Futuro as a monetary methodology for sustainability assessment based on the origin of components

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Abstract

Currently, the market price and the external costs do not directly correlate. In fact, long-lasting products with assumingly lower external costs are more expensive than disposable products. To this end, the futuro methodology aims to label goods with their sustainable prices, which shall include the external costs in order to serve as a valuable and understandable sustainable assessment indicator – for consumers as well as for producers. The research described in this paper concentrates on latest futuro research: The algorithm is based on the origin of components to allow straight-forward impact estimations. These estimations refer to national statistics and have the target to identify and assess key influencing parameters, which reflect a maximum share of the whole effects making an individual product (and in total the world) unsustainable. The results show the impact of unfair production and low wages and identify the debt of the Austrian population according to the selected social and ecological indicators. A detailed Life-Cycle-Assessment analysis of all products manufactured in the world would be very extensive. In contrast, the presented futuro methodology describes an approach which estimates the external costs with a comparable low effort.

Keywords

External costs of products, GHG, virtual water, wage disparities, sustainability assessment

1 Selection of key influencing parameters

The futuro methodology, aiming to complement the predominant ecological assessment methods, has always pursued to include social, ecologic and economic factors allowing constituting the social and economic disparities as well as the environmental consequences of the predominant current economic model. *"Resource-intensive products are exported by developing countries to industrial countries...such a resource-intensive pattern of international trade can have damaging effects on the global environment" (Chichilnisky and Galloping, 2008).*

The futuro research team has been working on the algorithm and the different methodological aims of futuro since 2002 (Jakubowicz et al., 2004; Bußwald et al., 2009). The method initially combined ten different indicators by monetary assessment. Actual research intended to reduce the number of indicators while possibly not loosing comprehensiveness by identifying key influencing parameters:

It is evident that the differences in wages are a major influencing factor regarding sustainability (Gallo, 2012; Downs, 2008; Nghia, 2010). Thus, the wages indicator has always been an important part of the futuro methodology. Previously, social issues were integrated in the futuro algorithm separately from wages. However, social issues such as cohesion, security and public social expenses, literacy rates and educational budgets - as important indicators for welfare levels - are already considered by the wages indicator, due to data overlaps (wages for people working for social services included in social expenses), transitive effects and correlations (Beça and Santos, 2010). Therefore, the current research concentrates on the wage indicator to reflect the social and economic effects.

Second, the availability of clean water is also connected to (toxic) emissions in water and soil. Consequently, for the ecological side, the indicator "water resources" as a major parameter for the ecosystem is integrated. Third, greenhouse gas (GHG) emissions have been selected to reflect climate and energy aspects.

2 Product and national level

"On the national level the methodology shall be used to calculate how much the consumers of one specific consuming country of the North "save" by unpaid/uncompensated external effects caused in the producing countries of the South" (Bußwald et al., 2009). Manufacturing plants were dislocated from the North (North-America, Europe) to the South (South America, parts of Asia and Africa) during the globalization (Chichilnisky and Galloping, 2008). Consequently, former "production countries" in the North turned to mainly consumption-

countries and still many products manufactured in the South are mainly consumed in the North (Boitier, 2012).

GHG-emissions, virtual water and unfair wages, our selected key representatives for external effects, are embodied in the product imports: In the countries from the South workers earn low wages, work under poor working conditions and have few rights. Few environmental standards exist and thus severe pollution and high GHG-emissions are frequent in these countries. Often, there are only few renewable water resources and a high level of water pollution and contamination.

GHGemissions, due to current rules of emission schemes, are allocated on the national level based on production figures (territorial principle). As a result, countries from the North account for decreasing or less increasing GHG-emissions (if not compensated by other effects) although consumers of the products predominantly living in the North. A consumption-based approach of the GHG-emissions allocation considers this discrepancy (Peters et al., 2011). Such an approach is also integrated in the research described in this paper.

If the national external effects of production are assigned to single products based on exports and production activities of the respective country, they can be further delegated to the consumers of the products.

