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Neuro fuzzy evaluation of circular economy based on waste generation, recycling, renewable energy, biomass and soil pollution

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A R T I C L E I N F O

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A B S T R A C T

In a closed loop structure, the circular economy reflects a concept for converting material and energy wastes into capital for other purposes. The circular economy's key goal is to reduce energy and material waste. The best-case scenario will be to eliminate wastes and repurpose them, which is one of the key goals of the circular economy. One of the most important purposes of incorporating of circular economy are decreasing of environmental pollution and improving of sustainably development. The sustainably development could be represented by gross domestic product (GDP). The main goal of the study was to analyze the effect of waste generation, recycling, renewable energy, biomass and soil pollution on the GDP. For such a purpose adaptive neuro fuzzy inference system (ANFIS) was implemented since the methodology is suitable for statistical investigation of strongly nonlinear data sample due to features of fuzzy logic system. The combination of generated municipal waste, renewable energy supply and phosphorus balance per hectare represents the most influential combination for GDP prediction. The obtained results could represent the best practices for implementation of circular economy concept.

1. Introduction

The circular economy is a framework for long-term sustainability that aims to reduce material and energy waste. Materials cycles are the central principle of the circular economy, which aims to minimize negative environmental effects, reduce energy consumption, and promote economic growth. The linear economy model has dominated industrial growth, resulting in pollution and the overuse of scarce natural resources. Reusing, remanufacturing, restoring, and updating goods or materials are all part of the circular economy. The circular economy in the energy sector is focused on renewable energy sources such as solar, wind, biomass, and waste-derived energy. One of the most critical circular economy principles is the use of biodegradable materials that can be returned to the atmosphere after being rejected, resulting in no waste.

Sakiewicz et al. (2020) verified (Sakiewicz et al., 2020) that the artificial neural network can be applied in different computational tasks in selected circular economy problems. Recycling and utilization of biomass constituents have been verified as the main factors in implementation of circular economy concept (Shanmugam et al., 2021). Circular economy presents a new way of economic growth based on effective usage of energy and material resources and environmental protection (Tang et al., 2020). Belmonte-Ureña et al. (2021)

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(Belmonte-Ureña et al., 2021) shown that in circular economy domain was made important contributions to research but these contributions are heterogeneous with important differences and academic research does not fully align with the policy agenda. Hence there is need for more comprehensive investigation of circular economy parameters. It has been shown that the sustainable development in Industry 4.0 context could contribute to circular economy (Akanbi et al., 2020; Zhou et al., 2020). Fan and Fang (2020) (Fan and Fang, 2020) shown that there are large distinctions between different regions in China in circular economy development. Hence each region and each country have different factors and influences in circular economy development. Circular economy is based on different variables and factors and experts from different fields could make decisions based on the multiple attributes. This is not easy task and hence there is need to develop a decision-making model based on the multivariable group, which could facilitate decision and coordination between the different experts (Tang and Liao, 2021). Cheng et al. (2019) (Cheng et al., 2019) indicated that the circular economy could improve economic development and ecological restoration as well. Magazzino et al. (2021) (Magazzino et al., 2021) shown important policy implications in periodical shift from the traditional linear economy to a circular economy. The impact of circular economy on economic growth has been investigated by Chen et al. (2020) (Chen et al., 2020) and results have been shown that the GDP growth rate decreases significantly but the economic decline gradually recovers as time goes on. Wang et al. (2021) (Wang et al., 2021) shown a positive correlation between resources and environmental performance with the driving factors for circular transformation being mainly GDP and leading industries.

Li et al. (2021) (Li et al., 2021) employed an energy-based method to assess sustainable urban development in order to construct circular economy eco-city where results shown the socio-economic development depends on the using of domestic non-renewable resources. Woodliffe et al. (2021) (Woodliffe et al., 2021) evaluated frameworks of the purification and activation of metal-organic schemes based on circular economy perspective. Based on the results of Abokersh et al. (2021) (Abokersh et al., 2021) the concept of circular economy could improve sustainability of energy storage 30 times. Alkhuzaim et al. (2020) (Alkhuzaim et al., 2020) has been shown that there is gap for future application and theoretical developments as the nexus between circular economy and sustainable management. Gao et al. (2021) (Gao et al., 2021) has been presented a strong positive correlation between urban resource productivity and economic development in circular economy context. Since the remanufacturing is the crucial part of the circular economy concept in article (Singhal et al., 2020) has been identified all critical factors for the remanufacturing. These factors are manufacturing design, strategy collection, management prescience and purchase are the most important factors for the remanufacturing. Mastellone (2020) (Mastellone, 2020) have been showed that it is possible to transform plastic waste management with economic sustainability which is correlated with circular economy. Li (2012) (Li, 2012) has been built an input-output analysis table and an evaluation model of circular economy in enterprise. Li Stumpf et al. (2021) (Li et al., 2021) has been presented three clusters for the circular economy implementation could be distinguished: design, management and recycling. Municipalities could be very important to support and facilitate a transformation towards a circular economy (Christensen, 2021). Upadhyay et al. (2021) (Upadhyay et al., 2021) presented that the mining sector could have a crucial role in transition to a low-carbon economy or circular economy. Construction and demolition waste management represents a foundation for sustainability concept in circular economy (Kabirifar et al., 2020, 2021). Waste to energy could represent a critical role for sustainable development based on circular economy (Vlachokostas et al., 2020; Swann et al., 2017; Mohammadi and Harjunkoski, 2020).

There are many initiatives in the works to incorporate circular economy best practices into the scheme. Recycling and reusing goods for the same or different items are the best practices. One of the most important purposes of incorporating of circular economy are decreasing of environmental pollution and improving of sustainably development. The sustainably development could be represented by gross domestic product (GDP).

The main aim of the study was to analyze the effect of waste generation, recycling, renewable energy, biomass and soil pollution on the GDP. For such a purpose adaptive neuro fuzzy inference system (ANFIS) (Jang, 1993; Shariati et al., 2020a; Sedghi et al., 2018; Safa et al., 2016a) was implemented since the methodology is suitable for statistical investigation of strongly nonlinear data sample due to features of fuzzy logic system (Safa et al., 2020; Pazhoohan et al., 2019; Shariati et al., 2020b; Mansouri et al., 2020). ANFIS could provide an important knowledge about the internal behavior of the main circular economy concepts.

Section 2 of the article describes the theoretical background of the circular economy concept. Section 3 of the article describes the used dataset and ANFIS methodology. Section 4 provides the main results obtained in the article. Section 5 gives the main concluding remarks based on the obtained results.

2. Theoretical background

2.1. Circular economy concept

The circular economy is an economic mechanism whose primary goal is to eradicate waste and make continuous use of resources. In order to build a closed loop structure, the key tasks in the circular economy are to reuse, restore, remanufacture, and recycle. The circular economy's key aim is to reduce resource inputs and waste, as well as pollution and carbon emissions. The circular economy's second aim is to keep goods, facilities, and infrastructure in use for longer periods of time. The circular economy principle is illustrated in Fig. 1. Different industrial processes should use domestic and oil wastes as inputs. As a result, in order to generate regenerative resources and remove waste materials and energy, a regenerative approach is needed. The circular economy has five key measures that result in a closed loop structure according to Fig. 1.

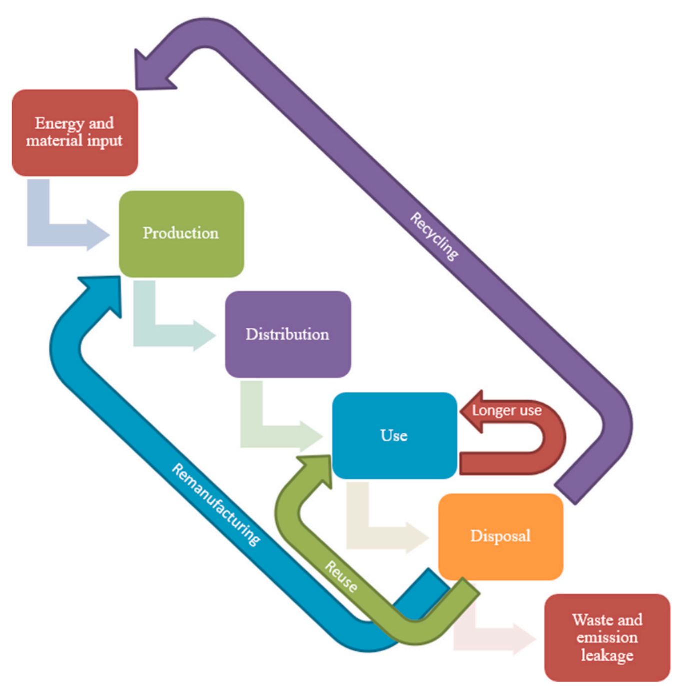

Fig. 1. Circular economy concept (Dong et al., 2021).

3. Methodology

3.1. Input and output data samples

In this study was used waste generation and recycling, renewable energy and biomass consumption and soil pollution for GDP prediction and evaluation based on OECD Green Growth database (https) which contains selected indicators for monitoring progress towards green growth to support policy making and inform the public at large. The database synthesizes data and indicators across a wide range of domains. The database covers OECD members.

The indicators are selected according to well-specified criteria and embedded in a conceptual framework. The main goal is to capture the main features of green growth based on environmental and resource productivity. There is need to indicate whether economic growth is becoming greener with more efficient use of natural capital and to capture aspects of production which are rarely quantified in economic models and accounting frameworks. The created dataset is based on waste generation and recycling, renewable energy and biomass consumption and soil pollution. The main output of the circular economy should be GDP. Fig. 2 shows the main structure of the concept.

The first parameter represents recycling of the municipal waste as percentage of all treated waste. Municipal waste generated is collected waste in municipalities in kg per person. Renewable energy supply is calculated as a share of renewable sources in Total Primary Energy Supply (TPES) (expressed as percentage). Renewable electricity is calculated as a share of renewables in electricity production (%).

Biomass consumption is expressed as a percentage of total domestic material consumption (DMC). Nitrogen balance represents difference between the total quantity of nitrogen inputs entering an agricultural system (mainly fertilisers, livestock manure), and the quantity of nitrogen outputs leaving the system (mainly uptake of nutrients by crops and grassland). Phosphorus balance represents difference between the total quantity of phosphorus inputs entering an agricultural system (mainly fertilisers, livestock manure), and the quantity of phosphorus outputs leaving the system (mainly uptake of nutrients by crops and grassland). Real GDP was used as output factor for evaluation of economic development. Table A1 in Appendix A1 represent the input data of the circular economy and the real GDP index as output.

3.2. ANFIS approach for selection procedure

Artificial neural networks are type of system which is suitable for nonlinear data samples due to multiple parallel computational functions (Shariati et al., 2020c; Wu et al., 2021; Ma et al., 2021; Jiao et al., 2021). ANFIS is a type of artificial neural network which is merged with fuzzy inference system (Mohammadhassani et al., 2014; Safa et al., 2016b). The fuzzy inference system is the main core of the ANFIS network. The main goal of the ANFIS procedure is to train the network with loaded data samples in order to find the best correlations between the input and output data samples. ANFIS network has 5 layers as it shown in Fig. 3. Each of the layer has specific function during training procedure. The main feature of the ANFIS approach is fuzzification of the input data samples by membership functions in range between 0 and 1. Hence there is no need for data normalization before ANFIS application.

Fig. 4 shows ANFIS selection procedure in MATLAB software. ANFIS methodology was implemented for the selection procedure. During selection procedure non-relevant parameters could be removed. Parameters with small relevance do not have high impact on the output. The data set is arranged from the data file in Table A1. The dataset is partitioned into a training set (trn_data) and a checking set (chk_data). The function "exhsrch" represents exhaustive search procedure within the given inputs. Fig. 5 shows the main concept of the circular economy through ANFIS procedure.

