



Flexibilities

Part 2

18th May 2010

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AP EnvEcon

Broader collaboration work!

PBL

Note on Data Sources and Methodology

Data sources

- Official national inventory submissions to 2007
- Recent official WM projection to 2010
- PRIMES BL 2009 for 2015 marker
- Linear interpolation of intervening years
- Multiple randomly generated scenarios

Methodology

- Design of excel models systems for each
- Evaluation of outcomes
- Alternative scenario runs
- Regional mapping
- Write up of results and policy recommendations

Summary of Data NO_x

	NO _x in 2010				
	<i>WM</i>	<i>Diff</i>	<i>Ceiling (NEC)</i>	<i>Gap to ceiling proportion</i>	<i>Full Ceiling target to gap Proportion</i>
Austria	154	51	103	49.5%	0.6%
Belgium	253	77	176	43.8%	0.9%
Bulgaria	247	0	247	0.0%	0.0%
Cyprus	19	-4	23	-17.4%	0.0%
Czech Republic	275	-11	286	-3.8%	-0.1%
Denmark	126	-1	127	-0.8%	0.0%
Estonia	39	-21	60	-35.0%	-0.2%
Finland	151	-19	170	-11.2%	-0.2%
France	1105	295	810	36.4%	3.3%
Germany	1112	61	1051	5.8%	0.7%
Greece	320	-24	344	-7.0%	-0.3%
Hungary	164	-34	198	-17.2%	-0.4%
Ireland	103	38	65	58.5%	0.4%
Italy	865	-125	990	-12.6%	-1.4%
Latvia	45	-16	61	-26.2%	-0.2%
Lithuania	110	0	110	0.0%	0.0%
Luxembourg	13	2	11	18.2%	0.0%
Malta	8	0	8	0.0%	0.0%
Netherlands	261	1	260	0.4%	0.0%
Poland	895	16	879	1.8%	0.2%
Portugal	242	-8	250	-3.2%	-0.1%
Romania	336	-101	437	-23.1%	-1.1%
Slovakia	90	-40	130	-30.8%	-0.4%
Slovenia	49	4	45	8.9%	0.0%
Spain	1145	298	847	35.2%	3.3%
Sweden	149	1	148	0.7%	0.0%
United Kingdom	1251	84	1167	7.2%	0.9%
EU-27	9525	522	9003	5.8%	5.8%

Summary of Data NMVOC

	NMVOC in 2010				
	<i>WM</i>	<i>Diff</i>	<i>Ceiling (NEC)</i>	<i>Gap to ceiling proportion</i>	<i>Full Ceiling target to gap Proportion</i>
Austria	140	-19	159	-11.9%	-0.2%
Belgium	134	-5	139	-3.6%	-0.1%
Bulgaria	175	0	175	0.0%	0.0%
Cyprus	8	-6	14	-42.9%	-0.1%
Czech Republic	164	-56	220	-25.5%	-0.6%
Denmark	85	0	85	0.0%	0.0%
Estonia	41	-8	49	-16.3%	-0.1%
Finland	130	0	130	0.0%	0.0%
France	1060	10	1050	1.0%	0.1%
Germany	987	-8	995	-0.8%	-0.1%
Greece	261	0	261	0.0%	0.0%
Hungary	123	-14	137	-10.2%	-0.2%
Ireland	54	-1	55	-1.8%	0.0%
Italy	941	-218	1159	-18.8%	-2.5%
Latvia	55	-81	136	-59.6%	-0.9%
Lithuania	92	0	92	0.0%	0.0%
Luxembourg	9	0	9	0.0%	0.0%
Malta	4	-8	12	-66.7%	-0.1%
Netherlands	162	-23	185	-12.4%	-0.3%
Poland	947	147	800	18.4%	1.7%
Portugal	194	14	180	7.8%	0.2%
Romania	347	-176	523	-33.7%	-2.0%
Slovakia	97	-43	140	-30.7%	-0.5%
Slovenia	37	-3	40	-7.5%	0.0%
Spain	761	99	662	15.0%	1.1%
Sweden	168	-73	241	-30.3%	-0.8%
United Kingdom	784	-416	1200	-34.7%	-4.7%
EU-27	7960	-888	8848	-10.0%	-10.0%

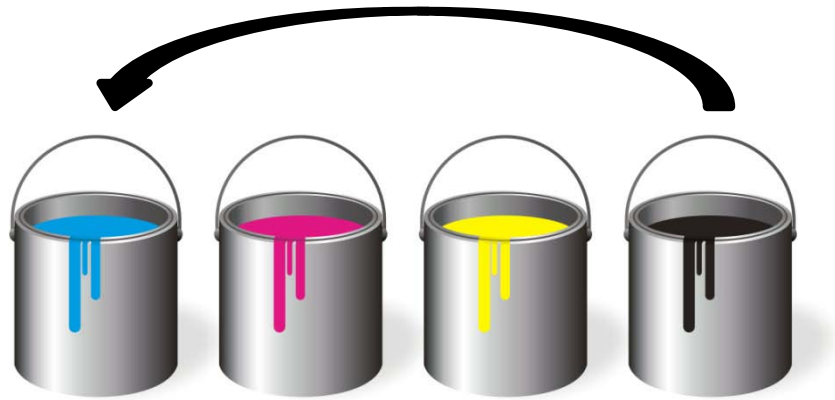
Summary of Data SO₂

	SO2 in 2010				
	<i>WM</i>	<i>Diff</i>	<i>Ceiling (NEC)</i>	<i>Gap to ceiling proportion</i>	<i>Full Ceiling target to gap Proportion</i>
Austria	26	-13	39	-33.3%	-0.2%
Belgium	90	-9	99	-9.1%	-0.1%
Bulgaria	380	-456	836	-54.5%	-5.5%
Cyprus	27	-12	39	-30.8%	-0.1%
Czech Republic	206	-59	265	-22.3%	-0.7%
Denmark	20	-35	55	-63.6%	-0.4%
Estonia	80	-20	100	-20.0%	-0.2%
Finland	98	-12	110	-10.9%	-0.1%
France	345	-30	375	-8.0%	-0.4%
Germany	459	-61	520	-11.7%	-0.7%
Greece	523	0	523	0.0%	0.0%
Hungary	72	-428	500	-85.6%	-5.2%
Ireland	30	-12	42	-28.6%	-0.1%
Italy	376	-99	475	-20.8%	-1.2%
Latvia	4	-97	101	-96.0%	-1.2%
Lithuania	145	0	145	0.0%	0.0%
Luxembourg	3	-1	4	-25.0%	0.0%
Malta	9	0	9	0.0%	0.0%
Netherlands	53	3	50	6.0%	0.0%
Poland	878	-519	1397	-37.2%	-6.3%
Portugal	133	-27	160	-16.9%	-0.3%
Romania	826	-92	918	-10.0%	-1.1%
Slovakia	65	-45	110	-40.9%	-0.5%
Slovenia	17	-10	27	-37.0%	-0.1%
Spain	401	-345	746	-46.2%	-4.2%
Sweden	33	-34	67	-50.7%	-0.4%
United Kingdom	454	-131	585	-22.4%	-1.6%
EU-27	5752	-2545	8297	-30.7%	-30.7%

