Annexes

Table of contents

Annex A. Technical Summary and Recommendations

Input Data: assessment and recommendations for the improvement of top down Ecological Footprint Assessments

Input data is a key component for all ecological footprint and biocapacity accounts. In situations where data gaps exist, the top down results for ecological footprint results are conservative and consumption patterns are assumed to be equivalent to the national average of Slovenia. In this study, the primary data source to differentiate regional consumption footprints from Slovenia-an national average footprint (table 2.1) was household expenditure (HHE) adjusted to purchasing power parity (PPP) with detailed resolution, obtained by COICOP category from Oxford Economics (Oxford Economics, 2014).

Research into improved dataset resolution suggests that coordination with regional statistical authorities, including national statistical databases (https://pxweb.stat.si, https://www.stat.si/) will be a key area to improve data quality and accuracy for regional ecological footprint calculations. While the top-down calculation applies a standard methodology and robust expenditure data, inclusion of locally gathered is important because it includes physical consumption data which can both supplement expenditure data and be used as a monitoring tool for annual update.

Category Resolution

In the most disaggregated form, the CLUM provides ecological footprints disaggregated into 52 detailed categories, which are defined according to COICOP household consumption categories. Ultimately, the top-down approach can provide accurate results to the degree that input data can reflect differences among regions for each COICOP category. The Oxford dataset provides PPP adjusted data at detailed resolution; however, the data are derived from internal models and may not reflect true consumer expenditures.

Economic and physical consumption statistics

Economic data can be highly reliable with proper resolution and proper adjustment. Outside the Oxford data, reliable results can be obtained with a combination of 3 data sources: detailed consumer expenditure, consumer price index (regional to national), local CO_2 intensity of energy consumption. The former two datasets allow a reliable economic proxy of consumption similar to PPP adjusted expenditure, and the latter, (CO_2) intensity, can reliably be used to determine carbon footprints at sub-national levels. In general, the availability of consistent economic data supports simple and comparable analyses, however, direct or physical data will provide even more robust results. Physical data can be used as the primary data source and supplemented by economic data for specific categories where scaling data is unavailable.

Housing and transportation are the largest footprint categories and can vary widely between regions; therefore, physical data reflecting the national average and regional averages is necessary for accurate results. Economic expenditure on these categories can also be useful, however these data need to be specifically adjusted with supplemental data to reflect differences in local pricing or else they will run a higher risk of capturing differences in local pricing rather than consumption.

Further coordination with regional statistics offices are recommended to align existing statistics and future collection with ecological footprint accounts. Table A.1.1 below provides a detailed disaggregation of consumption categories and sample physical or direct measures of consumption.

Regional Carbon intensity

CO2 emissions associated with energy consumption and vehicle tailpipe emissions make up most of our carbon footprint and are key parameters in monitoring the clean energy transition. The top down approach for ecological footprint accounting adjusts for the carbon intensities of various imported goods and services because it is based on a multi-regional input output model, which takes into account local CO2 emission intensities associated with all elements of the global supply chain from production to intermediate industries to final consumption. Within a country, CO2 emissions associated with energy consumption can vary greatly.

On both the supply side, the local CO2 intensity is a key factor that depends on the energy mix (renewable vs fossil-fuel based electricity production). Because local energy is used by both households and industry, consumption data is needed to differentiate between energy used by industries (which may be exported and consumed elsewhere) and energy consumed by household. CO2 intensity of production can also be used with additional information on the industrial vs household breakdown. On the demand side, factors like climate, and building construction (insulation, passive vs active heating and cooling) can greatly affect energy use.

Table A.1 below provides a detailed list with examples of data by consumption category. To develop a monitoring system for ecological footprint that is policy responsive, capturing elements which represent the largest footprints and fastest changing elements associated with policy implementations is critical. There are many potential data sources that can be used as proxy for consumption, however the identified proxies should be standardized across regions for have comparable results. Specifically, high priority categories are those associated with housing and transportation below, as well as regional carbon consumption intensities.

Additionally, as specific measures are passed, data which reflects the expected change in consumption associated with these measures can and should be recorded and incorporated into top-down calculations.

