Identification of economic and energy framework conditions of the Austrian climate and energy model regions

LINKS Working Paper 1.1

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14 March 2016

1. The aim of the working paper

By looking into the existing literature and official documents as well as various energy and economic data basis, the present working paper sets out to identify the existing economic and energy related framework conditions of 82 Austrian climate and energy model regions (CEMs). The question we set out to answer is how these framework conditions may influence the feasibility of achieving the model regions' climate and energy goals. In particular, what are the economic and energy related characteristics of the current climate and energy model regions? How can CEMs be clustered according to their economic and energy characteristics? Based on this cluster analysis of existing CEMs, we then investigate whether other municipalities share these characteristics and could therefore eventually become CEMs as well.

2. Energy demand, self-sufficiency potentials and renewable energy targets of Austria's CEMs

2.1. Status quo

As of November 1, 2015, 87 CEMs were operational in Austria, 82 of those CEMs had an implementation concept. Of the 82 analyzed implementation concepts, 64 provide comprehensive data regarding energy demand. The remaining 20 regions do not distinguish between electricity, heat and mobility, state contradicting data or provide no quantitative data at all. The implementation concept of the CEM Hartberg, for example, contains a CO_2 balance, but no quantitative energy demand or supply.

According to the energy data gathered from the analyzed implementation concepts, the average Austrian CEM has an energy demand of 29.95 MWh per capita and year (see Table 1). The annual average electricity demand amounts to 6.59 MWh per capita, which is below the average Austrian level of 7.23 MWh (Statistics Austria 2015a). The average annual CEM heating energy demand is 16.72 MWh per capita and considerably larger than the Austrian

average 10.7 MWh. The annual energy demand for mobility on the other hand is lower in the CEMs than in Austria as a whole, 9.01 MWh per capita in the CEMs compared to 10.24 MWh in Austria.

Table 1: Current energy demand in MWh per capita and year in Austria and in the CEMs as given in the implementation concepts

	Total	Heat	Electricity	Mobility
Data Coverage (% of concepts)	95%	91%	93%	83%
Austrian average	35.60	10.70	7.23	10.24
Average CEMs	29.95	16.72	6.59	9.01
Median CEMs	27.38	14.85	4.58	8.93
Minimum CEMs	4.27	3.91	0.66	1.55
Maximum CEMs	85.66	51.60	48.46	18.25

Source: own calculation based on data by CEM implementation concepts, Statistics Austria (2015a)

The differences when comparing average CEM data to the Austrian averages may result due to various reasons: different energy demands in foremost rural CEM regions as compared to the whole country, different system boundaries in the data acquisition, as well as potentially incomplete data sets. These differences across CEM concepts are also underlined by the high variance of the minimum and maximum levels (Table 1).

74% of the concepts also provide numbers for the overall regional energy production (Table 2). On average, Austrian CEMs produce 33% of their heating energy and 25% of the electricity demand by themselves. There are also CEMs with close to no domestic energy production and one which is already self-sufficient in heating. In electricity production, large scale hydropower plants are excluded in this calculation, since they generally supply a larger region with electricity than the respective CEM. Hence, they should not be assigned to the CEM alone. The energy production for mobility is very low in Austrian CEMs. Only 71% of the analyzed CEMs state the production of energy for mobility in their implementation concepts.

Table 2: Current rates of energy self-sufficiency in the Austrian CEMs based on implementation concepts

	Total	Heat	Electricity	Mobility
Data Coverage (% of concepts)	74%	85%	76%	71%
Average	21%	33%	25%	1%
Median	20%	33%	17%	0%
Minimum	3%	2%	0%	0%
Maximum	57%	100%	94%	7%

Regarding the presentation of a more detailed breakdown of the current energy production of CEMs, 78% of the analyzed concepts give at least some information on different sources of their energy production. Heat production is covered best, with specific production data from 67% of the regions. 62% also specify energy sources for electricity.

2.2. RES potentials and targets

As shown in Table 3, roughly 77% of the 82 analyzed implementation concepts state RES energy potentials. 80% state potentials for regional RES production of heat and 84% for electricity production. Again, mobility is represented in less detail, with only 35% of all CEM concepts providing information on potential energy production. The average RES potentials based on the information provided by the CEMs show that energy self-sufficiency is possible on average regarding heat and electricity, but not regarding mobility. Trading off excess heating energy and electricity for lacking energy for mobility, an overall energy autarky could be an option, as stated by some of the implementation concepts.

Table 3: CEMs' RES energy potentials and targets

	RES energy potentials				RES energy targets			
	Total	Heat	Electricity	Mobility	Total	Heat	Electricity	Mobility
Coverage (82 CEMs)	77%	80%	84%	35%	56%	45%	45%	24%
Average	145%	114%	373%	33%	66%	74%	71%	55%

Another important aspect in the implementation concepts is the definition of specific quantitative energy targets. 45% of the implementation concepts state quantitative targets for only heat or only electricity production and 56% state targets for both. Targets for the employment of RES in the mobility sector are only found in 24% of the CEMs. The RES energy targets of the CEMs are on average much lower than the stated RES potentials (Table 3). While the RES potentials show that energy autarky could be theoretically possible on average for the 82 analyzed CEMs, the self-set targets are well below 100% in all energy sectors. Heating targets are somewhat higher than electricity targets at 74% to 71%. The targets for mobility, on the other hand, are higher than the potentials. This is due to some CEMs' target definitions which use excess electricity in the mobility sector to achieve energy autarky in all three sectors.

Table 4 and Table 5 compare average heat and, respectively, electricity production as of the time of the concept development, to average potentials. There is no consistent year for calculating the potentials. The given potentials are mostly for 2020, some CEMs state potentials for the 2030s. Regarding heat production, the Austrian CEMs currently produce on

average 5.6 MWh per year and inhabitant, which accounts for 33% of their heating demand, from renewable resources within the regions. The resources used today are mostly biomass, amounting to 94%, followed by solar thermal energy, heat pumps, and other undefined energy sources. Biomass heating includes decentralized heating with wood as well as district heating using solid biomass or biogas as fuel. Heat from combined heat and power generation is also included. The stated potentials, on the other hand, would indicate a shift to heat pumps and a rise in solar energy.

Table 4 Current and potential average annual heat production in MWh per capita and by shares of energy sources

	Heat Demand [MWh]	Heat Production [MWh]				
		Total	Biomass	Solar	Heat pumps	Others
Current	16.72	5.60	94%	2%	2%	2%
Potential	14.06	11.95	84%	10%	7%	0%

Table 5 shows average electricity demand and production. For current electricity production we present values for production including large-scale hydropower plants as well as for production excluding them. Large-scale hydro power plants produce more electricity than demanded within a CEM and are therefore regarded as supra-regional plants which cannot be accounted for the CEM alone. Excluding them, on average 31% of the average electricity demand of 6.59 MWh per capita is produced within the CEMs. The majority of the electricity is produced from small-scale hydropower (72%), the rest comes from biomass, wind, biogas, PV and other sources. The potentials indicate a shift from hydropower to wind power and PV, and from solid biomass to biogas.

Table 5: Average annual electricity demand in MWh per capita and production shares

	Electricity Demand [MWh]	Electricity Production [MWh]						
		Total	Biomass	Biogas	Hydropower	Windpower	PV	Others
Current	6.59	4.19	3%	3%	87%	3%	1%	2%
Current excl. large scale hydropower	6.59	2.05	7%	6%	72%	7%	2%	5%
Potential	4.72	13.63	1%	11%	39%	32%	11%	5%

Since the number of CEM implementation concepts with stated potentials and targets is not very high and if stated, the data quality is heterogeneous (see discussion above), we consider the potentials provided by the “Maxi” scenario of Stanzer et al. (2010) for our further analysis. In the study by Stanzer et al. (2010), potentials of RES production and degrees of self-sufficiency are given for all Austrian districts. The values are provided in categories only,

so that we have to use the average value of the respective matching category. Assuming that the value of a district applies for all municipalities within it, we calculate the average values of the CEMs according to their municipalities. The aggregated results for all CEMs are given in Table 6.

Table 6: Potentials for electricity and heat self-sufficiency in CEMs based on Stanzer et al. (2010)

	Potential electricity self-sufficiency	Potential heat self-sufficiency
Average	126%	63%
Median	107%	62%
Minimum	26%	15%
Maximum	343%	113%
Share of CEMs with ≥ 100%	51%	6%

The comparison of the potentials given in the implementation concepts and those based on Stanzer et al. (2010), summarized in Table 7, shows that the CEMs tend to give higher values for their potentials. The potentials vary particularly regarding heat self-sufficiency, where 45% of the CEMs state to have the potential to become completely self-sufficient in contrast to only 6% as derived from the data from Stanzer et al. (2010). Possible reasons for this high spread are different assumptions in the calculation of future scenarios and potentials.

Table 7: Comparison of potentials for CEMs based on implementation concepts and Regio Energy

	Potential electricity self-sufficiency		Potential heat self-sufficiency	
	CEM concepts	Regio Energy	CEM concepts	Regio Energy
Average	373%	126%	114%	63%
Share of CEMs with ≥ 100%	55%	51%	45%	6%

Source: own calculation based on data by CEM implementation concepts and Regio Energy (Stanzer et al. 2010)

3. Economic structure of the Austrian CEMs

In addition to the discussion on the current state of RES energy production, RES targets and potentials towards the CEMs' goals of energy self-sufficiency and energy autarky in chapter 2, this chapter presents the current economic situation of those 82 CEMs that were part of the CEM program as of November 1, 2015, and published an implementation concept before this date. This survey of economic characteristics is done with the aim to determine the specific economic framework conditions in the different CEMs.

