Global Cement and Concrete Association

CONCRETE FUTURE

Future of the Cement CO_2 Protocol – Transition to V4.2

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FICEM C2 Congress, Santiago - Chile

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c44 members & c30 national partners

Present in most countries in the world

Present in all continents - GCCA is the leading global cement & concrete association

Our Members

- Asia Cement Corporation
- Arkan
- Breedon Group
- BUA Cement
- Buzzi
- Cementir Holding
- Cementos Argos
- Cemento Moctezuma
- Cementos Pacasmayo
- Cementos Progreso
- CEMEX
- Cimenterie Nationale
- Cimsa
- City Cement
- CNBM
- CRH
- Dangote
- Fletcher Building
- GCC
- Heidelberg Materials
- Hima Cement
- Holcim
- Huaxin Cement
- JK Cement
- JSW Cement
- Kartuli Cement
- Limak Cimento
- Medcem
- Molins
- Nesher Israel Cement Enterprises
- Norm Cement
- SCHWENK Zement
- Secil
- Siam Cement Group
- Siam City Cement
- Taiheiyo Cement
- TCC Group Holdings CO., LTD.
- TITAN Group
- TPI Polene
- UltraTech Cement
- UNACEM
- Vassiliko Cement
- Votorantim Cimentos
- Yura Cement

National & Regional Association Partners

- American Cement Association
- Asociación de Fabricantes de Cemento Portland – Argentina
- Asociación de Productores de Cemento – Peru
- Associação Brasileira de Cimento Portland – Brazil
- Association of German Cement Manufacturers (VDZ) – Germany
- Association Professionnelle des Cimentiers – Morocco
- Azerbaijan Cement Producers Association (ACPA)
- Betonhuis – Netherlands
- BIBM – Europe
- CANACEM – Mexico
- Canadian Precast Prestressed Concrete Institute
- Cement Association of Canada
- Cement Concrete & Aggregates Association – Australia
- Cement Europe
- Cement Industry Federation – Australia
- Cement Manufacturers Association – India
- Cement Manufacturers Ireland
- China Cement Association
- Concrete NZ – New Zealand
- European Federation Concrete Admixtures
- European Ready Mixed Concrete Organisation
- Federacion Iberoamericana del Hormigon Premezclado – LatAm
- Federacion Interamericana del Cemento (FICEM) – LatAm
- Japan Cement Association
- Mineral Products Association – United Kingdom
- National Ready Mixed Concrete Association – USA
- South Indian Cement Manufacturers Association
- Thai Cement Manufacturers Association
- Agrupación de Fabricantes de Cemento de España: Oficemen – Spain
- Turkish Cement Manufacturers Association (Turkcimento)

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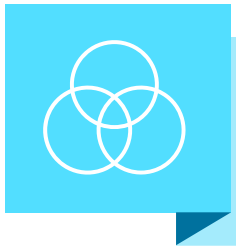
Setting the Scene

GCCA GNR 2.0 – Our Global Reporting and Measurement Tool

GCCA in Numbers (GNR) is one of the most reliable sources of truth for the cement and concrete sector. A ”well-oiled” data engine to monitor the sector’s performance towards Net Zero

01



All the data on GNR is published using the GCCA’s Cement CO_2 and Energy Protocol

Uniform

02

GCCA’s CO_2 Protocol is the most comprehensive standard which is based on GHG protocol and IPCC standards

Accurate

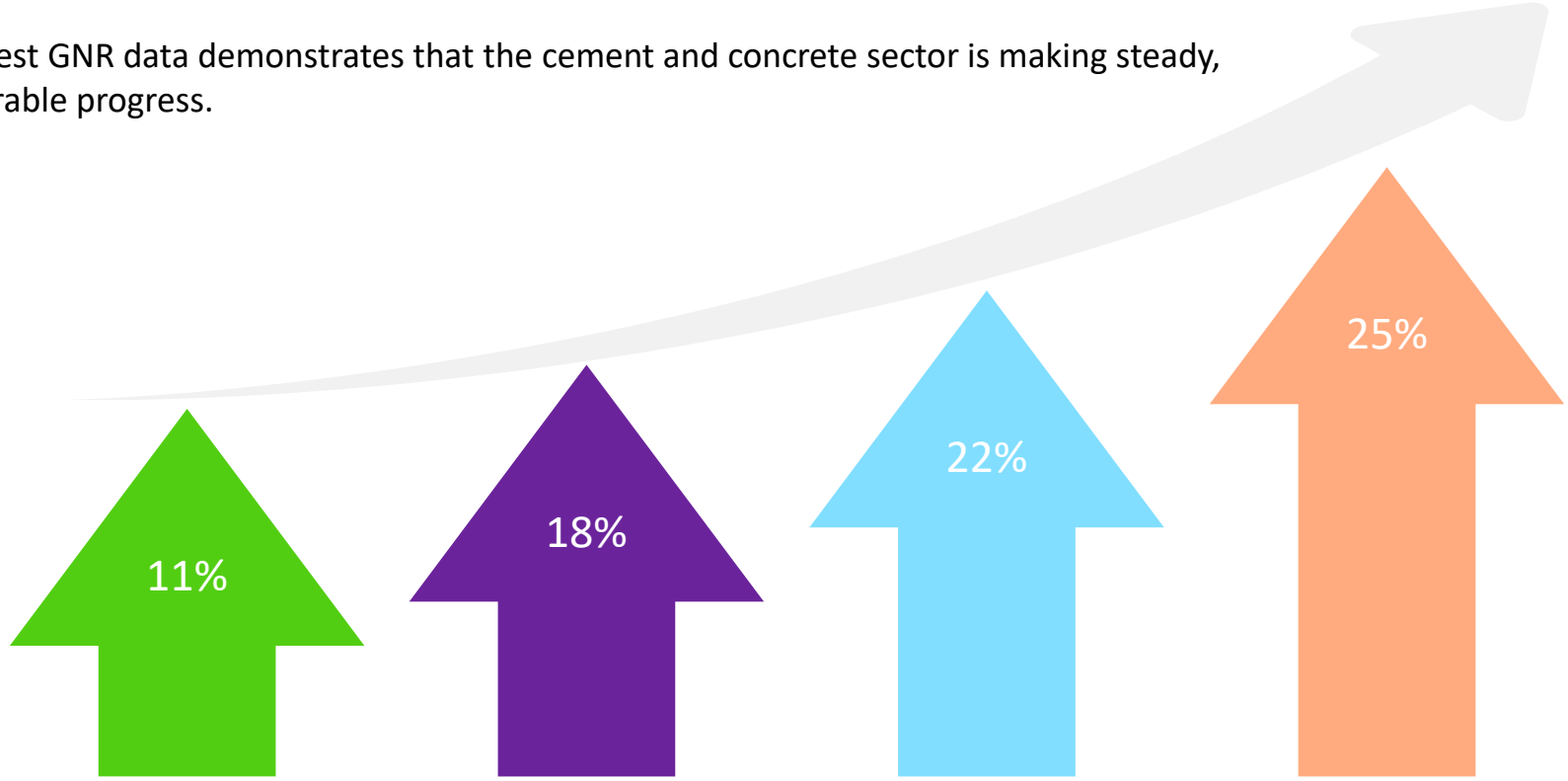
03

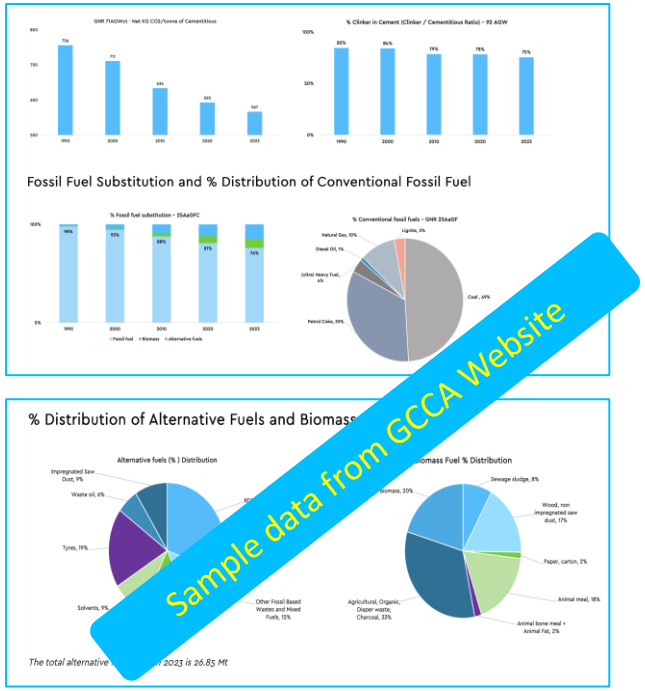
The data submitted to GNR is independently verified by PwC and external verifiers from GCCA

Verified Data

Our Global Success Stories (1990 – 2023)

The latest GNR data demonstrates that the cement and concrete sector is making steady, measurable progress.