Table A.1 COICOP categories with suggested physical input data

Physical consumption or Proxy data (by category)		
COICOP category	**Notes / Example physical data**	**measurement units**
Food and non-alcoholic beverages		
Food	Food consumption by category or type eg. meat, dairy, fish, grains, vegetables.	kg/pers per year
Housing		
Actual rentals for housing	Average size of housing	m2/person
Imputed rentals for housing	% of main construction material in each dwellings	%
	Estimated CO2 in construction process in each construction material ($1m^2$)	t CO_2/m^2
	Estimated CO2 in construction process in each dwelling type ($1m^2$)	t CO_2/m^3
	a number of people in a household	person
	average durability of housing	year
Maintenance and repair of the dwelling	number of persons per household	persons per household
Water supply and miscellaneous services relating to the dwelling	water use per person	l per pers per day
	Carbon Intensity of water usage	kg co2/litre of water
Electricity, gas and other fuels	Carbon Intensity of Electricity production	co2(kg)/kwh
	Average electricity usage per person (In households vs non-household)	kwh/person per year
	use of gas (In households vs non-household)	kwh/person per year
	average contribution of renewable energy (solar power, etc.)	%
	carbon (and land) intensity of renewable energy source	co2(kg)/kwh
Service for household maintenance	expenditure	$
Transport		
Purchase of vehicles	number of cars	cars owned per 1000 people
	type of cars (%) and these average CO2 efficiency (CO_2/litre)	%, CO_2/litre
Operation of personal transport equipment	personal cars: km driven	km driven per person and year
	average gas mileage	l/100km
Transport services	Distance traveled by public transit and mode	km/person per year
	average CO2 intensity by mode	CO_2/km
	Flight distance or time each year?	hours/person per year
	average distance of air transport	km/person per year
	carbon intensity of air transport	CO2/km
Goods		
	Municipal waste statistics can be used as a general proxy for consumable goods, however this assumes a constant rate of goods disposal. Economic expenditure is more appropriate and captures much more detail on the type of goods purchased.	
Services		
	Ecological Footprint associated with services is best approximated with economic data.	

Annex B. Verification of Slovenia's Carbon Footprint

Carbon footprint verification

The carbon component of the Ecological Footprint is calculated as the bioproductive area demanded for the sequestration of anthropogenic CO_2 released in the atmosphere due to the combustion of fossil fuel. This includes the fossil fuels burned to produce electricity and direct emissions from vehicles. The carbon Footprint is the sum of the carbon footprint of four sub-categories (see table B.1 below): fossil fuel emissions, "other sources", traded electricity, and international transport

Table B.1. Carbon footprint of Slovenia by category, and by the production(EFp), trade(EFi, EFe), and consumption(EFc) flows as shown in the National Footprint and biocapacity accounts workbook(NFA 2019).

Name [-]	EF_P [gha]	EF_I [gha]	EF_E [gha]	EF_C [gha]
Fossil Fuel Emissions	4,545,288	8,661,423	7,609,789	5,596,923
Other Sources	367,877	-	-	367,877
Traded Electricity	-	812,025	799,851	12,174
International Transport	-	616,837	-	616,837
TOTAL	**4,913,166**	**10,090,285**	**8,409,640**	**6,593,811**

BOX B.1: Data parameters of the carbon component of the Ecological Footprint

Details of the standard data sources used to calculate the carbon component of the Ecological Footprint in the NFA are provided below:

Fossil fuel combustion emissions:

National (territorial) emissions
The primary source for national emissions data is the International Energy Agency (IEA). Overall national emissions are taken from the line item 'CO2 fuel combustion' which is then calculated with an Ecological Footprint intensity of carbon emissions.

Carbon Footprint in trade
Embodied emissions in traded commodities is calculated from data on traded commodities is the United Nations Commodity Trade Statistics Database (Comtrade). The National Footprint Accounts uses a statistical data cleaning and data filling algorithm (GFN, 2017) to catch outliers which are likely errors in the raw data, and to fill values for years where a commodity traded is missing where it is statistically identified as a gap in data.

Other sources:

Fugitive emissions refers mainly to flaring of associated gas in oil and gas production (in some cases including indirect CO2 from methane venting) (IPCC Source/Sink Category 1B) (IEA 2019).

Industrial Processes refer to production of cement, lime, soda ash, carbides, ammonia, methanol, ethylene and other chemicals, metals and to the use of soda ash, limestone and dolomite, and non-energy use of lubricants and waxes. Emissions exclude Fuel combustion emissions. (IPCC Source/Sink Category 2) (IEA 2019).

Traded electricity

The carbon footprint associated with electricity exports and imports is calculated from national production intensity + regional imports intensity (for exports) and regional production intensity (for imports)

Emissions from international transport

Data from both the IEA and Comtrade are used in the calculation of the Ecological Footprint from international transport. In line with the IPCC Greenhouse Gas Inventory Guidelines, the IEA reports emissions from international transport as adjunct Memo items (Memo: International Aviation, and Memo: Marine Bunker Fuels), not included in the overall emissions. As these reported emissions are for transport to and from a nation, and not necessarily linked to activities of a nation's residents, the National Footprint Accounts re-allocate these emissions between all nations by its proportion of global imports. In this way those emissions are linked to the transport of goods consumed, and the Comtrade trade data is used to calculate the proportions of global trade.

