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Assessment Studies for Specific Biogas Sites in Slovenia

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Summary

In Slovenia there has been a substantial growth in the biogas plants in the last years. As a result of the favourable agricultural conditions and the supporting (feed-in) system that – for now - favours big installations this is happening mainly in the eastern part of the country (Pomurska region). In our opinion no additional support is needed there, furthermore some of the newest plants are moving from the desired (local) sustainable direction and part of the local population is already opposing them. Therefore we looked at other places instead. Still with good potential but less exploited. What we had also in mind was to make impact for promoting the biogas use as big as possible.

In this regard almost immediately comes to mind the southern part of Slovenia (**Dolenjska** region). It is less industrialised and of prevalent agricultural nature and with a good biomass potential. From 2008 on this can be verified also by means of EnGIS (an online geographical informational systems with the data about potential and already realised projects on RES). The most common or the most suitable or the first to be addressed it seems to be the stock-breeding since it is also more appropriate from the heat usage point of view. In the third step a suitable site was selected. It's a **pigs breeding facility in Klinja vas** near Kočevje. It used to sell around 25.000 piglets a year. The farm is now in reconstruction and the planned capacity is 60.000 piglets per year. The farm is one of the Farne Ihan company, which is the biggest pigs raising companies and that was one of the pioneers in producing biogas in Slovenia.

For the second example we looked into the opposite direction, to the northern part, (**Gorenjska** region), where at the prevalent smaller farms are to be found. This is also the sector where the biogas production potential was at least exploited and mayor support for the biogas is needed. In the last year possibilities for investors were improved through new financing options (structural funds for farmers), however, still a lot has to be done in terms of education and promotion. Going through all the steps and having in mind the wanted results we came to **Biotechnical centre Naklo**, which has its own (though a bit small) farm. There are, however quite some farmers in the neighbourhood. Since the centre is also an informal renewable energy centre; they have a PV plant installed and a micro biomass heating option planned. Adding a digestion plant would make a very useful case study for the farmers, schools and others a like. The fact that they already have an operating PV plant means that the possibilities are better as technical and licence and permits aspects are already been taken care of. The biogas plant in itself, however, would not make an economical option if this was not the case, since to small.

The third case is of another nature – use of municipal waste or landfill gas. It's yet another region (**Primorska**), this time to the west. It's a landfill of Nova Gorica near Stara Gora. There is enough room for the additional necessary installations and the site was already prepared for the landfill gas utilisation. It was used for disposal of over 1.000.000 m³ of waste and the landfill gas potential would be enough for 400 Nm³/h of gas for the period of 15 years, which is enough for the operation of a 700 kWe CHP unit.

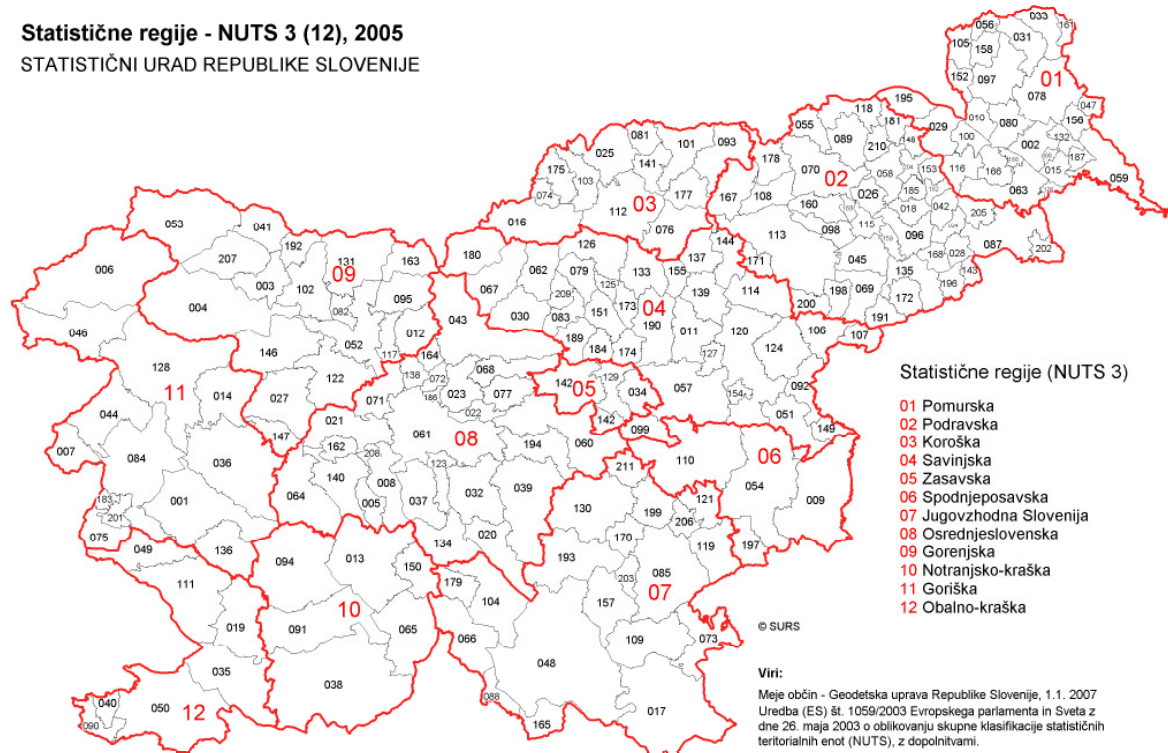
Results within Step 1: Selection of the Region

