Triggering the creation of biomass logistic centres by the agro-industry

SUCELLOG: IEE/13/638/SI2.675535

D6.5d
Report on individual auditing studies and diagnosis in Austria

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About SUCELLOG project

The SUCELLOG project - Triggering the creation of biomass logistic centres by the agro-industry - aims to widespread the participation of the agrarian sector in the sustainable supply of solid biofuels in Europe. SUCELLOG action focuses in an almost unexploited logistic concept: the implementation of agro-industry logistic centres in the agro-industry as a complement to their usual activity evidencing the large synergy existing between the agro-economy and the bio-economy. Further information about the project and the partners involved are available under www.sucellog.eu.

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About this document

This report corresponds to a part of the D6.5 Report on individual auditing studies and diagnosis in Spain, France, Italy and Austria of the SUCELLOG project. Lead by SPANISH COOPERATIVES, this document has been prepared by:

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1. Introduction

SUCELLOG supports the creation of biomass logistic centres inside agro-industries covering the gap of knowledge faced when willing to start this new activity. Within WP6, SUCELLOG provides an auditing service facilitating the decision making to agro-industries interested in becoming a logistic centre. Beneficiaries have been object of a previous diagnosis in order to evaluate the degree of matureness to start-up the new activity, their potential and their knowledge gaps.

A total of 20 agro-industries have been diagnosed in Austria and 6 of them were supported with a techno-economic feasibility study through an audit.

This document includes, in a first part, a collection of the individual reports of diagnosis carried out in Austria and, in the second part, the collection of the reports of the auditing services. Finally, a summary of the state of the country with respect to the implementation of the logistic centre in Austria is included.

2. Companies diagnosed in Austria

The following table presents the list of diagnosed agro-industries.

Table 1: List of diagnosed agro-industries in Austria.

Region	Agro-industry name	Sector
Carinthia	Karnitschnig Josef*	Drying plant
Carinthia	Kropiunig Franz	Central heating supply
Carinthia	Landwirtschaftliche Genossenschaft Klagenfur*t	Cereal dryer
Carinthia	Landwirtschaftliche Genossenschaft Lavanttal	Cereal dryer
Carinthia	Rainer Christian*	Saw. Harvest of cereal and corn
Lower Austria	BIOS 1, Biosubstratherstellungs- und Verwertungs-GmbH*	Corn cob dryer
Lower Austria	Lanzenlechner Biostrom KEG*	Dryer for corn, Animal feedstuff
Lower Austria	Nolz GmbH & Co KG*	Cereal dryer
Lower Austria	Öko Energie König Gmbh	Dryer for corn
Lower Austria	Ökoenergie Wulzeshofen	Cereal dryer
Styria	Agrarhandel Lorber	Animal feedstuff
Styria	Alvera AG*	Cereal dryer
Styria	Hebenstreit/MH Agrarhandel GmbH*	Soyabean dryer
Styria	Mühle Alfred Niederl	Buckwheat mill
Styria	Rauer Fritz*	Corn dryer
Upper Austria	Bioenergie Freistadt (Herbert Köppl)	Cereal dryer
Upper Austria	Gerhard Uttenthaller	Wheat, corn and sugar-beet producer
Upper Austria	Ludwig Mayrhofer*	Animal feedstuff
Upper Austria	Ökoenerige Zauner Maximilian*	Cereal dryer
Upper Austria	Wilhelm Weismann	Cereal dryer

The diagnosis served to evaluate the potentialities of these agro-industries to become biomass logistic centres. After a fair and transparent process, some of them (marked with an asterisk * in the table above) were selected to be beneficiaries of a more detailed study inside an auditing service.

2.1. Diagnosis of BC Regionalwärme GmbH Franz Karnitschnig

2.1.1. Company description

The BC Regionalwärme GmbH is the operator of a central heating supply based on biomass for the market town Grafenstein . Since November 2009, now provides the Naturwärme Grafenstein around 160 households with a total power output of 1000 kW with comfortable thermal energy.

2.1.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

They sell thermal energy produced with wood biomass. In generally the use wood chips but in the future they will also use corn cob.

B. Type of biomass resources available

The company has a good access to plant residues. Most of land is within 35 km and is formed by farmers which don´t use the corn cob. At present plant residues are cereal straw, corn stover, cereal residues, husks and corn cobs.

They don´t know the cost for the transport but capacities are available through the machinery ring and other hauliers sufficiently.

The residues are hitherto used for other purposes. Cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable. The harvest of corn cobs is not yet common but the company is searching solutions with providers of harvesting.

Carinthia is a high wooded area and has also a very large wood processing industry, because of this firewood, waste wood and waste from wood processing in large quantities and at relatively low costs is available.

C. Existing equipment in the agro-industry and availability

They have a biomass heating plant and use now wood chips. In future they are interesting in buying a grain drying plant.

D. Knowledge on the bioenergy sector

The company is currently user of solid biomass. They use wood chips and search for the possibility to use plant residues. Because of this they have a quite good knowledge about quality criteria of solid biomass.

E. Biomass market in the region

In the region of the company the use of solid biomass is quite common. Biomass is used in households, farms, public building and industries. Wood chips and wood

pellets are most important, crop residues are not common. In the region of Carinthia there is a very successful wood industry with very big capacities and because of this it is very easy to get cheap wood chips with high quality. There are also many farmers which produce wood chips. The costs of wood chips are about 80-90 €/t (dry base). The use of cobs is possible because in the region there is much corn but the systems of harvest and and storage of cobs are still not solved.

2.1.3. Conclusions

The interest of BC Regionalwärme GmbH in participating in the SUCELLOG project is good. They are searching different possibilities of using corn cob in their heating plant. They want to benefit from the knowledge of the project. The disadvantage is that they don´t have any equipment to produce corn cob grits or pellets. But they interested to invest in buying a cereal dryer.

2.2. Diagnosis of Franz Kropiunig

2.2.1. Company description

The Agricultural company Kropiunig is not very big but has different business activities. The location is in Keutschach am See.

The company has a small saw and is producing lumber. The wood chips they use in the small biomass heating plant and they sell the thermal energy to the households in the neighborhood. A very important activity is the harvest of cereal and corn.

2.2.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

They sell thermal energy produced with wood biomass. In generally the use wood chips but in the future they will also use corn cob. An important activity is also the harvest. They are searching for the possibility of harvesting the corn cob and because of this the have constructing a special harvester.

B. Type of biomass resources available

The company has a good access to plant residues. Most of land is within 50 km and is formed by farmers which don´t use the corn cob. At present plant residues have cereal straw, corn stover, cereal residues, husks and corn cobs.

The transport costs for the agricultural residues within 50 km are approximately € 12 per tonne. For distances less than 35 km they are approximately € 10 per tonne. Transport capacities are available through the machinery ring and other hauliers sufficiently.

The residues are hitherto used for other purposes. Cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable. The harvest of corn cobs is not yet common but the company is searching a solution.

Carinthia is a high wooded area and has also a very large wood processing industry, because of this firewood, waste wood and waste from wood processing in large quantities and at relatively low costs is available.