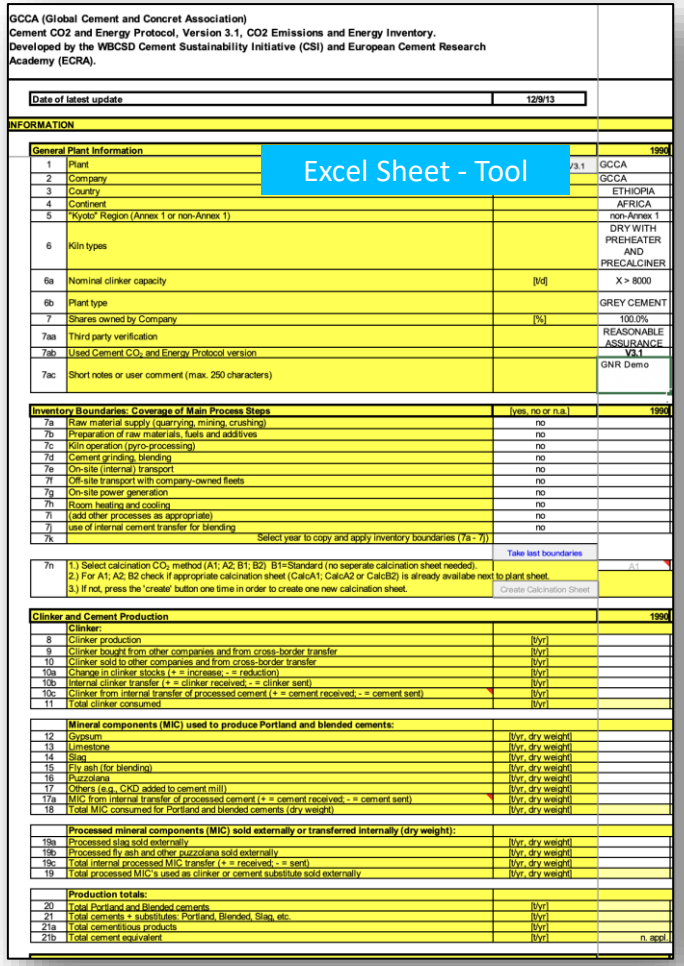




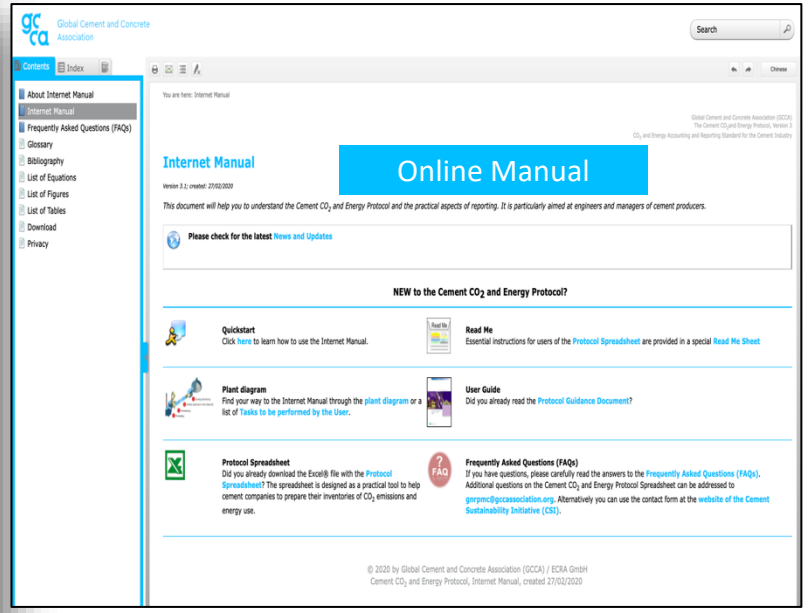
GCCA Cement CO_2 and Energy Protocol (Scope 1 and 2 Emission)

PDF Document

Excel Sheet - Tool



Online Manual

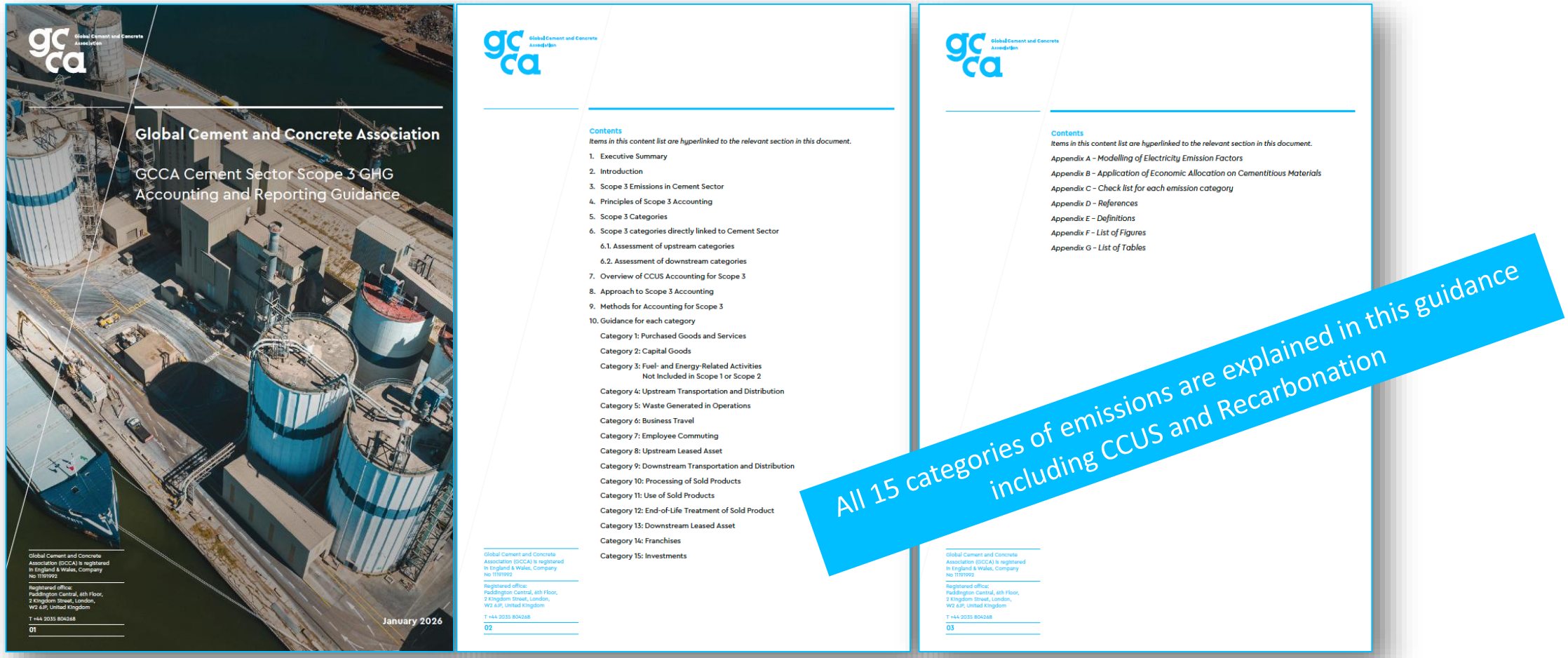


KPIs of GCCA Protocol Spreadsheet

- Clinker and cement production;
- Absolute gross and net CO_2 emissions ;
- Thermal energy consumption and fuel details;
- Power consumption;
- Process emissions;
- Use of mineral components and the proportion of clinker in cement.

More than 50 parameters form part of the GCCA GNR, making it one of the most comprehensive reporting systems globally

GCCA Scope 3 Emissions Guidance – New Launch!



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Updating the GCCA CO_2 Protocol (3.1 → 4.1) – More than a decade of an update

GCCA CO_2 and Energy Protocol Review – Transition to V4.1

A Paramount Milestone for Industry

- GCCA's CO_2 Protocol remains paramount within our industry, driving our efforts to monitor progress in a credible manner
- In response to new guidance from SBTi, Scope 3 emissions accounting, the GHG Protocol review as well as technological advancements on the path to net zero like CCUS and calcined clays, we have undertaken a thorough review and upgrade of the current GCCA CO_2 protocol, transitioning from V3.1 to V4.1

Nature of update in the CO_2 Protocol

GCCA CO_2 Protocol V4.1

Structural Update – Changes with respect to the structure of the protocol (Accounting sheets, Company Consolidation)

Conceptual Update – Updates and the addition of the existing concepts and new technical concepts in the protocol sheet