Summary of Data NH₃

	NH3 in 2010				
	<i>WM</i>	<i>Diff</i>	<i>Ceiling (NEC)</i>	<i>Gap to ceiling proportion</i>	<i>Full Ceiling target to gap Proportion</i>
Austria	62	-4	66	-6.1%	-0.1%
Belgium	69	-5	74	-6.8%	-0.1%
Bulgaria	108	0	108	0.0%	0.0%
Cyprus	6	-3	9	-33.3%	-0.1%
Czech Republic	60	-20	80	-25.0%	-0.5%
Denmark	65	-4	69	-5.8%	-0.1%
Estonia	9	-20	29	-69.0%	-0.5%
Finland	31	0	31	0.0%	0.0%
France	730	-50	780	-6.4%	-1.2%
Germany	610	60	550	10.9%	1.4%
Greece	63	-10	73	-13.7%	-0.2%
Hungary	78	-12	90	-13.3%	-0.3%
Ireland	104	-12	116	-10.3%	-0.3%
Italy	416	-3	419	-0.7%	-0.1%
Latvia	14	-30	44	-68.2%	-0.7%
Lithuania	84	0	84	0.0%	0.0%
Luxembourg	5	-2	7	-28.6%	0.0%
Malta	2	-1	3	-33.3%	0.0%
Netherlands	123	-5	128	-3.9%	-0.1%
Poland	302	-166	468	-35.5%	-3.9%
Portugal	69	-21	90	-23.3%	-0.5%
Romania	205	-5	210	-2.4%	-0.1%
Slovakia	27	-12	39	-30.8%	-0.3%
Slovenia	19	-1	20	-5.0%	0.0%
Spain	388	35	353	9.9%	0.8%
Sweden	50	-7	57	-12.3%	-0.2%
United Kingdom	294	-3	297	-1.0%	-0.1%
EU-27	3993	-301	4294	-7.0%	-7.0%

Gas Swapping



Principal of Gas Swapping

Countries may offset over compliance with one pollutant against a failure to comply with another.

Operation can be subject to certain constraints.

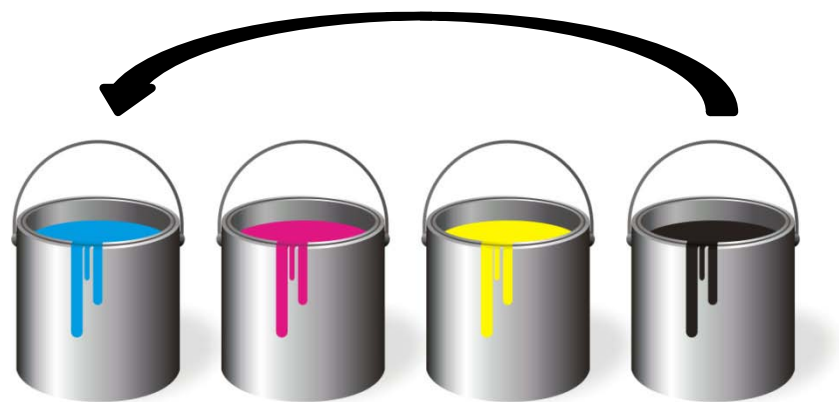
We propose a simplified approach where the 'exchange rate' is simply less favourable for member states.

For example, each tonne of an alternative pollutant is worth only half a tonne of any other. This is a working assumption but can be tailored based on scientific input.

Countries may then have the flexibility to pursue alternative additional abatement as part of their path to compliance.

How would compliance situation be changed?

Where would the swaps happen?



Assumed 'over compliance' Exchange Rate				0.5
	NOX	NMVOC	SO2	NH3
NOX	1	0.5	0.5	0.5
NMVOC	0.5	1	0.5	0.5
SO2	0.5	0.5	1	0.5
NH3	0.5	0.5	0.5	1

Credits Available & Required	NOX	NMVOC	SO2	NH3	Total
Austria	51.0	-9.5	-6.5	-2.0	33.0
Belgium	77.0	-2.5	-4.5	-2.5	67.5
Bulgaria	0.0	0.0	-228.0	0.0	-228.0
Cyprus	-2.0	-3.0	-6.0	-1.5	-12.5
Czech Republic	-5.5	-28.0	-29.5	-10.0	-73.0
Denmark	-0.5	0.0	-17.5	-2.0	-20.0
Estonia	-10.5	-4.0	-10.0	-10.0	-34.5
Finland	-9.5	0.0	-6.0	0.0	-15.5
France	295.0	10.0	-15.0	-25.0	265.0
Germany	61.0	-4.0	-30.5	60.0	86.5
Greece	-12.0	0.0	0.0	-5.0	-17.0
Hungary	-17.0	-7.0	-214.0	-6.0	-244.0
Ireland	38.0	-0.5	-6.0	-6.0	25.5
Italy	-62.5	-109.0	-49.5	-1.5	-222.5
Latvia	-8.0	-40.5	-48.5	-15.0	-112.0
Lithuania	0.0	0.0	0.0	0.0	0.0
Luxembourg	2.0	0.0	-0.5	-1.0	0.5
Malta	0.0	-4.0	0.0	-0.5	-4.5
Netherlands	1.0	-11.5	3.0	-2.5	-10.0
Poland	16.0	147.0	-259.5	-83.0	-179.5
Portugal	-4.0	14.0	-13.5	-10.5	-14.0
Romania	-50.5	-88.0	-46.0	-2.5	-187.0
Slovakia	-20.0	-21.5	-22.5	-6.0	-70.0
Slovenia	4.0	-1.5	-5.0	-0.5	-3.0
Spain	298.0	99.0	-172.5	35.0	259.5
Sweden	1.0	-36.5	-17.0	-3.5	-56.0
United Kingdom	84.0	-208.0	-65.5	-1.5	-191.0
EU-27	726.0	-309.0	-1270.5	-103.0	-956.5

