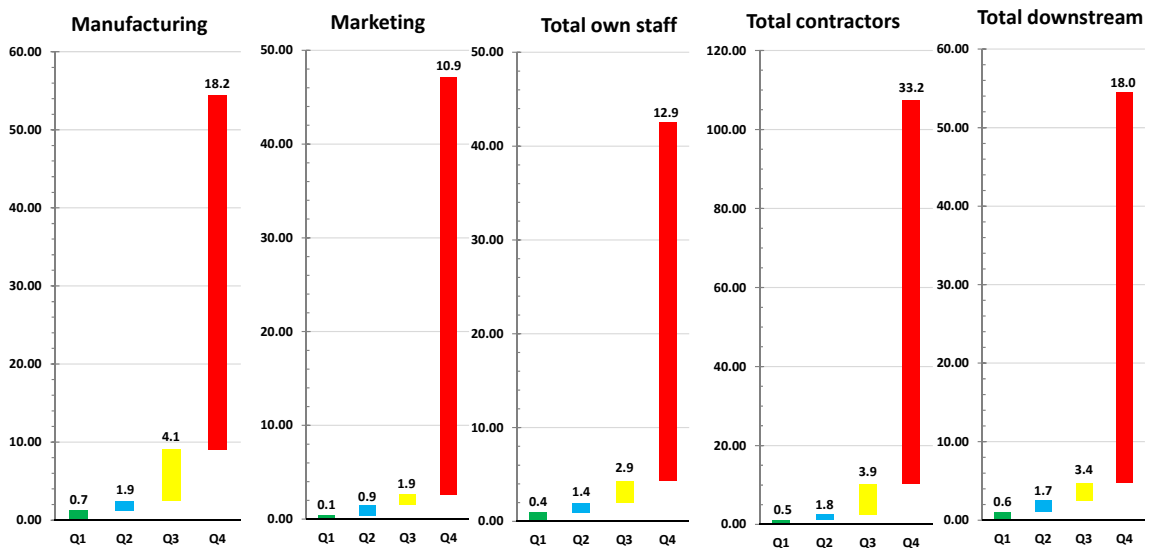
**Figure 1b** Cumulative Frequency Analysis All Injury Frequency



**Figure 1c** Cumulative Frequency Analysis Lost Work Injury Frequency



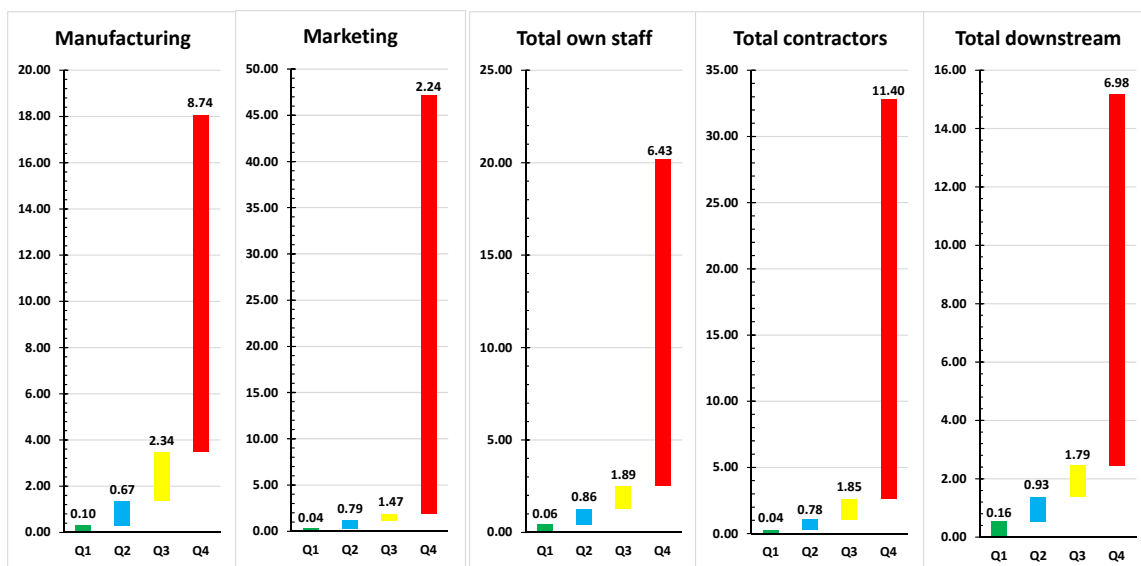
**Figure 2a** AIF quartile distribution ranges and average values for each quartile range



**Table 3** 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	1.24	0.67	0.00	0.39	0.12	0.00	0.96	0.38	0.00	1.10	0.52	0.00	1.02	0.65
Q2	1.24	2.51	1.86	0.39	1.48	0.91	0.96	2.02	1.38	1.10	2.53	1.79	1.02	2.52	1.74
Q3	2.51	9.04	4.13	1.48	2.65	1.90	2.02	4.33	2.91	2.53	10.37	3.88	2.52	4.68	3.38
Q4	9.04	54.49	18.22	2.65	47.17	10.93	4.33	42.52	12.86	10.37	107.37	33.19	4.68	54.49	18.03

**Figure 2b** LWIF quartile distribution ranges and average values for each quartile range

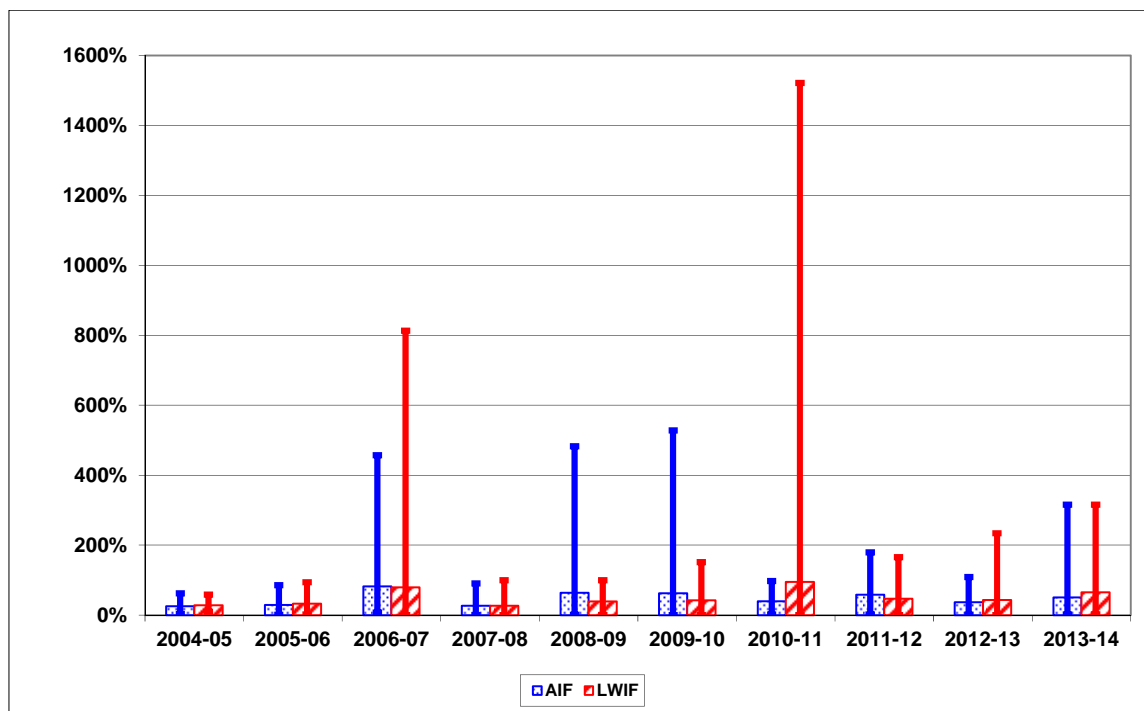


**Table 4** LWIF quartile distribution ranges and average values for each quartile range

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	0.30	0.10	0.00	0.28	0.04	0.00	0.43	0.06	0.00	0.28	0.04	0.00	0.53	0.16
Q2	0.30	1.38	0.67	0.28	1.20	0.79	0.43	1.29	0.86	0.28	1.05	0.78	0.53	1.38	0.93
Q3	1.38	3.47	2.08	1.20	1.86	1.47	1.29	2.50	1.89	1.05	2.59	1.85	1.38	2.44	1.79
Q4	3.47	18.04	8.74	1.86	47.17	2.24	2.50	20.15	6.43	2.59	32.78	11.40	2.44	15.16	6.98

The average performance indicator figures clearly conceal a wide range of individual values between reporting companies. **Figure 3** shows that the variability is significantly less when looking at year-on-year figures for each company individually.

**Figure 3** Year-on-year performance indicator variations  
Average for all reporting companies



In summary, there are large differences in reported figures between companies but, for the most part, these differences also do not change much over the years. This reflects genuine levels of performance achieved by different organisations but also differences in the way companies monitor and classify incidents and collect their data.

**LWI Causes**

The analysis of the data collected on causes for fatalities and injuries has generated much interest amongst the membership. In 2013 the Concaawe members agreed to adopt 16 cause categories to describe both fatalities and lost work time injuries (LWI). These cause categories are aligned with other organisations (e.g. OGP). In 2014 these cause categories continue to be used to categorise fatalities and LWIs. A summary of the categories and explanation is provided in **Appendix 3**. A total of 569 LWIs were reported in 2014 and all were allocated to the agreed categories within the company submissions.

The results are described in **Table 5** below.

**Table 5** Causes of LWI in 2014

		LWI 2014				2013
Causes 2014		Manufacturing	Marketing	Combined	Percentage	Percentage
Road accident	Road accident	5	17	22	3.9%	4.4%
Height/Falls	Falls from height	21	28	49	8.6%	10.3%
	Staff hit by falling objects	10	16	26	4.6%	3.6%
	Slips & trips (same height)	66	88	154	27.1%	32.7%
Burn/ electrical	Explosion or burns	26	9	35	6.2%	4.8%
	Exposure electrical	3	0	3	0.5%	0.6%
Confined space	Confined Space		1	1	0.2%	0.8%
Other causes	Assault or violent act		16	16	2.8%	1.7%
	Water related, drowning				0.0%	0.2%
	Cut, puncture, scrape	30	19	49	8.6%	5.0%
	Struck by	35	27	62	10.9%	9.6%
	Exposure, noise, chemical, biological, vibration	12	2	14	2.5%	2.6%
	Caught in, under or between	33	11	44	7.7%	7.3%
	Overexertion, strain	22	35	57	10.0%	12.4%
	Pressure release	3	2	5	0.9%	0.9%
	Other	25	7	32	5.6%	3.1%
	<b>Total</b>	291	278	569	100%	100%

