

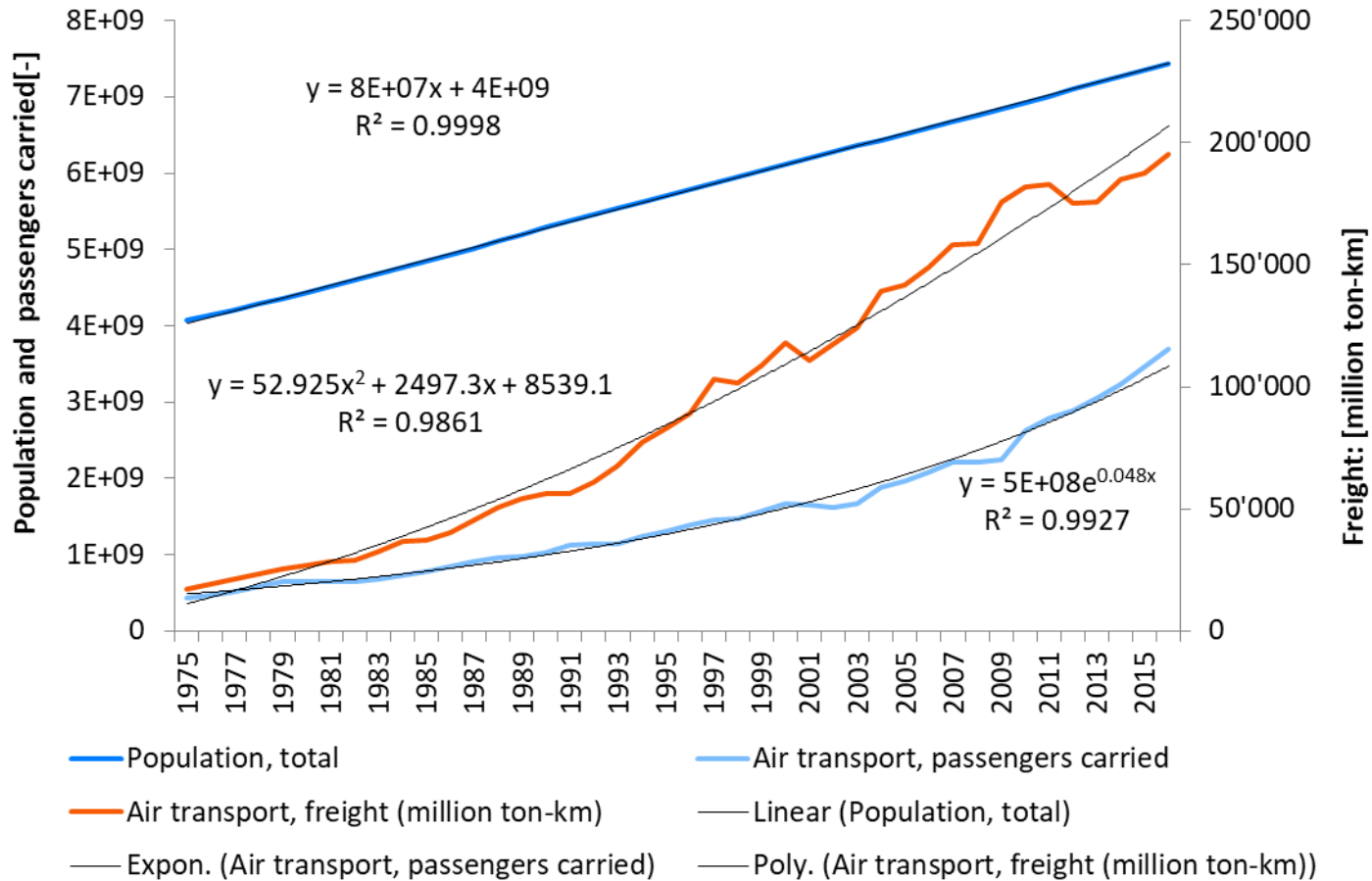
Best practice for calculating the carbon footprint of airplane transports