Net Remaining Compliance Problem	
Austria	1
Belgium	1
Bulgaria	0
Cyprus	0
Czech Republic	0
Denmark	0
Estonia	0
Finland	0
France	1
Germany	1
Greece	0
Hungary	0
Ireland	1
Italy	0
Latvia	0
Lithuania	0
Luxembourg	1
Malta	0
Netherlands	0
Poland	0
Portugal	0
Romania	0
Slovakia	0
Slovenia	0
Spain	1
Sweden	0
United Kingdom	0
EU-27	7

NOX MAP

Red Positive
Blue Negative

Legend I

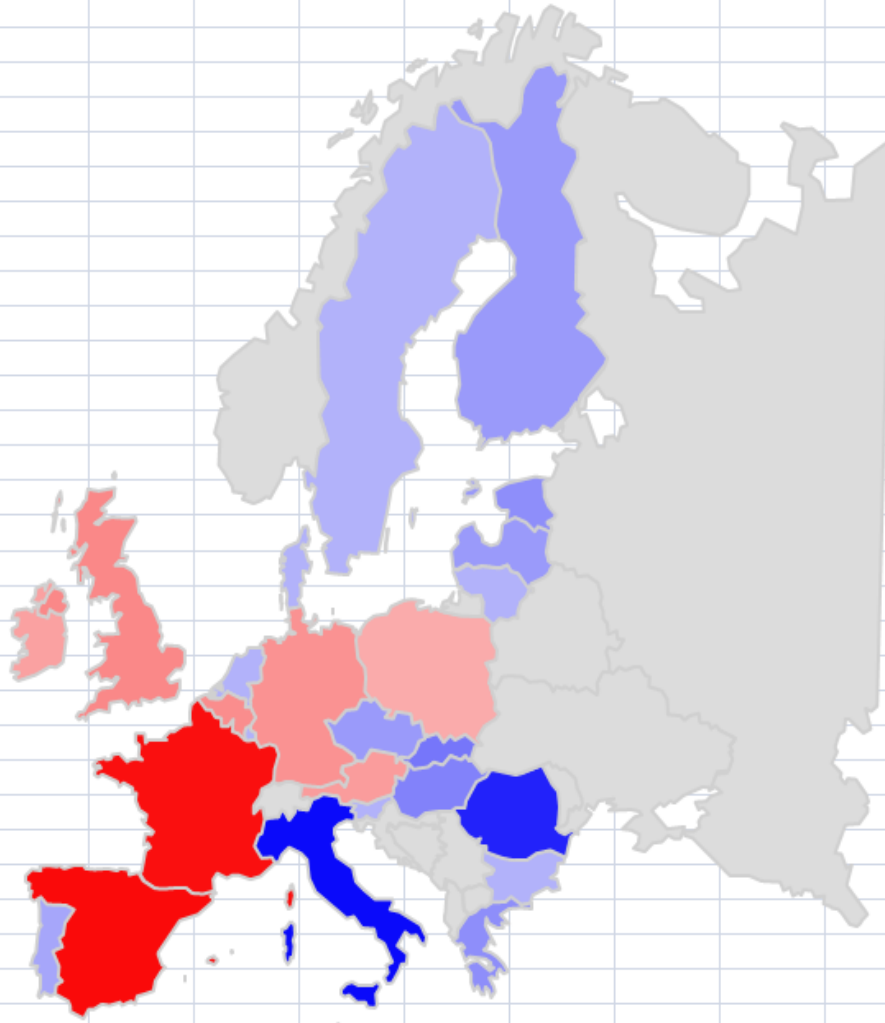
Absolute Gap to national ceiling

Kt of Pollutant

Legend II

Gap as a proportion of aggregate EU27 Ceiling

Kt of Pollutant



	Absolute Gap to national ceiling	Gap as a proportion of aggregate EU27 Ceiling
	<i>Kt of Pollutant</i>	<i>Kt of Pollutant</i>
	0	0.0%
	307	3.2%
	289	0.9%
	78	0.8%
	69	0.7%
	60	0.5%
	42	0.4%
	34	0.1%
	16	0.0%
	-2	-0.1%
	-10	-0.2%
	-19	-0.3%
	-28	-0.4%
	-37	-0.5%
	-46	-1.2%
	-107	-1.4%
	-125	-1.4%

Comments

The strongest of the requisite NOX swaps would take place in Spain and France with some 600kt of NOX requiring an offset - over 6% of the total EU27 NOX limit. This would be followed by more moderate needs for swap activity in the UK, Belgium, Germany and Austria of between 50 and 80kt. Amounting to approximately 3% of the EU27 NOX limit. Ireland and Poland follow with NOX emissions swaps of under 50kt - amounting to a combined level of 0.6% of the EU27 area aggregate NOX ceiling total. Many sources offer only very minor swap potential in NOX, however, Italy, Romania and Slovakia offer some significant additional reductions of NOX totalling over 260kt or 3% of the EU27 aggregate ceiling. For those with compliance problems with NOX, the domestic offset flexibility would see the gap to target narrowed somewhat for a number of countries. For the Netherlands, Poland, Slovenia, Sweden and the UK it would mean compliance with NOX and all other ceilings.