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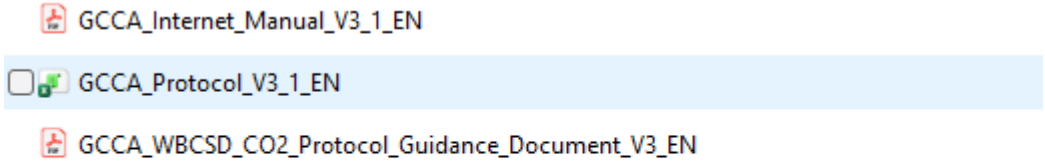
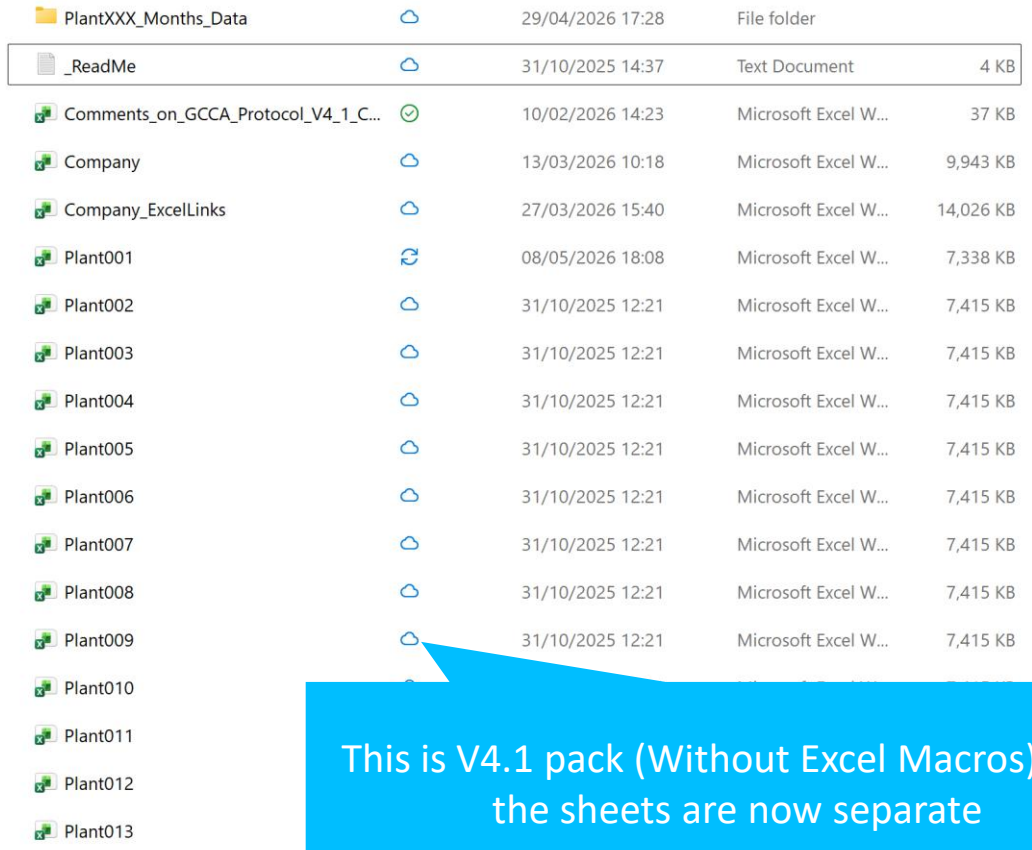
Structural Updates

Visual Difference V3.1 → V4.1



This is V3.1 pack (with Excel Macros)– One sheet and everything inside such as plant sheet, company sheet and calcination sheet

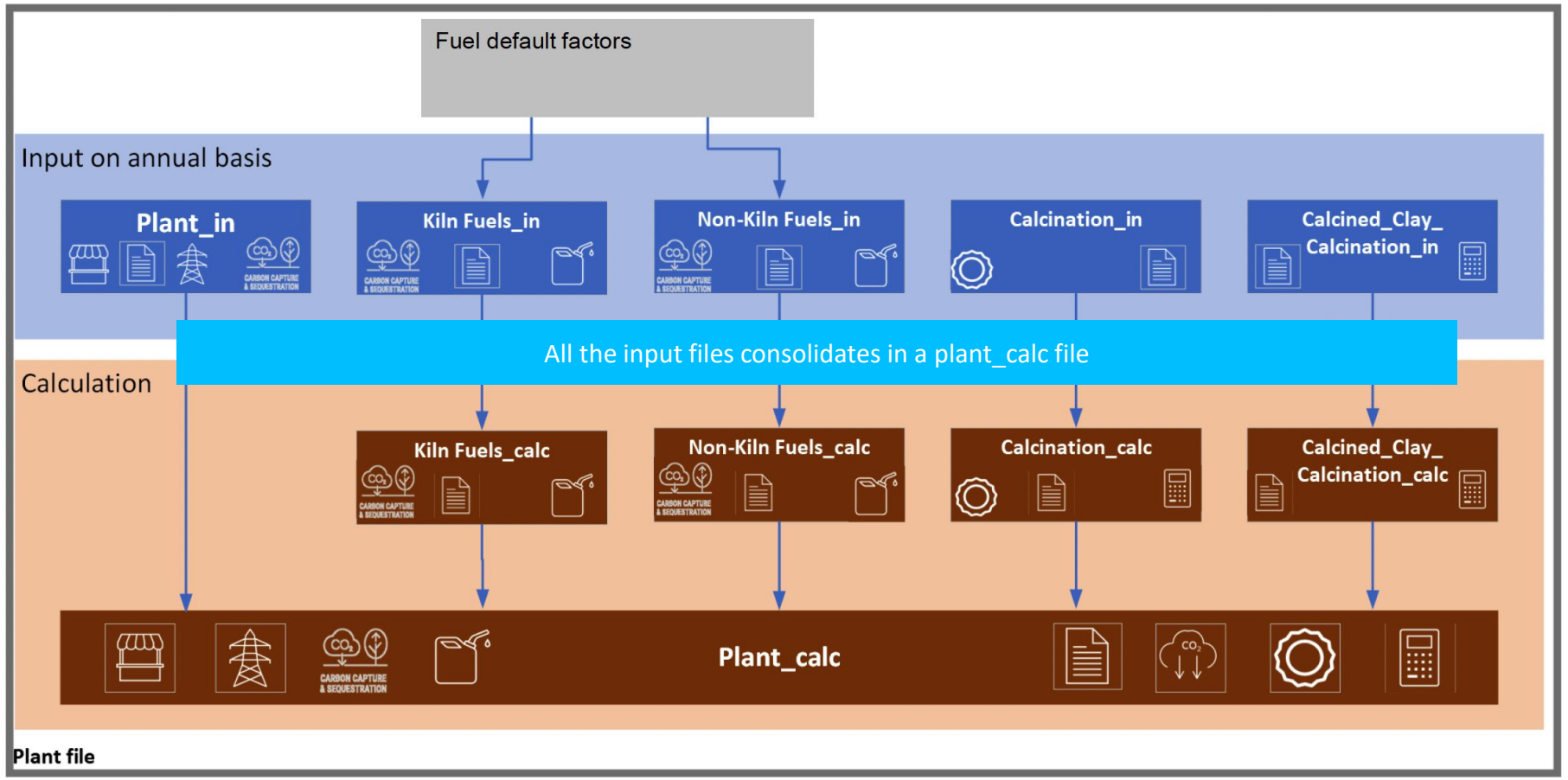


This is V4.1 pack (Without Excel Macros) – All the sheets are now separate

Most important changes in GCCA Protocol Version 4.1

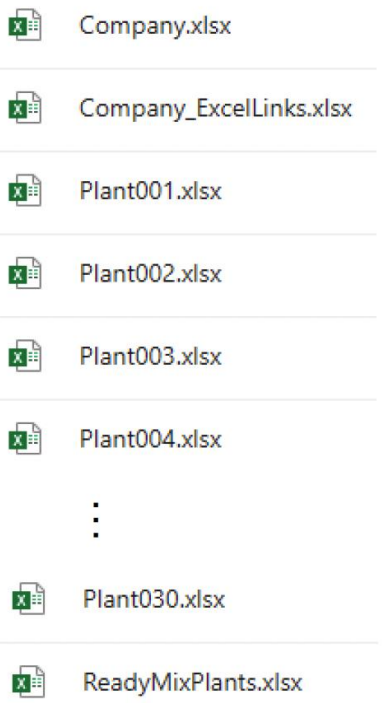
	Version 3.1	Version 4.1
Excel version	Excel 2010	Excel Online, very high level of **compatibility** with Excel365, Excel 2021 and Googel Sheets
Plant / company level	Both levels in one file	**Separate files for plant and company**
(Visible) sheets	Max. 7 per plant	1 plant file per plant with **13 sheets** **Input in separate sheets without any sheet protection** Calculation is separated and protected in calculation sheets, removable protection allows complete analysis of calculation details + 1 **ReadyMix file** per company for integrated ready mix business + 1 Company file with 1 company sheet + 1 sheet per plant
Macros	Used for sheet management and validation tool	**No macros used**, replaced by links between sheets and files Validation range not yet available, could be amended in an additional sheet
Database links	Transfer of data and inserting DB links was possible in the special Plant sheet transfer But manual transfer required, especially calculation of company sums required user programming	Input sheets for pasting data and inserting DB links Links between sheets and files provided as far as possible Paste & Copying data from plant to company file as robust backup solution (viable solution if links between files should be lost in diverse IT systems)
Verification	Calculation cells were password protected	Copy & Paste all inputs to a fresh download of GCCA Protocol version 4 and compare calculation results