To that end different economic data sets on the regional level are investigated and linked to each other in the following, as the implementation concepts do not provide the required economic information. However, these individual data sets are not available at comparable regional levels, such as the municipality or NUTS 3 level. Therefore, data processing is necessary to define the specific economic situations in the different regions. In the following sections the data basis, the methodology for data processing, and the obtained results are presented.

3.1. Economic data

For the economic assessment of the CEMs, economic data at the smallest regional scale (municipality) is needed. The national census of Austria of the year 2011 provides data on population, employed persons and commuters at municipality level (Statistics Austria 2013). In addition, the census of employment for the year 2012 is used because employment data is not available at the municipality level for the year 2011 (Statistics Austria 2014a). For the year 2011, employment data on district level, instead of municipality level, is used. This employment data set distinguishes between the primary, secondary and tertiary sector, and at a more detailed level between the sectors of the ÖNACE 2008 classification (Statistics Austria 2008; STATcube 2015). Additionally to this dataset, there is data on NUTS 3 level available for gross value added in 2011 for the primary, secondary and tertiary sectors of Austria (Statistics Austria 2014b).

For a classification of the regions into rural or urban regions, the degree of urbanization of the European Union is used (European Commission, 2015). The advantage of this approach is that the regions within the EU are classified into three groups of urbanization due to their population size and density as well as the contiguity of the local administrative units level 2 region, which equals the Austrian municipality level, with its neighbor regions on a harmonized size of grid cells of one square kilometer. This approach divides each square kilometer into rural grid cells (if the population density is smaller than 300 inhabitants per square kilometer or population of the contiguous area is smaller than 5,000 inhabitants), into urban clusters (if both values are equal or above this value threshold) or into high-density clusters (if the grid cell has a population density of at least 1,500 inhabitants and the overall population of this contiguous area is at least 50,000 inhabitants). Based on this classification approach, in a next step of our data processing exercise each municipality is then mapped to a certain class of urbanization. The municipality is classified as a densely populated area, if “at least 50% of the population lives in high-density clusters”, as an intermediate density area, if “less than 50% of the population lives in high-density clusters” but also “less than

50% lives in rural grid cells", or as a thinly populated are, if "more than 50% of the population lives in rural grid cells" (European Commission 2011, p.3).

3.2. Methodology for data processing

In order to obtain economic data for each CEM in 2011, we need to disaggregate first the gross value added on NUTS 3 level, which distinguishes for the primary, secondary and tertiary sector (*j*), into the ÖNACE 2008 sectors from section A to S (*i*). A disaggregation is then also needed at the regional level, from NUTS 3 level (*n*), to district level (*d*) and then to municipality level (*m*). For this double disaggregation, equation 1 is used:

$$GVA_{i,m} = \frac{GVA_{j,n}}{E_{j,n}} * \frac{E_m}{E_d} * E_{i,d} \quad (1)$$

In equation 1 the gross value added (*GVA*) of each ÖNACE 2008 sector (*i*) in each municipality (*m*) equals the GVA in the respective primary, secondary or tertiary sector (*j*) and NUTS 3 region (*n*) divided by the employment (*E*) in the respective primary, secondary or tertiary sector and NUTS 3 region, times the total employment in the respective municipality (only available for the year 2012, but the change from 2011 to 2012 can be assumed as negligible) divided by the total employment in the respective district (*d*) (again for the year 2012 for consistency), times the employment in the respective ÖNACE 2008 sector and district.

If the $GVA_{i,m}$ is summed up for each ÖNACE 2008 sector and each municipality, the whole gross value added of Austria have to be obtained, as it is shown in equation 2:

$$GVA = \sum_i \sum_m GVA_{i,m} \quad (2)$$

The second step comprises the aggregation of GVA to the CEM level. For that, the GVA of each ÖNACE 2008 sector for each CEM can be calculated with equation 3:

$$GVA_{i,mn} = \sum_{mc} GVA_{i,mc} \quad (3)$$

Note that each municipality belongs to a certain district (*md*), a certain CEM (*mc*) and a certain NUTS 3 region (*mn*), but this is not true for the higher levels, which means that not every district belongs as a whole to a certain CEM (*c*) or NUTS 3 region (*n*). However, as the data are needed on CEM level, they have to be aggregated to CEM level.

3.3. Economic data processing results

The economic data for each of the 82 analyzed CEMs are shown in Table 8 and Table 9, which are split and reduced for the reason of better clarity, as well as Table 15, Table 16 and Table 17 in the Appendix, which present the results in more detail on CEM level. In total, the

82 CEMs cover 25.9% of the Austrian population, namely 2,174,289 inhabitants. Regarding the population share of the CEMs, the data show heterogeneity of the different CEMs, as the population varies from 1,269 to 81,268. A change in the CEM guidelines in 2015, for example concerning a minimum of two municipalities per CEM or a minimum of 3.000 and a maximum of 60.000 inhabitants, might lead to a reduction of this gap for new CEMs in the future (Climate and Energy Fund, 2015). The average population in the CEMs amounts to 26,516 inhabitants, while most regions are below this value, indicated by the median of 19,370.

Table 8: CEMs – Population and Employment

CEM Code	Population	Area in ha	Employment							
			Employment	Employment / Population	Primary sector	Secondary sector	Tertiary sector	Share of the primary sector	Share of the secondary sector	Share of the tertiary sector
Sum CEM	2,174,289	3,531,505	956,923	44.0%	76,130	277,448	603,345	8.0%	29.0%	63.1%
Sum Austria	8,401,940	8,387,899	4,167,164	49.6%	176,914	966,962	3,023,288	4.6%	24.1%	71.4%
Percentage share	25.9%	42.1%	23.0%		43%	29%	20%			
Median	19,370	26,376	8,082	38.5%	660	2,372	4,919	9.2%	28.7%	60.3%
Average	26,516	43,067	11,670	41.7%	928	3,384	7,358	9.1%	29.4%	61.5%
Maximum value	81,268	201,929	60,146	124.9%	3,434	11,119	48,786	20.2%	39.8%	83.3%
Minimum value	1,269	1,047	151	11.9%	6	47	98	0.2%	16.5%	50.0%

Source: own calculation based on data by Statistics Austria (2013, 2014a, 2014b)

The same is true for the area of the CEMs; while the region with the largest size has more than 60,000 ha, the region with the lowest size has only 150 ha. The median of all CEMs is only 26,376 ha, while the mean of 43,067 ha is nearly 20,000 ha larger. As already mentioned, CEMs are, by definition, mostly rural and structurally weak regions, which is confirmed by the fact that with 42.1% of the Austrian territory, more area than inhabitants are covered by CEMs.

In contrast to the population share of the CEMs, the total employment of 956,923 within the CEMs relates only to a share of 23% of the total Austrian employment, which is lower than the respective population share. The most employees in an individual region are 60,146 employees in “K&E Modellregionen - Ausbau und Erhaltung der Erneuerbaren Energie”, a CEM including the City of St. Pölten. On the other side, the CEM with the lowest employees is the single-municipality-CEM “K&E Modellregion - EnergieGemeindeTrins Nachhaltige Modellgemeinde” with only 151 employees. The average number of employees in the CEMs is 11,670; the median is again below this value, with 8,082. The relation of employees to the population highlights that this share is higher in whole Austrian compared to the part of Austria covered by the CEM approach, but it also highlights the heterogeneity of the CEMs,

ranging from a minimum of 11.9% to a maximum of 124.9%, as well as an average of 41.7% and a median of 38.5%. While the CEM with the lowest relation of employees to the population is again K&E Modellregion - EnergieGemeindeTrins Nachhaltige Modellgemeinde", the CEM with the highest relation is "K&E Modellregionen - Energy Shopping Vösendorf", also a single-municipality-CEM with a large shopping centre and therefore a high share of commuters working in the municipality.

Regarding the proportion of employees in the different sectors, we find that the proportion in the primary and secondary sectors for all CEMs are larger than the Austrian average, while the proportion in the tertiary sector is smaller, which again is in line with the KLIEN definition of the CEMs as mostly rural areas. However, we find also considerable differences between the CEMs, with some CEMs having a proportion in primary sector above 20%, while others are below 2%. This heterogeneity is also visible in the secondary and tertiary sectors where the range goes from 16.5% to 39.8% for the secondary sector and from 50% to 83.3% for the tertiary sector.

Table 9 (and Table 17 in the Appendix) contain data on the CEMs' degree of urbanization and their gross value added. For the degree of urbanization the data shows that not one of the 920 CEM municipalities is classified as densely populated area, which means that larger cities are not part of the CEM program, which is again in accordance with the definition of CEMs as rural and structurally weak regions. Concerning intermediate density area and thinly populated area, our analysis shows that only 11% of the municipalities are classified as intermediate density area, while the other 89% are classified as thinly populated or rural area. The median of 0% for the CEM regions indicates that in more than 50% of the analyzed CEMs not one municipality is an intermediate density area. Again for the degree of urbanization, the heterogeneity between the CEMs is shown, as there are, despite the small number of intermediate density municipalities, CEMs with 100% intermediate density municipalities. These small suburban CEMs include the CEMs with the highest shares of employees in the tertiary sector.