NM VOC MAP

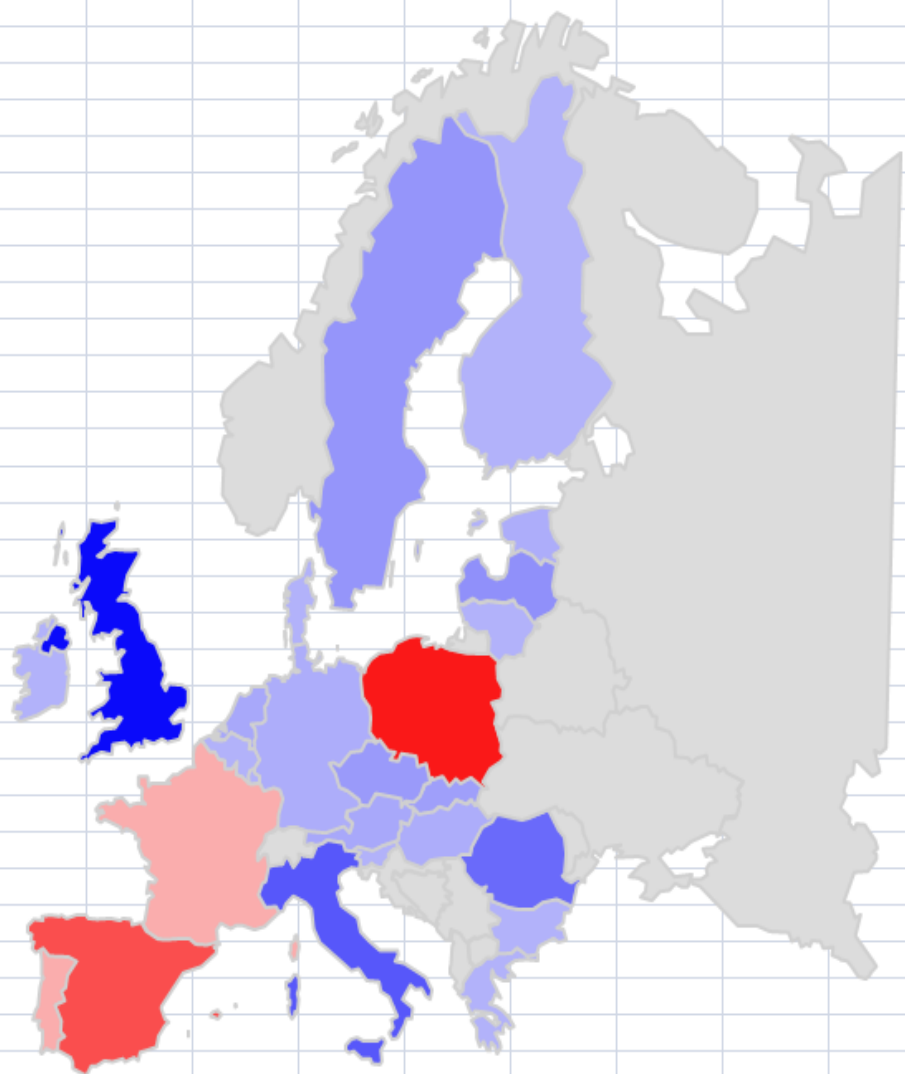
Red Positive
Blue Negative

Legend I

Absolute Gap to national

Legend II

Gap as a proportion of aggregate EU27



Kt of Pollutant

Kt of Pollutant

0

0.0%

135

1.8%

88

1.0%

6

0.1%

-5

-0.1%

-17

-0.2%

-29

-0.3%

-52

-0.6%

-64

-0.7%

-76

-0.9%

-88

-1.0%

-181

-2.1%

-228

-2.6%

-416

-4.7%

Comments

Only Poland and Spain face a particularly strong challenge with respect to NMVOC ceiling compliance with both requiring in the region of 100kt of reductions. In the case of NMVOCs there are however some particularly strong incidences of over-compliance with the UK, Romania and Italy achieving more than 800kt of additional NMVOC reductions - some 9% of the EU27 aggregate NMVOC ceiling emissions level. As the option only allows for domestic offsetting, the value of such large reductions to the member state is dependent on a requisite requirement of offsetting against another ceiling. However, on a broader perspective the NMVOC map and the subsequent maps will illustrate the regional areas where reductions or exceedances of a given pollutant are likely to occur.

SO2 MAP

Red Positive
Blue Negative

Legend I

Legend II

Absolute Gap to national

Gap as a proportion of aggregate EU27

Kt of Pollutant

Kt of Pollutant

0

0.0%

14

0.2%

-8

-0.1%

-19

-0.2%

-30

-0.4%

-41

-0.5%

-51

-0.6%

-62

-0.8%

-95

-1.1%

-106

-1.3%

-138

-1.7%

-345

-4.2%

-432

-5.2%

-465

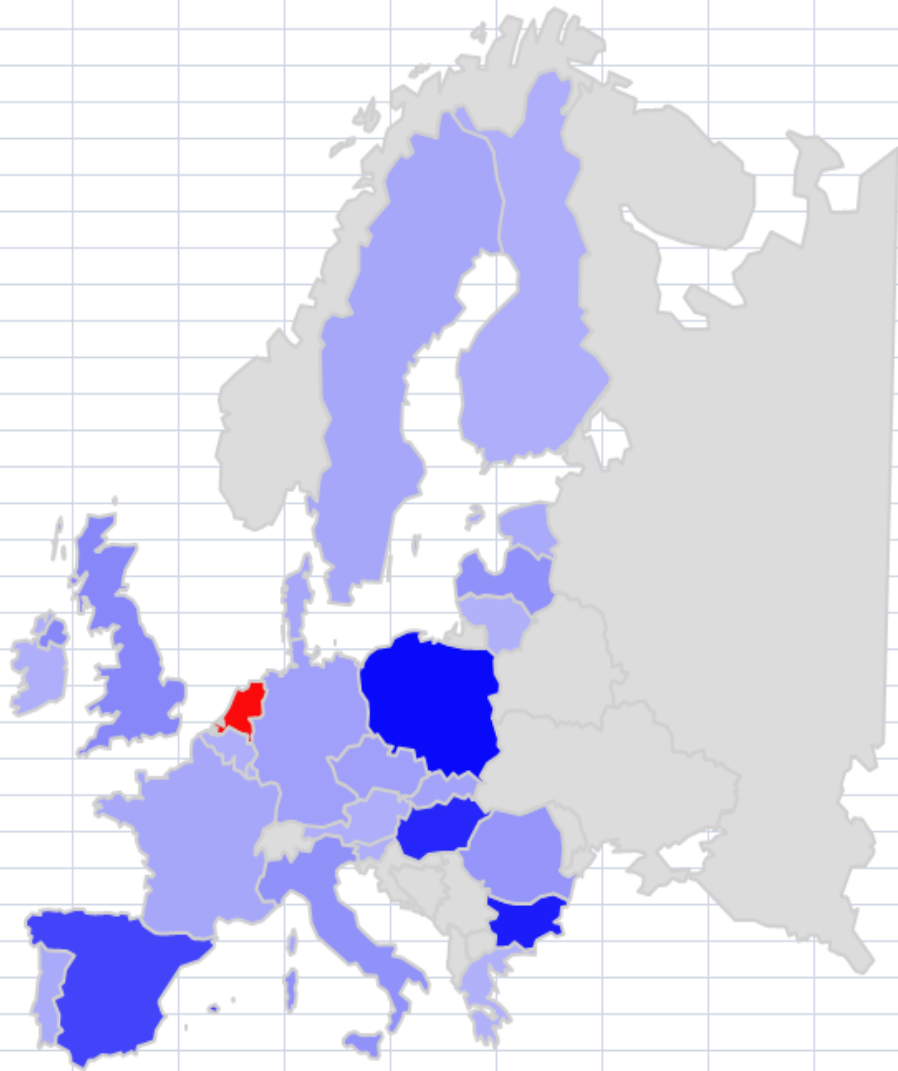
-5.6%

-519

-6.3%

Comments

SO2 is clearly the major success story of the four pollutants. Only the Netherlands seems likely to exceed the defined ceiling, and even at that the exceedance amounts to just 0.05% of the aggregate EU 27 ceiling for SO2. Most countries are then characterised by quite significant reductions in SO2 levels. On the whole, EU27 SO2 emissions seem set to be some 30% below the aggregate EU 27 ceiling. Thus SO2 offers a substantial part of the domestic offset swapping potential for countries.



