

Non-CO₂ greenhouse gas emissions in Energy Community countries 2015 to 2050

First GAINS model results

Energy Community Baseline scenario

October 20, 2021

IIASA Pollution Management Group, Energy, Climate and Environment Program

Peter Rafaj, Lena Höglund-Isaksson, Pallav Purohit, Wilfried Winiwarter, Adriana Gómez-Sanabria, Laura Warnecke

GAINS model Baseline scenario non-CO₂ GHGs

- IIASA's GAINS model was used to create a bottom-up inventory for year 2015 and projections to 2050 for **non-CO₂ greenhouse gas** emissions methane (CH₄), nitrous oxide (N₂O) and fluorinated gases (HFCs, PFCs, SF₆)
- **Consistent methodology** applied across all EU27 and ECE countries (follow IPCC guidelines 2006; 2019), e.g., for given technology and other circumstances same emission factor assumptions apply
- IIASA's Pollution Management Group has a long-standing **collaboration with UNECE countries** on air pollution in the context of the Convention on Long-Range Transboundary Air Pollution (LRTAP). For most ECE countries, the GAINS database has therefore been reviewed on a regular basis by national experts on air pollution

GAINS Baseline scenario for non-CO₂:

- **Energy** activity projections consistent with PRIMES model (2021)
- **Agricultural** activity projections consistent with CAPRI model (2021)
- **Waste** generation, **wastewater** organic content, **industrial processes** and **F-gas** use: projections derived in GAINS in consistency with macroeconomic projections from PRIMES (2021)
- **Emission control levels** reflect currently adopted legislation and regulations affecting non-CO₂ greenhouse gases

GAINS model Baseline scenario non-CO₂ GHGs

Principal sources
of information
for input to
GAINS Baseline
scenario:

ECE (all 9 countries)	EUROSTAT (2021) for historical activity data for agriculture and waste FAOSTAT (2021) for livestock information missing in EUROSTAT PRIMES model (Energy activity projections) CAPRI model (Livestock and fertilizer projections) Country expert communications during or after bilateral meetings (2021)
Albania	2nd National Communication to the UNFCCC (2012)
Bosnia	2nd National Communication of Bosnia and Herzegovina to the UNFCCC (2013) Biennial Update Report to the UNFCCC (2016)
Georgia	National Inventory Report 2010-2013 (2016) National Inventory Report (2019) 4th National Communication to UNFCCC (2020) 2nd Biennial Update Report to the UNFCCC (2019)
Kosovo	Kosovo Municipal Solid Waste Factsheet (2018) Green Report (2020) Kosovo Agency of Statistics. Greenhouse gas emissions in Kosovo 2014-2015, September 2016. Kosovo Environment 2020, Ministry of Economy and Environment
Moldova	National Inventory Report 1990-2016 published 2019 Republic of Moldova GGE emissions 19.04.2021, Excel file received from country experts Prochazkova et al. 2019, An analysis of waste management in the Republic of Moldova, Polish J Env Stud Skryhan et al., 2018 Waste Management in post-soviet countries: How far from the EU? Multidisciplinary J Waste Resources and Residues
Montenegro	Second Biennial update report on climate change Montenegro, 2019
North Macedonia	National Inventory Report/Biennial Update Report 3, 2019
Serbia	Serbia Municipal waste factsheet 2018. 1st Biennial Update Report of Serbia to the UNFCCC (2016)
Ukraine	Common Reporting Format Table to the UNFCCC (2020) Draft Second NDC report, April 2021