Description of the selected regions for potential Biogas Sites

Katalog regionalnih delitev 2007

karta št. 2b

Statistične regije - NUTS 3 (12), 2005
STATISTIČNI URAD REPUBLIKE SLOVENIJE



STATISTIČNI URAD REPUBLIKE SLOVENIJE

Figure1 : Statistical regions of Slovenia

Biogas Site 1: Farm Klinja vas



Figure2 : Farm Klinja vas

geography: Jugovzhodna Slovenija (No. 7 on the above map of the statistical regions – NUTS 3) region is situated in the south-eastern part of Slovenia in a transitional area between forested Dinaric Mountains and gently undulating hills on the extreme south-western margin of the Pannonian Plain. At the south western part of the region, densely forested Dinaric karst is one of the last Central European refuges of brown bear, lynx and wolf. This karst area with no springs nor surface water consists mostly of forested mountain ranges, with the majority of its population living in the fertile "polje"s (broad depressions in the karst area with flat and fertile bottom surrounded by forested mountains) between them. In the 14th century, local feudal lords colonised the karst area around the town of Kočevje with farmers from southern and central Germany. They cleared vast forests and preserved their language and culture through the centuries. After the end of World War II, their abandoned villages and fields were gradually overgrown by woodland. Today the region is divided among 16 municipalities, of which Kočevje with 555 km² is the largest municipality by area in Slovenia.

As early as the second half of the 19th century when industrialization began, this part of Slovenia was considered undeveloped. In the socialist period after World War II some (especially marginal) parts of the region were exempt from development schemes for political reasons. This caused intensive depopulation, accompanied by farmland reverting to forest. However, this lack of economic development 'saved' this region from the presence of heavy industry, a sector which has been facing severe problems in all other regions since Slovenia's independence. Consequently, the region's automobile, pharmaceutical and other light industry has been very successful by Slovenian standards, especially in Novo mesto, which is developing into a regional centre of growing importance, with ambitions to become a supra-regional centre.

The Jugovzhodna Slovenija region covers 2 675 km² (13.2% of the national territory, the largest region in Slovenia) and is, in spite of its relatively low altitude, the second most sparsely populated Slovenian region (51.7 inhabitants per km²). Other parts of the region are characterised by an undulating, partially karst landscape with a colourful mosaic of fields, meadows and vineyards around clustered villages, mostly inhabited by no more than 100 people. The climate is moderately continental with average monthly temperatures between 0.4°C (January) and 20.5°C (July). The average annual temperature is 10.5°C and annual precipitation is around 1 160 mm (between 1 400 and 830 mm). Low **population** density and a lot of young people. In 2002, the population of the region numbered 138 400, or 6.9% of the national population, which is a small number considering the region's surface area and economic potential. With 51.7 people per km², Jugovzhodna Slovenija is among the most sparsely settled regions in Slovenia

Jugovzhodna Slovenia's fertile soil and forest, which covers more than 70% of the region, are both of economic importance to the region. The entire region faces a considerable problem in the agricultural sector, mainly due to farms with widely scattered plots, and in some parts also due to the karst terrain which prevents the introduction of modern farming methods. In terms of **agriculture**, the region is characterised by mixed farming with a slight bias towards dairy and beef cattle farming. In some parts of eastern Jugovzhodna and on hills surrounding Bela krajina, fruit (apples, walnuts) and wine growing are important. Due to the unfavourable natural conditions (stony, mostly uneven terrain), almost all land remained in private ownership during the socialist period, resulting in numerous small farms and plots. This reduces the economic efficiency of farms on the one hand, but importantly contributes to landscape variety on the other. In marginal, hilly areas, as farming is abandoned, former meadows and pastures are now being overgrown by forests. Biogas production on farms could therefore mean an opportunity for the added value for them.