The standard source of national CO_2 emissions associated with fossil fuel combustion used in the Slovenia 2016 NFA workbook is the International Energy Agency, an intergovernmental organization established as part of the Organisation for Economic Co-operation and Development (OECD) framework, and which has been part of the process of developing the IPCC guidelines for emissions accounting. The IEA states that:

> "Based on the IEA globally collected energy data, the IEA estimates of CO2 emissions from fuel combustion are a global database obtained following harmonised definitions and comparable methodologies across countries. They do not represent an official source for national submissions, as national administrations should use the best available country-specific information to complete their emissions reporting. The IEA CO2 estimates can be compared with those reported by countries to the UNFCCC Secretariat to highlight

possible problems in methods, input data or emission factors. Still, care should be used in interpreting the results of any comparison since the IEA estimates may differ from a country's official submission for many reasons."

IEA, CO2 Emissions from Fuel Combustion: Database Documentation (2019 Edition)

The United Nations Framework Convention on Climate Change (UNFCCC) provides country reported GHG emissions which follow IPCC reporting guidelines and are expected to be consistent and comparable with IEA data, particularly for Annex I countries like Slovenia. Nevertheless, because methodologies may differ, results are not expected to be exactly the same. The values for Slovenia reported by IEA are 0.6% higher than those reported by UNFCCC.

Table B.2. Verified items in carbon Footprint of production

NFA 2016 Result (IEA)			Verification	
Name	**Production** [Mt CO_2 yr^{-1}]	**EF_P** [gha]	**Production** [Mt CO_2 yr^{-1}]	Source
CO2 Fuel Combustion	13.60	4,545,288	13.53	UNFCCC 1.AA Fuel Combustion - Sectoral Approach

Trade verification

The standard international data source for trade data in the NFA is the UN Comtrade, from which values are drawn in the SITC rev.1 coding system (Lin et al., 2017, Borucke et al., 2013). This coding system is used by Global Footprint Network as it is the oldest available coding system and the only one which allows the tracking of trade flows over the historical period of time covered by the National Footprint Accounts (1961-2016).

Because countries report their trade data in various coding systems, this comparison makes use of correspondence tables to match commodities in order to compare the values reported in different coding systems. The following sections compare 4-digit SITC rev.1 data from the Comtrade to Slovenia's reported data in 4 digit Combined Nomenclature and 2-digit SITC rev.4. At the time of development and publication of NFA 2019, the most recent year for which **Slovenia** trade data is available in UN Comtrade was 2016. Matching commodity groups from the 2016 Combined Nomenclature to the SITC-1 format used by GFN required a two-step process, where multiple correspondence tables were used to convert and reclassify categories to SITC-4, then to SITC-1. For major commodities and commodity groups, proper matching of codes was not a problem, however, more complex groupings (such as chemical products) which feature nested and overlapping categories are more difficult to compare across classification systems. For imports and for exports, the five largest commodities by ecological footprint were identified are compared side-by-side in tables B.3 and B.4. For each trade flow, the top five commodities represented 26% of the total Ecological Footprint either imported or exported, as tracked by the National Footprint and Biocapacity Accounts 2016 Edition.

Table B.3. Verified items in carbon Footprint of imports. The largest 5 commodities (of 625 total) by ecological footprint of imports represent 25.5% of the total Ecological Footprint of imported commodities.

Verified Import Commodities		Unverified			Verified		
		Imports (t/yr)	EF_I (gha)	Source	Imports (t/yr)	EF_I (gha)	Source
1	Products of polymerization and copolymerization	477,800	716,483	UN Comtrade	476,913	715,152	SiStat
2	Aluminium and aluminium alloys, unwrought	135,854	493,957	UN Comtrade	135,854	493,957	SiStat
3	Aluminium and aluminium alloys, worked	95,104	401,991	UN Comtrade	94,132	397,879	SiStat
4	Other inorganic bases and metallic oxides	457,903	343,323	UN Comtrade	402,912	302,092	SiStat
5	Iron & steel scrap	540,426	256,287	UN Comtrade	540,899	256,511	SiStat

Table B.4. Verified items in carbon Footprint of exports. The largest 5 commodities (of 625 total) by ecological footprint of exports represent 25.5% of the total Ecological Footprint of Exported commodities.