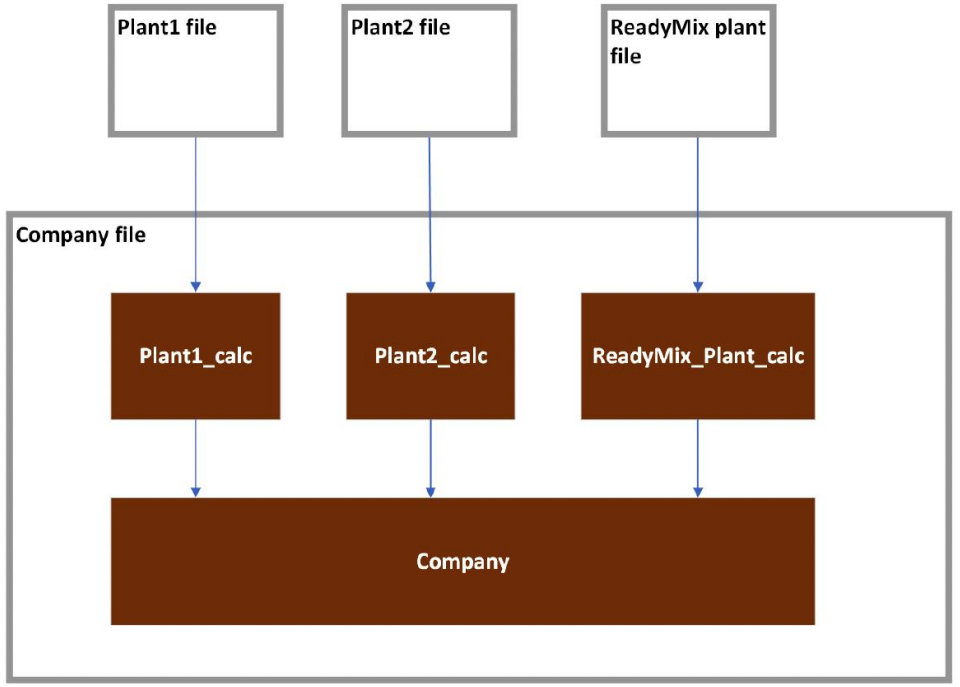
The Plant file



The Company file

- aggregation level: National company
- integrating data from Ready Mix Plants in the National company from one special plant level file

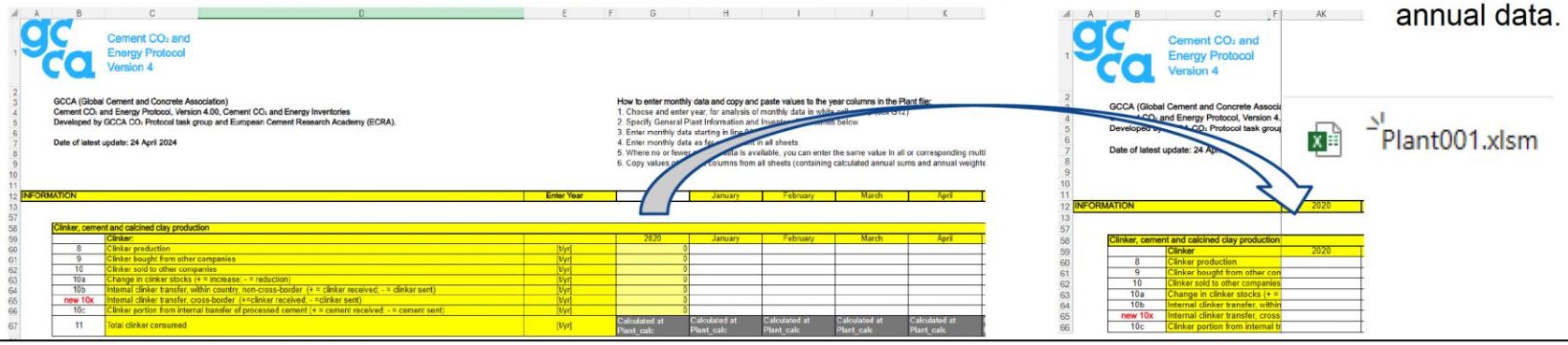




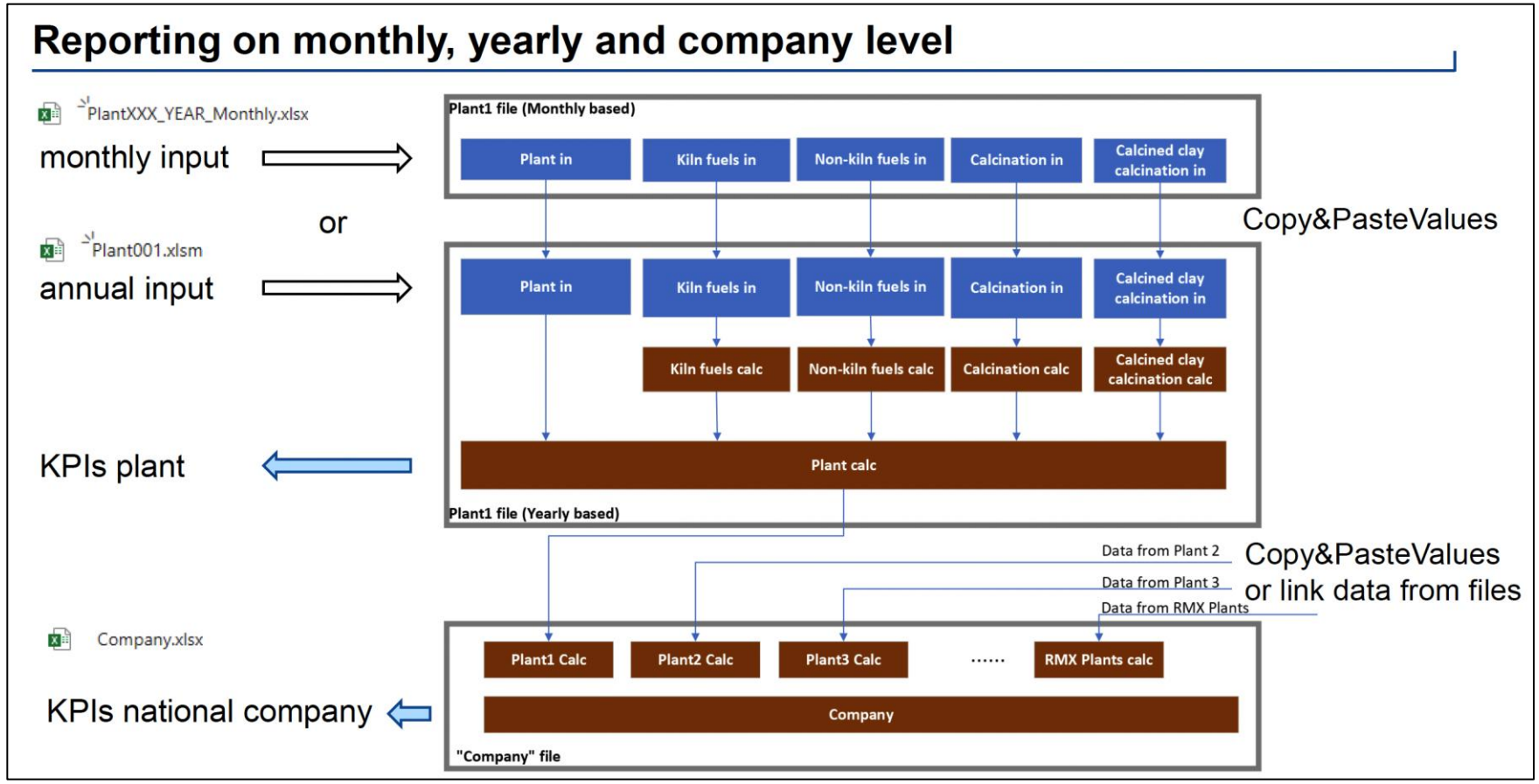
New Plant Monthly File

Aggregation of monthly input values

- The Plant monthly file is an optional additional level for plant and process specific data input on monthly basis.
- The PlantXXX_YEAR_Monthly.xlsx file is placed in a sub-folder and contains only dedicated input sheets with the name ending "..._in".
- Calculations of anual sums and annual weighted average values is performed in the first columns of the same input sheets.
- These columns are meant for Copying and Pasting Values (!) to the corresponding input sheets in the Plant file with annual data.



Reporting on Monthly, Yearly and Company Level



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Technical Updates

Changes to MIC Accounting – Big Update!! (1/2)

V4.1 separates production from movement by splitting cement into clinker and MIC components and excluding negative transfer values, ensuring all material is attributed only once at its source without distorting KPIs.

Scenario / Issue	What was WRONG in V3.1	What V4.1 FIXES
1. MIC transfer between plants (A → B)	- Movement-based accounting (+ received / – sent) - Producing plant loses MIC but keeps emissions - Receiving plant gains MIC without processing - KPIs distorted (A looks inefficient, B looks efficient)	- Reverse logic (+ sent / – received) - Producing plant keeps MIC entirely - Receiving plant shows flow but gets no KPI benefit
2. Inter-company MIC transfers (GCCA level)	- Same MIC counted twice: • Company A (produced) • Company B (used) - –100 and +100 do NOT cancel in KPIs → double counting - Inflates GCCA totals	- Introduce **19y (flag)** - Used at GCCA consolidation level only - Duplication removed centrally - Company KPIs remain unchanged
3. MIC in RMX (Concrete stage) – Boundary Increase to Concrete	- RMX completely missing from system - SCM used in concrete not captured - Underestimation of clinker substitution and sector progress	- RMX added to system boundary - New RMX MIC usage lines (e.g. 18 series) - Total SCM in concrete captured - Additional SCM visible (via comparison with cement)

Changes to MIC Accounting – Big Update!! (2/2)

4. Internal cement transfers (within company)	- Cement transfer treated as production - Clinker + MIC move to receiving plant - Producing plant penalised, receiving plant benefits - KPI distortion at plant level - Inconsistency between guidelines and Excel	- Transfers treated as **movement only** - Negative values NOT included in KPI formulas - Producer retains clinker + MIC - Receiving plant excluded from KPI impact - Excel logic aligned with methodology
5. External cement transfers (between companies)	- Clinker double counting: • Counted in cement production (seller) • Counted again as clinker bought (buyer) - MIC inside traded cement not properly captured	- Cement split into components: • **Clinker (10d)** • **MIC (17b)** - Seller reports negative (excluded) - Buyer reports positive - Negatives excluded → no duplication - Works without extra GCCA adjustment

