VERIFY GA meeting #1

WP5 – Reconciliation and assessment of different models and tools leading to verification of GHG inventories

WP6 – GHG monitoring and verification system

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ECMWF

Reading, UK

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Overview

- Overview of the tasks
- Deliverables
- Highlights (by Task)
  - Task 5.1 & 5.4 (Glen)
  - Task 5.5 (Philippe)
  - Task 5.2 & Task 5.3 (Roxana)
- Challenges and steps forward

WP5 – Reconciliation, Assessment, Budgets

- T5.1 Reconciliation of bottom-up emission estimates (M1-M12), Lead: CICERO
- T5.2 Reconciliation of bottom-up and top-down observation-based GHG budgets (M6-M48), Lead: VUA
- T5.3 Regular assessments of the full GHG balance of EU countries and ecosystems (M6-M48), Lead: VUA
- T5.4 Past trends, annual drivers analysis and short-term predictions of emissions (M12-M48), Lead: CICERO
- T5.5 Empirical derivations at carbon-climate feedbacks (M6-M48), Lead: CEA-LSCE

WP6 – GHG monitoring and verification system

- T6.1 Annual GHG fact sheets for the EU as a whole (M1-M30), Lead: JRC
- T6.2 Annual GHG budget fact sheets for US, China, Indonesia based on the methodology of Task 6.1 (M24-M42)
- T6.3 Establishment of the project-level data and information infrastructure (M12-M42), Lead: CEA-LSCE
  - Next session
- T6.4 Online visualization of the trends of GHG emissions from sources and sinks and progress towards reduction targets (M12-M46), Lead: JRC
  - Meeting in November (GEIA): China, US, China, Chile

WP5 – Status of Deliverables

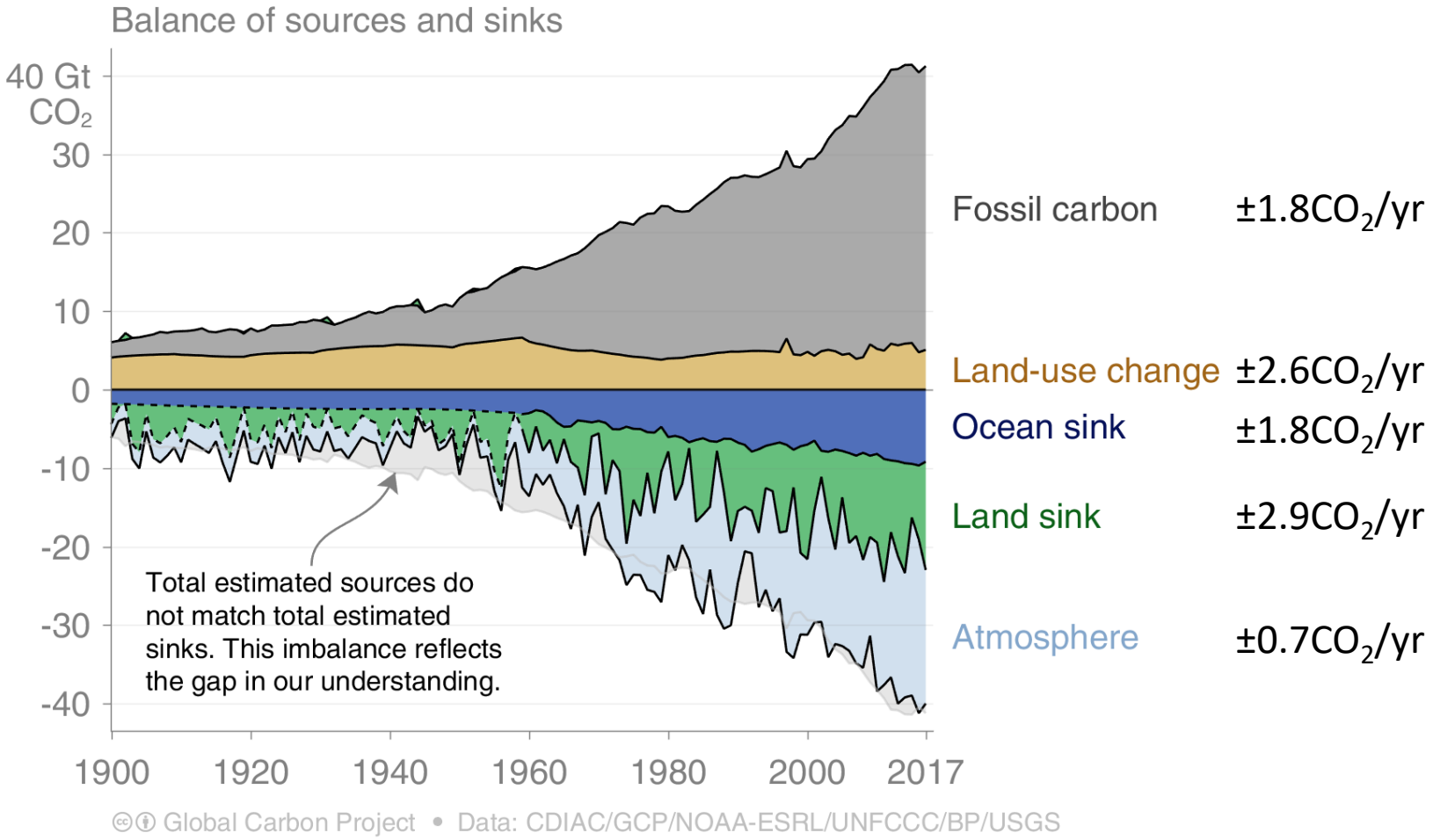
DEL n°	DEL Title	Leader	Due date	Status
5.2	First report on reconciliation	VUA	M9	Complete
5.1	Structural Uncertainties	CICERO	M12	Ongoing
5.3/4/5	Second/Third/Final report on reconciliation	VUA	M22/34/46	Ongoing
5.6/7/8	Fact sheets on GHG budgets	CICERO	M23/35/47	Planning
5.9/10	First/Second article on GHG budgets	VUA	M24/48	Planning
5.11	Projections & progress (CO_2)	CICERO	M34	Ongoing
5.12	Climate anomalies & variability	CEA	M36	Planning
5.13	Extreme events	CEA	M34	Planning

Task 5.1: Reconciliation

- T5.1 Reconciliation of bottom-up emission estimates (M1-M12), Lead: CICERO
  - Why are different emission datasets different?
    - System boundaries, input data, assumptions, etc
  - Fossil CO_2 Emissions
    - Most focus
  - Land-based CO_2 Emissions
    - Overlap with Task 3.2
  - Non-CO_2 Emissions
    - Covered somewhat in Task 5.2 (except energy and industry)

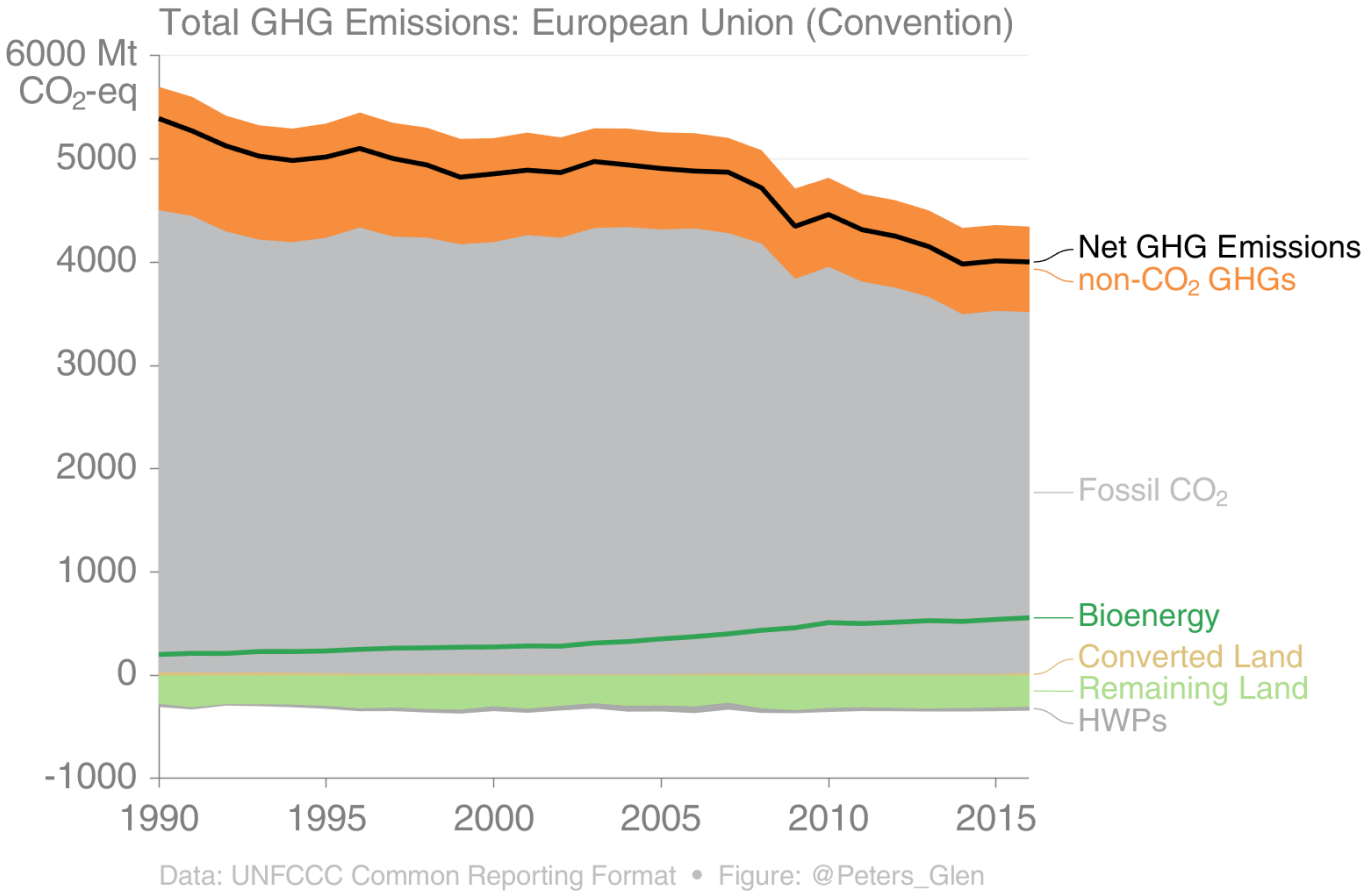
Global Carbon Budget – Uncertainties…

Emissions sources have rather significant uncertainties…
At the aggregate, fossil CO_2 emissions are almost as uncertain as other components

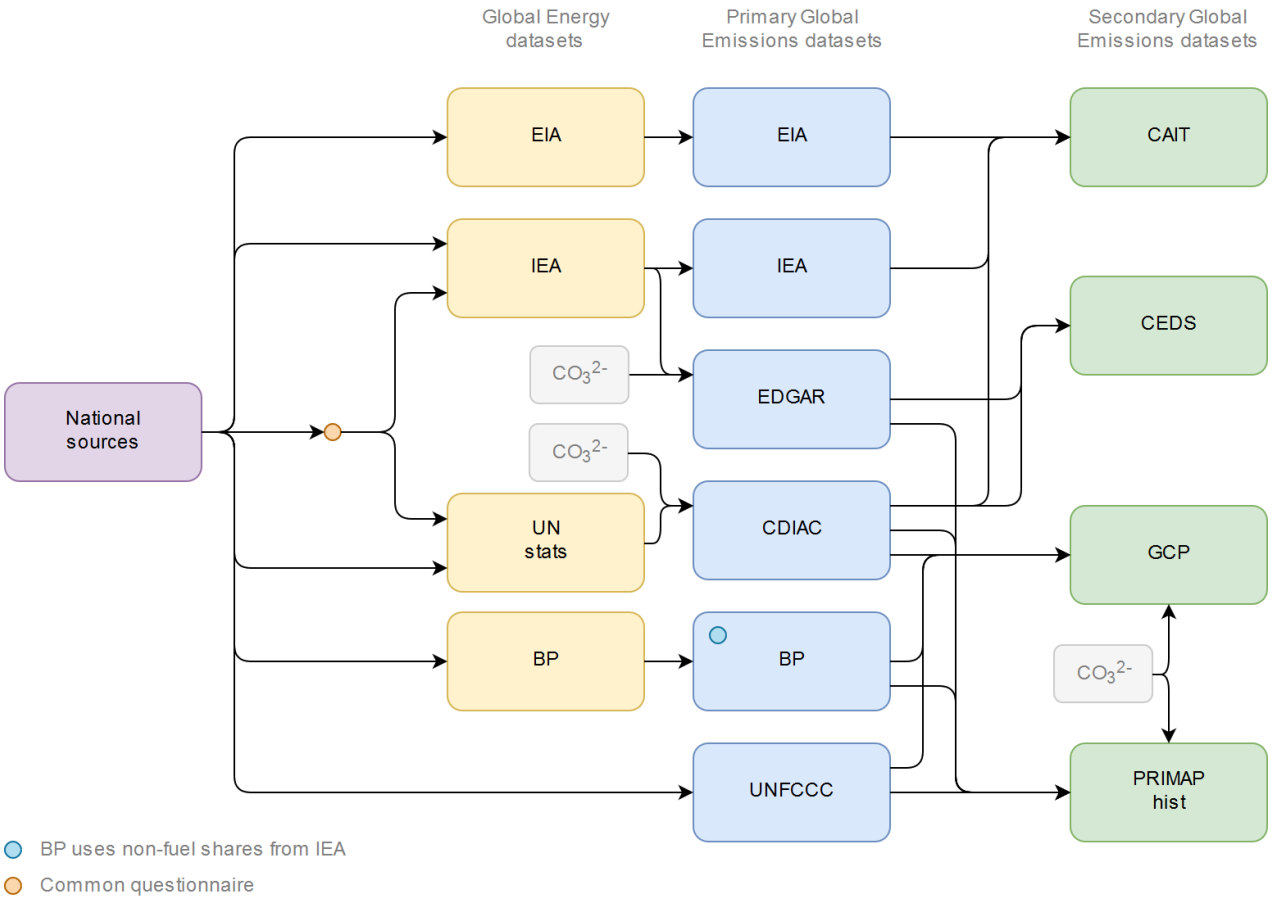


Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Joos et al 2013; Khatiwala et al. 2013; DeVries 2014; Le Quéré et al 2018; Global Carbon Budget 2018