C. Existing equipment in the agro-industry and availability

They have constructed a harvester which is able to harvest the corn cob. The have a biomass heating plant and use now wood chips.

D. Knowledge on the bioenergy sector

The company is currently of solid biomass. They use wood chips and search for the possibility to use plant residues. Because of this they have a quite good knowledge about quality criteria of solid biomass.

E. Biomass market in the region

In the region of the company the use of solid biomass is quite common. Biomass is used in households, farms, public building and industries. Wood chips and wood pellets are most important, crop residues are not common. In the region of Carinthia there is a very successful wood industry with very big capacities and because of this it is very easy to get cheap wood chips with high quality. There are also many farmers which produce wood chips. The costs of wood chips are about 80-90 €/t (dry base). The use of cobs is possible because in the region there is much corn but the systems of harvest and and storage of cobs are still not solved.

2.2.3. Conclusions

The interest of the company Kropiunig in participating in the SUCELLOG project is good. They are searching different possibilities of using corn cob in their heating plant. They want to benefit from the knowledge of the project. The disadvantage is that they don´t have any equipment to produce corn cob grits or pellets. But they have solutions for the harvest of corn cob.

2.3. Diagnosis of Landwirtschaftliche Genossenschaft Klagenfurt, St. Veit, Rosental.

2.3.1. Company description

The Agricultural cooperative Klagenfurt St. Veit Rosental (Landwirtschaftliche Genossenschaft Klagenfurt St. Veit Rosental) is a cooperative with different business activities. The main location is in Klagenfurt , but there are also branches out to other locations.

One important business activity is the trade in agricultural inputs. However, the cooperative is also an essential partner for the farmers in the sale of grain and corn. For this business activity, the cooperative has a grain drying plant and storage capacities. The grain drying plant is currently operated with fuel oil, but they would be interested in the future, to operate the drying plant by biomass and if practicable to operate with plant residues.

2.3.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The cooperative has a grain drying system that is to be replaced by a new one. Therefore, the new grain drying plant could be heated with biomass in the future.

B. Type of biomass resources available

The cooperative has among its members and cooperating farmers huge tracts of grain and corn, and would therefore have a good access to plant residues. Approximately 70 % of land within 35 km is formed by farmers who have a business relationship with the cooperative. At present plant residues are cereal straw, corn stover, cereal residues, husks and corn cobs.

The transport costs for the agricultural residues within 35 km are approximately € 10 per tonne. For distances less than 10 km they are approximately € 6 per tonne. Transport capacities are available through the machinery ring and other hauliers sufficiently.

The residues are hitherto used for other purposes. Cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable. The harvest of corn cobs is not yet common.

Carinthia is a very wooded area and has also a very large wood processing industry, because of this firewood, waste wood and waste from wood processing in large quantities and at relatively low costs are available.

C. Existing equipment in the agro-industry and availability

Present the cooperative is possessing a grain drying plant and a weighbridge.

As can be seen from the overview, the agricultural residues are available in the same period when the grain has to be drying.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grain drying plant	x	x	x	x	x	x	x				x	x
RESOURCES												
Crop residues								x	x	x		
Corn plant										x	x	
Husks								x	x	x		

D. Knowledge on the bioenergy sector

The agro-industry is currently not a consumer of solid biomass. They use fossil fuels for their activities. They don´t have experience in the production of solid biomass. But they have some knowledge about quality criteria of solid biomass. In future they will buy a new grain drying system and this would be an opportunity to change the heating system.

E. Biomass market in the region

In the region of the Agricultural cooperative the use of solid biomass is quite common. Biomass is used in households, farms, public building and industries. Wood chips and wood pellets are most important, crop residues are not common. In Carinthia ther is a very successful wood industry with very big capacities and because of this it is very easy to get cheap wood chips with high quality. There are also many farmers which produce wood chips. The costs of wood chips are about 80-90 €/t (dry base). The use of cobs is possible because in the region there is much corn but the systems of harvest and storage of cobs are still not solved.

2.3.3. Conclusions

The interest of Agricultural cooperative Klagenfurt in participating in the SUCELLOG project is high. They will make in future an important investment and because of this they are searching different possibilities. They want to benefit from the knowledge of the project. The disadvantage is that they don´t have any equipment to produce corn cob grits or pellets. But they want to make an economical comparison between the different heating systems for the new grain drying plant.

2.4. Diagnosis of Landwirtschaftliche Genossenschaft Lavanttal

2.4.1. Company description

The Agricultural cooperative Lavanttal is a cooperative with different business activities. The main location is in Wolfsberg, but there are also branches out to other locations.

One important business activity is the trade in agricultural inputs. However, the cooperative is also an essential partner for the farmers in the sell of grain and corn. For this business activity, the cooperative has a grain drying plant and storage capacities. The grain drying plant is currently operated with local heating system which is using biomass. The cooperative is not the operator of this local heating system, they only buy thermal energy.

2.4.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The cooperative has a grain drying system that is working with biomass. They have a vertical dryer.

B. Type of biomass resources available

The cooperative has among its members and cooperating farmers huge tracts of grain and corn, and would therefore have a good access to plant residues. Approximately 70 % of land is within 35 km is farmed by farmers who have a business relationship with the cooperative. At present plant residues are cereal straw, corn stover, cereal residues, husks and corn cobs.

The transport costs for the agricultural residues within 35 km are approximately € 10 per tonne. For distances less than 10 km they are approximately € 6 per tonne. Transport capacities are available through the machinery ring and other hauliers sufficiently.

The residues are hitherto used for other purposes. Cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable. The harvest of corn cobs is not yet common.

Carinthia is a very wooded area and has also a very large wood processing industry, beause of this firewood, waste wood and waste from wood processing in large quantities and at relatively low costs are available.

C. Existing equipment in the agro-industry and availability

Present the cooperative is posessing a grain drying plant and a weighbridge.

As can be seen from the overview, the agricultural residues are available in the same period when the grain has to be drying. Only the wood of pruning trees is also available in another period.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grain drying plant	x	x	x	x	x							x
RESOURCES												
Grain straw								x		x		
Corn cob										x	x	
Wood of pruning trees	x	x	x									

D. Knowledge on the bioenergy sector

The agro-industry is currently an indirect consumer of solid biomass. They don´t have experience in the production of solid biomass. But they have some knowledge about quality criteria of solid biomass. In the next 10 years they will ‘not make any changes.

E. Biomass market in the region

In the region of the Agricultural cooperative the use of solid biomass is quite common. Biomass is used in households, farms, public building and industries. Wood chips and wood pellets are most important, crop residues are not common. In the region of Lavanttal there is a very successful wood industry with very big capacities and because of this it is very easy to get cheap wood chips with high quality. There are also many farmers which produce wood chips. The costs of wood chips are about 80-90 €/t (dry base). The use of cobs is possible because in the region there is much corn but the systems of harvest and and storage of cobs are still not solved.

2.4.3. Conclusions

The interest of Agricultural cooperative Lavanttal in participating in the SUCELLOG project is very low. They don´t have any equipment to produce corn cob grits or pellets. They will not make any changes in the use of the heating system.