Verified Export Commodities		Unverified			Verified		
		Exports (t/yr)	EF_E (gha)	Source	Exports (t/yr)	EF_E (gha)	Source
1	Aluminium and aluminium alloys, worked	155,904	621,939	UN Comtrade	155,901	621,915	SiStat
2	Products of polymerization and copolymerization	302,428	428,013	UN Comtrade	330,496	467,733	SiStat
3	Aluminium and aluminium alloys, unwrought	91,622	314,408	UN Comtrade	105,540	362,165	SiStat
4	Passenger motor cars, other than buses	291,750	292,644	UN Comtrade	291,766	292,601	SiStat
5	Other metal salts & peroxysalts of inorganic acids	404,456	286,205	UN Comtrade	202,942	143,579	SiStat

The remaining 620 commodities were also compared in a similar manner, though the results featured some major differences when comparing at the 4-digit level. Unfortunately, the nature of category conversion and reclassification meant that it was unclear which differences were real and which were due to mismatched categories. To determine this, a secondary analysis was performed using 2016 data from

SiStat's "*Exports and imports by the Standard International Trade Classification, by countries, Slovenia, annually (cummulative data)".* Data is only available in the 2-digit SITC format, which makes this a much coarser analysis. Mismatching of codes was still a source of discrepancy between the datasets, however the aggregated categories provide a better view of which general categories are over or under-represented relative to data from UN Comtrade (table B.5).

Table B.5. Commodity Flow Comparisons using 2-digit SITC Categories, ordered by largest ecological footprint of trade (sum of import and export footprint)

	SLOVENIA (SiStat)				Tonnage - Footprint Conversion by 2-digit category		National Footprint and Biocapacity accounts (UN Comtrade)				Difference					
	[tonne yr^{-1}]		[1000 gha]		[1000 gha tonne^{-1}]		[tonne yr^{-1}]		[1000 gha]		[tonne yr^{-1}]		[1000 gha]		SiStat Estimate EF / NFA EF	
SITC Category Name	Slvn Imports	Slvn Exports	Efi	Efe	GFN EF/tonne imports	GFN EF/tonne exports	GFN Imports	GFN Exports	GFN EFi	GFN EFe	Dif Imports	Dif Exports	Dif EFi	Dif EFe	EF Import	EF Export
68 Non-ferrous metals	333,138	293,485	858	1,014	2.6	3.5	394,082	278,969	1,015	964	(60,943)	14,516	(157)	50	85%	105%
89 Miscellaneous manufactured articles, n.e.s.	126,049	232,589	182	285	1.4	1.2	614,332	540,739	886	662	(488,283)	(308,150)	(704)	(377)	21%	43%
52 Inorganic chemicals	448,750	377,883	340	269	0.8	0.7	1,259,121	772,435	955	551	(810,372)	(394,552)	(614)	(281)	36%	49%
78 Road vehicles (including air-cushion vehicles)	423,272	517,309	494	542	1.2	1.0	399,082	474,031	466	497	24,190	43,278	28	45	106%	109%
67 Iron and steel	1,195,563	625,011	590	277	0.5	0.4	1,158,099	609,937	571	270	37,465	15,074	18	7	103%	102%
77 Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., o	186,639	324,779	326	536	1.7	1.6	172,945	280,170	302	462	13,694	44,609	24	74	108%	116%
64 Paper,paperboard and articles of paper pulp, of paper or of paperboard	748,477	759,056	374	373	0.5	0.5	545,435	604,466	273	297	203,042	154,591	101	76	137%	126%
24 Cork and wood	1,294,842	3,741,482	127	434	0.1	0.1	1,172,188	3,496,994	115	405	122,654	244,488	12	28	110%	107%
28 Metalliferous ores and metal scrap	1,110,629	589,484	419	238	0.4	0.4	794,951	442,921	300	179	315,679	146,563	119	59	140%	133%
58 Plastics in non-primary forms	98,905	73,968	148	105	1.5	1.4	173,435	152,134	260	215	(74,529)	(78,167)	(112)	(111)	57%	49%
11 Beverages	680,489	1,621,896	141	302	0.2	0.2	680,489	1,621,891	141	302	(0)	4	(0)	0	100%	100%
62 Rubber manufactures, n.e.s.	66,953	128,277	98	178	1.5	1.4	123,670	169,958	181	236	(56,717)	(41,681)	(83)	(58)	54%	75%
25 Pulp and waste paper	560,423	155,045	305	78	0.5	0.5	560,423	155,045	305	78	(1)	0	(0)	0	100%	100%
53 Dyeing, tanning and colouring materials	111,745	217,233	154	229	1.4	1.1	109,712	213,381	151	225	2,033	3,853	3	4	102%	102%
74 General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.	106,029	163,453	135	197	1.3	1.2	107,494	170,789	136	206	(1,465)	(7,336)	(2)	(9)	99%	96%
66 Non-metallic mineral manufactures, n.e.s.	1,016,913	1,068,912	162	166	0.2	0.2	940,930	1,080,697	150	168	75,983	(11,785)	12	(2)	108%	99%
69 Manufactures of metals, n.e.s.	226,527	326,792	237	340	1.0	1.0	144,758	158,664	152	165	81,769	168,128	86	175	156%	206%
55 Essential oils and resinoids and perfume materials,toilet, polishing and cleansing preparations	106,725	117,853	113	147	1.1	1.2	119,242	151,553	126	189	(12,517)	(33,700)	(13)	(42)	90%	78%
51 Organic chemicals	384,387	170,715	327	110	0.8	0.6	327,112	40,145	278	26	57,275	130,570	49	84	118%	425%
08 Feeding stuff for animals (not including unmilled cereals)	651,919	372,518	238	145	0.4	0.4	463,341	345,809	169	135	188,578	26,709	69	10	141%	108%
59 Chemical materials and products, n.e.s.	177,744	173,144	140	147	0.8	0.9	178,768	171,564	141	146	(1,025)	1,580	(1)	1	99%	101%
71 Power-generating machinery and equipment	47,492	87,599	67	110	1.4	1.3	70,518	121,461	100	152	(23,026)	(33,863)	(33)	(42)	67%	72%
63 Cork and wood manufactures (excluding furniture)	286,411	294,386	79	119	0.3	0.4	291,742	345,538	81	139	(5,331)	(51,152)	(1)	(21)	98%	85%
54 Medicinal and pharmaceutical products	16,574	39,255	62	139	3.7	3.5	17,299	39,201	65	139	(725)	55	(3)	0	96%	100%
23 Crude rubber (including synthetic and reclaimed)	73,956	4,145	126	7	1.7	1.6	90,586	23,894	155	38	(16,630)	(19,749)	(28)	(32)	82%	17%

