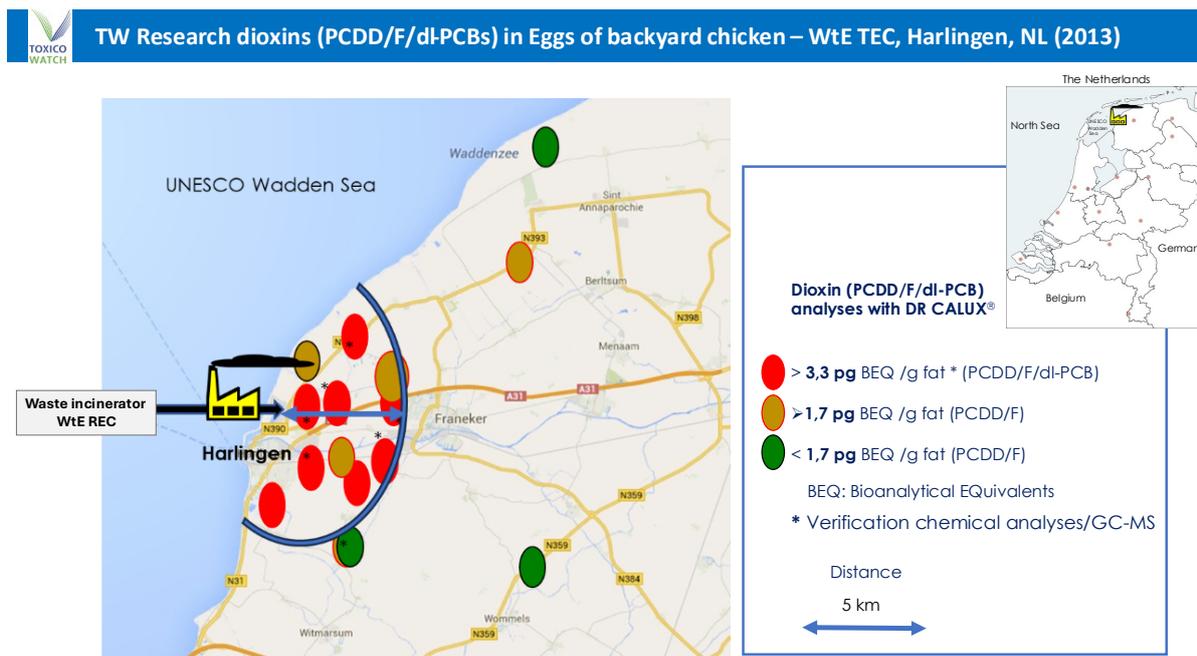


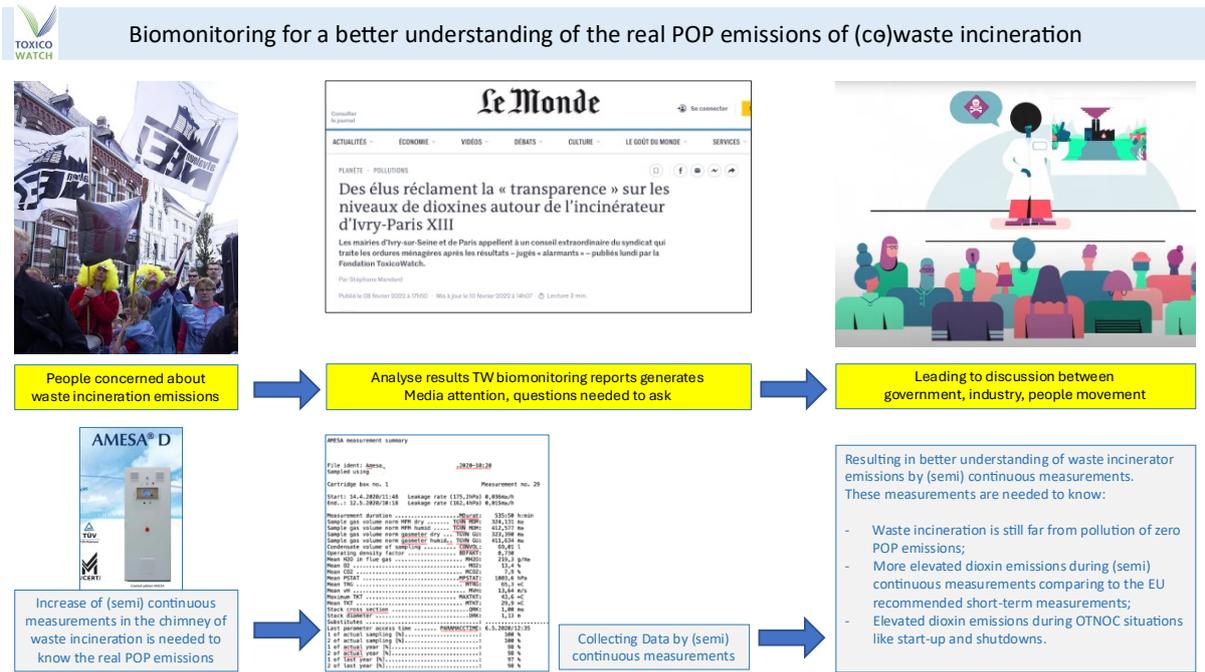
## Annex 2: Achievements 12 years ToxicoWatch biomonitoring