Comparing Table 8 to Table 9 indicates a certain dependency between employment and gross value added. In general, the populous CEMs with high employment relative to the population have the highest absolute GVA. The GVA per capita, which ranges from € 7,633 to € 89,539, again emphasizes the heterogeneity between the CEMs, as the highest GVA per capita being more than ten times higher than the lowest value. Again the two single-municipality-CEMs Vösendorf (maximum) and Trins (minimum) are those with the extreme values regarding GVA per capita. For the GVA per capita the results indicate that the CEMs with intermediate density area are those with the higher values on average. This is again true for the share of the tertiary sector relative to the other sectors, which means that those regions with relatively more intermediate density municipalities, have larger per capita GVA

and a higher share of GVA generated in the tertiary sector. In general the results show that 42.7% of GVA generated in the Austrian primary sector are produced in the CEMs, while only 26.7% and 18.5% are produced in the secondary and tertiary sector, respectively. Concerning the total GVA added the data display, that the tertiary sector is still the largest CEM sector with 60.9%, while the secondary and primary sector generates only 35.9% and 3.2%. Again the data differs between the CEMs for up to 40% for the secondary and tertiary sector.

Table 9: CEM – Degree of urbanization and gross value added

CEM Code	Degree of urbanization			Gross value added							
	Share of intermediate density area municipalities	Share of thinly-populated area municipalities	Sum of municipalities	Gross value added in million €	Gross value added per capita	Primary sector in million €	Secondary sector in million €	Tertiary sector in million €	Share of the primary sector	Share of the secondary sector	Share of the tertiary sector
Sum CEM	101	819	920	58,309.10	26,817.55	1,890.50	20,926.80	35,491.80	3.2%	35.9%	60.9%
Sum Austria				274,897.00	32,718.28	4,424.00	78,465.00	192,008.00	1.6%	28.5%	69.8%
Percentage share	11.0%	89.0%		21.2%		42.7%	26.7%	18.5%			
Median	0.0%	100.0%	9	479.59	22,360.71	17.92	156.15	290.77	4.1%	35.3%	60.3%
Average	15.2%	84.8%	11	711.09	25,290.24	23.05	255.20	432.83	4.2%	35.4%	60.4%
Maximum value	100.0%	100.0%	40	3,588.68	89,539.01	84.32	1,177.38	2,796.81	14.6%	58.9%	78.4%
Minimum value	0.0%	0.0%	1	9.69	7,633.40	0.10	3.66	5.93	0.1%	20.0%	37.7%

Source: own calculation based on data by Statistics Austria (2013, 2014a, 2014b); STATcube (2015); European Commission and Statistics Austria (2015)

4. Cluster analysis

The discussion in the previous chapters highlighted differences in reporting, ambitiousness of the goals and of potentials for energy-self-sufficiency as well as differences in size, GVA and economic structure between the CEMs. To identify and tackle these differences in order to determine conditions of economic viability regarding energy autarky and energy self-sufficiency in Austria's CEMs, the CEMs are grouped in sets of regions, which are preferably homogenous, but among each other heterogeneous, by means of a cluster analysis in this chapter. In section 4.1, the economic and energy related characteristics are discussed, while section 4.2 investigates whether there are other regions in Austria with a potential to become additional CEMs.

4.1. Economic and energy related characteristics of CEMs

A cluster analysis is used to group the very heterogeneous CEMs to better assess their characteristics and differences. It is based on economic data and energy data presented in the previous sections, the variables used for the cluster analysis are listed in Table 10. All variables are given in relative numbers to enable the comparison of CEMs with different sizes. The cluster analysis uses standardized values, so that variables with different ranges are treated equally.

Table 10: Variables for cluster analysis

Variables	Units	Source
Population density	inhabitants/ha	Statistics Austria (2013, 2015b)
Gross value added per capita	€/capita	STATcube (2015a); Statistics Austria (2014a, 2014b)
Employees primary sector	%	Statistics Austria (2014a, 2014b)
Employees secondary sector	%	Statistics Austria (2014a, 2014b)
Employees tertiary sector	%	Statistics Austria (2014a, 2014b)
Energy consumption	MWh/capita	CEM implementation concepts
Potential electricity self-sufficiency	%	Stanzer et al. (2010)
Potential heat self-sufficiency	%	Stanzer et al. (2010)

Due to the heterogeneity of data provided in the implementation concepts, only the CEMs' current energy consumption is taken from there. An inclusion of the potentials for heat and electricity self-sufficiency from the concepts would lead to the omission of 25% of the CEMs in the cluster analysis because of data gaps. To avoid this loss of cases considered in the clustered CEMs, we use data of Stanzer et al. (2010) instead. Stanzer et al. (2010) give information on RES potentials and hence self-sufficiency by 2020 of all Austrian districts for three scenarios. The district potentials of the "Maxi" scenario are used for all the districts' municipalities, which are then used to calculate the potential of the respective CEM according to the share of the area. With this data, 78 CEMs and therefore 95% can be assigned to a cluster; the missing 5% do not state their energy demand in the implementation concepts. All economic and population data employed in the cluster analysis is derived from Statistics Austria (see discussion above).

The cluster analysis is based on the hierarchical Ward method using squared Euclidean distances, which are minimized between the CEMs in one cluster. The Ward method delivers good results for three clusters, which are for themselves quite homogenous and between each other relatively heterogeneous. The average values of the Ward clusters are then taken

to perform a K-means cluster analysis. It is based on the existing cluster mean values, and assigns all CEMs to the clusters by comparing the variables of CEMs with the respective mean values. In this analysis, six CEMs switched between clusters. The new clusters are more homogenous according to mean and median values, and have greater differences between each other. Therefore, the results from the K-means method are used for the following analysis.

The three final clusters contain the 78 CEMs and are named “suburban”, “semi-rural” and “rural” cluster. They are distributed as shown in Figure 1. The average values, the total population and gross value added, as well as the number of CEMs in each cluster, are given in Table 11. The suburban cluster is the smallest one regarding the number of comprising CEMs, with only six of the 78 CEMs (8%). Its high population density, however, assigns a share of 12% of the CEM population to this cluster. The GVA per capita is also found to be highest in this cluster, yielding a share of 20% of the total GVA of the 78 CEMs. The semirural and rural clusters are more similar to each other, with the highest population in the rural cluster and a somewhat larger GVA in the semirural cluster.

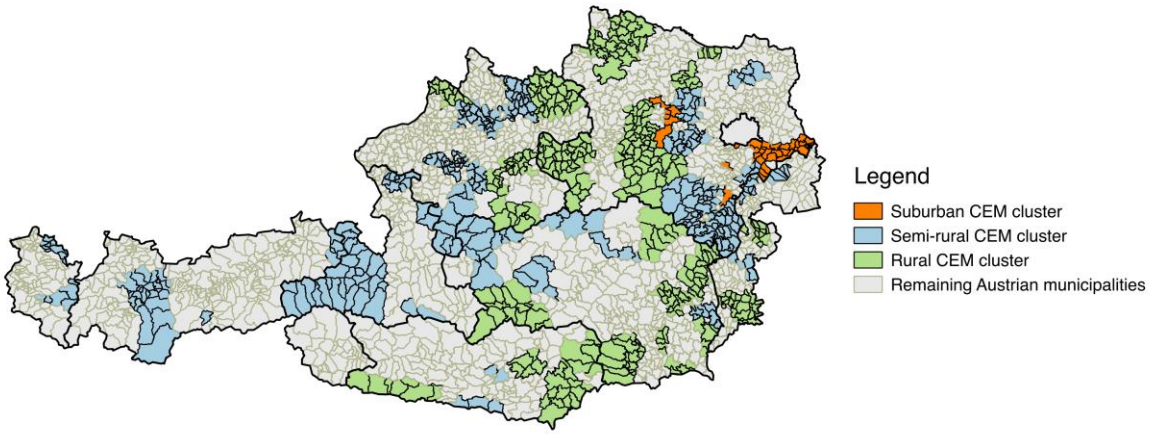

Figure 1: Mapping of clusters of Austrian CEMs

The population densities of the different clusters are shown in Figure 2. It shows clearly the high population density of the suburban cluster as compared to the others. The suburban CEMs have an average population density of 5.2 inhabitants/ha, while the population density of the semirural and rural clusters are both below 1 inhabitant/ha. Since the suburban cluster is the smallest, its total population is well below the population of the others, as shown in Table 11.

