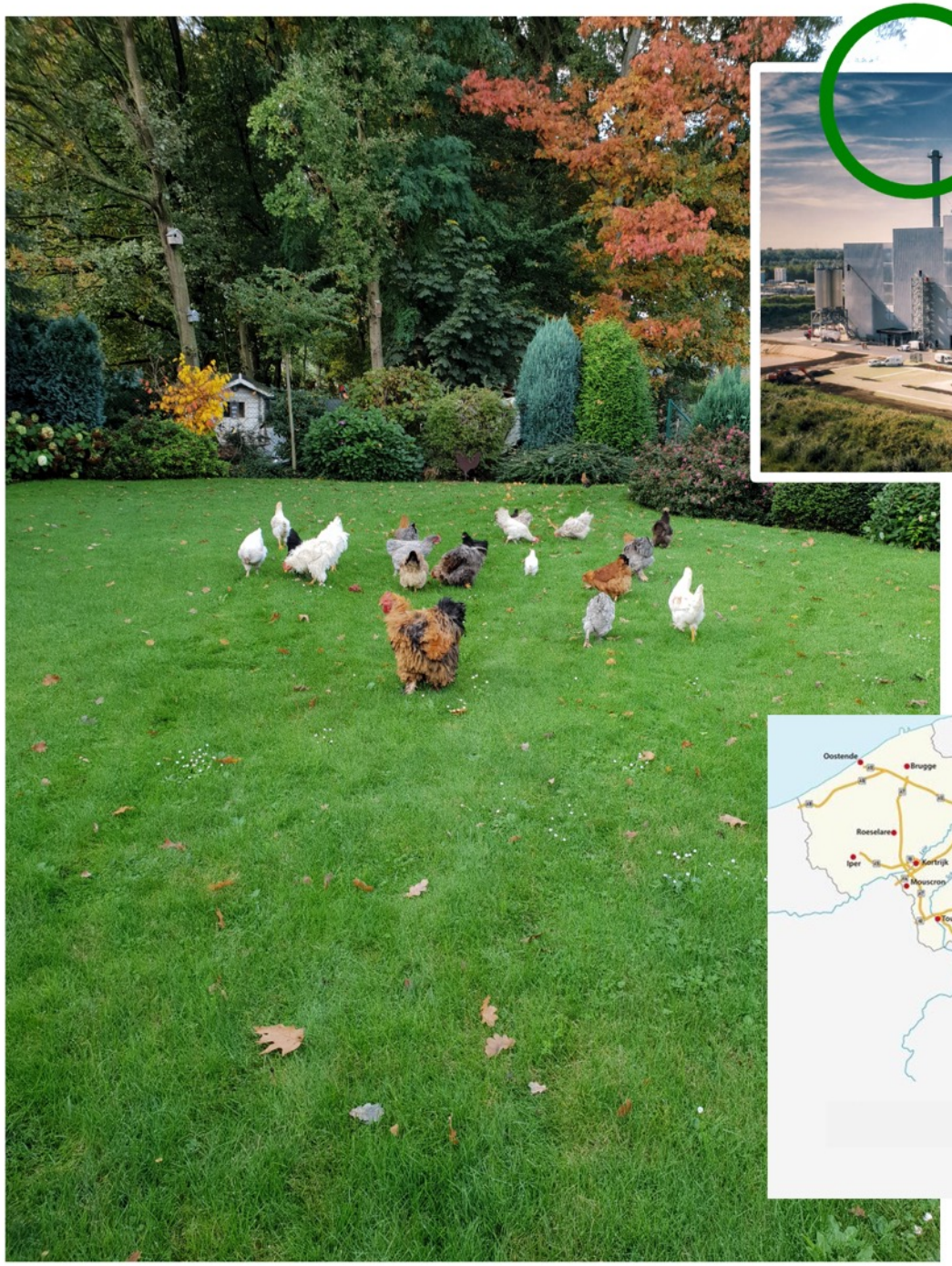
TOXICO WATCH

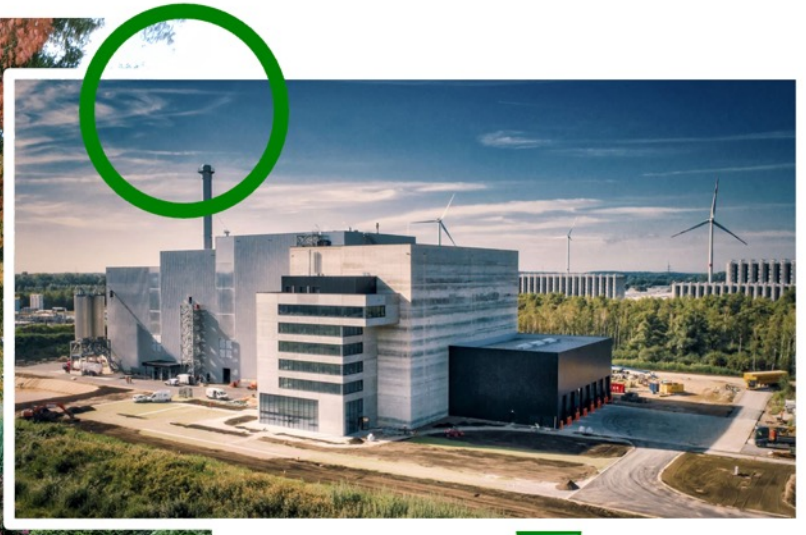
Biomonitoring research Beringen, Belgium

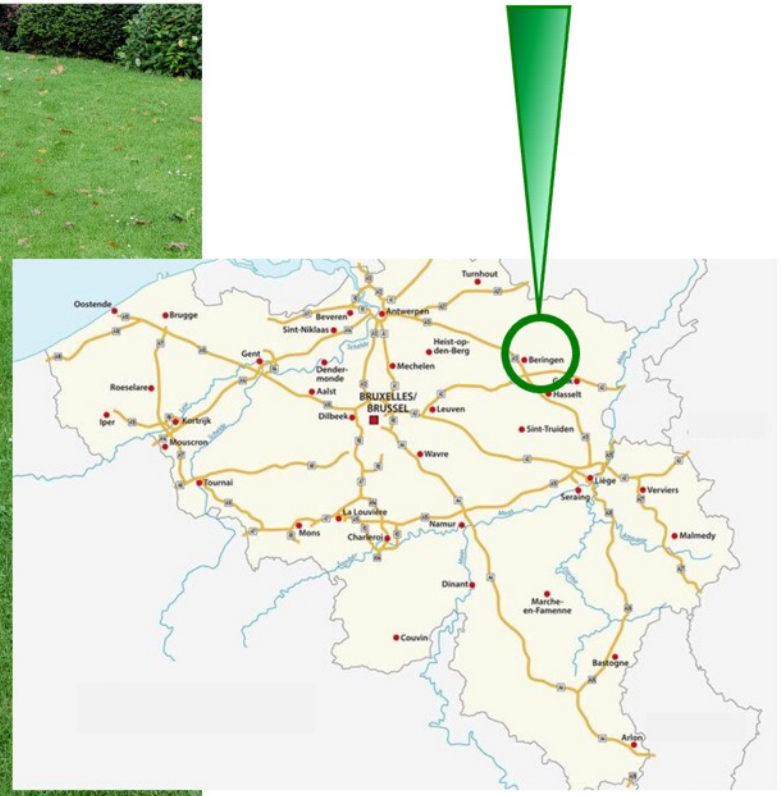
2019-2021

Results

11 mei 2022







TOXICO WATCH

Biomonitoring research Beringen, 2019-2021

Key findings

- DR CALUX shows dioxins in eggs exceed the EU-limit value
- GC-MS analysis shows fifty per cent (50%) of the eggs do not meet EU standards for safe egg consumption.
- The location close to the incinerator shows the highest increase of nearly all dioxins and furan congeners
- Five (5) locations show increases in octachlorodibenzo-p-dioxin (OCDD), Heptachlorodibenzofuran (HpCDF1), and 3,3′,3,3′,5-Pentachlorobiphenyl PCB 126, typical congeners for incomplete combustion processes in incineration.
- Passive sampling with “Bergerhoff gauges” shows increased dioxin levels verifying the finding in eggs
- Dioxins in the emissions of the incinerator show similar patterns to the patterns found in eggs
- Semi-continuous measurements of the incinerator, including periods of fire-off, shutdown and start-ups (OTNOC), are needed to determine the contribution of the incinerator to the found dioxin deposition in eggs
- Need for data on potential contaminants in the Beringen region, in particular, the industry covered by the EU Seveso regulations

11 mei 2022

beringen

This research was made possible by the city of Beringen thanks to the initiative of *Leefbaar Tervant*

LEEFBAAR TERVANT

EU regulations for dioxins (PCDD/F/dl-PCB)

Halogens

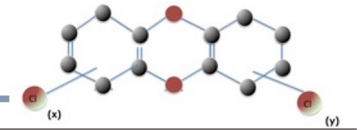
Chlorine (Cl)
Bromine (Br)
Fluorine (F)
Iodine (I)

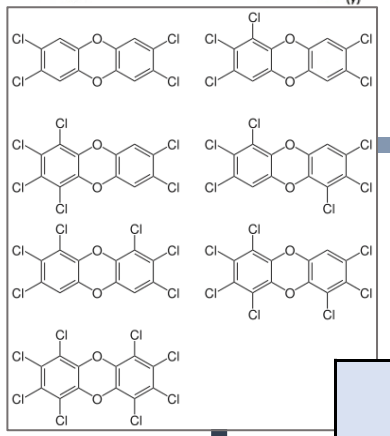
Chlorine can be substituted by an other halogen

EU regulations only for **PCDD/F in emissions**

EU regulations only on **Chlorinated** Persistent Organic Pollutants (POP)

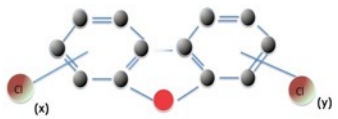
Dioxin
PCDD (75)
n = 7

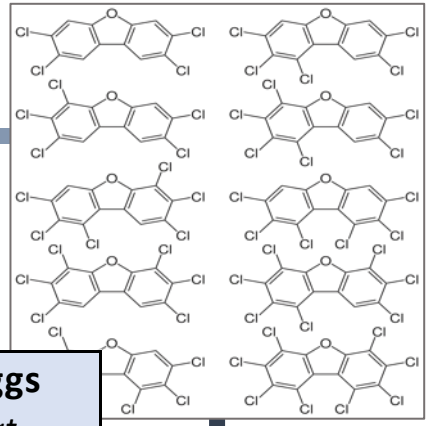




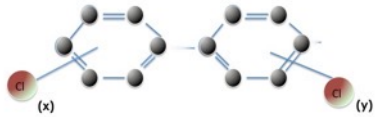
Furan
PCDF (135)
n = 10

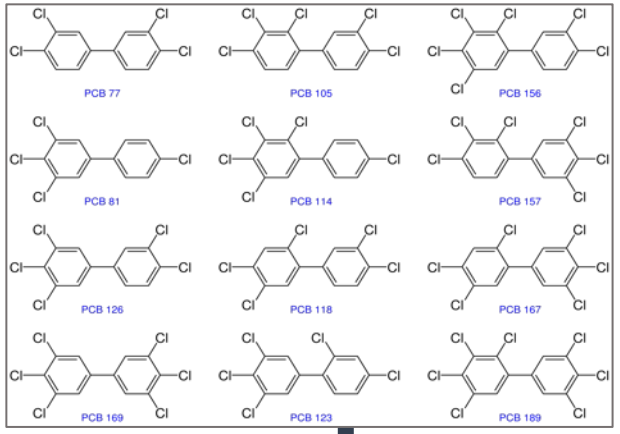
0.1 ng TEQ/Nm3





dioxin-like Polychlorinated biphenyl
dl-PCB (209)
n = 12





EU regulation Eggs
GC-MS pg TEQ/g fat

Action limit PCDD/F	**≥ 1.75 pg**

EU regulation Eggs
GC-MS pg TEQ/g fat

Limit PCDD/F	**≥ 2.5 pg**

EU regulation Eggs
GC-MS pg TEQ/g fat

Limit PCDD/F/dl-PCB	**≥ 5.0 pg**

EU regulation Eggs
GC-MS pg TEQ/g fat

Action limit dl-PCB	**≥ 1.75 pg**

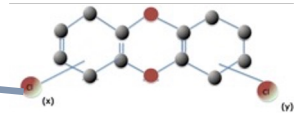
Chemical analysis (GC-MS) vs. bio-detection (DR CALUX)

Halogen elements:

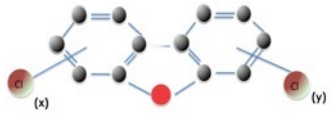
Chlorine (Cl)
Bromine (Br)
Fluorine (F)
Iodine (I)

Chlorine can be substituted by an other halogen in dioxins, UPOP

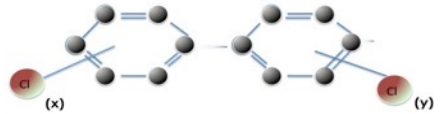
Dioxin PXDD



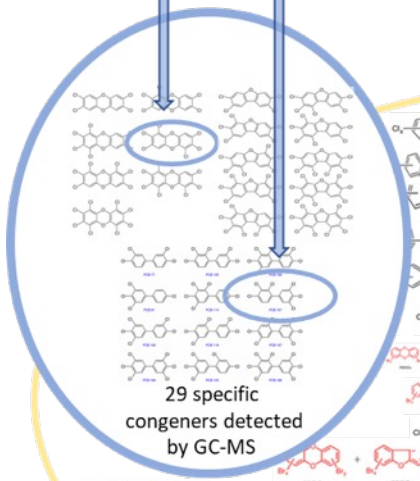
Furan PXDF



dioxin-like Poly-X-biphenyl dl-PXB



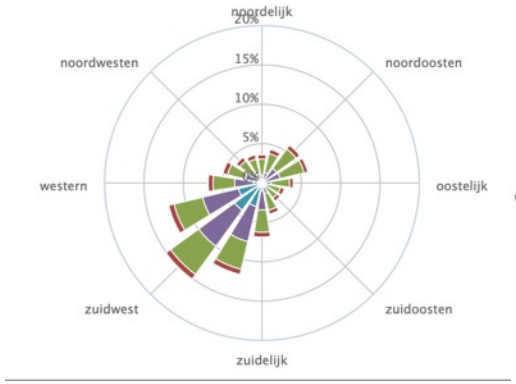
GC-MS individual chemical analyses



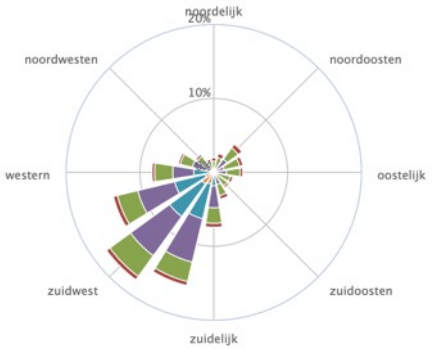
DR CALUX, analyses of the whole group of dioxin-like activity