GAINS model Baseline scenario non-CO₂

Energy Community: non-CO₂ greenhouse gases

+8% by 2030 from 2015

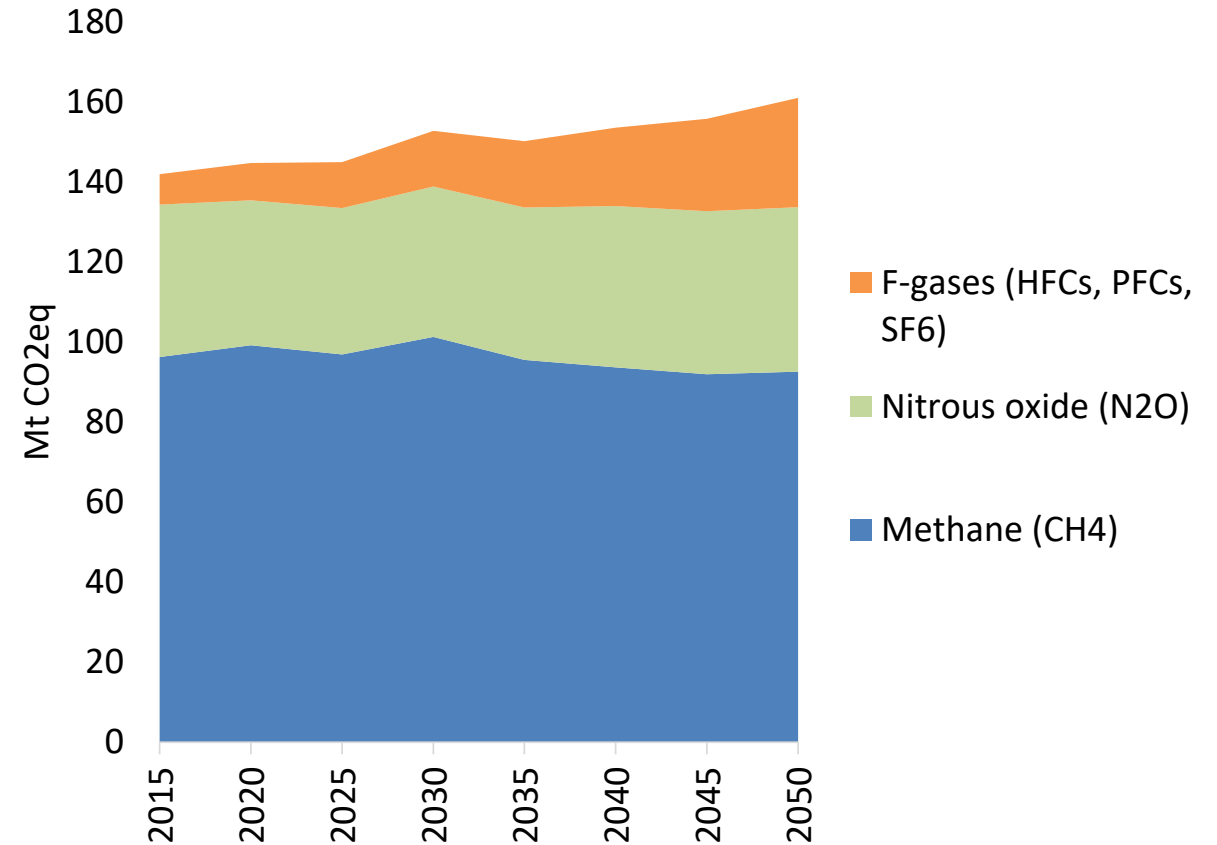
+13% by 2050 from 2015

Methane (CH₄) dominate with 2/3 of emissions

Nitrous oxide (N₂O) about a quarter of emissions

F-gases (HFCs, PFCs, SF₆): strong increase expected by +83% to 2030

and +260% to 2050



GAINS model Baseline scenario non-CO₂ GHGs

Agriculture:

+3% in 2015-2030 but stable at about 1/3 of non-CO₂ GHGs

About half from Livestock (primarily enteric fermentation) and half from agricultural soils (primarily fertilizer use)

Energy:

About 1/3 of emissions dropping to a quarter in 2050

Coal mining emissions peak in 2030, then decline sharply, while emissions from oil and gas systems increase.