Table 11: Results cluster analysis

	Suburban	Semi-rural	Rural
	Average values		
Population density (inhabitants/ha)	5.2	0.8	0.7
Gross value added per capita (€/capita)	51,062	25,103	21,493
Employees in primary sector (%)	1.8	6.8	12.8
Employees in secondary sector (%)	19.7	30.3	29.6
Employees in tertiary sector (%)	78.4	62.9	57.7
Energy consumption (MWh/capita)	36.0	28.6	30.4
Potential electricity self-sufficiency (%)	77.6	128.3	125.3
Potential heat self-sufficiency (%)	29.4	48.7	83.5
	Sum		
Number of CEMs	6	37	35
Total population	239,531	909,308	920,262
Total gross value added (million €)	11,209	23,339	21,397

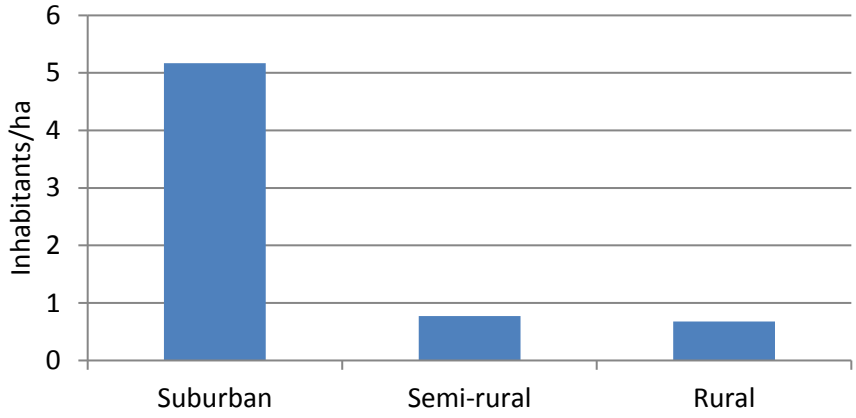

Figure 2: Population density in the three CEM clusters

We also find considerable differences between the clusters regarding the GVA per capita, as illustrated in Figure 3. The suburban cluster dominates the GVA per capita, with a value of

over 50,000 €/capita. The semirural and rural clusters are both below half of the suburban value. The rural cluster has the lowest GVA per capita, at slightly over 21,000 €/capita. Due to the high GVA per capita of the suburban cluster, the total GVA of the small suburban cluster accounts to 20% of the total GVA of all clustered CEMs.

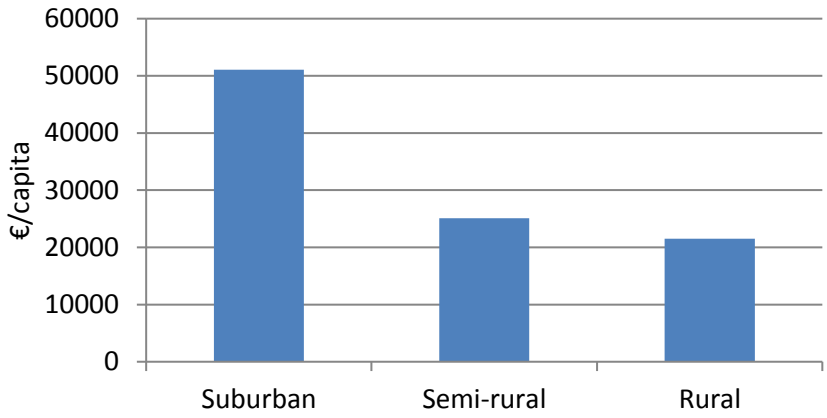

Figure 3: Gross value added per capita in the three CEM clusters

Figure 4 identifies the differences in the economic structure across the three CEM clusters. The suburban cluster is dominated by the tertiary sector, while the employment shares of the primary and secondary sectors are very small. This is different in the semi-rural cluster where both the primary and the secondary sector gain in importance. In the rural cluster, the share of the secondary sector is nearly as high as in the semi-rural cluster, but the share of the primary sector is almost doubled. It is also the cluster with the lowest employment shares in the tertiary sector.

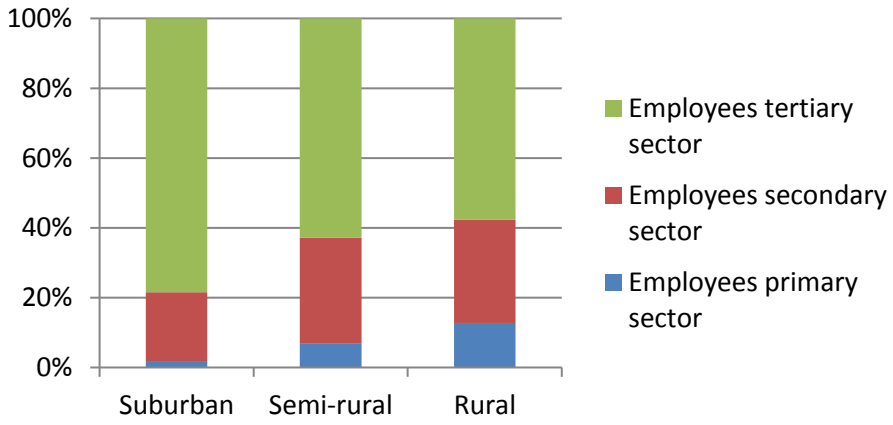

Figure 4: Economic structure of the three CEM clusters

The sectoral difference of employment in the ÖNACE 2008 sectors between the CEM clusters is also shown in Table 12, where the share of each sector is shown in percent for each cluster and for the 78 CEMs in total. While Table 12 already shows the differences in employment especially for the sectors A (Agriculture, forestry and fishing), C (Manufacturing), N (Administrative and support service activities) or P (Education), in Table 13 the ten most important ÖNACE 2008 sectors of each cluster are ranked, which makes for example the importance of the sector I (Accommodation and food service activities) in the semi-rural cluster more obvious.

Table 12 Economic structure of the three CEM clusters – all ÖNACE 2008 sectors

Sector	ÖNACE 2008 Sector	Index	Cluster			CEM
			Suburban	Semi-rural	Rural	Sum
Primary	Agriculture, forestry and fishing	A	1.9%	6.7%	11.7%	7.8%
Secondary	Mining and quarrying	B	0.1%	0.4%	0.2%	0.2%
	Manufacturing	C	10.9%	19.3%	21.5%	18.6%
	Electricity, gas, steam and air conditioning supply	D	0.2%	0.7%	0.6%	0.5%
	Water supply; sewerage, waste management and remediation activities	E	0.5%	0.6%	0.5%	0.6%
	Construction	F	6.5%	9.5%	9.6%	8.9%
	Wholesale and retail trade; repair of motor vehicles and motorcycles	G	16.5%	15.7%	14.2%	15.2%
Tertiary	Transportation and storage	H	7.8%	4.7%	3.8%	4.9%
	Accommodation and food service activities	I	3.8%	7.7%	6.0%	6.2%
	Information and communication	J	1.5%	0.9%	0.9%	1.0%
	Financial and insurance activities	K	2.9%	2.5%	2.4%	2.5%
	Real estate activities	L	1.5%	1.4%	1.1%	1.3%
	Professional, scientific and technical activities	M	5.2%	4.6%	3.5%	4.3%
	Administrative and support service activities	N	8.2%	2.9%	2.7%	3.8%
	Public administration and defense; compulsory social security	O	9.5%	4.0%	4.1%	5.1%
	Education	P	10.3%	6.8%	6.1%	7.2%
	Human health and social work activities	Q	7.4%	7.6%	7.5%	7.5%
	Arts, entertainment and recreation	R	1.4%	1.0%	0.7%	1.0%
	Other service activities	S	3.9%	3.0%	2.8%	3.1%
			100.0%	100.0%	100.0%	100.0%

Table 13: Economic structure of the three CEM clusters – the ten most important ÖNACE 2008 sectors

Ranking	ÖNACE Sector	Suburban	ÖNACE Sector	Semi-rural	ÖNACE Sector	Rural
1	G	16.5%	C	19.3%	C	21.5%
2	C	10.9%	G	15.7%	G	14.2%
3	P	10.3%	F	9.5%	A	11.7%
4	O	9.5%	I	7.7%	F	9.6%
5	N	8.2%	Q	7.6%	Q	7.5%
6	H	7.8%	P	6.8%	P	6.1%
7	Q	7.4%	A	6.7%	I	6.0%
8	F	6.5%	H	4.7%	O	4.1%
9	M	5.2%	M	4.6%	H	3.8%
10	S	3.9%	O	4.0%	M	3.5%

Figure 5 shows the energy consumption per capita and the potential degrees of self-sufficiency of the three clusters. Regarding the current energy demand based on the CEM implementation concepts, the suburban cluster has the highest value, followed by the rural cluster. The semi-rural cluster has the lowest current energy demand. The energy potentials for heat and electricity are from Stanzer et al. (2010) and show that semirural and rural clusters have the highest potentials to become self-sufficient. Electricity potentials are generally higher than heat potentials. According to these numbers, even rural CEMs on average do not have the potential to be fully independent in heat production, while both rural and semirural CEMs could become electricity exporters in the future. Suburban CEMs have on average quite low potentials to cover their energy demand, which correlates with the higher absolute demand.