3 The principal approach of the futuro methodology

The futuro-methodology is structured as follows:

1. Determination of the national or worldwide consumption (for input-parameters as virtual water) or emissions (for output-parameters as GHG) or status quo values (for wages) based on statistics and research results
2. Calculation of the input/output-intensities (virtual water/GHG) per produced or exported € from each country
3. Integration of the indicators in a pricing model to assess the consumption/emissions in monetary units

The result of the futuro-methodology is a value (in €) which ought to be added to the market-price of a certain product. The futuro-value demonstrates social and environmental fairness and sustainability. This additional charge supports consumers as a basis for decision-making. Thus, consumers can estimate which products are produced under more sustainable and fair conditions. At the same time the futuro values can serve producers as marketing tool and argumentation support.

Important basic parameters for the methodology are the Gross Domestic Product (GDP) and the export values from “producing countries” to “consuming countries”. Of course, each country can take the role of a producing as well as a consuming country. Austria, as the location of the futuro research team, is the main country analyzed within this research project. The export values to Austria are not directly taken from statistics. Instead, the values are calculated as a GDP-ratio from the exports of the world in the EU. Formula (1) shows this calculation.

$$(1)\ X_i^{\text{Ö}} = X_i^{EU} * \frac{BIP_{\text{Ö}}}{BIP_{EU}}$$

With:

$X_i^{\text{Ö}}$= exports from country i to Austria (Ö) in €

X_i^{EU}= exports from country i in the EU in €

$BIP_{\text{Ö}}$= GDP from Austria in €

BIP_{EU}= GDP from the EU (as the sum of GDPs from the 27 member states) in €

GDP data for each country are taken from the World Bank (World Bank, 2012) and export data from the UN database comtrade (UN, 2011). EU internal trade is deliberately excluded to focus on the North-South differences. The researchers are aware of the limitations of the GDP, but within the futuro-methodology the GDP serves as a purely economic indicator and not for quality of life or welfare. Table 1 shows an overview of the export values of different countries to Austria.

Table 1: Export value of selected countries to Austria 2011 in €

Countries	Export value to Austria in €
China	6,901,592,746
Brazil	894,044,821
Tunisia	233,234,026
India	930,392,431
Burkina Faso	1,494,665
Nigeria	570,378,517

4 Analysis and methodology for wages

The indicator „wages" pinpoints the pay gap and therefore the wage inequity between the classical consumption country (here Austria) and the classical production countries. It illustrates main social and economic impacts by calculating how much a certain product ought to be more expensive if it was manufactured in the consumption-country or if the workers in the production-country would earn as much as the workers in the consumption-country.

The "real-wages-ratio" between the production- and consumption-country is calculated to show this gap (Formula (3)). It is based on data of wages from men and women from each country of the world taken from the "Global Gender Gap Report" (World Economic Forum, 2012) combined with data of the economically active population from LABORSTA (ILO, 2012) to represent the mean estimated earned income per capita (Formula (2)). The differences in purchasing power are correctly considered (World Bank, 2012).

$$(2)\quad G_i = \frac{G_{i,m} * n_{i,m} + G_{i,f} * n_{i,f}}{n_{i,m} + n_{i,f}} * P_i * \gamma$$

With:

G_i= mean estimated earned income per capita weighted by the economically active population of the country i ($G_Ö$= of Austria) in PPP-USD

$G_{i,m}$ and $G_{i,f}$ = mean estimated earned income of the country i for men (m) and women (f) in PPP-USD

$n_{i,m}$ and $n_{i,f}$ = number of economically active men (m) and women (f) of the country i

P_i= purchasing power parity of the country i

γ= exchange rate USD/€

Formula (3) shows the calculation of the real-wages-ratio.

$$(3)\quad R_i = \frac{G_Ö}{G_i}$$

With: R_i= real-wages-ratio between Austria and the country i

4.1 Results

As a result, on national level, each Austrian saves 5,243 € per year (44 billion € in total) by consuming products from low-wages countries. Figure 1 shows the total wages debt of Austria broken down to the continents.