72 Machinery specialized for particular industries	62,657	106,707	75	124	1.2	1.2	57,034	105,101	68	122	5,623	1,606	7	2	110%	102%
27 Crude fertilizers, other than those of division 56,and crude minerals (excluding coal, petroleum and precious stones)	2,488,635	944,750	146	31	0.1	0.0	2,584,012	964,224	151	31	(95,376)	(19,473)	(6)	(1)	96%	98%
65 Textile yarn, fabrics, made-up articles, n.e.s., and related products	69,903	99,287	92	125	1.3	1.3	55,878	66,799	74	84	14,026	32,489	19	41	125%	149%
05 Vegetables and fruit	434,402	128,326	92	15	0.2	0.1	568,499	246,468	120	29	(134,097)	(118,142)	(28)	(14)	76%	52%
33 Petroleum, petroleum products and related materials	3,588,734	1,537,897	878	240	0.2	0.2	480,680	50,388	118	8	3,108,053	1,487,509	760	233	747%	3052%
83 Travel goods, handbags and similar containers	3,603	1,758	1	0	0.2	0.2	154,655	331,721	36	80	(151,052)	(329,963)	(35)	(79)	2%	1%
01 Meat and meat preparations	98,670	53,801	67	34	0.7	0.6	107,331	57,950	73	37	(8,661)	(4,149)	(6)	(3)	92%	93%
87 Professional, scientific and controlling instruments and apparatus, n.e.s.	7,911	12,613	43	66	5.4	5.2	6,660	12,164	36	63	1,252	449	7	2	119%	104%
07 Coffee, tea, cocoa, spices, and manufactures thereof	38,237	12,554	11	4	0.3	0.3	179,831	137,999	53	39	(141,593)	(125,445)	(41)	(35)	21%	9%
02 Dairy products and birds' eggs	102,039	366,992	35	45	0.3	0.1	114,769	355,899	40	44	(12,731)	11,093	(4)	1	89%	103%
82 Furniture, and parts thereof, bedding, mattresses, mattress supports,cushions and similar stuffed furnishings	77,526	118,385	33	48	0.4	0.4	77,842	118,834	34	48	(316)	(449)	(0)	(0)	100%	100%
84 Articles of apparel and clothing accessories	24,143	8,731	63	22	2.6	2.5	21,612	9,372	56	23	2,532	(641)	7	(2)	112%	93%
04 Cereals and cereal preparations	476,702	237,766	67	32	0.1	0.1	329,552	118,038	47	16	147,150	119,727	21	16	145%	201%
26 Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)	40,537	4,951	51	8	1.3	1.7	36,022	4,909	45	8	4,514	41	6	0	113%	101%
43 Animal or vegetable fats and oils, processed, waxes of animal or vegetable origin, inedible mixtures or preparations of animal or vege	12,302	9,541	6	4	0.5	0.4	66,958	12,039	34	5	(54,655)	(2,498)	(28)	(1)	18%	79%
73 Metalworking machinery	18,841	30,283	20	30	1.1	1.0	15,713	21,659	17	22	3,128	8,624	3	9	120%	140%
06 Sugars,sugar preparations and honey	89,508	43,456	24	11	0.3	0.3	92,977	44,614	25	12	(3,468)	(1,158)	(1)	(0)	96%	97%
00 Live animals other than animals of division 03	10,313	27,819	9	25	0.8	0.9	10,323	27,826	9	25	(10)	(7)	(0)	(0)	100%	100%
34 Gas, natural and manufactured	1,067,993	363,279	25	8	0.0	0.0	1,068,077	363,280	25	8	(83)	(0)	(0)	(0)	100%	100%
42 Fixed vegetable fats and oils, crude, refined or fractionated	59,208	17,043	23	6	0.4	0.4	58,812	17,043	23	6	397	(0)	0	(0)	101%	100%
21 Hides, skins and furskins, raw	19,494	21,980	13	14	0.7	0.6	19,539	22,016	13	14	(45)	(35)	(0)	(0)	100%	100%
88 Photographic apparatus, equipment and supplies and optical goods, n.e.s., watches and clocks	2,448	1,209	11	5	4.7	4.0	2,262	1,151	11	5	186	58	1	0	108%	105%
03 Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof	17,285	4,789	19	5	1.1	1.0	12,013	1,809	13	2	5,272	2,980	6	3	144%	265%
75 Office machines and automatic data-processing machines	4,113	3,174	19	7	4.5	2.2	2,298	2,032	10	4	1,815	1,142	8	3	179%	156%
76 Telecommunications and sound-recording and reproducing apparatus and equipment	6,836	3,256	13	6	1.9	1.8	4,854	1,913	9	3	1,981	1,343	4	2	141%	170%
79 Other transport equipment	14,521	18,180	17	20	1.2	1.1	3,217	7,682	4	8	11,305	10,498	13	11	451%	237%
85 Footwear	9,612	5,965	7	4	0.7	0.7	9,612	5,965	7	4	0	0	0	0	100%	100%