2.5. Diagnosis of Christian Rainer

2.5.1. Company description

The Rainer Company is located in Meiselding. One important business activity is the trade in agricultural products. For this business activity, the cooperative has a grain drying plant and storage capacities. The grain drying plant is currently operated with wood chips, but they would be interested in the future, to operate the drying plant by plant residues.

2.5.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The company has a grain drying system and in the future they will use plant residues for heating the drying system.

B. Type of biomass resources available

The company has among cooperating farmers huge tracts of grain and corn, and would therefore have a good access to plant residues. Within 35 km there are many farmers which have a business relationship with the company. At present plant residues are cereal straw, corn stover, cereal residues, husks and corn cobs.

Transport capacities are available through the machinery ring and other hauliers sufficiently.

The residues are hitherto used for other purposes. Cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable. The harvest of corn cobs is not yet common.

Carinthia is a wooded area and has also a very large wood processing industry, because of this firewood, waste wood and waste from wood processing in large quantities and at relatively low costs are available.

C. Existing equipment in the agro-industry and availability

Present in the cooperative is possessing a grain drying plant.

As can be seen from the overview, the agricultural residues are available in the same period when the grain has to be dried.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grain drying plant	x	x	x	x	x	x			x			x
RESOURCES												
Cereal straw							X	x				
Corn cob										x	x	

D. Knowledge on the bioenergy sector

The company is currently a consumer of solid biomass. But they have some knowledge about quality criteria of solid biomass. In future they will heat the grain drying system with plant residues.

E. Biomass market in the region

In the region of the company the use of solid biomass is quite common. Biomass is used in households, farms, public building and industries. Wood chips and wood pellets are most important, crop residues are not common. In Carinthia there is a very successful wood industry with very big capacities and because of this it is very easy to get cheap wood chips with high quality. There are also many farmers which produce wood chips. The costs of wood chips are about 80-90 €/t (dry base). The use of cobs is possible because in the region there is much corn but the systems of harvest and storage of cobs are still not solved.

2.5.3. Conclusions

The interest of company in participating in the SUCELLOG project is high. They want to benefit from the knowledge of the project. The disadvantage is that they don´t have any equipment to produce corn cob grits or pellets. But they want to make an economical comparison between using wood chips or plant residues.

2.6. Diagnosis of BIOS 1 Biosubstratherstellungs- u. Verwertungsgesellschaft m.b.H

2.6.1. Company description

The BIOS 1 agro-industry is located in Untergrafendorf in the centre of Lower Austria. Currently the company produces biogas out of residues and makes green electricity out of it. For this activity the company owns a truck fleet, which is used to collect the residues from industries. Furthermore BIOS 1 gets residues from the food industry as well as from supermarkets. The produced electricity is party used in their own facilities and the rest goes into the public electricity net. The waste heat from this process currently is used from drying as well as for soy refinement.

2.6.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The production of green electricity out of residues is the most important activity of BIOS 1.

Beside this the company also dries wheat, corn, hay and wood chips at their facility. Furthermore the company also started to produce pellets for animal feeding out of crops.

The company also has a soy refinement line with a capacity of about 2500 tons per year.

Beside those drying services, animal-feedstuff production and soy refinement activities the company searches a way to broaden its activities with the production of agro-fuels.

B. Type of biomass resources available

Through the current business activities and the connections to the surrounding agricultural companies, as well as through the own land areas which are operated by BIOS 1, the company has a really good access to corn. Furthermore there is straw, wood and prunings available in the area around Untergrafendorf.

C. Existing equipment in the agro-industry and availability

BIOS 1 owns a box driers with a capacity of around 100 tons per day, a screener, a mill for straw, hay and corn-cobs and wood. Furthermore BIOS 1 has a small pelletiser with a capacity of around 300 kg per hour, but this pelletiser should be replaced by a bigger one. This would bring more capacities also for a possible production of agro-fuels.

With the existing dryer the company can dry a lot of resources. As they have enough waste heat from the biogas production, they still have the capacity for more drying activities.

Furthermore the company can produce 200 kW electricity, which can be used for the other processes within the company.

Also BIOS 1 own a filling station for big bags.

Depending on the order situation, the dryer is used the whole year. But there are still capacities for new processes. As the competition of drying services has increased in Lower Austria, the company is interested in finding new own produces, where the dryer is needed.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Box dryer												
Pelletiser	x	x	x	x	x	x	x				x	x
Mill	x	x	x	x	x	x	x				x	x
Electricity production												
RESOURCES												
Corn										x	x	
Corn cob										x	x	
Cereal straw								x				
Hay					x	x	x	x	x			
Prunings	x	x	x	x	x	x	x	x	x	x	x	x

D. Knowledge on the bioenergy sector

In the area around Untergrafendorf mostly wood chips and pellets are used as solid biomass. Although there are areas in Lower Austria, where straw is used, those are not around the BIOS 1 facility.

BIOS 1 has experience in drying several products, but they have no knowledge in selling solid bio-fuels.

E. Biomass market in the region

In a radio of 20 kilometres around Untergrafendorf there are a lot of customers of solid biomass, like industries, district heating as well as private households.

Those consumers just use wood chips and wood pellets. In some cases also Miscanthus. There is currently no offer of other solid bio-fuels in the area.

New solid agro-fuels could be mainly used in industries and district heating, as those facilities have boilers which can handle the problems of agro-fuels, like slagging or high emissions.

2.6.3. Conclusions

BIOS 1 is an agro-industry which has a very good network in the agriculture and which always searches new way to diversity the company. The soy refinement and the production of animal feedstuff are examples for their willingness to diversify.

The company also own good equipment, has free capacities and enough storage capacity. Therefore the agro-industry can be seen as a good potential candidate for creating an agro-industry logistic centre.

The manager, Mr. Huber, likes the idea of creating a logistic centre and wants to further develop this idea, as this could be perfectly combined with the production of animal-feedstuff and would lead to a better degree of utilization for the machinery.

2.7. Diagnosis of Lanzenlechner Biostrom KEG

2.7.1. Company description

The company Lanzenlechner Biostrom is located in Mitterschildbach in the centre of Lower Austria. Currently the company produces biogas out of residues and makes green electricity out of it. The company also developed a section activity with the production of animal feedstuff out of alfalfa. Furthermore the agro-industry offers a drying service for wheat, corn and wood chips.

2.7.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The production of green electricity out of residues and a is the most important activity of Lanzenlechner.

Beside this the company also dries wheat, corn and wood chips at their facility. Furthermore the company also started to produce animal feedstuff out of alfalfa.

The company also manages a farm.

B. Type of biomass resources available

Through the current business activities and the connections to the surrounding agricultural companies, as well as through the own land areas which are operated by Lanzenlechner Biostrom, the company has a really good access to corn. Furthermore there is straw, sun flower, wood and prunings available in the area around MItterschildbach. All residues are available in a radius of 35 kilometres.

C. Existing equipment in the agro-industry and availability

Lanzenlechner Biostrom owns a dryer. Furthermore enough storage and loading space is available.