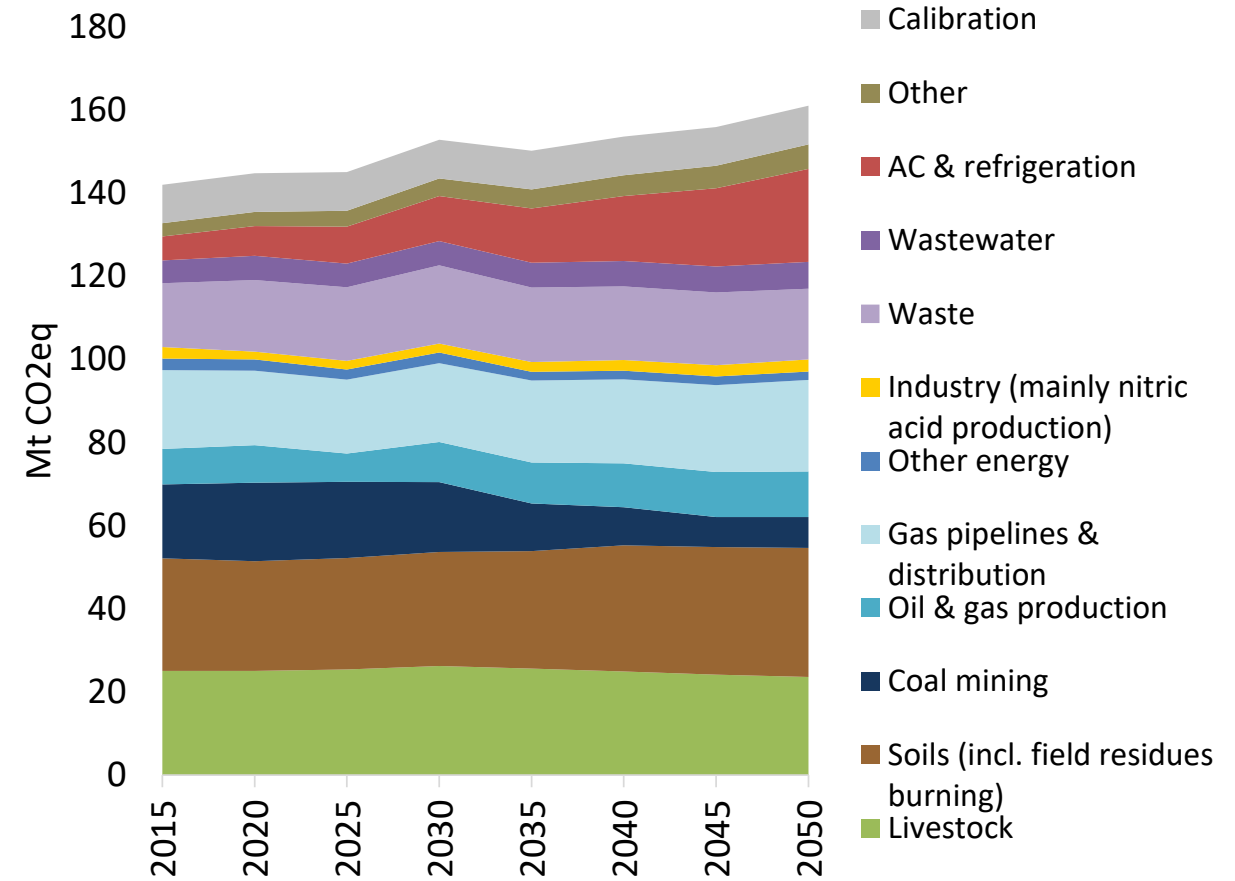
Waste & wastewater:

Stable at about 15%

Cooling: air-conditioning and refrigeration:

Contribution increase from 4% in 2015 to 15% in 2050

Calibration: Difference to CH₄ and N₂O emissions reported to the UNFCCC (2021) for year 2015 for Annex-1 countries (in this case only Ukraine)



GAINS model Baseline scenario non-CO₂ GHGs

GAINS model results: 2 display sheets

- Activity data projections for selected activities relevant for non-CO₂ GHGs
- Data source specified

- Emission projections: displayed by gas and source sectors and converted to kt CO₂eq using Global Warming Potentials from IPCC AR5 over 100 years.