DR CALUX Food (Eggs)	
pg BEQ / g fat	
≥ 1.7	EU Cut-off-Value PCDD/F
≥ 3.3	EU Cut-off-Value PCDD/F/dl-PCB

Wind rose in Beringen (Meteocast)



January



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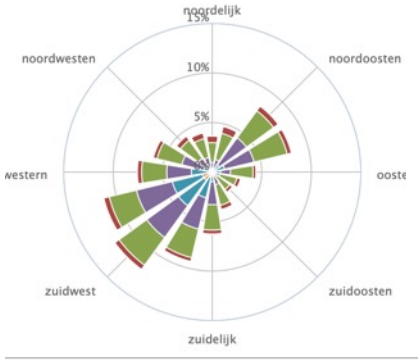

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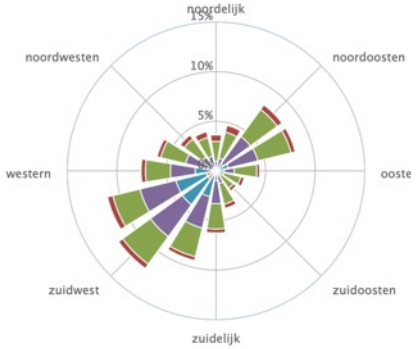
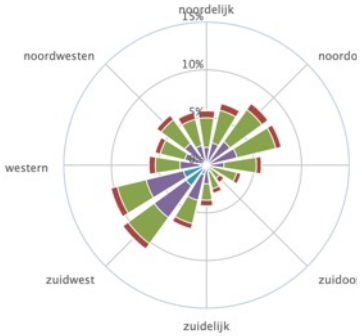


April



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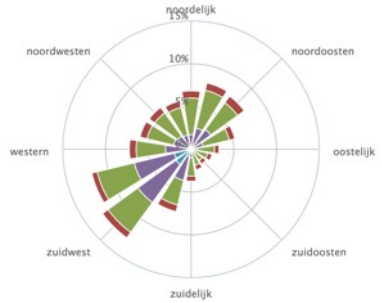

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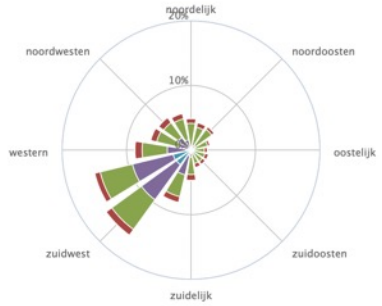

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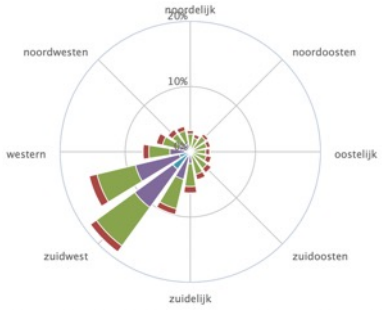

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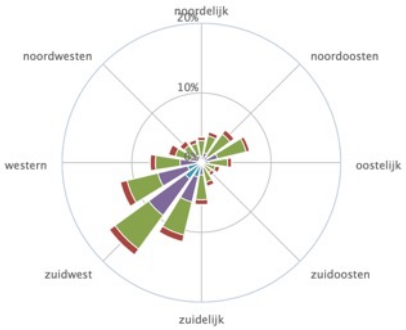

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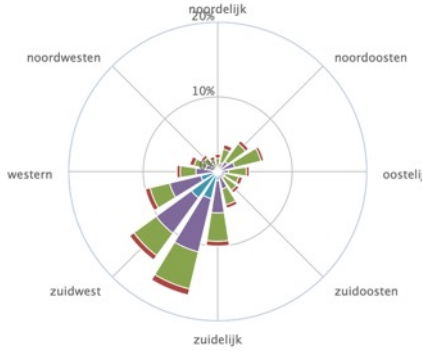

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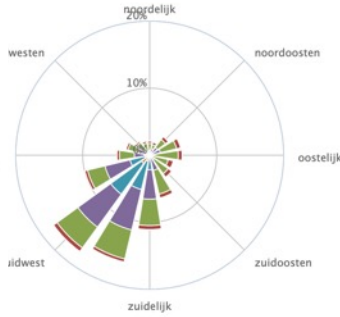


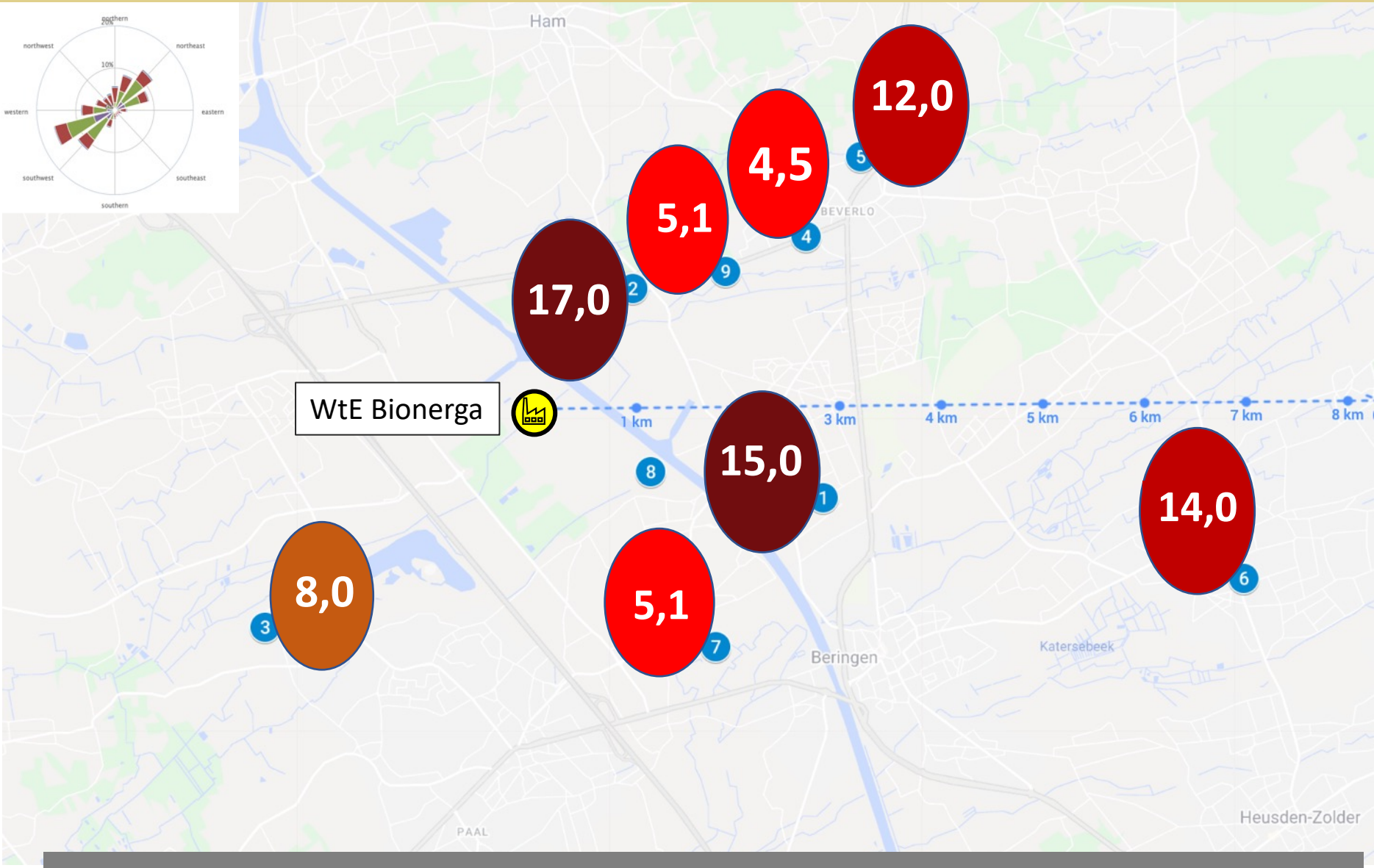
November

December

Dioxins (PCDD/F/dl-PCB) in eggs, Beringen - 2021

DR CALUX: PCDD/F/dl-PCB		
Regio	jaar/locatie	*pg BEQ/g vet*
Beringen	**2021 - BE-1**	**15,0**
Ham	**2021 - BE-2**	**17,0**
Paal	**2021 - BE-3**	**8,0**
Beverlo	**2021 - BE-4**	**4,5**
Beverlo	**2021 - BE-5**	**12,0**
Koersel	**2021 - BE-6**	**14,0**
Tervant.Z	**2021 - BE-7**	**5,1**
Beringen	**2021 - BE-9**	**5,1**
	Cut-off	**3,3**

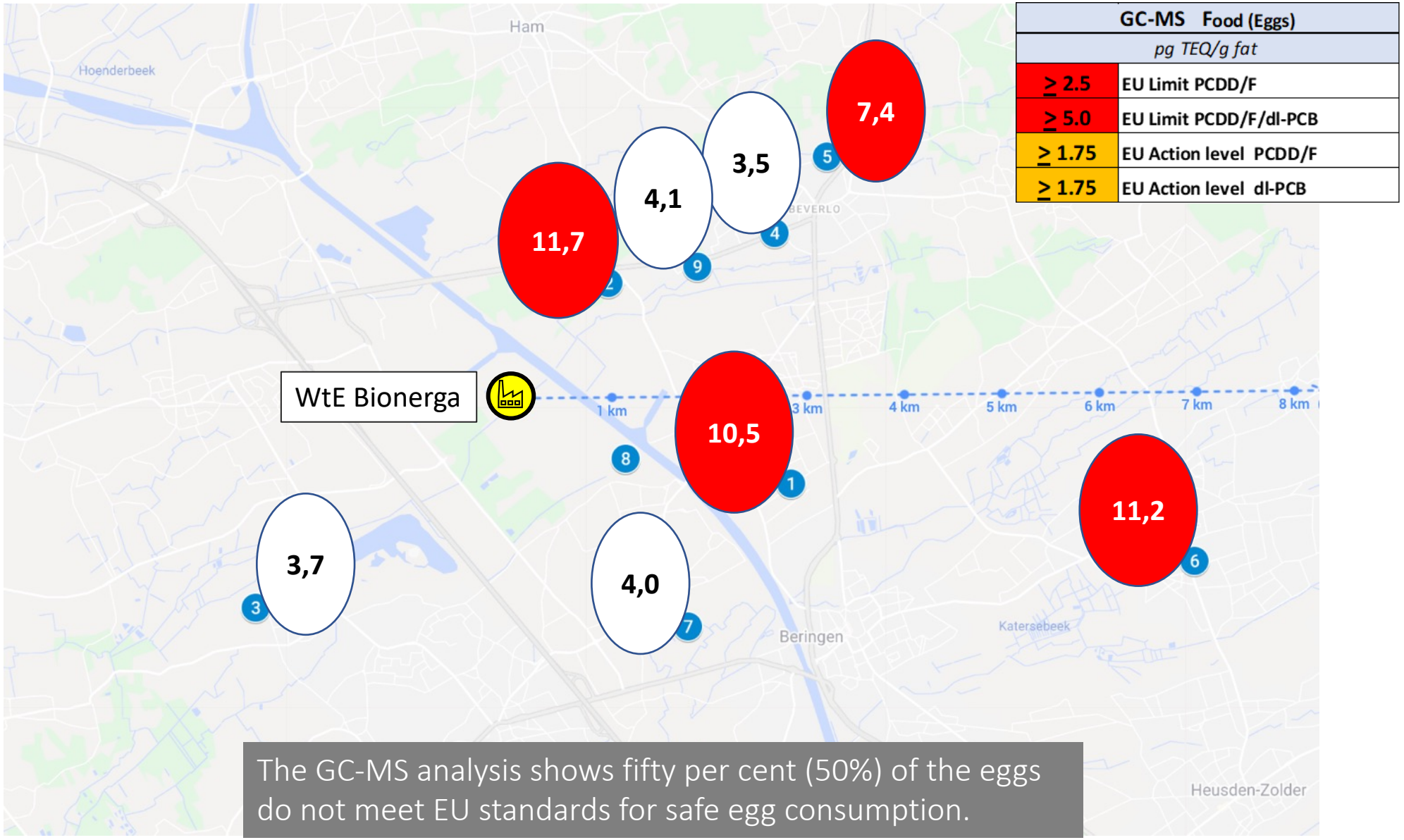
EU limit - Eggs DR CALUX	
Food (Eggs)	*pg BEQ/g fat*
PCDD/F/dl-PCB	**PCDD/F**
EU limit > 3.3	**EU limit > 1.7**
EU limit < 3.3	**EU limit < 1.7**
TW indicative scale	
> 15	**> 10**
> 10	**> 5**
> 6.6	**> 3.4**



Chicken eggs exceed the EU-limit for dioxins, 3.3 pg BEQ,
and has to be determined by the confirmatory method of GC-MS

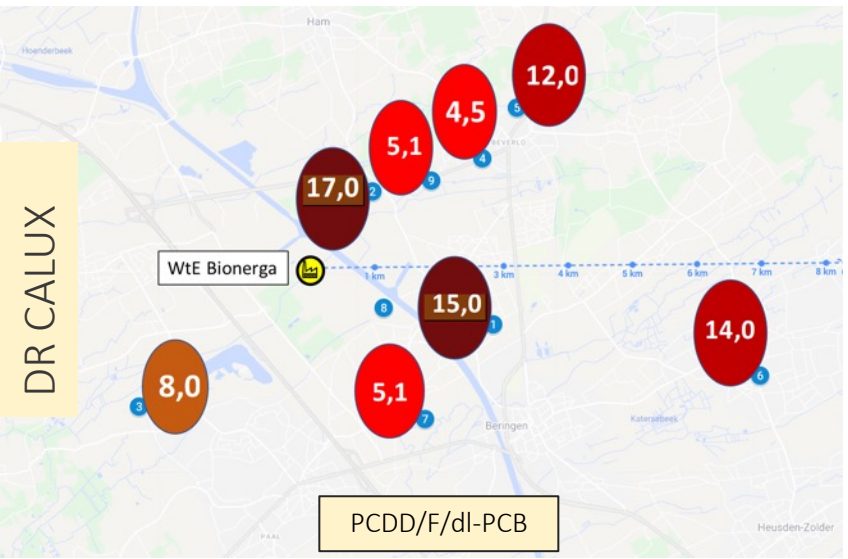
Dioxins (PCDD/F/dl-PCB) eggs GC-MS, Beringen - 2021