With the existing dryer the company can dry a lot of resources. As they have enough waste heat from the biogas production, they still have the capacity for more drying activities.

Depending on the order situation, the dryer is used the whole year. But there are still capacities for new processes. As the competition of drying services has increased in Lower Austria, the company is interested in finding new own produces, where the dryer is needed.

D. Knowledge on the bioenergy sector

In the area around Mitterschildbach mostly wood chips and pellets are used as solid biomass. Although there are areas in Lower Austria, where straw is used, those are not around the BIOS 1 facility.

Lanzenlechner Biostrom has experience in drying several products, but they have no knowledge in the production and trade of solid bio-fuels.

E. Biomass market in the region

In a radio of 20 kilometres around Mitterschildbach there are a lot of customers of solid biomass, like industries, district heating as well as private households.

Those consumers just use wood chips and wood pellets. In some cases also Miscanthus. There is currently no offer of other solid bio-fuels in the area.

New solid agro-fuels could be mainly used in industries and district heating, as those facilities have boilers which can handle the problems of agro-fuels, like slagging or high emissions.

The costs of wood chips in the region are between 90 and 140 € per ton dry base.

2.7.3. Conclusions

Lanzenlechner Biostrom is an agro-industry which has a very good network in the agriculture and which always searches new way to diversity the company.

The basic equipment for production an agro-fuel out of residues like corn corbs, like a dryer, storage space, loading space as well as machinery for harvest and transport of crops, is available.

The owner of Lanzenlechner Biostrom is very dedicated and wants to start with the production of an agro-fuel and likes to idea of creating a logistic centre.

2.8. Diagnosis of Nolz GmbH & Co KG

2.8.1. Company description

Nolz GmbH has its roots in the agricultural trade. Moreover the company is a wholesaler, where you get construction materials and they are also having a construction part. The agro-industry is located in Neidling in the centre of Lower Austria.

In the very beginning of the company (1987) was a normal agricultural company. Then they wanted to utilize their free storage capacity and therefore they started with the agricultural trade of barley. They bought the barley of farmers in the area and sold it to the Egger brewery.

2.8.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The main activity of Nolz is the trade with barley, wheat, corn as well as animal feedstuff.

The company also has equipment for drying and refinement as well as loading facilities.

B. Type of biomass resources available

Through the current business activities and the connections to the surrounding agricultural companies, the company has a really good access to agricultural residues in a radio of about 35 kilometres around the company. The available residues are straw, wheat, corn, prunings, corn-cobs and husks.

C. Existing equipment in the agro-industry and availability

The Nolz GmbH own a dryer with a drying power of 2.5 MW. The drying can handle several resources like wheat, corn, and so on. Furthermore the agro-industry owns a mill and a screener. Also a filling station for big bags is available. Moreover the company has enough storage capacity for broadening its activities. Depending on the order situation, the dryer is used from December to June.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
dryer							x	x	x	x	x	
Mill												
screener							x	x	x	x	x	
Filling station	x	x	x	x								x
RESOURCES												
Cereal straw							x	x	x			
Corn									x	x	x	
Prunings	x	x	x									x
Husk									x	x	x	

D. Knowledge on the bioenergy sector

In the area around the Nolz GmbH mostly wood chips and pellets are used as solid biomass. In some cases also Miscanthus. The company itself uses wood chips for heating their facilities. Although there are areas in Lower Austria, where straw is used, those are not around the Nolz facility.

E. Biomass market in the region

In a radio of 20 kilometres around Neidling there are a lot of customers of solid biomass, like district heating, public buildings as well as private households.

Those consumers just use wood chips and wood pellets. In some cases also Miscanthus. There is currently no offer of other solid bio-fuels in the area.

New solid agro-fuels could be mainly used in industries and district heating, as those facilities have boilers which can handle the problems of agro-fuels, like slagging or high emissions.

2.8.3. Conclusions

The Nolz GmbH is searching a way to broaden its business activities. The company has a lot of experience in the agricultural trade and therefore is well connected to farmers around.

As the company has no pelletiser and is not willing to invest in one, they can’t produce agro-pellets. But as Nolz GmbH plans to offer their agro-fuels for large boilers and for self-consumption for their drying process, they think the production of corn cob grits good be a good alternative. One issue that has to be solved is the logistic chain from the field to the facility. This has to be clarified with the farmers.

Mr. Nolz likes the idea of creating a logistic centre and wants to further develop this idea. Therefore he is very interested in diversity the activities of his company.

2.9. Diagnosis of Ökoenergie König GmbH

2.9.1. Company description

The Ökoenergie König agro-industry is located in Inning in the centre of Lower Austria. Currently the company produces biogas and makes green electricity out of it. For this activity the company has agrarian areas where a part of the in the biogas facility used resources are cultivated. The rest of the resources will be bought at the market. The waste heat from the biogas production currently is used for drying activities.

2.9.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The production of green electricity out of residues is the most important activity of Ökoenergie König.

Beside this the company also dries wheat, pumpkin seed and wood chips at their facility. The drying is offered as a service. The dried products will not be refined within their facilities.

B. Type of biomass resources available

Through the current business activities and the connections to the surrounding agricultural companies, as well as through the own land areas which are operated by Ökoenergie König, the company has a really good access to corn. Furthermore there is straw, wood and prunings available in the area around Inning. The distance to those residues is small than 35 kilometres.

C. Existing equipment in the agro-industry and availability

Ökoenergie König owns a box driers with a capacity of around 50 cubic metre per day, if corn is dried.

With the existing dryer the company can dry a lot of resources. As they have enough waste heat from the biogas production, they still have the capacity for more drying activities.

Depending on the order situation, the dryer is used the whole year. But there are still capacities for new processes. As the competition of drying services has increased in Lower Austria, the company is interested in finding new own produces, where the dryer is needed.

E. Knowledge on the bioenergy sector

In the area around Inning mostly wood chips and pellets are used as solid biomass. Although there are areas in Lower Austria, where straw is used, those are not around the Ökoenergie König facility.

Ökoenergie König has experience in drying several products and they are using several residues in the biogas facility, but they have no knowledge in selling solid bio-fuels. The owner of the company has a quite good knowledge about quality criteria of solid biomass.

F. Biomass market in the region

In a radio of 20 kilometres around Inning there are a lot of customers of solid biomass, like industries, district heating, public buildings as well as private households.

Those consumers just use wood chips and wood pellets. In some cases also Miscanthus. There is currently no offer of other solid bio-fuels in the area.

New solid agro-fuels could be mainly used in industries and district heating, as those facilities have boilers which can handle the problems of agro-fuels, like slagging or high emissions.

2.9.3. Conclusions

Ökoenergie König searches new way to broaden its business activities. With the available waste heat, they have the potential to dry agrarian residues like corn cobs and produce corn cob grits in a second step for instance.

For the creation of an agro-industry logistic centre storage space and a mill is missing. Those equipments would have to be bought. Furthermore there is no station to fill smaller amounts. They just can load trucks.