Activity type	Description of activity	unit	2015	2020	2025	2030	2035	2040	2045	2050	Main activity data sources
Livestock	Dairy cows	[1000 heads]	3240	2904	3250	3646	3435	3129	3139	3105	CAPRI model (2021)
	Milkyield	[kg/head]	12768	13093	13898	14897	15197	15782	15366	15383	CAPRI model (2021)
	Non-dairy cattle	[1000 heads]	530	428	428	428	428	428	428	428	CAPRI model (2021)
	Pigs	[1000 heads]	12220	12464	12891	13718	13929	13318	13377	13556	CAPRI model (2021)
	Horses	[1000 heads]	9	10	10	10	10	10	10	10	CAPRI model (2021)
	Sheep and goats	[1000 heads]	1305	1192	1246	1314	1468	1884	1954	2024	CAPRI model (2021)
Agricultural waste burning	Burning of agricultural field	[Mt residues burned]	2016	2016	2016	2016	2016	2016	2016	2016	GAINS (2020) -derived from
Soils	Mineral fertilizer	[kt N]	0	0	0	0	0	0	0	0	CAPRI model (2021)
	Crop residues to fields	[kt N]	60	13	12	11	7	7	6	5	GAINS model, country exp
	Histosols	[M ha]	36	35	34	31	21	17	13	14	Ukraine UNFCCC-CRF tabl
Fossil fuel production and transportation	Brown coal	[Mt coal]	0	0	0	0	0	0	0	0	PRIMES model (2021)
	Hard coal	[Mt coal]	180	186	291	525	345	343	350	419	PRIMES model (2021)
	Abandoned coal mines	[kt CH4]	641	659	338	457	553	612	623	575	Ukraine UNFCCC-CRF tabl
	Oil production	[PJ crude oil]	6230	4369	4370	4792	5104	5357	5592	5925	PRIMES model (2021)
	Natural gas production	[PJ natural gas]	531	537	544	570	589	603	627	667	PRIMES model (2021)
	Long-distance gas transmi	[PJ gas transmitted]	922	818	762	843	889	933	960	1002	PRIMES model (2021)
	Gas distribution network -c	[PJ gas consumed]	20	20	20	20	20	20	20	20	PRIMES model (2021)
	Gas distribution network -c	[PJ gas consumed]	20	20	20	20	20	20	20	20	PRIMES model (2021)

Greenhouse gas	Aggregate sector	Emission source	UNFCCC CRF code updated 2015	Global warming potential over 100 years (IPCC, 2014)	2015	2020	2025	2030	
				t CO ₂ eq/ t pollutant	kt CO ₂ eq	kt CO ₂ eq	kt CO ₂ eq	kt CO ₂ eq	
Methane	CH4	Agriculture	Dairy cows	3A; 3.B	28	13770	14475	14643	15421
	CH4	Agriculture	Non-dairy cattle	3A; 3.B	28	5121	4836	5458	6039
	CH4	Agriculture	Pigs	3A; 3.B	28	2124	2244	2383	2561
	CH4	Agriculture	Poultry	3A; 3.B	28	164	159	165	169
	CH4	Agriculture	Other livestock	3A; 3.B	28	2105	1949	2023	2184
	CH4	Agriculture	Rice cultivation	3C	28	101	91	91	91
	CH4	Agriculture	Agricultural waste burning	3F	28	1691	1839	1839	1839
	CH4	Waste	Industrial solid waste	5A; 5C	28	2554	2484	2662	2803
	CH4	Waste	Municipal solid waste	5A; 5C	28	12667	14680	14940	15765
	CH4	Wastewater	Industrial wastewater	5D	28	1886	1898	1949	2225
	CH4	Wastewater	Domestic wastewater	5D	28	1808	2112	1987	1907
	CH4	Energy	Coalmining & Abandoned	1.B.1	28	17795	18483	17933	16406
	CH4	Energy	Production of crude oil	1.B.2.a; 1.B.2.b;	28	1814	2029	3327	4897
	CH4	Energy	Production of natural gas	1.B.2.a; 1.B.2.b;	28	6739	6946	3473	4731

Thank You

Name
Program
Email
Web