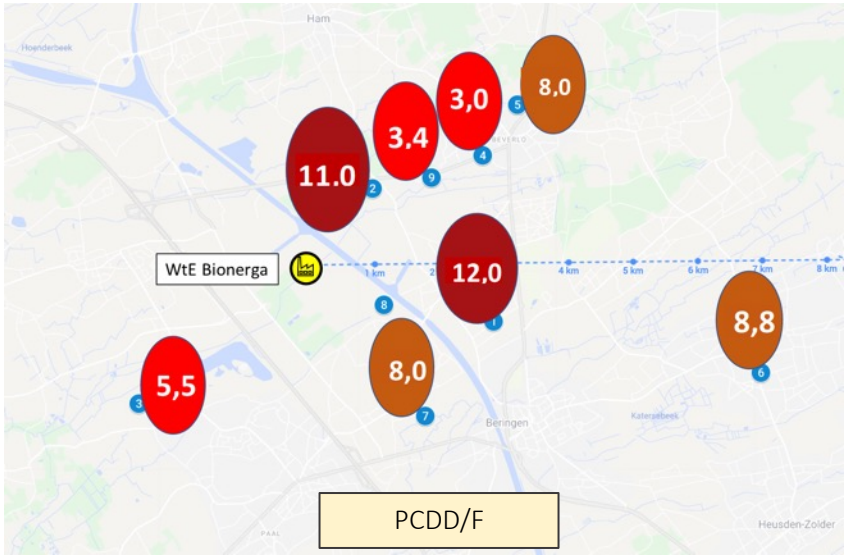
Beringen - 2021	
GC-MS: PCDD/F/dl-PCB	
Jaar/Locatie	*pg TEQ/g vet*
2021 - BE-1	10,51
2021 - BE-2	11,65
2021 - BE-3	3,70
2021 - BE-4	3,50
2021 - BE-5	7,40
2021 - BE-6	11,2
2021 - BE-7	4,00
2021 - BE-9	4,10
2019 - BE-1	10,0
2019 - BE-2	3,11
2019 - BE-3	1,60
2019 - BE-4	6,21
2019 - BE-5	11,58
2019 - BE-6	6,10
2019 - BE-7	6,31
2019 - BE-8	9,10
EU limit	5,0

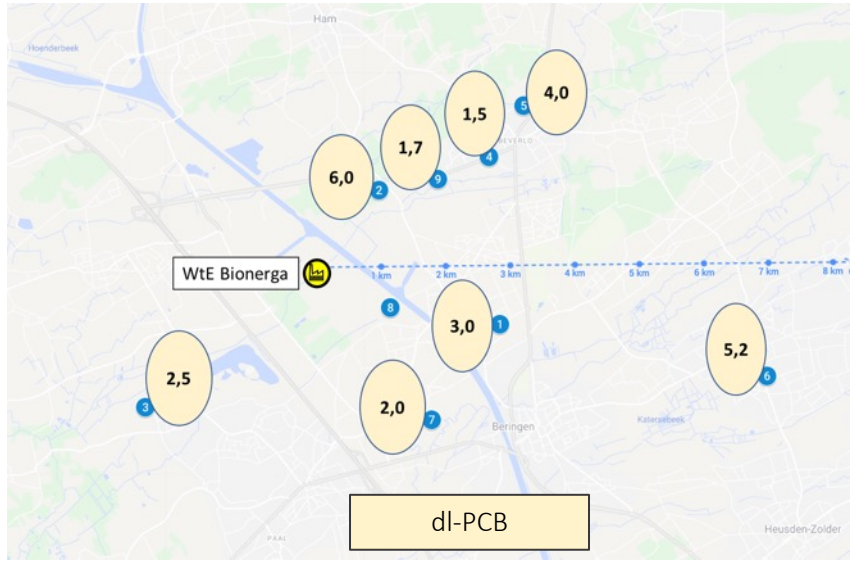


Specified for dioxins and PCB eggs backyard chicken, Beringen/Belgium - 2021

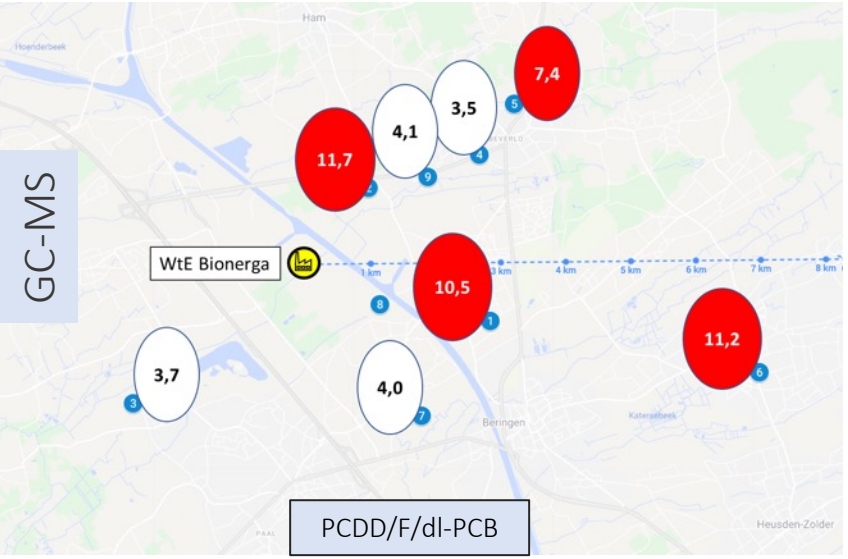
DR CALUX

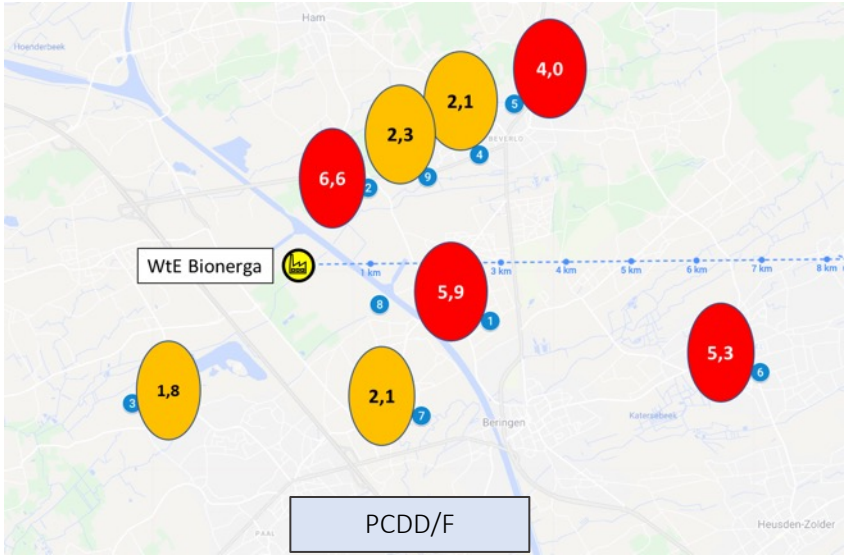


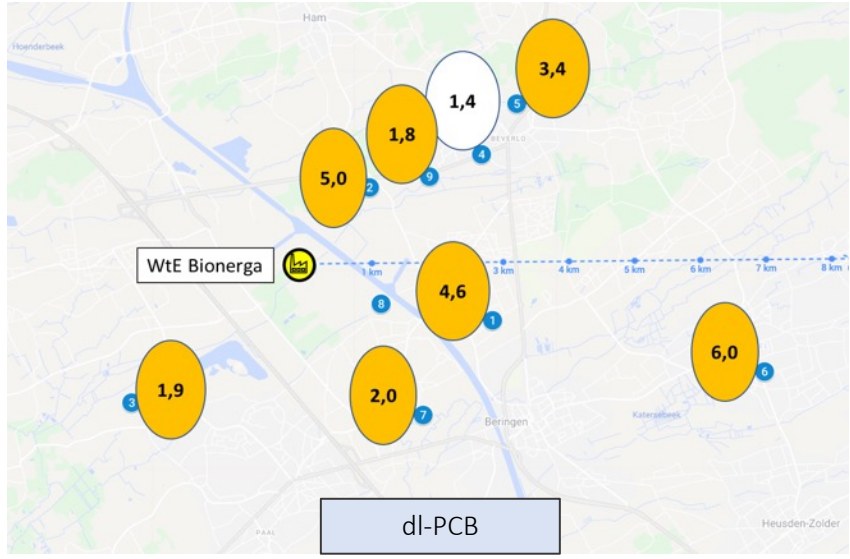




GC-MS





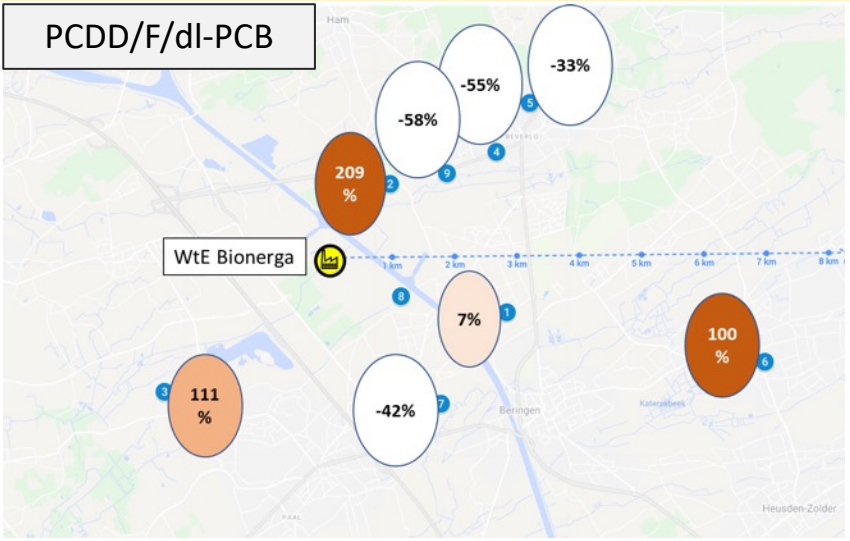


Changes in dioxins and PCBs in eggs 2019 – 2021, Beringen

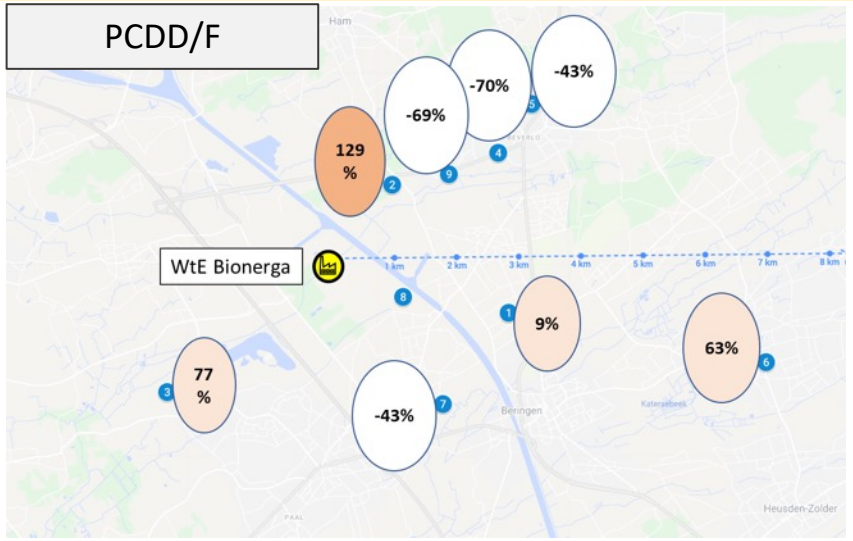
TW indicatieve legenda	
Verhoging %	
	> 500 %
	> 300 %
	> 200 %
	> 100 %
	< 100 %