In 2013 ToxicoWatch (TW) initiated an alternative biomonitoring studies to monitor dioxins (PCDD/F/dl-PCBs) in eggs of backyard chickens, owned by private chicken coop owners in the vicinity of the latest built (2011), state-of-the-art Waste-to-Energy (WtE) incinerator REC in Harlingen, the Netherlands. Thirteen backyard chicken coops within a 3 km radius of the waste incinerator and five reference locations shown an elevated dioxin level in the eggs (2013). The publication of the results initiates several documentaries on national TV and a counter research by the government. Upon validation of the results by the National Health Service of the Netherlands (NL), *Rijksinstituut voor Volksgezondheid en Milieu* (RIVM), a joint committee, (Committee 1), comprising the Dutch Health Service, and representants of the local population was established. ToxicoWatch (A. Arkenbout) an independent toxicologist specialising in persistent organic pollutants (POPs), joined this committee for two years (2015-2017). The committee approved the installation of AMESA for semi-continuous measurement of flue gases of the REC waste incinerator, for a period of 2,5 years (2015 - April 2017). Also, biomonitoring POP research on grass and soil, research of the air quality, research on hydrochloric acid (HCl), and analyses of PAH in the environment was conducted by this committee.

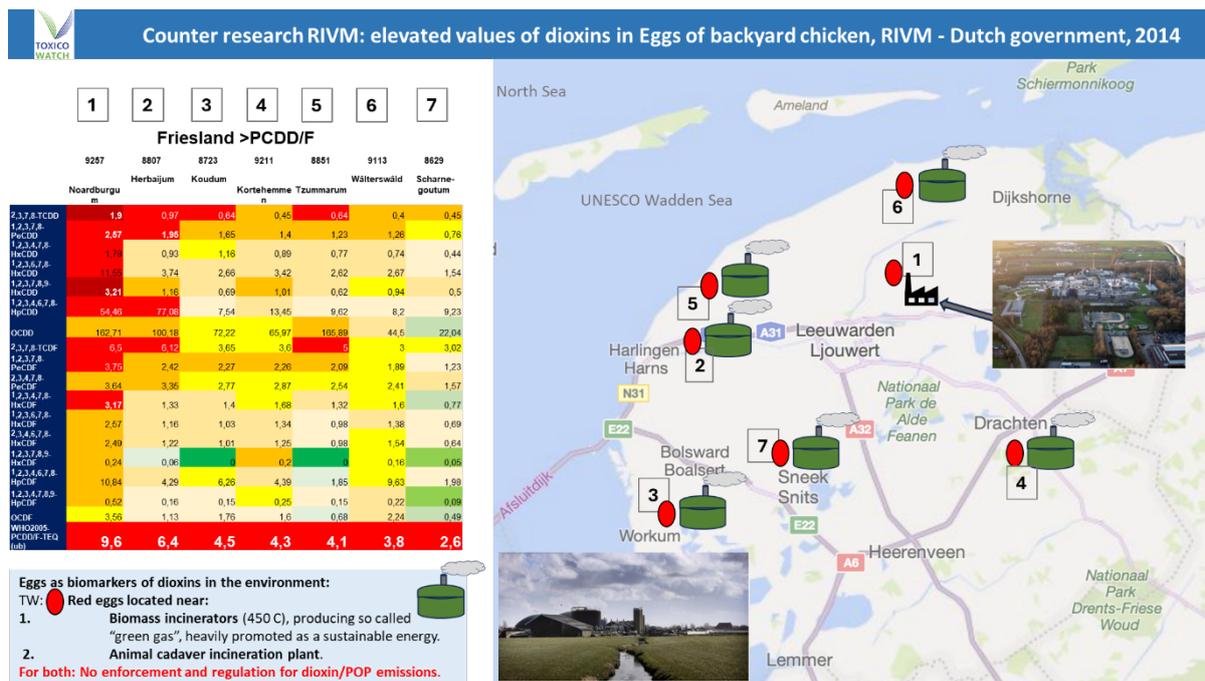
A technical commission (Dutch: *Fase-II-overleg*) was installed by the Provincial Government with participation of the management of the waste incinerator, after a calamity on October 1<sup>st</sup>, 2015, with high dioxin emissions. It is worth noting, that without the installation (2015) of the semi-continuous (AMESA) monitoring system, this huge eruption (of a yearly load of dioxins (PCDD/F/dl-PCBs) within an hour), never would be detected at all. A list of concerns and issues were identified, including closing bypass pipes structurally and implementing additional alarm systems. However, after two years (2015 until January 2017), when again a major dioxin emission was measured, the management of the REC waste incinerator ceased cooperation. An end-evaluation report on the results of the semi-continuous measurements was never provided. Structural problems remained unsolved, such as the frequent start-ups (see Annex), temperature issues, and the ongoing excessive hydrochloric acid (HCl) emissions. Recently, permits have been issued to burn more waste with consequently significantly higher hydrochloric acid (HCl) emissions. Surprisingly, the 'state-of-the-art' WtE incinerator REC was several times nominated as the greenest industry in the Netherlands. Since begin 2017, no semi-continuous measurements have been conducted anymore, resulting now in 2025, a gap of 8 years of unknowing the real POP emissions into the surrounding environment.