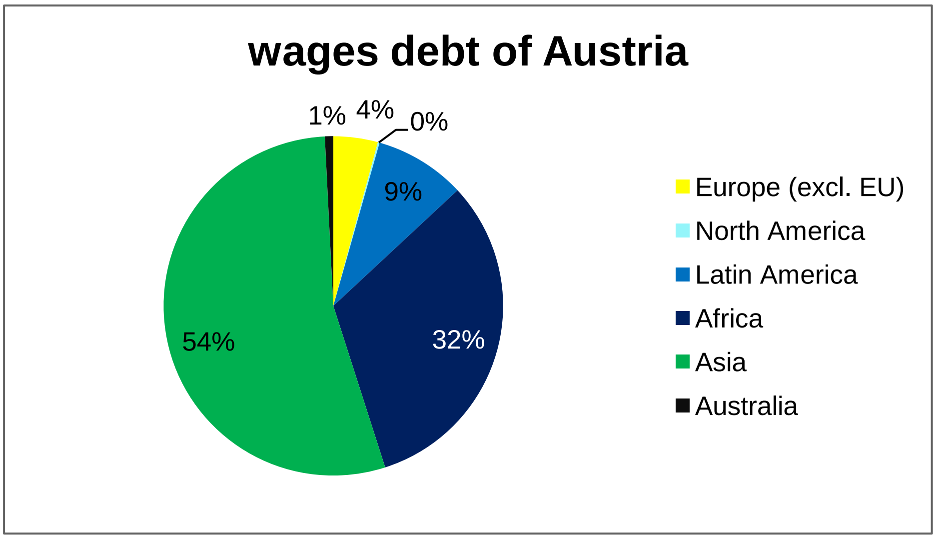

Figure 1: Austria's wages debt, 2013

The majority of the wages debt to Africa and Asia corresponds to the countries shown in Figure 2.

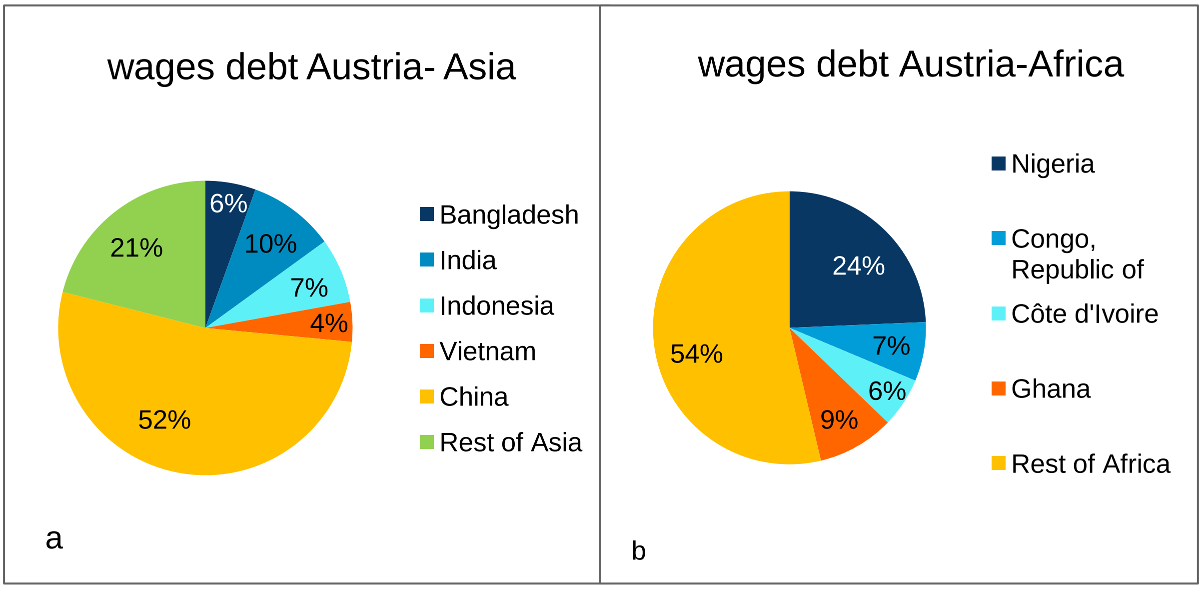

Figure 2: Wages debt of Austria to Asia (a) and Africa (b), 2013

The wages debt is determined by the real-wage-ratio and by the volume of the exports to Austria.