DR CALUX

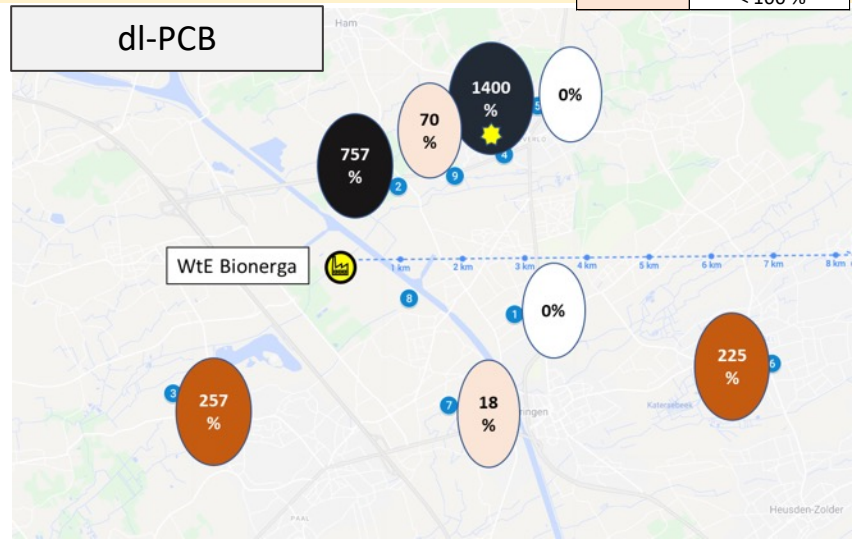
PCDD/F/dl-PCB



PCDD/F

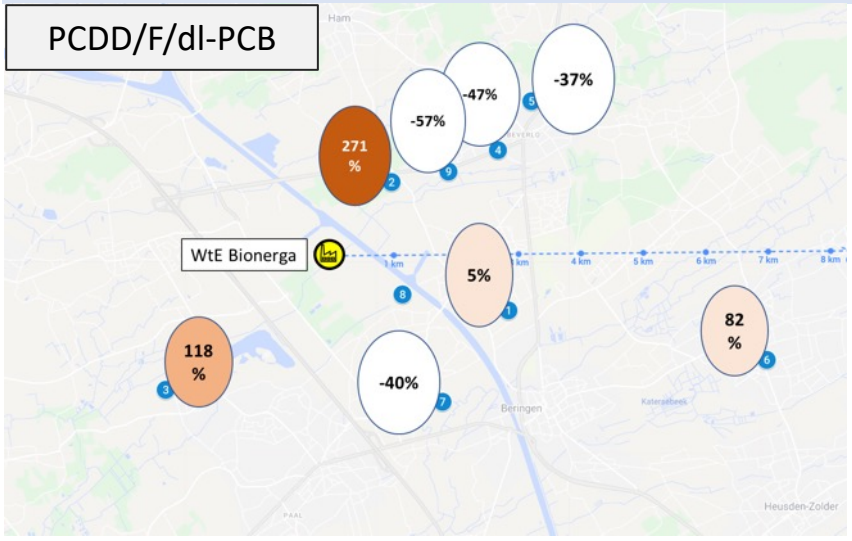


dl-PCB

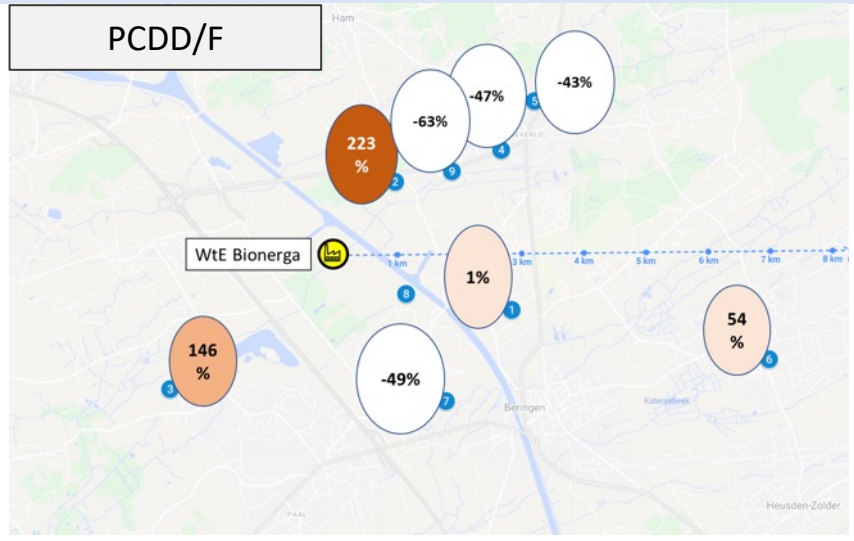


GC-MS

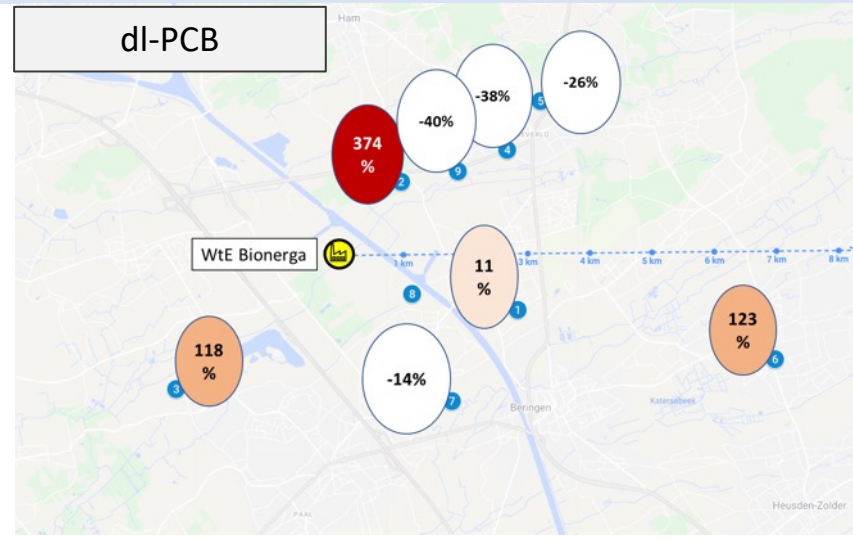
PCDD/F/dl-PCB



PCDD/F



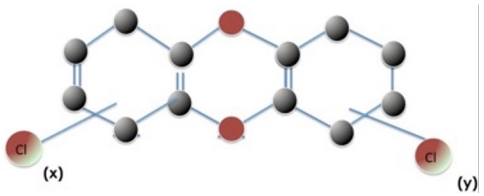
dl-PCB



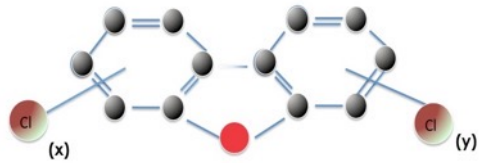
Four locations has elevated values dioxins and/or PCB compared to 2019

Typical combustion related congeners of dioxins

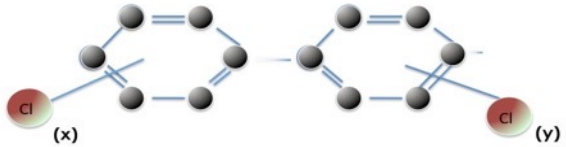
Dioxin
PCDD (75)
n = 7



Furan
PCDF (135)
n = 10



dioxin-like Polychlorobiphenyl
dl-PCB (209)
n = 12



	Dioxins, furans (PCDD/F) and dioxin-like PCBs	
Abbreviation	**Congeners**	**TEF**
Dioxins (n=7)		
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
PCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
HxCDD1	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0,1
HxCDD2	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0,1
HxCDD3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0,1
HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0,01
OCDD	Octachlorodibenzo-p-dioxin	0,0003

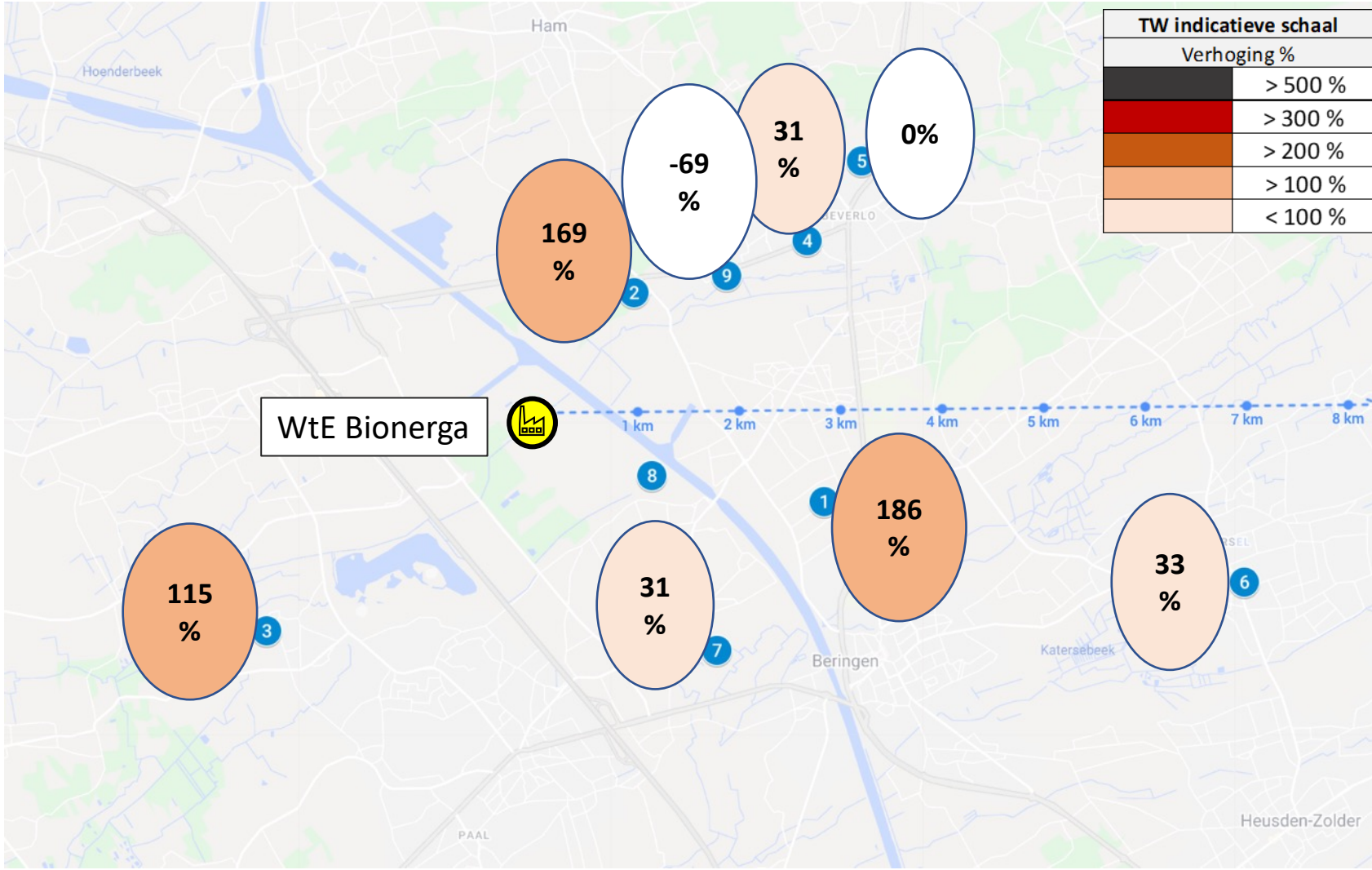
Furans (n=10)		
TCDF	2,3,7,8-Tetrachlorodibenzofuran	0,1
PCDF1	1,2,3,7,8-Pentachlorodibenzofuran	0,03
PCDF2	2,3,4,7,8-Pentachlorodibenzofuran	0,3
HxCDF1	1,2,3,4,7,8-Hexachlorodibenzofuran	0,1
HxCDF2	1,2,3,6,7,8-Hexachlorodibenzofuran	0,1
HxCDF3	1,2,3,7,8,9-Hexachlorodibenzofuran	0,1
HxCDF4	2,3,4,6,7,8-Hexachlorodibenzofuran	0,1
HPCDF1	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0,01
HPCDF2	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0,01
OCDF	Octachlorodibenzofuran	0,0003

Polychlorinated biphenyl (n=12)		
PCB77	3,3',4,4'-Tetrachlorobiphenyl (#77)	0,0001
PCB81	3,4,4',5-Tetrachlorobiphenyl (#81)	0,0003
PCB126	3,3',4,4',5-Pentachlorobiphenyl (#126)	0,1
PCB169	3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	0,03
PCB105	2,3,3',4,4'-Pentachlorobiphenyl (#105)	0,00003
PCB114	2,3,4,4',5-Pentachlorobiphenyl (#114)	0,00003
PCB118	2,3',4,4',5-Pentachlorobiphenyl (#118)	0,00003
PCB123	2,3,4,4',5-Pentachlorobiphenyl (#123)	0,00003
PCB156	2,3,3',4,4',5-Hexachlorobiphenyl (#156)	0,00003
PCB157	2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	0,00003
PCB167	2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	0,00003
PCB189	2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	0,00003

Changes in dioxins are most pronounced for **octachlorodibenzo-p-dioxin (OCDD), Heptachlorodibenzofuran (HpCDF1),** and 3,3′,3,3′,5-Pentachlorobiphenyl (PCB 126), typical congeners for incomplete combustion processes in incineration.

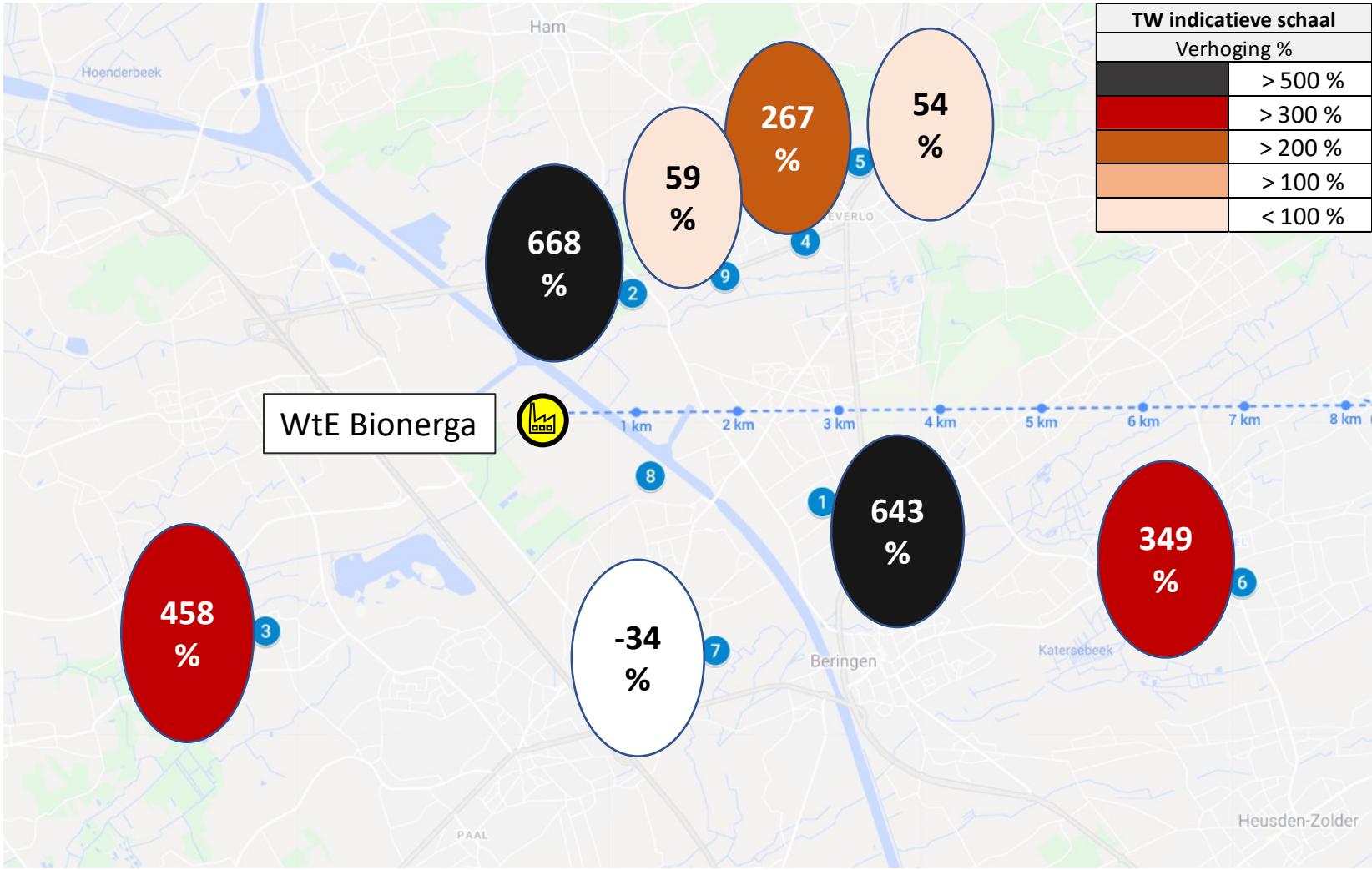
Changes in concentration octachlorodibenzo-p-dioxin (OCDD) 2019 - 2021