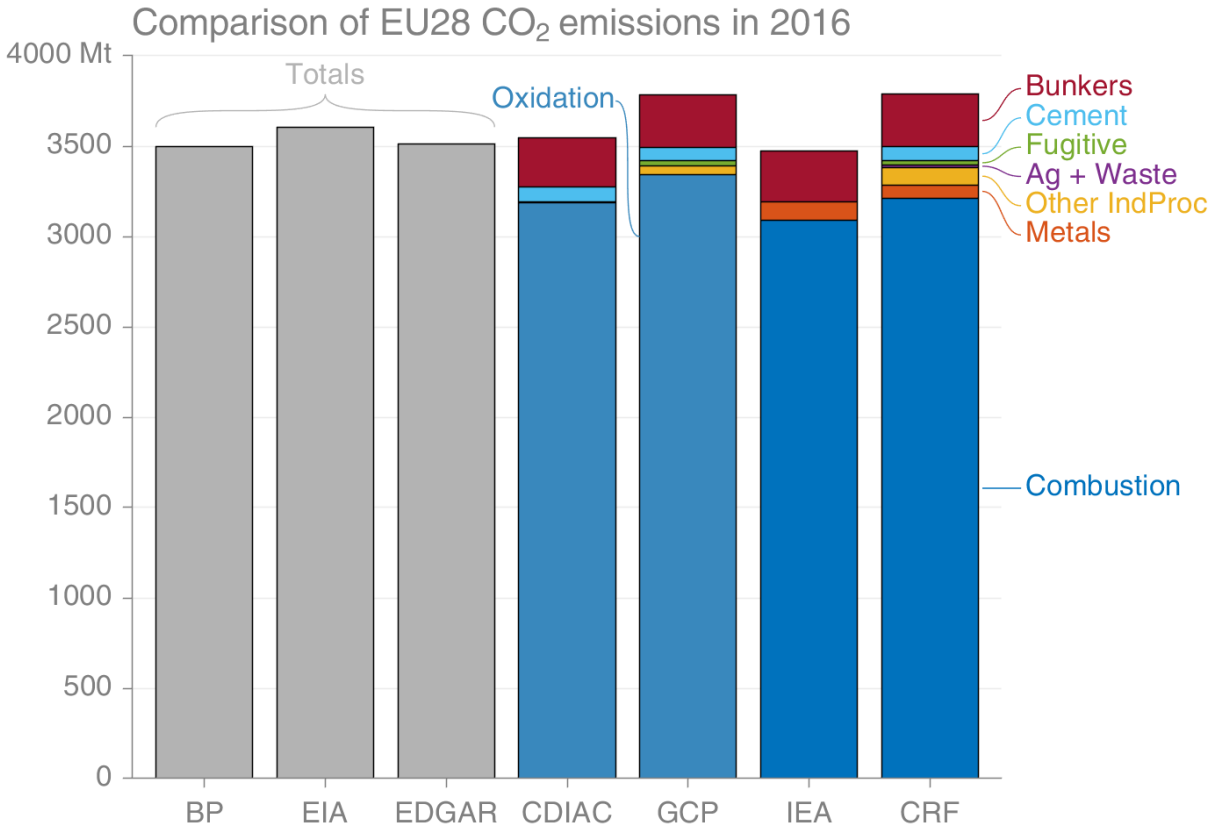
EU28 Reported GHG Emissions



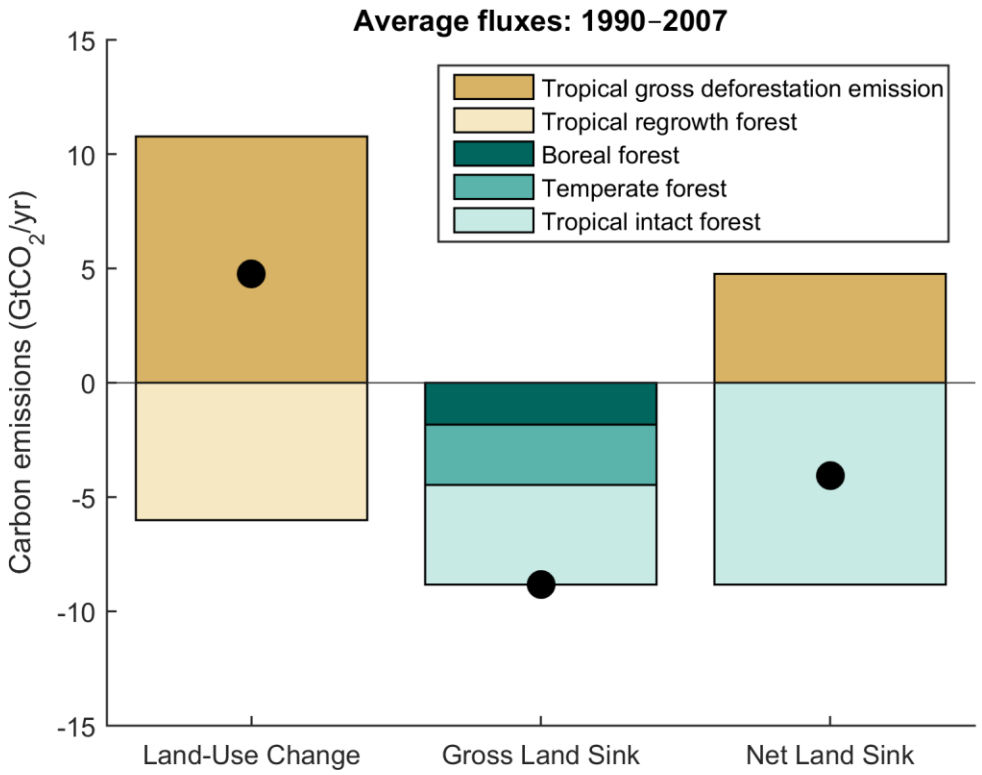
Task 5.1: Reconciliation – Fossil CO_2



Task 5.1: Reconciliation – Fossil CO_2



Task 5.1: Reconciliation – Land



Task 5.1: Reconciliation – Land

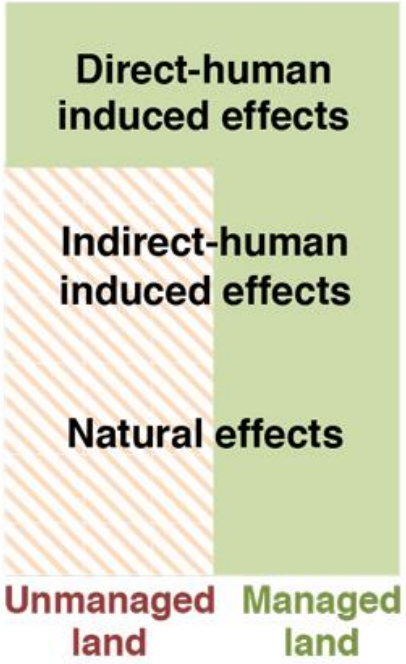
Effects of various factors on the forest CO_2 fluxes

Direct-human induced effects
- Land use change
- Harvest and other management

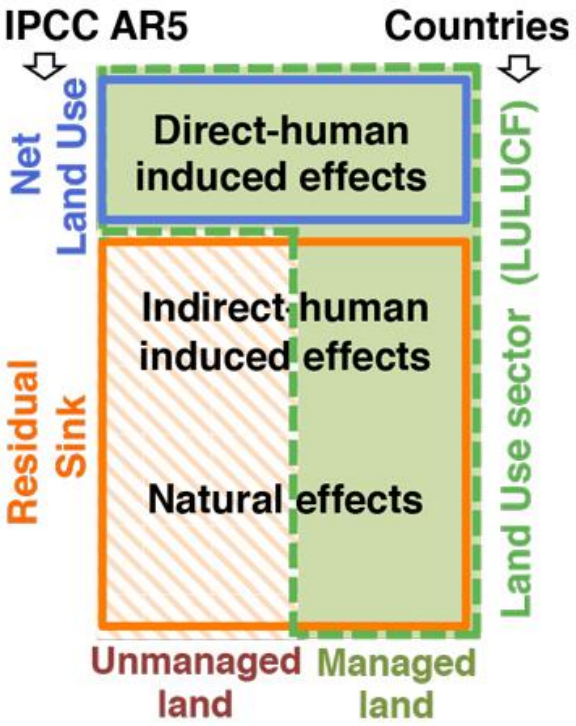
Indirect-human induced effects
- Climate change induced change in T°, precipitation, length of growing season
- Atmospheric CO2 fertilisation and N deposition, impact of air pollution
- Changes in natural disturbances regime

Natural effects
- Natural interannual variability
- Natural disturbances

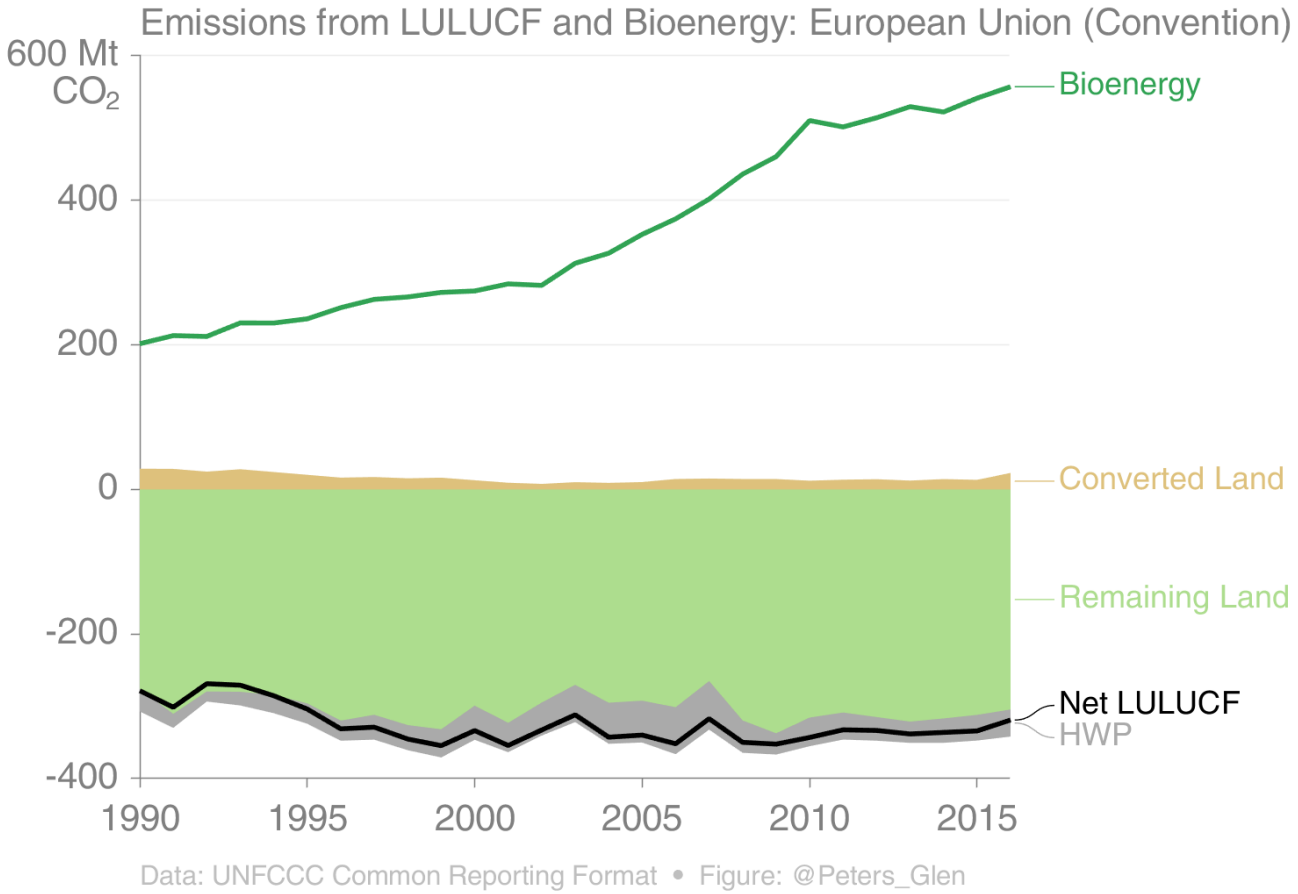
Where these effects occur in countries' GHG inventories



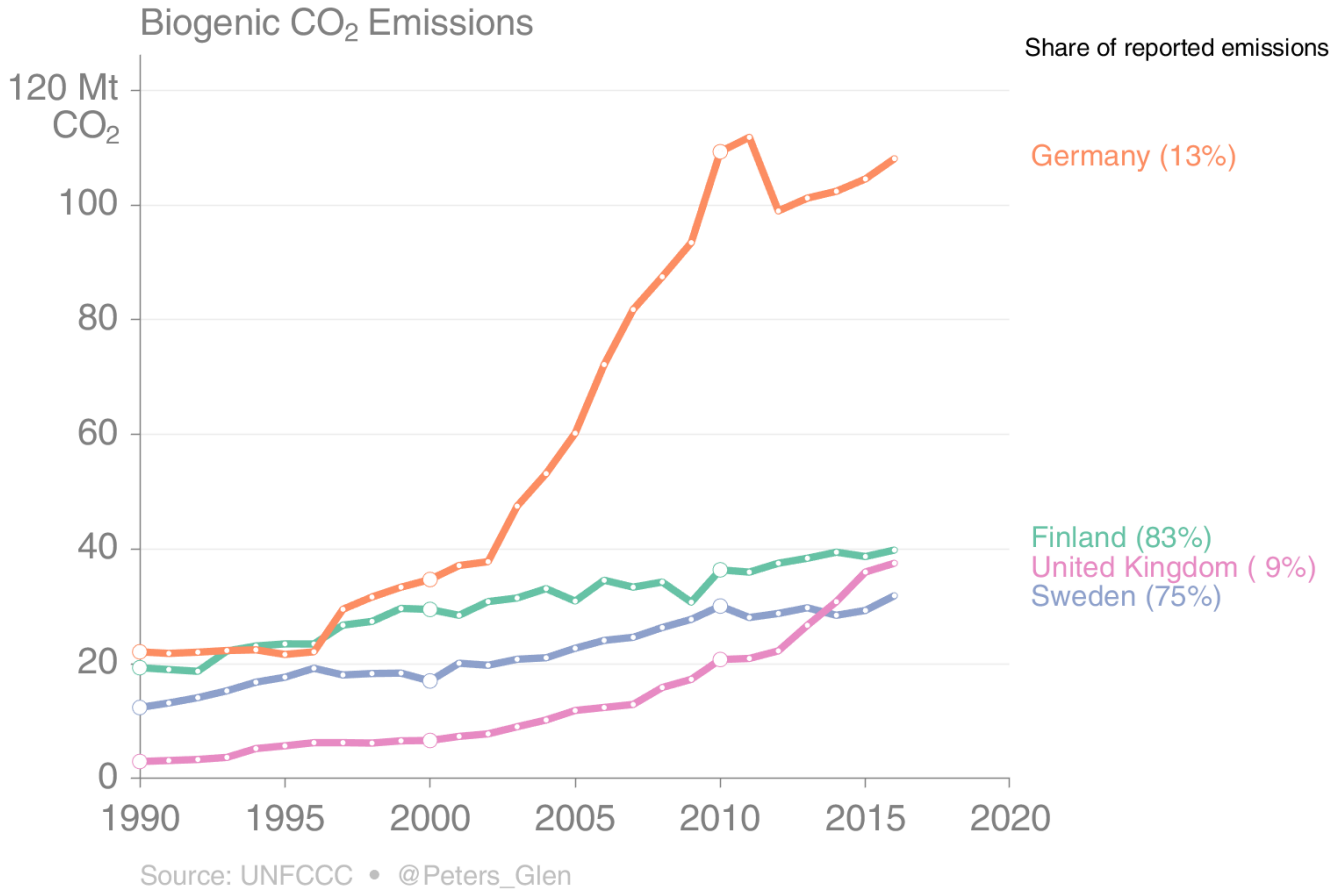
How these effects are captured:



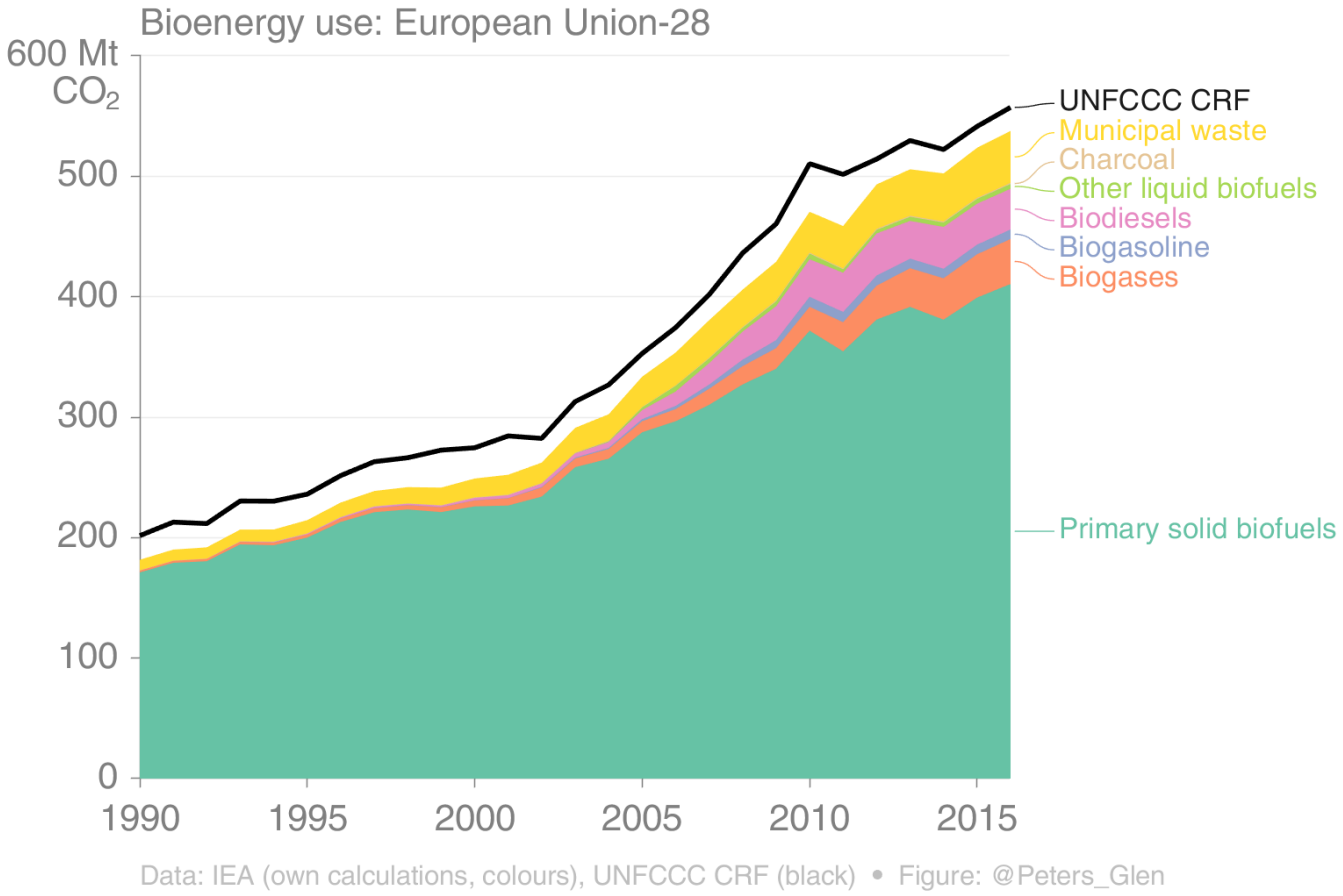
Task 5.1: Reconciliation – Land



Task 5.1: Reconciliation - Bioenergy



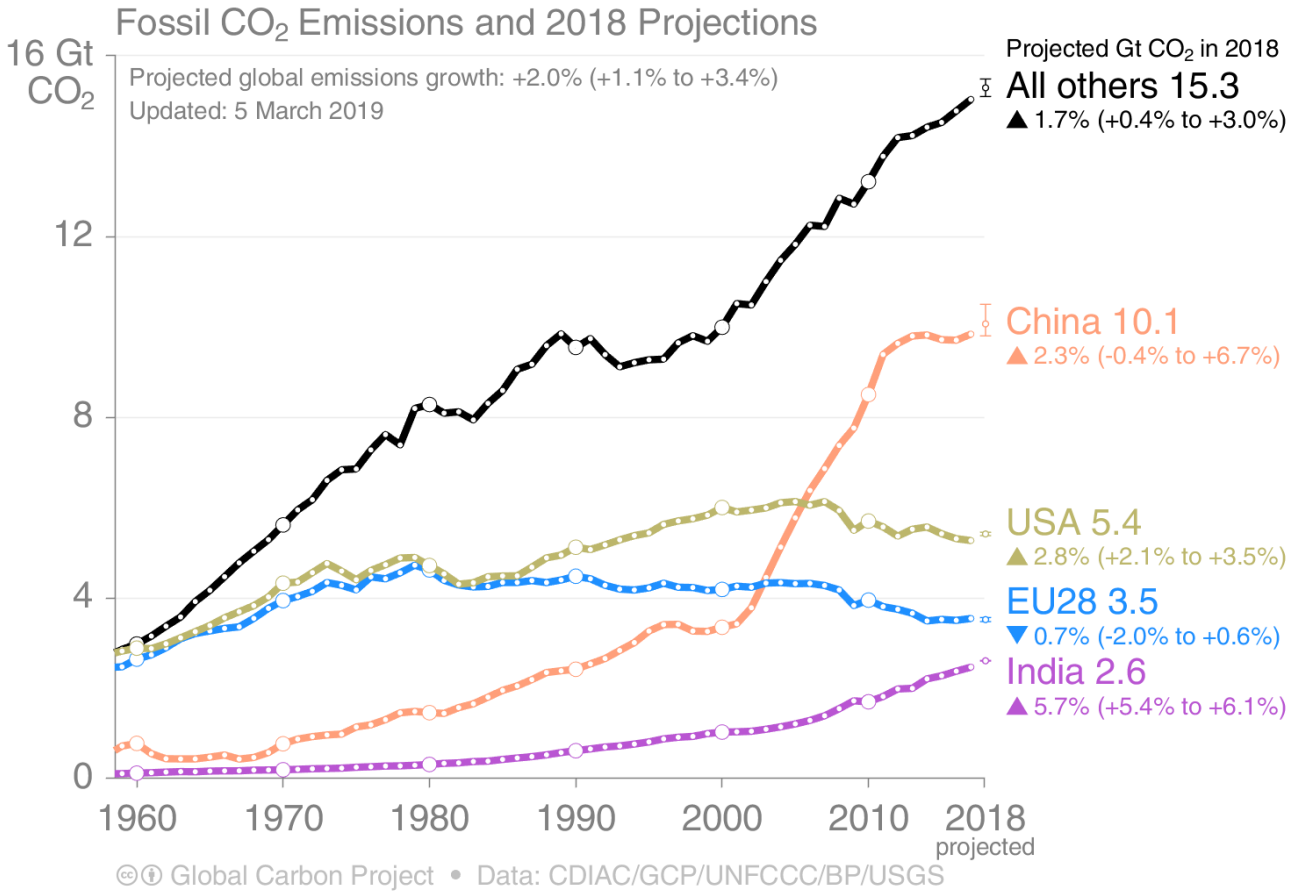
Task 5.1: Reconciliation – Bioenergy



Task 5.4 – Short-term projections

- T5.4 Past trends, annual drivers analysis and short-term predictions of emissions (M12-M48), Lead: CICERO
  - T5.4.1 Country-level projections of CO2 from fossil fuels and industry (M12-M36) (CICERO).
  - T5.4.2 Country-level projections of CO2 from land-use change (CICERO).
  - T5.4.3 Post-projection evaluation and updates (M12-M48) (CICERO)

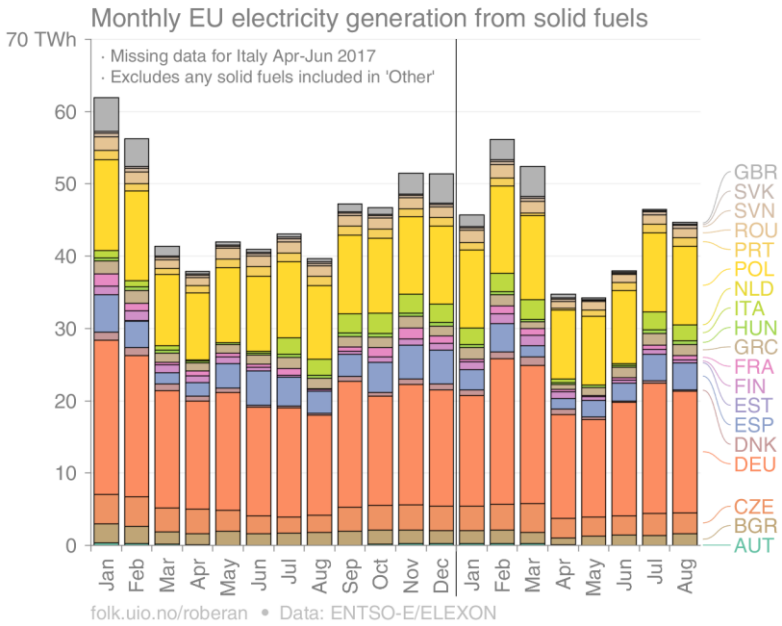
Task 5.4: Projections

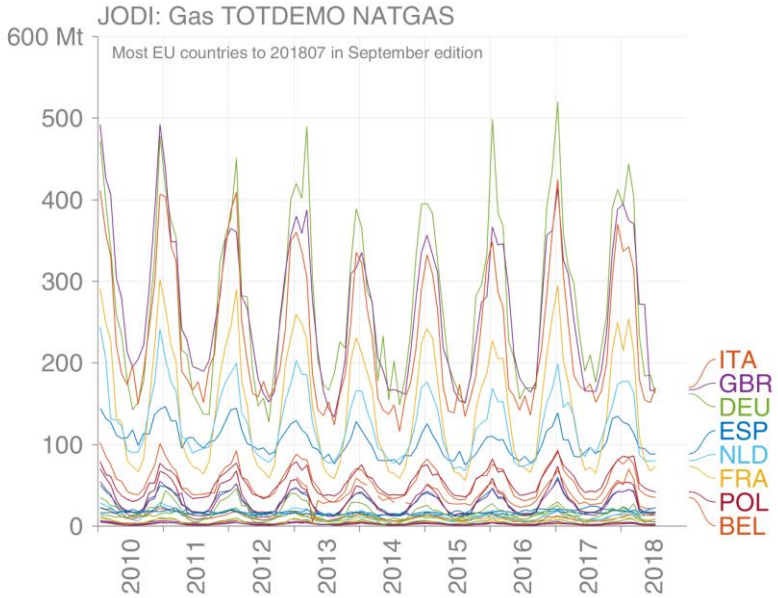


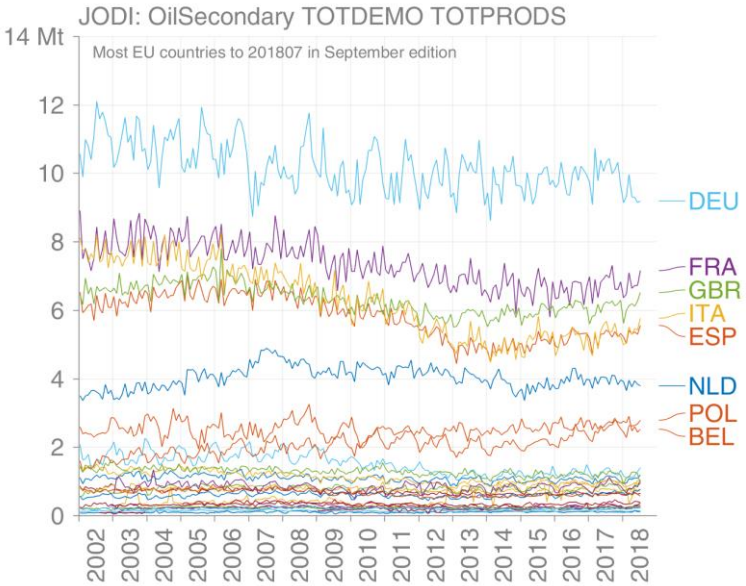
Task 5.4: Projections

	November 2018 estimate	March 2019 estimate
Global	+2.7% (+1.8% to +3.7%)	+2.0% (+1.2% to +3.3%)
China	+4.7% (+2.0% to +7.4%)	+2.3% (-0.4% to +6.7%)
USA	+2.5% (+0.5% to +4.5%)	+2.8% (+2.1% to +3.5%)
EU28	-0.7% (-2.6% to +1.3%)	-0.7% (-2.0% to +0.6%)
India	+6.3% (+4.3% to +8.3%)	+5.7% (+5.4% to +6.1%)
Other countries	+1.8% (+0.5% to +3.0%)	+1.7% (+0.4% to +3.0%)

Task 5.4: Projections





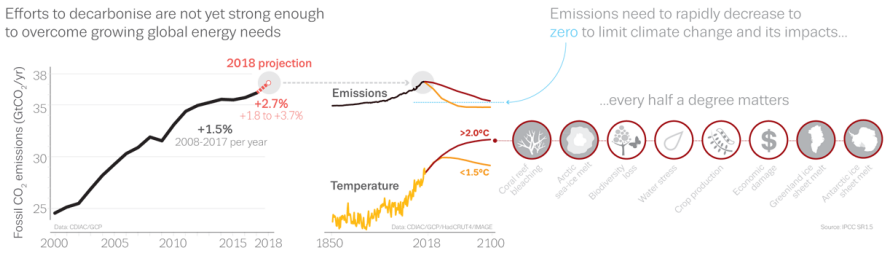


Dissemination (Global Carbon Budget)