61 Leather, leather manufactures, n.e.s., and dressed furskins	7,025	7,802	5	5	0.7	0.6	7,084	7,881	5	5	(59)	(79)	(0)	(0)	99%	99%
81 Prefabricated buildings, sanitary, plumbing, heating and lighting fixtures and fittings, n.e.s.	28,794	94,218	26	91	0.9	1.0	7,967	1,965	7	2	20,827	92,253	19	89	361%	4795%
12 Tobacco and tobacco manufactures	4,837	382	8	0	1.7	0.5	4,837	382	8	0	0	0	0	0	100%	100%
29 Crude animal and vegetable materials, n.e.s.	19,720	14,782	6	2	0.3	0.1	19,460	14,779	6	2	260	3	0	0	101%	100%
22 Oil-seeds and oleaginous fruits	22,461	33,549	3	4	0.1	0.1	22,676	20,898	3	3	(215)	12,650	(0)	2	99%	161%
09 Miscellaneous edible products and preparations	67,496	36,785	15	5	0.2	0.1	21,253	6,750	5	1	46,243	30,035	11	4	318%	545%
32 Coal,coke and briquettes	460,363	3,386	5	0	0.0	0.0	460,364	3,413	5	0	(1)	(27)	(0)	(0)	100%	99%
41 Animal oils and fats	3,147	1,923	1	0	0.3	0.1	4,903	2,147	1	0	(1,756)	(224)	(0)	(0)	64%	90%
56 Fertilizers (other than those of group 272)	217,249	51,692	44	10	0.2	0.2	1,146	4	0	0	216,103	51,687	43	10	18953%	1174812%
96 Coin (other than gold coin), not being legal tender	0	-	0	-	0.4	0.4	0	0	0	0	0	(0)	0	(0)	100%	0%
35 Electric current	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
57 Plastics in primary forms	497,480	352,013	746	498	1.5	1.4	-	-	-	-	497,480	352,013	746	498	0%	0%
97 Gold, non-monetary (excluding gold ores and concentrates)	10	11	0	0	0.4	0.4	-	-	-	-	10	11	0	0		
TOTAL	**20,655,398**	**17,262,199**	**8,961**	**8,040**	**0**	**0**	**17,600,526**	**15,629,510**	**8,661**	**7,608**	**3,054,871**	**1,632,689**	**300**	**432**	**103%**	**106%**

Comparison at the 2-digit level revealed a number of differences at the aggregate category level, however because the deviations between data sources occur in both directions across so many categories, it is likely that the differences the result of mis-matching of categories. Two categories showing notable differences, include “56 Fertilizers (other than those of group 272)”, and “33 Petroleum, petroleum products and related materials”, and indicate trade flows 1-2 orders of magnitude larger in the SiStat database compared to UN Comtrade. It is deduced that specific commodities within these two aggregate categories likely make up the bulk of the difference between the total tonnage reported by the two datasets.

To estimate the total ecological footprint using Slovenia’s national statistics database, the aggregate footprint intensity per ton was calculated for each aggregate 2-digit category and applied to the raw tonnage reported in SiStat. Two categories, “57 Plastics in primary forms” and “97 Gold, non-monetary (excluding gold ores and concentrates)” were not present in the NFA dataset and footprints were approximated by assuming the intensity of similar categories, “56- plastic, non-primary" and “96 Coin (other than gold coin), not being legal tender” respectively. The totals were then applied to the calculation template and compared to the current footprint values.