Eggs Beringen 2021					
Changes in concentratie OCDD 2019-2021					
Location	Code	Year	*pg /g fat*	Difference 2019	%
Beringen	**BE-1**	**2021**	**91.00**	**59.20**	**186%**
Ham	**BE-2**	**2021**	**87.00**	**54.70**	**169%**
Paal	**BE-3**	**2021**	**8.10**	**4.33**	**115%**
Beverlo	**BE-4**	**2021**	**28.00**	**6.60**	**31%**
Beverlo	**BE-5**	**2021**	**14.00**	**0.00**	**0%**
Koersel	**BE-6**	**2021**	**27.00**	**6.70**	**33%**
Tervant.Z	**BE-7**	**2021**	**41.00**	**9.70**	**31%**
Beringen	**BE-9**	**2021**	**19.00**	**-41.60**	**-69%**
	BE-1	2019	**31.80**		
	BE-2	2019	**32.30**		
	BE-3	2019	**3.77**		
	BE-4	2019	**21.40**		
	BE-5	2019	**14.00**		
	BE-6	2019	**20.30**		
	BE-7	2019	**31.30**		
	BE-8	2019	**60.60**		



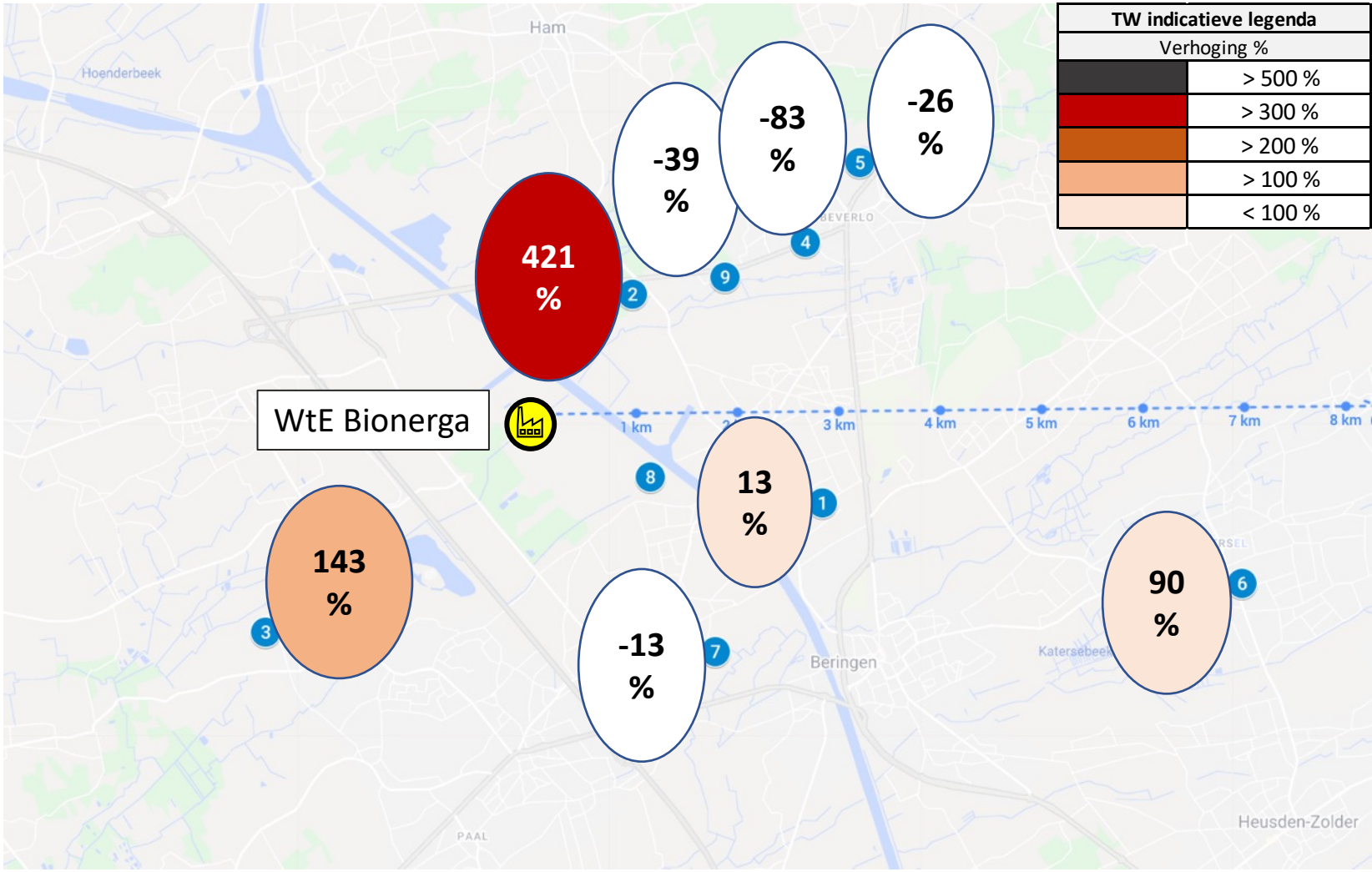
Changes in concentration 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF1) 2019 - 2021

Eggs Beringen 2021					
Changes in concentration HpCDF1					
Location	Code	Year	*pg /g fat*	Difference 2019	%
Beringen	**BE-1**	**2021**	**46.00**	**39.81**	**643%**
Ham	**BE-2**	**2021**	**57.00**	**49.58**	**668%**
Paal	**BE-3**	**2021**	**4.60**	**3.78**	**458%**
Beverlo	**BE-4**	**2021**	**15.00**	**10.91**	**267%**
Beverlo	**BE-5**	**2021**	**9.00**	**3.17**	**54%**
Koersel	**BE-6**	**2021**	**17.00**	**13.21**	**349%**
Tervant.Z	**BE-7**	**2021**	**6.60**	**-3.40**	**-34%**
Beringen	**BE-9**	**2021**	**12.00**	**4.43**	**59%**
	BE-1	2019	**6.19**		
	BE-2	2019	**7.42**		
	BE-3	2019	**0.825**		
	BE-4	2019	**4.09**		
	BE-5	2019	**5.83**		
	BE-6	2019	**3.79**		
	BE-7	2019	**10.00**		
	BE-8	2019	**7.57**		

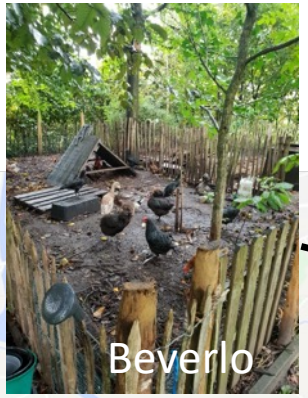


Changes in concentration 3,3′,3,3′,5-Pentachlorobiphenyl (PCB 126) - 2021

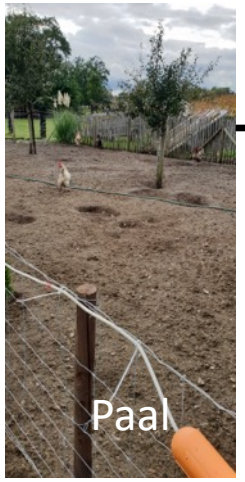
Eggs Beringen 2021					
concentrations PCB 126					
Location	Code	Year	*pg /g fat*	Difference 2019	%
Beringen	**BE-1**	**2021**	**44.00**	**5.10**	**13%**
Ham	**BE-2**	**2021**	**46.00**	**37.17**	**421%**
Paal	**BE-3**	**2021**	**17.00**	**9.99**	**143%**
Beverlo	**BE-4**	**2021**	**3.50**	**-17.70**	**-83%**
Beverlo	**BE-5**	**2021**	**31.00**	**-10.70**	**-26%**
Koersel	**BE-6**	**2021**	**47.00**	**22.20**	**90%**
Tervant.Z	**BE-7**	**2021**	**18.00**	**-2.80**	**-13%**
Beringen	**BE-9**	**2021**	**17.00**	**-11.00**	**-39%**
	BE-1	2019	**38.90**		
	BE-2	2019	**8.83**		
	BE-3	2019	**7.01**		
	BE-4	2019	**21.20**		
	BE-5	2019	**41.70**		
	BE-6	2019	**24.80**		
	BE-7	2019	**20.80**		
	BE-8	2019	**28.00**		

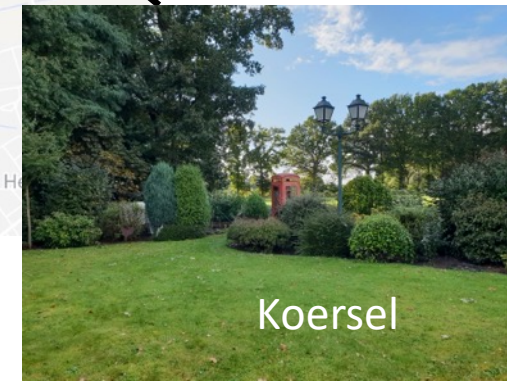


Five locations closely considered- Beringen, 2019 - 2021



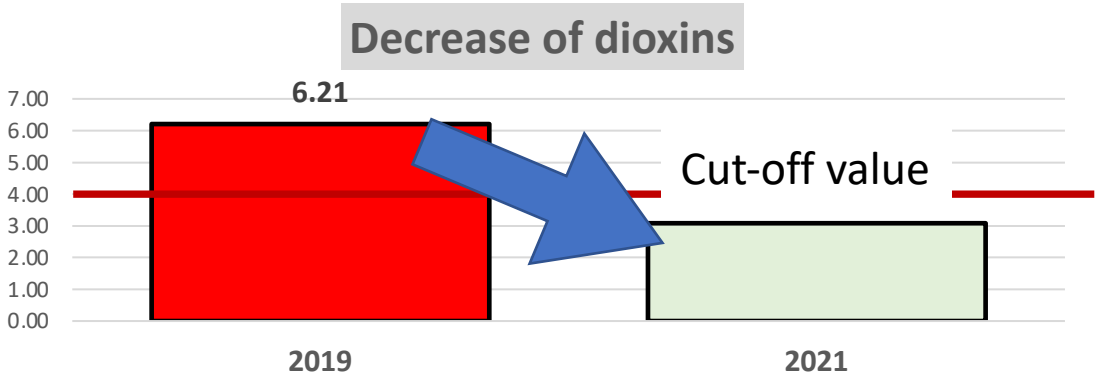
WtE Incinerator Bionerga, BE

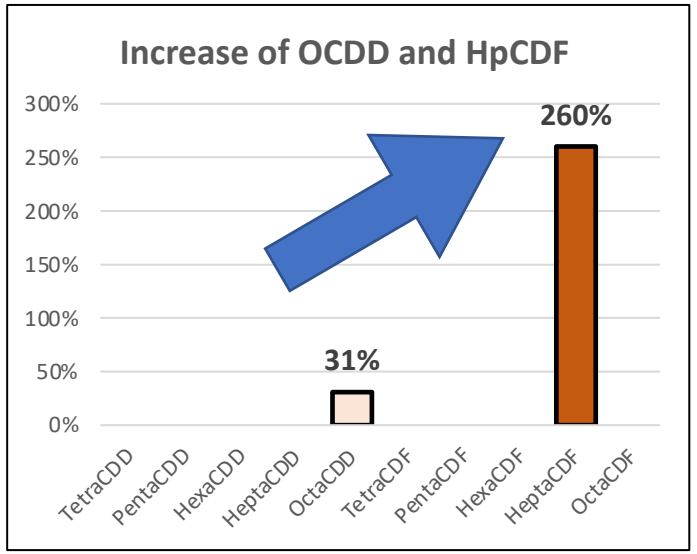




Cleaner soil, less dioxins, but congeners OCDD and HpCDF1 increase

Location BE-4: PCDD/F (Medium Bound)				
	pg/g fat		Difference	
	2019	2021	Absolute	%
PCDD	37.91	37.89	-0.02	0%
PCDF	21.60	25.86	4.26	20%
PCDD/F	59.51	63.75	4.24	7%
BE-4: Dioxins (PCDD)				
TetraCDD	0.28	0.10	-0.18	-64%
PentaCDD	1.07	0.31	-0.76	-71%
HexaCDD	4.47	2.98	-1.49	-33%
HeptaCDD	10.70	6.50	-4.20	-39%
OctaCDD	21.40	28.00	6.60	31%
BE-4: Furans (PCDF)				
TetraCDF	3.01	0.70	-2.31	-77%
PentaCDF	5.58	2.40	-3.18	-57%
HexaCDF	6.60	4.96	-1.64	-25%
HeptaCDF	4.44	16.00	11.56	260%
OctaCDF	1.96	1.80	-0.16	-8%