Biogas Site 2: *Biotechnical Centre Naklo, Strahinj*



Figure3 : Aerial view of Biotechnical centre Naklo

Geography: Gorenjska (No 9), the most Alpine of all Slovenian regions is situated in the north-western part of the country. Most of the region is covered by the towering Julian Alps. Due to its natural beauty, almost the entire Julian Alps range is protected as the Triglav National Park. The Karavanke range along the Austrian border also belongs to the high Alpine regions. Between these two mountainous areas, the Upper Sava valley runs in an east-west direction. Further to the east it opens up into the densely populated Ljubljana Basin where the town of Kranj, the centre of Gorenjska, is situated in the middle of the plain. The region is divided between 17 municipalities.

Economically, Gorenjska is one of the most developed regions in Slovenia. Its prosperity is based on a well developed industrial tradition, dating back to the 19th century when it developed from ironworks and shoemaking which were very important at that time. Tourism in Bled, Kranjska Gora and Bohinj, and agriculture on the plains and in the surrounding mountains are also of significance.

population: In 2002 197 300 people lived in this mountainous region (9.9 % of the national population). The average population density at 92.3 people per km² was only slightly below the national average, however there are large differences between the urban municipality of Kranj in the plain (over 340 people per km²) and the mountainous Bohinj (15.8 people per km²).

Agriculture is oriented towards dairy and beef cattle farming. The farmers producing on arable land mainly silage corn for fodder, cereals (wheat and barley) and potatoes. 51% of farms have less than 5 hectares of agricultural land. This agricultural structure is therefore favourable for biogas production, although in smaller scale.

Biogas Site 3: Landfill, Stara Gora

Geography: Between high Alps and the Mediterranean Plain Goriška (No. 11) is the fourth largest Slovenian region, while only the seventh by population. The Goriška region occupies 2 325 km² (11.5% of the national territory) and is mostly covered with high mountains and hills in the Soča river basin. In the north there are high Julian Alps with the deeply incised upper Soča valley. The middle part comprises heavily dissected Idrija mountains in the Idrija river basin, towards the south extending into the forested Trnovski gozd karst plateau with altitudes 1 000-1 300 m and into the slightly lower Banjšice plateau. On their southern side, the plateaus descend steeply - with over a 1 000 m high escarpment - into the fertile Vipava valley along the Vipava river, the Gorica plain along the Soča and the Goriška brda hills along the Italian border.

The southern part of the region has Mediterranean climate with the average annual temperature of 12.5°C in Bilje (monthly temperatures between 3.5°C in January and 22.2°C in July). The average annual precipitation ranges between 1 870 and 1 070 mm (in the mountainous part between 2 000-3 500 mm). The peculiarity of the Vipava valley is bora, a turbulent descending wind which can blow with a speed of over 50 m/s in winter months.

In the central mountainous part of the region, one of the most important mercury mines in the world operated for almost five centuries in Idrija. After 1986 it was gradually shut down, while the town with the surroundings was very successfully reoriented into manufacturing of machine equipment and electro-technical industry. The situation in the southern, Mediterranean part of the region is entirely different. After the town of Gorica (Gorizia in Italian) was given to Italy in 1947, the town of Nova Gorica which gradually developed into an important regional centre was established on the Slovene side of the border. The advantage of this part of the region is also the Mediterranean climate, enabling specialisation of agriculture into wine, fruit and vegetables growing. Although the Vipava Valley is the largest plain in the Mediterranean part of Slovenia, favourable natural conditions for growing more sensible fruits and vegetables are far from being fully exploited compared to the plain on the Italian side of the border.