NH3 MAP

Red Positive
Blue Negative

Legend I

Legend II

Absolute Gap to national

Gap as a proportion of aggregate EU27

Kt of Pollutant

Kt of Pollutant

0

0.0%

55

1.3%

32

0.7%

-1

0.0%

-6

-0.1%

-11

-0.2%

-15

-0.4%

-20

-0.5%

-25

-0.6%

-34

-0.8%

-53

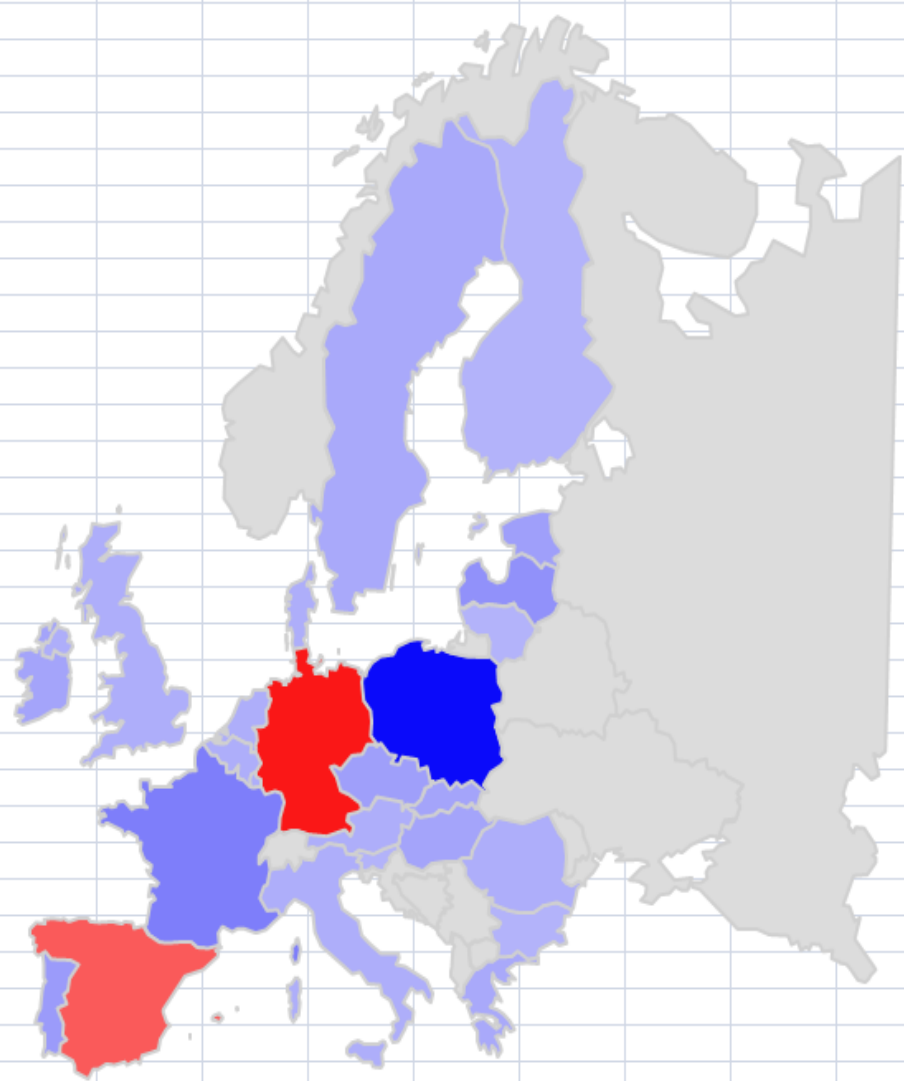
-1.2%

-166

-3.9%

Comments

Ammonia emissions keep comparatively close to the individual national ceilings, with few outliers of scale in either compliance or non-compliance. Germany and Spain are the sole exceedances, amounting to a total of just under 100kt or 2.2% of the aggregate EU 27 ammonia ceiling. In terms of over compliance Poland and France lead the way accounting for an additional 5% reduction of the aggregate NH3 ceiling emissions level. They are followed by a cluster of countries with more moderate additional reductions, with most being comparatively close to the original ceiling, and in compliance.



Over Compliance Pledge TAF I



Principal of OC Pledge

The over compliance pledge would afford no penalty for a further three years on commitment of over-compliance on that new date. The objective would be to increase the annual rate of reduction on top of meeting the necessary ceiling. Failure to achieve the new pledge would be treated as non-compliance up to the present day with penalties appropriately scaled.

C	Ceiling
EIC	Emissions in compliance year
E5	Emissions 5 years before compliance year

Overcompliance pledge is the greater reduction of:

1. Pledge = $C - ((E5-C)/5) * \text{Penalty rate}$
2. Pledge = $C - ((EIC-C)/5) * \text{Penalty rate}$

An advantage of the approach is that it frees up funds nationally for initiative to reduce emissions. It seeks an accelerated rate of lasting emissions reductions. If it fails the community still receives the penalties that would have otherwise been due. A rational country taking this option will make significant efforts to reduce emissions. Thus even failure may have the effect of stimulating greater emission reduction effort than the original ceiling compliance level alone.



3 Year Average TAF II



Principal of 3 Year Average

The three year average compliance operates on the simple premise that emissions for the purpose of compliance are based not on those in a single year, but rather on a three year average.

Three year average operates on a formula as follows:

$$(Year X - 1 plus Year X plus Year X + 2) / 3$$

The question as to whether this is an option or a requisite form of compliance testing is important.

And seems to have been answered...