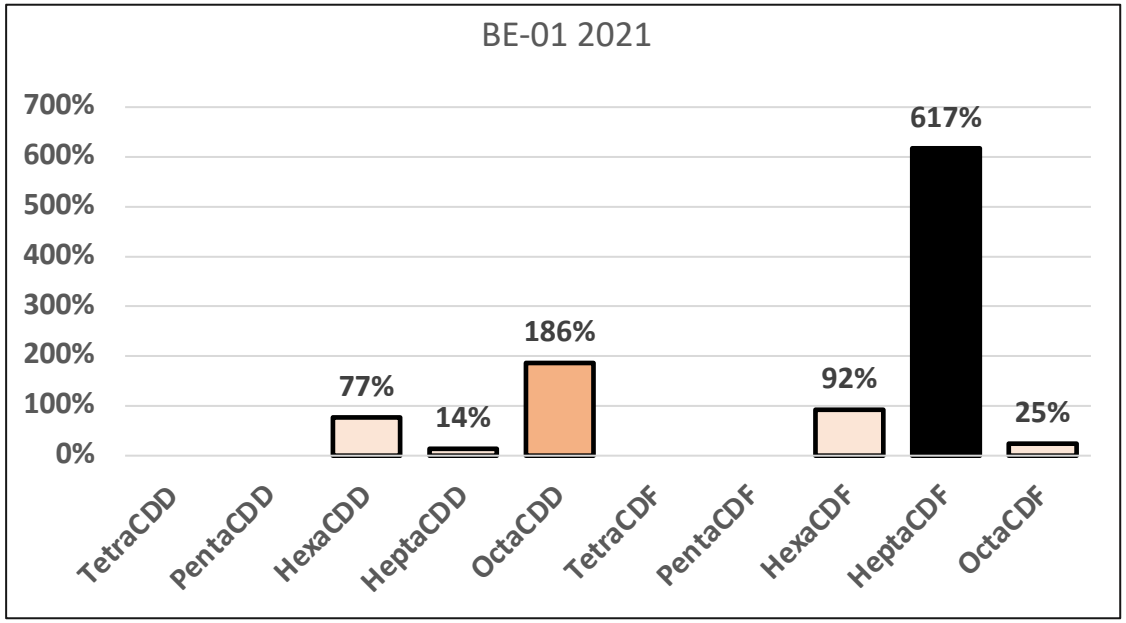
TW indicative scale	
Increase %	
	> 500 %
	> 300 %
	> 200 %
	> 100 %
	< 100 %

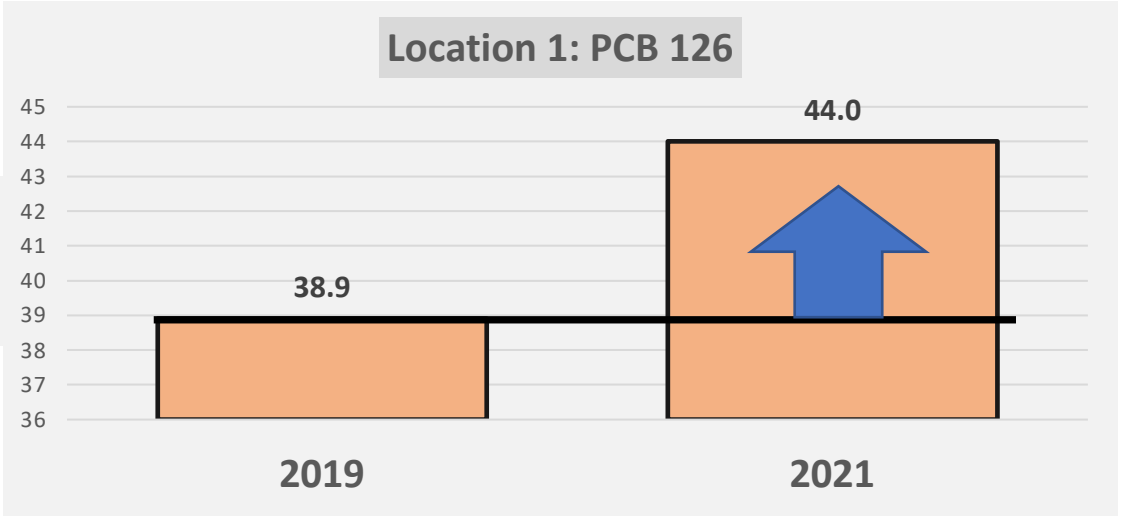
A ‘cleaner’ soil for the chicken resulting in dioxins decrease, but congeners OCDD and HpCDF1 increase

Increase of dioxins and PCB in eggs at location **BE-1** , Beringen - 2021

Location BE-1: PCDD/F (Medium Bound)				
	pg/g fat		Difference	
	2019	2021	Absolute	%
PCDD	53.43	118.62	65.20	122%
PCDF	28.52	70.66	42.14	148%
PCDD/F	81.95	189.28	107.33	131%
BE-1: Dioxins (PCDD)				
TetraCDD	0.61	0.22	-0.39	-64%
PentaCDD	1.78	1.10	-0.68	-38%
HexaCDD	6.94	12.30	5.36	77%
HeptaCDD	12.30	14.00	1.70	14%
OctaCDD	31.80	91.00	59.20	186%
BE-1: Furans (PCDF)				
TetraCDF	5.79	2.50	-3.29	-57%
PentaCDF	7.33	6.40	-0.93	-13%
HexaCDF	6.20	11.90	5.71	92%
HeptaCDF	6.48	46.46	39.98	617%
OctaCDF	2.73	3.40	0.67	25%

TW indicative scale	
Increase %	
	> 500 %
	> 300 %
	> 200 %
	> 100 %
	< 100 %

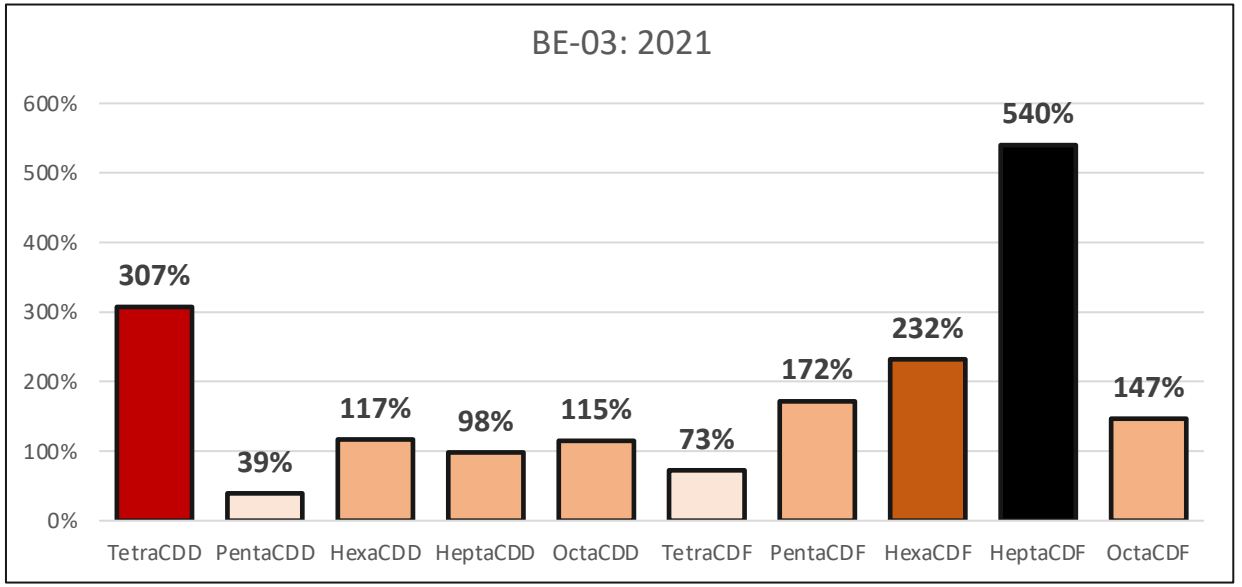




Increase of congeners OCDD , HpCDF1 and PCB 126

All dioxin congeners increase at location **BE-3**

Locatie: **BE-3**			
Jaar	**2019**	**2021**	
Afstand (m)	3700		
Ras	Mix	Mix	
Hennen (n)	6	8	
Leeftijd (mnd)	12	240	
Eieren/maand (n)	120	180	
Buitenverblijf (m2)	400	400	
Binnenverblijf (m2)	2	2	
Terrein	aarde	aarde	
	gras	gras	
		vegetatie	
Voedsel	geperst graan	geperst graan	
	maiskorrel	maiskorrel	
Allesbrander	nee	nee	
Binnenverblijf	hout	hout	
	steen	steen	
Houtkachel intern	ja	ja	
Pesticiden gebruik	buren	buren	
DR CALUX BEQ			%
PCDD/F BEQ	3.1	**5.5**	**77%**
dl-PCB	**0.7**	**3.5**	**400%**
PCDD/F/dl-PCB	3.8	**8.0**	**111%**
GC-MS TEQ			
PCDD/F TEQ	**0.7**	**1.6**	**115%**
dl-PCB	**0.9**	**1.9**	**122%**
PCDD/F/dl-PCB	**1.6**	**3.5**	**119%**



TW indicative scale
Increase %
> 500 %
> 300 %
> 200 %
> 100 %
< 100 %

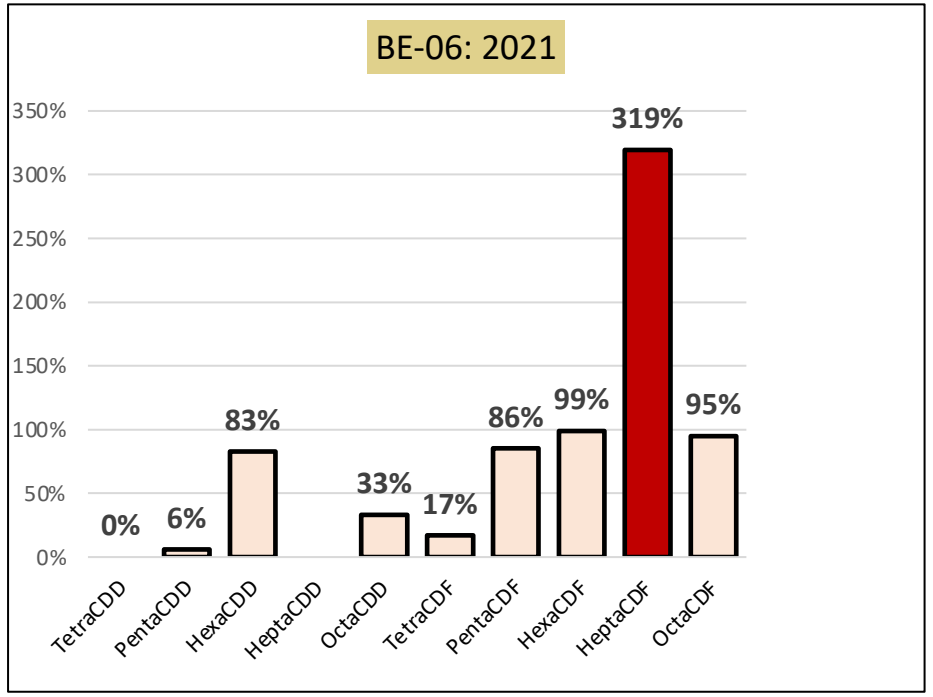
All dioxin congeners increase

Extreme elevation of dl-PCB at location BE-06, Beringen - 2021

Locatie 6 GC-MS									
	pg BEQ/g vet			pg TEQ/g vet		%	pg /g vet		%
	2019	2021	%	2019	2021		2019	2021	
PCDD				1.77	2.01	14%	35.11	41.93	19%
PCDF				1.68	3.28	95%	18.15	42.96	137%
PCDD/F	**5.4**	**8.0**	48%	3.45	5.29	53%	53.26	84.89	59%
dl-PCB	**1.6**	**4.0**	150%	2.65	5.91	123%	2420.24	36299.50	1400%
PCDD/F/dl-PCB	**7.0**	**12.0**	71%	**6.1**	**11.2**	84%	2473.50	36384.39	1371%

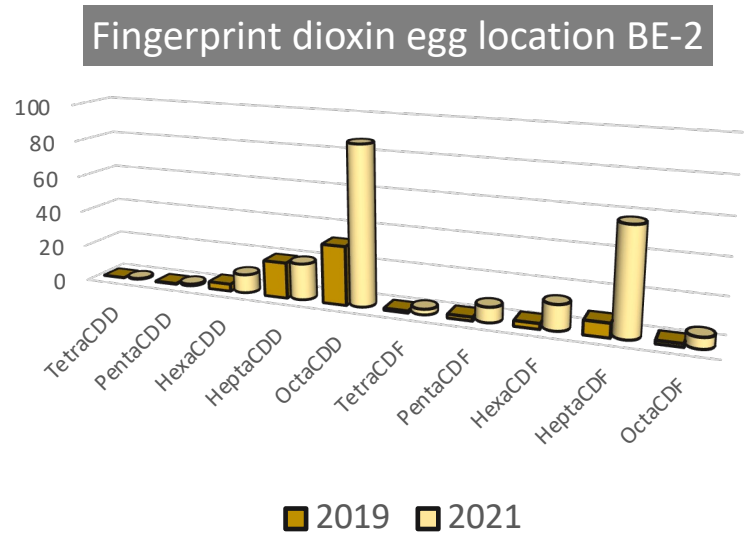
TW indicative scale	
Increase %	
	> 500 %
	> 300 %
	> 200 %
	> 100 %
	< 100 %