- a. Bringing **public and governmental awareness** of POP emissions analysed in the surrounding environment of WtE REC waste incinerator by biomonitoring research on dioxins in eggs of backyard chicken (2013).

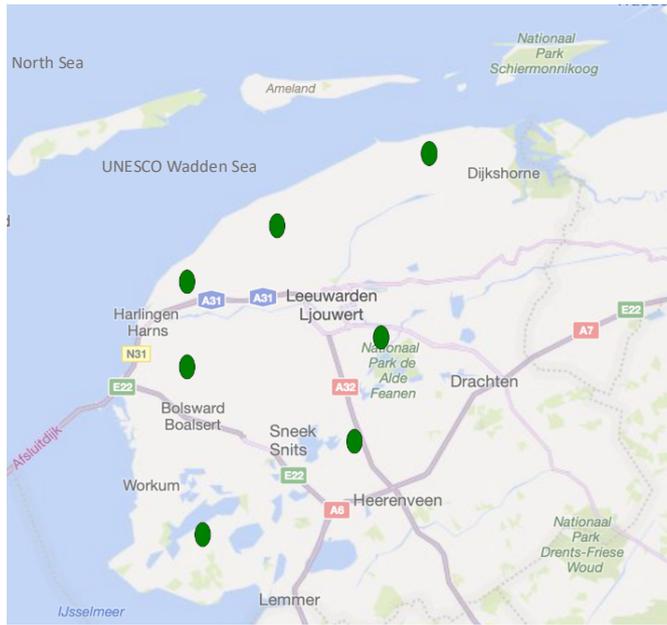


- b. TW-Participation in joint committee (NL: *Begeleidingsgroep* and technical committee (NL: *Fase II-overleg*, see introduction), together with the Regional/Provincial Governments, and the management WtE REC, (2015-2017). Therefore TW could study on the non-average emission data of the flue gasses for these two years.
- c. **TW research of the data of the RIVM counter research (2014) on dioxins in eggs of backyard chicken** could started 2,5 years later, when finally, the RIVM location data came available, due to juridical pressure. The two figures below show that the with dioxins contaminated eggs in Friesland were located nearby a Biomass incineration facility, with low temperatures and no monitoring and no enforcement, concerning POP emissions and combustion temperatures.