4.2 Limitation

The indicator “wages” of course cannot completely depict reality. Data which could improve the indicator are not available at the moment, for instance, self-employed incomes are missing in the income-statistics. Furthermore, income data does not relate to the working hours, which would augment the precision. In addition, data about sectoral incomes would be important for the interpretation of the results on product level.

5 Analysis and methodology for water

When importing a product, virtual water which is needed during the production process and the whole product life cycle is also imported. This becomes especially crucial, if production regions suffer from water stress. Water stress, defined by the UN (UN, 2013), implies less than 1,700 m^3 renewable water resources per capita and year. Countries who suffer from (absolute) water scarcity dispose of less than (500) 1,000 m^3 renewable water resources per capita and year. Mekonnen and Hoekstra have calculated the amount of virtual water exports from each country (Mekonnen and Hoekstra, 2011), which we use as follows to calculate the virtual water imports to a consuming country (formula (4)):

$$(4)\ W_i^{Ö} = W_i * \frac{X_i^{Ö}}{X_i}$$

With:

$W_i^{Ö}$= virtual water exports from country i to Austria (Ö) in m^3
W_i= total virtual water exports of country i (in the world) in m^3
$X_i^{Ö}$= total exports from the country i to Austria in €
X_i= total exports of the country i (in the world) in €

Additionally, the waterintensity (I_w) of the exports of the country i is calculated:

$$(5)\ I_{w,i} = \frac{W_i \mathrm{m}^3}{X_i\ €}$$

The costs of the virtual water exports to Austria are calculated by formula (6).

$$(6)\ Mw_i^{Ö} = I_{w,i} * \psi * X_i^{Ö}$$

With:

$Mw_i^{Ö}$= Austria’s costs of the virtual water exports from country i to Austria in €
ψ = water price in € per m^3 water

5.1 Results

Austria's renewable water resources amount to 6,538 m^3 per capita and year (FAO, 2012). Austria imports 13,399 Mm^3 virtual water each year (Mekonnen and Hoekstra, 2011), from which 1,019 Mm^3 are from regions under water stress, 377 Mm^3 from regions under water scarcity and 780 Mm^3 from regions under absolute scarcity. Based on a water price of 3.50 € per m^3 the total costs of Austria's water imports are 945 € per capita. The virtual water exports from regions who dispose of enough (=1,700 m^3) renewable water resources after subtracting their virtual water exports are not priced. The following Table 2 shows important key figures:

Table 2: Virtual water key figures of selected countries 2013

Countries	Renewable water resources in m^3/capita/year	Water-intensity of the exports in m^3/€	Virtual water exports in the world in Mm^3	Virtual water exports to Austria in Mm^3	Amount of renewable water resources after subtracting virtual water exports in m^3/capita/year
China	2,041	0.1	142,697	661	1,935
Brazil	27,551	0.56	112,492	501	26,972
India	1,165	0.53	124,875	491	1,0656
Tunisia	396	0.70	9,765	163	-508
Burkina Faso	737	1.49	2,713	2	582
Nigeria	1,360	0.08	7,485	43	1,316

5.2 Limitation

If a region suffers from water stress before or after its water exports in the world, those water exports should be valued higher than those from regions with enough water resources. As a result, the water exports from regions with enough water are not included in the calculation. In addition, the water exports from regions under water stress have been assigned the costs relating to seawater desalination costs as follows:

Apparently, there are enough seawater resources worldwide. The costs of the seawater desalination vary. They depend on the method used, the energy source used and the capacity. The costs per m^3 seawater desalinated in a plant which uses solar energy or photovoltaic are at least 3.50 € (Karagiannis and Soldatos, 2008). This water price is chosen.

6 Analysis and methodology for greenhouse gas emissions

The GHG-emissions, which correlate to the consumption of a country, are not accounted by the conventional production-based approach of emissions-allocation on the national level (Steinberger et al., 2012). Our futuro approach is consumption-based properly integrating emissions which are imported and exported.