Snapshot from the protocol sheet V 4.1

	Cement Constituents used to produce Portland and blended Cements	
12	Gypsum	[t/yr, dry weight]
13	Limestone	[t/yr, dry weight]
14	Slag	[t/yr, dry weight]
15	Fly ash (for blending)	[t/yr, dry weight]
16	Puzzolana	[t/yr, dry weight]
new 16a	Calcined clays	[t/yr, dry weight]
17	Others (e.g., CKD added to cement mill)	[t/yr, dry weight]
17a	Cement constituents from internal transfer of processed cement (+ = cement received; - = cement sent)	[t/yr, dry weight]
18	Total cement constituents consumed for Portland and blended cements (dry weight)	[t/yr, dry weight]
	Processed MICs sold externally to Construction Industry:	
19a	Processed slag sold externally	[t/yr, dry weight]
19b	Processed fly ash and other puzzolana sold externally	[t/yr, dry weight]
new 19bb	Other processed MICs sold externally (e.g. limestone, clacined clays, burned shale...)	[t/yr, dry weight]
19	Total processed MIC's used as clinker or cement substitute sold externally	[t/yr, dry weight]
new 19y	Informative: Processed slag, fly ash, puzzolans and all other MICs sold externally and reported by another cement player to GCCA	[t/yr, dry weight]
	Processed MICs transferred internally and MICs Destination Information	
19c	Total internal processed MIC transfer (- = received; + = sent)	[t/yr, dry weight]
new 19e	Informative: Processed slag, fly ash, puzzolans transferred to own Ready-Mix / Precast businesses	[t/yr, dry weight]
new 19f	Informative: All other processed MICs transferred to own Ready-Mix / Precast businesses	[t/yr, dry weight]
	Production totals:	
20	Total Portland and blended cements (all types together except pure slag cement and direct fly ash sales)	[t/yr]
21	Total cements + substitutes: portland, blended, slag, calcined clay etc. incl. direct fly ash sales	[t/yr]
21a	Total cementitious products	[t/yr]
21b	Total cement equivalent	[t/yr]
	Mineral Components (MIC) used to produce Portland and blended Cements in Ready-mix / Precast Businesses:	
new 18a	Limestone	[t/yr, dry weight]
new 18b	Slag	[t/yr, dry weight]
new 18c	Fly ash (for blending)	[t/yr, dry weight]
new 18d	Puzzolana	[t/yr, dry weight]
new 18e	Calcined clays	[t/yr, dry weight]
new 18f	Others (e.g., CKD added to cement mill)	[t/yr, dry weight]
new 18g	Total MIC consumed for Portland and blended cements in Ready-mix / Precast businesses (dry weight)	[t/yr, dry weight]
	Production totals (including integrated Ready-Mix / Precast Businesses):	
new 20a	Total Portland and Blended cements (including integrated Ready-Mix / Precast Businesses)	[t/yr]
new 21aa	Total cements + substitutes: Portland, Blended, Slag, etc. (including integrated Ready-Mix / Precast Businesses)	[t/yr]
new 21aaa	Total cementitious products (including integrated Ready-Mix / Precast Businesses)	[t/yr]
new 21ba	Total cement equivalent (including integrated Ready-Mix / Precast Businesses)	[t/yr]

Red lines are the updates

Note: The Protocol is being road-tested by GCCA members. We aim to launch the final sheet by February 2025.

Changes to Kiln Fuels Accounting

Fuels types used have evolved over the last decade, hence there was a need to review fuels categories and emissions factors to align with current industry practices. Use of fuels in other processes (e.g.: CCUS, Calcined clays, …) than clinker manufacturing has to be accounted for to provide accurate results

Scenario	Status in V3.1	What changed in V4.1?
Fuel Categories Naming	In 3.1 there are two sections for fuels – Kiln Fuels and Non-Kiln Fuels	In 4.1 we have updated to Kiln fuels and other kiln fuels. Other kiln fuels represents an accurate way as it also includes fuel consumption for Calcined Clay, CCUS Steam generation , etc.
Fuel types	Less fuel types	More fuel types in each category. It also includes Green and Blue/Gray Hydrogen
Emission factors	Outdated emission factors	Updated emission factors reflecting the new reality and based on latest ECRA , IPCC and GCCA defaults for improved accuracy
Structure	Fuels present in the plant sheet at the bottom	Fuels now as a separate sheet under plant sheet to improve sheet handling and aiding accurate calculations

V3.1 vs V4.1 – Updates in types of Fuel Category

V3.1

Kiln Fuel Consumption in tonnes per year	
101	**Conventional fossil fuels (excl. drying of raw materials and fuels)**
102	coal + anthracite
103	petrol coke
104	(ultra) heavy fuel
105	diesel oil
106	natural gas
107	shale
107a	lignite
108	**Alternative fossil and mixed fuels (excl. drying of raw materials and fuels)**
109	waste oil
110	tyres
111	RDF including plastics
112	solvents
113	impregnated saw dust
113a	mixed industrial waste
114	other fossil based wastes and mixed fuels
115	**Biomass fuels (excl. drying of raw materials and fuels)**
116	dried sewage sludge
117	wood, non impregnated saw dust
118	paper, carton
119	animal meal
120	animal bone meal
121	animal fat
122	agricultural, organic, diaper waste, charcoal
123	other biomass

V4.1

Fuel type	
Conventional Fossil Fuels	
	Coal + anthracite
	Petrol coke
	(ultra) Heavy fuel
	Diesel oil
	Gasoline
	Natural gas
	Shale
	Lignite
	Liquefied Petroleum Gas (LPG)
	Other fossil fuels
Alternative Fossil and Mixed Fuels	
	Waste oil
	Bio and mixed diesel
	Waste tyres
	RDF
	Non-recyclable 100% plastics
	Solvent based fuel
	Impregnated saw dust
	Mixed industrial waste
	Dried sewage sludge with fossil content
	Other fossil based wastes and mixed fuels
Biomass based Fuels	
	Dried sewage sludge 100% biogenic
	Wood, non impregnated saw dust
	Paper, carton
	Animal waste (animal meal, animal bone meal and animal fat)
	Agricultural, organic, diaper waste, charcoal
	Biogas
	Other biomass based fuel
Hydrogen	
	Hydrogen (green)
	Hydrogen (blue/gray)

Snapshot from the protocol sheet V3.1

Kiln Fuel Consumption in terajoules (TJ) per year			1990	1991	1992	1993	1994	1995	1996	1997	1998
161	**Conventional fossil fuels**	[TJ/yr]	This is the total heat consumption of all conventional fossil kiln fuels. This result is registered in line 2								
162	coal + anthracite	[TJ/yr]									
163	petrol coke	[TJ/yr]									
164	(ultra) heavy fuel	[TJ/yr]									
165	diesel oil	[TJ/yr]	Heat consumption of conventional fossil kiln fuels, calculated from the amount of each fuel and their l								
166	natural gas	[TJ/yr]									
167	shale	[TJ/yr]									
167a	lignite	[TJ/yr]									
168	**Alternative fossil and mixed fuels, excluding biomass fraction of mixed fuels**	[TJ/yr]	This is the total heat consumption of all alternative fossil kiln fuels. This result is registered in line 27								
169	waste oil	[TJ/yr]									
170	tyres	[TJ/yr]									
171	RDF including plastics	[TJ/yr]									
172	solvents	[TJ/yr]	Heat consumption of alternative fossil kiln fuels, calculated from the amount of each fuel and their lov								
173	impregnated saw dust	[TJ/yr]									
173a	mixed industrial waste	[TJ/yr]									
174	other fossil based wastes (excl. biomass content of mixed fuels)	[TJ/yr]									
175	**Biomass fuels - total,** incl. biomass cont. from alternative fossil fuels	[TJ/yr]	This is the total heat consumption of all biomass kiln fuels. This result is registered in line 28 above								
176	sewage sludge	[TJ/yr]									
177	wood, non impregnated saw dust	[TJ/yr]									
178	paper, carton	[TJ/yr]									
179	animal meal	[TJ/yr]									
180	animal bone meal	[TJ/yr]	Heat consumption of biomass kiln fuels, calculated from the amount of each fuel and their lower heat								
181	animal fat	[TJ/yr]									
182	agricultural, organic, diaper waste, charcoal	[TJ/yr]									
183	other biomass	[TJ/yr]									
183a	biomass content from alternative fuels	[TJ/yr]									