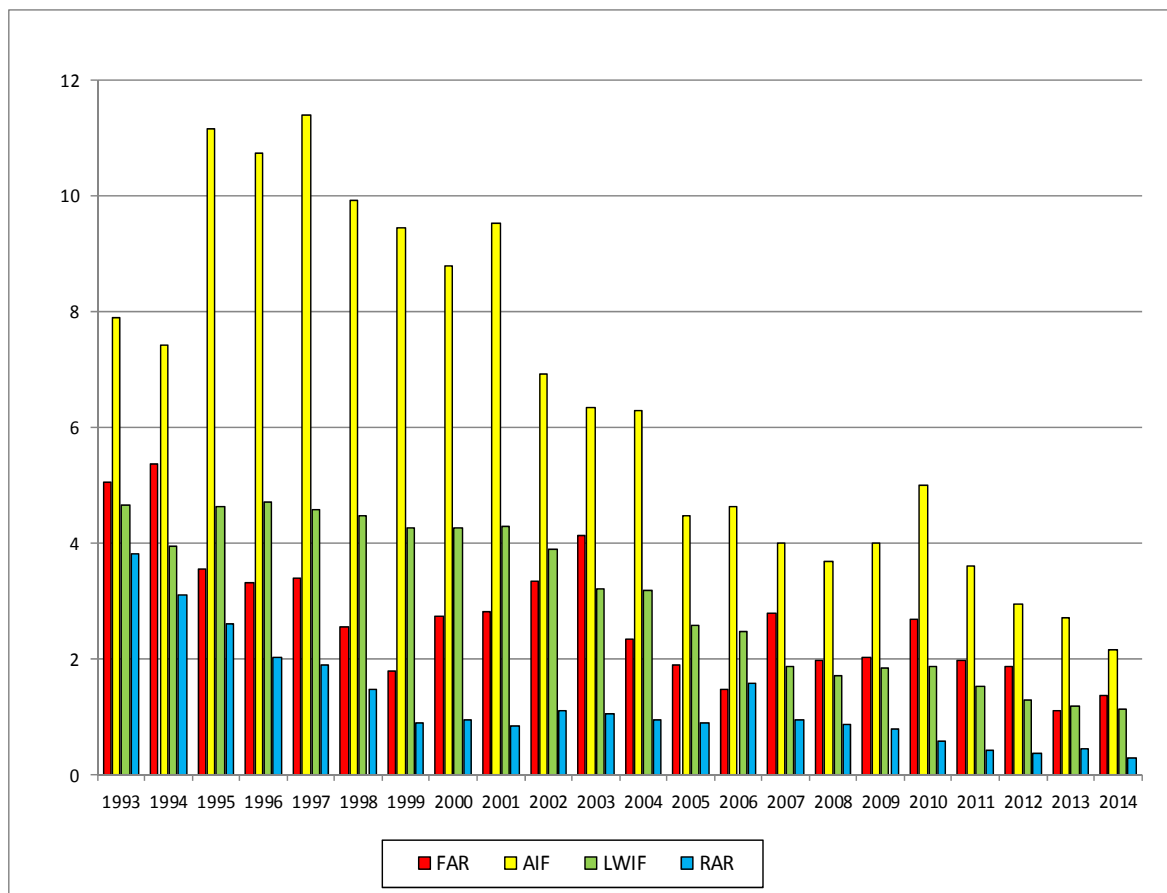
As this is the second year of using the new 16 categories for all incidents, a summary of the 2013 results has been included in the table for comparison. The outcome in terms of the % allocation of causes is very consistent from 2013 to 2014. This consistency in the causes will clearly aid in identifying areas of concern for all Companies. After only 2 years of collecting the new data it is already possible to draw some limited conclusions about the causes of LWI which could suggest areas of focus. Slips & trips (same height), 27.1%, Struck by, 10.9%, Overexertion & strain, 10.0%, Falls from height, 8.6%, Cut, puncture, scrape, 8.6% are the major causes of LWIs in 2014 and together account for 65% of all LWIs. The causes 'Struck by' and 'Fall from height' also account for 4 of the 7 fatalities in 2014. Undoubtedly, as further years of data is collected, it will be possible to confirm the major risk areas for LWIs and assist in identifying potential areas of focus.



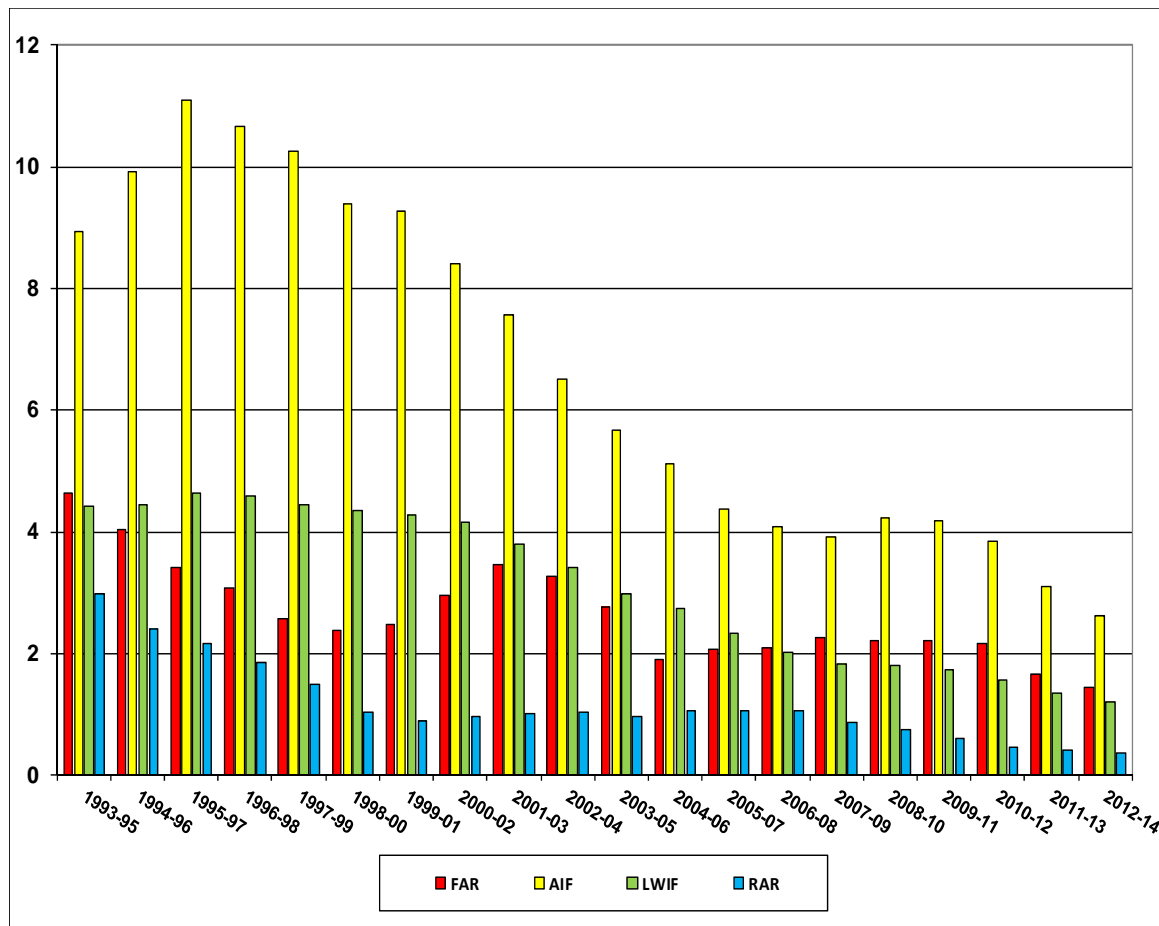
#### 4. HISTORICAL TRENDS

The performance indicators are of particular interest when considering their evolution over the years. The historical trends for the European downstream oil industry as a whole are shown in **Figures 4a/b** and **Table 6**.

**Figure 4a** Historical evolution of main performance indicators  
Yearly data for the whole European downstream industry



**Figure 4b** Historical evolution of main performance indicators  
3-year rolling average for the whole European downstream industry