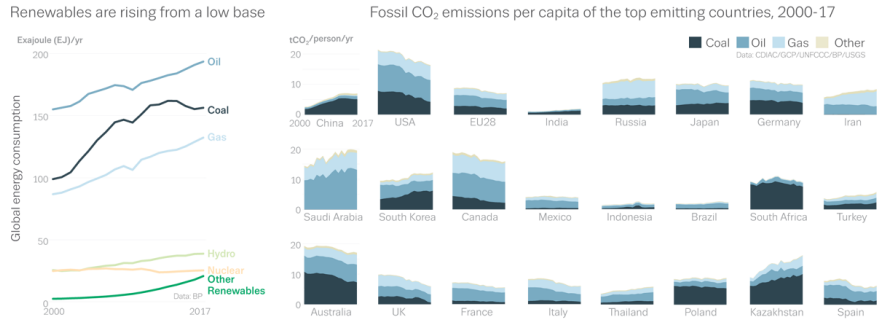
Global Carbon Budget 2018

Renewables rising fast but not yet enough to reverse emissions trend

Fossil CO_2 emissions are projected to rise more than 2%

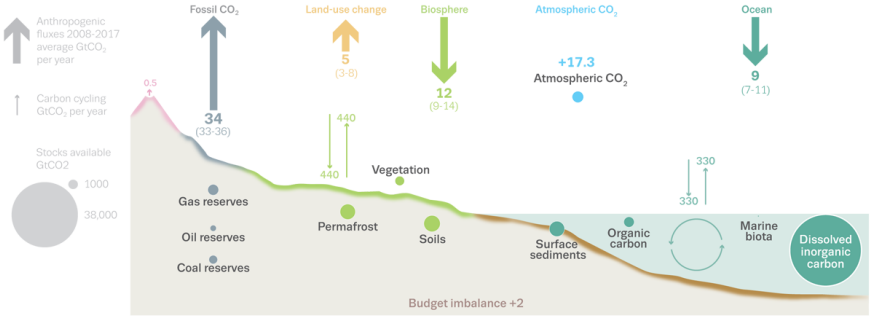


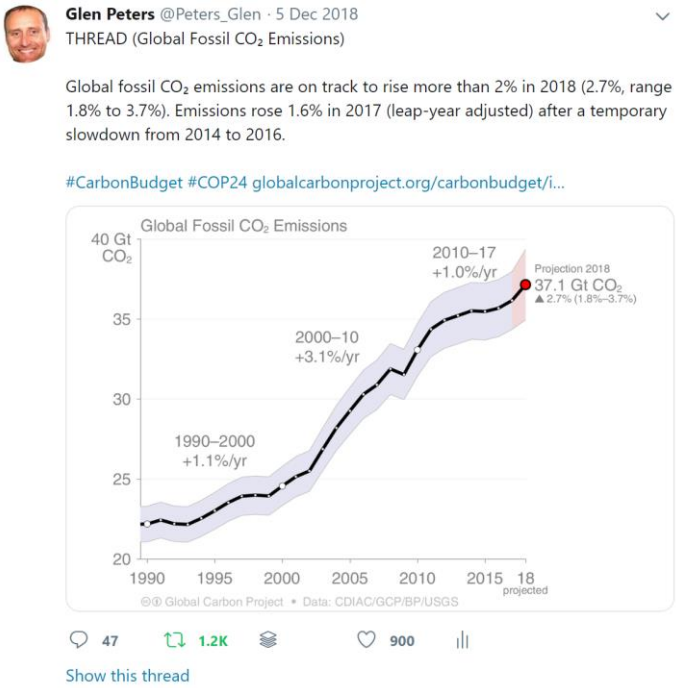
Coal is changing trajectory, renewables are rising, oil & gas continue unabated

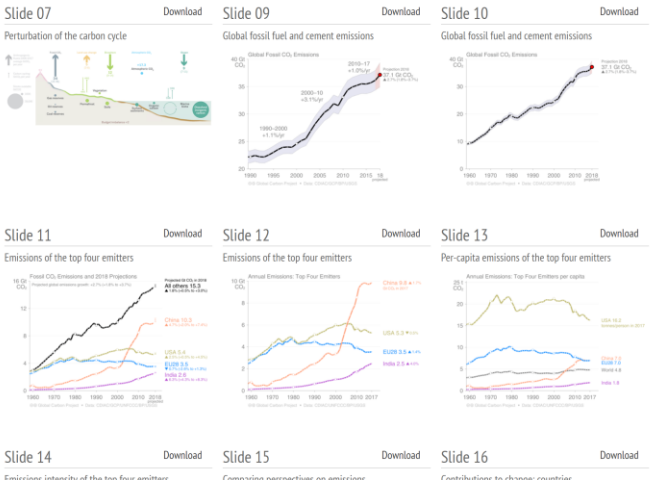


The rise in atmospheric CO_2 causes climate change

The global carbon cycle 2008-2017







New position

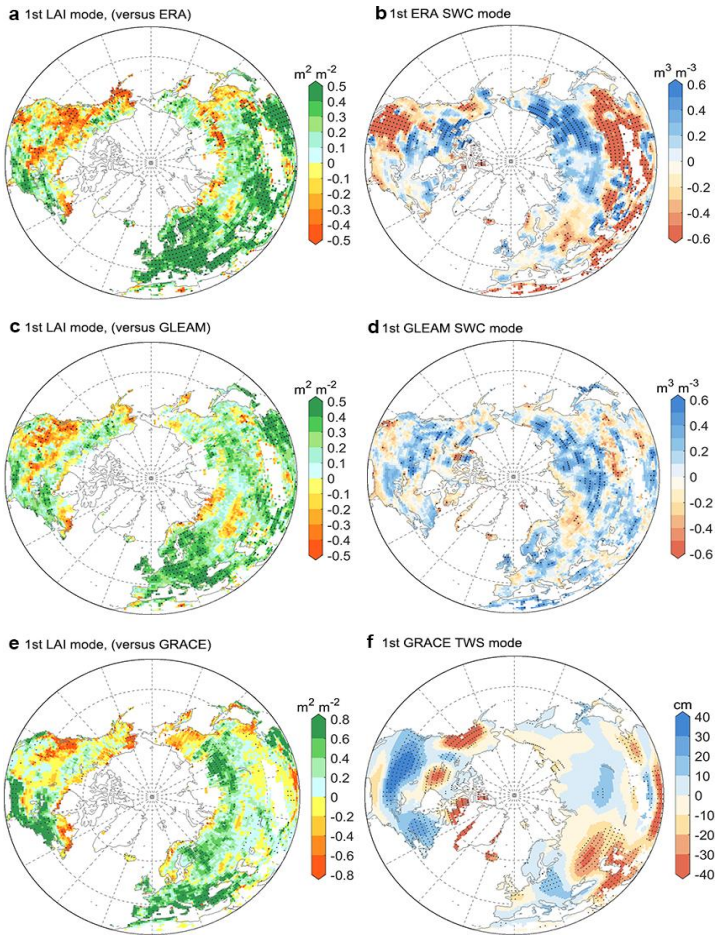
Task 5.5 Carbon-Climate Feedbacks

- T5.5 Empirical derivations at carbon-climate feedbacks (M6-M48), Lead: CEA-LSCE
  - T5.5.1 Impact of climate variability on GHG fluxes (M6-M24) (CEA-LSCE).
  - T5.5.2 Seasonal legacy effects on GHG fluxes (M12-M24) (CEA-LSCE)
  - T5.5.3 Extreme climate events attribution (M24-M48) (CEA-LSCE).
  - T5.5.4 Impacts of climate anomalies on CO2 emissions (M12-M36) (CEA-LSCE).

  - T5.5.1 Analysis of Trendy models (waiting for EC data)
  - T5.5.2 Analysis of spring LAI – summer soil moisture legacy effects in offline and online (coupled) models
  - T5.5.3 Drought 2018 task force with ICOS and simulation protocol for models + analysis plan

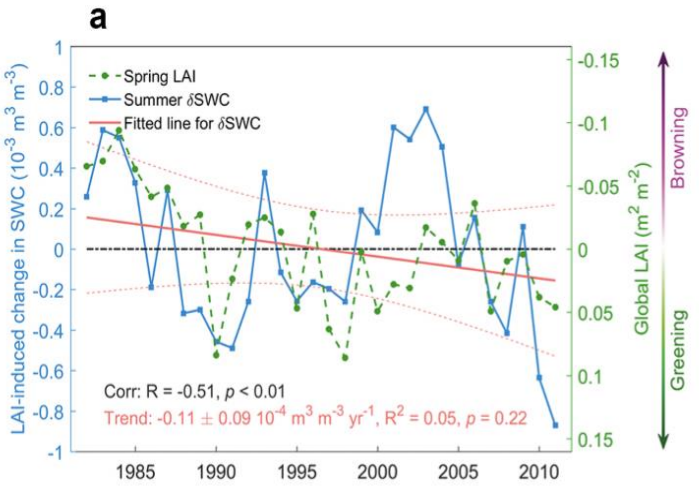
Task 5.5 Carbon-Climate Feedbacks

Heterogeneous regression maps of first SVD mode calculated from the cross-covariance matrix between the two fields



Spring LAI mode coupled to summer SM

Summer soil moisture mode coupled with spring LAI



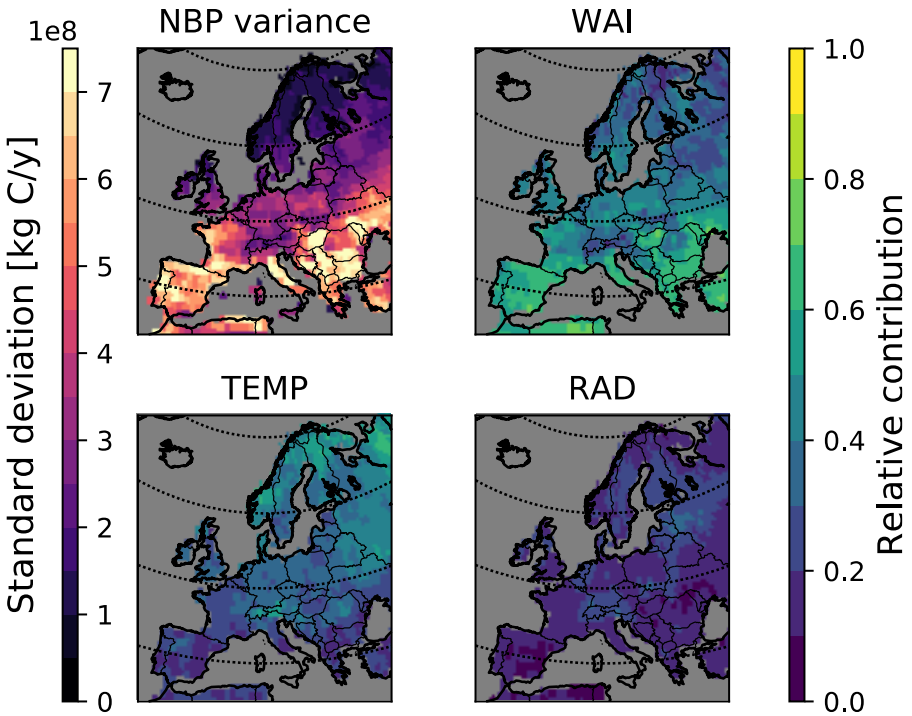
LMDZ coupled simulations with satellite LAI variable in spring and LAI seasonal climatology in summer

Waiting for WP3 VERIFY model output to be available

Lian et al. In review

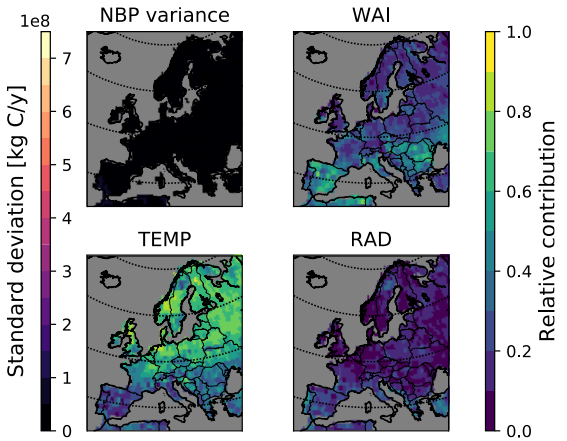
VARIANCE AND DRIVERS OF NBP

Trendy V6 global models Annual

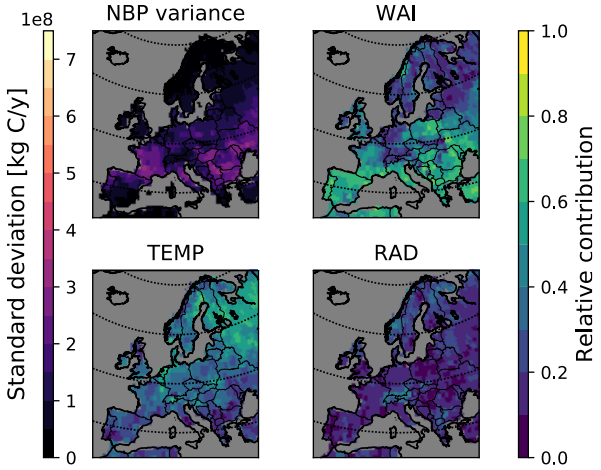


Waiting for WP3 VERIFY model output to be available

January



July



WP5 – Highlights

- D5.2 Reconciliation of bottom-up and top-down methods at sub-national scales (**M12, with annual updates**), VUA