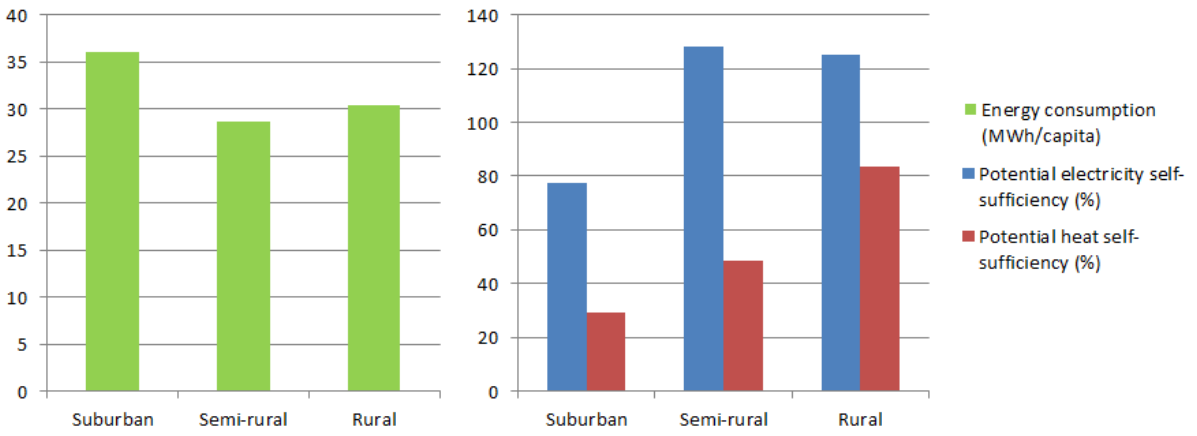

Figure 5: Energy consumption and potentials of the three CEM clusters

4.2. Potential for additional CEMs

An additional cluster analysis of the remaining Austrian municipalities based on the means of the CEM clusters provides information on potential new CEMs. We use the same variables as in the first cluster analysis (see Table 10) with the exception of the current energy demand which is based on the CEMs' implementation concepts and therefore not available for non-CEM municipalities. The CEMs clustered before are not included in this analysis, but the CEMs which dropped out of the first analysis due to lacking data on energy demand are. We apply again the k-means method, taking the CEM clusters' average values as the starting point. Additionally, we introduce a fourth, urban cluster as comprising municipalities clearly would fall outside the definition of CEM. The initial mean value for this new cluster is calculated from the six largest Austrian municipalities with more than 60,000 inhabitants. After the clustering, 26 Austrian municipalities are part of the urban cluster. The newly clustered municipalities as well as the previously identified CEM clusters are both shown in a map of Austria in Figure 6.

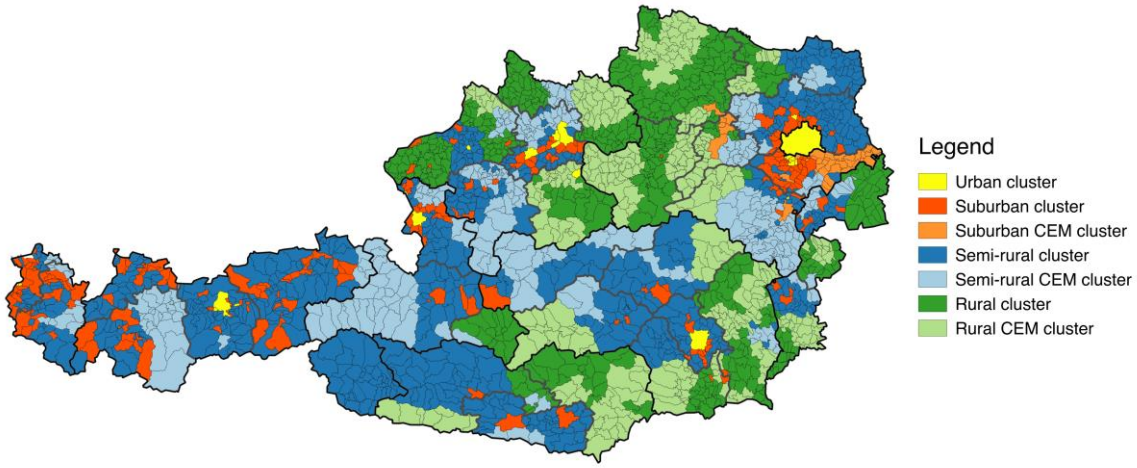

Figure 6 Clusters of CEMs and remaining Austrian municipalities

The municipalities assigned to the urban cluster are mostly large cities and smaller municipalities close to them, while the suburban municipalities are more scattered over Austria, especially in Western Austria. The semi-rural and rural clusters are all close to CEMs

of the same cluster, with a similar regional distribution as the CEM clusters were. Again, Western Austria is foremost semi-rural, while Lower and Upper Austria as well as Burgenland and Carinthia have a considerable share of rural areas.

Table 14 shows the average values as well as aggregated population and GVA for the four clusters, based on the additional cluster analysis of remaining Austrian non-CEM municipalities. The suburban, semi-rural and rural clusters have similar averages values as for the respective CEM only clusters (see Table 11), with the main difference that the suburban cluster is now closer to the rural and semi-rural clusters. The new urban cluster, on the other hand, differs greatly from the others; only the GVA per capita is close to the suburban cluster. Otherwise, it has the highest population density and employment share of the tertiary sector and the lowest share of the primary sector and the lowest potentials for energy self-sufficiency.

Table 14: Results of the cluster analysis for the remaining Austrian municipalities

	Urban	Suburban	Semi-rural	Rural
	Average values			
Population density (inhabitants/ha)	17.5	3.1	0.9	0.8
Gross value added per capita (€/capita)	42,244	43,015	17,505	17,398
Employees in primary sector (%)	2.3	4.3	6.3	12.4
Employees in secondary sector (%)	24.1	28.7	30.1	30.0
Employees in tertiary sector (%)	73.6	67.0	63.7	57.6
Potential electricity self-sufficiency (%)	85.6	126.1	148.6	152.2
Potential heat self-sufficiency (%)	25.9	39.1	49.7	76.2
	Sum			
Population	2,709,449	1,544,204	2,356,040	1,792,247
Gross value added (Million €)	120,458	64,486	51,030	38,845

5. Discussion and conclusions

The cluster analysis has shown that most CEMs are found to be in the semi-rural and rural clusters, and only a few (six out of 78) in the suburban cluster. The suburban cluster is the cluster that differs most from the other clusters, and is characterized by a high population density and high gross value added per capita. It is furthermore characterized by very low employment levels in the primary sector and a dominance of the tertiary sector. Energy

consumption per capita is found to be quite high for the suburban cluster, while the potential degrees of energy self-sufficiency are lowest in this cluster.

The semi-rural and rural clusters, on the other hand, share many similarities. They have both low population densities and only around half of the suburban cluster's GVA per capita. Furthermore, energy consumption and potential electricity self-sufficiency are similar between the semi-rural and rural CEM cluster. The differences between the two clusters the do exist, are mainly to be found in their economic structures and their heat potentials. Moreover, the share of employees in the primary sector in the rural cluster is nearly twice the share in the semi-rural cluster. The shares of the secondary sector are almost equal in both clusters, while the semi-rural cluster has a higher share in the tertiary sector. The potential for self-sufficiency in heat is by far the highest in the rural cluster.

When extending the cluster analysis to the remaining areas of Austria, we find that the majority of Austria, except for the large cities, matches the semi-rural and rural CEMs nicely. The CEMs in these clusters are characterized by low energy consumption and hence higher potentials for self-sufficiency, which qualifies them as potential energy exporters, especially regarding electricity. The high energy potentials hold for most of remaining Austria as well. This implies that large parts of Austria could be successful CEMs and, more important, become partly independent on heat imports and even be electricity exporters.

In this working paper we set out to analyses the Austrian CEMs regarding their economic and energy characteristics. In particular we wanted to find out what constitute necessary framework conditions that allow CEMs to achieve their climate and energy goals, such as the ambitious goal of some CEMs to become energy autarkic in the medium to long term. We find, based on a cluster analysis of 78 CEMs, that mainly rural and semi-rural Austrian regions have the theoretical potential to become energy autarkic. Their high levels of potential electricity and heat self-sufficiency are not only driven by the availability of renewable energy resources but also on the socioeconomic structure of these regions, characterized, in contrast to the suburban cluster, by lower population densities, lower gross value added, higher shares of employment in the primary and secondary sector, lower shares of employment in the tertiary sector, and lower levels of energy consumption.

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Appendix

Table 15 CEMs – Code and Name

CEM Code	CEM Name
b287550	K&E Modellregionen - ENERGIE KOMPASS BGLD: Energieregion Leithaland
b287549	K&E Modellregionen - ENERGIE KOMPASS BGLD: Energieregion Mittelburgenland
b287558	K&E Modellregionen - Energie Kompass Bgld: Kirschblüten Energieregion
b287562	K&E Modellregionen - ENERGIE KOMPASS BGLD: Naturpark Geschriebenstein
b287545	K&E Modellregionen - ENERGIE KOMPASS BGLD: Thermenregion Stegersbach
a974941	K&E Modellregionen - Das ökoEnergieland - vom Modell zur Wirklichkeit
b287583	K&E Modellregionen - Nachhaltiges Saalachtal
b287581	K&E Modellregionen - Nationalpark Hohe Tauern
b370022	K&E Modellregion - Oberpinzgau Energiereich
b370024	K&E Modellregion - Pillersee Tal-Leogang
b068980	K&E Modellregionen - Energieregion Salzburger Seenland
b178957	K&E Modellregionen - Ökoenergiebezirk Fürstenfeld
b178958	K&E Modellregionen - Ökoregion Lamingtal
b178945	K&E Modellregionen - Salzkammergut Ausseerland
a974948	K&E Modellregionen - Energiekultur-Region Kulmland
b370018	K&E Modellregion - Energieregion Stiefingtal
b287565	K&E Modellregionen - Klima- und Energiemodellregion Mureck KEMM
b287553	K&E Modellregionen - Klima- und Energiemodellregion "Holzwelt Murau"
b178943	K&E Modellregionen - Innovationsraum Unteres Mürztal
b069002	K&E Modellregionen - CO2-neutrale Kleinregion Hartberg
b178938	K&E Modellregion - EnergieOFFENSIVE Formbacherland
b287578	K&E Modellregionen - Klimaschutzregion NATURPARK PÖLLAUER TAL
b178944	K&E Modellregionen - Naturpark Steirische Eisenwurzen
a974944	K&E Modellregionen - Ökoregion Kaindorf
b068973	K&E Modellregionen - Modellregion am Grimming
b178936	K&E Modellregion - Energie Pölstal
b068974	K&E Modellregionen - Energie Impuls Vorau
b287577	K&E Modellregionen - Klima & Energie Modellregion Gröbming
b068998	K&E Modellregionen - 2 Kleinregionen auf dem Weg zur nachhaltigen Energie
a974942	K&E Modellregionen - Energieregion Schilcherland - Unsere Region ist am Zug!