Estimated Ecological Footprint from Carbon verification

The comtrade data used in the NFA underreported both the import and export trade flows, resulting in 3 and 6 percent differences, respectively, however, the final verified value for the carbon footprint, 6,439,560 gha (table B.6) and for total ecological footprint did not differ greatly from the original value reported in the NFA, 6,593,811 (table B.1). The effect of balancing trade flows, and the fact that the underreported categories had low footprint intensities resulted in the relatively small difference. Overall, the combined effect of applying the country reported CO2 emissions data for UNFCCC and estimated trade data from SiStat resulted in a difference of 0.1% to the total Ecological Footprint of Slovenia as compared to the standardized input data used by Global Footprint Network.

Table B.6. Carbon footprint of Slovenia by category, estimated after recalculation with trade data from SiStat and nationally reported CO2 emissions

Name [-]	EF_P [gha]	EF_I [gha]	EF_E [gha]	EF_C [gha]
Fossil Fuel Emissions	4,521,893	8,960,945	8,040,166	5,442,672
Other Sources	367,877	-	-	367,877
Traded Electricity	-	812,025	799,851	12,174
International Transport	-	616,837	-	616,837
TOTAL	**4,889,771**	**10,389,807**	**8,840,017**	**6,439,560**

References:

D. Lin, L. Hanscom, J. Martindill, M. Borucke, L. Cohen, A. Galli, E. Lazarus, G. Zokai, K. Iha, D. Eaton, M. Wackernagel. 2019. Working Guidebook to the National Footprint and Biocapacity Accounts. Oakland: Global Footprint Network.

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Eggleston, S., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. (eds.). IPCC-TSU NGGIP, IGES, Japan. Internet: www.ipcc-nggip.iges. or.jp/public/2006gl/index.html.

Annex C. Consulting and Verification of Ecological Footprint Projections and Scenarios

As part of this project, Global footprint network researchers corresponded with Stritih Consulting on the development of the report "Ecological Footprint of Slovenia – Calculation of Projections and Scenarios for the reduction of Ecological Footprint for selected measures", in particular for the proper application and integration of scenarios and projections to derive potential national outcomes in Ecological Footprint and biocapacity. Through our interaction and earlier participation in the 2018 workshop, as evidenced through the detailed application and discussion of ecological footprint and biocapacity outcomes by measure, we confirm that the calculations were applied in a consistent manner and the assumptions made suggest a high level of rigor and strong understanding of the calculations and accounting methodology in the National Footprint Accounts.

Clarifications

The report compared differences between UNFCCC and NFA National Footprint Biocapacity Accounts (NFA) framework and results, and here we offer minor clarifications.

1. Alignment of metric and results: Within the NFA, the production footprint component of the carbon footprint uses input data from International Energy Agency(IEA) and this data is aligned and comparable with CO2 emissions reported to UNFCC; both sources follow IPCC guidelines for greenhouse gas (GHG) reporting. While IEA is independently calculated, UNFCC data are self-reported by each country. Production, as well as trade flows, are used to calculate the Ecological Footprint of Consumption; and the projection report appropriately makes projections based on estimates of each of these components (production, import, and export) separately. Note that the NFA country workbook for Slovenia is produced to provide of calculation transparency and allows self-calculation and substitution of data in the case of updated, improved, or otherwise preferred data.
2. Net emissions in the UNFCC framework are reported as production(territorial) emissions adjusted by carbon uptake. Whereas these two opposing flows (emission and update) are captured and expressed in the NFA as the carbon footprint and forest biocapacity, respectively.
3. Other Greenhouse gases(GHG): The most current NFA(2019 Edition) calculations, include only CO2 emissions rather than a full set of GHG emissions reported in the UNFCC dataset. The conceptual framework for Ecological Footprint accounting does not limit the inclusion of greenhouse gases to CO2, but rather limitation of data to accurately trace additional greenhouse gas emissions embedded in trade has prevented inclusion of current ghg's into current (NFA) results. Future accounts should take steps to include basic estimates of production and trade flows to improve results.

The results, calculations and assumptions were reviewed and confirmed. They are carried out to the best available current assessment of the situation; however, we note that the assumptions should be reviewed

regularly and assessed as new information becomes available. For example, section 3.1.2 describes a baseline scenario for 2030. It is very difficult to quantitatively estimate the frequency and severity of extreme weather events with high certainty and in a spatially explicit manner, however the assumptions made in the report on these types of events are conservative and can be updated as new models are developed. Additionally, and world changing recent events such as COVID-19 have had significant effect on global production and consumption patterns which cannot be assessed under current levels of uncertainty associated with both the biophysical aspects of interaction between and humanity and our environment as well as the psychological aspect of societal decision making and the concept of connectedness. As the world adjusts and recovers from COVID-19 it would be prudent to re-assess baseline scenarios and potential reduction measures.

