Report of normalization of metal depletion

This report describes the data used for the normalization of ReCiPe in SimaPro.
The best option for the determination of the normalizing factors for the minerals is the use of the apparent consumption of regions. The USA has good data for the apparent consumption, for each mineral the apparent consumption is recorded for decades. These statistics can be found on the website of US geological survey (http://www.usgs.gov).
The apparent consumption of European countries is not so easily determined. For this reason the apparent consumption of the USA was used and extrapolated to get the apparent consumption of the EU25+3. This was done in two different ways. The first way was the relative number of inhabitants; the second was the use of GNP. The table below shows the world production, the apparent consumption of the USA and the calculated apparent consumption using the two different ways.

	Apparent consumption USA (kg)	**World production (kg)**	**Apparent consumption EU (kg) using inhabitants**	Apparent consumption EU (kg) using BNP
Al	4,08E+09	**2,43E+10**	**6,94E+09**	3,55E+09
Fe	4,54E+10	**8,50E+11**	**7,73E+10**	3,95E+10
Zn	1,33E+09	**8,77E+09**	**2,26E+09**	1,16E+09
Pb	1,74E+09	**3,20E+09**	**2,96E+09**	1,51E+09
Ni	2,33E+08	**1,29E+09**	**3,96E+08**	2,03E+08
Cu	3,09E+09	**1,32E+10**	**5,26E+09**	2,69E+09
Co	1,17E+07	**3,60E+07**	**1,99E+07**	1,02E+07
Cr	6,57E+08	**4,75E+09**	**1,12E+09**	5,72E+08
Mo	2,86E+07	**1,35E+08**	**4,87E+07**	2,49E+07
U	2,00E+07	**3,61E+07**	**3,40E+07**	1,74E+07
Mn	7,68E+08	**6,96E+09**	**1,31E+09**	6,68E+08
Pd	1,33E+05	**1,74E+05**	**2,26E+05**	1,15E+05
Ag	6,28E+06	**1,81E+07**	**1,07E+07**	5,47E+06
Sn	5,72E+07	**2,78E+08**	**9,73E+07**	4,98E+07
Ir	2,70E+03	**2,85E+03**	**4,59E+03**	2,35E+03
Au	3,37E+05	**2,59E+06**	**5,73E+05**	2,93E+05
Ru	2,09E+04	**2,59E+04**	**3,56E+04**	1,82E+04
Rh	1,74E+04	**2,27E+04**	**2,96E+04**	1,51E+04
Pt	7,21E+04	**1,55E+05**	**1,23E+05**	6,28E+04
Os	1,33E+02	**6.00E+02**	**2,26E+02**	1,16E+02

The source (except uranium and PGM metals) of the data of the world production is U.S. Geological Survey (USGS) (http://minerals.usgs.gov/ds/2005/140/).
Apparent consumption was used and secondary production was subtracted.
Data world production was used from this source also. The world production only includes primary production.
Steel production: iron and steel figures were used and iron and steel scrap was subtracted.

The source of the world production of uranium is the world nuclear association: http://www.world-nuclear.org/info/inf23.html, data from 2002. The figures are from the salt U_3O_8, the figures were calculated to kg U.
The source of the apparent consumption of uranium of the USA was the energy information administration (http://www.eia.doe.gov/cneaf/nuclear/umar/table1.pdf). The figures were also of U_3O_8 and calculated to kg U. The apparent consumption of uranium of the Eu25+3 extrapolated in this way is very high, 94% of the world production. This can not be correct as the apparent consumption of the USA added with the apparent consumption of the EU25+3 is much more than the world production. This will not cause a significant deviation of the normalisation as the impact of uranium only accounts for 0.2% of the impact of all the extracted resources.

For PGM http://minerals.usgs.gov/minerals/pubs/commodity/platinum/ was used and apparent consumption was calculated with the formula: Apparent consumption = mining + import – export

The world production of platinum and palladium was reported by USGS but the world production of Ir, Os, Rh and Ru was not reported differentiated but combined (51.4 tonne). The differentiation was done on basis of refinery or smelter output. The ratio was 2200:0:17500:20000. For Osmium the world production would be zero. Three sources of world production were found:
0.6 tonne: http://www.mapsofworld.com/referrals/metals/platinum/osmium.html
0.06 tonne: http://environmentalchemistry.com/yogi/periodic/Os.html
1 to 2 tonne: http://www.periodieksysteem.com/elem_nl.cfm?IDE=Os

0.6 tonne was used for the normalization.

The apparent European consumption of a few minerals was found on the following site:
http://www.coleurope.eu/file/content/StudyProgrammes/eco/chair/toyota/200612_conference/Papers/Christmann_Paper_Growth_Conf_Bruges.pdf

These figures are compared for a reality check:

Metal	Christman (kg)	Extrapolated, GNP (kg)	
Steel	$3.26*10^{11}$	$3.95*10^{10}$	
Aluminium	$6.2*10^{9}$	$3.55*10^{9}$	
Copper	$4*10^{9}$	$2,69*10^{9}$	
Zinc	$2.3*10^{9}$	$1,16*10^{9}$	

The table above shows that the apparent consumption of aluminium, copper and zinc are higher according Chritsman than according our calculation. The apparent consumption of steel is actually 8 times higher than our calculation. This figure is more than 1/3 of the world production, which does make it a credible figure as a lower value would be expected. The other figures are in the same range.