The ANFIS models are presented as root mean square error (RMSE), coefficient of determination (R2), and Pearson coefficient (r):

1) RMSE

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(P_i - O_i)^2}{n}},$$

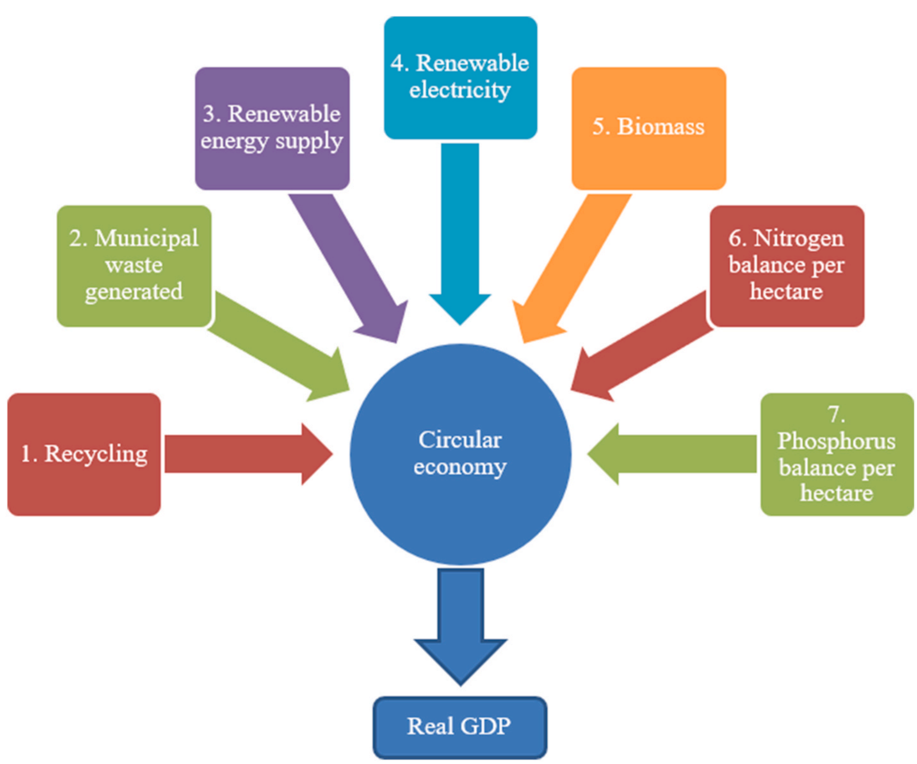

Fig. 2. Circular economy inputs and output.

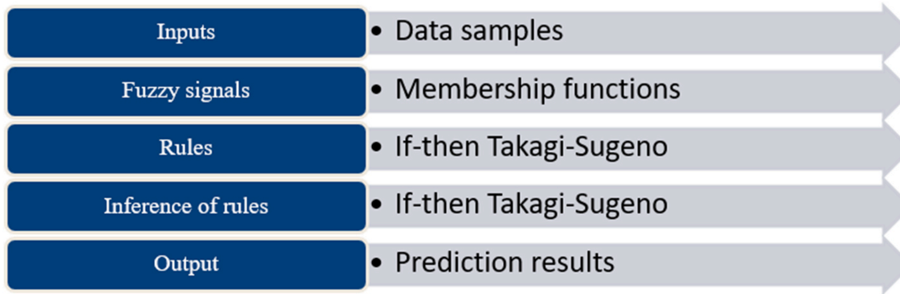

Fig. 3. ANFIS structure.

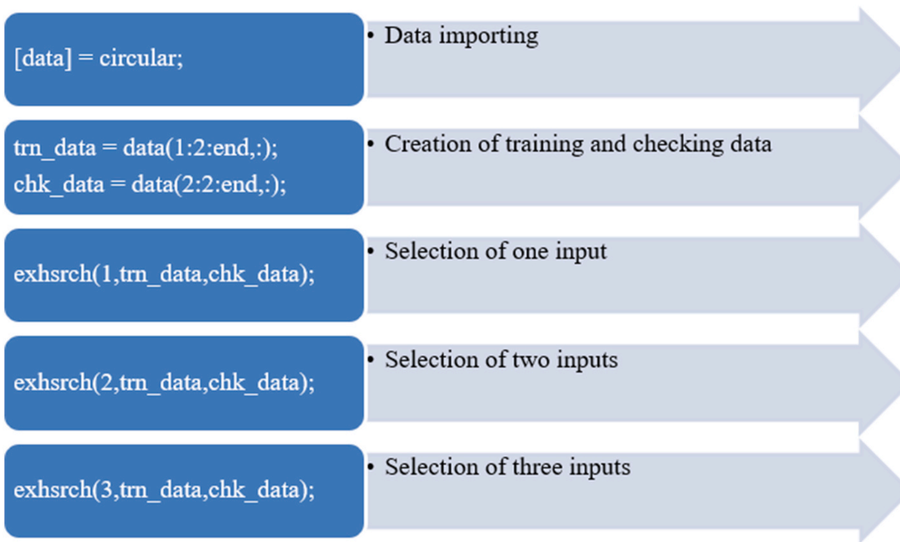

Fig. 4. ANFIS selection procedure.

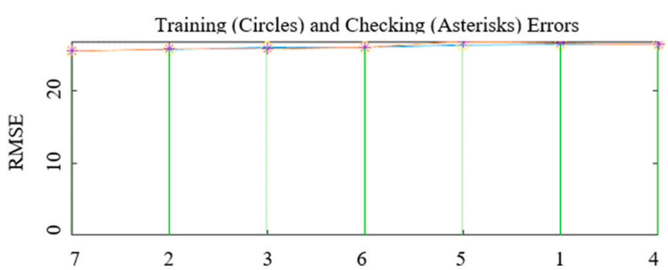

Fig. 5. RMS errors of the single parameters.

2) Pearson correlation coefficient (r)

$$r = \frac{n\left(\sum_{i=1}^{n} O_i \cdot P_i\right) - \left(\sum_{i=1}^{n} O_i\right)\cdot\left(\sum_{i=1}^{n} P_i\right)}{\sqrt{\left(n\sum_{i=1}^{n} O_i^2 - \left(\sum_{i=1}^{n} O_i\right)^2\right)\cdot\left(n\sum_{i=1}^{n} P_i^2 - \left(\sum_{i=1}^{n} P_i\right)^2\right)}}$$

3) Coefficient of determination (R^2)

$$R^2 = \frac{\left[\sum_{i=1}^{n}\left(O_i - \overline{O_i}\right)\cdot\left(P_i - \overline{P_i}\right)\right]^2}{\sum_{i=1}^{n}\left(O_i - \overline{O_i}\right)\cdot\sum_{i=1}^{n}\left(P_i - \overline{P_i}\right)}$$

where P_i and O_i are known as the experimental and forecast values, respectively, and n is the total number of checking data.

4. Results

In the first stage ANFIS network is trained with data section in Table A1 where there are 7 input variables and the output is GDP. The main goal is to determine RMS errors of each single parameter from Table A1 based on the GDP prediction. Fig. 5 shows the RMSE errors of the single parameters. One can note the parameter 7 has the smallest RMS error hence the strongest relevance in regard to the GDP prediction. The parameter 7 represents the phosphorus balance per hectare. Phosphorus balance reveals the status of environmental pressures, such as declining soil fertility in the case of a nutrient deficit, or the risk of polluting soil, water and air in the case of a nutrient surplus.

Table 1 shows the numerical RMS errors of the all-single parameters based on the GDP prediction. There are two RMS errors, for training (trn) and for checking (chk) of the ANFIS models. 50% data were used as training data while remaining 50% data were used as checking data. There are 7 ANFIS models with single input and single output in this stage. Each of the ANFIS model is trained with one epoch in order to determine the parameters' relevance to the GDP. Based on the comparison of the training and checking errors there is no overfitting in the

Table 1
RMSEs of the single parameters.

	Recycling	Municipal waste generated	Renewable energy supply	Renewable electricity	Biomass	Nitrogen balance per hectare	Phosphorus balance per hectare
Recycling	trn = 26.3490, chk = 26.4967						
Municipal waste generated		trn = 25.6365, chk = 25.7063					
Renewable energy supply			trn = 25.9167, chk = 25.6960				
Renewable electricity				trn = 26.3574, chk = 26.2860			
Biomass					trn = 26.2468, chk = 26.7334		
Nitrogen balance per hectare						trn = 25.9402, chk = 25.9366	
Phosphorus balance per hectare							trn = 25.4376, chk = 25.3965

ANFIS models since the training and checking errors are comparable. Further one can combine two parameters to investigate their influence on the GDP. Fig. 6 shows the optimal combination of the one input in circular economy based on the largest GDP changing.

Fig. 7 shows the RMS errors of the combinations of two parameters while Table 2 shows the numerical values of the RMS errors. One can note the combination of parameters 2 and 7 is the optimal combination for the GDP prediction. In other words, the combination of municipal waste generated, phosphorus balance per hectare is the most relevant combination for the GDP. It means if one change the municipal waste generated, phosphorus balance per hectare in the same time the GDP will have the largest change. Municipal waste is waste collected by or on behalf of municipalities. It includes household waste originating from households (i.e. waste generated by the domestic activity of households) and similar waste from small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses that treat or dispose of waste at the same facilities used for municipally collected waste. Based on the comparison of the training and checking errors there is no overfitting in the ANFIS models since the training and checking errors are comparable. Further one can combine two parameters to investigate their influence on the GDP. Fig. 8 shows the optimal combination of the two inputs in circular economy based on the largest GDP changing.

Fig. 9 shows the RMS errors of the combinations of three parameters while Table 3 shows the numerical values of the RMS errors. One can note the combination of parameters 2, 3 and 7 is the optimal combination for the GDP prediction. In other words, the combination of municipal waste generated, renewable energy supply, phosphorus balance per hectare is the most relevant combination for the GDP. It means if one change the municipal waste generated, renewable energy supply, phosphorus balance in the same time the GDP will have the largest change. Renewables include hydro, geothermal, solar (thermal and PV), wind and tide/wave/ocean energy, as well as combustible renewables (solid biomass, liquid biomass, biogas) and waste (renewable municipal waste). Based on the comparison of the training and checking errors there is overfitting in the ANFIS models since the training and checking errors are comparable. Fig. 10 shows the optimal combination of the three inputs in circular economy based on the largest GDP changing.

Three selected parameters are extracted and new ANFIS model is generated and trained with 100 epochs. Fig. 11 shows the ANFIS prediction of GDP index based on three selected combinations. The all data are used for ANFIS training and checking as well. In other words, ANFIS was trained with all data and then checking against the same data. There is medium prediction accuracy based on three inputs. Prediction accuracy is low based on the one or two inputs. Table 4 shows the statistical indicators for the prediction accuracy of the GDP based on the three selected combinations.

The results show, for improvement of Phosphorus balance per hectare GDP will change drastically. Plot the data distribution in Fig. 12 represents potential gaps in the input data that might cause this counterintuitive result. The lack of training data could cause the anomalous results. Because data distribution strongly affects prediction accuracy, the data distribution should be taken into account when the ANFIS models are interpreted.

5. Discussion and conclusion

Since ecological and environmental sustainability are at the forefront of the economy, the circular economy is the economy for the future. The circular economy's central concept is human life's long-term viability. The circular economy may offer a way to overcome the current production and consumption model, which is limited in terms of energy resources. This economy is focused on a closed-loop system in which the primary energy and material resources are urban and industrial wastes.

The main goal of the study was to analyze the effect of waste generation, recycling, renewable energy, biomass and soil pollution on the gross domestic product (GDP). For such a purpose adaptive neuro fuzzy inference system (ANFIS) was implemented. The consumption of metals as a percentage of Domestic Material Consumption (DMC) represents the most influential factor for GDP prediction. The main concluding remarks could be summed as follows:

- Phosphorus balance per hectare is the most relevant factor for the GDP,
- The combination of municipal waste generated and phosphorus balance per hectare is the most relevant combination of two factors for the GDP,
- The combination of municipal waste generated, renewable energy supply and phosphorus balance per hectare is the most relevant combination of three factors for the GDP.