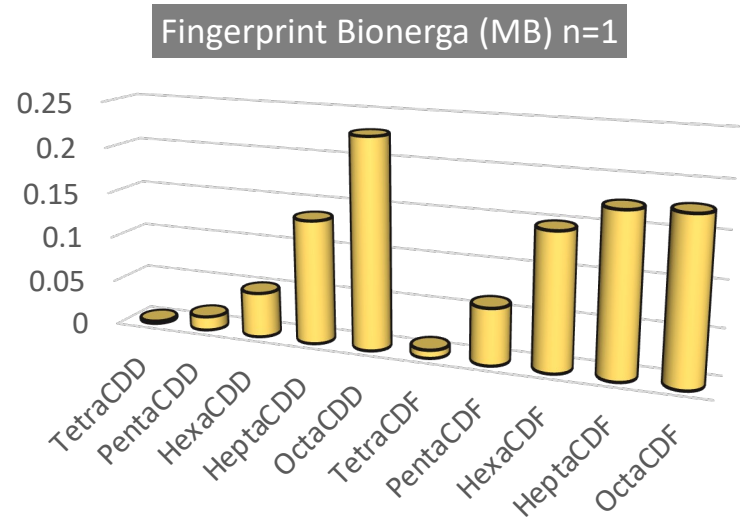
1400 % increase of dioxin-like PCB

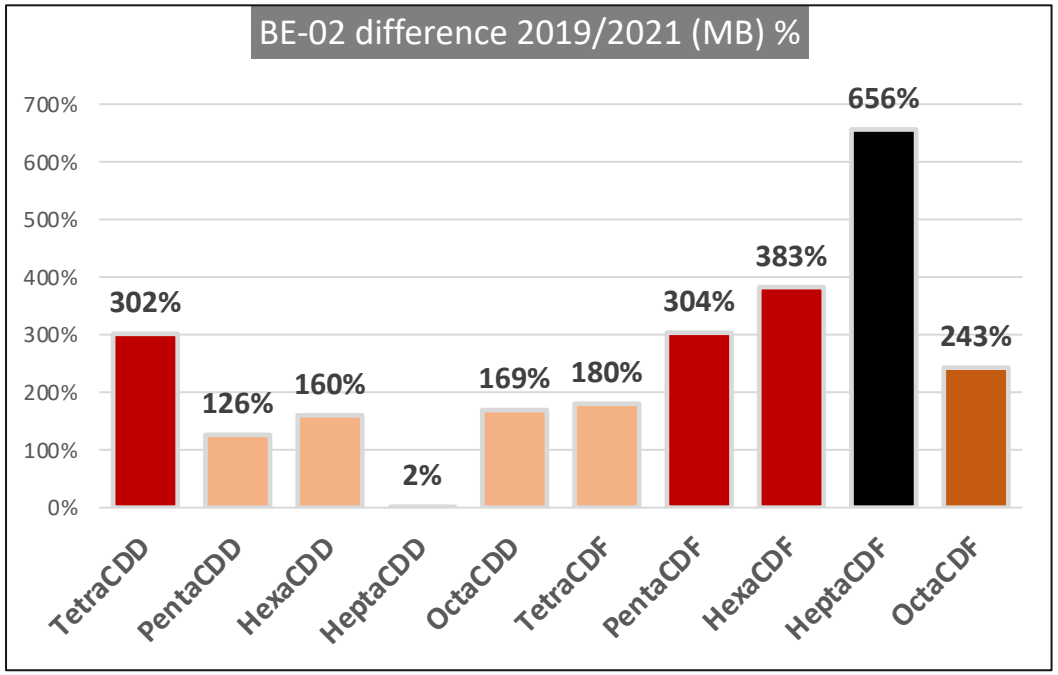


319 % increase of HpCDF

Highest increase of dioxins and PCB 126 at nearest location BE-02





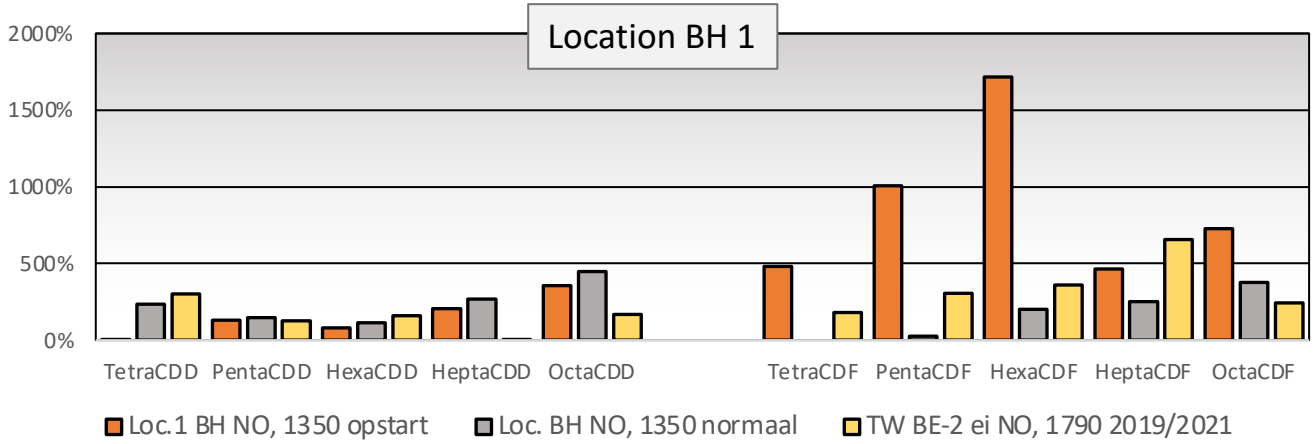


The location close to the incinerator shows the highest increase of dioxins

Bergerhoff (BH) gauges

% toename conc. PCDD/F

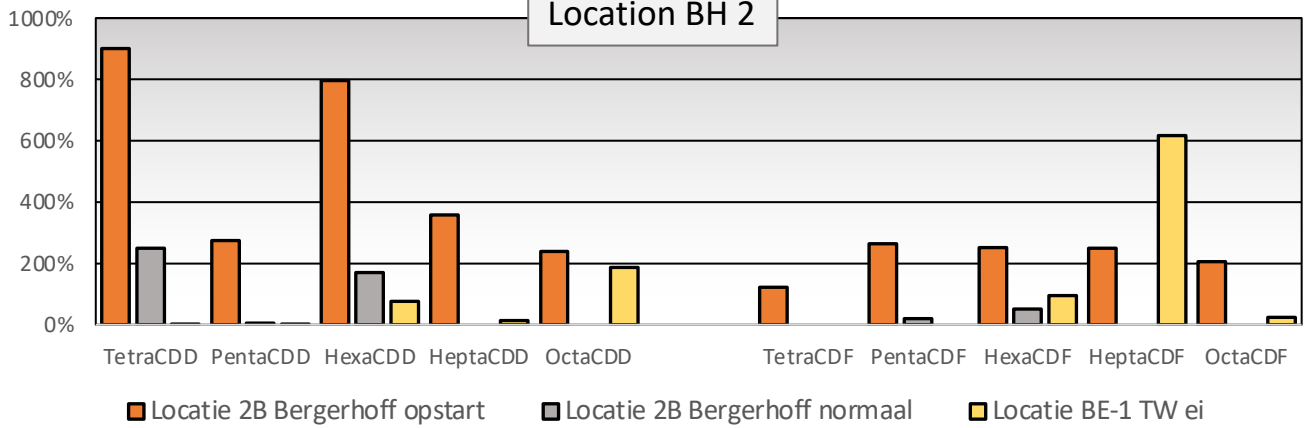
Location BH 1

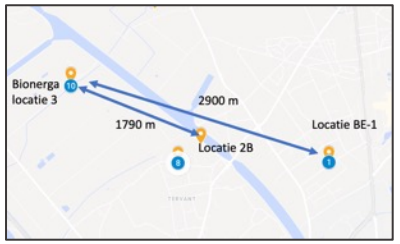


Location BH 1

Increases of dioxins compared to the results **before** the incinerator started

Location BH 2





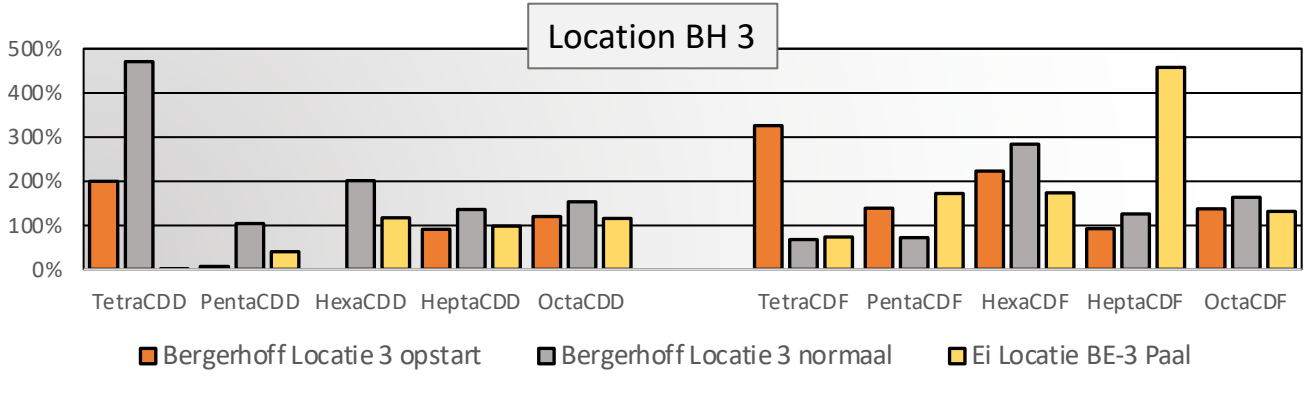
Location BH 2

Dioxins at start-up WTE

Dioxins at normal operation WtE

TW egg sample 2021

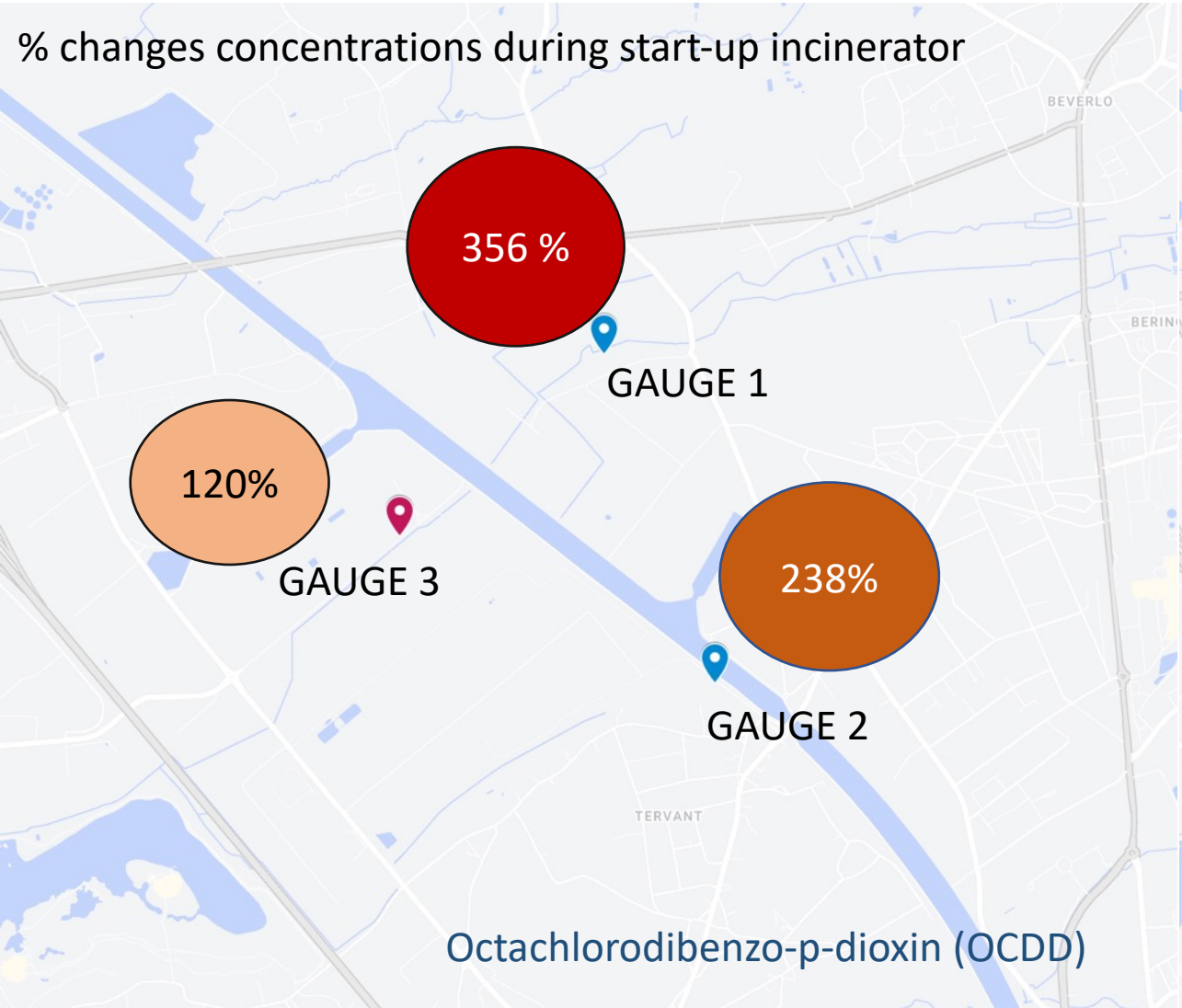
Location BH 3

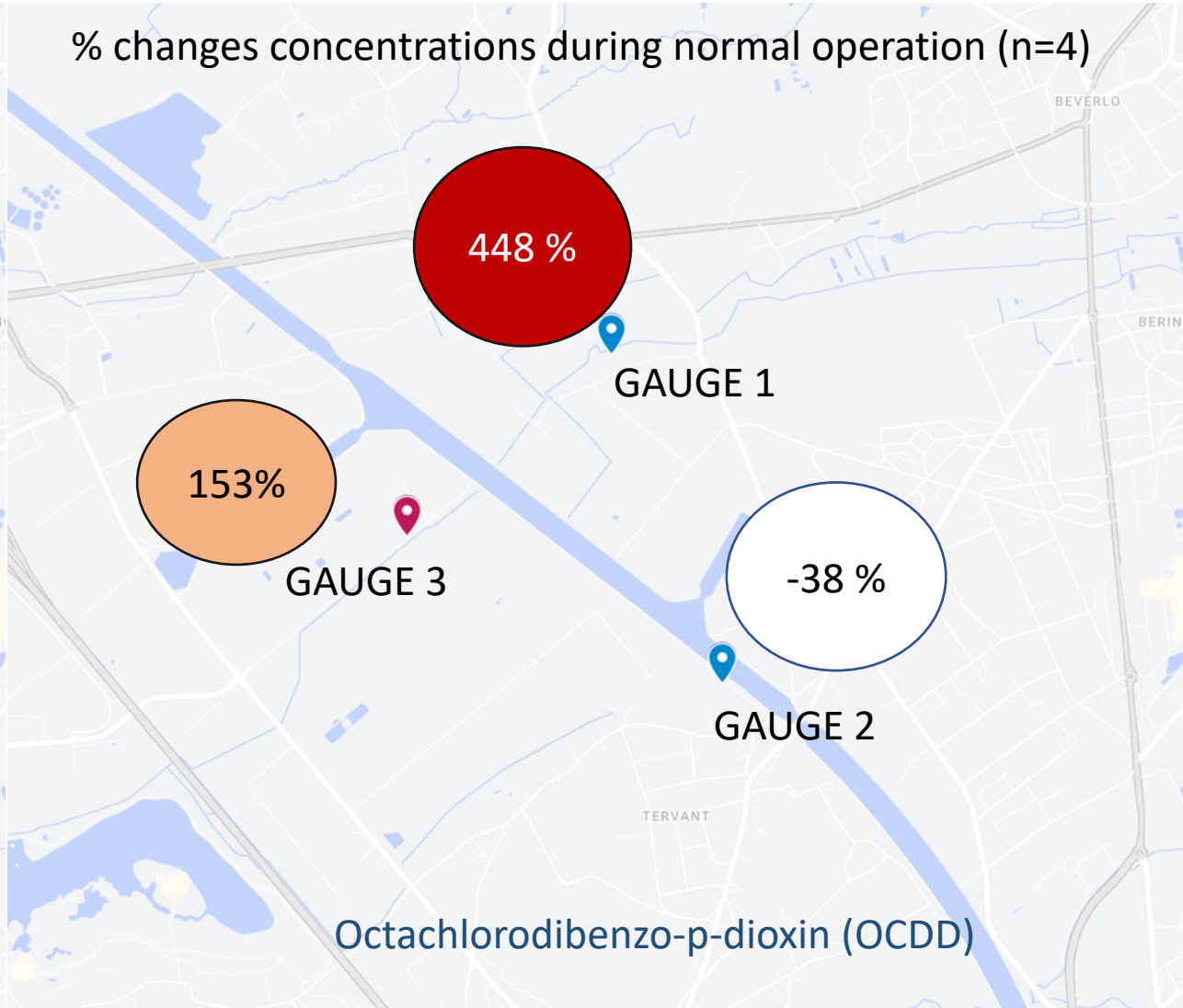


Location BH 3

Octachlorodibenzo-p-dioxin (OCDD)