It is divided among 12 municipalities. In mountainous parts of the region, the majority of settlements and agricultural land is located in the narrow river valleys - the areas outside the valleys are sparsely settled due to steep slopes. The Soča river with its tributaries is an important resource - in its middle course hydroelectric plants are installed, while its upper course is protected as a national heritage due to its exceptional beauty and preserved natural condition. Numerous small hydroelectric plants are installed on smaller tributaries in the mountains. An important natural resource are also broadleaf and mixed forests covering almost two thirds of the region, while agricultural land covers almost exclusively its southern part.

The region successfully took advantage of its border position to establish numerous ties with the economy on the Italian side of the border. Service activities generate the largest share (56.3%) of gross value added in the region, the secondary sector contributes 40.2%, while the contribution of the primary sector is 3.5%. Within Goriška, the orientation of the **agriculture** varies extremely between its mountainous parts and its lower southern part where strong impact of the Mediterranean climate is felt. In higher parts, almost exclusively dairy and beef cattle farming prevails with sheep farming slowly emerging in some areas. The southern part of the region is specialised in growing more sensitive types of fruit (peaches, pears, apricots and cherries) and wine growing, especially in the Goriška brda hills and in the Lower Vipava Valley. Vegetables production is also important for the region.

Biomass supply

Biogas Site 1: *Klinja vas*

Biomass supply in this case is pig manure from the farm that originates on the same spot hence no particular logistic study is necessary here. In case of interest it could be broadened by some green biomass from the neighboring farms. The potential could be checked by online platform EnGIS for example.

The quantity of pig manure is around 80 m³ per day. Annual production of farm is around 50.000 piglets.

Since the farm Ihan was one of the first that introduced biogas production in Slovenia – back in 1995 (at the central location at Ihan), they have accumulated quite some experience with it and they are eager and willing to promote biogas, they could be a potential partner for the campaign and/or they could share their experience with farmers at the seminars.

In 2005 the farm founded its own company FI-EKO for the purposes of the green electricity production (from anaerobic purifying of the pigs manure) and they acquired also the status of the so called qualified electricity producer.

Biogas Site 2: *Strahinj*

In the case of Biotechnical centre Naklo figures are much lower as here is not that much about farming production than it is about farming learning. Furthermore it is a sustainable way of (eco)farming hence the importance and synergies are even greater.

Anyway the biomass available is both cattle manure and green biomass. The quantities are shown in the table below and comprise the input available at the center and from the 5 neighboring farms.

Farm on its own is able to produce enough input for about 50 kW biogas CHP production unit and double that if input from the surroundings is taken into account. This option however is not clear, as it may effect the farm eco status.

Anyway the new supporting sheme for RES (currently in preparation) foresses some bonus for feed-in tariffs for the electricity production from smaller biogas plants, therefore it might well prove even an economical option.

Since they are an educational organization and they are also becoming a research RES centre – in 2007 they installed at the time the biggest PV plant in Slovenia, they are going to use biomass for heating – and they are quite close to Kranj and Ljubljana as well, they form a natural choice for biogas campaign or seminar venue.

Table 1: Estimated biogas potential for Strahinj for the centre alone and centre together with some neighbouring farmers

Biomass Sources	biogas yield in m3 / t	Available tons per year	Available biogas yield per year (m3)	Available biogas yield per year (m3)
Cow Manure	30	1.070	32.100	32.100
farmers	30	1.550	46.500	
Cow droppings (fresh)	90	0	0	0
farmers	90	270	24.300	
Chicken Litter	130	0	0	0
farmers	130	300	39.000	
Clover	94	308	28.952	28.952
Grass Silage	130	300	39.000	39.000
farmers	130	270	35.100	
Mais Silage	200	150	29.939	29.939
farmers	200	409	81.818	
TOTAL			356.710	129.991



Figure 4: Layout of the Biotechnical Centre Naklo

Biogas Site 3: Stara Gora

Landfill Stara Gora is about 15 km from the town Nova Gorica and it was used for disposal of over 1.000.000 m³ of waste since its creation. For the potential only waste after 1990 is taken into account. This would mean about 400.000 m³ of material. According to the monitoring content of the methane would be between 50 and 60 %. The landfill gas potential would be enough for 400 Nm³/h of gas for the period of 15 years. Which is enough for the operation of a 700 kWe CHP unit.

Biogas Digestate Utilisation

Biogas Site 1: *Klinja vas*

To use the digestate as a fertilizer – estimated production of 40 t per day - should not be a problem since the farm lies in the middle of the fields and there is also enough room for the digestate container.