However, a very precise allocation of the GHG-emissions due to international trade would be very complex, thus a simplified allocation method was developed by the research team, simpler than multi-regional-input-output models (Andrew and Forgie, 2008; Lenzen et al., 2007; Peters, 2008), as follows:

First of all the GHG-intensity [kg/€] (formula (7)) of the production in each country is calculated. The data of the local GHG-emissions are taken from the International Energy Agency (IEA, 2012). The GHG-exports from one country to Austria are calculated by multiplying the total exports from the country to Austria with the GHG-intensity of the production (formula (8)).

$$(7)\quad I_{c,i} = \frac{E_i}{BIP_i}$$

With:

$I_{c,i}$= GHG-intensity of the country i in kg CO_2-equivalent (CO_2e) per € ($I_{c,ö}$= GHG-intensity of Austria)

E_i= local, production-based CO_2e emissions of the country i in kg

BIP_i= Gross Domestic Product in € of the country i

Austria's GHG-intensity is 0.32 kg/€ and the arithmetic mean worldwide is 0.76 kg/€.

$$(8)\quad C_i^{Ö} = I_{c,i} * X_i^{Ö}$$

With:

$C_i^{Ö}$= GHG-exports from the country i to Austria in kg

$X_i^{Ö}$= total exports from the country i to Austria in €

To integrate the GHG-emissions into the final futuro-value, a proper CO_2-price is required. The GHG-exports to Austria are then multiplied with this defined price (formula (9)). Thus, the GHG-costs of the imports to Austria can be quantified as follows:

$$(9)\ Mc_i^{\text{Ö}} = C_i^{\text{Ö}} * \varphi$$

With:
$\mathrm{M}c_i^{\text{Ö}}$= GHG-costs of the exports from the country i to Austria in €
φ= CO_2-price in € per kg CO_2

The GHG-exports of Austria are calculated again as a part of the GHG-exports of the EU.

6.1 Results

The consumption-based GHG-emissions of Austria are defined by the local GHG-emissions, the GHG-imports and the GHG-exports.

Austria's GHG-emissions account 89.9 Mt on a production-based approach, which are 10.58 t per capita. On a consumption-based approach the EU-intern trade is neglected and Austria's GHG-imports and exports are quantified as a share of the EU-imports and –exports. The GHG-imports of the EU amount to 1.7 Gt CO_2e (billion tons) and the GHG-exports amount to 741 Mt CO_2e. Austria's share of the EU-imports is 38 Mt CO_2e and of the EU-exports 16 Mt. Thus, Austria's consumption-based GHG-emissions without the EU internal GHG-trade are 115.7 Mt, which are 13.6 t per capita. Thus, 33 % of the consumption-based emissions are related to imports. The sustainable level of the GHG-emissions is 2.7 t per capita each year to achieve the 2-degree-goal with a probability of 75 %. With a rising population the sustainable level will decline to 1 t per capita (WBGU, 2009). As a result, Austria emits nearly 4 times those emissions which are sustainable on the production-based approach and 6 times on the consumption-based approach.

The result of the futuro-methodology, which states that about 30 % of the consumption-based GHG-emissions are related to the imports, is consistent with the results described in the literature. For instance, the OECD countries consume 30 % more GHG-emissions than they produce (Bruckner et. al, 2010). The G7 countries import 36 % of their consumption-based GHG-emissions (Chen and Chen, 2011). The economic powerful European countries import 20-50 % of their consumption-based GHG-emissions and totally 23 % of the global GHG-emissions are traded all over the world (Davis and Caldeira, 2009). Table 3 shows GHG key figures of selected countries.

Table 3: GHG key figures of selected countries 2013

Countries	Local GHG-emissions in Mt	GHG-intensity in kg/€	GHG-exports to Austria in kg
China	10.693	1,197	8.263.297.967
Brazil	1.604	0,886	792.551.345
Tunisia	37	0,463	107.929.303
India	2.694	0,757	704.331.739
Nigeria	223	0,691	393.945.978,66

The Chinese GHG-exports to Austria account for 10 % of the local, production-based GHG-emissions of Austria, 10.5 % of the total GHG-imports of Austria (including EU-internal) and 21.7 % of Austria's GHG-imports without the EU-intern-trade. Table 4 shows the consumption and production-based GHG-emissions of selected countries.