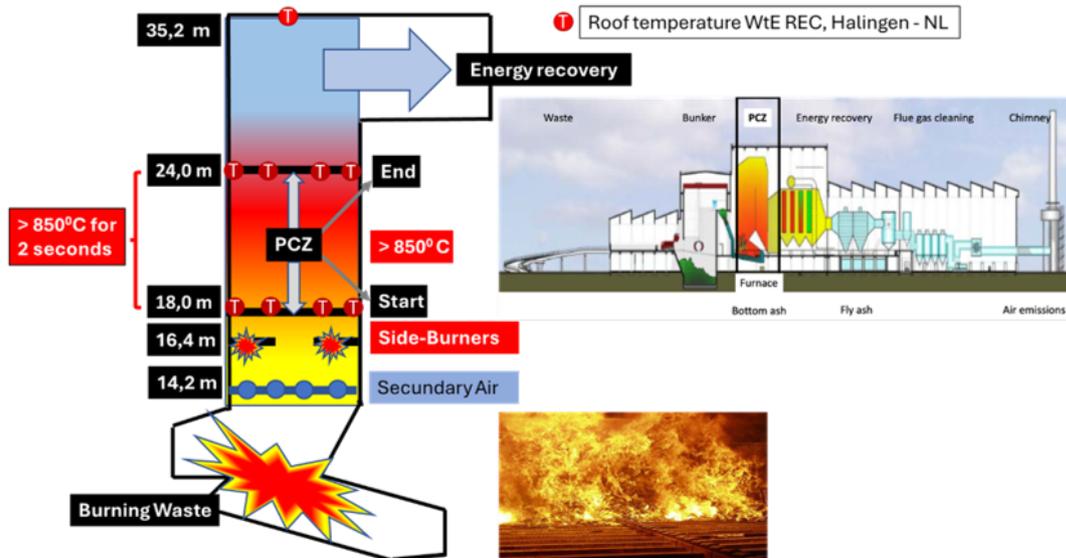


Friesland < PCDD/F

	8561 Balk	9286 Twijzel	9077 Vrouwen- parochie	8853 Klooster- Lidlum	8821 Kimsward	8857 Wijnal-T4	9286 Twijzel
2,3,7,8-TCDD	0,00	0,086	0,14	0,14	0,17	0,14	0,12
1,2,3,7,8- PeCDD	0,00	0,21	0,33	0,29	0,44	0,46	0,55
1,2,3,4,7,8- HxCDD	0,00	0,21	0,35	0,20	0,39	0,49	0,48
1,2,3,6,7,8- HxCDD	0,15	0,67	0,72	0,92	1,00	1,90	1,54
1,2,3,7,8,9- HxCDD	0,06	0,29	0,46	0,28	0,41	0,56	0,50
1,2,3,4,6,7,8- HpCDD	0,58	2,71	6,16	3,65	3,30	6,90	11,57
OCDD	5,30	12,26	86,15	21,60	6,10	12,00	42,39
2,3,7,8-TCDF	0,23	0,49	0,82	0,87	1,10	1,20	1,1
1,2,3,7,8- PeCDF	0,07	0,31	0,50	0,51	0,75	0,97	0,75
2,3,4,7,8- PeCDF	0,08	0,40	0,57	0,63	0,98	0,95	1,01
1,2,3,4,7,8- HxCDF	0,08	0,35	0,55	0,50	0,75	0,88	0,79
1,2,3,6,7,8- HxCDF	0,00	0,27	0,39	0,38	0,57	0,74	0,61
2,3,4,6,7,8- HxCDF	0,07	0,32	0,45	0,43	0,60	0,83	0,66
1,2,3,7,8,9- HxCDF	0,00	0,00	0,00	0,00	0,05	0,06	0,07
1,2,3,4,6,7,8- HpCDF	0,28	1,18	1,39	2,33	1,10	7,40	3,51
1,2,3,4,7,8,9- HpCDF	0,00	0,05	0,09	0,07	0,10	0,15	0,11
OCDF	0,28	0,39	0,50	0,66	0,34	1,40	1,05
WHO2005- PCDD/F-TEQ (ug)	0,2	0,7	1,1	1,1	1,5	1,7	1,7



- d. Due to research of these raw minute data of the control-room and from the semi-continuous/long term measurements by the AMESA monitoring system of the flue gasses, awareness of no compliance, by the WtE REC, with the required 850°C for 2 seconds residents time in the Post Combustion Zone (PCZ) in 2015-2017. Mostly due to production failures and/or technical calamities, like i.e. wet waste (sewage sludge), or high (toxic) caloric waste content, dioxins and other POPs have been emitted into the surrounding environment of Harlingen region.



Full load						
End PCZ	29,94			29,73		
Axe	Axis 2 (Right)			Axis 3 (Right)		
Sample point	94	283	471	471	283	94
14:50-15:20	849	909	971	875	824	795
15:20-15:50	924	853	860	819	792	828
15:50-16:20	950	878	846	801	821	856
16:20-16:50	964	907	839	782	826	868
16:50-17:00	911	953	979	893	862	830
17:20-17:30	922	931	953	870	843	836

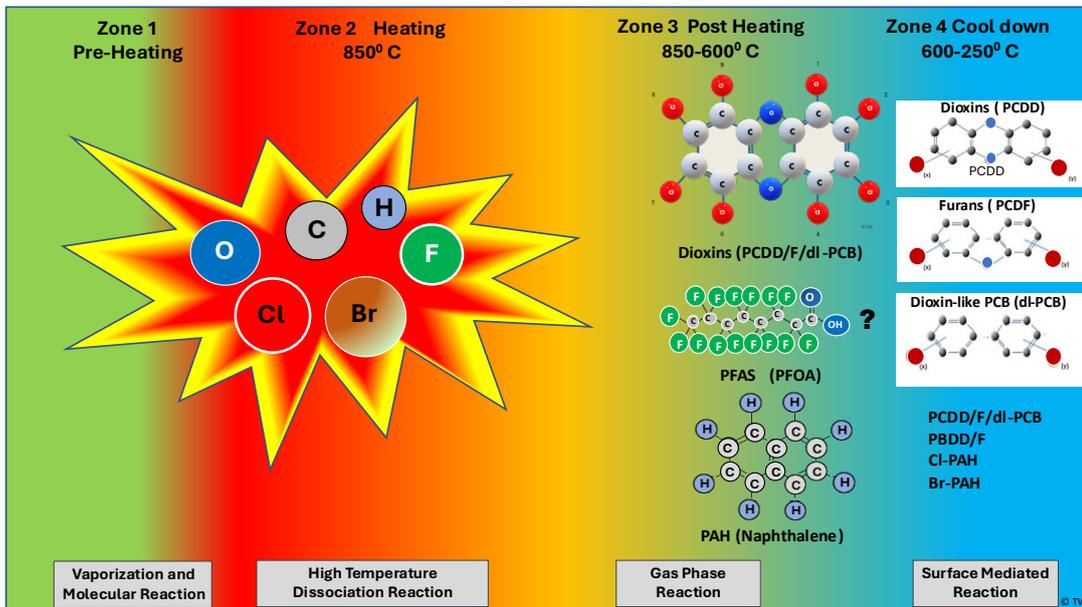
Full load						
End PCZ	29,94			29,73		
Axe	Axis 2 (Right)			Axis 3 (Right)		
Sample point	94	283	471	471	283	94
14:50-15:20	849	909	X	X	824	795
15:20-15:50	924	853	X	X	792	828
15:50-16:20	950	878	X	X	821	856
16:20-16:50	964	907	X	X	826	868
16:50-17:00	911	953	X	X	862	830
17:20-17:30	922	931	X	X	843	836