Snapshot from the protocol sheet V4.1

KILN FUEL INPUT		YEAR 2024 -->										<-- YEAR 2024
		CO_2 Emission Factor (EF) base		Volume			Ash Content for correction of Calcination EF			Lower Heating Value (LHV)		
Fuel type		Emission Factor Basis total carbon (TC) [kg CO_2/GJ]	Biogenic carbon content [% Cbio/TC]	Volume Unit	Kiln fuels	Drying of raw materials and fuels	Ash content of kiln fuels [Mass%]	Ash CaO content of kiln fuels [Ash mass%]	Ash MgO content of kiln fuels [Ash mass%]	LHV Unit	Kiln fuels	Drying of raw materials and fuels
Conventional Fossil Fuels												
	Coal + anthracite	96.00	0.0%	[t/yr]						[GJ/t]	26.090	26.090
	Petrol coke	92.80	0.0%	[t/yr]						[GJ/t]	32.500	32.500
	(ultra) Heavy fuel	77.40	0.0%	[t/yr]						[GJ/t]	40.400	40.400
	Diesel oil	74.10	0.0%	[t/yr]						[GJ/t]	43.000	43.000
	Gasoline	69.30	0.0%	[t/yr]						[GJ/t]	44.300	44.300
	Natural gas	56.10	0.0%	[1000 Nm3/yr]						[GJ/1'000 Nm3]	38.400	38.400
	Shale	107.00	0.0%	[t/yr]						[GJ/t]	8.900	8.900
	Lignite	101.00	0.0%	[t/yr]						[GJ/t]	22.000	22.000
	Liquefied Petroleum Gas (LPG)	63.10	0.0%	[t/yr]						[GJ/t]	47.300	47.300
	Other fossil fuels	101.00	0.0%	[t/yr]						[GJ/t]	30.000	30.000
Alternative Fossil and Mixed Fuels												
	Waste oil	74.00	0.0%	[t/yr]						[GJ/t]	40.370	40.370
	Bio and mixed diesel	74.10	0.0%	[t/yr]						[GJ/t]	42.600	42.600
	Waste tyres	85.00	27.0%	[t/yr]						[GJ/t]	28.200	28.200
	RDF	85.00	0.0%	[t/yr]						[GJ/t]	21.000	21.000
	Non-recyclable 100% plastics	85.00	0.0%	[t/yr]						[GJ/t]	23.000	23.000
	Solvent based fuel	74.00	0.0%	[t/yr]						[GJ/t]	22.860	22.860
	Impregnated saw dust	75.00	0.0%	[t/yr]						[GJ/t]	15.600	15.600
	Mixed industrial waste	85.00	0.0%	[t/yr]						[GJ/t]	23.000	23.000
	Dried sewage sludge with fossil content	110.00	80.0%	[t/yr]						[GJ/t]	14.500	14.500
	Other fossil based wastes and mixed fuels	90.00	0.0%	[t/yr]						[GJ/t]	25.000	25.000
Biomass based Fuels												
	Dried sewage sludge 100% biogenic	110.00	100.0%	[t/yr]						[GJ/t]	14.500	14.500
	Wood, non impregnated saw dust	112.00	100.0%	[t/yr]						[GJ/t]	15.600	15.600
	Paper, carton	110.00	100.0%	[t/yr]						[GJ/t]	15.500	15.500
	Animal waste (animal meal, animal bone meal and animal fat)	89.00	100.0%	[t/yr]						[GJ/t]	18.000	18.000
	Agricultural, organic, diaper waste, charcoal	110.00	100.0%	[t/yr]						[GJ/t]	15.600	15.600
	Biogas	54.60	100.0%	[1000 Nm3/yr]						[GJ/1'000 Nm3]	40.320	40.320
	Other biomass based fuel	110.00	100.0%	[t/yr]						[GJ/t]	11.600	11.600
Hydrogen												
	Hydrogen (green)	0.00	0.0%	[t/yr]						[GJ/t]	120.000	120.000
	Hydrogen (blue/gray)	0.00	0.0%	[t/yr]						[GJ/t]	120.000	120.000
Biomass Content from Alternative Fuels												

Updated default Emission Factors in Fuel Accounting

FUEL DEFAULT VALUES			CO_2 Emission Factor (EF) based on tot	Lower Heating Value (LHV)	Density	
Fuel type			Biogenic carbon content Cbio/TC]	LHV Unit	Lower Heating Value (LHV)	Density [kg/m³]
Conventional Fossil Fuels						
	Coal + anthracite	[kg CO_2/GJ]	0.0%	[GJ/t]	26.090	
	Petrol coke	[kg CO_2/GJ]	0.0%	[GJ/t]	32.500	
	(ultra) Heavy fuel	[kg CO_2/GJ]	0.0%	[GJ/t]	40.400	
	Diesel oil	[kg CO_2/GJ]	0.0%	[GJ/t]	43.000	
	Gasoline	[kg CO_2/GJ]	0.0%	[GJ/t]	44.300	
	Natural gas	[kg CO_2/GJ]	0.0%	[GJ/1000 Nm3]	38.400	0.80
	Shale	[kg CO_2/GJ]	0.0%	[GJ/t]	8.900	
	Lignite	[kg CO_2/GJ]	0.0%	[GJ/t]	22.000	
	Liquefied Petroleum Gas (LPG)	[kg CO_2/GJ]	0.0%	[GJ/t]	47.300	
	Other fossil fuels	[kg CO_2/GJ]	0.0%	[GJ/t]	30.000	
Alternative Fossil and Mixed Fuels						
	Waste oil	[kg CO_2/GJ]		[GJ/t]	40.370	
	Bio and mixed diesel	[kg CO_2/GJ]		[GJ/t]	42.600	
	Waste tyres	[kg CO_2/GJ]	27.0%	[GJ/t]	28.200	
	RDF	[kg CO_2/GJ]		[GJ/t]	21.000	
	Non-recyclable 100% plastics	[kg CO_2/GJ]		[GJ/t]	23.000	
	Solvent based fuel	[kg CO_2/GJ]		[GJ/t]	22.860	
	Impregnated saw dust	[kg CO_2/GJ]		[GJ/t]	15.600	
	Mixed industrial waste	[kg CO_2/GJ]		[GJ/t]	23.000	
	Dried sewage sludge with fossil content	[kg CO_2/GJ]	80.0%	[GJ/t]	14.500	
	Other fossil based wastes and mixed fuels	[kg CO_2/GJ]		[GJ/t]	25.000	
Biomass based Fuels						
	Dried sewage sludge 100% biogenic	[kg CO_2/GJ]	100.0%	[GJ/t]	14.500	
	Wood, non impregnated saw dust	[kg CO_2/GJ]	100.0%	[GJ/t]	15.600	
	Paper, carton	[kg CO_2/GJ]	100.0%	[GJ/t]	15.500	
	Animal waste (animal meal, animal bone meal and animal fat)	[kg CO_2/GJ]	100.0%	[GJ/t]	18.000	
	Agricultural, organic, diaper waste, charcoal	[kg CO_2/GJ]	100.0%	[GJ/t]	15.600	
	Biogas	[kg CO_2/GJ]	100.0%	[GJ/1000 Nm3]	40.320	0.80
	Other biomass based fuel	[kg CO_2/GJ]	100.0%	[GJ/t]	11.600	
Hydrogen						
	Hydrogen (green)	[kg CO_2/GJ]	0.0%	[GJ/t]	120.000	
	Hydrogen (blue/gray)	[kg CO_2/GJ]	0.0%	[GJ/t]	120.000	

Sources for the default Emission factors!

GCCA sources of information and references
Default values presented are averages of following IPCC default values for the EF / LHV: 98.3 / 26.7 for anthracite, 94.6 / 28.2 for coking coal, 94.6 / 25.8 for other bituminous coal, 96.1 / 18.9 for sub-bituminous coal.
EF Based on measurements compiled by CSI Task Force 1 in 2012, revised and amended by GCCA CO_2 Protocol Task Group from the EF and LHV values reported in the GNR project by GCCA member companies for 2023
IPCC default values for Ultra Heavy Fuel
IPCC default values for Gas/Diesel Oil
IPCC default values for Motor Gasoline
IPCC default values for Natural Gas = 48.0 GJ/t * 0.8 t/1000 Nm^3
IPCC default values for Oil shale and tar gas
EF IPCC default values for Lignite, LHV value for Lignite dust from IPCC emission factor database (EFDB)
IPCC default values for LPG
Conservative default value for mixed fossil fuel based on anthracite, lignite and petcoke
EF Based on measurements compiled by CSI Task Force 1 in 2012, revised and amended by GCCA CO_2 Protocol Task Group based on EF and LHV values reported in the GNR project by GCCA member companies for 2023
IPCC default values for Gas/Diesel Oil for EF and LHV
EF Based on best estimate by CSI Task Force 1 in 2012, revised and amended by GCCA CO_2 Protocol Task Group based on EF and LHV values reported in the GNR project by GCCA member companies for 2023. See GCCA CO_2
EF and LHV compiled by GCCA CO_2 Protocol Task Group based on values reported in the GNR project by GCCA member companies for 2023. When biogenic carbon is contained, its percentage will show significant difference accor
EF and LHV based on average values covering 50% of values analysed by VDZ. When biogenic carbon is contained, its percentage will show significant difference according to fuel sources and composition.
EF Based on measurements compiled by CSI Task Force 1 in 2012, revised and amended by GCCA CO_2 Protocol Task Group based on EF and LHV values reported in the GNR project by GCCA member companies for 2023
EF Based on measurements compiled by CSI Task Force 1 in 2012, revised and amended by GCCA CO_2 Protocol Task Group based on EF and LHV values reported in the GNR project by GCCA member companies for 2023
EF and LHV based on average values covering 50% of values analysed by VDZ. When biogenic carbon is contained, its percentage will show significant difference according to fuel sources and composition.
EF according to IPCC default value for solid biomass, revised and amended by GCCA CO_2 Protocol Task Group based on LHV and Biomass values reported in the GNR project by GCCA member companies for 2023
EF and LHV covering 80% of values analysed by VDZ. When biogenic carbon is contained, its percentage will show significant difference according to fuel sources and composition.
EF according to IPCC default value for solid biomass, revised and amended by GCCA CO_2 Protocol Task Group based on LHV values reported in the GNR project by GCCA member companies for 2023. If pure biogenic carbon conte
IPCC default values for Wood/Wood Waste
EF and LHV analysed by GCCA CO_2 Protocol Task Group based on values reported in the GNR project by GCCA member companies for 2023
EF Based on measurements compiled by CSI Task Force 1 in 2012, revised and amended by GCCA CO_2 Protocol Task Group based on EF and LHV values reported in the GNR project by GCCA member companies for 2023
IPCC default values for Solid Biofuels averaged
IPCC default value for Gas Biomass = 50.4 GJ/t * 0.8 t/1000 Nm3
IPCC default values for Other non-fossil fuels based on biomass fractions of municipal wastes
IEA 2024, Hydrogen Production and Infrastructure Projects Database: https://www.iea.org/data-and-statistics/data-product/hydrogen-production-and-infrastructure-projects-database
IEA 2024, Hydrogen Production and Infrastructure Projects Database: https://www.iea.org/data-and-statistics/data-product/hydrogen-production-and-infrastructure-projects-database

ISO Alignment

In 2021, ISO/ DIS 19694 Series specifically ISO/ DIS 19694-3: Cement was published. It is generally aligned with the GCCA CO_2 and Energy Protocol thanks to industry input. Nevertheless, on a few topics, the ISO standard being more recent, contains additional information or clarification which should be implemented into the new Protocol version.