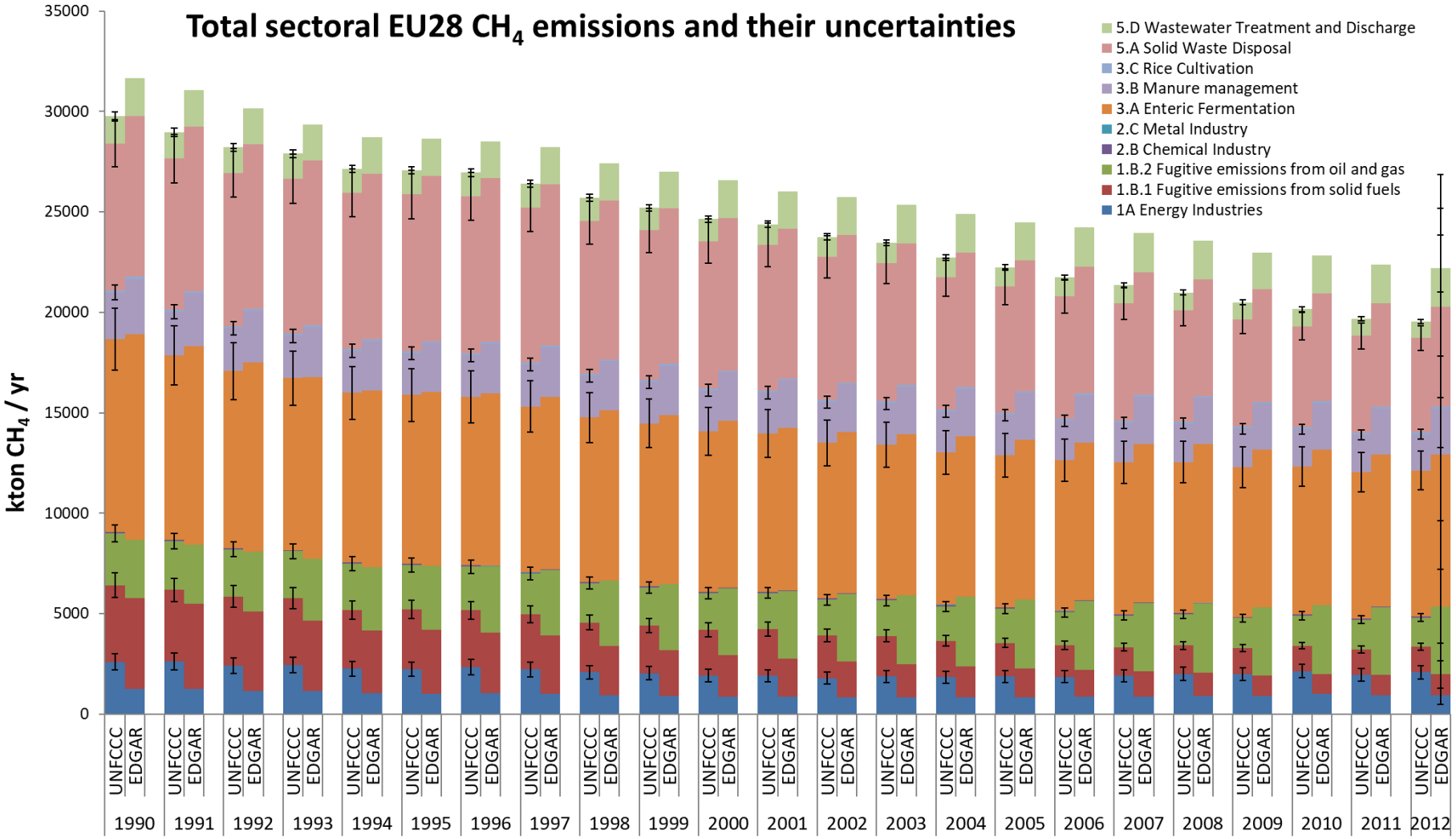
Report reconciling the differences between bottom-up and top-down emission estimates, providing a assessment of persistent differences and their potential causes – **first report completed in November 2018**

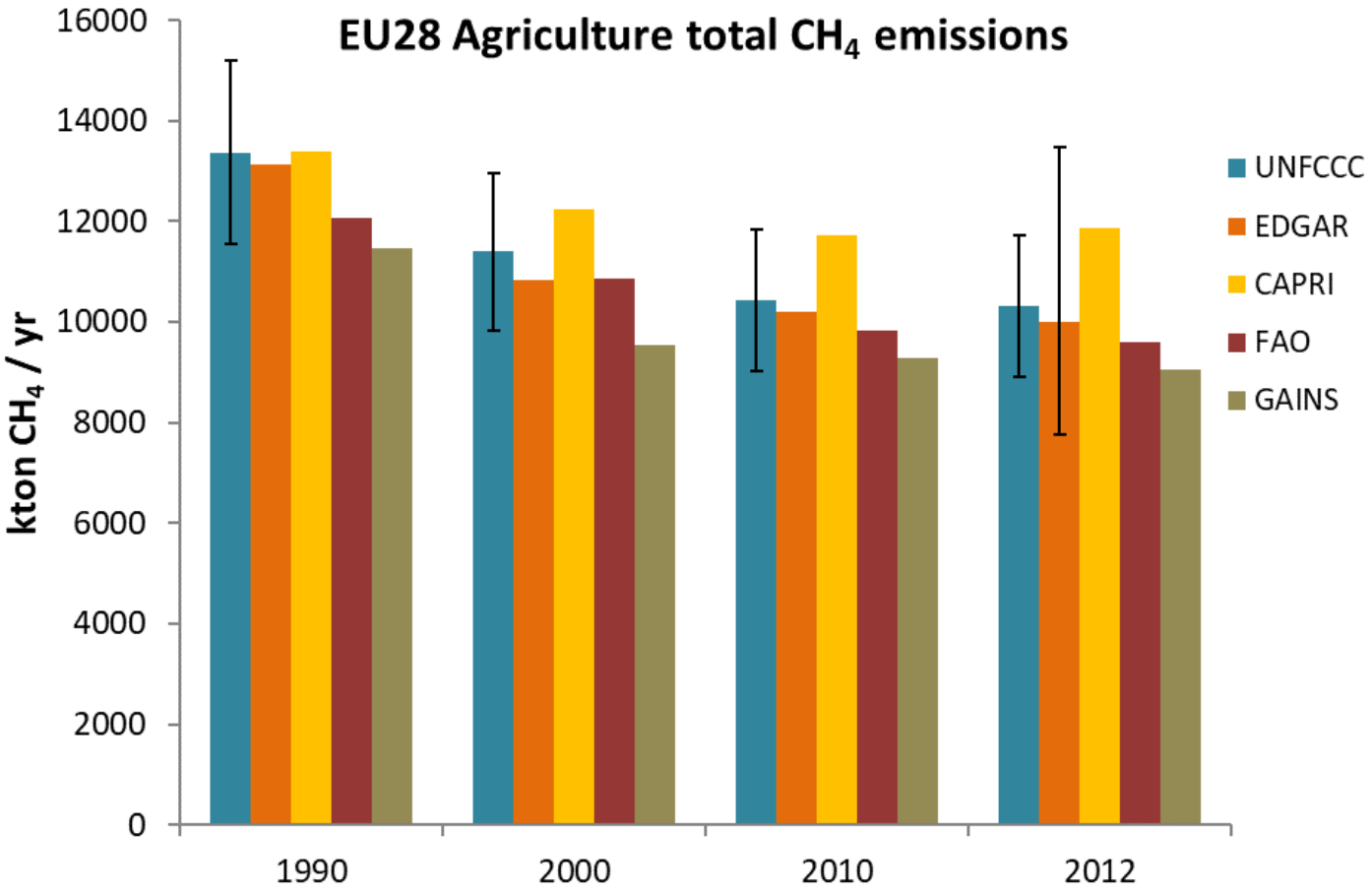
- the report represents a ‘proof of concept’ and a first compilation of pre-VERIFY data at the country level
- It stands as a collection of products already published delivered by VERIFY partners.
- it forms the basis for the analysis of the total uncertainties and aims in presenting the reader with existent data sources and their GHG estimates and uncertainties, highlighting the differences and inconsistencies between emissions.

- The analysis was carried for the three gases for total EU28

Work packages	Partners and data activities
WP1	UNFCCC country submissions and uncertainties
WP3	(JRC) Soil eroded C (Lugato et al., 2016) and direct soil emissions of N_2O -N (Lugato et al., 2017) (IIASA) GAINS – CH_4 and N_2O emissions from all sectors (JRC) CBM – C dynamics NBP
WP4	(JRC) EDGAR - EU total and sectoral $CH_4$and N_2O emissions with uncertainties
	(JRC) CAPRI - CH_4 and N_2O emissions from agriculture
	(WUR) EFISCEN – Forest NBP
	(JRC) Inverse CH_4 emissions from ensemble, Bergamaschi et al., 2018
	(JRC) Inverse N_2O emissions from InGOS, JRC Reports Bergamaschi et al., 2018
WP7	(GCP) Inverse net CO_2 fluxes from GCP and CH_4 from natural wetlands (GCP) BLUE_GCP2018 and H&N 2017 - C emissions from land-use change (NEW)

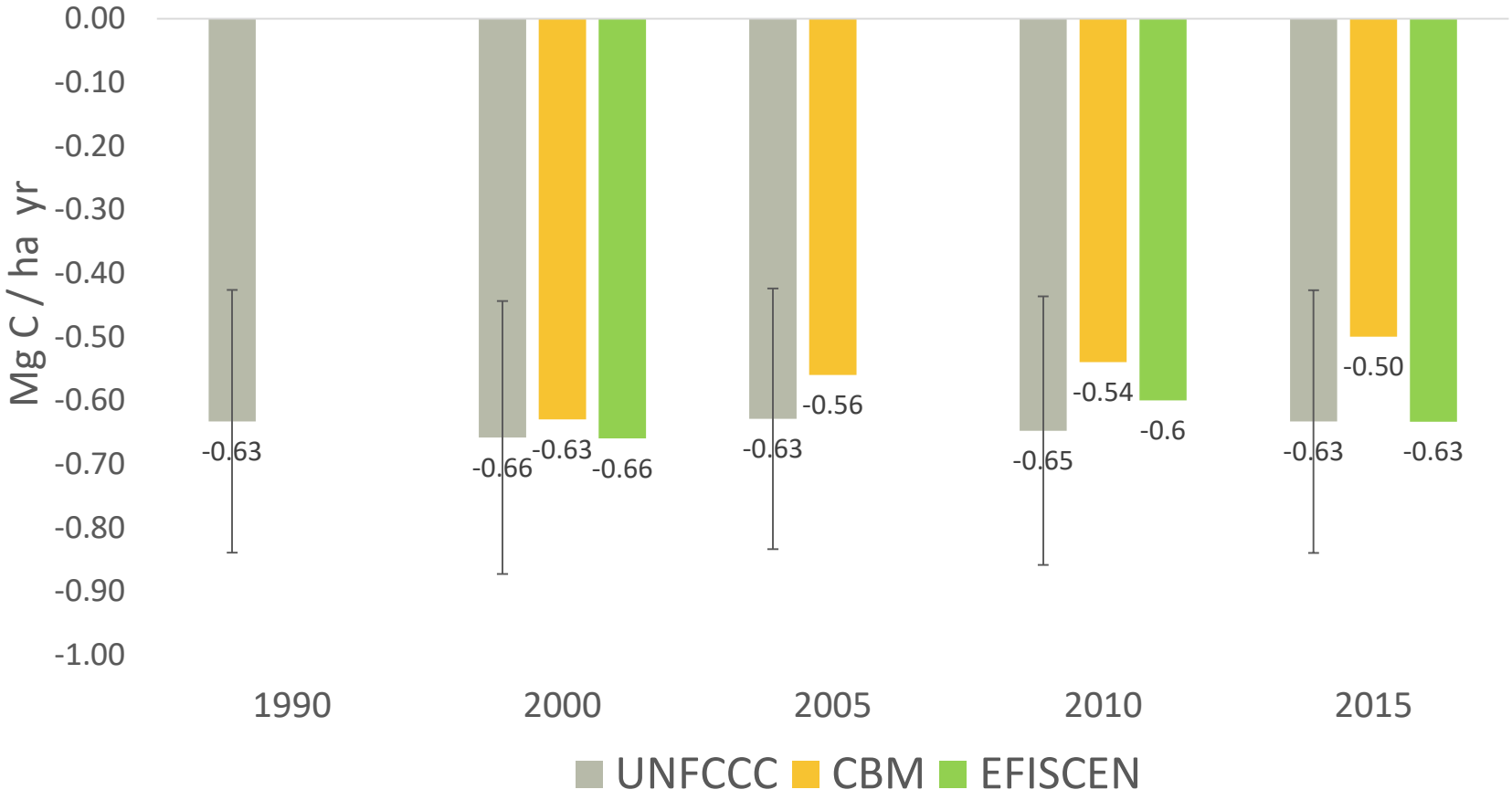
Bottom-up activity data and uncertainties