Biogas Site 2: *Strahinj*

The same is even truer also for the farm in Strahinj since the quantity expected here is much less and they have their land as well. Should surpluses occur there should not be a problem to storage them and sell them as a fertilizer to neighboring farmers, especially because of the eco farming and hence pure - un

Biogas Site 3: *Stara Gora*

At the landfill gas utilisation no digestate occurs or more exactly it remains under ground.

Results within Step 2: Selection of the biogas neighbourhood

Sale of energy in the neighbourhood of the biogas plant

Biogas Site 1: Klinja vas

Sale and Purchase of Electricity:

Site name:	Figure	Comments
Distance to the general electric grid in meters:	200 m	
Voltage of the general electric grid nearby in kV:	20 kV	
Space for transformation station on-site in m ² :		space is enough

Use of Heat:

	kW	Brief description of heat use (Distance to heat customer in meters	
Plant size in kWel	300		
Heat Supply Total in kWth	386		
Heat Supply Summer	386		
Heat Supply Winter	386		
Heat Demand 1 in Summer	100	heating of digestors	50
Heat Demand 1 in Winter	200	heating of digestors	50
Heat Demand 2 in Summer	200	pig farm	400
Heat Demand 2 in Winter	350	pig farm	400
Heat Demand 3 in Summer	/		
Heat Demand 3 in Winter	/		
Remaining Heat Load Summer	86		
Remaining Heat Load Winter	0		

Biogas Site 2: *Strahinj*

Sale and Purchase of Electricity:

Site name:	Figure	Comments
Distance to the general electric grid in meters:		already electricity producer (83 kW PV plant)
Voltage of the general electric grid nearby in kV:		20
Space for transformation station on-site in m ² :		

Use of Heat:

	kW	Brief description of heat use (Distance to heat customer in meters)
Plant size in kWel	98	
Heat Supply Total in kWth	123	There are more buildings (see pictures)
Heat Supply Summer	123	
Heat Supply Winter	123	
Heat Demand 1 in Summer	150	Heat demand in summer is needed for preparing sanitary hot water, s
Heat Demand 1 in Winter		Heat demand in winter for the school is around 615 MWh, therefore c
Heat Demand 2 in Summer		
Heat Demand 2 in Winter		
Heat Demand 3 in Summer		
Heat Demand 3 in Winter		
Remaining Heat Load Summer	0	
Remaining Heat Load Winter	0	

Biogas Site 3: *Stara Gora*

For the utilization of the landfill gas a CHP unit of 700 kW_e could be used.

Results within Step 3: Selection of the Biogas Site itself

Requirements towards the biogas plant site

Biogas Site 1: *Klinja vas*



Figure5:Ortophoto of Farm Klinja vas

Available space

Site name:	Figure	Comments
Space for Biogas Plant (in m2)	1,5 ha	exact figures are not known but should be enough, since the farm is now in reconstruction and biogas production is one of the foreseen options
Space for the storage of biomass on-site:	0,5 ha	
Space for the storage of biomass at the producer		
Space for the sludge storage	1,5 ha	

Sufficient Road Access

Site name:	Figure	Comments
Distance to intersectorial road (in km)	0,2	

Additional site requirements

Site name:	Yes	No	Comments
Site access for trucks possible	x		
Soil contamination is unlikely	x		
Soil is suitable for industrial construction		x	
Planning instrument prohibits biogas plant on – site		x	
Planning instruments foresees residential, cultural or nature protected areas nearby		x	
Residential, cultural or nature areas do exist in the proximity		x	

Ownership structure

Site name:	
Who is the owner of the selected site:	Farme Ihan d.d.
Will the owner also be the operator of the biogas plant	yes
Is there a basic possibility to buy the land	yes

Biogas Site 2: *Strahinj*



Figure 6: Ortophoto of Biotechnical Centre Naklo



Figure 7: Ortophoto of Biotechnical Centre Naklo with surroundings

Available space

Site name:	Figure	Comments
Space for Biogas Plant (in m2)		exact figures are not known but should be enough for all the necessary installations
Space for the storage of biomass on-site:		
Space for the storage of biomass at the producer		
Space for the sludge storage		

Sufficient Road Access

Site name:	Figure	Comments
Distance to intersectorial road (in km)		road access is good