The following changes are proposed to ensure full alignment of next Protocol version with newly adopted ISO:

ISO topic 1. CO_2 emissions categories versus scope

ISO topic 2 Other GHG emissions

ISO topic 3. BPD, CKD and filter dust concept

ISO topic 4. Determination of CO_2 from raw material calcination

ISO topic 5. Fuel with ash content

ISO topic 6. Consideration of biomass

Calcined Clay Accounting

Background

- With the emergence of calcined clays, it was necessary to include accounting of related emissions into the Protocol
- We developed a dedicated calcined clay unit calculation section with own performance indicators (suitable for both stand-alone and integrated Calcined Clay production)

Basis for the set up:

- The Calcined Clay section will follow a similar structure as a cement plant, but in a simplified form. (Calcination process happens at ~800°C "only")
- Fuels will be treated as a new fuel category
- Clays are usually not "100% pure“. They may contain some calcium carbonate which gets partially calcined
- The relevance of non GHG emissions will be explored via a dedicated data collection process at a later point in time

CCUS Accounting

With the ongoing deployment of CCUS and the expected essential role of it in reaching our net zero target, there is a need to define how to account for captured emissions as well as for (additional) emissions from auxiliary equipment related CO_2 capture.

There is also a need to define rules for negative emissions accounting specifically in the situation of partial capture, use and storage.

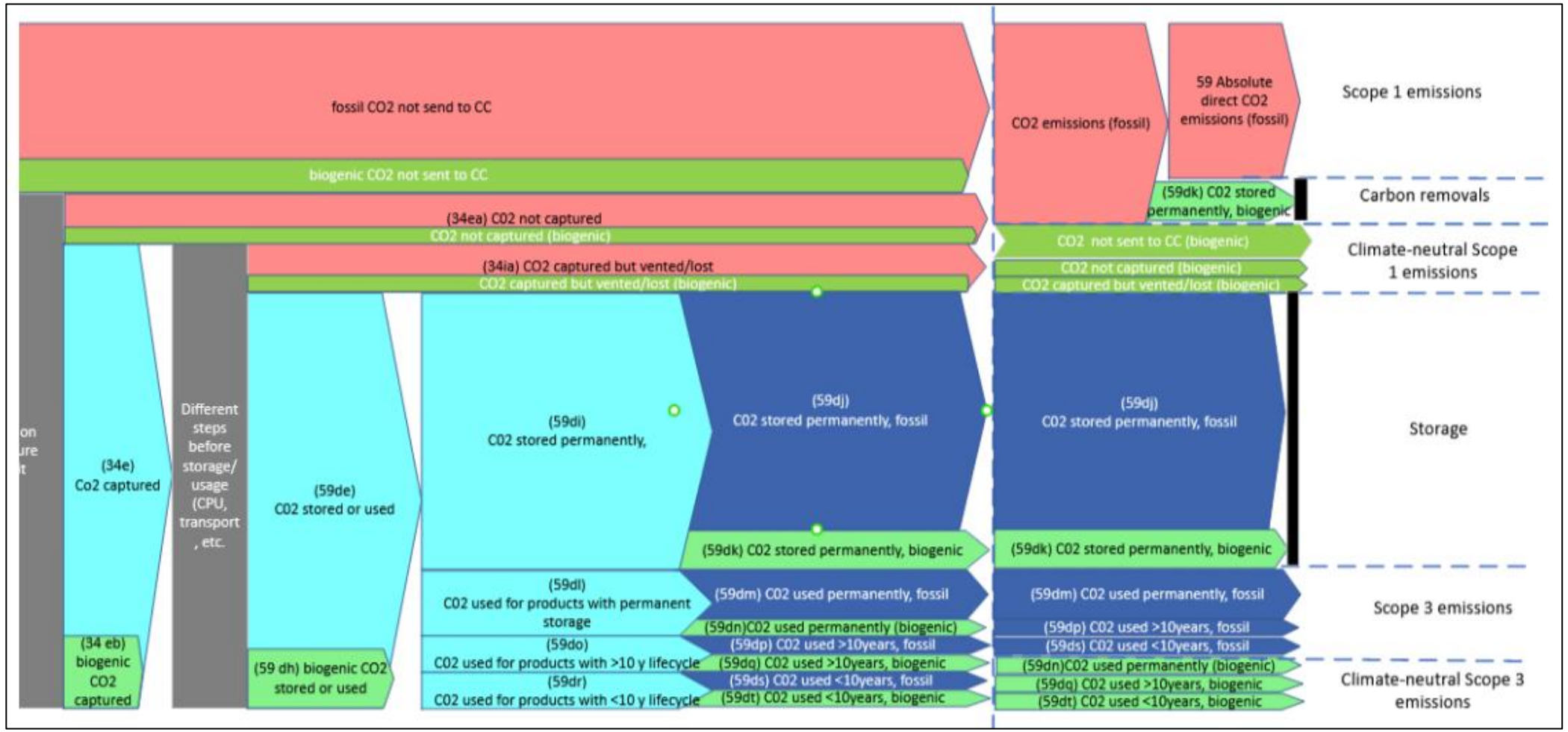
CCUS topic 1 : Accounting of negative emissions also in case of usage and partial capture

CCUS topic 2 : Accounting scenarios and emissions accounting for CCUS unit : technologies, electricity generations, utilities, CO_2, steam, ….

CCUS Topic 1 – Negative emissions and CCU accounting - proposed principles

1. What is captured and either stored or used should be deducted from scope 1 emissions. In case of use, the emissions will become part of downstream emissions and must be reported as scope 3.
2. For scope 1 accounting only permanent storage will be able to reduce emissions and will not have an impact on scope 3.
3. Non-permanent storage utilization cases will be accounted as part of scope 3 emissions
4. Biogenic carbon stored can be deducted (negative emissions)
5. In case of partial use or storage, accounting can be based on local practices as this does not lead to differences in residual emissions (note: scope 3 emissions reporting is mandatory to ensure fair level playing field)

CCUS Accounting Diagram



CCUS Topic 2: CCUS Accounting Sheet – Snapshot from Protocol Version

Carbon Capture Utilization and Storage		
	CCUS basic Information	
new 34b	Nominal CO_2 capture capacity	[t CO_2/hr]
new 34c	Operating hours of the CO_2 capture unit	[hrs/yr]
new 34j	Percentage of captured biogenic CO_2 that can be accounted as carbon removal	[%]
	CO_2 sent to CO_2 Capture Unit	
new 34cb	CO_2 sent to and available for CO_2 capture unit (total, fossil and biogenic from kiln operations, CCUS power generation, etc.)	[t CO_2/yr]
new 34cd	Biogenic CO_2 sent to and available for CO_2 capture unit (from kiln operations, CCUS power generation, etc.)	[t CO_2/yr]
new 59df	Biogenic fraction of CO_2 sent to CO_2 capture unit	[%]
new 34ce	Check input: Biogenic CO_2 sent to CO_2 capture unit cannot exceed biogenic CO_2 generated at the plant	Status
	CO_2 captured/not captured/vented	
new 34e	CO_2 captured	[t CO_2/yr]
new 34 eb	Biogenic CO_2 captured	[t CO_2/yr]
new 34ea	CO_2 not captured	[t CO_2/yr]
new 34i	CO_2 captured but vented during processing/transport/storing/utilization process	[t CO_2/yr]
new 34ib	Biogenic CO_2 captured but vented during processing/transport/storing/utilization process	[t CO_2/yr]
	CO_2 stored and used	
new 34ja	CO_2 priorization method (Origin of CO_2 sent to CO_2 capture unit)	Select option
new 34jc	CO_2 stored or used	[t CO_2/yr]
new 34jd	Biogenic CO_2 stored or used	[t CO_2/yr]
new 34f	CO_2 stored permanently	[t CO_2/yr]
new 34fa	Biogenic CO_2 stored permanently	[t CO_2/yr]
new 34fb	CO_2 used for products with permanent storage	[t CO_2/yr]
new 34fc	Biogenic CO_2 used for products with permanent storage	[t CO_2/yr]
new 34g	CO_2 used for products with >10 years lifecycle (Plastics, other, etc).	[t CO_2/yr]
new 34ga	Biogenic CO_2 used for products with >10 years lifecycle (Plastics, other, etc).	[t CO_2/yr]
new 34h	CO_2 used for products with <10 years lifecycle (Fuels, other, etc)	[t CO_2/yr]
new 34ha	Biogenic CO_2 used for products with <10 years lifecycle (Fuels, other, etc)	[t CO_2/yr]
new 34ia	Check inputs: Biogenic CO_2 stored/used cannot exceed biogenic CO_2 captured	Status
	CCUS Steam Balance	
new 34k	Total steam production for CCUS	[MWh/yr]
new 34p	CO_2 per steam unit produced on site	[kg CO_2/MWh]
new 34l	Steam received from external sources	[MWh/yr]
new 34m	CO_2 per steam unit produced externally	[kg CO_2/MWh]
new 34n	Steam sold for external use	[MWh/yr]
new 34o	Total carbon capture unit steam consumption	[MWh/yr]