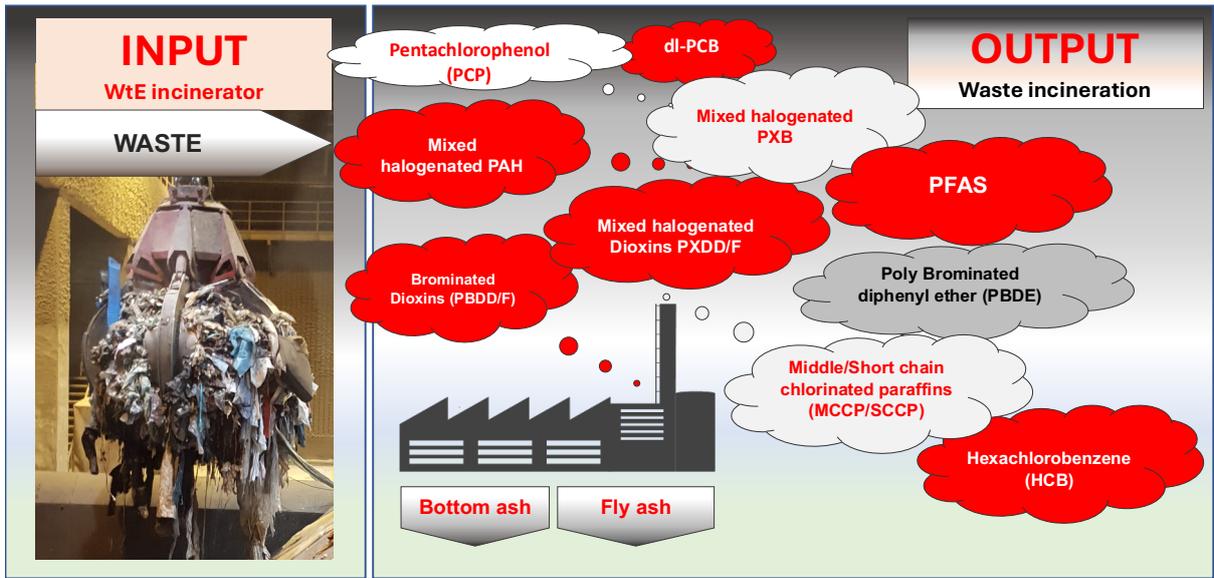
Part Load						
End PCZ	29,94			28,7		
Axe	Axis 2 (Right)			Axis 3 (Right)		
Sample point	94	283	471	471	283	94
14:50-15:20	955	917	882	829	856	863
15:20-15:50	953	887	872	826	825	852
15:50-16:20	898	873	898	826	820	836
16:20-16:50	877	897	910	840	837	835
16:50-17:00	877	912	924	844	836	817
17:20-17:30	934	927	941	863	857	849

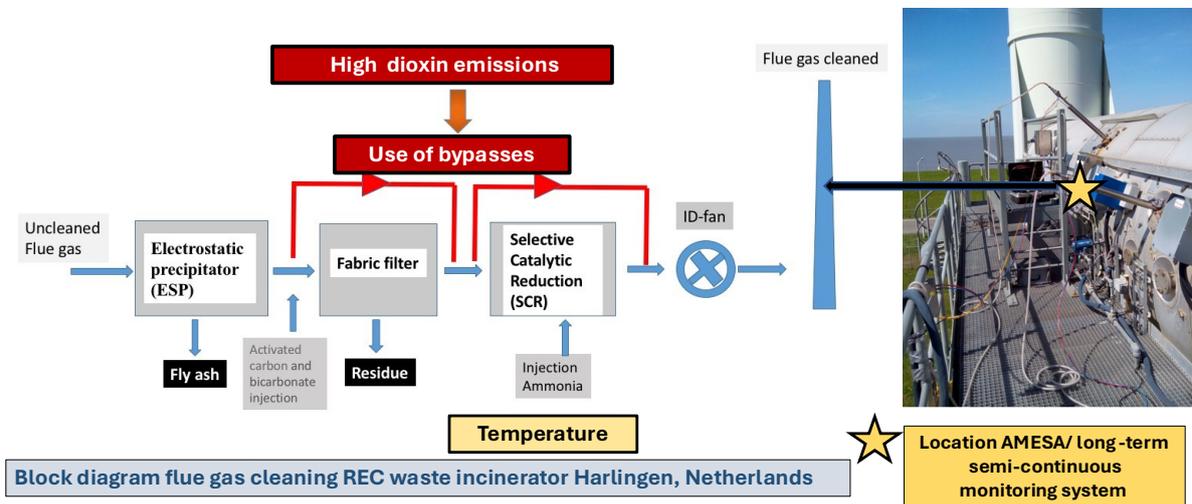
Part Load						
End PCZ	29,94			28,7		
Axe	Axis 2 (Right)			Axis 3 (Right)		
Sample point	94	283	471	471	283	94
14:50-15:20	955	917	X	X	856	863
15:20-15:50	953	887	X	X	825	852
15:50-16:20	898	873	X	X	820	836
16:20-16:50	877	897	X	X	837	835
16:50-17:00	877	912	X	X	836	817
17:20-17:30	934	927	X	X	857	849