Additional site requirements

Site name:	Yes	No	Comments
Site access for trucks possible	x		
Soil contamination is unlikely	x		
Soil is suitable for industrial construction	x		
Planning instrument prohibits biogas plant on – site		x	
Planning instruments foresees residential, cultural or nature protected areas nearby		x	
Residential, cultural or nature areas do exist in the proximity	x		

Ownership structure

Site name:	
Who is the owner of the selected site:	Biotehniški center Naklo
Will the owner also be the operator of the biogas plant	probably
Is there a basic possibility to buy the land	

Biogas Site 3: Landfill Stara Gora

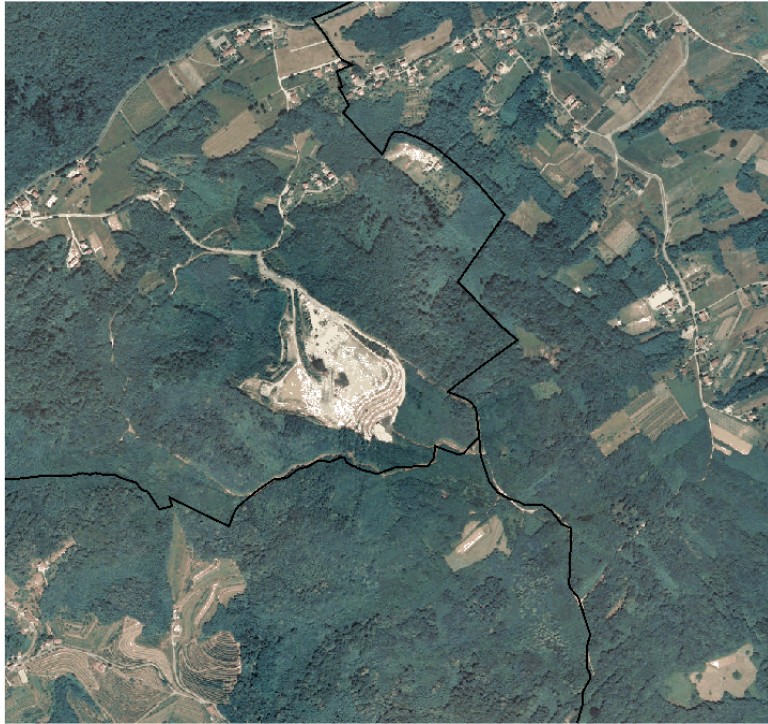


Figure 8: Ortophoto of landfill Stara Gora with surroundings



Figure 9: Ortophoto of landfill Stara Gora

Available space

Site name:	Figure	Comments
Space for Biogas Plant (in m2)		enough space for necessary installations
Space for the storage of biomass on-site:		
Space for the storage of biomass at the producer		
Space for the sludge storage		

Sufficient Road Access

Site name:	Figure	Comments
Distance to intersectorial road (in km)		road access is good

Additional site requirements

Site name:	Yes	No	Comments
Site access for trucks possible	x		
Soil contamination is unlikely	x		
Soil is suitable for industrial construction	x		
Planning instrument prohibits biogas plant on – site		x	
Planning instruments foresees residential, cultural or nature protected areas nearby		x	
Residential, cultural or nature areas do exist in the proximity	x		

Ownership structure

Site name:	
Who is the owner of the selected site:	Komunala Nova Gorica d.d.
Will the owner also be the operator of the biogas plant	yes
Is there a basic possibility to buy the land	

Results within Step 4: Optimising the soft requirements for selected sites

Biogas Site 1: *Klinja vas*

The decision for sustainable energy in the municipality of Kočevje and in the region as well is been already shown trough projects realised. Biomass district heating system is one of the biggest and more successful in Slovenia. Producing biogas at the farm means also less odor emissions to the neighbors therefore the support is clear.

The farm is a subsidiary of Farme Ihan where they have good experience and know-how on biogas. In 2005 they formed a company FI-EKO for this reason.

Biogas Site 2: *Strahinj*

The same is true also for Biotechnological Centre Naklo in Strahinj. Know how in the region is not yet to be found really, however the idea was presented from the experts already and there is also the utility company Gorenjske elektrarne that is investigating about possibilities of biogas plants in Gorenjska region ant that already installed the PV plant in Strahinj. They also want to take active part in the RES research centre.

Biogas Site 3: *Stara Gora*

Also political support in this municipality/region is clear. In Nova Gorica a local energy agency was founded last year.