2.10. Diagnosis of Ökoenergie Wulzeshofen GenmbH

2.10.1. Company description

The Ökoenergie Wulzeshofen agro-industry is located in Wulzeshofen in the north of Lower Austria, near the border to the Czech Republic. Currently the company produces biogas and makes green electricity out of it. Beside this the company also produces animal feedstuff and has a wheat drying service. Furthermore they produce briquettes out of scrap wood.

2.10.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The production of green electricity out of residues is the most important activity of Ökoenergie Wulzeshofen.

Beside this the company also dries wheat at their facility. Furthermore the company also started to produce pellets for animal feeding out of crops. Furthermore they produce briquettes out of scrap wood. Moreover they have own agrarian areas.

B. Type of biomass resources available

Through the current business activities and the connections to the surrounding agricultural companies, as well as through the own land areas which are operated by Ökoenergie Wulzeshofen, the company has a really good access to corn. Furthermore there is straw, wood and prunings available in the area around Inning. The distance to those residues is less than 35 kilometres.

C. Existing equipment in the agro-industry and availability

Ökoenergie Wulzeshofen owns a dryer. Furthermore has enough storage and loading space.

With the existing dryer the company can dry a lot of resources. As they have enough waste heat from the biogas production, they still have the capacity for more drying activities.

Depending on the order situation, the dryer is used between December and June. But there are still capacities for new processes. As the competition of drying services has increased in Lower Austria, the company is interested in finding new own produces, where the dryer is needed. The briquette machine is used the whole year, depending on the availability of scarp wood.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
dryer							x	x	x	x	x	
Briquette machine												
RESOURCES												
Cereal Straw							x					
Corn cob									x	x		

D. Knowledge on the bioenergy sector

In the area around Wulzeshofen mostly wood chips and pellets are used as solid biomass. Although there are areas in Lower Austria, where straw is used, those are not around the Ökoenergie Wulzeshofen facility.

Ökoenergie Wulzeshofen has experience in drying several products and they are using several residues in the biogas facility. The company also has experience in producing and selling briquettes. The owner of the company has a good knowledge about quality criteria of solid biomass.

E. Biomass market in the region

In a radius of 20 kilometres around Wulzeshofen there are a lot of customers of solid biomass, like industries, district heating, public buildings as well as private households.

Those consumers just use wood chips and wood pellets. In some cases also Miscanthus. There is currently no offer of other solid bio-fuels in the area.

New solid agro-fuels could be mainly used in industries and district heating, as those facilities have boilers which can handle the problems of agro-fuels, like slagging or high emissions.

The costs of wood chips in the region are between 100 and 140 € per ton dry base.

2.10.3. Conclusions

Ökoenergie Wulzeshofen is an agro-industry which has a very good network in the agriculture and which always searches new way to diversity the company.

The basic equipment for production of an agro-fuel out of residues like corn corbs, like a dryer, storage space, loading space as well as machinery for harvest and transport of crops, is available.

Generally, the company is interested in the SUCELLOG project and wants to be informed about the further developments of the project, but can’t imagine creating a logistic centre under current legal legislation and economic situation.

2.11. Diagnosis of Lorber KG

2.11.1. Company description

Lorber KG is an agro-industry processing spelt. It is located in the south of Styria in Wagendorf.

The agro-industry processes and therefore dries the spelt and produces food and animal feedstuff. During the production there are spelt husks created, which are currently just rarely used. Most of them are not used and have to be disposed.

Therefore the agro-industry searches a way to use the spelt husks and is interested in figuring out if it is possible to make an agro-fuel out of it.

2.11.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

This agro-industry dries spelt for food and animal feedstuff. Therefore they are included in the most interesting sectors selected by the project. For their regular activity they need a silo-dryer which can also be used for drying residues.

B. Type of biomass resources available

The agro-industry has access to spelt husks from their regular production process. As they are processing the spelt through the whole year, the residues are also available during the whole year.

As the residues come from their own process, the agro-industry is already the owner of the spelt husks. Therefore there is no need for an additional purchase or delivery of residues. Currently, most of the husks have no use and have to be disposed. Small amounts are used as animal feedstuff.

In the area there are existing logistic chains for gathering forestry wood which can be an opportunity to look for synergies.

C. Existing equipment in the agro-industry and availability

The Lorber KG has a silo dryer which could be used for drying a variety of residues. The dryer is mainly used from August to October. Therefore there is a huge idle period from November to July, as you can see in the following graph:

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Silo dryer	x	x	x	x	x	x	X				x	x
RESOURCES												
Spelt husk	x	x	x	x	x	x	x	x	x	x	x	x

However, it has to be mentioned that the spelt husks are already dried with the spelt during the regular activity. Therefore the dry husks are the residue and no additional drying is necessary. But the dryer could be useful if the company considers making any mixtures of spelt husks and wooden biomass, e.g..

The problem of the Lorber KG is that there is no further equipment available to process the spelt residues. At least they would need a pelletizer and a mill. The agro-industry has currently no clue how and where they could pelletize their spelt husks.

D. Knowledge on the bioenergy sector

The agro-industry is already a consumer of solid biomass. They use wood chips as heat resource in their industry. However Lorber KG has no experience in the production of solid biomass. Furthermore the manager wasn't quite sure about quality characteristics. He just mentioned the moisture content.

E. Biomass market in the region

In the region of the Lorber KG the use of solid biomass is quite common. Biomass is used in farms, industries, public buildings and households. The agro-industry thinks that they could use the spelt pellets mainly in their own company, in farms and other industries. The distance to those customers would be up to 35 kilometres and the demand would be quite seasonal during winter. Furthermore the manager of Lorber thinks that spelt pellets cannot fulfil the quality requirements for households.

The biomass used is wooden biomass in form from logs, chips and pellets. The price for logs is about 130€/t (m 20%), for chips about 90 €/t (dry base) and about 220 €/t for pellets.

Although there are no costs for the spelt residues for Lorber KG, it seems not very likely that they can produce a product that has a competitive market price. As they argo-industry has no experience how much the pelletizing would cost, we just assume the pelletizing costs of the Tschiggerl example, which is about 120€/t. As the mentioned most possible customers use mainly chips and logs. Maybe they could produce a compatible product for households, if they mix the spelt with wood.

2.11.3. Conclusions

The interest of the Lorber KG in using their currently not used residue is very high. Therefore they are also interested in participating in the SUCELLOG project during the next step of a feasibility study. However the Lorber KG not just focuses on the thermal use of its residue as biofuel, but also on other material utilization.

The great advantage of this agro-industry is that they have a free, unused residue. However the knowledge about burning pellets from spelt husks is very limited at the moment, which is a huge disadvantage. Furthermore the missing pelletizing line is a huge problem.

2.12. Diagnosis of Alwera AG

2.12.1. Company description

The Alwera AG is a huge Austrian agro-industry with about 220 employees. It's headquarter is Wollsdorf in the east of Styria.

The company is a full logistic company in the field of corn, pumpkin and scarlet runner bean. Alwera makes provides contract crop-growing and harvesting, they are drying and processing the crops. Furthermore they are selling the processed products into the market.

Through their production process Alwera has access to several residues. They are especially interested in using their corn cobs as an agro-fuel. Therefore they are interested in creating a logistic centre at their location in Donnersdorf in the south-east of Styria.