- e. Raise awareness of the EU regulations, concerning waste combustion temperatures of  $850^{\circ}\text{C}$  for 2 sec in PCZ. Which is in fact far too low to the destruct the toxic POPs chemical molecule structures of our daily (household) waste content. For PFAS much higher combustion temperatures are needed,  $> 1100-1600^{\circ}\text{C}$ . But even if these high temperatures are implemented, still the 'novo synthesis'-phase in the production process is a challenge to deal with. Meaning that in these cooling down phase, the destructed molecules can form by  $600-250^{\circ}\text{C}$ , as ideal temperatures for these novo synthesis into new structures of dioxins, PFAS, PAH. A solid double filter system is critical needed, to avoid/minimalize POPs emissions by waste incineration.

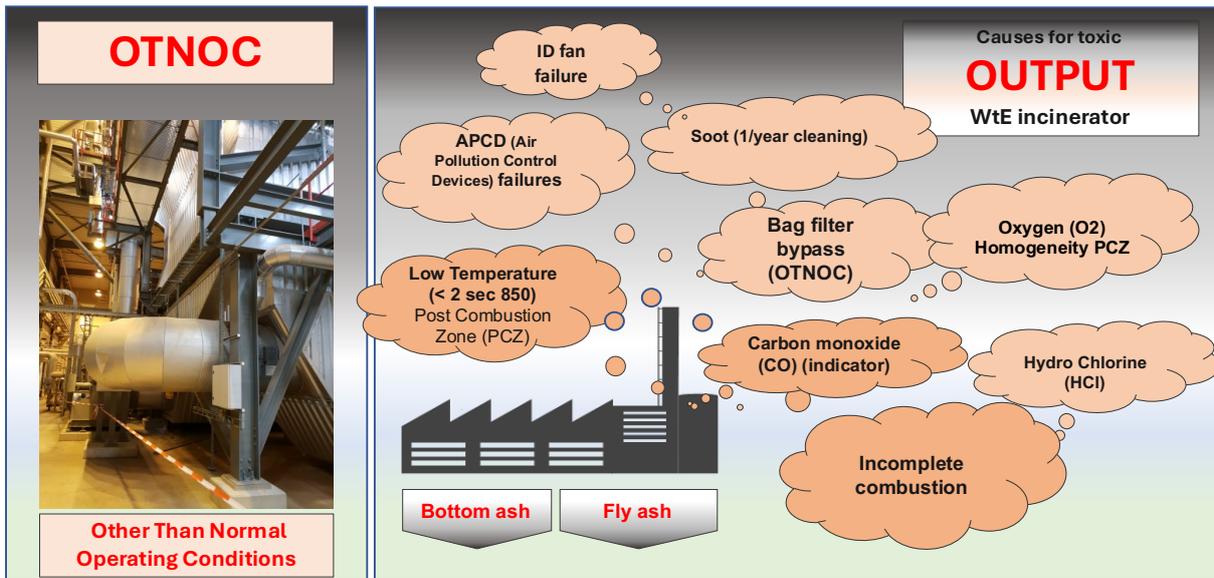




f. TW participation in technical workgroups of governments and waste industry and TW study of the un-averaged data, resulted in the findings of the flue gasses, were bypassed during several crisis waste incineration production situations, also called Other Than Normal Operation Conditions (OTNOC).



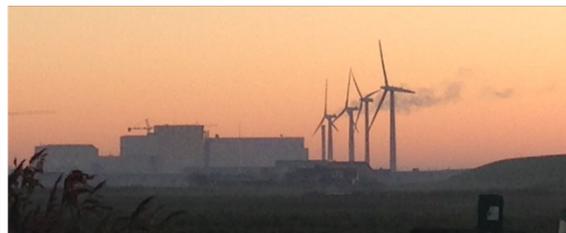
g. During OTNOC situations, there is NO monitoring on POP emissions, by regulations. TW research contribute to the understanding and need to implement monitoring on POPs just in case of OTNOC by stricter the emissions regulations.