Based on the results one can conclude the soil quality is very important factor for the economic development in circular economy. Municipal waste generated is only important if it is combined in the same time with the phosphorus balance per hectare. In other words one needs to change two factors in the same time in order to take effect of the

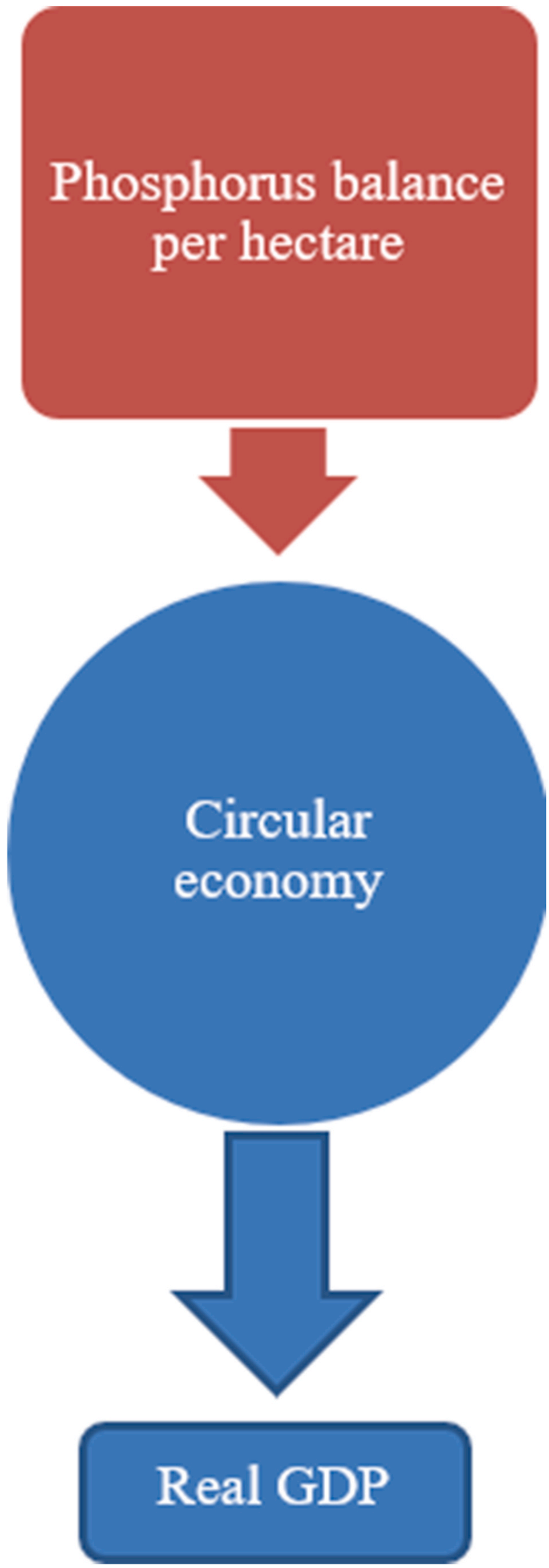

Fig. 6. Optimal combination with one input in circular economy.

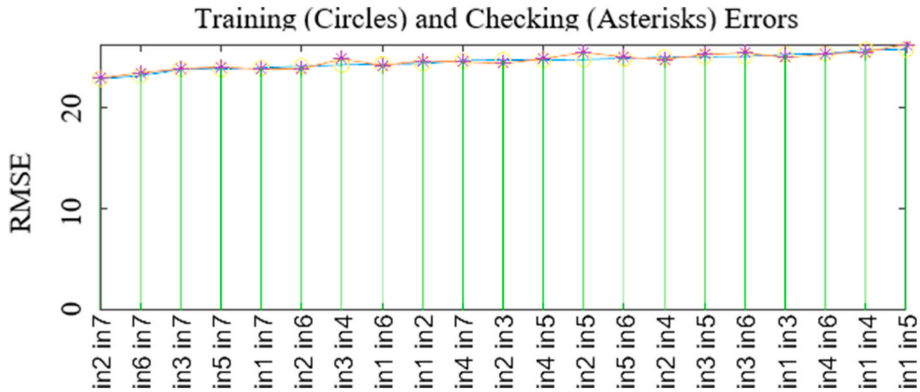

Fig. 7. RMS errors of the combinations of two parameters.

Table 2
RMSEs of the single and two parameters combinations.

	Recycling	Municipal waste generated	Renewable energy supply	Renewable electricity	Biomass	Nitrogen balance per hectare	Phosphorus balance per hectare
Recycling	trn = 26.3490, chk = 26.4967						
Municipal waste generated	trn = 24.3312, chk = 24.6173	trn = 25.6365, chk = 25.7063					
Renewable energy supply	trn = 25.2304, chk = 24.9239	trn = 24.6878, chk = 24.3398	trn = 25.9167, chk = 25.6960				
Renewable electricity	trn = 25.6953, chk = 25.4908	trn = 24.9624, chk = 24.7584	trn = 24.1909, chk = 24.7831	trn = 26.3574, chk = 26.2860			
Biomass	trn = 25.7347, chk = 26.2311	trn = 24.7390, chk = 25.4513	trn = 25.0286, chk = 25.2182	trn = 24.6944, chk = 24.8011	trn = 26.2468, chk = 26.7334		
Nitrogen balance per hectare	trn = 24.2743, chk = 24.1641	trn = 24.0795, chk = 23.8318	trn = 25.0371, chk = 25.4165	trn = 25.3175, chk = 25.2677	trn = 24.8271, chk = 24.9787	trn = 25.9402, chk = 25.9366	
Phosphorus balance per hectare	trn = 23.9170, chk = 23.7928	trn = 22.8294, chk = 22.8941	trn = 23.7711, chk = 23.8365	trn = 24.6352, chk = 24.5124	trn = 23.7880, chk = 23.9979	trn = 23.1352, chk = 23.4348	trn = 25.4376, chk = 25.3965

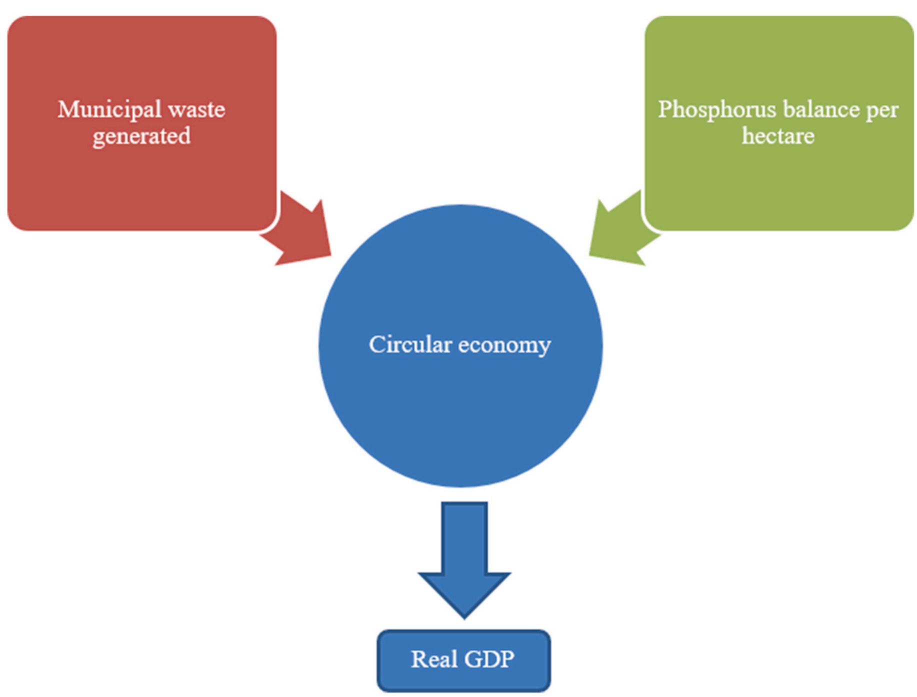

Fig. 8. Optimal combination with two inputs in circular economy.

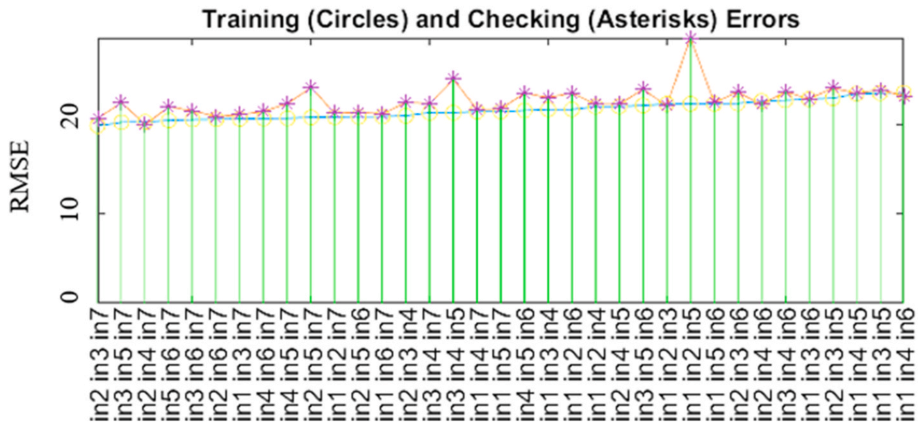

Fig. 9. RMS errors of the combinations of three parameters.

Table 3
RMSEs of the combinations of three parameters.

Combinations of three inputs	Training	Checking
Recycling, Municipal waste generated, Renewable energy supply	trn = 22.3711	chk = 22.1136
Recycling, Municipal waste generated, Renewable electricity	trn = 22.0591	chk = 22.3027
Recycling, Municipal waste generated, Biomass	trn = 22.3775	chk = 29.7572
Recycling, Municipal waste generated, Nitrogen balance per hectare	trn = 21.7415	chk = 23.5699
Recycling, Municipal waste generated, Phosphorus balance per hectare	trn = 20.8755	chk = 21.2912
Recycling, Renewable energy supply, Renewable electricity	trn = 21.7377	chk = 23.0881
Recycling, Renewable energy supply, Biomass	trn = 23.5637	chk = 23.9330
Recycling, Renewable energy supply, Nitrogen balance per hectare	trn = 22.8843	chk = 22.9294
Recycling, Renewable energy supply, Phosphorus balance per hectare	trn = 20.6824	chk = 21.1250
Recycling, Renewable electricity, Biomass	trn = 23.4871	chk = 23.5361
Recycling, Renewable electricity, Nitrogen balance per hectare	trn = 23.6018	chk = 23.2588
Recycling, Renewable electricity, Phosphorus balance per hectare	trn = 21.4853	chk = 21.7344
Recycling, Biomass, Nitrogen balance per hectare	trn = 22.3779	chk = 22.5129
Recycling, Biomass, Phosphorus balance per hectare	trn = 21.4907	chk = 21.7906
Recycling, Nitrogen balance per hectare, Phosphorus balance per hectare	trn = 20.9290	chk = 21.2265
Municipal waste generated, Renewable energy supply, Renewable electricity	trn = 21.0244	chk = 22.5085
Municipal waste generated, Renewable energy supply, Biomass	trn = 22.9959	chk = 24.1310

(*continued on next page*)

Table 3 (*continued*)

Combinations of three inputs	Training	Checking
Municipal waste generated, Renewable energy supply, Nitrogen balance per hectare	trn = 22.4151	chk = 23.6865
Municipal waste generated, Renewable energy supply, Phosphorus balance per hectare	trn = 19.8961	chk = 20.7129
Municipal waste generated, Renewable electricity, Biomass	trn = 22.0676	chk = 22.2956
Municipal waste generated, Renewable electricity, Nitrogen balance per hectare	trn = 22.6648	chk = 22.2818
Municipal waste generated, Renewable electricity, Phosphorus balance per hectare	trn = 20.3500	chk = 20.0223
Municipal waste generated, Biomass, Nitrogen balance per hectare	trn = 20.9232	chk = 21.4170
Municipal waste generated, Biomass, Phosphorus balance per hectare	trn = 20.8465	chk = 24.1877
Municipal waste generated, Nitrogen balance per hectare, Phosphorus balance per hectare	trn = 20.6426	chk = 20.9283
Renewable energy supply, Renewable electricity, Biomass	trn = 21.3784	chk = 25.1033
Renewable energy supply, Renewable electricity, Nitrogen balance per hectare	trn = 22.7603	chk = 23.7287
Renewable energy supply, Renewable electricity, Phosphorus balance per hectare	trn = 21.3717	chk = 22.3997
Renewable energy supply, Biomass, Nitrogen balance per hectare	trn = 22.1719	chk = 24.0146
Renewable energy supply, Biomass, Phosphorus balance per hectare	trn = 20.2912	chk = 22.5017
Renewable energy supply, Nitrogen balance per hectare, Phosphorus balance per hectare	trn = 20.5996	chk = 21.5991
Renewable energy supply, Biomass, Nitrogen balance per hectare	trn = 21.6144	chk = 23.5582
Renewable electricity, Biomass, Phosphorus balance per hectare	trn = 20.7472	chk = 22.3806
Renewable electricity, Nitrogen balance per hectare, Phosphorus balance per hectare	trn = 20.7167	chk = 21.5214
Biomass, Nitrogen balance per hectare, Phosphorus balance per hectare	trn = 20.5041	chk = 22.0372

both parameters.