	NOX				NMVOC				SO2				NH3			
Rolling Average 2010	3 Yr Avg NOX	NOX Ceiling	3 Yr Avg Gap to Ceiling	2010 Gap to Ceiling	3 Yr Avg NMVOC	NMVOC Ceiling	3 Yr Avg Gap to Ceiling	2010 Gap to Ceiling	3 Yr Avg SO2	SO2 Ceiling	3 Yr Avg Gap to Ceiling	2010 Gap to Ceiling	3 Yr Avg NH3	NH3 Ceiling	3 Yr Avg Gap to Ceiling	2010 Gap to Ceiling
Austria	152	103	49	51	142	159	-17	-19	25	39	-14	-13	62	66	-4	-4
Belgium	245	176	69	77	135	139	-4	-5	94	99	-5	-9	70	74	-4	-5
Bulgaria	222	247	-25	0	158	175	-17	0	399	836	-437	-456	96	108	-12	0
Cyprus	18	23	-5	-4	8	14	-6	-6	25	39	-14	-12	6	9	-3	-3
Czech Republic	266	286	-20	-11	167	220	-53	-56	192	265	-73	-59	63	80	-17	-20
Denmark	128	127	1	-1	86	85	1	0	19	55	-36	-35	65	69	-4	-4
Estonia	36	60	-24	-21	38	49	-11	-8	72	100	-28	-20	9	29	-20	-20
Finland	152	170	-18	-19	125	130	-5	0	88	110	-22	-12	32	31	1	0
France	1069	810	259	295	1036	1050	-14	10	336	375	-39	-30	718	780	-62	-50
Germany	1103	1051	52	61	1014	995	19	-8	450	520	-70	-61	611	550	61	60
Greece	309	344	-35	-24	239	261	-22	0	466	523	-57	0	62	73	-11	-10
Hungary	162	198	-36	-34	123	137	-14	-14	75	500	-425	-428	77	90	-13	-12
Ireland	99	65	34	38	54	55	-1	-1	33	42	-9	-12	106	116	-10	-12
Italy	870	990	-120	-125	932	1159	-227	-218	356	475	-119	-99	411	419	-8	-3
Latvia	42	61	-19	-16	54	136	-82	-81	4	101	-97	-97	14	44	-30	-30
Lithuania	95	110	-15	0	85	92	-7	0	115	145	-30	0	74	84	-10	0
Luxembourg	14	11	3	2	9	9	0	0	3	4	-1	-1	5	7	-2	-2
Malta	8	8	0	0	4	12	-8	-8	9	9	0	0	2	3	-1	-1
Netherlands	260	260	0	1	161	185	-24	-23	51	50	1	3	124	128	-4	-5
Poland	835	879	-44	16	866	800	66	147	851	1397	-546	-519	308	468	-160	-166
Portugal	228	250	-22	-8	202	180	22	14	131	160	-29	-27	69	90	-21	-21
Romania	320	437	-117	-101	352	523	-171	-176	727	918	-191	-92	194	210	-16	-5
Slovakia	85	130	-45	-40	88	140	-52	-43	62	110	-48	-45	28	39	-11	-12
Slovenia	48	45	3	4	37	40	-3	-3	17	27	-10	-10	19	20	-1	-1
Spain	1143	847	296	298	770	662	108	99	486	746	-260	-345	386	353	33	35
Sweden	148	148	0	1	165	241	-76	-73	33	67	-34	-34	50	57	-7	-7
United Kingdom	1231	1167	64	84	814	1200	-386	-416	438	585	-147	-131	294	297	-3	-3
EU-27	9289	9003	286	524	7862	8848	-986	-888	5558	8297	-2739	-2544	3954	4294	-340	-301

3 year average useful?	NOX	NMVOC	SO2	NH3	Total
Austria	YES	NO	YES	NO	2
Belgium	YES	NO	NO	NO	1
Bulgaria	YES	YES	NO	NO	2
Cyprus	YES	YES	YES	NO	3
Czech Republic	YES	NO	YES	NO	2
Denmark	NO	NO	YES	NO	1
Estonia	YES	YES	YES	NO	3
Finland	NO	YES	YES	NO	2
France	YES	YES	YES	NO	3
Germany	YES	NO	YES	NO	2
Greece	YES	YES	YES	NO	3
Hungary	YES	NO	NO	NO	1
Ireland	YES	YES	NO	NO	2
Italy	NO	YES	YES	NO	2
Latvia	YES	YES	NO	NO	2
Lithuania	YES	YES	YES	NO	3
Luxembourg	NO	YES	YES	NO	2
Malta	YES	YES	NO	NO	2
Netherlands	YES	YES	YES	NO	3
Poland	YES	YES	YES	NO	3
Portugal	YES	NO	YES	NO	2
Romania	YES	NO	YES	NO	2
Slovakia	YES	YES	YES	NO	3
Slovenia	YES	YES	YES	NO	3
Spain	YES	NO	NO	NO	1
Sweden	YES	YES	YES	NO	3
United Kingdom	YES	NO	YES	NO	2
EU-27	23	17	20	0	60

Compliance problems	NOX	NMVOC	SO2	NH3	Total
Austria	1	0	0	0	1
Belgium	1	0	0	0	1
Bulgaria	0	0	0	0	0
Cyprus	0	0	0	0	0
Czech Republic	0	0	0	0	0
Denmark	1	1	0	0	2
Estonia	0	0	0	0	0
Finland	0	0	0	1	1
France	1	0	0	0	1
Germany	1	1	0	1	3
Greece	0	0	0	0	0
Hungary	0	0	0	0	0
Ireland	1	0	0	0	1
Italy	0	0	0	0	0
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Luxembourg	1	0	0	0	1
Malta	0	0	1	0	1
Netherlands	0	0	1	0	1
Poland	0	1	0	0	1
Portugal	0	1	0	0	1
Romania	0	0	0	0	0
Slovakia	0	0	0	0	0
Slovenia	1	0	0	0	1
Spain	1	1	0	1	3
Sweden	1	0	0	0	1
United Kingdom	1	0	0	0	1
EU-27	11	5	2	3	21

Split Ambition Targets



Principal of Split Ambition Targets

The split ambition target is based on the principle of splitting a target into two components a fixed value and a flexible range portion. The flexible range portion has the possibility of increasing or decreasing as initial uncertainties in the process become understood. For simplicity we assume an aggregate uncertainty to be applicable for each countries emission projection and corresponding ceiling - in this case we assume this aggregate range to be +/- 7%. In practice this component, and the fixed ceiling in particular, could be modified to support attainment of a specific minimum goal. The parameters and sample values for this assessment are as follows:

Ceiling (C) : 100kt

Uncertainty range (U) 7%

Calculation of the fixed and flexible portions of the ceilings are then as follows:

Fixed ceiling (FC):	$FC = C - (C*U)$	FC = 93kt
Flexible range (FR):	$FR = C*U$	FR = 7kt
Upper ceiling (UC):	$UC = C + FR$	UC = 107kt
Lower ceiling (LC):	$LC = FC$	LC = 93kt

We do not define the conditions under which the flexible range would be adjusted, although in principal these could be for community wide factors (e.g. the failure of an EU wide technology to deliver expected emission reductions), or for unforeseen national factors (e.g. underestimation of activity, overestimation of activity). In the scenario below we examine how variations of EU wide flexibility adjustments and nationally approved adjustments may interact. The distinction between the variations being that EU wide adjustments would affect all parties whereas national variations are country specific.