Table 4: Consumption-based GHG-emissions of selected countries in CO_2-equivalent

Countries	Local GHG-emissions in Mt	Local GHG-emissions per capita in t	GHG-imports in Mt	GHG-exports in Mt	Consumption-based GHG-emissions in Mt	Consumption-based GHG-emissions per capita in t
Austria (excl EU)	89.90	10.58	38.33	12.53	115.70	13.61
China	10,693.30	7.92	1,847.64	1,783.96	10,756.98	7.97
Brazil	1,603.50	8.25	177.31	178.14	1,420.63	7.31

The costs of the consumption-based GHG-emissions from Austria amount to 870 € per capita. The GHG-debt of Austria's inhabitants is calculated based on the costs of all consumption-based GHG-emissions which exceed the sustainable level of 2.7 t per capita.

To define a CO_2-price which refers to the damage GHG cause is problematic. While prices for CO_2-compensation are available, they are not "eligible" for our case as GHG-emissions emitted today exceed a rate which could be compensated: To compensate the emissions which exceed 2.7 t per capita, 194 billion ha worldwide or 5,677 ha per capita are necessary (the total arable land corresponds to 14.9 billion ha (FAO, 2013)). According to the Stern Review (Stern Review, 2006) the costs of the damage CO_2 causes are at least 80 USD

(=66.7 €) per ton. According to Bowen (Bowen, 2011) the costs of CO_2 rise 3 to 5 % each year which means that CO_2 per ton costs at least 80 € today.

6.2 Limitation

The calculated GHG-intensity of production might be even higher in reality, because the GDP includes not only the products manufactured in one country but also services delivered which of course include a lower GHG-intensity.

The definition of a proper CO_2-price is another limitation further discussed in chapter 7.

In addition, the transport of the goods and the transport related GHG-emissions are not explicitly considered in the current methodology (only via GDP values). Consequently, the GHG-emissions on the consumption-based approach and the GHG-imports and exports are rather underestimated and can thus be seen as a first, conservative estimate.

The calculation of the GHG-intensity differs from the approach for water-intensity. The GHG-intensity describes the intensity of production and the water-intensity describes the intensity of the total exports. This difference occurs due to the better data availability of water exports and total exports than production key figures as they are available for GHG.

7 Pricing

One of the biggest problems with the indicators “virtual water” and “GHG” was to define an adequate price. A worldwide water price which includes several costs (e.g. groundwater exploration, transport, water treatment, water supply) is not available. In addition, the local water prices in the different countries are not consistent and are distorted by market and local policy mechanisms.

By the prices currently chosen for water and GHG-emissions, Austria’s GHG-imports only cost 360 € per capita, which seems low compared to the water debt (=945 €) and the wage debt (=5,240 €).

8 Application of the methodology for products

On the product level the external costs of products are calculated as sum of the wages debt, the included virtual water and the included GHG, all based on the import values of products or product groups.

8.1 Wages

To define the wage dept of a certain product, the futuro wages factor is multiplied with the import value of the product. The wages factor is representing the wages ratio between production and consumption country.

8.2 GHG

The calculation of the included GHG in a certain product from one country is based on the GHG-intensity of the production country multiplied by the CO_2-price.

This approach includes a kind of a national mean GHG-intensity of a country, a sectoral calculation of GHG-intensities would be more precise and could be realized by sectoral weighing factors.

8.3 Virtual water

To define the quantity of included virtual water in products from certain regions, the water-intensity is viable. The water-intensity, m^3 water per imported €, is multiplied with the water price (=3.50 €). Again, weighing factors to reflect sectoral differences in water-intensities would improve the results.

8.4 Futuro-value

The three indicators are added to the final futuro-value which represents the external and additional costs of certain products or product groups from certain countries or regions.

Table 5 shows an overview of the three indicators and the futuro-value of selected countries and Table 6 of the constituted regions.