The results in this study could be of high practical importance since policy makers could determine which factors are important for GDP and to increase development of these factors. On the contrary, the parameters with small relevance should be funded as well but not in large amounts. For example, if one stop funding the parameters with the small relevance for GDP it could trigger the other parameters negatively in regard to the GDP. It is shown that some parameters do not have impact on the GDP but if one combine in the same time two irrelevant parameter it could cause strong relevance.

The used Green Growth Databased in this study represent a relevant databased for circular economy. However, based on the data distribution which could strongly affects prediction accuracy, the data distribution should be taken into account when the ANFIS models are interpreted. Based on the statistical indicators one can conclude the ANFIS models are with strong correlations and the results could be used in practical purposes.

The main goal of the circular economy is to increase economic development hence GDP is taken into account in this study. GDP is one of the most important indicators for the economic development. Therefore, one need to connect circular economy with GDP since the main goal of the circular economy is to improve economic development or GDP. The obtained results in this study could be use by any country since most of the indicators exist in every country. The purpose of the study was to guide sustainable future by incorporating circular economy concept. Policy makers could establish their politics based on the input data relevance.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

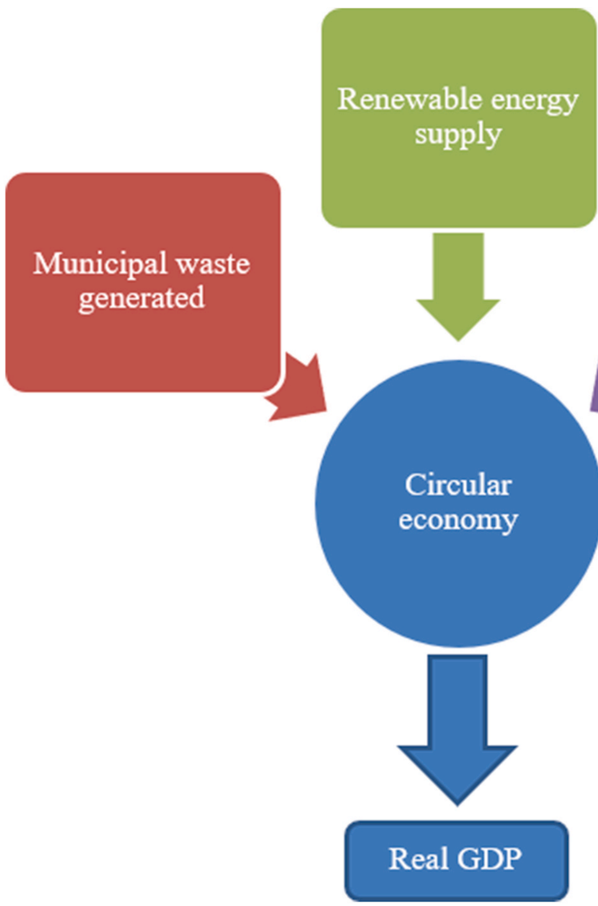

Fig. 10. Optimal combination with three inputs in circular economy.

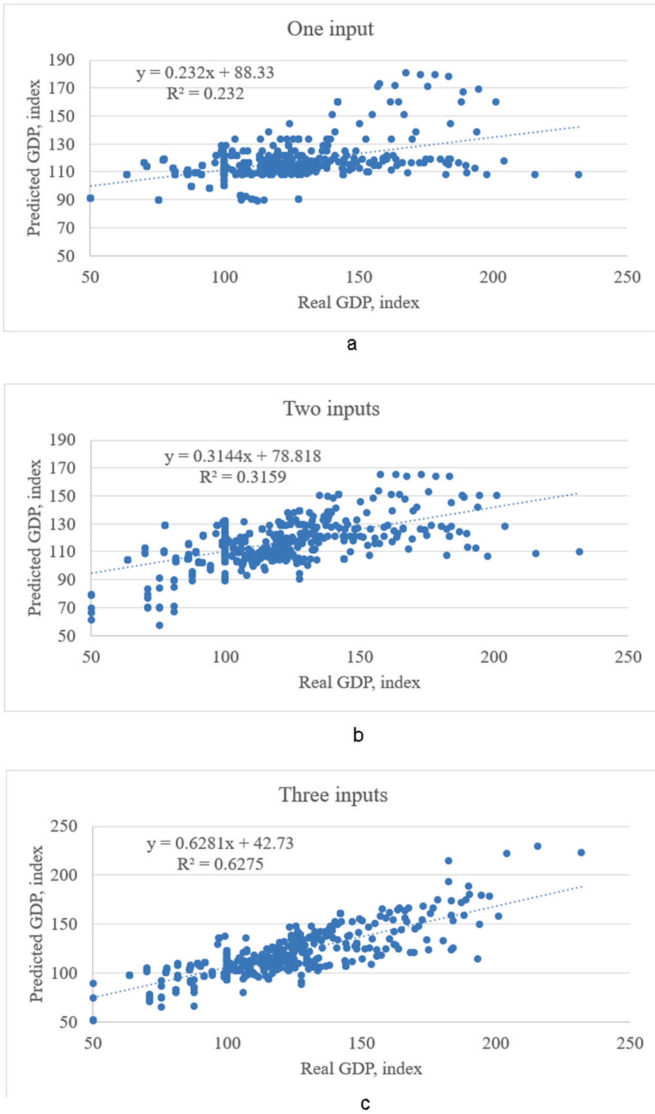

Fig. 11. ANFIS prediction of GDP based on the selected input combinations.

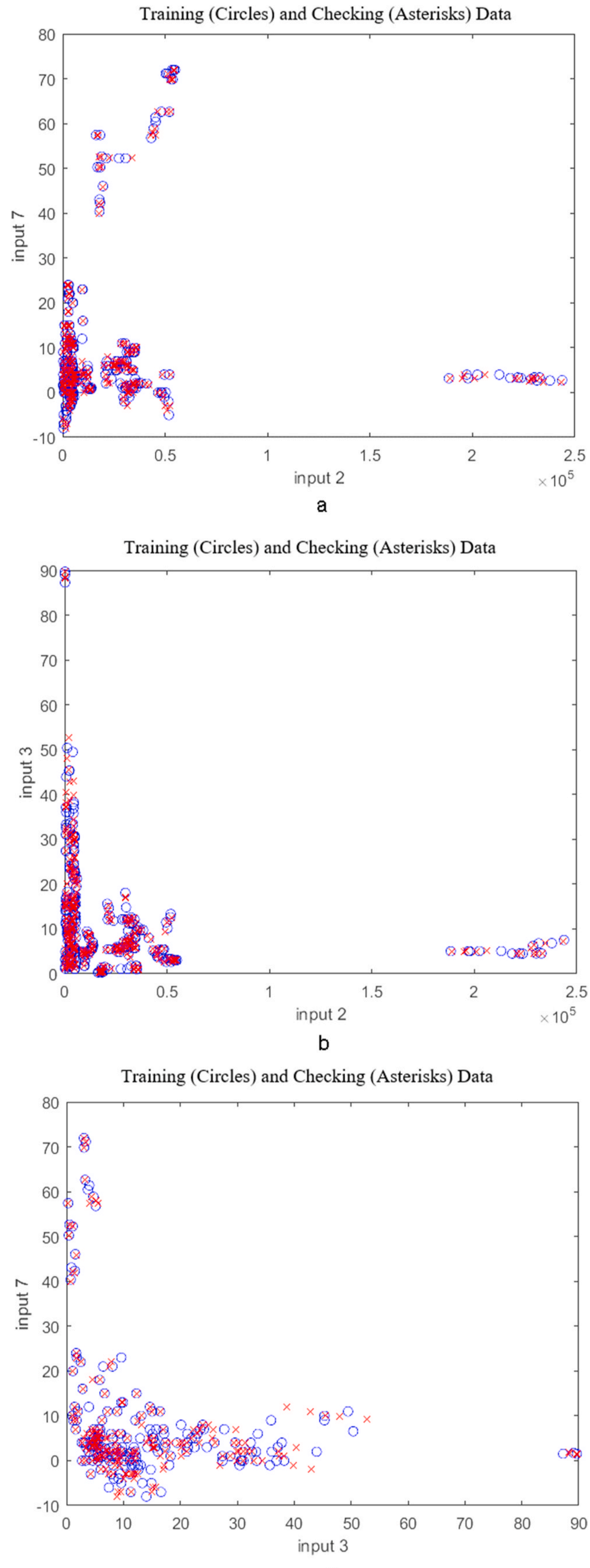

Fig. 12. Data distribution for three selected input parameters.

Table 4
Statistical indicators of ANFIS prediction of GDP based on the selected input combinations.

	One input	Two inputs	Three inputs
r	0.4817	0.5621	0.7922
R^2	0.232	0.3159	0.6275
RMSE	23.571	22.2465	16.4152

Appendix A1

Table A1
Input and output parameters

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
3,866.00	12,873.00	5.69	8.80	28.17	15.33	0.72	118.24
4,019.50	13,096.50	5.69	8.80	28.17	15.33	0.72	118.24
4,173.00	13,320.00	5.69	8.80	28.17	15.33	0.72	118.24
4,242.00	13,534.00	5.29	8.60	25.50	16.54	0.68	135.68
4,393.00	13,450.00	5.45	10.36	25.29	17.12	0.81	141.00
4,313.67	13,572.33	5.49	10.49	26.70	18.66	0.81	144.64
4,234.33	13,694.67	6.01	13.12	24.90	18.39	0.77	148.31
4,155.00	13,817.00	6.25	14.60	26.00	19.17	0.99	151.56
4,094.00	14,003.00	6.32	13.30	25.88	19.81	1.06	155.76
3,808.00	13,539.00	6.55	14.50	25.74	18.65	0.81	159.34
3,854.00	13,751.00	6.97	15.60	25.63	19.83	0.85	164.04
820.00	3,476.00	21.97	70.51	24.31	44.00	5.00	86.31
879.00	4,110.00	21.97	70.51	24.31	44.00	5.00	86.31
941.00	4,241.00	21.97	70.51	24.31	44.00	5.00	86.31
987.00	4,240.00	21.97	70.51	24.31	44.00	5.00	86.31
1,061.00	4,496.00	21.97	70.51	24.31	44.00	5.00	86.31
1,129.00	4,646.00	22.98	72.54	24.33	46.00	6.00	100.00
1,125.00	4,634.00	22.98	72.54	24.33	46.00	6.00	100.00
1,115.00	4,914.00	22.98	72.54	24.33	46.00	6.00	100.00
1,110.00	4,932.00	22.98	72.54	24.33	46.00	6.00	100.00
1,116.00	4,686.70	22.98	72.54	24.33	46.00	6.00	100.00
1,179.70	4,731.70	21.12	63.40	25.51	28.00	2.00	109.15
1,258.50	4,932.50	21.12	63.40	25.51	28.00	2.00	109.15
1,318.00	4,951.10	21.12	63.40	25.51	28.00	2.00	109.15
1,476.00	4,996.90	21.12	63.40	25.51	28.00	2.00	109.15
1,491.90	4,921.00	21.12	63.40	25.51	28.00	2.00	109.15
1,272.20	4,700.80	27.42	66.24	27.89	30.00	0.00	116.46
1,145.60	4,806.90	26.96	65.69	27.85	39.00	−1.00	119.87
1,168.00	4,883.30	30.64	74.70	27.31	37.00	0.00	120.68
1,202.40	4,905.20	30.18	78.17	28.20	47.00	2.00	120.71
1,231.00	4,832.50	30.76	81.45	29.64	31.00	0.00	121.51
1,240.50	4,836.00	29.89	76.91	27.85	46.00	0.00	122.74
1,253.80	4,928.40	30.41	78.26	29.06	32.00	−1.00	125.19
1,296.40	5,017.60	29.85	75.70	27.21	46.00	2.00	128.19
1,309.43	4,830.52	1.10	1.26	43.47	190.00	20.00	100.00
1,391.47	4,801.85	1.10	1.26	43.47	190.00	20.00	100.00
1,468.51	4,981.23	1.10	1.26	43.47	190.00	20.00	100.00
1,430.22	4,824.05	1.10	1.26	43.47	190.00	20.00	100.00
1,500.16	5,058.69	1.10	1.26	43.47	190.00	20.00	100.00
1,637.69	5,052.39	1.99	2.46	42.29	146.00	11.00	110.10
1,682.60	5,114.83	1.99	2.46	42.29	146.00	11.00	110.10
1,741.41	5,242.92	1.99	2.46	42.29	146.00	11.00	110.10
1,659.91	5,140.70	1.99	2.46	42.29	146.00	11.00	110.10
1,693.61	5,042.39	1.99	2.46	42.29	146.00	11.00	110.10
1,669.13	4,971.96	4.73	6.92	41.23	142.00	5.00	118.51
17.60	1,877.00	52.76	99.00	56.51	37.28	9.21	182.74
40.00	1,218.00	50.38	98.23	56.44	28.16	6.54	190.50
100.20	1,267.00	48.00	99.66	56.37	28.61	9.77	197.85
0.00	3,120.00	3.43	3.97	28.98	56.00	3.00	91.76
0.00	3,200.00	3.43	3.97	28.98	56.00	3.00	91.76
0.00	3,280.00	3.43	3.97	28.98	56.00	3.00	91.76
17.00	3,017.00	3.43	3.97	28.98	56.00	3.00	91.76
18.00	3,365.00	3.43	3.97	28.98	56.00	3.00	91.76
19.00	3,434.00	3.92	3.13	26.91	65.00	2.00	100.00
15.00	2,798.00	3.92	3.13	26.91	65.00	2.00	100.00
16.00	2,845.00	3.92	3.13	26.91	65.00	2.00	100.00
16.00	2,857.00	3.92	3.13	26.91	65.00	2.00	100.00
138.00	2,841.00	3.92	3.13	26.91	65.00	2.00	100.00
166.00	2,954.00	4.61	3.82	21.44	72.00	0.00	121.13
200.60	3,039.00	4.61	3.82	21.44	72.00	0.00	121.13
276.08	3,025.00	4.61	3.82	21.44	72.00	0.00	121.13
279.85	3,176.00	4.61	3.82	21.44	72.00	0.00	121.13
352.79	3,310.00	4.61	3.82	21.44	72.00	0.00	121.13
451.77	3,334.00	6.94	6.92	20.57	67.00	−2.00	136.93
495.70	3,358.00	7.91	8.35	22.06	80.00	−3.00	139.34
665.28	3,233.00	8.54	9.30	20.58	88.00	−1.00	138.24
685.92	3,228.23	9.37	10.82	22.01	76.00	−3.00	138.18
736.02	3,260.58	9.96	10.78	23.29	63.00	−4.00	141.30
850.91	3,337.34	10.19	11.40	21.07	98.00	−1.00	148.92
957.60	3,579.62	10.38	11.43	23.79	92.00	−3.00	152.70