2.12.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

At the location in Donnersdorf this agro-industry dries and processes corn. Therefore they are included in the most interesting sectors selected by the project. For their regular activity they have a box dryer, where they dry the whole corn cob (cob + seeds). Then they separate the seed from in cob in their facilities. The corn cob is a residue of the process.

B. Type of biomass resources available

Through his current activity Alwera has access to corn cobs, which will be harvested from September to October. In comparison to other corn drying companies like Tschiggerl Agrar, Alwera has a different harvesting method. They pick up the whole corn cob (cob + seeds) and they separate them during their pre-treatment actions in their facility. Therefore the corn cobs are already available at the facility of Alwera. Currently those cobs have no use and they will be disposed. This means that the residue has no additional costs for the company, neither in purchasing nor in transport.

The corn comes from farmers in a radio of 35 km from the location Donnersdorf. Alwera has valid contracts with all this farmers.

In the area there are existing logistic chains for gathering forestry wood which can be an opportunity to look for synergies.

C. Existing equipment in the agro-industry and availability

Alwera has a box which could be used for drying and processing a variety of residues. This dryer mainly used from September to October. Therefore there is a huge idle period from November to August, as you can see in the following graph:

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Box dryer	x	x	x	x	x	x	x	x			x	x

As the whole cob (cob + seeds) will be dried during Alwera's main acitivity, there is no further need to dry the corn cobs, as they are already dries. The corn cobs are available during their main activities, but it should be no problem to store the cobs.

As the corn cobs are available in the same period like the corn seeds, the idle period doesn't fit really well with the harvesting time of the cobs. But it should be no problem to store the cobs meanwhile and process them during the idle period of the agro-industry.

The problem of Alwera is that there is no further equipment available to process the corn cob residues. At least they would need a mill to produce corn cob grits.

D. Knowledge on the bioenergy sector

The agro-industry is currently not a consumer of solid biomass. They use fossil fuels for their activities. But they also made some first tests of heating with whole corn cobs. However Alwera has no experience in the production of solid biomass. But they have some knowledge about quality criteria of solid biomass.

E. Biomass market in the region

In the region of Alwera the use of solid biomass is quite common. Biomass is used in farms, industries, public buildings and households. But in the first step the agro-industry thinks that they could use the whole corn cobs to subsidize the fossil fuels in their own company. The additional cobs could be sold to district heatings and bigger farms. If they see a further demand in public buildings and households they could also invest in machines to produce corn cob grits, but this will be not the first step.

As the main user of the corn cobs would be the agro-industry itself, there is no distance. District heatings as possible consumers are in a distance up to 35 kilometres.

As Alwera has no additional costs for the agro-fuel (whole corn cob), instead of storing costs, it should be economical feasible. But if they want to use the cobs as fuel they have to invest in a new boiler.

The district heatings currently are using wood chips which cost about 90 €/t (dry base). Therefore the whole cobs could be also a cheap alternative.

2.12.3. Conclusions

The interest of the Alwera AG in participating in the SUCELLOG project is very high. They mainly want to benefit from the knowledge of the project, to use their residues as fuel for their main activity. Additional residues should be sold to district heatings. Through this new activity Alwera thinks that they can save costs and gain additional revenues.

The great advantage of this agro-industry is that they have a free, unused residue. Furthermore they have also a huge customer, namely the Alwera AG itself. These are perfect preconditions for the SUCELLOG project. The disadvantage of the agro-industry is that they don’t have equipment to produce corn cob grits or pellets.

2.13. Diagnosis of MH Agrarhandel GmbH

2.13.1. Company description

The MH Agrarhandel GmbH is a small agro-industry located in the south-east of Styria in Haselbach near Fehring.

The agro-industry is currently drying with soy from famers around the agro-industry's location. Furthermore the company is selling the processed soy into the market. During the production soy husks accrues, which are currently not used and have to be disposed.

Therefore the agro-industry searches a way to use the soy husks and is interested in figuring out if it is possible to make an agro-fuel out of it.

2.13.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

This agro-industry dries soy for food and animal feedstuff. Therefore they are included in the most interesting sectors selected by the project. For their regular activity they need a silo-dryer which can also be used for drying residues.

B. Type of biomass resources available

The agro-industry has access to soy husks from their regular production process. As they are processing the soy from January until the end of November, the residues are available nearly during the whole year.

As the residues come from their own process, the agro-industry is already the owner of the spelt husks. Therefore there is no need for an additional purchase or delivery of residues. Currently, the husks have no use and have to be disposed.

In the area there are existing logistic chains for gathering forestry wood which can be an opportunity to look for synergies.

C. Existing equipment in the agro-industry and availability

The MH Agrarhandel GmbH has a silo dryer which could be used for drying a variety of residues. The dryer is mainly used from July to October. Therefore there is a huge idle period from November to June, as you can see in the following graph:

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Silo dryer	x	x	x	x	x	x					x	x

However, it has to be mentioned that the soy husks are already dried with the soy during the regular activity. Then the company separates the soy from the husk. Therefore, the dry husks are the residue and no additional drying is necessary. But the dryer could be useful if the company considers making any mixtures for soy husks and

wooden biomass, e.g.. Furthermore the company has enough space in their facility to create an agro-logistic centre.

The problem of the MH Agrarhandel GmbH is that there is no further equipment available to process the soy residues. At least they would need a pelletizer and a mill. The agro-industry has currently no clue how and where they could pelletize their soy husks.

D. Knowledge on the bioenergy sector

The agro-industry isn't a consumer of solid biomass. Currently they are using fossil fuels for their activities. Furthermore the MH Agrarhandels GmbH has no experience in the production of solid biomass, the manager knows a lot about quality characteristics of solid biomass.

E. Biomass market in the region

In the region of the MH Argarhandels GmbH the use of solid biomass is quite common. Biomass is used in farms, industries, public buildings and households. The agro-industry thinks that they could sell the soy husk pellets to customers in the region, especially to farmers and other industries. The distance to those customers would be up to 35 kilometres and the demand would be quite seasonal during winter.

The biomass currently used is wooden biomass in form from logs, chips and pellets. The price for logs is about 130€/t (m 20%), for chips about 90 €/t (dry base) and about 220 €/t for pellets.

Although there are no costs for the soy husk residues for Argarhandel GmbH, it seems not very likely that they can produce a product that has a competitive market price. As they argo-industry has no experience how much the pelletizing would cost, we just assume the pelletizing costs of the Tschiggerl example, which is about 120€/t.

2.13.3. Conclusions

The interest of the MH Agrarhandels GmbH in broadening his business activities his very high. They think that the production of biofuel out of agrarian residues could be a very good opportunity for the company. Therefore they are interested in participating in the SUCELLOG project during the next step of a feasibility study.

The great advantage of this agro-industry is that they have a free, unused residue. However the knowledge about burning pellets from soy husks is very limited at the moment, which is a huge disadvantage. Furthermore the missing pelletizing line is a huge problem.