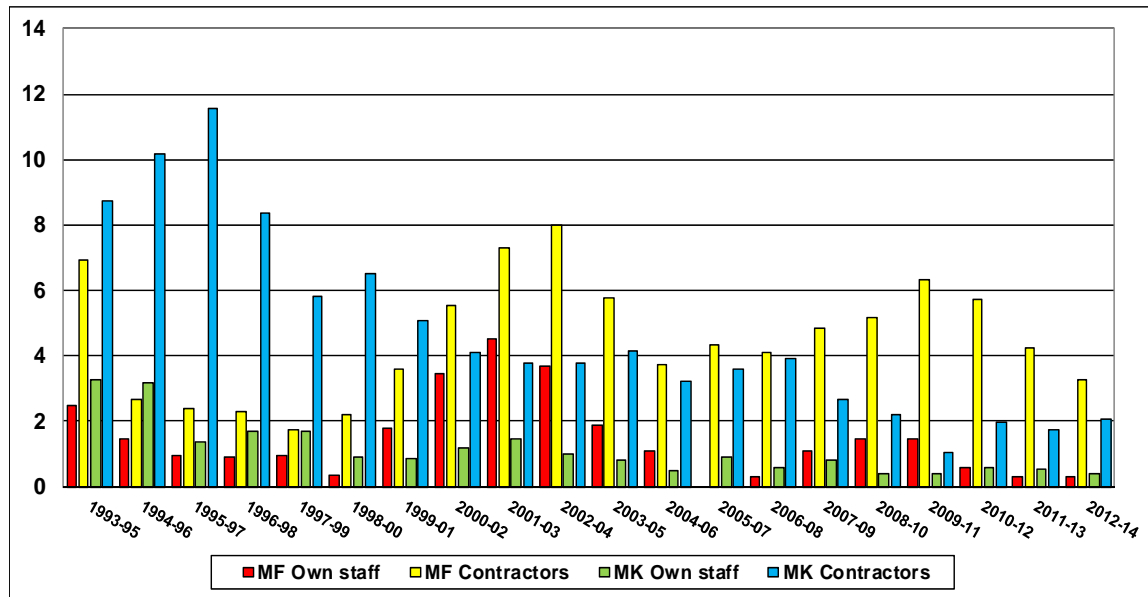


**Table 6** Historical evolution of performance indicators

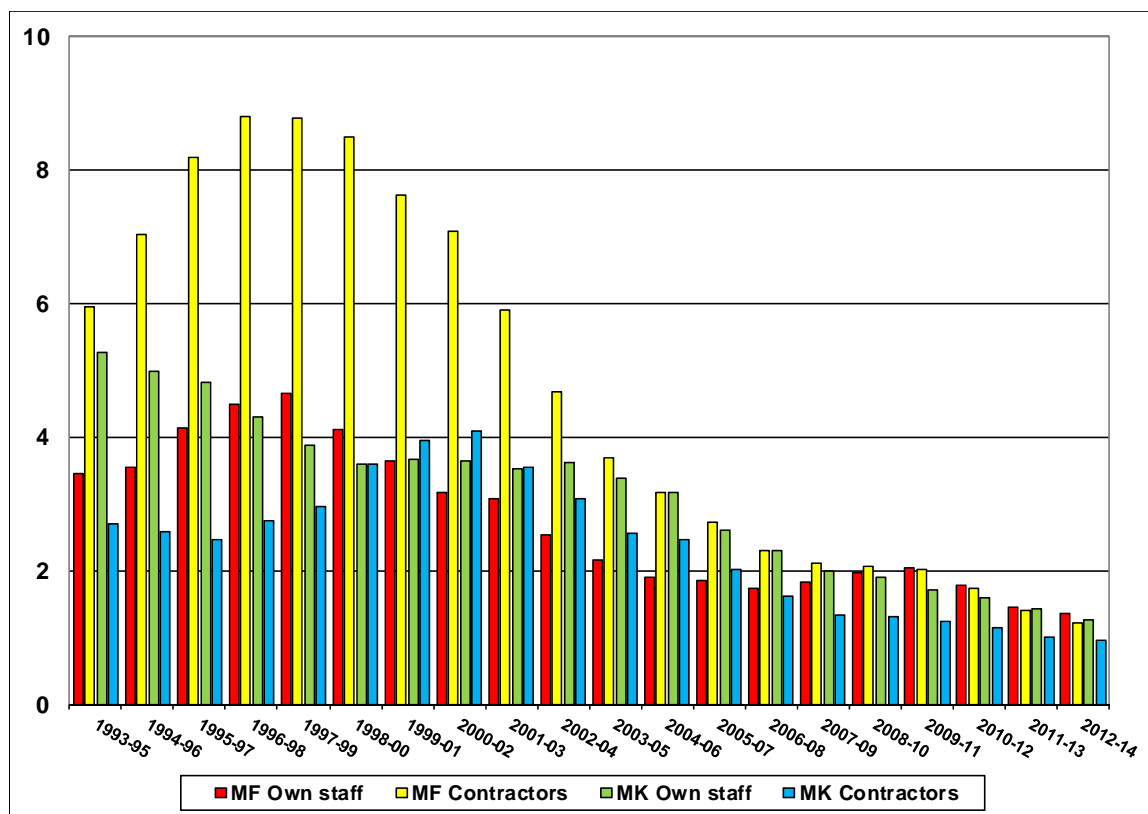
Year	Fatalities	FAR	AIF	LWIF	LWIS	RAR	Million Hours Reported
1993	18	5.0	7.9	4.7	27	3.8	357.0
1994	19	5.4	7.4	4.0	25	3.1	354.8
1995	13	3.5	11.2	4.6	24	2.6	366.4
1996	14	3.3	10.7	4.7	19	2.0	420.6
1997	15	3.4	11.4	4.6	23	1.9	442.0
1998	12	2.6	9.9	4.5	22	1.5	469.7
1999	8	1.8	9.4	4.3	21	0.9	448.5
2000	13	2.7	8.8	4.3	25	0.9	475.1
2001	14	2.8	9.5	4.3	24	0.8	495.5
2002	16	3.3	6.9	3.9	23	1.1	480.0
2003	22	4.1	6.3	3.2	30	1.0	531.6
2004	12	2.3	6.3	3.2	33	1.0	513.3
2005	11	1.9	4.5	2.6	35	0.9	581.7
2006	7	1.5	4.6	2.5	30	1.6	477.5
2007	15	2.8	4.0	1.9	35	0.9	538.2
2008	11	2.0	3.7	1.7	28	0.9	555.5
2009	11	2.0	4.0	1.8	29	0.8	545.5
2010	14	2.7	5.0	1.9	30	0.6	522.2
2011	11	2.0	3.6	1.5	41	0.4	559.8
2012	10	1.9	3.0	1.3	29	0.4	534.3
2013	6	1.1	2.7	1.2	34	0.5	539.8
<b>2014</b>	<b>7</b>	<b>1.4</b>	<b>2.2</b>	<b>1.1</b>	<b>43</b>	<b>0.3</b>	<b>507.7</b>
<b>Averages</b>							
1993-2014	13	2.6	6.1	2.9	27	1.0	487.1
<b>3-year rolling average</b>							
Year	Fatalities	FAR	AIF	LWIF	LWIS	RAR	Million Hours Reported
1993-95	17	4.6	8.9	4.4	25	3.0	359.4
1994-96	15	4.0	9.9	4.5	22	2.4	380.6
1995-97	14	3.4	11.1	4.6	22	2.2	409.7
1996-98	14	3.1	10.7	4.6	21	1.9	444.1
1997-99	12	2.6	10.3	4.4	22	1.5	453.4
1998-00	11	2.4	9.4	4.3	23	1.0	464.4
1999-01	12	2.5	9.3	4.3	23	0.9	473.0
2000-02	14	3.0	8.4	4.1	24	1.0	483.5
2001-03	17	3.5	7.6	3.8	25	1.0	502.3
2002-04	17	3.3	6.5	3.4	28	1.0	508.3
2003-05	15	2.8	5.7	3.0	32	1.0	542.2
2004-06	10	1.9	5.1	2.7	33	1.1	524.2
2005-07	11	2.1	4.4	2.3	33	1.0	532.5
2006-08	11	2.1	4.1	2.0	31	1.1	523.7
2007-09	12	2.3	3.9	1.8	31	0.9	546.4
2008-10	12	2.2	4.2	1.8	29	0.7	541.1
2009-11	12	2.2	4.2	1.7	33	0.6	542.5
2010-12	12	2.2	3.8	1.6	34	0.5	538.7
2011-13	9	1.7	3.1	1.3	35	0.4	544.6
<b>2012-14</b>	<b>8</b>	<b>1.5</b>	<b>2.6</b>	<b>1.2</b>	<b>35</b>	<b>0.4</b>	<b>527.2</b>

Figures 5a-c show the 3-year rolling average for FAR, AIF and LWIF segmented into the Manufacturing and Marketing activities, each split between own staff and contractors.

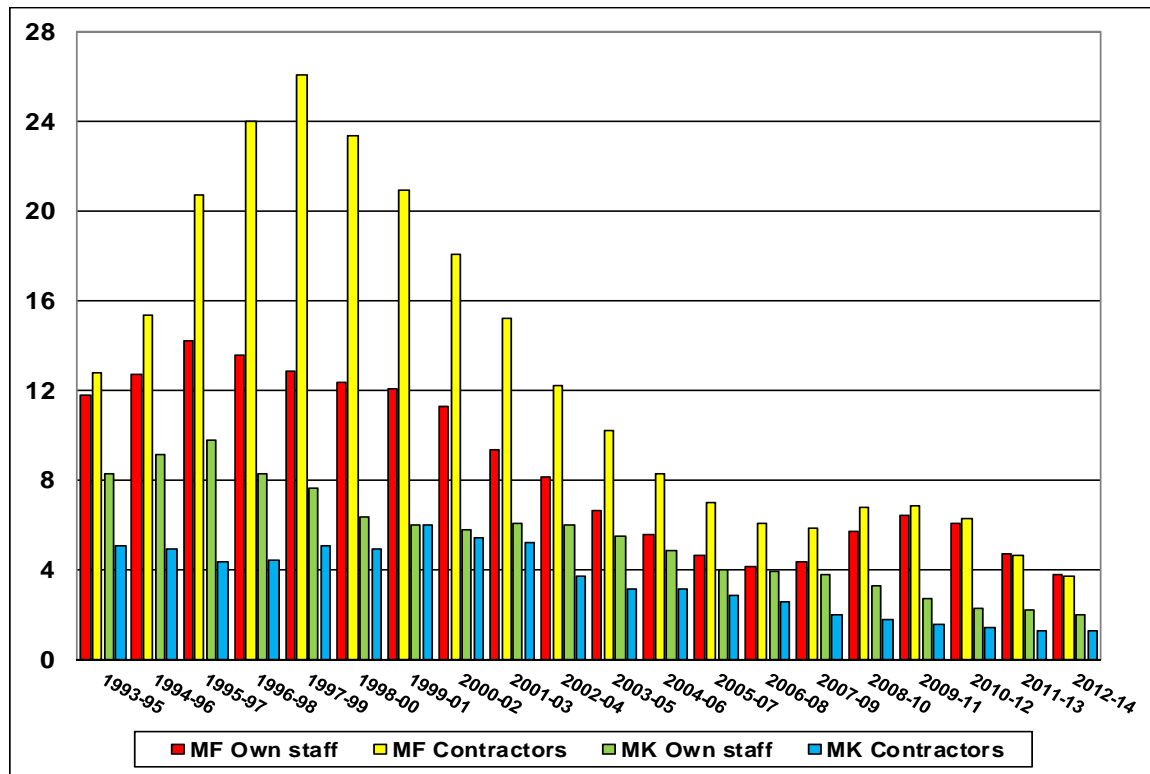
**Figure 5a** Historical evolution of Fatality Accident Rate segmented 3-year rolling average (MF: Manufacturing; MK: Marketing)



**Figure 5b** Historical evolution of Lost Work Injury Frequency (LWIF) segmented 3-year rolling average (MF: Manufacturing; MK: Marketing)



**Figure 5c** Historical evolution of All Injury Frequency segmented 3-year rolling average (MF: Manufacturing; MK: Marketing)



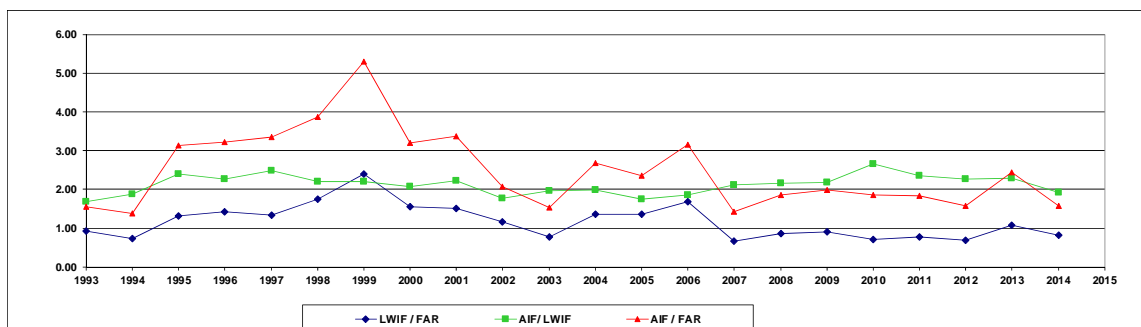
A total of 7 fatalities were reported for 2014, all being the consequence of independent incidents. The absolute number of fatalities and the FAR have been at consistently low levels since 2004 and this continues in 2014. In 2014, 6 of the 7 Fatalities were Contractors, both Manufacturing (5) and Marketing (1). Clearly this is of concern and the focus must continue on ensuring that the contractor workforce is fully integrated into the companies’ safety management systems. As discussed in Section 2, it should be kept in mind that the FAR is notoriously prone to large variations.

The LWIF of 1.1 recorded for 2014 is the lowest value since the collection of this data commenced in 1993 and maintains the trend of less than 2.0 for the eighth consecutive year, the longest consistent period since Concaawe started to collect safety data. This indicator initially had greater reductions in Manufacturing than in Marketing, however, since 2006 figures for the 4 categories continue to remain very close.

The figures suggest that AIF peaked around 1996-97 but this is likely the result of improved reporting standards. Since this time the trend has been slowly downward.

In 2014, the road traffic accident rate was 0.3, consistent with the rates achieved over the last few years. Road safety has been a major focus for the industry and it is pleasing to see the sustained reduction in the number of accidents being maintained. These accidents essentially occur in the Marketing activity where the bulk of the driving takes place. However, there was still 1 fatality as a result of a road accident in 2014.