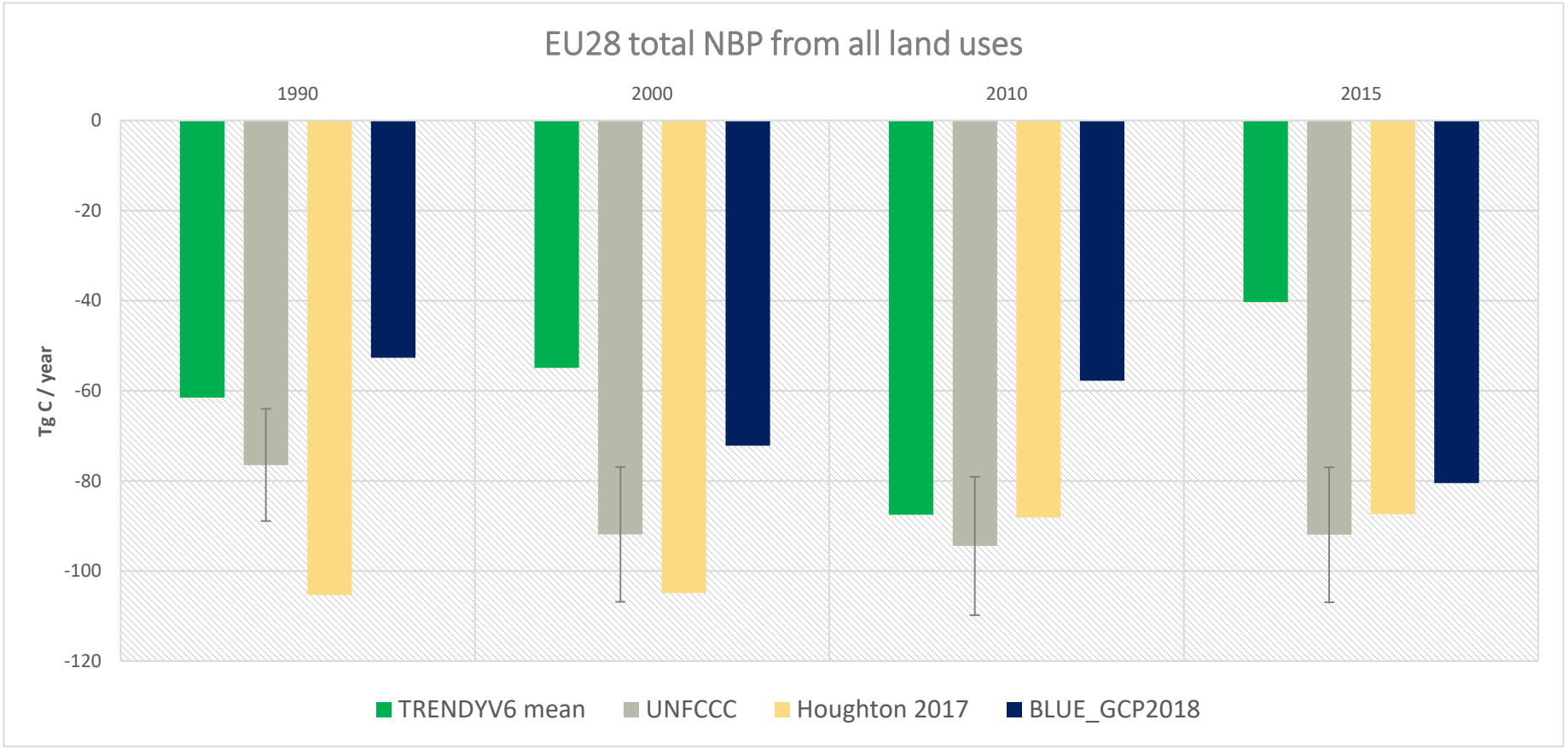




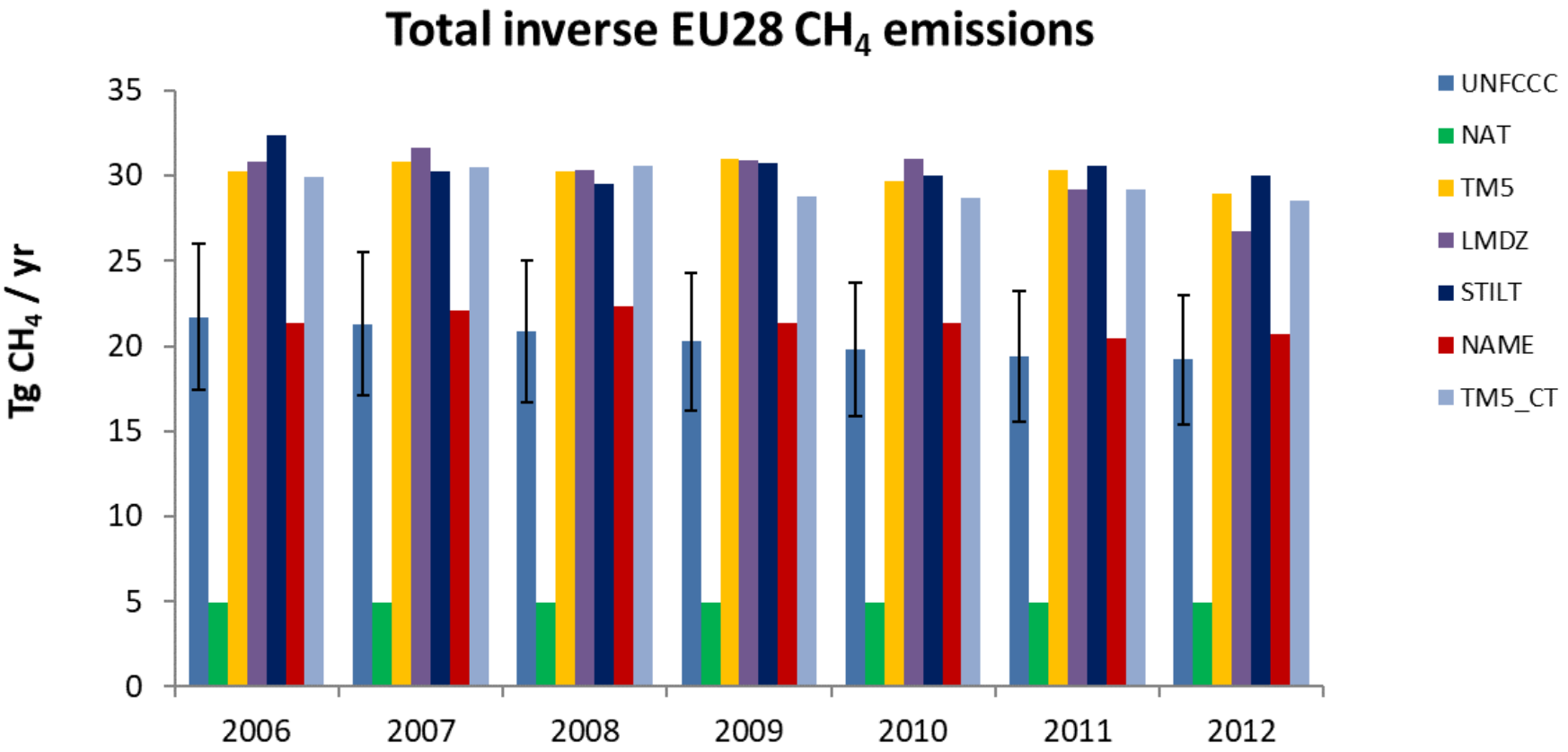
a plausible cause of the differences between CAPRI and the other emissions is the use of higher Tier for calculating emissions (e.g. cattle)

Total EU28 NBP for Forest Land remaining Forest Land



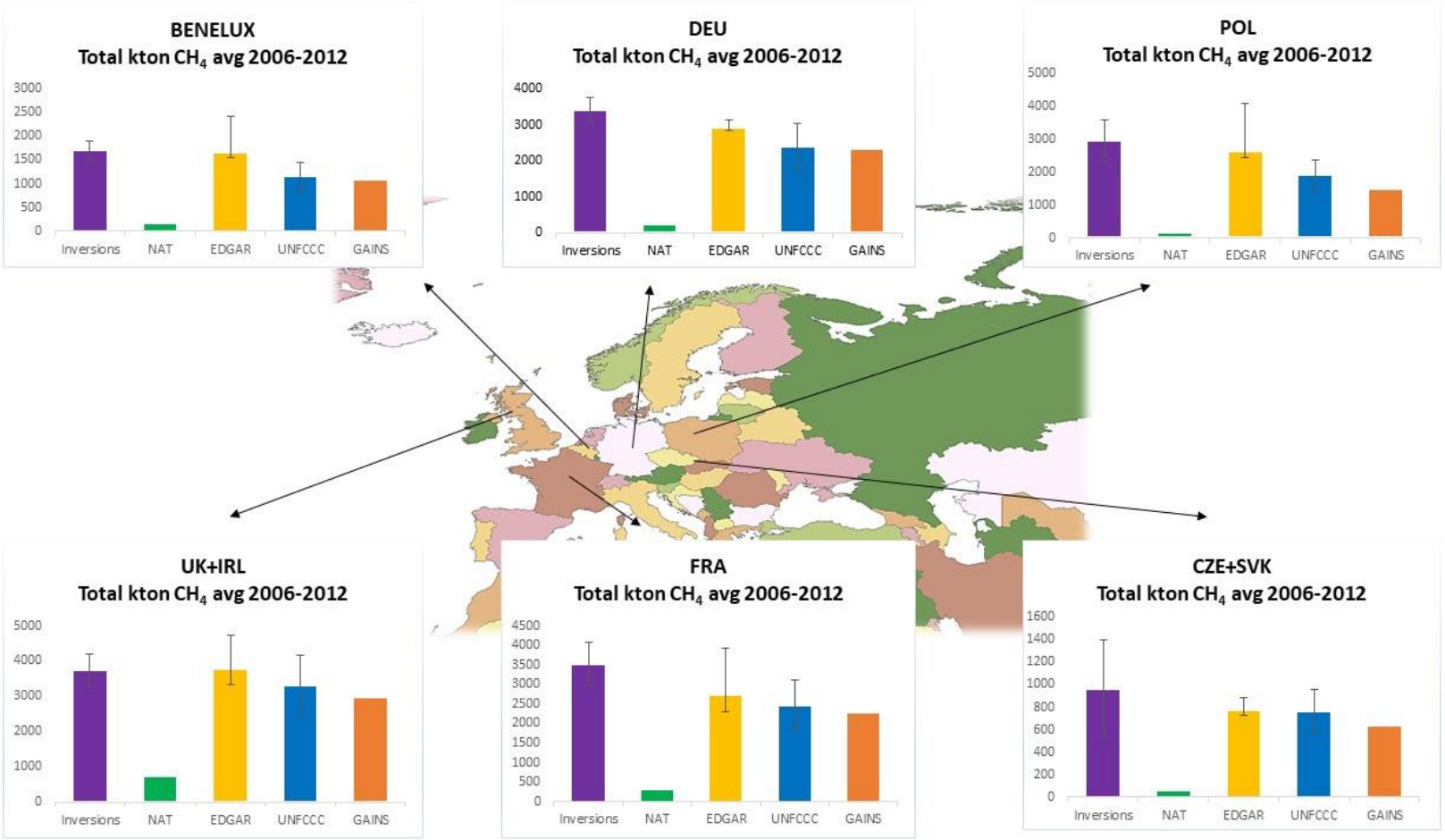

EU28 total NBP from all land uses
1990
2000
2010
2015
0
-20
-40
-60
-80
-100
-120
Tg C / year
TRENDYV6 mean
UNFCCC
Houghton 2017
BLUE_GCP2018

TOP-DOWN ACTIVITY DATA AND UNCERTAINTIES



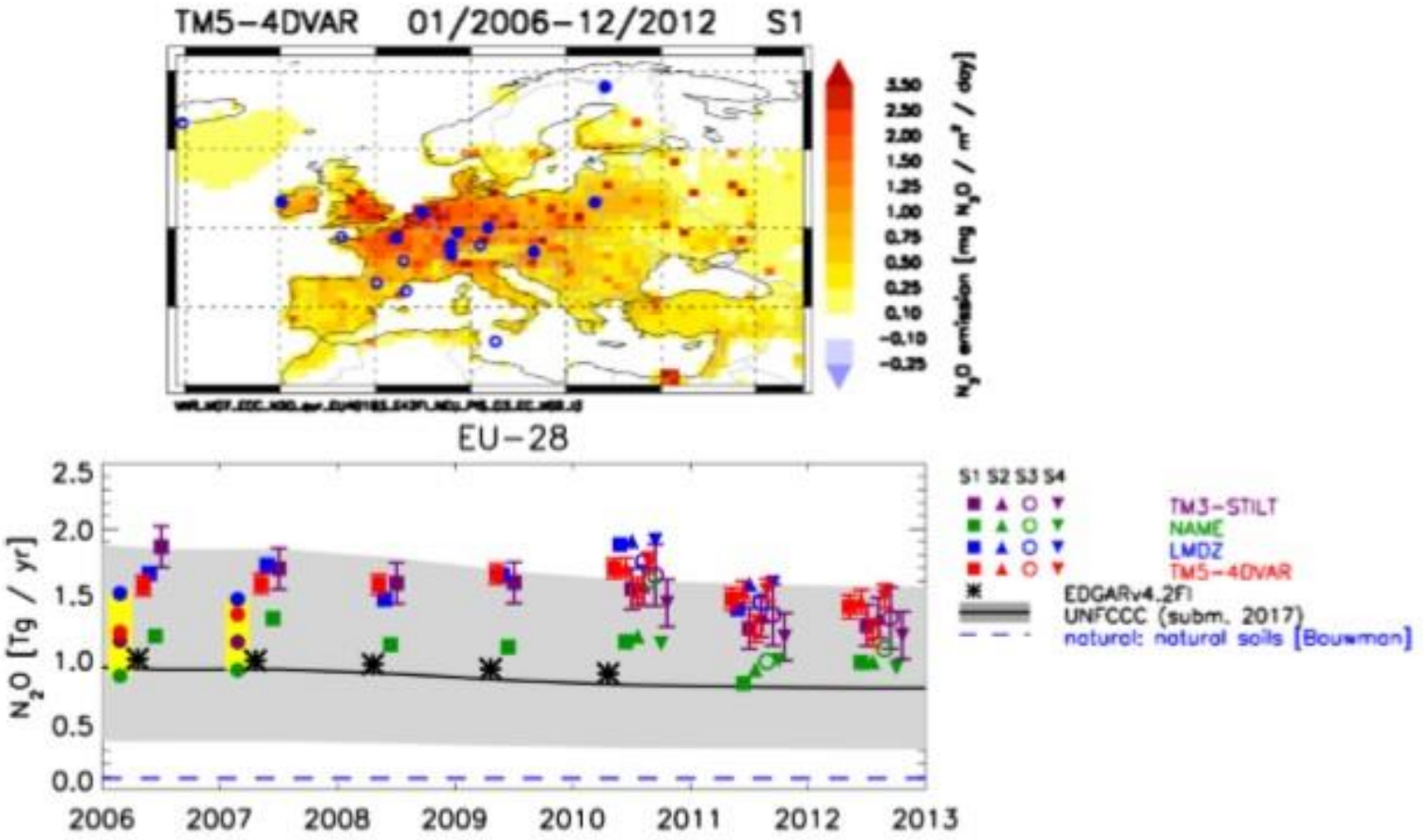
Total inverse CH_4 emissions for all anthropogenic sectors for EU28 from an inverse model ensemble (Bergamaschi et al., 2018). Natural emissions (NAT) are from WETCHIMP inter-comparison (Melton et al., 2013).

SOME COUNTRY EXAMPLES – RECONCILING BOTTOM UP-TOP DOWN ESTIMATES



We selected six countries/groups which are best constrained by atmospheric observations as defined by the inverse CH_4 emissions model setup. These example countries/groups are Germany, France, UK+Ireland, BENELUX, Czech Republic+Slovakia and Poland.

INVERSE N_2O emissions



The top-down estimates of total N_2O emissions for EU28 are broadly consistent with the values reported to the UNFCCC within the very large uncertainties (~100%) of the reported values. However the top-down estimates are in the upper part of UNFCCC uncertainty range.