These are illustrative scenarios only - not operational recommendations. They are presented using the NOX data as the basis for analysis.



Scenario 1 - NOX - Random national with no EU wide change

	Ceiling	Fixed Ceiling	Flexible Range	Upper Ceiling	Lower Ceiling
Austria	103	95.8	7.2	110.2	95.8
Belgium	176	163.7	12.3	188.3	163.7
Bulgaria	247	229.7	17.3	264.3	229.7
Cyprus	23	21.4	1.6	24.6	21.4
Czech Republic	286	266.0	20.0	306.0	266.0
Denmark	127	118.1	8.9	135.9	118.1
Estonia	60	55.8	4.2	64.2	55.8
Finland	170	158.1	11.9	181.9	158.1
France	810	753.3	56.7	866.7	753.3
Germany	1051	977.4	73.6	1124.6	977.4
Greece	344	319.9	24.1	368.1	319.9
Hungary	198	184.1	13.9	211.9	184.1
Ireland	65	60.5	4.6	69.6	60.5
Italy	990	920.7	69.3	1059.3	920.7
Latvia	61	56.7	4.3	65.3	56.7
Lithuania	110	102.3	7.7	117.7	102.3
Luxembourg	11	10.2	0.8	11.8	10.2
Malta	8	7.4	0.6	8.6	7.4
Netherlands	260	241.8	18.2	278.2	241.8
Poland	879	817.5	61.5	940.5	817.5
Portugal	250	232.5	17.5	267.5	232.5
Romania	437	406.4	30.6	467.6	406.4
Slovakia	130	120.9	9.1	139.1	120.9
Slovenia	45	41.9	3.2	48.2	41.9
Spain	847	787.7	59.3	906.3	787.7
Sweden	148	137.6	10.4	158.4	137.6
United Kingdom	1167	1085.3	81.7	1248.7	1085.3

National variability	EU Uncertainty	Hi Lo Same	New Ceiling
7.0	0.0	Lower	102.8
10.0	0.0	Lower	173.7
34.0	0.0	High	263.7
3.0	0.0	High	24.4
38.0	0.0	High	304.0
16.0	0.0	High	134.1
2.0	0.0	Lower	57.8
12.0	0.0	High	170.1
24.0	0.0	Lower	777.3
35.0	0.0	Lower	1012.4
29.0	0.0	High	348.9
16.0	0.0	High	200.1
1.0	0.0	Lower	61.5
16.0	0.0	Lower	936.7
7.0	0.0	High	63.7
12.0	0.0	High	114.3
1.0	0.0	High	11.2
1.0	0.0	High	8.4
13.0	0.0	Lower	254.8
1.0	0.0	Lower	818.5
13.0	0.0	Lower	245.5
51.0	0.0	High	457.4
11.0	0.0	High	131.9
4.0	0.0	High	45.9
80.0	0.0	High	867.7
16.0	0.0	High	153.6
93.0	0.0	High	1178.3

Summary Scenario 1	
Higher ceilings	17
Lower ceilings	10
Same ceilings	0
Change in aggregate ceiling	-84
Proportion of orginal aggregate ceiling	-1%

Total	9003	8372.79	630.21	9633.21	8372.79	546	0	8918.79
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Scenario 2 - NOX - Random national with EU wide increase in ceiling

	Ceiling	Fixed Ceiling	Flexible Range	Upper Ceiling	Lower Ceiling
Austria	103	95.8	7.2	110.2	95.8
Belgium	176	163.7	12.3	188.3	163.7
Bulgaria	247	229.7	17.3	264.3	229.7
Cyprus	23	21.4	1.6	24.6	21.4
Czech Republic	286	266.0	20.0	306.0	266.0
Denmark	127	118.1	8.9	135.9	118.1
Estonia	60	55.8	4.2	64.2	55.8
Finland	170	158.1	11.9	181.9	158.1
France	810	753.3	56.7	866.7	753.3
Germany	1051	977.4	73.6	1124.6	977.4
Greece	344	319.9	24.1	368.1	319.9
Hungary	198	184.1	13.9	211.9	184.1
Ireland	65	60.5	4.6	69.6	60.5
Italy	990	920.7	69.3	1059.3	920.7
Latvia	61	56.7	4.3	65.3	56.7
Lithuania	110	102.3	7.7	117.7	102.3
Luxembourg	11	10.2	0.8	11.8	10.2
Malta	8	7.4	0.6	8.6	7.4
Netherlands	260	241.8	18.2	278.2	241.8
Poland	879	817.5	61.5	940.5	817.5
Portugal	250	232.5	17.5	267.5	232.5
Romania	437	406.4	30.6	467.6	406.4
Slovakia	130	120.9	9.1	139.1	120.9
Slovenia	45	41.9	3.2	48.2	41.9
Spain	847	787.7	59.3	906.3	787.7
Sweden	148	137.6	10.4	158.4	137.6
United Kingdom	1167	1085.3	81.7	1248.7	1085.3

National variability	EU Uncertainty	Hi Lo Same	New Ceiling
2.0	2.4	Lower	100.2
22.0	4.1	High	188.3
31.0	5.7	High	264.3
3.0	0.5	High	24.6
23.0	6.6	High	295.6
17.0	2.9	High	135.9
5.0	1.4	High	62.2
5.0	3.9	Lower	167.0
36.0	18.7	Lower	808.0
93.0	24.3	High	1094.7
17.0	7.9	High	344.9
21.0	4.6	High	209.7
5.0	1.5	High	67.0
115.0	22.9	High	1058.6
2.0	1.4	Lower	60.1
7.0	2.5	High	111.8
1.0	0.3	High	11.5
1.0	0.2	High	8.6
15.0	6.0	High	262.8
86.0	20.3	High	923.8
3.0	5.8	Lower	241.3
54.0	10.1	High	467.6
3.0	3.0	Lower	126.9
2.0	1.0	Lower	44.9
66.0	19.6	High	873.3
15.0	3.4	High	156.1
143.0	27.0	High	1248.7