Table 5: Futuro-value and indicators of selected countries 2013

Countries	Wage inequity [€/€]	GHG-intensity [kg/€]	GHG-intensity [€/€]	Water-intensity [m^3/€]	Water-intensity [€/€]	Futuro-value per imported €
China	1.83	1.20	0.10	0.10	0.00	1.9
Brazil	2.34	0.89	0.07	0.56	0.00	2.4
India	2.46	0.76	0.06	0.53	1.85	4.4
Tunisia	0.68	0.46	0.04	0.70	2.44	3.2
Burkina Faso	12.20	0.00	0.00	1.49	5.23	17.4
Nigeria	6.08	0.69	0.06	0.08	0.27	6.4
Russia	0.02	1.05	0.08	0.16	0.00	0.1
USA	0.00	0.56	0.04	0.27	0.00	0.0
Australia	0.38	0.84	0.07	0.46	0.00	0.4
Japan	0.39	0.39	0.03	0.02	0.00	0.4
Turkey	0.09	0.41	0.03	0.22	0.00	0.1
Thailand	1.42	0.92	0.07	0.29	0.00	1.5
Congo, Dem.Rep.of	29.69	55.73	4.44	0.00	0.00	34.1

Table 6: Futuro-value and indicators of regions (individual countries are aggregated by using weighting factors according to import shares to Austria) in € 2013

Region	Futuro-value weighted in €	Wage inequity weighted in €	GHG-intensity weighted in €	Water-intensity weighted in €
Australia and Oceania	1.2	0.94	0.06	0.24
EU	0.0	0.00	0.00	0.00
Northern Europe	0.2	0.15	0.02	0.00
Eastern Europe	2.5	1.44	0.09	0.92
North Africa	2.2	1.46	0.05	0.74
West Africa	7.5	6.91	0.08	0.54
East Africa	17.2	11.05	0.07	6.05
southern Africa	2.9	2.23	0.09	0.61
Central Africa	14.7	14.04	0.66	0.00
North America	0.1	0.01	0.05	0.00
Latin America	1.6	1.47	0.05	0.04
Middle East	0.9	0.67	0.07	0.11
East Asia	1.4	1.29	0.12	0.02
South and Southeast Asia	3.7	2.54	0.09	1.08
Central Asia	7.8	4.49	0.30	3.04
Russia	0.1	0.02	0.08	0.00

9 Research outlook

Further research plans to integrate transport effects, which are currently only roughly treated (and badly allocated) by national GHG-emissions. The calculation of sector specific factors will improve the estimation quality compared to pure national averages.

Algorithms to smoothly calculate futuro-values for local products (without including import values) will also be developed in the future.

10 Literature

Andrew, R. and Forgie, V. (2008). A three-perspective view of greenhouse gas emission responsibilities in New Zealand. Ecological Economics 68: 194–204.

Beça, P. and Santos, R. (2010). Measuring sustainable welfare: A new approach to the ISEW. Ecological Economics 69: 810-819.

Boitier, B. (2012). CO2 emissions production-based accounting vs. consumption: Insights from the WIOD databases. WIOD Conference Paper, April.

Bowen, A. (2011). The case for carbon pricing. Policy Brief. Available from: http://www.lse.ac.uk/GranthamInstitute/publications/Policy/docs/PB_case-carbon-pricing_Bowen.pdf [Accessed Date: 18-08-2013]

Bruckner, M., Polzin, C. and Giljum, S. (2010). Counting CO2 emissions in a globalized world. DIE Research Project: Development Policy- Questions for the future. Bonn. Deutsches Institut für Entwicklungspolitik.

Bußwald, P., Jakubowicz, D., Sedlak, M. and Supper, S. (2009). Futuro- an integrated sustainability algorithm for products including social aspects.

Bußwald, P., Jakubowicz, D., Sedlak, M. and Supper, S. (2009). Futuro - Living on the South - a Social LCA Methodology. Presentation at the Solidarische Ökonomie Kongress, BOKU. Vienna, 20.-22. February 2009.

Chen, Z.M. and Chen, C.Q. (2011). Embodied carbon dioxide emission at supra-national scale: A coalition analysis for G7, BRIC, and the rest of the world. Energy Policy 39: 2899-2909.