**Figure 6** Relationship between the frequencies FAR, AIF and LWIF

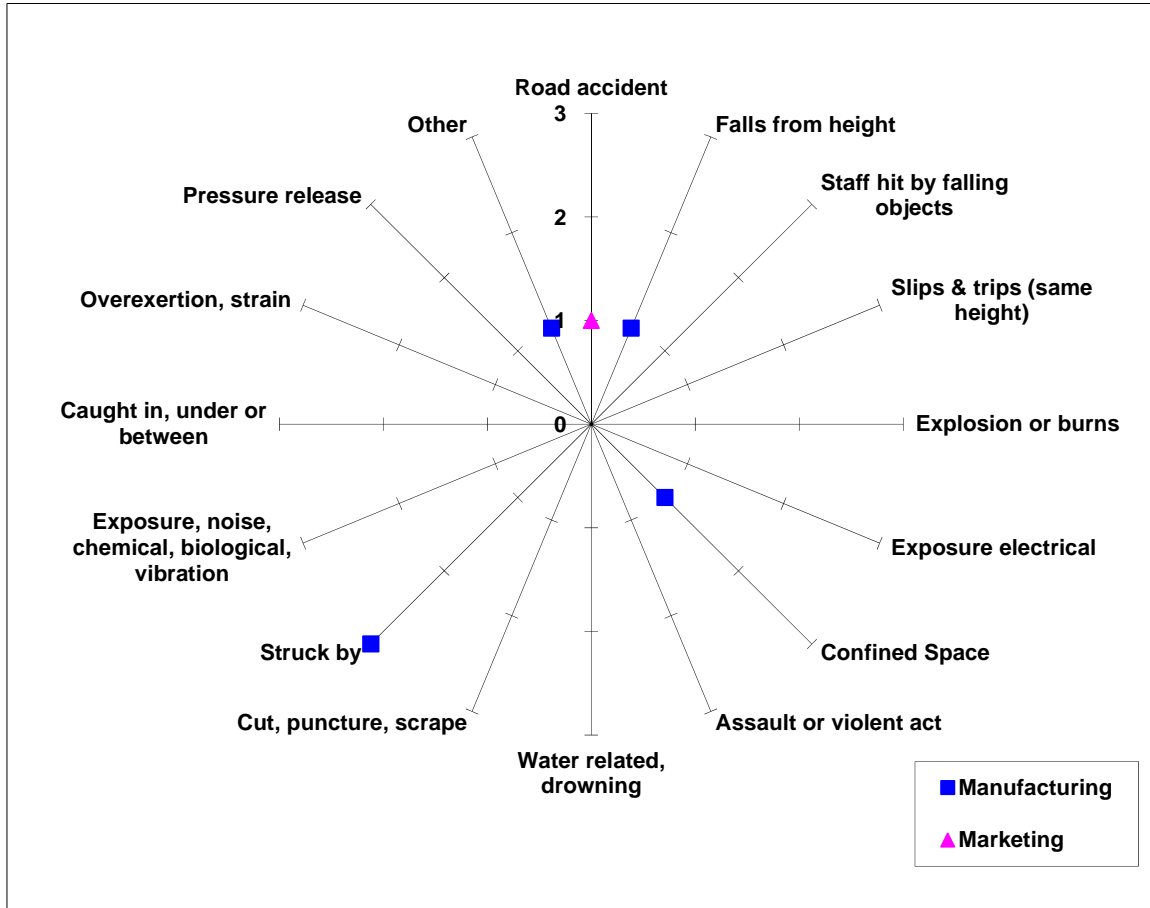


**Figure 6** illustrates the relationship between the frequencies, FAR, AIF and LWIF and illustrates the declining number of fatalities until 1999 whereas the total number of incidents remained fairly constant. The period from 2000 to 2003 saw a steady increase in fatalities while both AI and LWI were still on a decreasing trend, resulting in a decrease of the ratios. The lower number of fatalities from 2004 to 2009 reversed the trend resulting in relatively steady ratios with a small positive spike in 2006 when there were only 7 fatalities. Following a spike in the graph in 2013 caused by the reduced number of fatalities (6), the graphs have returned to the trend in 2014 with reduced AIF and LWIF rates together with the 7 fatalities recorded.

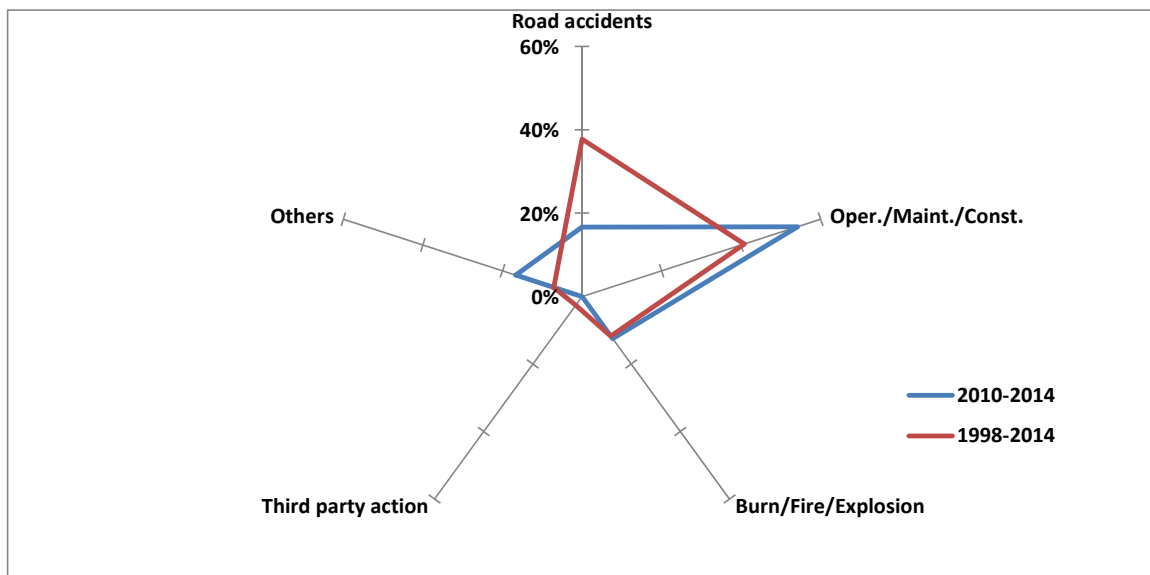
**Figure 7** details the causes of the 7 fatalities recorded in 2014 and **Figure 8** shows the percentage of the main causes over the last 5 years and for all years since this information was first collected in 1998. In 2014, 3 fatalities were caused as a result of being struck by equipment, 1 fatality was the result of a fall from height, 1 fatality resulted from a road accident, 1 fatality was a result of a confined space incident and 1 fatality is described as “Other”.

For the last 5-year period, construction/maintenance/operations activities and road accidents remain the principal causes of fatalities. However these results are likely to change as we develop more experience with the new cause categories.

**Figure 7** Causes of fatalities in 2014



**Figure 8** Causes of fatalities from 2010 to 2014 and from 1998 to 2014



## 5. 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. In 2010 the Safety Management Group of Concaawe decided to expand the scope of industry wide safety performance indicators to address process safety, following the reporting guidelines that were developed by the API [17, 18]. Combining a focus on process safety in conjunction with the personal safety factors collected thus far will contribute to a further reduction in serious injury rates in the industry.

The Concaawe Membership was requested to report their PSPI indicators as defined by the API in 2008 [20] and as further refined in the ANSI/API recommended practise that was published in 2010 [21]. The PSPI-data that were requested are the number of Tier 1 and 2 Process Safety Events (PSE's), as further defined in **Appendix 2** of this report. The definitions of these slightly differ from those that are described in the ANSI/API guideline to align the quantities to SI-metric units (kg/m/sec) and the inclusion of the European Classification and Labelling definitions that are in force in the EU [22] that can be used as an alternative for classifying the PSE. However, for the time being most Concaawe members have expressed a preference for reporting their PSE's according to the ANSI/API definitions.

The aggregated 2014 results per sector and for the whole of the European downstream oil industry are shown in **Table 7**. **Figure 8a** shows the total Process Safety Event Rate (PSER) on a cumulative frequency basis which allows individual companies to benchmark their own results against the group. The PSER is the number of PSE per million total work hours reported. The distribution per quartile and average values for each quartile range are shown for Total PSE and Total PSER in **Figures 8b/c**.

In **Figures 9a/b/c** the cumulative frequencies for the PSER are given for Manufacturing only, as the data are sufficiently robust to allow the analysis provided in these presentations. These allow individual companies to benchmark their results for the Manufacturing sector against the group.

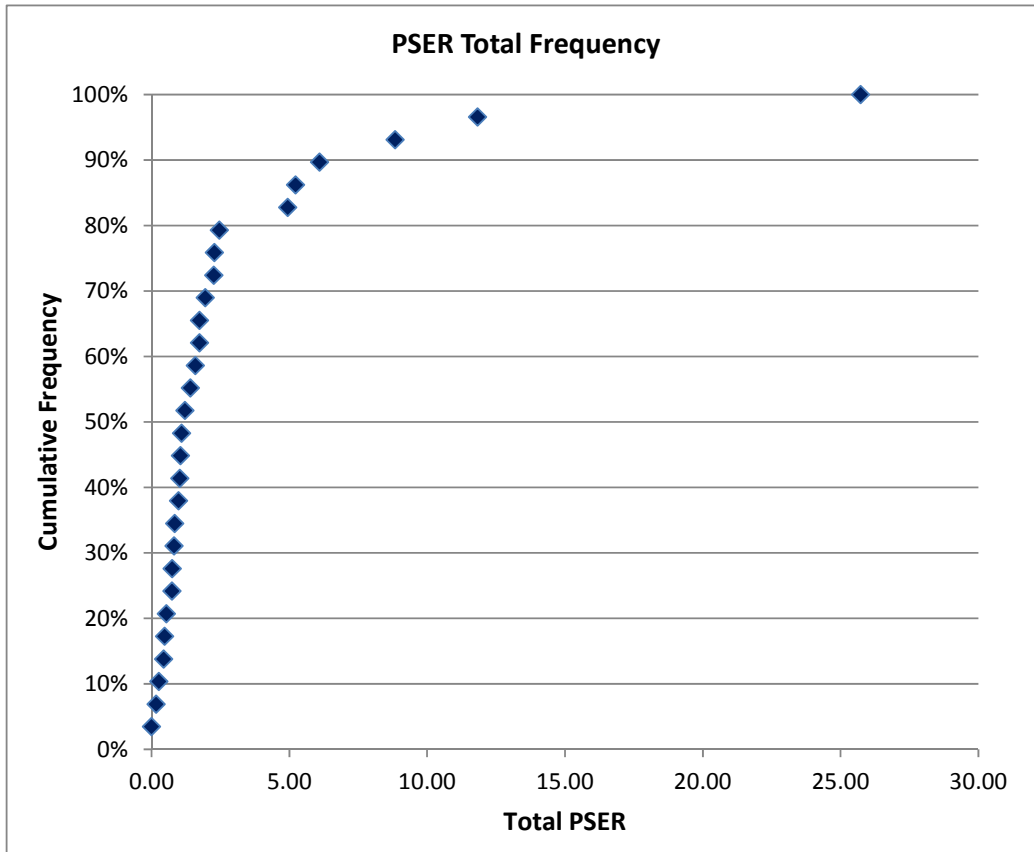
**Table 7** Aggregated 2014 Process Safety results for all reporting companies

Sector		Manufacturing	Marketing	Both Sectors
Companies	Total	37	24	23
	PS reporting	29	16	15
	%	78%	67%	65%
Hours worked Mh	Total	239.0	268.7	507.7
	PS reporting	205.5	214.5	419.9
	%	86%	80%	83%
T-1 PSE	PSI	74	8	82
T-2 PSE	PSI	258	55	313
T-1 PSER	PSI/Mh <sub>reported</sub>	0.36	0.04	0.20
T-2 PSER	PSI/Mh <sub>reported</sub>	1.26	0.26	0.75
Total PSER	PSI/Mh <sub>reported</sub>	1.62	0.29	0.94

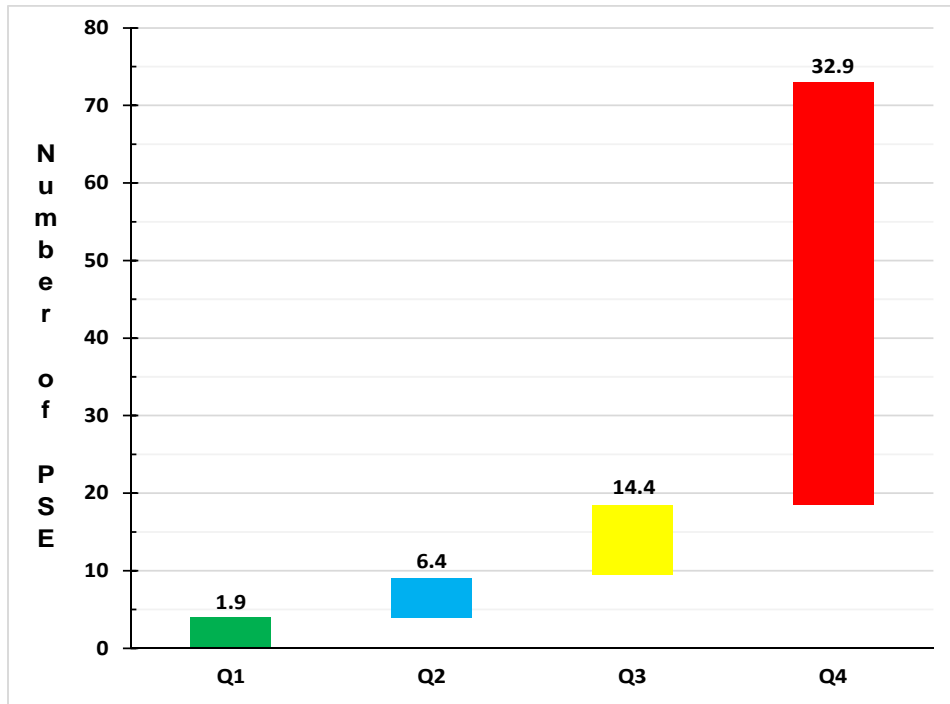
a) All companies provided both T-1 and T-2 PSEs for 2014.



