Supplementary Okala Impact Factors

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Okala Impact Factors help design teams to create solutions that abate environmental and human health damage. The listed Okala Impact Factors (OIF) and global warming potentials values supplement the OIF found in *Okala Practitioner*.[1] *Okala Practitioner* describes in detail how OIF values result from thorough life cycle emissions data and robust impact characterization science. OIF 2014 should not be used in combination with earlier OIF.

The aluminum casting factors indicate the impacts of casting aluminum. They do not include the impacts from the production of aluminum, so aluminum production impacts should be calculated and added separately.

We burn a fuel for its energy. *Okala Practitioner* reported factors for fuel production, not fuel combustion, so these new factors combine impacts from production and combustion. For this, we modeled representative combustion scenarios: typical vehicles, two-stroke motors (such as lawnmowers), home-scale furnaces and larger boilers.[2, 3]

For biodiesel, ethanol and wood, we calculated impacts from human-caused (anthropogenic) global warming emissions differently than those from naturally caused (biogenic) global warming emissions. Over a biofuel's life cycle, the amount of biogenic carbon in the fuel equals the amount of biogenic carbon that is exchanged with the atmosphere. Conforming with protocol, we assigned biogenic combustion emissions a value of zero.[4] The resulting global warming values for these combusted biofuels are shown in blue.

Material or Process	**Okala Impact Factor 2014**	Unit	Description	Source	CO_2 eq. in lbs.
METAL PROCESSING					
Al. lost foam casting	1.2	/lb.	lost foam casting, sans aluminum	US, O	1.5
Al. prec. sand casting	16	/lb.	precision sand casting, sans aluminum	US, O	3.2
Al. SPM casting	16	/lb.	semi-permanent mold casting, sans al.	US, O	2.2
ASSORTED MATERIALS					
Borosilicate glass	1.6	/lb.	thermally resistant bottle glass, Pyrex	EI	2
Tempered flat glass	0.66	/lb.	glass strengthened by heat tempering	EI, O	1.1
COMBUSTED FUELS			**PRODUCTION & COMBUSTION INCLUDED**		
Gasoline, vehicle	14	/gal.	lead-free gas, 26 mpg vehicle	US, O	23
Gasoline, small motor	17	/gal.	lead-free gas, two-stroke motor	US, O	54
Diesel, vehicle	14	/gal.	low-sulphur diesel, 31 mpg vehicle	EI, O	26
Diesel, small motor	20	/gal.	low-sulphur diesel, two-stroke motor	EI, O	74
Rapeseed biodiesel	30	/gal.	rapeseed methyl ester, 31 mpg vehicle	EI, O	27
Soy biodiesel	9.1	/gal.	soybean oil methyl ester, 31 mpg vehicle	EI, O	15
Ethanol, sugarcane	13	/gal.	sugarcane ethanol, 26 mpg vehicle	EI, O	6.5
Ethanol, corn	16	/gal.	corn ethanol, 26 mpg vehicle	EI, O	17
Light fuel oil	11	/gal.	light fuel oil, 20 kW furnace	EI, O	25
Hard coal	1.2	/lb.	hard coal supply mix, 200 kW boiler	EI, O	25
Natural gas	0.04	/MJ	sweetened natural gas, 20 kW furnace	EI, O	0.11
Wood chips	1.6	/ft^3	dry chips, 30 lb./ ft^3, 20 kW furnace	EI, O	31
TRANSPORT					
Garbage truck	3	/ton-mi.	21-ton municipal waste collection truck	EI	2.9

1. Philip White, Louise St. Pierre and Steve Belletire, 2013: *Okala Practitioner: Integrating Ecological Design*, ISBN 978-0-9851674-0-0
2. US EPA, 2014: *Greenhouse Gas Emissions from a Typical Passenger Vehicle*, Office of Transportation and Air Quality, EPA-420-F-14-040a
3. Roger McDonald, 2009: Gas, Oil and Wood Fueled Heating System Emissions, Brookhaven National laboratory, Upton, NY, USA
4. Philippe Ciais, Christopher Sabine, et al, 2013: Chapter 6. Carbon and Other Biogeochemical Cycles, in *Climate Change: The Physical Science Basis*, Fifth Report of the IPPC, Cambridge University Press, Cambridge, UK