a974945	K&E Modellregionen - Energie = MZ2 Zukunftsenergien für Mürzzuschlag
b370016	K&E Modellregion - Start up Energieregion Weiz-Gleisdorf
b178962	K&E Modellregionen - "Wechsel wirkt" im steirischen Wechselland
a974933	K&E Modellregionen - CO2-neutrale Region Osttirol
b370023	K&E Modellregion - Imst
b178937	K&E Modellregion - EnergieGemeindeTrins Nachhaltige Modellgemeinde
a974898	K&E Modellregionen - Energie- und Umweltnetzwerk Vorderwald
b287573	K&E Modellregionen - Klima- und Energiemodellregion Klostertal
a974925	K&E Modellregionen - Biosphärenpark und Energiemodellregion - E-REGIO II
a974940	K&E Modellregionen - Energiemodellregion LechWarth
b287576	K&E Modellregionen - Klima- und Energie- Modellregion "Terra amicitiae"
b287547	K&E Modellregionen - Energieparadies-Lavanttal
b370017	K&E Modellregion - Karnische Energie
a974937	K&E Modellregionen - FEnergiereich
a974905	K&E Modellregionen - Klima- und Energiemodellregion Südkärnten
b370014	K&E Modellregion - St. Veit
b287564	K&E Modellregionen - Alternatives Zwentendorf - Tullnerfeld West
b068988	K&E Modellregionen - Energie- und Klima-Modellregion Amstetten Nord
b068985	K&E Modellregionen - Energie- und Klima-Modellregion Amstetten Süd
b068984	K&E Modellregionen - Klima- und Modellenergieregion Römerland Carnuntum - Auf dem Weg zur 100% Erneuerbare Energie Region
b370020	K&E Modellregion - Schmidatal
b287561	K&E Modellregionen - Leiser Energieberge
b068989	K&E Modellregionen - Badener Energiekur
b178949	K&E Modellregionen - Krems
b178955	K&E Modellregionen - Wachau-Dunkelsteinerwald
b287567	K&E Modellregionen - Klima- und Energiemodellregion Pulkautal
a974951	K&E Modellregionen - Modellregion Kleinregion ASTEG
b069000	K&E Modellregionen - Bucklige Welt
a974930	K&E Modellregionen - Klima- und Energiemodellregion Ebreichsdorf
b178947	K&E Modellregionen - Elsbeere Wienerwald
a974954	K&E Modellregionen - Übermorgen selbst Versorgen
b068992	K&E Modellregionen - Energieregion Mostviertel Mitte
b068977	K&E Modellregionen - Klima und Energiemodellregion NÖ Süd
b178953	K&E Modellregionen - Energy Shopping Vösendorf
b068982	K&E Modellregionen - Klima- und Energiemodellregion Wagram
b069001	K&E Modellregionen - Ausbau und Erhaltung der Erneuerbaren Energie
b068997	K&E Modellregionen - Zwettler Reize ... für innovative Energiezukunft

b287559	K&E Modellregionen - Modellregion auf Schiene
b287546	K&E Modellregionen - wn.energiefit
a974950	K&E Modellregionen - Energiezukunft Thayaland
b287557	K&E Modellregionen - Welterbe- und Energieregion Inneres Salzkammergut
a974943	K&E Modellregionen - Kima- und Energie-Modellregion Donau-Böhmerwald
a974934	K&E Modellregionen - Klima- und Energiemodellregion Eferding
a974918	K&E Modellregionen - Energie-Modellregion Freistadt
b068972	K&E Modellregionen - Regionale Energie für Generationen
a974913	K&E Modellregionen - Klima-, Energie und Kulturlandschaftsmodell Donautal
b287569	K&E Modellregionen - Energie- u. Klimaschutzkonzept LAG SternGartl Guse
b068987	K&E Modellregionen - Energieeffizienz & Kleinwasserkraft Traunsteinreg.
a974931	K&E Modellregionen - Energieregion Traunviertler Alpenvorland
b068978	K&E Modellregionen - Energieoptimierung uwe (Urfahr West)
a974929	K&E Modellregionen - Energierregion Vöckla-Ager
b068971	K&E Modellregionen - Klima- und Ökoenergiemodellregion Hausruck Nord

Table 16 CEMs – Population and Employment

CEM Code	Population	Area in ha	Employment							
			Employment	Employment / Population	Primary sector	Secondary sector	Tertiary sector	Share of the primary sector	Share of the secondary sector	Share of the tertiary sector
b287550	17,827	14,825.08	5,132	28.8%	402	1,766	2,965	7.8%	34.4%	57.8%
b287549	16,549	22,939.35	8,092	48.9%	682	2,830	4,579	8.4%	35.0%	56.6%
b287558	9,074	14,478.40	2,207	24.3%	228	668	1,311	10.3%	30.3%	59.4%
b287562	9,082	19,054.87	2,445	26.9%	145	709	1,590	5.9%	29.0%	65.1%
b287545	7,948	9,074.41	2,529	31.8%	258	617	1,654	10.2%	24.4%	65.4%
a974941	16,936	39,588.44	5,817	34.3%	560	1,426	3,831	9.6%	24.5%	65.8%
b287583	30,825	78,512.77	14,164	45.9%	908	3,957	9,298	6.4%	27.9%	65.6%
b287581	30,061	99,432.43	15,039	50.0%	967	4,206	9,866	6.4%	28.0%	65.6%
b370022	21,903	98,576.54	9,099	41.5%	583	2,542	5,973	6.4%	27.9%	65.6%
b370024	12,865	32,459.92	5,096	39.6%	342	1,321	3,433	6.7%	25.9%	67.4%
b068980	42,183	25,897.04	18,487	43.8%	848	5,416	12,223	4.6%	29.3%	66.1%
b178957	19,010	20,478.02	11,180	58.8%	841	3,518	6,822	7.5%	31.5%	61.0%
b178958	1,989	15,388.52	342	17.2%	13	128	201	3.8%	37.4%	58.8%
b178945	12,735	52,177.40	5,017	39.4%	380	1,438	3,200	7.6%	28.7%	63.8%
a974948	9,818	10,638.24	3,213	32.7%	390	1,186	1,637	12.1%	36.9%	50.9%
b370018	10,576	13,216.96	2,673	25.3%	316	707	1,650	11.8%	26.5%	61.7%
b287565	11,165	16,562.69	3,786	33.9%	540	837	2,409	14.3%	22.1%	63.6%