Input values

Red lines are the updates

CO_2 Capture		
new 99b	Direct gross CO_2 from operations of the CO_2 capture unit	[t CO_2/yr]
new 99g	CO_2 capture rate (CO_2 captured/CO_2 sent to capture unit)	[%]
	Specific Energy Use of Carbon Capture Unit	
new 99m	Power consumption per CO_2 captured	[MWh/t CO_2 captured]
new 99n	Specific steam consumption per CO_2 captured	[MWh/t CO_2 captured]
new 99o	Specific heat consumption per CO_2 captured	[MWh/t CO_2 captured]
	Specific direct CO_2 Generation	
new 100a	Gross CO_2 generation per ton CO_2 captured	[t CO_2/t CO_2 captured]
new 100b	Gross CO_2 generation per ton CO_2 stored	[t CO_2/t CO_2 stored]
new 100c	Gross CO_2 generation per ton CO_2 sent to use	[t CO_2/t CO_2 used]
	Specific indirect CO_2 Emissions	
new 100d	Specific indirect CO_2 emissions from external power generation per tonne of CO_2 stored	[t CO_2/t CO_2]
new 100e	Specific indirect CO_2 emissions from external steam generation per tonne of CO_2 stored	[t CO_2/t CO_2]
	Specific CCUS rates	
new 100f	CO_2 stored per ton CO_2 generated at the plant	[t CO_2/t CO_2]
new 100g	CO_2 sent to use per ton CO_2 generated at the plant	[t CO_2/t CO_2]

Performance Indicators

Recarbonation

The objective is to ensure benefits from natural recarbonation is attributed to clinker production.

Added a line in the CO_2 protocol for natural recarbonation potential which is related to the volume of clinker produced.

The natural recarbonation potential = Clinker produced*20%*525 (kgCO_2/tonne clinker) / 1000

This calculation method is in line with the IPCC compliant IVL Tier 1 methodology

Basis for the set up:

a) Use of the default process emission factor (525 kCO_2/tonne clinker) for "traditional" clinker; decarbonated raw materials do not influence the recarbonation potential of clinker (and influence on emissions is accounted for in process emissions accounting)

b) The task group recommends to only consider the 20% recarbonation occurring the use phase in this version of the CO_2 protocol, but not to consider the 3% recarbonation that typically occur during the end-of-life phase. For other clinker types, an additional calculation sheet based on the Steinour's formula will be provided to replace the default emission factor (525 kCO_2/tonne clinker).

c) Further details on the rules of enhanced recarbonation will be added at a later stage in the protocol

	Recarbonation	
new 39ce	CO_2 reabsorbed through recarbonation of products from clinker	[t CO_2/yr]

Snapshot from the protocol sheet V4.X

Power Balance

	Electrical Power Balance		
		On-Site Power Generation	
	33a	Total power generation from separate on-site power generation	[MWh/yr]
	33aa	Power delivered to cement plant	[MWh/yr]
new	33aax	Power delivered to calcined clay production unit	[MWh/yr]
new	33aay	Power delivered to CCUS unit	[MWh/yr]
new	33aaw	Power delivered to the on-site hydrogen production unit	[MWh/yr]
	33ab	Power delivered externally	[MWh/yr]
	33ac	Power consumed by seperate on-site power generation equipment	[MWh/yr]
new	33aaz	Total renewable power generated	[MWh/yr]
	33ad	Fossil CO_2 per power unit produced by separate on-site power generation	[kg CO_2/MWh]
		Waste Heat Recovery	
	33b	Total power generation from waste heat recovery	[MWh/yr]
	33ba	Power delivered to cement plant	[MWh/yr]
new	33bay	Power delivered to calcined clay production unit	[MWh/yr]
new	33baz	Power delivered to CCUS unit	[MWh/yr]
	33bb	Power delivered externally	[MWh/yr]
	33bc	Power consumed by waste heat recovery equipment	[MWh/yr]
		External Power Delivery	
	33c	Total external power consumption for cement manufacturing	[MWh/yr]
	33ca	External power delivered to cement plant	[MWh/yr]
	33cc	Cement-related external power delivered to waste heat recovery plant	[MWh/yr]
	33cb	Cement-related external power delivered to seperate on-site power generation plant	[MWh/yr]
new	33f	External power delivered to calcined clay facility	[MWh/yr]
new	33g	External power delivered to CCUS unit	[MWh/yr]
new	33h	External power delivered to on-site hydrogen production unit	[MWh/yr]
new	33x	Share of renewables in grid mix - Market Based	[%]
new	33y	Share of renewables in grid mix - Location based	[%]
new	33dy	CO_2 per power unit produced externally (market based)	[kg CO_2/MWh]
new	33dx	CO_2 per power unit produced externally (location based)	[kg CO_2/MWh]
	33d	CO_2 per power unit produced externally	[kg CO_2/MWh]
		Power Consumption Totals	
	33e	Power consumption up to and including clinker production	[MWh/yr]
new	33h	Power consumption of carbon capture unit	[MWh/yr]
	33	Total cement plant power consumption (incl. Hydrogen, CCUS and Calcined Clay production)	[MWh/yr]
	Waste Heat Use		
	34	Waste heat supplied to external consumers	[GJ/yr]
	34a	Waste heat used internally for separate on-site power generation and CCUS power generation	[GJ/yr]
new	34ab	Waste heat used internally for calcined clay production	[GJ/yr]
new	34ac	Waste heat used internally for CCUS	[GJ/yr]

Power Balance is now more advanced with clear distinction for renewables , Calcined Clay operations and CCUS unit power delivery

Materiality of CO_2 emissions generated by using Urea

Background: the question was whether emissions generated by the usage of Urea in cement production should be accounted for. To decide whether these emissions are significant enough to be included in the Protocol, the task group conducted a materiality assessment for the same. The results of the assessment is discussed below.

Requirementt of Urea in cement production: Urea is used in the Cement production process to reduce the NO_x emissions which are generated throughout the process. While using this Urea for SCR or SNCR reactions there is a release of CO_2 in the air.

Conclusion: Carbon dioxide emissions from this process have been assessed and proven to be negligible *(potential contribution of less than 0.1% of a cement plant gross emissions).* Thus, it was concluded that the CO_2 emissions generated by using Urea won't be accounted in the revised CO_2 protocol. It was further decided to **include a chapter in the CO_2 protocol explaining the non-materiality of the Urea.**

Materiality CO_2 emissions generated by the used of explosives in the Cement manufacturing process

Background: the question was whether emissions generated by generated by the usage of explosives in cement production should be included. To decide whether these emissions are significant enough to be included in the Protocol the task group conducted a materiality assessment for the same. The results of the assessment is discussed below.

Requirement of explosives in cement manufacturing: Explosives are used in the Cement manufacturing process to excavate the raw materials (Limestone, clay) from the quarries.
The most commonly use explosive type is ANFO (Ammonium Nitrate Fuel Oil). Other explosives used in lower amounts and only for specific rock hardness are emulsions, gel, dynamite or TNT.
ANFO consists of 94% porous ammonium nitrate (NH_4NO_3) (AN), which acts as the oxidizing agent and absorbent for the fuel, and 6%fuel oil (FO). The chemistry of ANFO detonation is the reaction of ammonium nitrate with a long-chain alkane (C_nH_{2n+2}) to form nitrogen, carbon dioxide, and water.

Conclusion: Upon conducting the materiality of the explosive used in the quarries it was found out that the corresponding additional CO_2 generated due to explosives is = 0.02 kg/ton clinker, which is not material. Thus, it was concluded that the CO_2 emissions generated by using explosives won't be accounted in the revised CO_2 protocol. It was further decided to include a chapter in the revised CO_2 protocol explaining the non materiality of the explosives.

Global Cement and Concrete Association

CONCRETE FUTURE

What's Next?

CO_2 Protocol Review - Timelines

2026	2027	GNR – Campaigns
• Feb – May : Members to test V4.1 • June – October: ECRA and GCCA to work on finalising the comments and prepare V4.2 • November – V4.2 Ready for member implementation • November (mid – end) : ECRA - GCCA Train the trainer program	• Transition Phase: Full phase implementation of V4.2 and minor updates pushing to V4.3 • Flush our V3.1 and replace with V4.2 on GCCA and make it official	• Under GNR campaigns we collect data with a two-year gap. Meaning in any running year we publish data with a gap of two years. 2026 will see data from 2024 and so on.. • Members will submit 2025 data using V3.1 • Members will submit 2026 data using V4.2 and so on..

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CONCRETE FUTURE

Thank You!

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