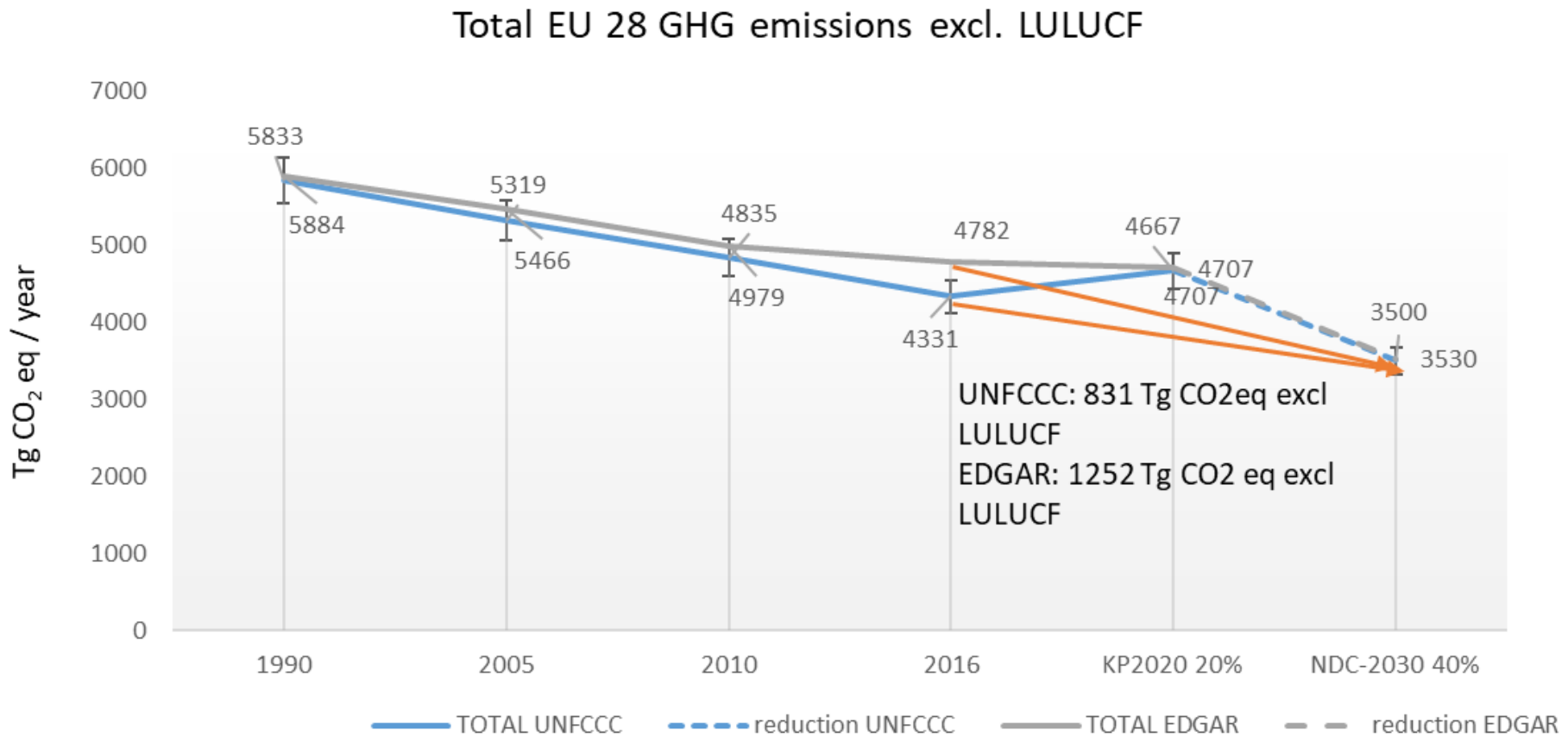
SOME PRELIMINARY RESULTS

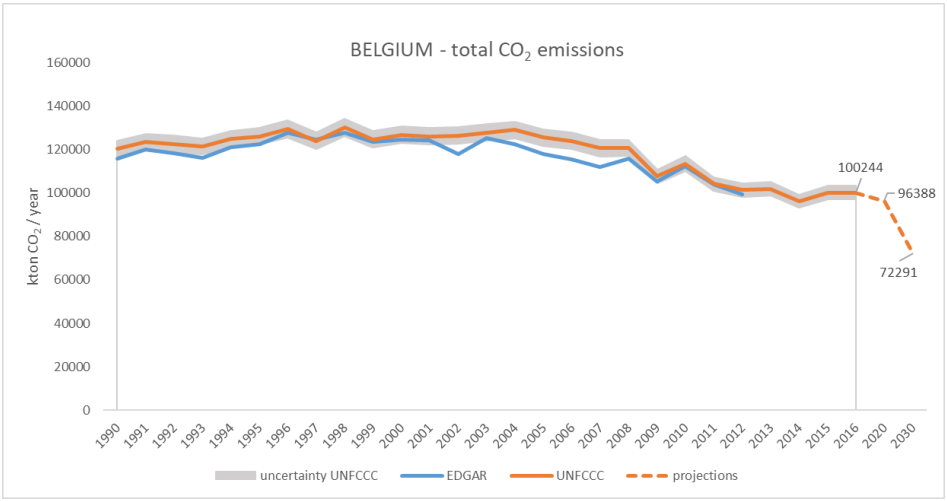
- Total EU28 GHG emissions and projections (per gas)
- Emissions per country and per gas: totals and sectoral split

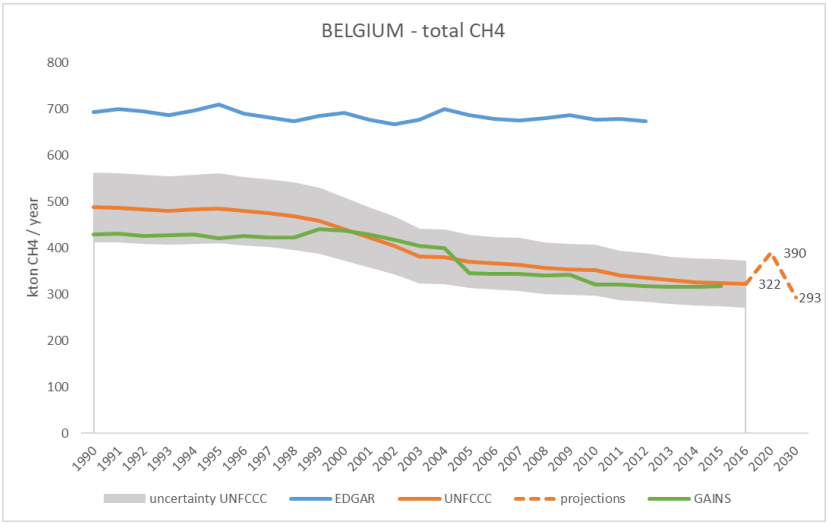
(looking at target reductions by 2020 and 2030 compared to 1990)

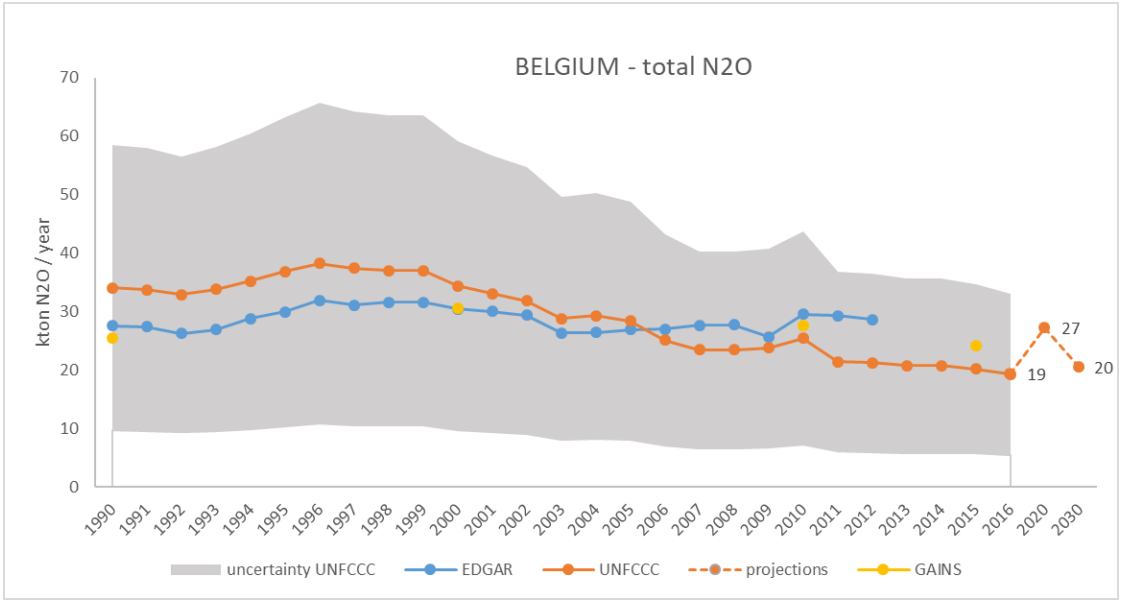
- Country fact sheets / diagrams

EU 28 CURRENT SITUATION




BELGIUM - total CO_2 emissions
kton CO_2 / year
160000
140000
120000
100000
80000
60000
40000
20000
0
100244
96388
72291
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2020 2030
uncertainty UNFCCC
EDGAR
UNFCCC
projections


BELGIUM - total CH4
kton CH4 / year
800
700
600
500
400
300
200
100
0
390
322
293
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2020 2030
uncertainty UNFCCC
EDGAR
UNFCCC
projections
GAINS


BELGIUM - total N2O
kton N2O / year
70
60
50
40
30
20
10
0
27
19
20
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2020 2030
uncertainty UNFCCC
EDGAR
UNFCCC
projections
GAINS

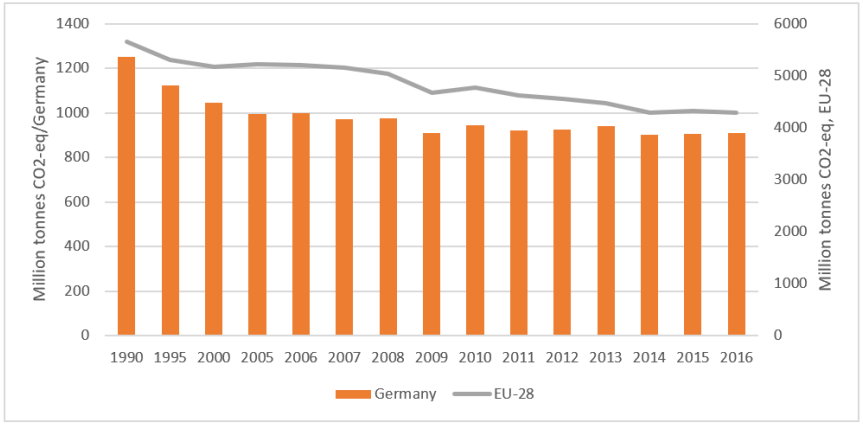
Fact sheets

- Different types of fact sheets
  - WP1 (inventory), WP5 (budgets), WP6 (policy)
- WP5 has close contact with WP1 – received the uncertainties from UBA
- WP5 has regular meetings with WP6 (@JRC Greet and Efisio) – discussions over the format of the countries fact sheets and EDGAR uncertainty calculation
- We are busy with the aggregation of all data information per country and producing country GHG budgets – fact sheets
- Waiting and hoping to receive before summer country totals and uncertainties from WP2-4 up to 2017

WP1 Fact Sheets

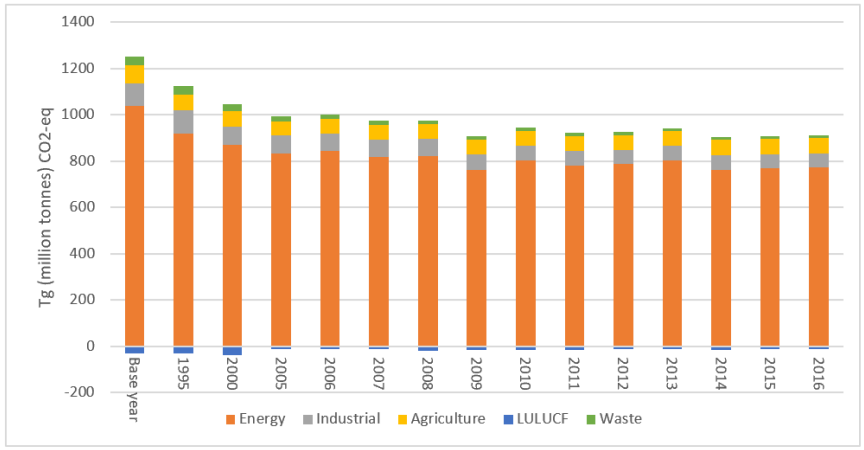
Fact Sheet: Germany

1. Total Greenhouse Gas Emissions

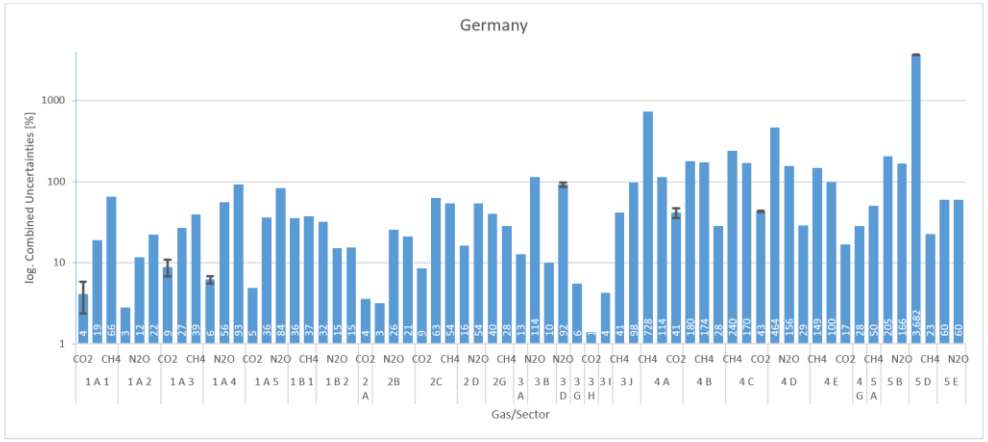


Graph 1 Total Greenhouse Gas Emissions of Germany and EU-28 from 1990 (base year) until 2016 (Mt. CO2-eq). In total, in Germany greenhouse gas emissions, calculated as CO2 equivalents, decreased by 27.3 %, with respect to 1990 (NIR 2018)

2. Trends in greenhouse gas emissions per sectors/gases in Germany



National Uncertainty Assessment



: This Graph shows the aggregated Combined Uncertainties in % for each gas/sector for Germany, calculated based on the Monte Carlo Simulation. For a better representation, the Y axes was logarithmized. The white numbers in each blue bar represent the rounded uncertainty value. For such gas/sector combinations with an error indicator above the bar have a variance that is greater than the overall variances for Germany. In this case, the mean was 0,32. The calculations contributing to this graph are based on the Uncertainty Assessment in 2016, NIR, and CRF tables // Meaning of CRF Codes at the end of the fact sheet (Annex 1)

WP6: REACHING OUT TO POLICYMAKERS

Country fact sheet: Austria

1. Total greenhouse gas emissions

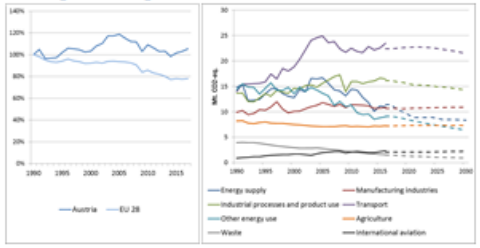


Figure 1: Left side: Total greenhouse gas emissions 1990-2017 (index 1990=100%). Right side: Total greenhouse gas emissions by sector – historical emissions 1990-2016, projections 2017-2030 (Mt. CO2-eq.).1

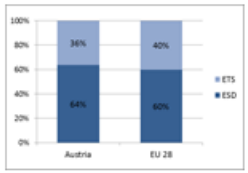


Figure 2: Share of emissions covered by the ETS and the ESD (2016).2

1 National total, including international aviation.
2 Excludes international aviation. CO2 from domestic aviation and LULUCF.