(*continued on next page*)

Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
1,134.20	5,176.51	10.14	11.20	22.79	102.00	0.00	160.59
391.00	2,725.00	6.69	5.04	44.42	156.00	15.00	86.20
800.00	3,253.00	6.69	5.04	44.42	156.00	15.00	86.20
662.00	3,104.00	6.69	5.04	44.42	156.00	15.00	86.20
710.00	3,141.00	6.69	5.04	44.42	156.00	15.00	86.20
820.00	3,329.00	6.69	5.04	44.42	156.00	15.00	86.20
755.00	3,546.00	9.64	15.46	37.76	132.00	13.00	100.00
787.00	3,519.00	9.64	15.46	37.76	132.00	13.00	100.00
796.00	3,568.00	9.64	15.46	37.76	132.00	13.00	100.00
926.00	3,618.00	9.64	15.46	37.76	132.00	13.00	100.00
934.00	3,757.00	9.64	15.46	37.76	132.00	13.00	100.00
977.00	3,990.00	15.03	27.07	32.16	111.00	11.00	106.84
977.00	4,021.00	15.03	27.07	32.16	111.00	11.00	106.84
1,149.00	4,313.00	15.03	27.07	32.16	111.00	11.00	106.84
1,559.00	4,560.00	15.03	27.07	32.16	111.00	11.00	106.84
1,310.00	4,206.00	15.03	27.07	32.16	111.00	11.00	106.84
1,310.00	4,206.00	20.13	31.98	43.34	90.00	8.00	107.97
1,364.00	4,803.00	22.24	40.25	39.19	88.00	7.00	109.42
1,215.00	4,508.00	24.12	48.33	39.29	83.00	7.00	109.66
1,247.00	4,564.00	24.93	45.96	40.45	87.00	8.00	110.69
1,275.00	4,558.00	27.72	55.88	41.19	80.00	7.00	112.48
1,356.00	4,671.00	29.83	65.43	37.75	80.00	7.00	115.11
121.46	587.19	11.30	1.09	33.40	19.00	−7.00	142.33
70.27	536.00	11.30	1.09	33.40	19.00	−7.00	142.33
122.35	602.00	11.30	1.09	33.40	19.00	−7.00	142.33
77.51	524.00	11.30	1.09	33.40	19.00	−7.00	142.33
51.83	452.00	11.30	1.09	33.40	19.00	−7.00	142.33
40.66	406.00	15.18	8.05	24.47	29.00	−6.00	140.10
58.17	399.00	14.93	9.14	24.06	26.00	−5.00	150.53
52.39	371.00	15.68	12.34	26.29	24.00	−6.00	155.23
48.86	386.29	14.03	9.19	21.75	26.00	−8.00	157.32
124.60	469.55	14.93	11.16	24.81	22.00	−7.00	162.02
117.39	472.55	16.61	14.45	26.47	22.00	−7.00	165.01
676.85	2,600.00	23.93	33.41	21.80	55.00	8.00	100.00
627.91	2,412.00	23.93	33.41	21.80	55.00	8.00	100.00
620.73	2,384.40	23.93	33.41	21.80	55.00	8.00	100.00
632.04	2,427.90	23.93	33.41	21.80	55.00	8.00	100.00
638.70	2,453.40	23.93	33.41	21.80	55.00	8.00	100.00
652.00	2,505.80	23.51	33.25	23.57	49.00	7.00	113.78
676.88	2,600.10	23.51	33.25	23.57	49.00	7.00	113.78
695.24	2,674.90	23.51	33.25	23.57	49.00	7.00	113.78
714.64	2,768.00	23.51	33.25	23.57	49.00	7.00	113.78
615.06	2,562.00	23.51	33.25	23.57	49.00	7.00	113.78
495.00	2,519.00	25.53	29.99	21.05	57.00	5.00	119.15
592.00	2,719.00	25.98	32.89	20.28	50.00	4.00	122.18
589.00	2,738.00	29.42	40.56	20.53	48.00	4.00	120.48
510.41	2,681.55	29.64	35.97	20.16	47.00	4.00	119.39
474.33	2,629.88	30.18	38.58	23.94	48.00	4.00	118.95
770.31	2,738.28	32.36	44.50	23.48	50.00	4.00	119.60
808.31	2,767.93	31.42	44.23	23.27	47.00	4.00	122.96
770.96	2,811.59	33.60	46.61	21.17	51.00	6.00	126.98
2,481.00	28,253.00	7.19	15.36	33.03	55.00	11.00	86.54
2,653.00	28,950.00	7.19	15.36	33.03	55.00	11.00	86.54
3,048.00	29,677.00	7.19	15.36	33.03	55.00	11.00	86.54
3,523.00	30,449.00	7.19	15.36	33.03	55.00	11.00	86.54
3,822.00	30,612.00	7.19	15.36	33.03	55.00	11.00	86.54
4,045.00	31,232.00	6.25	12.97	34.04	58.00	9.00	100.00
4,410.00	32,198.00	6.25	12.97	34.04	58.00	9.00	100.00
4,715.00	32,684.00	6.25	12.97	34.04	58.00	9.00	100.00
4,725.00	31,400.00	6.25	12.97	34.04	58.00	9.00	100.00
4,970.00	32,444.00	6.25	12.97	34.04	58.00	9.00	100.00
5,533.00	33,347.00	5.77	9.86	32.65	51.00	5.00	108.71
5,806.00	33,962.00	5.77	9.86	32.65	51.00	5.00	108.71
6,079.00	34,577.00	5.77	9.86	32.65	51.00	5.00	108.71
6,385.00	34,501.00	5.77	9.86	32.65	51.00	5.00	108.71
6,688.00	34,426.00	5.77	9.86	32.65	51.00	5.00	108.71
6,937.00	34,609.00	7.99	13.85	35.62	40.00	1.00	113.25
7,184.00	34,790.00	7.00	11.62	34.69	52.00	2.00	115.73
7,293.00	34,484.00	8.21	15.01	37.23	40.00	1.00	116.09
7,402.00	34,176.00	9.07	17.21	36.63	45.00	2.00	116.76
7,605.00	34,260.00	8.82	16.58	40.06	45.00	1.00	117.88
7,808.00	34,344.00	8.94	15.98	38.35	42.00	0.00	119.19
8,256.77	35,355.86	9.77	17.70	36.75	50.00	3.00	120.49
8,706.39	35,817.34	9.57	16.63	39.36	39.00	1.00	123.26
8,908.74	35,888.63	10.39	19.67	34.91	40.00	1.00	125.46

(*continued on next page*)

Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
20,144.00	52,810.00	2.67	6.20	23.58	110.00	4.00	100.00
19,632.00	52,075.00	2.67	6.20	23.58	110.00	4.00	100.00
22,015.00	52,772.00	2.67	6.20	23.58	110.00	4.00	100.00
21,425.00	49,622.00	2.67	6.20	23.58	110.00	4.00	100.00
19,587.00	48,434.00	2.67	6.20	23.58	110.00	4.00	100.00
20,734.00	46,555.00	5.48	10.29	27.43	85.00	0.00	102.70
21,195.00	46,426.00	5.48	10.29	27.43	85.00	0.00	102.70
22,555.00	47,887.00	5.48	10.29	27.43	85.00	0.00	102.70
22,752.00	48,367.00	5.48	10.29	27.43	85.00	0.00	102.70
22,204.00	48,466.00	5.48	10.29	27.43	85.00	0.00	102.70
22,476.00	49,237.00	9.33	16.78	30.58	78.00	−1.00	108.90
23,135.00	50,237.00	10.20	20.43	31.33	89.00	0.00	113.18
23,596.00	49,759.00	11.37	22.99	32.93	75.00	−3.00	113.65
23,094.00	49,570.00	11.47	24.07	31.00	79.00	−1.00	114.15
24,302.00	51,102.00	11.92	26.13	34.43	66.00	−4.00	116.67
25,155.00	51,625.00	12.64	29.39	34.28	82.00	−2.00	118.41
25,435.00	52,133.00	12.53	29.41	33.95	68.00	−3.00	121.05
25,355.00	51,790.00	13.32	33.40	34.53	62.00	−5.00	124.20
359.00	4,447.00	5.38	7.76	47.21	82.00	5.00	100.00
370.00	4,559.00	5.38	7.76	47.21	82.00	5.00	100.00
375.00	4,640.10	5.38	7.76	47.21	82.00	5.00	100.00
382.00	4,710.30	5.38	7.76	47.21	82.00	5.00	100.00
481.01	4,781.50	5.38	7.76	47.21	82.00	5.00	100.00
543.24	4,853.00	5.62	10.78	37.93	72.00	3.00	121.00
551.00	4,927.10	5.62	10.78	37.93	72.00	3.00	121.00
904.62	5,001.60	5.62	10.78	37.93	72.00	3.00	121.00
796.98	5,077.00	5.62	10.78	37.93	72.00	3.00	121.00
936.00	5,154.00	5.62	10.78	37.93	72.00	3.00	121.00
872.00	5,917.00	7.91	18.34	24.89	71.00	2.00	119.03
832.00	5,586.00	8.21	13.76	30.59	52.00	−1.00	106.95
747.00	5,463.00	9.43	16.70	35.38	50.00	−1.00	99.37
647.00	5,284.00	11.42	25.12	34.87	56.00	2.00	96.65
652.00	5,315.00	10.79	24.19	32.17	59.00	0.00	97.32
698.00	5,277.00	12.20	28.66	31.50	59.00	0.00	96.92
56.29	4,552.00	3.32	0.69	35.17	40.00	0.00	100.00
56.92	4,603.00	3.32	0.69	35.17	40.00	0.00	100.00
67.29	4,646.00	3.32	0.69	35.17	40.00	0.00	100.00
116.99	4,700.00	3.32	0.69	35.17	40.00	0.00	100.00
501.00	4,591.60	3.32	0.69	35.17	40.00	0.00	100.00
403.00	4,646.00	6.02	5.23	29.07	19.00	−2.00	123.98
432.00	4,711.00	6.02	5.23	29.07	19.00	−2.00	123.98
490.00	4,593.50	6.02	5.23	29.07	19.00	−2.00	123.98
607.00	4,553.00	6.02	5.23	29.07	19.00	−2.00	123.98
576.00	4,312.00	6.02	5.23	29.07	19.00	−2.00	123.98
641.00	4,033.00	10.48	8.08	38.22	38.00	−3.00	123.27
654.00	3,809.00	11.13	7.52	44.39	31.00	−3.00	125.66
832.00	3,988.00	11.95	7.64	38.91	43.00	0.00	123.93
799.00	3,738.00	13.02	9.20	42.66	37.00	−1.00	126.23
923.00	3,795.00	12.00	10.72	38.11	25.00	−3.00	131.57
963.00	3,712.00	11.99	10.64	31.38	36.00	−1.00	136.60
998.00	3,721.00	11.75	10.21	40.77	29.00	−3.00	139.52
1,010.00	3,768.00	11.13	10.59	28.47	33.00	0.00	145.54
32.00	158.00	89.75	99.99	28.95	7.43	1.45	132.33
39.00	164.00	89.67	99.98	28.85	8.48	1.53	134.04
42.00	167.00	89.60	99.97	20.44	8.27	1.53	139.58
37.00	175.00	89.09	99.98	28.80	8.88	1.74	142.49
40.30	194.60	88.34	99.98	34.75	8.42	1.73	149.26
56.10	219.90	87.25	99.98	22.17	7.21	1.54	159.15
42.80	225.30	88.18	99.98	23.55	7.67	1.89	166.38
124.00	1,848.20	1.45	4.14	51.67	72.00	12.00	63.82
130.00	1,898.00	1.45	4.14	51.67	72.00	12.00	63.82
150.00	2,000.00	1.45	4.14	51.67	72.00	12.00	63.82
161.00	2,056.70	1.45	4.14	51.67	72.00	12.00	63.82
205.00	2,168.00	1.45	4.14	51.67	72.00	12.00	63.82
254.00	2,278.70	1.70	5.01	34.37	71.00	24.00	100.00
284.00	2,704.00	1.70	5.01	34.37	71.00	24.00	100.00
463.00	2,720.40	1.70	5.01	34.37	71.00	24.00	100.00
650.00	2,917.90	1.70	5.01	34.37	71.00	24.00	100.00
835.00	3,000.60	1.70	5.01	34.37	71.00	24.00	100.00
898.00	3,040.70	2.50	7.31	25.87	64.00	22.00	129.70
1,064.00	3,384.60	2.50	7.31	25.87	64.00	22.00	129.70
1,081.00	3,397.70	2.50	7.31	25.87	64.00	22.00	129.70
976.86	3,224.28	2.50	7.31	25.87	64.00	22.00	129.70
902.17	2,952.98	2.50	7.31	25.87	64.00	22.00	129.70
910.00	2,846.00	4.62	13.23	43.64	45.00	18.00	132.40

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Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
861.00	2,823.00	5.84	19.97	51.51	28.00	18.00	133.20
828.50	2,692.50	5.93	19.36	48.70	35.00	18.00	133.37
828.50	2,692.50	6.44	22.01	50.55	50.00	21.00	135.00
863.17	2,619.02	7.50	24.77	50.41	46.00	21.00	146.67
863.17	2,619.02	8.08	27.97	47.87	48.00	21.00	183.59
935.25	2,763.17	7.92	24.86	43.06	54.00	22.00	187.26
871.86	2,768.04	9.62	28.95	41.94	62.00	23.00	204.35
930.00	25,780.00	4.85	17.47	28.88	68.00	7.00	90.31
1,199.00	25,960.00	4.85	17.47	28.88	68.00	7.00	90.31
1,874.00	26,605.00	4.85	17.47	28.88	68.00	7.00	90.31
2,235.00	26,846.00	4.85	17.47	28.88	68.00	7.00	90.31
2,595.00	28,364.00	4.85	17.47	28.88	68.00	7.00	90.31
2,888.00	28,959.00	5.90	18.85	26.78	71.00	7.00	100.00
3,513.00	29,409.00	5.90	18.85	26.78	71.00	7.00	100.00
2,727.00	29,864.00	5.90	18.85	26.78	71.00	7.00	100.00
3,108.00	30,035.00	5.90	18.85	26.78	71.00	7.00	100.00
3,509.00	31,150.00	5.90	18.85	26.78	71.00	7.00	100.00
3,683.00	31,668.00	7.57	16.32	24.91	63.00	0.00	104.66
3,813.00	32,516.00	7.57	16.32	24.91	63.00	0.00	104.66
5,536.00	32,536.00	7.57	16.32	24.91	63.00	0.00	104.66
4,631.00	32,461.00	7.57	16.32	24.91	63.00	0.00	104.66
6,042.00	32,107.00	7.57	16.32	24.91	63.00	0.00	104.66
6,107.00	32,440.00	12.58	25.76	26.39	59.00	−1.00	103.16
7,149.00	31,386.00	12.52	27.59	25.75	63.00	−3.00	103.89
7,177.00	29,994.00	14.80	31.02	27.92	80.00	−2.00	100.79
7,335.00	29,573.00	16.97	38.91	33.59	70.00	−2.00	98.94
7,472.00	29,652.00	18.06	43.39	37.90	66.00	−1.00	98.93
7,864.00	29,524.00	17.22	38.68	36.24	66.00	−1.00	99.70
2,668.87	50,256.63	3.39	11.42	15.54	170.77	71.16	87.94
3,100.00	51,132.00	3.39	11.42	15.54	170.77	71.16	87.94
3,727.75	50,902.94	3.39	11.42	15.54	170.77	71.16	87.94
4,115.38	51,267.90	3.39	11.42	15.54	170.77	71.16	87.94
4,701.00	51,800.00	3.39	11.42	15.54	170.77	71.16	87.94
5,100.00	52,224.00	3.09	9.40	16.83	166.42	69.87	94.67
5,465.00	52,908.00	3.09	9.40	16.83	166.42	69.87	94.67
5,860.00	53,098.00	3.09	9.40	16.83	166.42	69.87	94.67
6,491.00	53,605.00	3.09	9.40	16.83	166.42	69.87	94.67
7,032.00	53,699.00	3.09	9.40	16.83	166.42	69.87	94.67
7,860.00	54,833.00	3.06	9.26	16.48	170.78	71.97	100.00
8,247.00	54,681.00	3.06	9.26	16.48	170.78	71.97	100.00
8,638.00	54,199.00	3.06	9.26	16.48	170.78	71.97	100.00
9,157.00	54,271.00	3.06	9.26	16.48	170.78	71.97	100.00
9,400.00	53,376.00	3.06	9.26	16.48	170.78	71.97	100.00
10,026.00	52,720.00	3.30	8.88	17.72	169.12	62.63	106.05
10,204.00	52,024.00	3.30	8.88	17.72	169.12	62.63	106.05
10,304.00	50,816.00	3.30	8.88	17.72	169.12	62.63	106.05
9,776.00	48,106.00	3.30	8.88	17.72	169.12	62.63	106.05
9,502.00	46,252.00	3.30	8.88	17.72	169.12	62.63	106.05
9,446.00	45,359.00	3.75	9.62	19.86	173.58	60.43	106.57
9,156.00	45,430.00	4.07	10.40	20.38	170.60	57.49	106.44
9,127.00	45,234.00	4.01	9.95	20.62	173.89	61.38	108.03
9,117.00	44,874.00	4.31	10.87	20.93	180.02	58.80	110.19
8,972.00	44,317.00	4.72	12.55	21.15	175.39	58.89	110.61
8,843.00	43,981.00	5.18	14.40	21.58	172.27	58.09	111.96
8,619.00	43,170.00	5.13	14.28	22.08	179.29	56.79	112.54
8,495.00	42,894.00	5.56	15.92	22.61	179.32	57.32	114.98
1,423.50	30,646.10	1.08	6.04	15.68	241.41	52.25	50.26
2,476.89	33,669.80	1.08	6.04	15.68	241.41	52.25	50.26
2,157.88	27,410.00	1.08	6.04	15.68	241.41	52.25	50.26
2,640.05	22,973.10	1.08	6.04	15.68	241.41	52.25	50.26
3,258.36	21,213.10	1.08	6.04	15.68	241.41	52.25	50.26
4,012.00	17,438.00	0.30	1.66	12.28	258.24	57.45	75.69
4,775.66	18,222.60	0.30	1.66	12.28	258.24	57.45	75.69
5,076.06	17,481.70	0.30	1.66	12.28	258.24	57.45	75.69
5,682.00	16,272.80	0.30	1.66	12.28	258.24	57.45	75.69
6,348.81	16,649.10	0.30	1.66	12.28	258.24	57.45	75.69
6,996.00	16,949.90	0.40	1.42	14.20	253.96	50.27	100.00
7,636.53	17,702.10	0.40	1.42	14.20	253.96	50.27	100.00
8,011.00	18,214.20	0.40	1.42	14.20	253.96	50.27	100.00
8,372.37	18,518.90	0.40	1.42	14.20	253.96	50.27	100.00
8,975.00	18,252.00	0.40	1.42	14.20	253.96	50.27	100.00
9,944.00	17,665.00	0.51	1.04	13.31	237.15	52.66	127.84
11,096.00	19,006.00	0.51	1.04	13.31	237.15	52.66	127.84
11,112.00	18,581.00	0.51	1.04	13.31	237.15	52.66	127.84
10,753.00	17,943.00	0.72	1.25	14.26	196.94	40.41	157.89