2.14. Diagnosis of Mühle Alfred Niederl

2.14.1. Company description

Mühle Alfred Niederl is a mill in the south of Styria in St. Peter am Ottersbach. The agro-industry processes buckwheat and produces flour.

During the production of the flour buckwheat husks accrues as a residue. This residue is currently rarely used. Most of the times the buckwheat husks have to be disposed. Sometimes they are used as animal feedstuff.

Therefore the agro-industry searches a way to use the buckwheat husks and is interested in figuring out if it is possible to make an agro-fuel out of it.

2.14.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

This agro-industry mills buckwheat and creates flour. This type of agro-industry is not included in the most interested sectors for the project. However, the agro-industry has a lot of unused buckwheat husks as a residue and wants to figure out what they can do with them. For their regular activity they have a mill and a sieve.

B. Type of biomass resources available

The agro-industry has access to buckwheat husks from their regular production process. As they are processing the buckwheat through the whole year, the residues are also available during the whole year.

As the residues come from their own process, the agro-industry is already the owner of the buckwheat husks. Therefore there is no need for an additional purchase or delivery of residues. Currently, most of the husks have no use and have to be disposed. Small amounts are used as animal feedstuff.

In the area there are existing logistic chains for gathering forestry wood which can be an opportunity to look for synergies.

C. Existing equipment in the agro-industry and availability

The Mühle Alfred Niederl has a mill and a sieve, but that equipment is not very useful for the production of agro-fuels.

However, it has to be mentioned that the buckwheat husks doesn’t need any drying as the husks are already dried during the regular activity. Furthermore the agro-industry has enough space in their facility to create an agro-logistic centre.

The problem of the Mühle Alfred Niederl is that there is no further equipment available to process the soy residues. At least they would need a pelletizer to produce an agro-

fuel out of their husks. The agro-industry has currently no clue how and where they could pelletize their buckwheat husks. As their regular activity has no real idle periods, it will also be hard to establish a logistic-centre.

D. Knowledge on the bioenergy sector

The agro-industry has no experience and knowledge on the bioenergy sector. For most of their activities they currently use hydropower and electricity. Therefore there is no potential for a self-consumption of the agro-fuel within the agro-industry. Furthermore the company has no experience in the production of solid biomass and the manager didn't know anything about quality characteristics of solid biomass.

E. Biomass market in the region

In the region of the company the use of solid biomass is quite common. Biomass is used in farms, industries, public buildings and households. The agro-industry thinks that farms, households and other agro-industries could be possible consumers of an agro-fuel out of buckwheat husks. The distance to those customers would be up to 35 kilometres and the demand would be quite seasonal during winter.

The biomass used is wooden biomass in form from logs, chips and pellets. The price for logs is about 130€/t (m 20%), for chips about 90 €/t (dry base) and about 220 €/t for pellets.

Although there are no costs for the husks residues for the agro-industry, it seems not very likely that they can produce a product that has a competitive market price. As the argo-industry has no experience in the production of solid biomass and have no knowledge about quality criteria, it will be hard to produce a suitable product. Furthermore the company don't how and where to pelletize the residue and how much the pelletizing would cost. Therefore we just assume the pelletizing costs of the Tschiggerl example, which is about 120€/t. Therefore it could maybe possible to produce products for current pellet users, although we do not know the burning characteristics of buckwheat.

2.14.3. Conclusions

The interest of the Mühle Alfred Niederl in using their currently not used residue is very high. Therefore they are also interested in participating in the SUCELLOG project during the next step of a feasibility study. However the agro-industry not just focuses on the thermal use of its residue as biofuel, but also on other material utilization.

The great advantage of this agro-industry is that they have a free, unused residue. However they don't have any knowledge or experience about burning biofuels at the moment, which is a huge disadvantage. Furthermore the missing pelletizing line is a huge problem. Also there are no idle periods.

2.15. Diagnosis of Friedrich Rauer

2.15.1. Company description

Friedrich Rauer is the owner of an agro-industry with the same name. The industry is located in the east of Styria in Bad Blumau.

The company is currently drying cereal and corn from famers around the agro-industry's location. Furthermore Rauer is selling the processed products into the market.

As Friedrich Rauer knows the new agro-industry logistic centre of Tschiggerl Agrar, which has a quite similar main activity, he also thought about commercializing corn cobs and especially corn cob grits as an agro-fuel.

2.15.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

This agro-industry dries corn and cereals. Therefore they are included in the most interesting sectors selected by the project. For their regular activity they need a belt-dryer and a mill which can be used for processing residues.

B. Type of biomass resources available

Through his current activity Rauer has access to corn cobs, which will be harvested from September to November.

All of the cobs could from farmers associated to Rauer in a radio of 35 km from the agro-industry, which currently sell just the corn seeds to Rauer. A logistic centre could be a win-win situation for the agro-industry, which increases the workload and creates new value, as well as for the farmers, who could sell their currently unused corn cobs.

The transport to the agro-industry could be done during the harvest and transport from the corn seeds, as there is normally enough transport capacity available during the harvesting process. The main problem is that there are at the moment not a lot of harvesting machines, which could harvest corn and cobs in one step.

In the area there are existing logistic chains for gathering forestry wood which can be an opportunity to look for synergies.

C. Existing equipment in the agro-industry and availability

Friedrich Rauer has a belt dryer and a mill which could be used for drying and processing a variety of residues. Both are mainly used from September to November. Therefore there is a huge idle period from December to August, as you can see in the following graph:

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Belt-dryer	x	x	x	x	x	x	x	x				x
Mill	x	x	x	x	x	x	x	x				x

As the corn cobs are available in the same period like the corn seeds, the idle period doesn't fit really well with the harvesting time of the cobs. But it should be no problem to store the cobs meanwhile and process them during the idle period of the agro-industry.

However, it has to be mentioned that the corn cobs normally doesn't need any drying. As the moisture content of the cobs is normally about 10%. Therefore the belt-dryer is not necessary for the cobs, but it could be useful if the company considers making any mixtures for cobs and other residues, which has to be dried.

What's very useful for Rauer to become an agro-industry logistic centre is the fact that he owns a mill, which could be used to produce corn cob grits.

D. Knowledge on the bioenergy sector

The agro-industry is already a consumer of solid biomass. They use wood chips as heat resource in their industry. They also made some first tests of heating with corn cobs in their facility. However Rauer has no experience in the production of solid biomass. But Friedrich Rauer has a really good knowledge about quality criteria of solid biomass. He mentioned moisture, calorific and ash content. Furthermore he knew about possible problems slagging and corrosion problems in boilers, if fuels with bad quality are used.

E. Biomass market in the region

In the region of Rauer the use of solid biomass is quite common. Biomass is used in farms, industries, public buildings and households. The agro-industry thinks that they could use the whole corn cobs mainly in their own company, in farms and district heatings. Furthermore corn cob grits should be used in households and smaller farms. The distance to those customers would be up to 35 kilometres and the demand would be quite seasonal during winter.

The biomass used in the region is wooden biomass in form from logs, chips and pellets. The price for logs is about 120€/t (m 20%), for chips about 90 €/t (dry base) and about 230 €/t for pellets.