**Figure 8a** Cumulative Frequency Analysis Total PSER



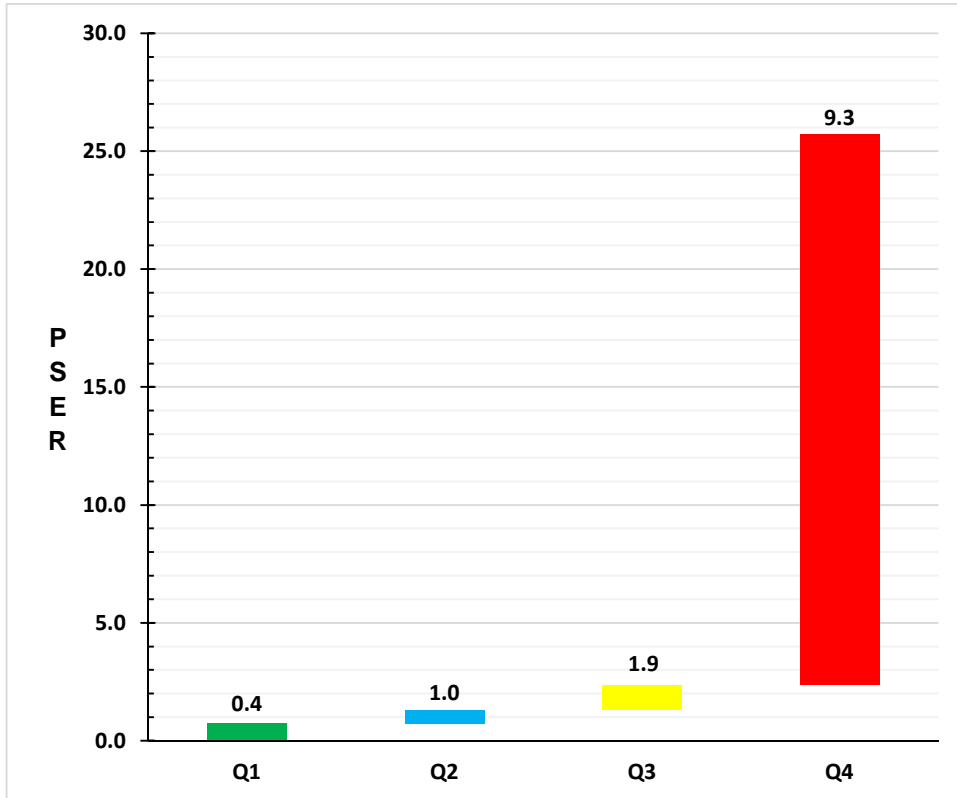
**Figure 8b** Total PSE quartile distribution ranges and average values for each quartile range



**Table 8** Total PSE quartile distribution ranges and average values for each quartile range

PSE	Low	High	Average
Q1	0	4	1.9
Q2	4	9	6.4
Q3	9	18.5	14.4
Q4	18	73	32.9

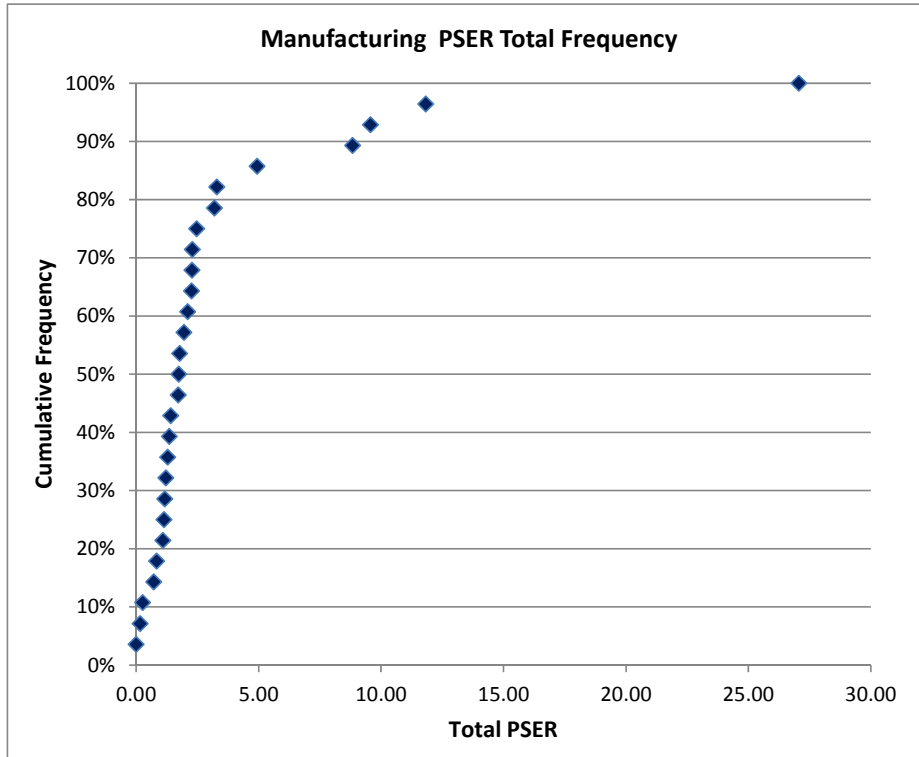
**Figure 8c** Total PSER quartile distribution ranges and average values for each quartile range



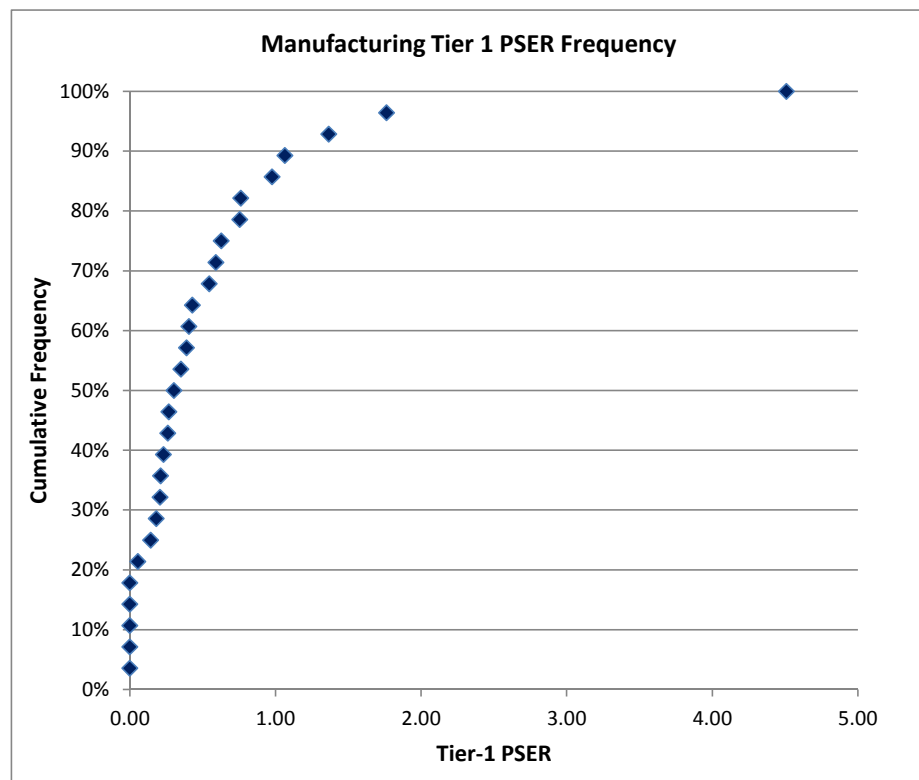
**Table 9** Total PSER quartile distribution ranges and average values for each quartile range

PSER	Low	High	Average
Q1	0	0.75	0.4
Q2	0.76	1.22	1.0
Q3	1.22	2.37	1.9
Q4	2.29	25.73	9.3

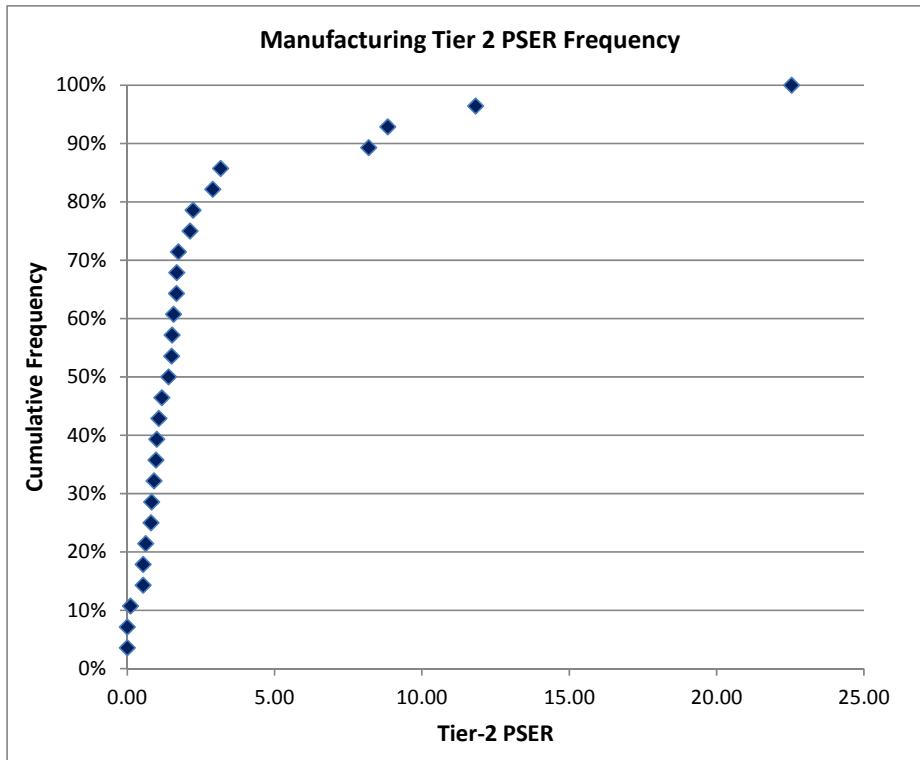
**Figure 9a** Cumulative frequency chart for all Manufacturing PSER