- h. TW has shown by study, the need for semi-continuous/ Long-term monitoring (i.e. by AMESA system) of POPs, like dioxins, PFAS, PAH and heavy metals of the flue gases, which are released through the chimney of the waste incinerator REC, Harlingen NL. Instead of only relying on the very limited short-term monitoring of 2x or even 1x six (6) hours per year under ideal production and preannounced. A similar TW study in Paris, Ivry-sur-Seine in France was conducted in 2022 with a published TW report in 2023.

Parallel measurements of short and long-term measurements

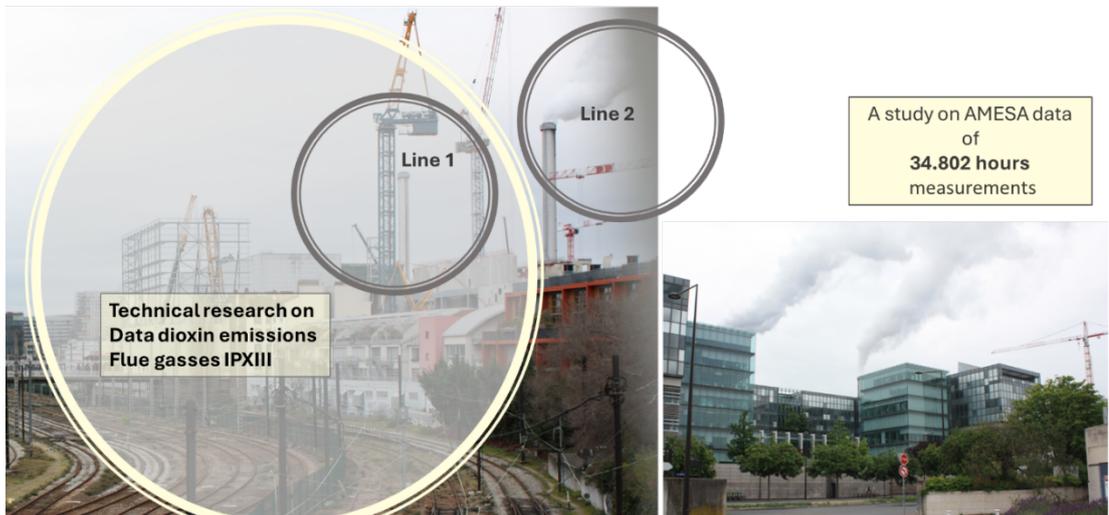
Sampling REC Harlingen NL	Hours	ng TEQ/Nm <sup>3</sup> upperbound (UB)	Difference
Short-term, March 30, 2016	6	<0,00001	>1290
Long-term, March 26– April 26, 2016	256	0,01290	
Short-term, 8 March 2017	6	0,00001	
Long-term March 7 – April 5, 2017	690	0,00460	



- i. TW contribution by participating technical workgroup and research contributed in technical improvements of the flue gasses filter systems WtE REC, Harlingen, NL.



- j. Due to the experience of TW as participant of this Dutch technical workgroup, TW could perform a similar study of 2 year on technical emission data (2020-2021) of the flue gases in Paris, Ivry-sur-Seine, France. This TW-Paris study confirms TW research of 2-year semi-continuous data of the flue gasses of WtE REC in Harlingen, NL (2015-2017), that POPs could be emitted by waste incineration, especially during OTNOC situations, when semi-continuous monitoring is turned off/out of operation.



- k. TW research has shown, already in 2015, that PFAS substances has been emitted by the flue gasses of waste incineration WtE REC (2017), as one of the first in this field. These TW findings are presented at the Dioxin Conference, the *International Symposium on Halogenated*

Persistent Organic Pollutants (POPs) in Krakow, Poland (2018). At this conference the non-compliance of the 850°C for 2 seconds residents time at the Post Combustion Zone (PCZ), WtE REC, Harlingen, NL (2017) has been presented as well, to bring awareness for the risks of POP that are emitted by waste incineration.

**PFAS (PFOS and PFOA) emissions and Temperatures/Oxygen of the WtE REC, Harlingen, NL**  
 Presented at the Dioxin Conference, Krakow Poland

**Emissions of dl-PCB, PBB, PBDD/F, PBDE, PFOS, PFOA and PAH from a waste incinerator**

Arkenbout A, Bouman KJAM  
ToxicWatch, Harlingen, NL

**Introduction**

In 2012 a permit for the incinerator was established. The Netherlands, with a permit granted for mass emissions of 102 kg PCBs per year. The Netherlands has high compliance with POPs. The PCBs are by far the most abundant POPs in the waste. The PCBs are by far the most abundant POPs in the waste. The PCBs are by far the most abundant POPs in the waste.