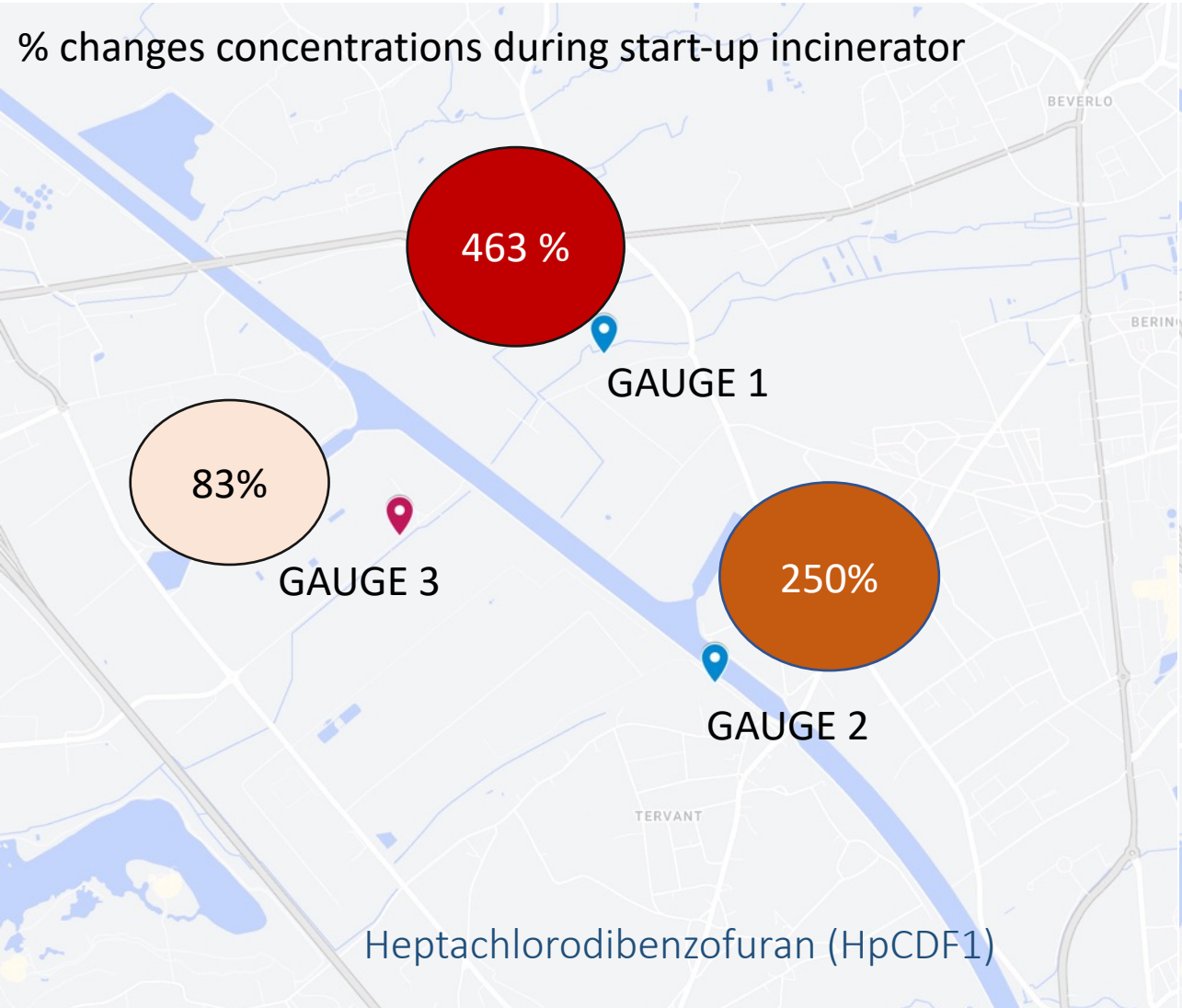
Bergerhoff gauges, Beringen 2019- 2021

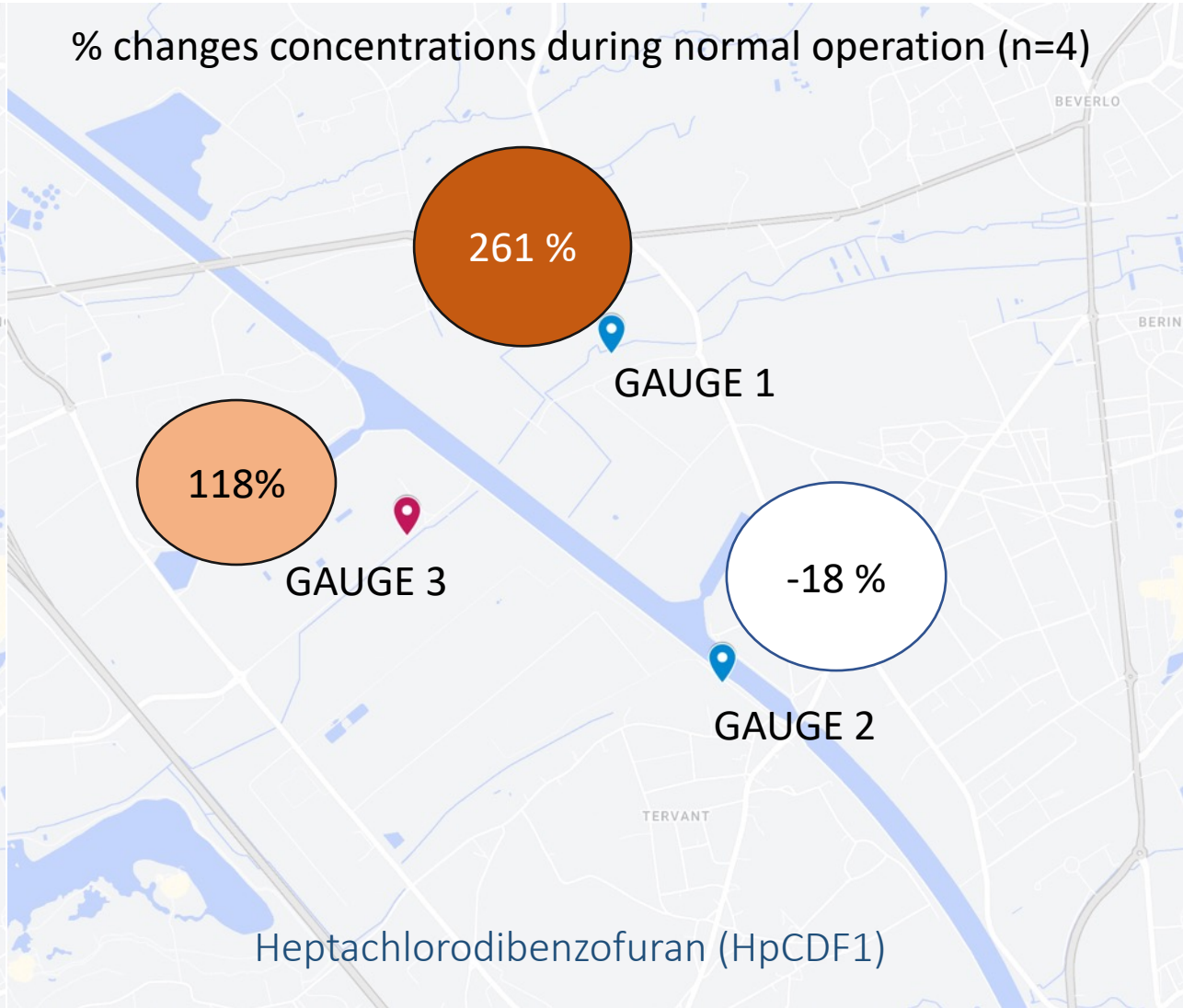




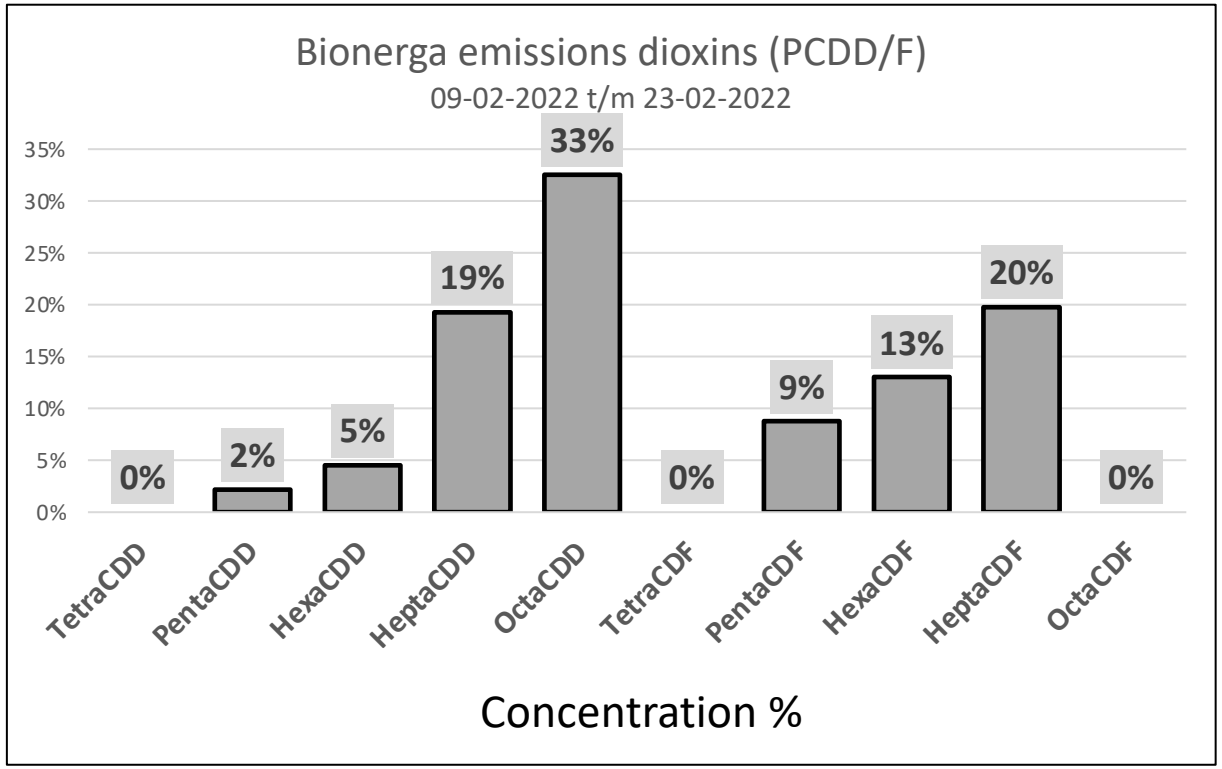
Heptachlorodibenzofuran (HpCDF1)

Bergerhoff gauges, Beringen 2019- 2021





Bionerga fingerprint profile dioxins (PCDD/F), Beringen 2021



Based on measurement of 334 hours semi-continuous measurement.
No data available from Other Than Normal Operation Conditions (OTNOC)

Need for all data files, uncorrected of the semi-continous measurements, including the periods of fire-off, shutdown and start-ups, to determine the contribution of the incinerator to the found dioxin deposition in eggs

Potential confounders of dioxin emissions in region Beringen

Company name	Industrial activity
4Hamcogen (Ham)	Waste collection, processing and disposal activities; materials recovery
Ashland Industries (Paal)	Manufacture of chemicals and chemical products
Borealis Polymers (Paal)	Manufacture of rubber and plastic products
By-cast (Tessenderlo)	Manufacture of heat exchangers
Chevron Phillips (Paal)	Manufacture of chemical products
DOW Belgium (Tessenderlo)	Manufacture of polyethylene
IKO Sales International (Ham)	Manufacture of other non-metallic mineral products
Marlux (Tessenderlo)	Manufacture of terrace tiles
MFI (Paal)	Surface treatment of metals
Moderna Drukkerij (Paal)	Printing and reproduction of recorded media
P.I. of Europe (Paal)	Manufacture of chemical products
Pittsburgh Corning Europe (Tessenderlo)	Manufacture of foam glass (insulation)
Printing Partners (Paal)	Newspaper printing
Styron Belgium (Tessenderlo)	Manufacture of polystyrene
Tessenderlo Chemie (Ham)	Manufacture of chemical products
Wienerberger (Tessenderlo)	Manufacture of bricks

Seveso-bedrijven: Borealis Polymers, Hercules Beringen en Neste Oil, in Tessenderlo, Tessenderlo Chemie, Chevron Phillips, Dow Belgium, Ecolab, Limburgse Vinyl Maatschappij en Primagaz, en in Heusden-Zolder, Rezinal en Umicore Oxyde.

Need for data on potential contaminants in the Beringen region,
in particular the industry covered by the EU Seveso regulations.