**Figure 9b** Cumulative frequency chart for Tier 1 Manufacturing PSER



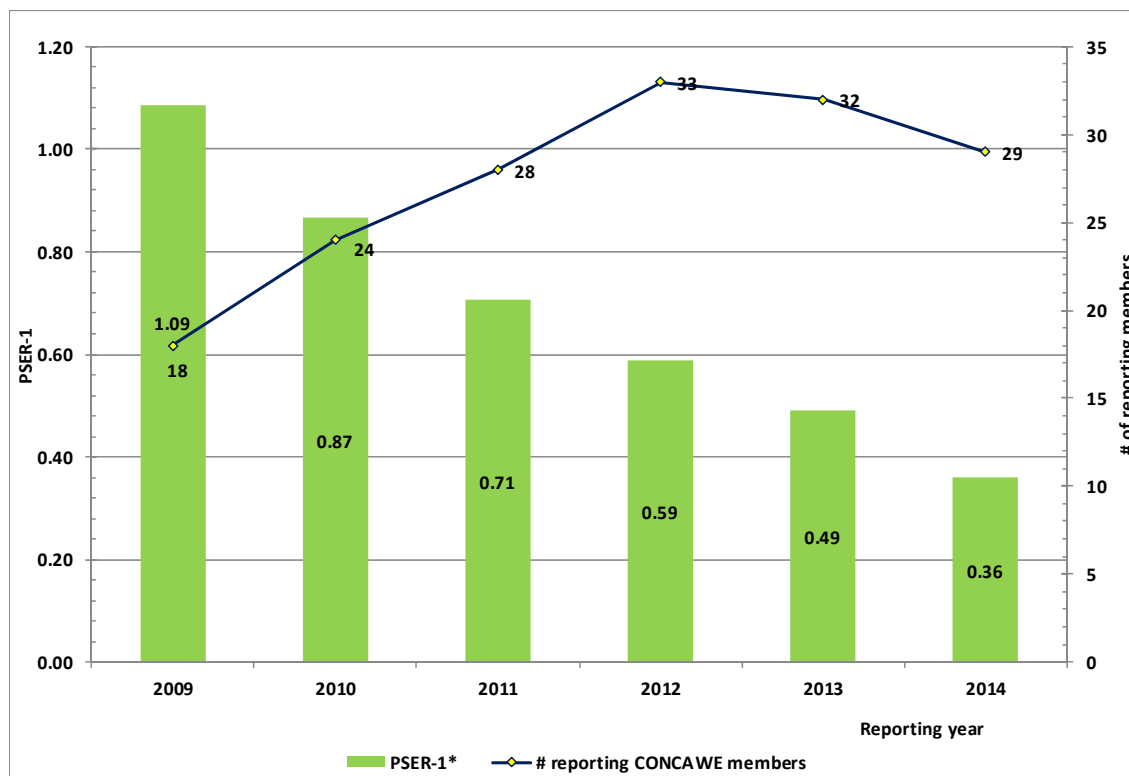
**Figure 9c** Cumulative frequency chart for Tier 2 Manufacturing PSER



The data provided indicated that none of the Tier 1 PSEs from Manufacturing Companies resulted in a fatality. The number of LWIs resulting from the PSEs is not established, as this information is not available.

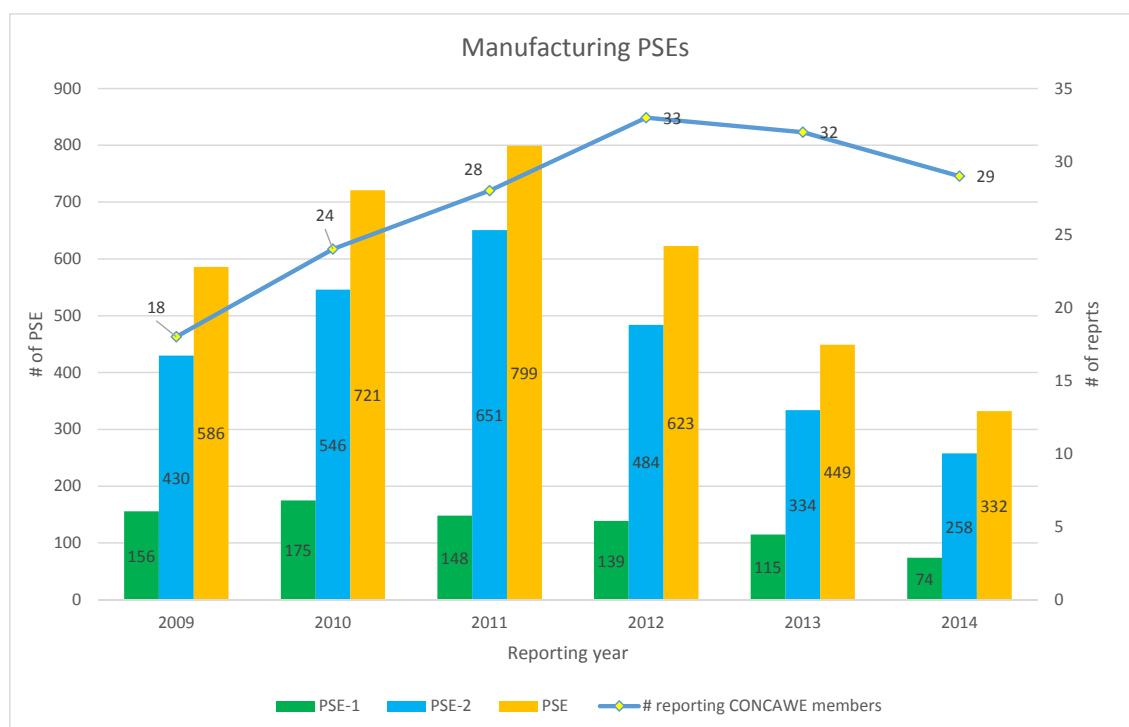
The extent of reporting of Process Safety data was a reduction versus that reported for 2013. In this sixth year of data collection a total of 78% of the Manufacturing operations and 67% of the Marketing operations provided the requested information. The results for 2014 are included in this report and continue to show a significant reduction in the number of Process Safety Events (PSE) and in Process Safety Event Rates (PSER) versus prior years. This is demonstrated in the range of graphs for Manufacturing and Total PSPI (Process Safety Performance Indicator) responses presented in **Figures 10a-e** which show the results recorded by this survey over the 6 years of Concaawe reporting and the associated trends.

**Figure 10a** Manufacturing PSER-1 2009-2014

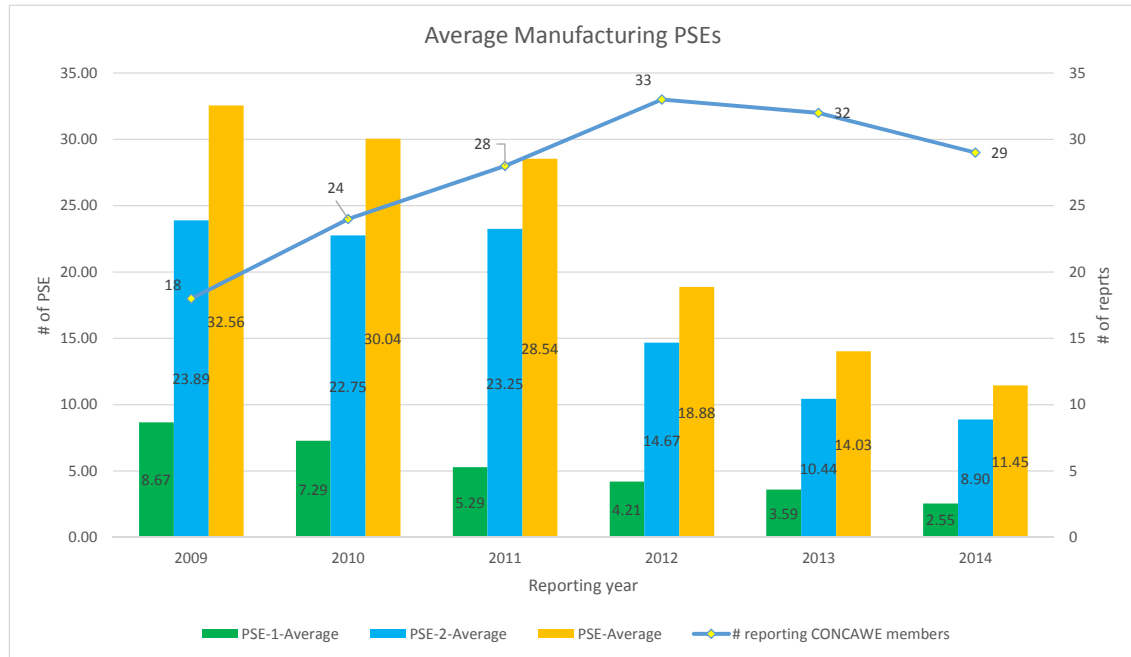


\* PSER-1 the number of releases of hazardous substances per 1 million hours worked causing a fatality, injury, fire or explosion leading to damages valued over € 25,000 or above set threshold values indicative to have the potential to cause these (see appendix 2).

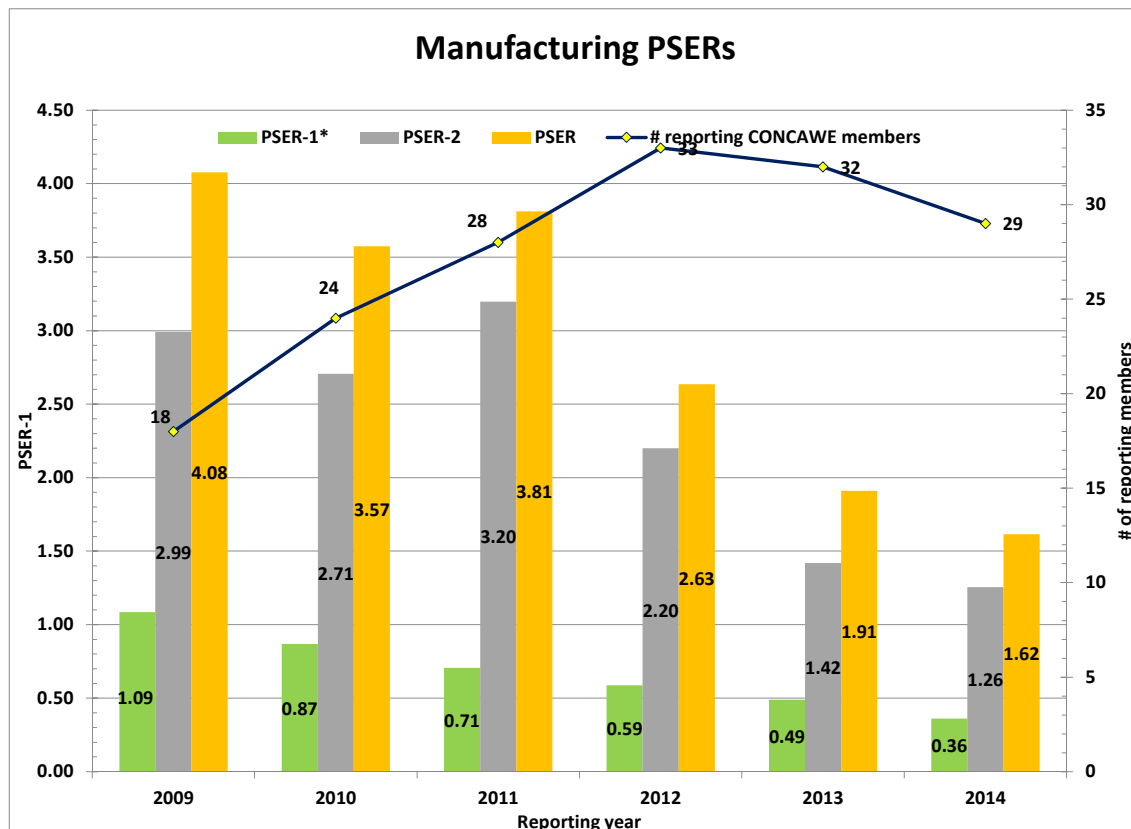
**Figure 10b** Manufacturing Total PSEs 2009-2014