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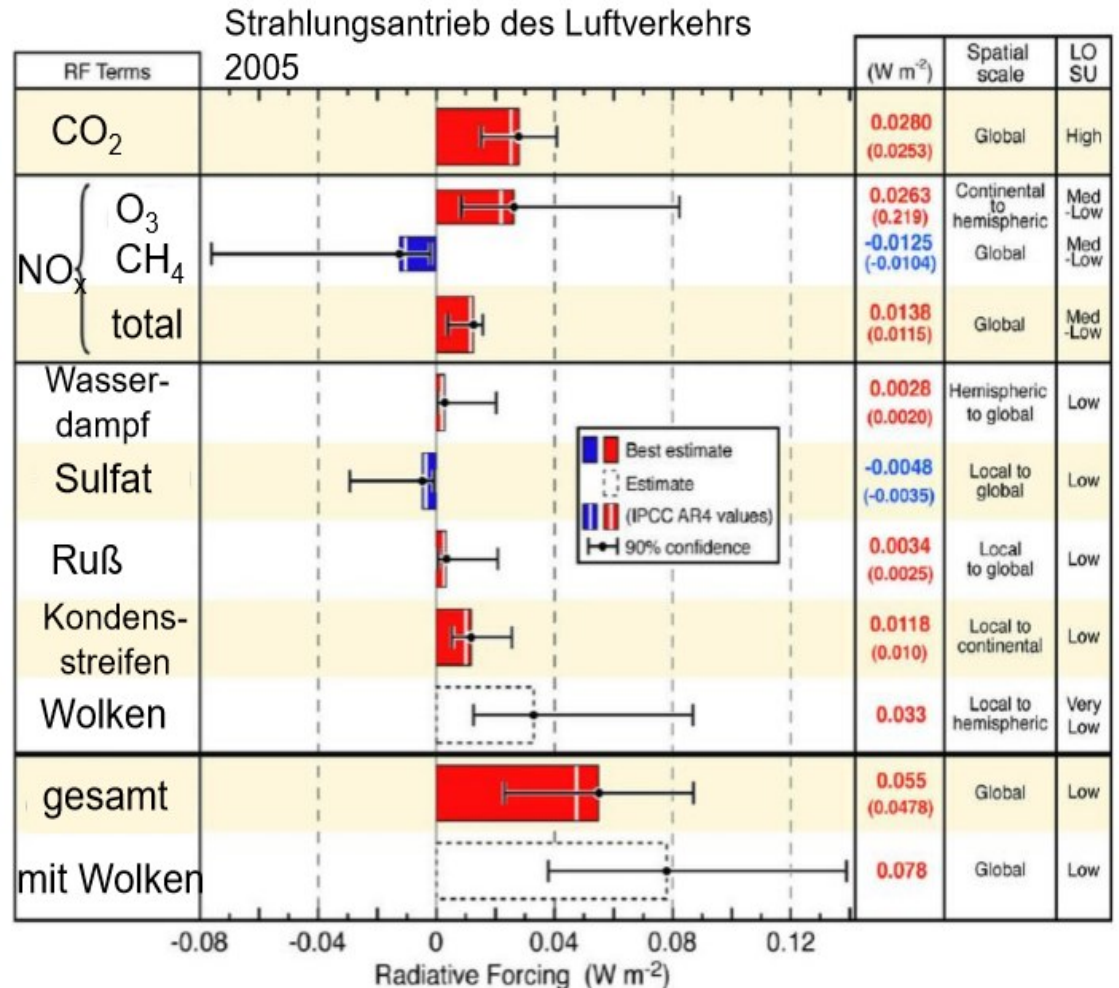
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Exponential growth of air transport



<http://data.worldbank.org>, online 14.08.2017

GWP of air transport: non-CO₂-effects



Quelle: Lee et al. 2009 mit eigenen Ergänzungen

IPCC 2013 - physical science basis:

Persistent contrails from aviation contribute a RF of +0.01 (+0.005 to +0.03) W m⁻² for year 2011, and the combined contrail and contrail-cirrus ERF from aviation is assessed to be +0.05 (+0.02 to +0.15) W m⁻².