b287553	29,186	138,411.50	11,099	38.0%	1,904	2,715	6,480	17.2%	24.5%	58.4%
b178943	26,050	11,145.45	13,211	50.7%	507	4,939	7,765	3.8%	37.4%	58.8%
b069002	12,434	9,894.57	8,979	72.2%	1,309	2,410	5,260	14.6%	26.8%	58.6%
b178938	6,373	7,227.53	2,295	36.0%	334	616	1,344	14.6%	26.8%	58.6%
b287578	8,237	12,282.66	2,656	32.2%	387	713	1,556	14.6%	26.8%	58.6%
b178944	6,341	63,136.54	2,520	39.7%	182	724	1,614	7.2%	28.7%	64.1%
a974944	6,169	7,910.92	2,404	39.0%	350	645	1,409	14.6%	26.8%	58.6%
b068973	12,008	20,758.62	8,140	67.8%	616	2,333	5,191	7.6%	28.7%	63.8%
b178936	6,872	53,068.73	2,142	31.2%	157	714	1,271	7.3%	33.3%	59.3%
b068974	4,820	8,127.03	1,657	34.4%	241	445	971	14.6%	26.8%	58.6%
b287577	9,532	52,746.20	3,370	35.4%	255	966	2,149	7.6%	28.7%	63.8%
b068998	17,637	23,634.14	5,411	30.7%	808	1,442	3,161	14.9%	26.6%	58.4%
a974942	60,689	86,401.78	26,091	43.0%	2,652	10,073	13,366	10.2%	38.6%	51.2%
a974945	39,976	84,847.36	14,660	36.7%	994	5,837	7,829	6.8%	39.8%	53.4%
b370016	43,633	28,469.40	25,647	58.8%	3,036	9,783	12,828	11.8%	38.1%	50.0%
b178962	10,320	19,495.16	2,708	26.2%	395	727	1,586	14.6%	26.8%	58.6%
a974933	49,319	201,929.64	21,441	43.5%	1,859	6,643	12,939	8.7%	31.0%	60.3%
b370023	56,557	172,381.82	23,201	41.0%	866	5,573	16,762	3.7%	24.0%	72.2%
b178937	1,269	4,877.73	151	11.9%	6	47	98	3.8%	31.4%	64.8%
a974898	9,370	15,396.55	3,272	34.9%	104	1,161	2,007	3.2%	35.5%	61.3%
b287573	16,811	20,635.10	7,591	45.2%	186	2,814	4,591	2.5%	37.1%	60.5%
a974925	3,284	19,217.63	837	25.5%	21	310	506	2.5%	37.1%	60.5%
a974940	1,723	10,927.66	1,197	69.5%	30	442	725	2.5%	36.9%	60.6%
b287576	19,729	24,814.36	5,507	27.9%	503	1,570	3,434	9.1%	28.5%	62.4%
b287547	40,996	63,386.42	19,651	47.9%	1,957	7,336	10,359	10.0%	37.3%	52.7%
b370017	18,718	80,896.69	7,324	39.1%	998	1,943	4,383	13.6%	26.5%	59.8%
a974937	16,616	13,440.53	7,180	43.2%	675	2,207	4,298	9.4%	30.7%	59.9%
a974905	42,237	90,821.18	15,430	36.5%	1,638	5,921	7,871	10.6%	38.4%	51.0%
b370014	24,501	32,177.36	10,804	44.1%	1,110	3,367	6,326	10.3%	31.2%	58.6%
b287564	13,493	15,647.24	5,136	38.1%	423	1,228	3,486	8.2%	23.9%	67.9%
b068988	65,637	47,797.06	31,893	48.6%	3,190	11,119	17,583	10.0%	34.9%	55.1%
b068985	58,173	83,939.75	21,863	37.6%	2,061	7,482	12,321	9.4%	34.2%	56.4%
b068984	74,060	58,406.73	48,834	65.9%	1,465	8,409	38,961	3.0%	17.2%	79.8%
b370020	11,473	25,096.29	2,395	20.9%	364	449	1,583	15.2%	18.7%	66.1%
b287561	18,840	32,240.02	9,234	49.0%	864	2,228	6,142	9.4%	24.1%	66.5%
b068989	25,093	2,688.33	12,442	49.6%	392	3,285	8,765	3.2%	26.4%	70.4%
b178949	24,032	5,169.90	17,560	73.1%	303	3,807	13,450	1.7%	21.7%	76.6%
b178955	29,289	45,199.11	10,746	36.7%	1,689	2,583	6,474	15.7%	24.0%	60.2%
b287567	6,565	12,898.45	1,268	19.3%	193	237	838	15.2%	18.7%	66.1%
a974951	6,586	18,370.59	2,601	39.5%	526	534	1,541	20.2%	20.5%	59.3%

b069000	48,801	82,448.97	15,130	31.0%	1,199	4,939	8,993	7.9%	32.6%	59.4%
a974930	21,491	13,173.78	5,358	24.9%	169	1,415	3,774	3.2%	26.4%	70.4%
b178947	42,881	45,474.54	13,216	30.8%	1,384	3,615	8,218	10.5%	27.3%	62.2%
a974954	10,164	36,076.31	3,804	37.4%	475	1,289	2,040	12.5%	33.9%	53.6%
b068992	81,268	170,031.37	29,640	36.5%	3,322	9,005	17,312	11.2%	30.4%	58.4%
b068977	74,455	110,761.59	27,074	36.4%	2,083	8,777	16,214	7.7%	32.4%	59.9%
b178953	6,245	1,047.30	7,799	124.9%	83	1,525	6,192	1.1%	19.5%	79.4%
b068982	16,764	26,855.07	4,469	26.7%	359	1,068	3,042	8.0%	23.9%	68.1%
b069001	68,796	22,672.50	60,146	87.4%	1,159	10,200	48,786	1.9%	17.0%	81.1%
b068997	11,247	25,617.87	7,842	69.7%	1,585	1,609	4,647	20.2%	20.5%	59.3%
b287559	20,670	25,464.60	10,328	50.0%	1,150	3,742	5,437	11.1%	36.2%	52.6%
b287546	41,305	6,089.03	32,442	78.5%	60	5,368	27,014	0.2%	16.5%	83.3%
a974950	26,738	66,914.10	11,797	44.1%	1,704	4,002	6,091	14.4%	33.9%	51.6%
b287557	42,769	98,085.78	17,493	40.9%	805	5,767	10,921	4.6%	33.0%	62.4%
a974943	42,421	61,519.91	17,243	40.6%	2,218	5,316	9,709	12.9%	30.8%	56.3%
a974934	35,785	29,166.36	13,226	37.0%	1,271	4,263	7,692	9.6%	32.2%	58.2%
a974918	65,113	99,409.79	21,662	33.3%	3,434	4,963	13,265	15.9%	22.9%	61.2%
b068972	10,989	63,872.75	4,348	39.6%	380	1,658	2,310	8.7%	38.1%	53.1%
a974913	20,556	30,265.43	6,444	31.3%	697	2,205	3,541	10.8%	34.2%	55.0%
b287569	45,561	41,956.43	13,957	30.6%	1,515	3,656	8,786	10.9%	26.2%	63.0%
b068987	55,854	39,842.54	29,277	52.4%	1,363	9,899	18,015	4.7%	33.8%	61.5%
a974931	67,040	53,598.62	28,967	43.2%	2,816	10,523	15,627	9.7%	36.3%	53.9%
b068978	25,656	17,028.61	5,954	23.2%	644	1,555	3,756	10.8%	26.1%	63.1%
a974929	54,970	31,706.51	26,369	48.0%	1,586	9,304	15,479	6.0%	35.3%	58.7%
b068971	21,556	23,211.05	8,073	37.5%	715	2,738	4,620	8.9%	33.9%	57.2%
Sum CEM	2,174,289	3,531,505.62	956,923	44.0%	76,130	277,448	603,345	8.0%	29.0%	63.1%
Sum Austria	8,401,940	8,387,899.21	4,167,164	49.6%	176,914	966,962	3,023,288	4.6%	24.1%	71.4%
Percentage share	25.9%	42.1%	23.0%		43%	29%	20%			
Median	19,370	26,376.06	8,082	38.5%	660	2,372	4,919	9.2%	28.7%	60.3%
Average	26,516	43,067.14	11,670	41.7%	928	3,384	7,358	9.1%	29.4%	61.5%
Maximum value	81,268	201,929.64	60,146	124.9%	3,434	11,119	48,786	20.2%	39.8%	83.3%
Minimum value	1,269	1,047.30	151	11.9%	6	47	98	0.2%	16.5%	50.0%

Source: own calculation based on data by Statistics Austria (2013, 2014a, 2014b)

Table 17 CEM – Degree of urbanisation and gross value added

CEM Code	Degree of urbanisation			Gross value added							
	Share of intermediate density area municipalities	Share of thinly-populated area municipalities	Sum of municipalities	Gross value added in million €	Gross value added per capita	Primary sector in million €	Secondary sector in million €	Tertiary sector in million €	Share of the primary sector	Share of the secondary sector	Share of the tertiary sector
b287550	33.3%	66.7%	9	295.58	16,580.54	13.14	115.82	166.62	4.4%	39.2%	56.4%
b287549	0.0%	100.0%	12	399.55	24,143.63	25.82	147.27	226.47	6.5%	36.9%	56.7%
b287558	0.0%	100.0%	5	124.96	13,771.42	7.43	43.84	73.68	5.9%	35.1%	59.0%
b287562	0.0%	100.0%	5	126.69	13,949.78	4.27	40.01	82.41	3.4%	31.6%	65.1%
b287545	0.0%	100.0%	7	129.68	16,316.46	5.33	36.87	87.48	4.1%	28.4%	67.5%
a974941	0.0%	100.0%	18	299.44	17,680.48	11.56	85.28	202.60	3.9%	28.5%	67.7%
b287583	10.0%	90.0%	10	958.61	31,098.38	17.98	257.31	683.31	1.9%	26.8%	71.3%
b287581	10.0%	90.0%	10	1,017.38	33,843.88	19.11	272.97	725.31	1.9%	26.8%	71.3%
b370022	0.0%	100.0%	9	615.84	28,116.85	11.55	165.31	438.98	1.9%	26.8%	71.3%
b370024	0.0%	100.0%	6	354.04	27,519.55	6.24	104.37	243.43	1.8%	29.5%	68.8%
b068980	20.0%	80.0%	10	1,328.67	31,497.82	18.23	446.52	863.92	1.4%	33.6%	65.0%
b178957	27.3%	72.7%	11	598.68	31,492.85	17.86	205.73	375.09	3.0%	34.4%	62.7%
b178958	0.0%	100.0%	2	23.09	11,606.43	0.54	11.51	11.04	2.3%	49.8%	47.8%
b178945	0.0%	100.0%	6	299.59	23,525.30	13.60	86.97	199.03	4.5%	29.0%	66.4%
a974948	0.0%	100.0%	12	167.68	17,078.80	8.28	69.39	90.01	4.9%	41.4%	53.7%
b370018	0.0%	100.0%	9	148.69	14,059.15	7.41	52.92	88.36	5.0%	35.6%	59.4%
b287565	0.0%	100.0%	9	198.51	17,779.28	11.91	55.55	131.05	6.0%	28.0%	66.0%
b287553	0.0%	100.0%	34	605.06	20,731.25	55.78	190.07	359.22	9.2%	31.4%	59.4%
b178943	100.0%	0.0%	4	891.72	34,231.22	20.94	444.45	426.33	2.3%	49.8%	47.8%
b069002	25.0%	75.0%	4	457.97	36,831.73	27.79	140.95	289.22	6.1%	30.8%	63.2%
b178938	0.0%	100.0%	5	117.05	18,366.30	7.10	36.03	73.92	6.1%	30.8%	63.2%
b287578	0.0%	100.0%	6	135.46	16,445.17	8.22	41.69	85.55	6.1%	30.8%	63.2%
b178944	0.0%	100.0%	8	150.68	23,762.95	6.52	43.76	100.40	4.3%	29.0%	66.6%
a974944	0.0%	100.0%	7	122.64	19,879.47	7.44	37.75	77.45	6.1%	30.8%	63.2%
b068973	40.0%	60.0%	5	486.02	40,474.42	22.06	141.08	322.87	4.5%	29.0%	66.4%
b178936	0.0%	100.0%	8	125.07	18,199.22	4.60	50.00	70.47	3.7%	40.0%	56.3%
b068974	0.0%	100.0%	5	84.52	17,534.93	5.13	26.01	53.38	6.1%	30.8%	63.2%
b287577	0.0%	100.0%	10	201.23	21,111.43	9.13	58.41	133.68	4.5%	29.0%	66.4%
b068998	0.0%	100.0%	13	275.28	15,608.18	17.15	84.31	173.82	6.2%	30.6%	63.1%
a974942	17.5%	82.5%	40	1,566.89	25,818.43	64.03	790.94	711.92	4.1%	50.5%	45.4%
a974945	31.3%	68.8%	16	996.16	24,918.90	41.05	525.26	429.85	4.1%	52.7%	43.2%
b370016	35.0%	65.0%	20	1,341.97	30,755.88	64.48	572.18	705.32	4.8%	42.6%	52.6%
b178962	0.0%	100.0%	5	138.10	13,382.09	8.38	42.51	87.22	6.1%	30.8%	63.2%