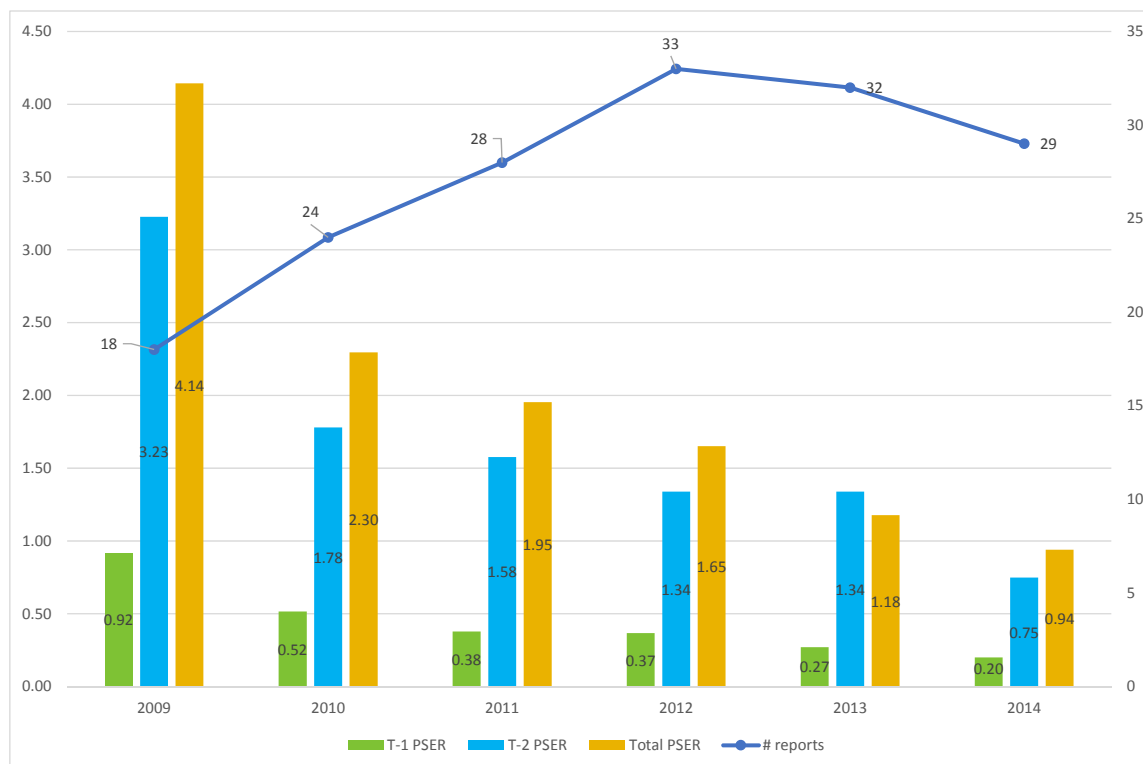
**Figure 10c** Average Manufacturing PSEs 2009-2014



**Figure 10d** Manufacturing PSERs 2009-2014



**Figure 10e** Total PSERs 2009-2014





## 6. 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.

**Table 10** Comparison of the safety performance of the downstream oil industry

	CONCAWE	OGP 2013 <sup>(1)</sup>		CEFIC	API 2013
	2014	Europe	World	2012	Manufacturing
FAR	1.4	2.3	2.1	Not reported	NA
AIF	2.2	2.6	1.6	Not reported	NA
LWIF	1.1	1.0	0.5	4.9	5.6 <sup>(2)</sup>
OGP	Oil & Gas Producers				
CEFIC	Conseil Européen des Fédérations de l'Industrie Chimique				
API	American Petroleum Institute				
	<sup>(1)</sup> Own staff and contractors				
	<sup>(2)</sup> Estimated from 2.1 injuries per 100 FT oil and gas workers API WIS-report 2003-2013				

The OGP statistics concern the “upstream” oil industry covering oil and gas exploration and production activities [25]. For 2014, OGP recorded a significantly higher FAR. However, the sector shows marginally better AIF and LWIF performances than the downstream, on a global basis, as was the case in previous years.

The 2012 data for the EU chemical industry (CEFIC) [24], the 2013 data for OGP [25] and the 2013 data for API [28] have been shown because the 2014 data from these organisations is not yet publicly available.

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## APPENDIX 1 EUROPEAN OIL INDUSTRY STATISTICS DEFINITIONS AND GUIDING NOTES

1. Hours worked           Hours worked by employees and contractors. Estimates should be used where contractor data is not available.
2. Fatality                 This is a death resulting from a work related injury where the injured person dies within twelve months of the injury.
3. 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.
4. Total days lost         The number of calendar days lost through LWIs counting from the day after the injury occurred.
5. 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.
6. 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.
7. 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.
8. LWIF                    Lost Workday Injury Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
9. LWIS                    Lost Workday Injury Severity is the total number of days lost as a result of LWIs divided by the number of LWIs.
10. 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.
11. 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

12. RAR	Road Accident Rate is calculated from the number of accidents divided by the kilometres travelled expressed in millions.
13. FAR	Fatal Accident rate is calculated from the number of fatalities divided by the number of hours worked expressed in hundred millions
14. COCO	Company owned and operated sites
15. CODO	Company owned, Dealer operated sites
16. DOCO	Dealer owned, Company operated sites
17. DODO	Dealer owned and operated sites
18. 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).
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. Tier 1 PSE	<p>A Tier 1 Process Safety Event (T-1 PSE) is a loss of primary containment (LOPC) with the greatest consequence. A T-1 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO<sub>2</sub> or compressed air), from a process that results in one or more of the consequences listed below:</p> <ul style="list-style-type: none"> <li>• An employee, contractor or subcontractor “days away from work” injury and/or fatality; or</li> <li>• Hospital admission and/or fatality of a third-party; or</li> <li>• Officially declared community evacuation or community shelter-in-place; or</li> <li>• Fires or explosions resulting in greater than or equal to €25,000 of direct cost to the Company; or</li> <li>• A pressure relief device (PRD) discharge to atmosphere greater than the threshold quantities described in <b>Table A2-1</b> of <b>Appendix 2</b> that:             <ul style="list-style-type: none"> <li>▪ contained liquid carryover; or</li> <li>▪ was discharged to an unsafe location; or</li> <li>▪ resulted in an onsite shelter-in-place; or</li> <li>▪ resulted in public protective measures (e.g., road closure); or</li> </ul> </li> <li>• A release of material greater than the threshold quantities described in <b>Table A2-1</b> of <b>Appendix 2</b> in any one-hour period.</li> </ul>

21. Tier 2 PSE                      A Tier 2 Process Safety Event (T-2 PSE) is a LOPC with lesser consequence. A T-2 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO<sub>2</sub> or compressed air), from a process that results in one or more of the consequences listed below and is not reported in Tier 1:
- An employee, contractor or subcontractor recordable injury; or
  - A fire or explosion resulting in greater than or equal to €2,500 of direct cost to the Company; or
  - A pressure relief device (PRD) discharge to atmosphere or to a downstream destructive device greater than the threshold quantity in **Table A2-2 of Appendix 2** that results in one or more of the following four consequences:
    - liquid carryover; or
    - discharge to a potentially unsafe location; or
    - an onsite shelter-in-place; or
    - public protective measures (e.g., road closure) and;
  - A release of material greater than the threshold quantities described in **Table A2-2 of Appendix 2** in any one-hour period.
22. 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.

**Other definitions and guidance**

- 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.
- 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.

Separate statistics are collected for Manufacturing and Marketing

Where data are not available directly, Members are requested to present the best estimate possible.

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## APPENDIX 2 CONCAWE PROCESS SAFETY PERFORMANCE INDICATORS DEFINITIONS

Within ConcaWE the decision was taken to start gathering Process Safety Performance Indicator (PSPI) data as of 2010.

Aligning this initiative with developments globally, the decision was taken to adopt the indicators of the ANSI/API guideline “Process Safety Performance Indicators for the Refining and Petrochemical Industries” that was published as ANSI/API Guideline 754 in April 2010 [REF 1].

The performance indicators that ConcaWE collects from its membership for the European Refining and Distribution Industry are the Tier 1 and 2 PSPI of the ANSI/API guideline with alteration to use the criteria that are embedded in EU-legislation and the fact that in Europe quantities are reported in the SI-metric system (kg/m/sec). The classification of Process Safety Events (PSE) otherwise should follow the scheme set in the ANSI/API guideline.

The reporting of these indicators is still evolving but limited analyses can now be performed for the European Refining and Distribution Industry that allows comparing with other regions where this data is collected and reported.

In the API guidance 4 Tiers of PSPIs are mentioned. However, the data collection and evaluation within ConcaWE is restricted to only Tier 1 & 2 PSPIs.

The criteria for the classification of Tier 1 and 2 PSEs are provided below taken from the ANSI/API guidance modified for the European context. This includes Table A2-1 and 2.

### **Tier 1 Performance Indicator — Process Safety Event (T-1 PSE)**

#### **Tier 1 Indicator Purpose**

The count of Tier 1 process safety events is the most lagging process safety performance indicator (PSPI) and represents incidents with greater consequence resulting from actual losses of containment.

#### **Tier 1 Indicator Definition and Consequences**

A Tier 1 Process Safety Event (T-1 PSE) is a loss of primary containment (LOPC) with the greatest consequence as defined by this document. A T-1 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen or other inert gases, compressed CO<sub>2</sub> or compressed air<sup>1</sup>), from a process that results in one or more of the consequences listed below:

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<sup>1</sup> Non-toxic and non-flammable materials (e.g., steam, hot water, nitrogen, compressed CO<sub>2</sub> or compressed air) have no threshold quantities and are only included in this definition as a result of their potential to result in one of the other consequences. Event involving these only become reported, if these result in one of the consequences indicated.

- An employee, contractor or subcontractor “days away from work” injury and/or fatality; or
- A hospital admission and/or fatality of a third-party; or
- An officially declared community evacuation or community shelter-in-place; or
- A fire or explosion resulting in greater than or equal to €25,000 of direct cost to the Company; or
- A pressure relief device (PRD) discharge to atmosphere or to a downstream destructive device that results in one or more of the following four consequences:
  - liquid carryover; or
  - discharge to a potentially unsafe location; or
  - an on-site shelter-in-place; or
  - public protective measures (e.g., road closure);
 and a PRD discharge quantity greater than the threshold quantities in **Table A2-1**; or
- Any release of material greater than the threshold quantities described in **Table A2-1** in any one-hour period.

**Calculation of Tier 1 PSE Rate**

The Tier 1 PSE Rate shall be calculated as follows:

$$\text{Tier 1 PSE Rate} = (\text{Total Tier 1 PSE Count} / \text{Total Work Hours}) \times 1,000,000^2$$

<sup>2</sup> Total work hours include employees and contractors. The 1,000,000 hours is the Concaawe denominator that is also applied in the operational safety statistics frequency estimations.



**Table A2-1** Tier-1 Material Release Threshold Quantities

Threshold Release Category	Material Hazard Classification <sup>1,3,4</sup>	Threshold Quantity (outdoor release)	Threshold Quantity (indoor <sup>2</sup> release)
1	TIH Zone A or EU-CLP Category 1 Hazardous Materials <sup>5</sup>	5 kg	2.5 kg
2	TIH Zone B or EU-CLP Category 2 Hazardous Materials <sup>5</sup>	25 kg	12.5 kg
3	TIH Zone C or EU-CLP Category 3 Hazardous Materials <sup>5</sup>	100 kg	50 kg
4	TIH Zone D or EU CLP Category 4 Hazardous Materials <sup>5</sup>	200 kg	100 kg
5	Flammable Gases or Liquids with Boiling Point ≤ 35°C and Flash Point < 23°C or Other Packing Group I Materials	500 kg	250 kg
6	Liquids with Boiling Point > 35°C and Flash Point < 23°C or Other Packing Group II Materials	1000 kg	500 kg
7	Liquids with Flash Point ≥ 23°C and ≤ 60°C or Liquids with Flash Point > 60°C released at a <u>temperature at or above Flash Point</u> or strong acids/bases or Other Packing Group III Materials	2000 kg	1000 kg

<sup>1</sup> Many materials exhibit multiple hazards. Correct placement in Hazard Zone or Packing Group shall preferentially follow the rules of the UN Recommendations on the Transportation of Dangerous Goods, Section 2 [REF 2] or the Classifications according to DOT 49 CFR 173.2a [REF 3], as explained in the ANSI/API guideline 754 Annex B. Alternatively, the classifications of EU Regulation EC-1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 [REF 4] that implement the UN harmonised System can be used.