Literature research by ESU-services in 2013:

Group	Application	RFI, CO2 stratosphere	RFI, other aircraft CO2	RFI, fully on CO2, stratosphere	calculated GWP per pkm	Interpretation	Scientific background paper
1	ecoinvent v2.2	1	1	1.0	0.127	Frischknecht et al. 2007b	IPCC 2007
	SimaPro	1	1	1.0	0.127	PRé Consultants 2012	IPCC 2007
	PAS 2050:2011	1	1	1.0	0.127	Separate reporting of aircraft CO2 is necessary.	Carbon Trust & DEFRA 2011
	ISO/CD 14067.3:2011	1	1	1.0	0.127	CO2 from aircrafts should be reported separately, no recommendation for assessment.	International Organization for Standardization (ISO) 2011
	Product Accounting & Reporting Standard	?	?			For air travel emission factors, multipliers or other corrections to account for radiative forcing may be applied to the GWP of emissions arising from aircraft transport. If applied companies should disclose the specific factor used.	WBCSD & WRI 2011
	ILCD Handbook	1	1	1.0	0.127	Not mentioned as a specific issue	Hauschild et al. 2011
-	Forster et al. 2006, 2007, without cirrus	1.2	1.2	1.8	0.148	Gössling & Upham 2009	Cited as Forster et al. (2006, 2007) ¹
2	PCF - Germany	2.7	1	2.7	0.171	Grießhammer & Hochfeld 2009	IPCC 2007; Penner et al. 2000
	atmosfair	3	1	3.0	0.178	atmosfair 2008	Grassl & Brockhagen 2007 based on IPCC 2007
	EcoPassenger	3	1	3.0	0.178	Based on (atmosfair 2008), calculated range of total RFI of 1.27 to 2.5 based on travel distances.	Knörr 2008
	CO2OL, www.co2ol.de	1.27-2.7	1.27-2.7	3.0	0.178	Depending on travel distance. Own assumption based on (Grießhammer & Hochfeld 2009; Knörr 2008).	Knörr 2008
	ESU-services, scenario, 2010	2.99	1	3.0	0.178	Geometric mean of RFI 1.9 to 4.7, atmosfair concerning application only to CO2, stratosphere	Grassl & Brockhagen 2007 based on IPCC 2007



Literature research by Niels Jungbluth in 2013:

Group	Application	RFI, CO2 stratosphere	RFI, other aircraft CO ₂	RFI, fully on CO ₂ , stratosphere	calculated GWP per pkm	Interpretation	Scientific background paper
3	Stockholm Environment Institute	2	2	5.2	0.235	Kollmuss & Crimmins 2009	IPCC 2007
	Umweltbundesamt	2	2	5.2	0.235	UBA 2012	Lee et al. 2009 and other literature
	myclimate	2	2	5.2	0.235	myclimate 2009	Kollmuss & Crimmins 2009
	Lee et al. 2009	2	2	5.2	0.235	N. Jungbluth N. Jungbluth ² , calculation in the paper shows the contribution of different emissions and the influence of time frames	Lee et al. 2009; Lee et al. 2010
	Peters et al. 2011	1.8	1.8	4.6	0.219	Calculation of emissions weighting factors (EWFs) with 5 different metrics (GWP, GTP, SGTP, and two economic metrics, relative damage cost (RDC) and a cost-effective trade-off (CETO)). The range found for the EWF was 1.3 to 2.9. Using the GWP metric 1.7 is provided as best estimate.	Peters et al. 2011
	Azar & Johansson 2012	1.7 (1.3-2.9)	1.7 (1.3-2.9)	3.9	0.202		Azar & Johansson 2012
4	Forster et al. 2006, 2007, with max. cirrus	2.8	2.8	8.5	0.321	Gössling & Upham 2009	Cited as Forster et al. (2006, 2007)
	ecoinvent, scenario	2.72	2.72	8.2	0.312	Frischknecht et al. 2007b, GWP also calculated for single emissions	IPCC 2007