Chichilnisky, G. and Galloping, G. (2008). The environmental impact of globalization in Latin America: a prospective approach. Managing Human-Dominated Ecosystems 8440: 271-303.

Davis, S.J. and Caldeira, K. (2009). Consumption-based accounting of CO_2 emissions. PNAS Vol.10 No.12: 5687-5692.

Downs, TJ. (2008). Transforming impact assessment for sustainable development and poverty eradication. Engineering Sustainability 161: 39-53.

FAO (2013). Statistical Yearbook 2013: World Food and Agriculture.

FAO (2012). Aquastat: Total internal renewable water resources per capita. Available from: http://www.fao.org/nr/water/aquastat/data/query/results.html [Accessed Date: 06-08-2013]

Gallo, E. (2012). Health and the green economy: challenges for sustainable development and the eradication of poverty. Ciência & saude coletiva 17: 1457-1468.

IEA (2012). CO2 emissions from fuel combustion (2012 Edition)-Part III Greenhouse-Gas Emissions: 46-51.

ILO (2012). Laborsta: The economically active population. Available from: http://laborsta.ilo.org/STP/guest [Accessed Date: 06-08-2013]

Jakubowicz, D., Supper, S. and Bußwald, P. (2004). FUTURO, der Nachhaltigkeitspreis. Sustainable Austria 28: 1-24.

Karagiannis, I.C. and Soldatos, P.G. (2008). Water desalination cost literature: review and assessment. Desalination 223: 448-456.

Lenzen, M., Murray, J., Sack, F. and Wiedmann, T. (2007). Shared producer and consumer responsibility — theory and practice. Ecological Economics 61: 27–42.

Mekonnen, M.M. and Hoekstra, A.Y. (2011). The green, blue and grey water footprint of crops and derived crops products. Hydrology and Earth System Sciences 15: 1577-1600.

Mekonnen, M.M. and Hoekstra, A.Y. (2011). National water footprint accounts: The green, blue and grey water footprint of production and consumption. Value of Water Research Report Series No. 50. UNESCO-IHE, Delft, the Netherlands.

Mózner, Z.V. (2012). A consumption-based approach to carbon emission accounting-sectoral differences and environmental benefits. Journal of Cleaner Production 42: 83-95.

Nghia, N.C. (2010). Management Research about Solutions for the Eradication of Global Poverty: A Literature Review. Journal of sustainable development Vol. 3 No.1: 17-28.

Peters, G.P., Minx, J.C., Weber, C.L. and Edenhofer, O. (2011). Growth in emissions transfer via international trade from 1990 to 2008. PNAS Vol.108 No.21: 8903-8908.

Peters, G.P. (2008). From production-based to consumption-based national emission inventories. Ecological Economics 65: 13–23.

Steinberger, J.K., Roberts, J.T., Peters, G.P. and Baiocchi, G. (2012). Pathways of human development and carbon emissions embodied in trade. Nature Climate Change 2: 81-85.

Stern Review (2006). The economics of climate change. Available from: http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/sternreview_report_complete.pdf [Accessed Date: 18-08-2013]

UN (2013). Water for Life Decade: Water scarcity. Available from: http://www.un.org/waterforlifedecade/scarcity.shtml [Accessed Date: 06-08-2013]

UN (2011). Comtrade. Trade Flows: Import EU-27. Available from: http://comtrade.un.org/db/dqBasicQueryResults.aspx?cc=total&px=S1&r=ALL&y=2011&p=0&rg=2&so=9999 [Accessed Date: 05-08-2013]

WBGU (2009). Kassensturz für den Weltklimatag- Der Budgetansatz. Sondergutachten, Berlin.

World Bank (2012). GDP ranking, PPP based. Available from: http://data.worldbank.org/data-catalog/GDP-PPP-based-table [Accessed Date: 05-08-2013]

World Bank (2012). PPP conversion factor to market exchange rate ratio. Available from: http://data.worldbank.org/indicator/PA.NUS.PPPC.RF [Accessed Date: 06-08-2013]

World Economic Forum (2012). The Global Gender Gap Report 2012.