**Methods and materials**

The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

**Results**

Polychlorinated biphenyls were detected during an incineration. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

**Conclusions**

The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

**100<sup>th</sup> Anniversary of Regaining Independence by Poland**

38<sup>th</sup> International Symposium on Halogenated Persistent Organic Pollutants

**Dioxin 2018**

10<sup>th</sup> International PCB Workshop

26 - 31 August 2018, Krakow, Poland

**Temperature and Oxygen levels in the Post Combustion Zone of a Waste-to-Energy Incinerator**

Arkenbout A., ToxicWatch Foundation, Harlingen, the Netherlands

**Introduction**

The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

**Methods and materials**

The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

**Results**

The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

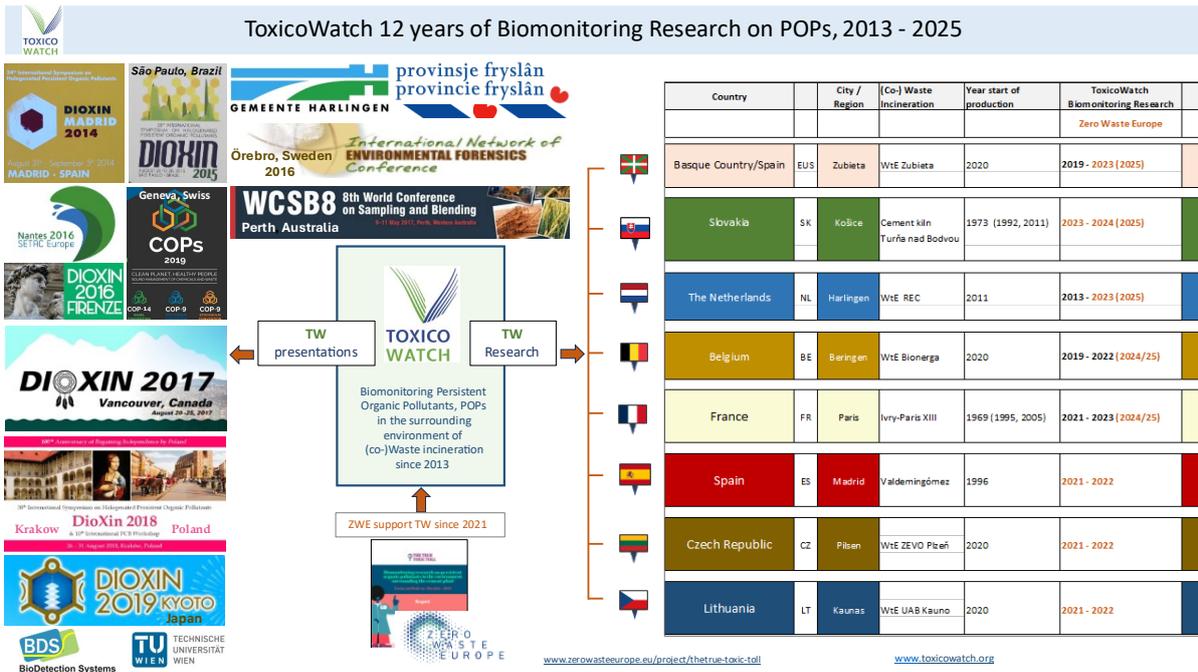
**Conclusions**

The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator. The incinerator is equipped with a highly efficient incinerator.

TW started research on demand of concerned local people and local politic parties in Harlingen, The Netherlands in 2013 by TW's own initiative an independent biomonitoring study on dioxins in backyard chicken eggs in the surrounding environment of the newly built WtE waste incinerator REC (2011). The high documented level of dioxins in these eggs resulted in national attention with several documentaries on the national Dutch TV and counter research from the Ministry of Health (VROM). From 2014 till 2019 TW has presented at Dioxin conferences and other relevant toxicological conferences and symposia (SETAC, INEF and BDS) about the NL research findings as well of TW biomonitoring in other European countries on POP in relation to emissions of waste incineration. TW attended, based on its research, the Basel Rotterdam Stockholm conventions (BRS COPs 2017 & 2019). Since 2021 'Zero Waste Europe' in Brussels has supported TW financially regarding multi-year biomonitoring research projects, in several European countries, on POPs in in surrounding areas of (co-)waste incineration.

There is no further information on emissions from the waste incinerator from 2017 to 2025, as semi-continuous measurements were unilaterally stopped by management in 2017. This was in response to a second major breakdown, and an emission of 1.8 ng TEQ/Nm3 was recorded, but never evaluated. However, the incinerator is only permitted to conduct 6 hours of dioxin measurements once a year due to the incinerator's good results of performance. This is far from the truth, but it shows the great influence of industry.

Anecdotaly, the 'Lickebaert' affair, with high levels of dioxins in the environment, led to the development of a new technique to monitor dioxins in a cheaper way. The Dutch biotech company BioDetection Systems now holds the patent for this CALUX technique and provides testing services for these substances worldwide.



Since 2013 several TW biomonitoring research and presentations have been presented in European countries, to raise awareness of health risks of persistent organic pollutants, like dioxins, PFAS, PAH and heavy metals released into the environment by industrial emissions and residues.