<sup>2</sup>A structure composed of four complete (floor to ceiling) walls, floor and roof.

<sup>3</sup> For solutions not listed on the UNDG, the anhydrous component shall determine the TIH hazard zone or Packing Group classification. The threshold quantity of the solution shall be back calculated based on the threshold quantity of the dry component weight.

<sup>4</sup> For mixtures where the UNDG classification is unknown, the fraction of threshold quantity release for each component may be calculated. If the sum of the fractions is equal to or greater than 100%, the mixture exceeds the threshold quantity. Where there are clear and independent toxic and flammable consequences associated with the mixture, the toxic and flammable hazards are calculated independently.

<sup>5</sup> For vapours, the hazardous classifications only apply to inhalation toxicity. Whereas for liquids, the oral and dermal toxicity should be assessed, as well as described in the ANSI/API guideline Annex B.

## **Tier 2 Performance Indicators – Process Safety Events (T-2-PSE)**

### **Tier 2 Indicator Purpose**

The count of Tier 2 process safety events represents LOPC events with a lesser consequence. Tier 2 PSEs, even those that have been contained by secondary systems, indicate system weaknesses that may be potential precursors of future, more significant incidents. In that sense, Tier 2 PSEs can provide a company with opportunities for learning and improvement of its process safety performance.

### **Tier 2 Indicator Definition and Consequences**

A Tier 2 Process Safety Event (T-2 PSE) is a LOPC with lesser consequence. A T-2 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO<sub>2</sub> or compressed air<sup>1</sup>), from a process that results in one or more of the consequences listed below and is not reported in Tier 1:

An employee, contractor or subcontractor recordable injury; or

- A fire or explosion resulting in greater than or equal to €2,500 of direct cost to the Company; or
- A pressure relief device (PRD) discharge to atmosphere or to a downstream destructive device that results in one or more of the following four consequences:
  - liquid carryover; or
  - discharge to a potentially unsafe location; or
  - an onsite shelter-in-place; or
  - public protective measures (e.g., road closure);

and a PRD discharge quantity greater than the threshold quantity in **Table A2-2**; or

- A release of material greater than the threshold quantities described in **Table A2-2** in any one-hour period.

### **Calculation of Tier 2 PSE Rate**

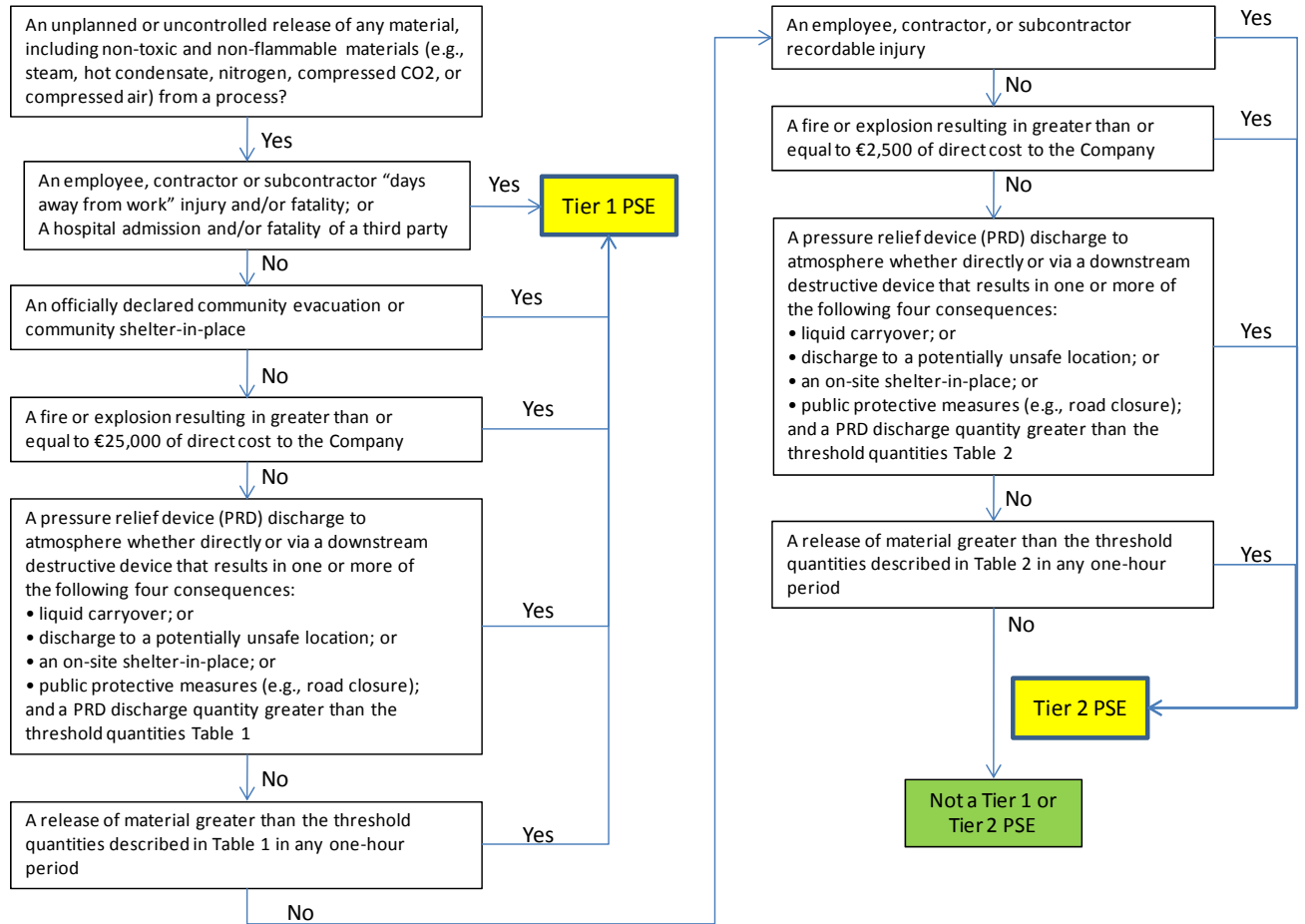
The Tier 2 PSE rate shall be calculated as follows:

$$\text{Tier 2 PSE Rate} = (\text{Total Tier 2 PSE Count} / \text{Total Work Hours}) \times 1,000,000^5$$

**Table A2-2** Tier-2 Material Release Threshold Quantities

Threshold Release Category	Material Hazard Classification <sup>1,3,4</sup>	Threshold Quantity (outdoor release)	Threshold Quantity (indoor <sup>2</sup> release)
1	TIH Zone A or EU-CLP Category 1 Hazardous Materials <sup>5</sup>	0.5 kg	0.25 kg
2	TIH Zone B or EU-CLP Category 2 Hazardous Materials <sup>5</sup>	2.5 kg	1.25 kg
3	TIH Zone C or EU-CLP Category 3 Hazardous Materials <sup>5</sup>	10 kg	5 kg
4	TIH Zone D or EU CLP Category 4 Hazardous Materials <sup>5</sup>	20 kg	10 kg
5	Flammable Gases or Liquids with Boiling Point ≤ 35°C and Flash Point < 23°C or Other Packing Group I Materials	50 kg	25 kg
6	Liquids with a Boiling Point > 35°C and Flash Point < 60°C or Liquids with Flash Point > 60°C released at or above Flash Point; or Other Packing Group II and III Materials or Strong acids and bases	100 kg	50 kg
7	Liquids with Flash Point > 60°C released at a temperature below Flash Point or Moderate acids/bases	1000 kg	500 kg
<p>In order to simplify determination of reporting thresholds for Tier 2, Categories 6 and 7 in Tier 1 have been combined into one category in Tier 2 (Category 6). The simplification is intended to provide less complicated requirements for those events with lesser consequences.</p>			
<p><sup>1</sup> Many materials exhibit multiple hazards. Correct placement in Hazard Zone or Packing Group shall <u>preferentially follow the rules</u> of the UN Recommendations on the Transportation of Dangerous Goods, Section 2 [REF 2] or the Classifications according to DOT 49 CFR 173.2a [REF 3], as explained in the ANSI/API guideline 754 Annex B. Alternatively, the classifications of EU Regulation EC-1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 [REF 4] that implement the UN harmonised System can be used.</p> <p><sup>2</sup>A structure composed of four complete (floor to ceiling) walls, floor and roof.</p> <p><sup>3</sup> For solutions not listed on the UNDG, the anhydrous component shall determine the TIH hazard zone or Packing Group classification. The threshold quantity of the solution shall be back calculated based on the threshold quantity of the dry component weight.</p> <p><sup>4</sup> For mixtures where the UNDG classification is unknown, the fraction of threshold quantity release for each component may be calculated. If the sum of the fractions is equal to or greater than 100%, the mixture exceeds the threshold quantity. Where there are clear and independent toxic and flammable consequences associated with the mixture, the toxic and flammable hazards are calculated independently.</p> <p><sup>5</sup> For vapours, the hazardous classifications only apply to inhalation toxicity. Whereas for liquids, the oral and dermal toxicity should be assessed, as well as described in the ANSI/API guideline Annex B.</p>			

PSE Classification Decision Logic Tree



## Bibliography of Appendix 2

The following documents are directly referenced in this recommended practice.

- [1] API (2010) ANSI/API Recommended practice 754. Process safety performance indicators for the refining and petrochemical industries. Washington DC: American Petroleum Institute
- [2] UNECE (2009) European agreement concerning the international carriage of dangerous goods by road (ADR 2009) ECE/TRANS/202, Vol. I and II. Geneva: United Nations Economic Commission for Europe
- [3] U.S. Government (2006) 49 CFR – Chapter 1 – Part 173. Classification of a material having more than one hazard
- [4] EU (2008) Regulation (EC) No. 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No. 1907/2006. Official Journal of the European Union No. L353, 31.12.2008

## FURTHER READING

The following documents are not directly referenced in this note but provide a useful source of relevant information.

- [A] API (2008) API guide to report process safety incidents – December 2007 (report year 2008). Washington DC: American Petroleum Institute
- [B] Center for Chemical Process Safety (2009) Guidelines for process safety metrics. Hoboken, New Jersey: John Wiley& Sons, Inc.
- [C] Baker, J.A. et al (2007) The report of the BP U.S. refineries independent safety review panel - January 2007
- [D] Broadribb, M.P. et al (2009) Cheddar or Swiss? How Strong are your Barriers? (One company's experience with process safety metrics). Presentation at 5th Global Congress on Process Safety, April 26-30, 2009, Tampa FL
- [E] Center for Chemical Process Safety (2007) Guidelines for risk based process safety. Hoboken, New Jersey: John Wiley& Sons, Inc.
- [F] NEI (2007) Regulatory assessment performance indicator guideline. NEI 99-02 Revision 5. Washington DC: Nuclear Energy Institute
- [G] OECD (2008) Guidance on developing safety performance indicators related to chemical accident prevention, preparedness and response. Series on Chemical Accidents No. 19. Paris: Organisation for Economic Coordination and Development
- [H] U.S. Chemical Safety and Hazard Investigation Board (2007) Investigation report - Refinery explosion and fire (15 killed, 180 injured). BP, Texas City, March 23, 2005. Report No. 2005-04-I-TX

**APPENDIX 3 CONCAWE CATEGORIZATION OF CAUSES FOR FATALITIES AND LWIS**

<b>Categorization of Fatalities or LWIs</b>		
<b>Previous Category</b>	<b>Incident Category (Concawe)</b>	<b>Description</b>
<b>Road accident</b>	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.
<b>Height/Falls</b>	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.
<b>Burn/electrical</b>	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.
<b>Confined space entry</b>	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.
<b>Construction / Maintenance &amp; Other</b>	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 flying or falling 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.

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