We fully support the conclusions of the report, “Ecological Footprint of Slovenia – Calculation of Projections and Scenarios for the reduction of Ecological Footprint for selected measures” and find that the examples and measures recommended are well researched, and would further add that the recommendations stated should be viewed as examples of solutions which form a subset of many possible existing interventions. These are strongly in alignment with our suggested framework, presented in the main report. We highly recommend the proposed solutions and emphasize that innovative solutions should not limited to those presented in the report.

The projections and scenarios themselves are well thought out, and we recommend further set of analyses to improve on the static elements of the approaches used. Such analysis would incorporate more dynamic elements to capture synergistic effects and complex interactions that may occur in the future and once developed, can be quickly re-parameterized to reflect the rapidly changing world.

Lastly and most importantly, the proposed recommendations are largely focused on Ecological Footprint and biocapacity effects and would be greatly improved if they are supported with additional analysis on economic effects. Cost benefit analyses of this nature are needed to assess the viability and practical implementation of measures.

Annex D. Selection and Training of the National Representative for Calculating Regional Ecological Footprints

Identification of candidate organizations

In the initial stage of selection and training of a national representative to support the realization of SDS' environmental objectives and of regional development programs, Global Footprint Network identified possible organizations who are potential matches to provide a national representative to participate in an in-depth training. These organizations operate in the field of implementing comprehensive assessments of the state of the environment. Eight institutions (Table 2) were identified, and evaluated in their organizational capacities based on three selection criteria: (1) capacity to perform technical ***calculation***, (2) capacity for ***interpretation*** of technical calculations to policy and action, and (3) capacity for ***communication*** activities.

From the initial list of 8 organizations, a subset of organizations was identified who function as research institutions and scored highly on the evaluation criteria. These organizations were the Statistical Office of the Republic of Slovenia, the Energy Efficiency Centre at the Jožef Stefan Institute, the University of Ljubljana Department of Geography, and the University of Primorska Department of Geography.

Table 2.2 High level evaluation of organizations.

Table D.1 Evaluation of national research institutions

Evaluation description:

-**Green**: Close match between ideal trainee profile and candidate organization expertise

-**Light Green**: Medium match between ideal trainee profile and candidate organization expertise

-**Grey**: Low match between ideal trainee profile and candidate organization expertise

Organization	Calculation	Interpretation	Communication
Statistical Office of the Republic of Slovenia			
Association of Municipalities and Towns of Slovenia			
Ministry of Environment and Spatial Planning of Slovenia			
Institute of Macroeconomic Analysis and Development of the Republic of Slovenia			
Energy Efficiency Centre at the Jožef Stefan Institute			
Institute for Youth Participation, Health and Sustainable Development			
University of Ljubljana, Faculty of Arts, Department of Geography			
University of Primorska, Faculty of Arts, Department of Geography			

It should be noted that statistical institutes, such as the Statistical Office of the Republic of Slovenia, are the main data producers in the country and theoretically have maximum authority for handling national and regional Footprint assessments. Statistical institutes seem to be ideal bodies for maintaining the Footprint calculation, both at the national and regional level, along with the interpretation and analysis of the results and communication. However, there could be difficulty in implementing top-down methodology in national statistical offices that are not fully committed to the Ecological Footprint framework and methodology. Additionally, the Ministry of Environment and Spatial Planning of Slovenia is responsible for the Slovenia's National Environmental Action Program 2030 and Development Strategy

2030. The ministry is well positioned to use the Ecological Footprint methodology and results at the regional level to support its work for ensuring policy coherence and assessing the sustainability progress in development actions, policies and strategies implemented within Slovenia.

Universities and official research institutions identified here are well situated to provide strong candidates in terms of technical ability to produce Ecological Footprint calculations and interpret results. However, the communication of the Ecological Footprint results by academic institutions for regional development planning, which are mainly done through municipalities and research offices, may require additional communications support from partner organizations.

Selection criteria for national representative

On January 30, 2020, the Slovenian Environment agency invited the identified organizations to nominate national representatives by the 31st of January in order to facilitate the original timeline of the project. Due to the short time span, the organizations were not able to prepare nominations. As of February 2nd, all identified organizations were informed that the deadline for nominees is extended to 7th of February, 2020.

The criteria for selecting nominees are (1) their experience with Ecological Footprint accounting concepts, (2) subnational calculation knowledge, and (3) technical ability to perform Ecological Footprint calculations. Technical abilities include analytical expertise (using data analysis tools such as MATLAB, Python, or R), high proficiency in Excel, and prior experience with Input-Output (IO) analysis.