a974933	9.1%	90.9%	33	1,167.00	23,662.28	18.00	408.00	741.00	1.5%	35.0%	63.5%
b370023	12.5%	87.5%	24	1,912.69	33,818.86	18.02	394.86	1,499.82	0.9%	20.6%	78.4%
b178937	0.0%	100.0%	1	9.69	7,633.40	0.10	3.66	5.93	1.0%	37.8%	61.2%
a974898	0.0%	100.0%	8	257.45	27,475.63	2.95	104.00	150.50	1.1%	40.4%	58.5%
b287573	25.0%	75.0%	4	646.73	38,470.56	6.77	256.48	383.48	1.0%	39.7%	59.3%
a974925	0.0%	100.0%	6	71.28	21,704.80	0.75	28.27	42.27	1.0%	39.7%	59.3%
a974940	0.0%	100.0%	2	101.92	59,153.45	1.10	40.25	60.57	1.1%	39.5%	59.4%
b287576	0.0%	100.0%	3	363.74	18,436.92	9.28	151.31	203.15	2.6%	41.6%	55.9%
b287547	20.0%	80.0%	5	1,115.54	27,210.92	40.62	503.22	571.70	3.6%	45.1%	51.2%
b370017	0.0%	100.0%	7	416.74	22,264.28	23.92	117.62	275.21	5.7%	28.2%	66.0%
a974937	50.0%	50.0%	2	419.63	25,254.54	16.19	133.59	269.85	3.9%	31.8%	64.3%
a974905	0.0%	100.0%	13	874.59	20,706.65	34.00	406.18	434.41	3.9%	46.4%	49.7%
b370014	20.0%	80.0%	5	603.18	24,618.72	23.04	231.01	349.13	3.8%	38.3%	57.9%
b287564	0.0%	100.0%	5	354.60	26,280.40	15.04	137.18	202.38	4.2%	38.7%	57.1%
b068988	18.8%	81.3%	16	1,903.71	29,003.69	82.66	827.84	993.21	4.3%	43.5%	52.2%
b068985	15.8%	84.2%	19	1,306.40	22,457.14	53.39	557.06	695.95	4.1%	42.6%	53.3%
b068984	11.1%	88.9%	27	3,430.69	46,323.18	31.27	767.12	2,632.30	0.9%	22.4%	76.7%
b370020	0.0%	100.0%	6	133.19	11,608.71	19.44	26.69	87.06	14.6%	20.0%	65.4%
b287561	20.0%	80.0%	5	529.36	28,097.59	45.38	144.14	339.84	8.6%	27.2%	64.2%
b068989	100.0%	0.0%	1	900.25	35,876.47	8.37	299.70	592.18	0.9%	33.3%	65.8%
b178949	100.0%	0.0%	1	941.39	39,172.24	7.77	210.46	723.16	0.8%	22.4%	76.8%
b178955	5.9%	94.1%	17	579.66	19,791.09	43.29	176.65	359.72	7.5%	30.5%	62.1%
b287567	0.0%	100.0%	6	70.49	10,736.56	10.29	14.12	46.08	14.6%	20.0%	65.4%
a974951	0.0%	100.0%	4	125.86	19,110.26	13.49	29.50	82.87	10.7%	23.4%	65.8%
b069000	9.4%	90.6%	32	854.79	17,515.80	30.85	359.02	464.91	3.6%	42.0%	54.4%
a974930	20.0%	80.0%	5	387.67	18,038.73	3.61	129.06	255.01	0.9%	33.3%	65.8%
b178947	14.3%	85.7%	14	787.46	18,363.75	34.20	281.01	472.25	4.3%	35.7%	60.0%
a974954	0.0%	100.0%	7	193.13	19,001.16	12.18	71.28	109.67	6.3%	36.9%	56.8%
b068992	0.0%	100.0%	40	1,700.05	20,919.01	84.32	664.64	951.09	5.0%	39.1%	55.9%
b068977	15.2%	84.8%	33	1,529.93	20,548.38	53.61	638.05	838.27	3.5%	41.7%	54.8%
b178953	100.0%	0.0%	1	559.17	89,539.01	1.77	139.07	418.33	0.3%	24.9%	74.8%
b068982	0.0%	100.0%	8	308.76	18,418.05	12.76	119.37	176.63	4.1%	38.7%	57.2%
b069001	40.0%	60.0%	5	3,588.68	52,164.03	28.38	763.49	2,796.81	0.8%	21.3%	77.9%
b068997	0.0%	100.0%	1	379.49	33,741.23	40.68	88.94	249.87	10.7%	23.4%	65.8%
b287559	11.1%	88.9%	9	528.67	25,576.72	29.49	206.86	292.31	5.6%	39.1%	55.3%
b287546	100.0%	0.0%	1	1,788.38	43,296.89	1.54	390.24	1,396.60	0.1%	21.8%	78.1%
a974950	0.0%	100.0%	15	592.45	22,157.49	43.72	221.24	327.49	7.4%	37.3%	55.3%
b287557	33.3%	66.7%	9	1,143.68	26,740.89	21.72	510.06	611.90	1.9%	44.6%	53.5%
a974943	0.0%	100.0%	29	933.22	21,999.06	46.83	350.00	536.40	5.0%	37.5%	57.5%
a974934	15.4%	84.6%	13	868.82	24,279.00	23.07	393.71	452.05	2.7%	45.3%	52.0%

a974918	11.1%	88.9%	27	1,132.12	17,386.94	72.48	326.78	732.85	6.4%	28.9%	64.7%
b068972	0.0%	100.0%	9	315.06	28,670.48	10.70	185.51	118.85	3.4%	58.9%	37.7%
a974913	0.0%	100.0%	12	374.86	18,235.82	20.39	160.98	193.49	5.4%	42.9%	51.6%
b287569	5.6%	94.4%	18	829.88	18,214.79	29.37	297.04	503.47	3.5%	35.8%	60.7%
b068987	27.3%	72.7%	11	1,885.13	33,751.07	37.51	886.09	961.54	2.0%	47.0%	51.0%
a974931	31.6%	68.4%	19	2,060.72	30,738.60	79.23	1,177.38	804.10	3.8%	57.1%	39.0%
b068978	25.0%	75.0%	8	375.94	14,653.21	11.69	143.56	220.70	3.1%	38.2%	58.7%
a974929	27.3%	72.7%	22	1,699.61	30,918.87	44.33	831.68	823.60	2.6%	48.9%	48.5%
b068971	0.0%	100.0%	12	473.17	21,950.55	20.92	199.83	252.41	4.4%	42.2%	53.3%
Sum CEM	101	819	920	58,309.10	26,817.55	1,890.50	20,926.80	35,491.80	3.2%	35.9%	60.9%
Sum Austria				274,897.00	32,718.28	4,424.00	78,465.00	192,008.00	1.6%	28.5%	69.8%
Percentage share	11.0%	89.0%		21.2%		42.7%	26.7%	18.5%			
Median	0.0%	100.0%	9	479.59	22,360.71	17.92	156.15	290.77	4.1%	35.3%	60.3%
Average	15.2%	84.8%	11	711.09	25,290.24	23.05	255.20	432.83	4.2%	35.4%	60.4%
Maximum value	100.0%	100.0%	40	3,588.68	89,539.01	84.32	1,177.38	2,796.81	14.6%	58.9%	78.4%
Minimum value	0.0%	0.0%	1	9.69	7,633.40	0.10	3.66	5.93	0.1%	20.0%	37.7%

Source: own calculation based on data by Statistics Austria (2013, 2014a, 2014b); STATcube (2015); European Commission and Statistics Austria (2015)