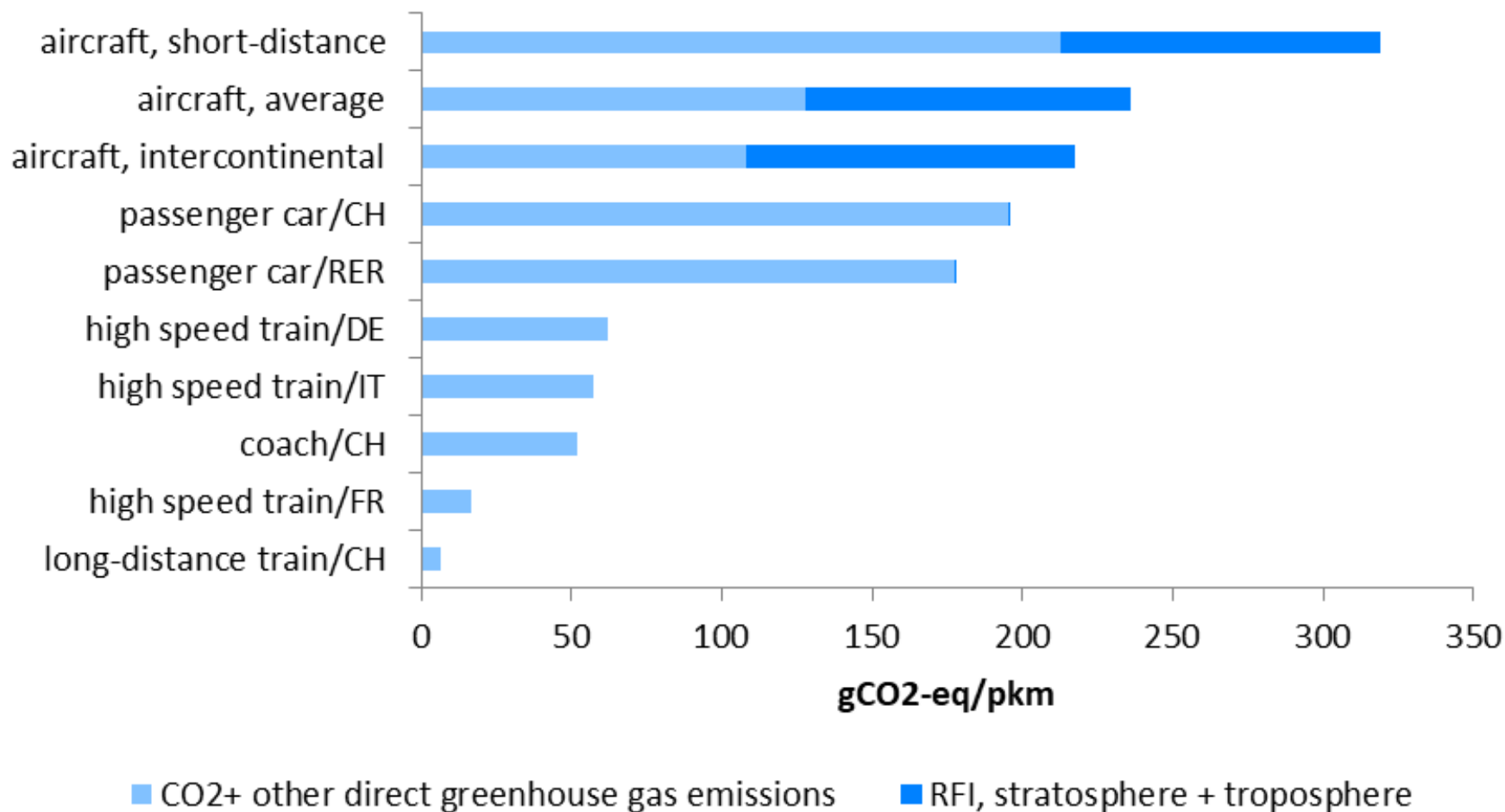
¹ <http://www.sciencedirect.com/science/article/pii/S1352231005010587>

² According to a personal communication with C. Soli in April 2012.

Recommendation

For the time being an RFI of 2 on total aircraft CO₂ (or 5.2 for the CO₂ emissions in the higher atmosphere according to share in ecoinvent v2.2 data) is considered to be the best-practice approach to show the potential impacts of aviation in LCA

Change in impact of transportation per km (ecoinvent v2.2 and KBOB 2016)



Outlook

- Factor for LCI data needs to be revised if the ratio on “higher atmosphere” emissions changes
- Shares in report presented by Frischknecht seemed to be very different, but electronic data were not available for full comparison

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