4. ETS emissions

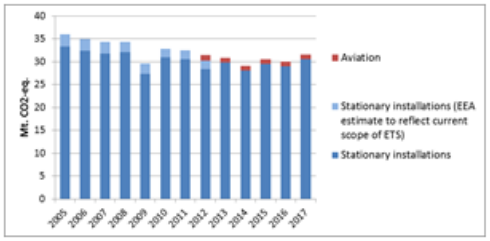


Figure 3: ETS emissions (Mt. CO2-eq.).3

3. Emissions in Effort Sharing sectors

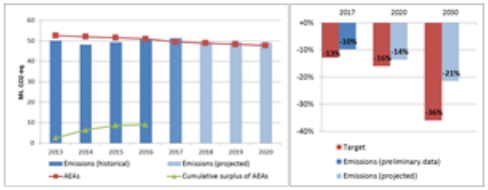


Figure 4: Left side: Emissions, annual emission allocations (AEAs) and accumulated surplus/ deficit of AEAs under the Effort Sharing Decision 2013-2020 (Mt. CO2-eq.). Right side: Emissions and targets under the Effort Sharing Decision/ Effort Sharing Regulation 2017, 2020 and 2030 as percentage change from 2005.

3 The scope of ETS was extended from 2013. To reflect the current scope of ETS, an estimate made by EEA is included in the figures from 2005 to 2012. This estimate covers only emissions from stationary installations.

4. Land use, land use change and forestry

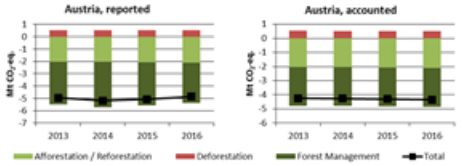


Figure 5: Reported and accounted emissions and removals from LULUCF4

Reported quantities under the Kyoto Protocol for Austria show net removals of, on average, -5.0 Mt CO_2-eq. for the period 2013 to 2016. In this regard Austria contributes with 1.5% to the annual average sink of -324.4 Mt CO_2-eq. of the EU-28. Accounting for the same period depicts net credits of, on average, -4.5 Mt CO_2-eq, which corresponds to 3.7% of the EU-28 accounted sink of -115.7 Mt CO_2-eq. Reported net removals are highest for 2014 and decreased slightly over the following years, while accounted net credits show no notable trend. In this preliminary simulated accounting exercise potential credits by Forest Management of, on average, -2.6 Mt CO_2-eq. per year are capped to -2.7 Mt CO_2-eq. per year. Austria is one of eight EU Member States which exceed the cap of 3.5% from emissions of the base year (1990).

Data sources:

Figure 1: Annual European Union greenhouse gas inventory 1990–2016 (European Environment Agency). Approximated EU greenhouse gas inventory 2017 (European Environment Agency), Member States national projections, reviewed by the European Environment Agency.

Figure 2: ETS data viewer (abstract from European Union Transaction Log 20.07.2018). Final reviewed ESD data (...).

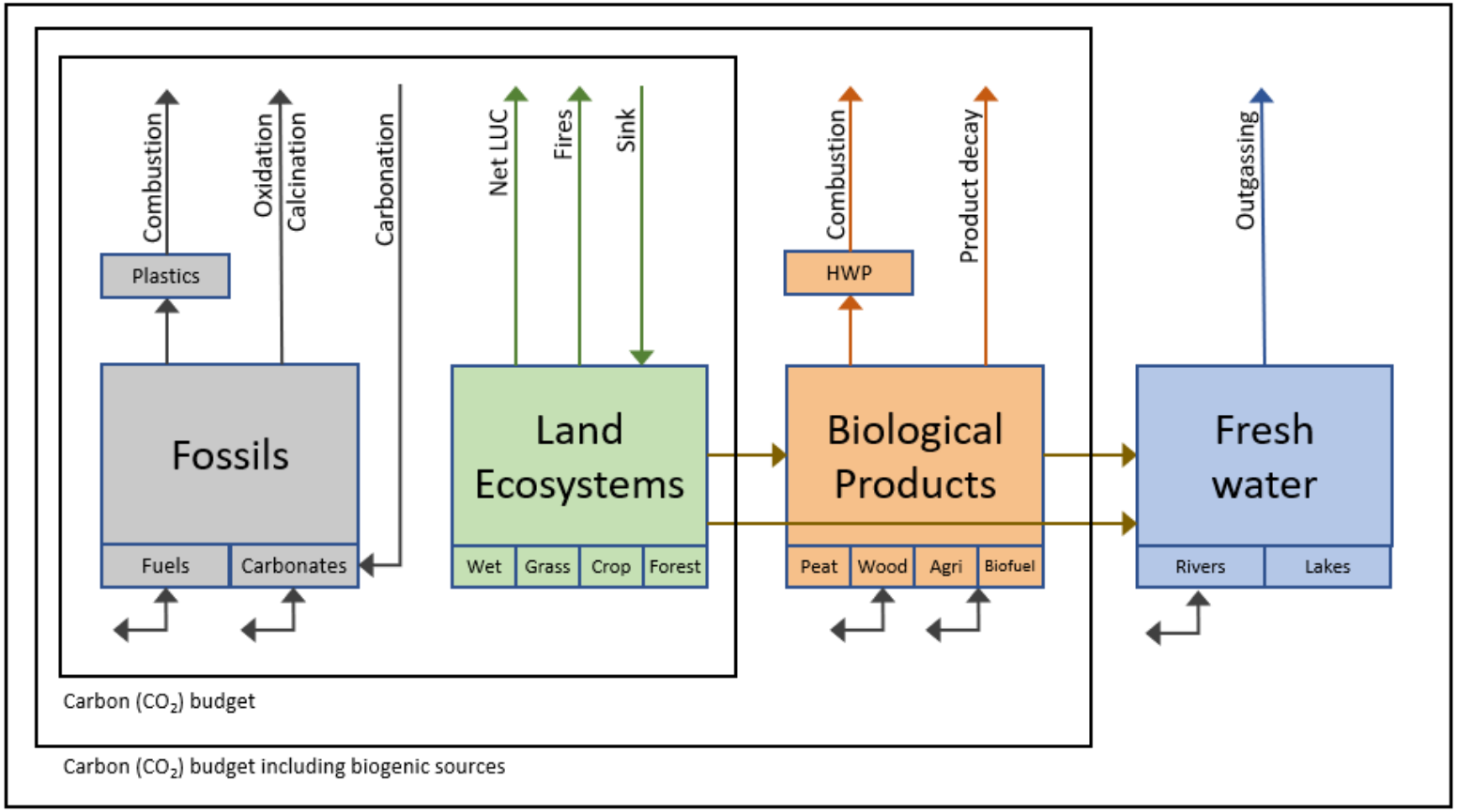
Figure 3: ETS data viewer (abstract from European Union Transaction Log 20.07.2018).

Figure 4: Final reviewed ESD data 2013-2016 (...). Approximated EU greenhouse gas inventory 2017 (European Environment Agency), Member States national projections, reviewed by the European Environment Agency.

Figure 5: European Commission based on data accounted and reported by Member States under the Kyoto Protocol (...).

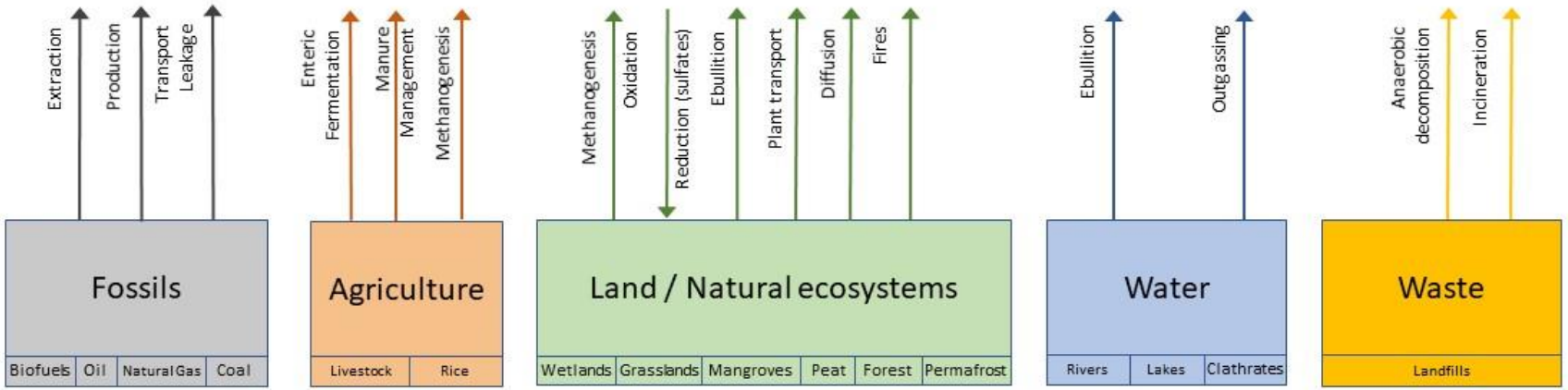
4 The differences between reported and accounted emissions from LULUCF under the Kyoto Protocol are described in part 1b.

Task 5.3: Budget – Fact Sheet – CO_2



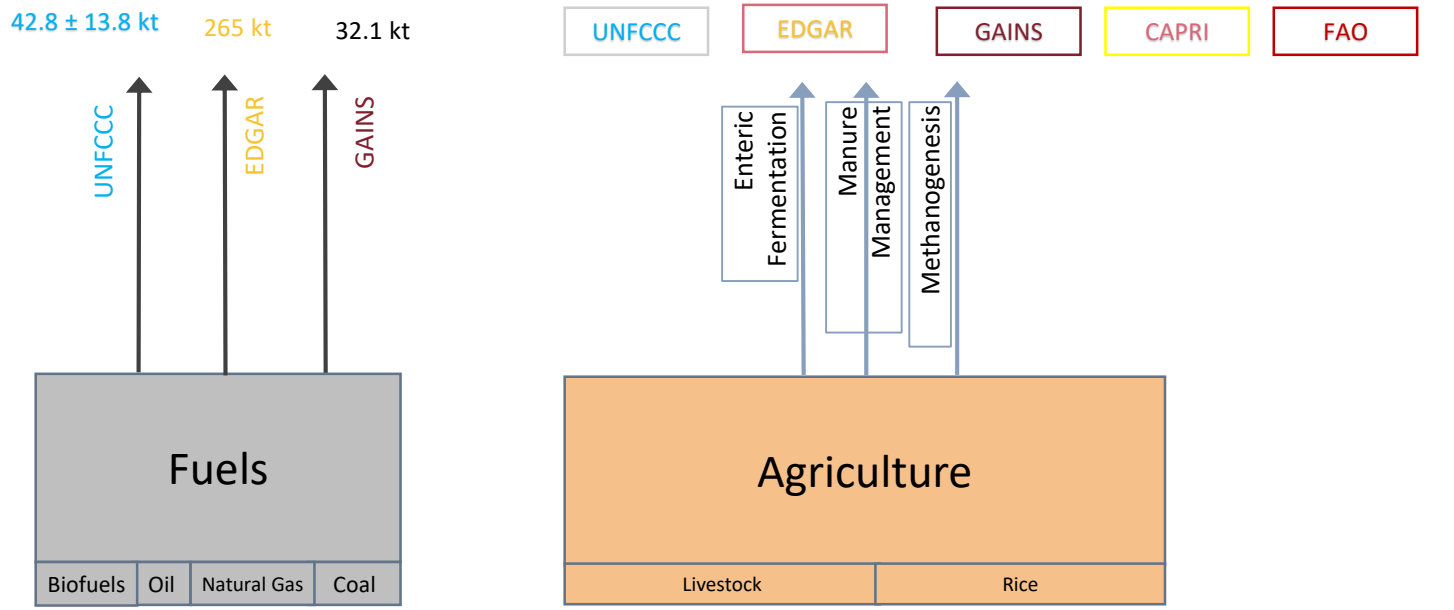
Task 5.3: Budget – Fact Sheet – CH_4

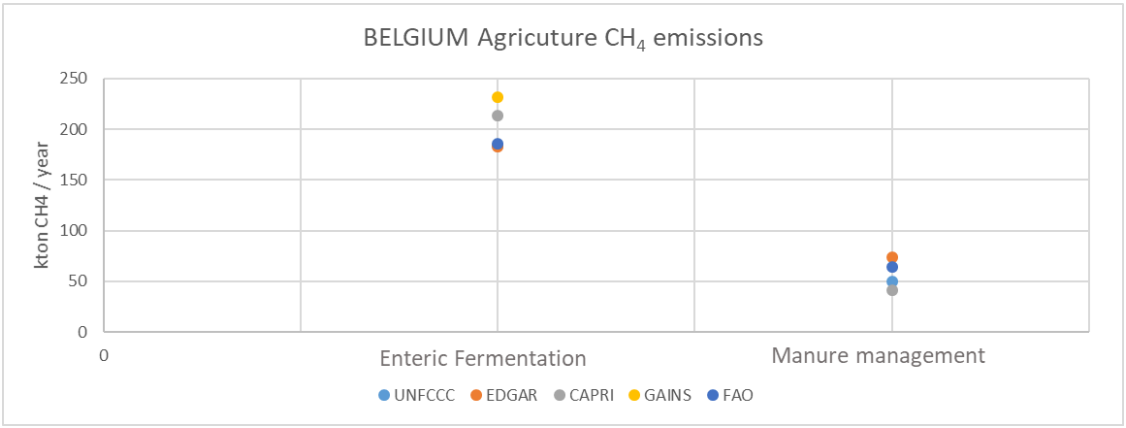
Country-level CH_4 balance: Suggested Framework



BELGIUM: Country-level CH_4 balance: last available year

last available year: UNFCCC 2016; EDGAR 2012; GAINS 2015; CAPRI 2014; FAO 2016





Discussion points

- Task 5.1: Where to draw the line?
  - What is needed on LUC and non-CO_2
- Task 5.3: Full GHG Budgets
  - What components, how detailed?
  - What years for budget estimates?
- Fact sheets
  - WP1 (inventory), WP5 (budgets), WP6 (policy)
- Data delivery
  - Country level: Specific format (based on agreed mask)
- Scientific paper (ESSD)
  - Take governance from GCB (e.g. authorship)