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Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
10,412.00	17,861.00	0.74	1.44	14.85	203.55	39.98	163.71
10,436.00	17,881.00	0.86	1.34	24.59	222.57	43.05	167.64
10,432.00	17,786.00	1.01	1.63	25.46	216.45	42.35	172.95
10,586.00	18,219.00	1.47	1.57	24.75	213.99	42.34	178.49
10,927.00	18,705.00	1.48	1.94	26.44	192.88	41.77	183.50
11,615.00	19,627.00	1.52	2.84	28.34	206.16	46.05	188.91
11,828.96	19,523.67	1.67	3.31	28.28	212.17	45.89	194.88
0.00	657.00	27.37	73.81	67.17	9.00	1.00	77.57
0.00	650.00	27.37	73.81	67.17	9.00	1.00	77.57
0.00	621.09	27.37	73.81	67.17	9.00	1.00	77.57
0.00	597.38	27.37	73.81	67.17	9.00	1.00	77.57
0.00	613.12	27.37	73.81	67.17	9.00	1.00	77.57
0.00	642.00	31.08	68.25	54.33	11.00	0.00	100.00
0.00	713.00	31.08	68.25	54.33	11.00	0.00	100.00
3.12	793.00	31.08	68.25	54.33	11.00	0.00	100.00
13.65	695.00	31.08	68.25	54.33	11.00	0.00	100.00
24.68	720.38	31.08	68.25	54.33	11.00	0.00	100.00
26.29	716.00	32.59	69.59	28.68	16.00	2.00	148.32
28.99	760.00	32.59	69.59	28.68	16.00	2.00	148.32
38.35	860.92	32.59	69.59	28.68	16.00	2.00	148.32
42.75	751.92	32.59	69.59	28.68	16.00	2.00	148.32
55.53	752.96	32.59	69.59	28.68	16.00	2.00	148.32
59.63	680.14	31.81	54.86	16.64	29.00	2.00	144.80
62.15	720.64	33.31	50.49	16.91	28.00	2.00	154.17
83.53	657.61	37.38	66.63	20.20	24.00	1.00	160.72
142.00	704.00	37.12	56.92	20.59	28.00	3.00	164.44
170.00	726.00	37.16	54.52	25.19	28.00	2.00	166.20
182.00	798.06	36.05	50.17	27.97	28.00	2.00	172.86
120.85	802.47	38.15	54.17	31.02	27.00	1.00	176.96
141.33	798.19	43.95	72.53	26.09	23.00	2.00	182.72
150.25	785.07	40.44	52.03	23.38	29.00	3.00	190.07
0.00	1,275.92	9.45	3.06	59.87	31.00	6.00	100.00
0.00	1,313.45	9.45	3.06	59.87	31.00	6.00	100.00
0.00	1,395.10	9.45	3.06	59.87	31.00	6.00	100.00
0.00	1,327.61	9.45	3.06	59.87	31.00	6.00	100.00
14.00	1,260.12	9.45	3.06	59.87	31.00	6.00	100.00
14.00	1,287.37	9.94	3.19	45.50	35.00	13.00	144.35
14.00	1,325.72	9.94	3.19	45.50	35.00	13.00	144.35
79.56	1,353.61	9.94	3.19	45.50	35.00	13.00	144.35
100.59	1,368.98	9.94	3.19	45.50	35.00	13.00	144.35
86.62	1,205.53	9.94	3.19	45.50	35.00	13.00	144.35
43.37	1,252.62	15.10	18.24	44.41	44.00	6.00	153.04
244.12	1,339.28	14.47	26.19	43.86	40.00	5.00	162.28
261.21	1,330.16	15.74	26.12	51.69	29.00	7.00	168.52
261.31	1,280.05	17.39	36.21	50.03	31.00	2.00	174.50
267.89	1,270.25	18.30	40.75	42.97	25.00	1.00	180.67
298.17	1,300.00	20.14	39.41	46.78	25.00	1.00	184.33
61.62	285.26	1.16	40.81	28.41	157.00	9.00	100.00
66.39	285.21	1.16	40.81	28.41	157.00	9.00	100.00
66.43	291.29	1.16	40.81	28.41	157.00	9.00	100.00
70.58	306.43	1.16	40.81	28.41	157.00	9.00	100.00
72.15	310.89	1.16	40.81	28.41	157.00	9.00	100.00
80.10	312.76	1.62	6.25	24.68	130.00	7.00	115.65
83.99	322.65	1.62	6.25	24.68	130.00	7.00	115.65
86.02	333.37	1.62	6.25	24.68	130.00	7.00	115.65
88.97	340.69	1.62	6.25	24.68	130.00	7.00	115.65
89.30	338.14	1.62	6.25	24.68	130.00	7.00	115.65
92.72	344.26	3.05	8.29	27.52	127.00	4.00	130.49
97.59	345.33	3.02	9.29	25.58	138.00	5.00	133.81
96.41	346.09	3.37	11.18	28.68	125.00	4.00	133.34
94.56	334.72	3.88	20.00	21.68	127.00	4.00	138.21
99.06	348.15	4.91	20.90	26.18	129.00	4.00	144.15
100.88	345.95	5.55	32.28	18.70	129.00	4.00	150.35
143.73	21,062.33	12.12	24.69	39.51	27.91	2.05	70.28
517.50	21,967.53	12.12	24.69	39.51	27.91	2.05	70.28
662.00	28,089.50	12.12	24.69	39.51	27.91	2.05	70.28
694.60	29,472.40	12.12	24.69	39.51	27.91	2.05	70.28
719.00	30,509.60	12.20	23.65	41.03	23.40	1.10	77.30
753.20	31,959.40	12.20	23.65	41.03	23.40	1.10	77.30
689.80	29,272.40	12.20	23.65	41.03	23.40	1.10	77.30
720.00	30,550.50	12.20	23.65	41.03	23.40	1.10	77.30
729.40	30,952.00	12.20	23.65	41.03	23.40	1.10	77.30
724.30	30,733.00	11.21	19.80	34.69	24.65	1.58	100.00
742.10	31,488.60	11.21	19.80	34.69	24.65	1.58	100.00
780.47	32,173.60	11.21	19.80	34.69	24.65	1.58	100.00

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Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
820.50	32,915.70	11.21	19.80	34.69	24.65	1.58	100.00
895.00	34,604.00	11.21	19.80	34.69	24.65	1.58	100.00
1,150.00	35,404.90	9.76	15.20	33.61	22.82	2.05	107.38
1,176.00	36,135.00	9.76	15.20	33.61	22.82	2.05	107.38
1,202.20	36,865.00	9.76	15.20	33.61	22.82	2.05	107.38
1,346.80	37,595.00	9.76	15.20	33.61	22.82	2.05	107.38
1,500.00	38,325.00	9.76	15.20	33.61	22.82	2.05	107.38
1,695.00	40,058.75	8.49	16.60	33.77	22.43	1.81	115.58
1,980.00	41,062.50	7.98	14.89	33.10	23.11	2.00	119.81
2,100.00	42,102.75	7.59	13.79	33.35	21.44	1.67	124.18
1,899.00	9,529.00	1.80	3.31	42.62	254.00	23.00	100.00
1,917.00	9,550.00	1.80	3.31	42.62	254.00	23.00	100.00
2,022.00	9,684.00	1.80	3.31	42.62	254.00	23.00	100.00
2,039.00	9,504.00	1.80	3.31	42.62	254.00	23.00	100.00
2,183.00	9,746.00	1.80	3.31	42.62	254.00	23.00	100.00
2,142.00	9,769.00	2.82	7.45	43.29	204.00	16.00	106.90
2,247.00	9,761.00	2.82	7.45	43.29	204.00	16.00	106.90
2,388.00	9,922.00	2.82	7.45	43.29	204.00	16.00	106.90
2,450.00	9,868.00	2.82	7.45	43.29	204.00	16.00	106.90
2,384.00	9,738.00	2.82	7.45	43.29	204.00	16.00	106.90
2,354.00	9,484.00	3.93	9.39	46.84	172.00	12.00	114.48
2,291.00	9,479.00	4.46	10.81	45.60	172.00	7.00	116.25
2,196.00	9,203.00	4.58	12.09	52.25	169.00	3.00	115.05
2,112.00	8,840.00	4.52	11.91	55.88	171.00	5.00	114.90
2,112.00	8,894.00	4.78	11.27	53.26	162.00	1.00	116.54
2,176.00	8,866.00	4.97	12.40	53.17	192.00	4.00	118.82
2,291.00	8,861.00	5.01	12.83	51.74	194.00	4.00	121.43
2,327.00	8,792.00	5.42	14.87	56.61	187.00	2.00	124.96
608.76	2,295.00	35.95	95.74	17.10	83.00	9.00	116.92
598.00	2,403.00	42.81	96.54	15.94	97.00	11.00	118.07
620.00	2,392.00	45.31	97.97	14.54	90.00	10.00	121.26
589.68	2,517.96	38.66	97.68	12.18	102.00	12.00	122.52
566.97	2,175.44	45.31	97.66	12.28	89.00	9.00	124.93
571.50	2,187.22	45.50	97.68	10.02	87.00	10.00	127.39
1,104.90	3,946.17	49.47	97.79	13.62	95.00	11.00	128.75
13.00	12,226.00	4.28	1.63	43.74	44.00	4.00	100.00
147.00	11,109.00	4.28	1.63	43.74	44.00	4.00	100.00
116.00	10,509.00	4.28	1.63	43.74	44.00	4.00	100.00
145.00	9,925.00	4.28	1.63	43.74	44.00	4.00	100.00
243.00	9,759.00	4.28	1.63	43.74	44.00	4.00	100.00
367.00	12,169.00	4.87	2.48	43.09	45.00	5.00	116.20
487.00	12,235.00	4.87	2.48	43.09	45.00	5.00	116.20
580.00	12,264.00	4.87	2.48	43.09	45.00	5.00	116.20
895.00	12,194.00	4.87	2.48	43.09	45.00	5.00	116.20
1,421.00	12,053.00	4.87	2.48	43.09	45.00	5.00	116.20
1,783.00	12,032.00	7.23	6.93	33.86	52.00	5.00	146.77
1,173.00	12,129.00	7.86	8.05	29.37	53.00	6.00	153.75
1,244.00	12,084.00	8.82	10.44	33.51	48.00	3.00	155.79
1,499.00	11,295.00	8.77	10.41	34.42	55.00	3.00	157.54
2,180.00	10,330.00	9.15	12.52	37.39	40.00	0.00	162.86
2,867.00	10,863.00	9.45	13.80	32.18	48.00	2.00	169.76
3,243.48	11,654.34	8.82	13.73	35.06	44.00	1.00	175.10
3,198.68	11,968.72	8.58	14.19	34.77	48.00	1.00	183.55
3,269.05	12,485.42	8.53	12.74	30.68	62.00	4.00	193.38
40.01	3,528.95	16.43	28.30	24.56	44.00	11.00	81.85
53.51	3,740.45	16.43	28.30	24.56	44.00	11.00	81.85
67.05	4,013.21	16.43	28.30	24.56	44.00	11.00	81.85
81.79	4,197.81	16.43	28.30	24.56	44.00	11.00	81.85
108.68	4,426.90	16.43	28.30	24.56	44.00	11.00	81.85
157.29	4,704.56	15.28	29.67	18.81	39.00	5.00	100.00
189.56	4,709.17	15.28	29.67	18.81	39.00	5.00	100.00
212.66	4,595.15	15.28	29.67	18.81	39.00	5.00	100.00
226.94	4,692.78	15.28	29.67	18.81	39.00	5.00	100.00
319.57	4,665.19	15.28	29.67	18.81	39.00	5.00	100.00
405.78	4,745.18	13.13	17.88	16.56	45.00	10.00	104.40
475.35	4,898.08	13.13	17.88	16.56	45.00	10.00	104.40
527.90	4,967.27	13.13	17.88	16.56	45.00	10.00	104.40
566.65	5,471.84	13.13	17.88	16.56	45.00	10.00	104.40
648.21	5,496.27	13.13	17.88	16.56	45.00	10.00	104.40
619.35	5,457.14	23.23	52.81	17.43	39.00	4.00	107.54
594.79	5,177.78	22.49	46.48	18.43	40.00	3.00	105.71
549.48	4,765.92	20.31	42.50	19.95	44.00	4.00	101.42
594.12	4,597.94	24.66	58.32	23.63	38.00	3.00	100.49
764.67	4,710.46	26.04	60.74	23.01	45.00	4.00	101.28
677.77	4,768.81	22.60	47.53	24.38	44.00	5.00	103.10

(*continued on next page*)

Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
699.04	4,890.59	25.79	54.63	25.30	47.00	7.00	105.18
604.14	5,006.55	21.22	39.12	23.71	46.00	6.00	108.87
34.23	1,368.69	2.75	14.98	37.28	45.00	0.00	100.00
35.78	1,285.97	2.75	14.98	37.28	45.00	0.00	100.00
34.44	1,449.11	2.75	14.98	37.28	45.00	0.00	100.00
47.05	1,511.24	2.75	14.98	37.28	45.00	0.00	100.00
45.55	1,400.03	2.75	14.98	37.28	45.00	0.00	100.00
13.79	1,467.77	4.30	14.91	35.71	34.00	−3.00	127.79
13.57	1,523.99	4.30	14.91	35.71	34.00	−3.00	127.79
38.90	1,579.06	4.30	14.91	35.71	34.00	−3.00	127.79
59.65	1,685.53	4.30	14.91	35.71	34.00	−3.00	127.79
72.45	1,654.35	4.30	14.91	35.71	34.00	−3.00	127.79
98.15	1,719.01	7.43	21.63	34.29	46.00	−3.00	162.39
113.45	1,678.92	7.45	17.67	36.27	32.00	−6.00	167.01
140.75	1,656.57	8.16	19.32	33.99	41.00	−3.00	170.18
107.89	1,644.64	8.31	22.28	34.38	41.00	−4.00	171.31
88.42	1,732.99	8.90	22.94	37.03	19.00	−8.00	175.84
136.23	1,784.18	9.61	22.68	29.63	38.00	−5.00	184.30
291.07	1,889.53	9.56	24.72	36.17	16.00	−7.00	188.23
433.31	2,057.79	9.15	23.81	28.97	33.00	−4.00	193.96
603.24	2,254.09	9.11	21.76	31.44	23.00	−7.00	201.27
21.05	1,185.93	8.95	25.18	18.67	65.00	11.00	81.78
89.68	1,158.79	8.95	25.18	18.67	65.00	11.00	81.78
13.95	952.68	12.29	28.66	16.41	86.00	15.00	100.00
62.17	812.06	12.29	28.66	16.41	86.00	15.00	100.00
92.08	834.02	12.29	28.66	16.41	86.00	15.00	100.00
182.65	969.21	12.29	28.66	16.41	86.00	15.00	100.00
168.63	988.73	10.61	23.65	21.22	44.00	5.00	119.15
145.46	1,036.47	10.61	23.65	21.22	44.00	5.00	119.15
216.90	1,060.09	10.61	23.65	21.22	44.00	5.00	119.15
189.87	1,094.76	10.61	23.65	21.22	44.00	5.00	119.15
189.14	1,069.35	10.61	23.65	21.22	44.00	5.00	119.15
203.21	1,003.90	15.30	29.22	17.32	46.00	3.00	130.73
258.30	852.12	14.19	24.38	21.46	50.00	3.00	131.85
270.24	744.01	15.19	27.84	22.00	57.00	4.00	128.37
239.05	853.39	17.13	32.32	23.17	69.00	6.00	127.05
258.82	891.71	18.07	38.52	24.33	43.00	1.00	130.57
430.04	925.94	16.04	29.39	23.00	45.00	2.00	133.45
379.72	942.84	16.55	31.18	24.78	42.00	1.00	137.71
411.74	974.10	15.17	27.71	21.18	65.00	5.00	144.31
1,415.00	20,076.00	5.46	14.72	28.97	34.00	6.00	81.82
1,640.00	21,125.20	5.46	14.72	28.97	34.00	6.00	81.82
1,860.00	22,174.40	5.46	14.72	28.97	34.00	6.00	81.82
2,067.00	22,423.00	5.46	14.72	28.97	34.00	6.00	81.82
1,920.00	24,470.00	5.46	14.72	28.97	34.00	6.00	81.82
1,778.00	26,505.00	5.62	15.61	26.68	40.00	5.00	100.00
2,956.00	26,616.00	5.62	15.61	26.68	40.00	5.00	100.00
3,811.00	26,404.00	5.62	15.61	26.68	40.00	5.00	100.00
3,770.00	27,270.00	5.62	15.61	26.68	40.00	5.00	100.00
3,730.00	25,746.00	5.62	15.61	26.68	40.00	5.00	100.00
3,685.00	25,683.00	5.94	14.60	19.26	38.00	6.00	117.53
3,646.33	26,209.19	5.94	14.60	19.26	38.00	6.00	117.53
3,495.95	26,153.99	5.94	14.60	19.26	38.00	6.00	117.53
3,898.39	25,316.94	5.94	14.60	19.26	38.00	6.00	117.53
3,810.97	25,107.98	5.94	14.60	19.26	38.00	6.00	117.53
4,174.67	23,774.42	11.84	32.78	27.45	35.00	3.00	123.27
3,782.46	22,672.41	11.85	30.02	31.92	30.00	2.00	122.27
4,277.34	21,896.34	12.92	29.58	37.23	34.00	5.00	118.65
3,284.30	21,184.20	15.22	39.58	44.75	29.00	3.00	116.95
3,525.50	20,836.40	15.59	40.11	42.59	39.00	4.00	118.57
3,892.00	21,157.80	14.06	34.96	40.86	39.00	4.00	123.11
3,944.80	21,541.80	14.64	38.57	43.74	39.00	7.00	126.85
4,032.90	22,017.90	13.13	32.21	38.05	49.00	8.00	130.62
1,091.00	3,773.00	31.00	57.25	33.50	55.00	2.00	100.00
1,135.20	3,907.20	31.00	57.25	33.50	55.00	2.00	100.00
1,294.82	4,149.00	31.00	57.25	33.50	55.00	2.00	100.00
1,313.76	4,159.21	31.00	57.25	33.50	55.00	2.00	100.00
1,384.76	4,142.88	31.00	57.25	33.50	55.00	2.00	100.00
1,474.28	4,320.73	28.79	51.29	38.41	45.00	1.00	113.84
1,657.52	4,461.26	28.79	51.29	38.41	45.00	1.00	113.84
1,591.18	4,459.95	28.79	51.29	38.41	45.00	1.00	113.84
1,520.47	4,475.97	28.79	51.29	38.41	45.00	1.00	113.84
1,604.40	4,390.48	28.79	51.29	38.41	45.00	1.00	113.84
1,414.40	4,140.11	33.40	55.30	32.64	38.00	0.00	124.35
1,407.60	4,277.87	32.91	55.95	31.45	42.00	0.00	128.32

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Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
1,404.73	4,323.52	36.90	59.07	29.76	31.00	0.00	127.57
1,444.79	4,371.47	34.45	54.03	29.10	35.00	0.00	129.08
1,419.74	4,294.87	35.73	55.84	30.12	31.00	−1.00	132.51
1,418.49	4,421.57	43.02	63.27	28.40	32.00	−2.00	138.46
1,434.51	4,439.40	38.25	57.17	27.83	36.00	0.00	141.33
1,425.82	4,550.93	39.90	57.88	26.67	35.00	−1.00	144.96
1,319.66	4,415.56	37.82	55.80	25.73	60.00	4.00	147.78
910.60	4,100.60	14.67	54.98	22.07	81.00	12.00	91.38
951.20	4,131.20	14.67	54.98	22.07	81.00	12.00	91.38
986.68	4,096.70	14.67	54.98	22.07	81.00	12.00	91.38
1,020.23	4,140.20	14.67	54.98	22.07	81.00	12.00	91.38
1,160.51	4,161.50	14.67	54.98	22.07	81.00	12.00	91.38
1,240.00	4,240.00	17.02	57.23	23.85	73.00	7.00	89.24
1,315.00	4,280.00	17.02	57.23	23.85	73.00	7.00	89.24
1,349.00	4,294.00	17.02	57.23	23.85	73.00	7.00	89.24
1,406.00	4,369.00	17.02	57.23	23.85	73.00	7.00	89.24
1,445.00	4,555.00	17.02	57.23	23.85	73.00	7.00	89.24
1500.00	4,731.00	17.39	57.00	26.27	67.00	4.00	100.00
1,584.00	4,794.00	17.39	57.00	26.27	67.00	4.00	100.00
1,578.00	4,936.00	17.39	57.00	26.27	67.00	4.00	100.00
1,596.00	4,916.00	17.39	57.00	26.27	67.00	4.00	100.00
1,640.00	4,900.00	17.39	57.00	26.27	67.00	4.00	100.00
1,730.00	4,940.00	15.56	55.86	23.57	66.00	3.00	107.40
1,785.00	5,330.00	15.56	55.86	23.57	66.00	3.00	107.40
1,855.00	5,465.00	15.56	55.86	23.57	66.00	3.00	107.40
1,893.00	5,653.00	15.56	55.86	23.57	66.00	3.00	107.40
1,871.00	5,461.00	15.56	55.86	23.57	66.00	3.00	107.40
1,878.00	5,565.00	18.29	56.73	21.74	72.00	4.00	120.71
1,895.00	5,478.00	17.32	54.10	22.23	61.00	3.00	123.03
1,939.00	5,576.00	19.87	59.48	21.98	64.00	4.00	124.53
1,919.00	5,708.00	19.41	59.20	21.56	70.00	4.00	126.79
1,960.00	6,006.00	20.18	58.03	22.04	69.00	3.00	129.90
1,924.00	6,030.00	21.22	62.23	21.91	68.00	4.00	132.05
1,874.00	6,050.00	21.16	61.88	22.32	69.00	4.00	134.75
1,846.00	5,992.00	21.32	62.78	22.72	66.00	3.00	136.89
2,946.00	33,763.00	12.53	32.89	31.75	33.57	8.78	215.80
2,982.00	34,173.00	12.08	29.34	31.53	31.40	9.01	231.99
2,836.00	33,954.00	1.02	2.66	35.75	107.00	10.00	100.00
3,181.00	34,945.00	1.02	2.66	35.75	107.00	10.00	100.00
3,733.00	35,532.00	1.02	2.66	35.75	107.00	10.00	100.00
4,698.00	35,279.00	1.02	2.66	35.75	107.00	10.00	100.00
5,657.00	36,121.00	1.02	2.66	35.75	107.00	10.00	100.00
6,362.00	35,121.00	1.75	4.28	36.33	91.00	9.00	114.21
7,107.00	35,479.00	1.75	4.28	36.33	91.00	9.00	114.21
7,680.00	34,780.00	1.75	4.28	36.33	91.00	9.00	114.21
7,775.00	33,424.00	1.75	4.28	36.33	91.00	9.00	114.21
7,890.34	32,507.45	1.75	4.28	36.33	91.00	9.00	114.21
8,068.62	31,954.51	3.61	6.91	43.03	90.00	6.00	117.18
8,134.03	31,066.06	4.30	9.65	43.34	85.00	6.00	118.68
8,173.10	30,412.98	4.53	11.43	44.18	88.00	6.00	120.37
8,459.58	30,890.41	5.57	14.97	45.02	88.00	7.00	123.00
8,466.00	31,129.42	6.86	19.25	44.11	85.00	5.00	126.53
8,557.79	31,475.01	8.05	24.96	44.23	83.00	5.00	129.52
8,640.00	31,710.00	8.51	24.85	42.05	87.00	6.00	131.75
8,324.00	30,912.00	9.56	29.66	43.97	86.00	6.00	134.04
26,345.00	188,939.00	5.02	11.53	21.69	32.22	3.19	71.32
29,511.00	188,449.00	5.02	11.53	21.69	32.22	3.19	71.32
32,677.00	194,990.00	5.02	11.53	21.69	32.22	3.19	71.32
34,310.00	197,748.00	5.02	11.53	21.69	32.22	3.19	71.32
39,245.00	200,742.00	5.02	11.53	21.69	32.22	3.19	71.32
41,867.00	197,113.00	5.07	10.80	19.88	37.09	3.99	80.96
42,756.00	195,943.00	5.07	10.80	19.88	37.09	3.99	80.96
43,472.00	202,393.00	5.07	10.80	19.88	37.09	3.99	80.96
44,162.00	206,040.00	5.07	10.80	19.88	37.09	3.99	80.96
46,085.00	213,080.00	5.07	10.80	19.88	37.09	3.99	80.96
48,090.00	220,854.00	4.48	8.21	21.78	34.37	3.25	100.00
48,199.00	218,450.00	4.48	8.21	21.78	34.37	3.25	100.00
49,197.00	222,560.00	4.48	8.21	21.78	34.37	3.25	100.00
50,839.00	223,548.00	4.48	8.21	21.78	34.37	3.25	100.00
52,707.00	230,534.00	4.48	8.21	21.78	34.37	3.25	100.00
53,742.00	230,180.00	4.54	8.58	21.65	33.10	3.37	113.57
56,118.00	233,237.00	4.54	8.58	21.65	33.10	3.37	113.57
57,243.00	232,693.00	4.54	8.58	21.65	33.10	3.37	113.57
56,209.00	229,200.00	4.54	8.58	21.65	33.10	3.37	113.57
56,273.00	222,188.00	4.54	8.58	21.65	33.10	3.37	113.57

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Table A1 (*continued*)

Recycling	Municipal waste generated	Renewable energy supply, % total energy supply	Renewable electricity, % total electricity generation	Biomass, % of DMC	Nitrogen balance per hectare	Phosphorus balance per hectare	Real GDP, Index 2000 = 100
59,203.00	227,749.00	5.68	10.12	30.03	31.33	2.60	118.79
60,500.00	228,583.00	6.18	12.23	30.09	33.81	2.99	120.64
59,393.00	228,873.60	6.43	12.01	32.30	34.42	3.00	123.35
58,913.00	231,395.60	6.78	12.64	34.11	30.60	2.69	125.62
60,010.00	234,416.50	6.90	12.98	35.53	27.64	2.29	128.79
61,289.00	237,782.19	6.84	13.23	37.11	27.53	2.67	132.76
62,178.00	243,225.00	7.17	14.82	38.60	26.42	2.25	135.03
60,763.00	243,724.30	7.54	16.84	40.17	27.01	2.78	138.18

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