Summary Scenario 2	
Higher ceilings	20
Lower ceilings	7
Same ceilings	0
Change in aggregate ceiling	+355
Proportion of original aggregate ceiling	+4%

Total	9003	8372.79	630.21	9633.21	8372.79	793	207.9693	9358.1858
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Scenario 3 - NOx - Random national with EU wide decrease in ceiling

	Ceiling	Fixed Ceiling	Flexible Range	Upper Ceiling	Lower Ceiling
Austria	103	95.8	7.2	110.2	95.8
Belgium	176	163.7	12.3	188.3	163.7
Bulgaria	247	229.7	17.3	264.3	229.7
Cyprus	23	21.4	1.6	24.6	21.4
Czech Republic	286	266.0	20.0	306.0	266.0
Denmark	127	118.1	8.9	135.9	118.1
Estonia	60	55.8	4.2	64.2	55.8
Finland	170	158.1	11.9	181.9	158.1
France	810	753.3	56.7	866.7	753.3
Germany	1051	977.4	73.6	1124.6	977.4
Greece	344	319.9	24.1	368.1	319.9
Hungary	198	184.1	13.9	211.9	184.1
Ireland	65	60.5	4.6	69.6	60.5
Italy	990	920.7	69.3	1059.3	920.7
Latvia	61	56.7	4.3	65.3	56.7
Lithuania	110	102.3	7.7	117.7	102.3
Luxembourg	11	10.2	0.8	11.8	10.2
Malta	8	7.4	0.6	8.6	7.4
Netherlands	260	241.8	18.2	278.2	241.8
Poland	879	817.5	61.5	940.5	817.5
Portugal	250	232.5	17.5	267.5	232.5
Romania	437	406.4	30.6	467.6	406.4
Slovakia	130	120.9	9.1	139.1	120.9
Slovenia	45	41.9	3.2	48.2	41.9
Spain	847	787.7	59.3	906.3	787.7
Sweden	148	137.6	10.4	158.4	137.6
United Kingdom	1167	1085.3	81.7	1248.7	1085.3

National variability	EU Uncertainty	Hi Lo Same	New Ceiling
1.0	-2.4	Lower	94.4
12.3	-4.1	Lower	171.9
17.3	-5.7	Lower	241.3
1.6	-0.5	Lower	22.5
20.0	-6.6	Lower	279.4
8.9	-2.9	Lower	124.1
4.2	-1.4	Lower	58.6
11.9	-3.9	Lower	166.1
56.7	-18.7	Lower	791.3
73.6	-24.3	Lower	1026.7
24.1	-7.9	Lower	336.1
13.9	-4.6	Lower	193.4
4.6	-1.5	Lower	63.5
69.3	-22.9	Lower	967.1
4.3	-1.4	Lower	59.6
7.7	-2.5	Lower	107.5
0.8	-0.3	Lower	10.7
0.6	-0.2	Lower	7.8
18.2	-6.0	Lower	254.0
61.5	-20.3	Lower	858.7
17.5	-5.8	Lower	244.2
30.6	-10.1	Lower	426.9
9.1	-3.0	Lower	127.0
3.2	-1.0	Lower	44.0
59.3	-19.6	Lower	827.4
10.4	-3.4	Lower	144.6
81.7	-27.0	Lower	1140.0

Summary Scenario 3	
Higher ceilings	0
Lower ceilings	27
Same ceilings	0
Change in aggregate ceiling	-214
Proportion of original aggregate ceiling	-2%

Total	9003	8372.79	630.21	9633.21	8372.79	624	-207.9693	8788.8207
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Range of Change

Summary of All 150 Scenarios		
Max Aggregate Change in NOX Ceiling	336	3.7% higher ceiling level
Min Aggregate Change in NOX Ceiling	-401	4.5% reduced ceiling level

Summary of Scenario 1 – Random National – No EU Wide Change		
Max Aggregate Change in Ceiling	+201	2.2% higher ceiling level
Min Aggregate Change in Ceiling	-231	2.6% reduced ceiling level

Summary of Scenario 2 – Random National – EU Wide Increase		
Max Aggregate Change in Ceiling	+336	3.7% higher ceiling level
Min Aggregate Change in Ceiling	+37	0.4% higher ceiling level

Summary Scenario 3 – Random National – EU Wide Decrease		
Max Aggregate Change in Ceiling	+35	0.4% higher ceiling level
Min Aggregate Change in Ceiling	-401	4.5% reduced ceiling level

Summary

Domestic Gas Swap

Creates incentive to seek least cost reductions across all pollutants beyond ceiling

Administratively simple and easily combined with other options

Using a less favourable exchange rate should protect net effects

Environmental 'windfalls' are not always desirable



Overcompliance pledge

Penalty rate is critical

Would expect relatively limited interest from member states

May be useful for those with confidence in abatement plan and/or restricted financing

Would require 2nd administrative check for final compliance



Summary

Three Year Average

Offers some potential to allow for slower burn 'measures' to take effect

Simple mechanism

Should only be an option



Split Ambition Targets

Can quickly address EU wide measure issues

Can account for national forecasts being either over or under estimated

Ceilings can swing up or down – but with a constraint on effects with fixed ceiling

Aggregate change is unlikely to be dramatic

Administratively more challenging

Requires more national and central capacity to engage and manage

This may be useful regardless as part of ongoing monitoring and review



Concluding Thoughts

- No shortage of contemporary examples of unprecedented events and uncertainty
'Ash clouds, energy price peaks, economic crises, research revelations'
- The following will lose support where participation is optional, and contribute to challenges and process delays where participation is mandatory:
 1. Adopting an environment at **any** cost approach
 2. Failing to acknowledge 'acknowledged' issues
 3. Not recognising uncertainty in some manner
- National capacities and engagement are key to effective management of collaborative policy areas such as climate and transboundary air pollution
- These capacities become more important with the adoption of flexibilities into the process and the more uncertain nature of non-technical measures growing in significance.

Research Recommendation

- Three Year Average should be adopted as an option
- This addresses the phased effects of a measure – but does little for uncertainty.

- Domestic Gas Swaps offer a simple and effective means of offering greater abatement scope to countries working towards compliance.
- Exchange rate can constrain ‘effect risk’

- Arguably a further more significant flexibility is required to address potential uncertainty
- Split ambition targets offers a mechanism that reduces the potential for strategic behaviour and allows for a defined degree of flexibility
- Aggregate effect changes would likely be limited and may be favourable



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