Although we do not really know the purchasing price of the corn cobs yet, we can assume that whole corn cobs, and the production of grits is quite cheap. Therefore it should be possible to produce a solid bio-fuel, which is cheaper than comparable biomass competitors.

2.15.3. Conclusions

The interest of Friedrich Rauer in broadening his business activities his very high. He thinks that the production of biofuel out of agrarian residues could be a very good opportunity for this. Therefore he is interested in participating in the SUCELLOG project during the next step of a feasibility study.

The advantages of Rauer are that he has mill to produce corn cob grits and he has access to corn cobs through his main activity. Furthermore he already did some combustion tests of corn cobs in his own facility, which shows his huge interest in this topic. A disadvantage is that the logistic chain for corn cobs is not 100 % developed yet.

2.16. Diagnosis of Bioenergie Freistadt

2.16.1. Company description

The Bioenergy Freistadt is a Biogasplant using renewable raw materials for producing biogas (gasification). The company produces green electricity with 250 kW electrical power and about 280 kWh thermal-energy (waste heat) which is used for drying wood-chips, wheat and corn. The produced electricity is partly used for their own consumption. Surplus electrical power is sold to the specially founded stated-owned company OeMAG (Abwicklungsstelle für Ökostrom).

The company is located in the north-east part of Upper-Austria in the political distric Freistadt. Freistadt is a well wooded region an close to a new highway/freeway with a lot of roadside woods (trees and bushes). In this region there are many biomass-district-heating-plants with above-average biomass-consumption caused by the rough climate.

2.16.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The production of green electricity out of renewable raw materials is the most important activity. The fermented material of the biogas-process is used as fertiliser for the agricultural fields.

Furthermore activity is drying-service for payment (contract drying) of wood chips, wheat and corn.

Especially wood-chips of deciduous wood and bushes have to be dried.

Drying of wheat and corn is only necessary in rainy (wet) years

B. Type of biomass resources available

There is a large potential in the next years of roadside woods (trees and bushes) along the new highway called “S10”. This woods have to be cut back every three years. This big quantity of wood can not be used or storage without drying. Actually the most of this wood is shredded and composted with high costs.

The owner of this residues is the governmental road maintainer “ASFINAG”. This material is mostly available in the summer-months. The wood harvest and the transport is managed by the ASFINAG.

C. Existing equipment in the agro-industry and availability

The company has two trailers for drying with a capacity of about 20 m^3 a day.

With the existing dryer the company can dry a lot of resources. As they have enough waste heat from the biogas production, they still have the capacity for more drying activities. The capacity for drying depends of the year and the weather and the amount of wheat and corn to dry because this has always the first priority.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dryer					x	x	x	x				
Wood chipper					x	x	x	x				
RESOURCES												
Wood				x	x	x	x	x	x	x		

D. Knowledge on the bioenergy sector

The operators of the biogas plant are owners of forests and agricultural lands and have a lot of experience with production of solid biomass fuels.

E. Biomass market in the region

In the region of Freistadt there are a lot of biomass-district-heating plants. In this region there are a lot of customers of solid biomass, like industries, district heating as well as private households. Especially private owners of heating plants prefer high quality wood chips. This means low moisture and quick drying directly after harvesting.

On the other side some big district-heating plants do not really need high quality wood-chips because there is a great offer of low priced biofuels in this highly wooded region.

2.16.3. Conclusions

Actually the large offer and the small demand on solid biomass fuels caused by warm winters and very cheap fossil energy (gas and oil) decrease the prices and make it not easy to use alternative raw materials.

2.17. Diagnosis of Gerhard Uttenthaller

2.17.1. Company description

Mr. Gerhard Uttenthaller is an owner of a farm in Eferding – a small city in the middle of Upper-Austria near by the river “Danube”. This region is known for its very fertile soil. Mr. Uttenthallers farm is a typical grain farm for market fruit production without livestock.

2.17.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

He produces wheat, corn and sugar-beet. The yearly production is about 80 tons of grain, 150 tons corn and 300 tons sugar-beet. Furthermore production of biomass-woodchips (about 200 m³ per year) from his own forest (8 ha).

The crop harvest is done by a machinery contractor.

Mr. Uttenthaller is also an owner of two biomass-heating plants.

B. Type of biomass resources available

There is a large potential of cereal straw. The yearly amount is about 35 tons. Actually 2/3 are sold to a cattle farm for bedding and 1/3 is left on the fields as fertiliser. The heating value is nearly the same as wood. Its about 4.5 kWh/kg.

Other biomass resources are about 20 tons of corn crops from the own maize. There is a very big potential for much more for this resources in this region.

There are thousands of ha of maize in this region where the corn cobs are hardly used.

C. Existing equipment in the agro-industry and availability

Unfortunately there is no combine harvester in this region which is able to collect the corn cobs separately.

Transport logistic is available.

There is a possibility for drying in a solar dryer in a short distance (less than 5 km).

Chopping the corn cobs is not necessary because they are mixed up with wood-chips for heating.

D. Knowledge on the bioenergy sector

Mr. Uttenthaller has a big knowledge and experiences in biomass fuels.

E. Biomass market in the region

Around Eferding there are 4 biomass-district-heating plants with a thermal capacity of about 6 MW with a need of about 16000 cbm woodchips. Private owners of biomass boilers are also interested in using dried corn cobs as fuel.

Also the local cooperative runs a biomass boiler to dry cereals, rape seed, soybean and maize. This thermal energy could also be produced from corn cobs.

2.17.3. Conclusions

The region Eferding has not very large forests, using corn cobs or other residues would be useful to produce energy for drying processes, district heating plants and private owner of biomass boilers. The potential of corn cobs is big, about 30 per cent of the fields in this region are used to produce maize for a starch producing company.

2.18. Diagnosis of Ludwig Mayrhofer

2.18.1. Company description

Mr. Ludwig Mayrhofer is an owner of a farm in Nußbach, a region in the south part of Upper-Austria. 20.7 % of the municipal territory of Nußbach is forest and 69.4 % of the area is used for agriculture. There is also a big biomass-district-heating plant.

2.18.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The main task of his company is hog feeding for producing pigs and piglets. Another important task is producing grain (rapeseed, wheat), maize.

The company is also engaged in sawing wood in its own saw-mill and producing wooden biofuels, as woodchips and firewood.

Furthermore the company has an own solar powered dryer which can also be operated by heating with woodchips.

B. Type of biomass resources available

In the vicinity of 50 km is a great potential for grain straw (rapeseed, wheat) and maize corn cobs.

Actually the straw is used for bedding for the livestock-farming or is left on the soils for fertilising reasons.

Wheat straw is available for about € 20,- per ton. Its pressed to bales for effective logistic and selling.

At the moment the maize cobs are not collected because therefore there are no machines available.

C. Existing equipment in the agro-industry and availability

Unfortunately there is no combine harvester in this region which is able to collect the corn cobs separately.

The company is owner of tractors and trailers so the transport logistic is no problem.

The straw balling presses are provided by agricultural machine contactors.

The company also owns stationary and portable drying plants powered by solar energy and wooden biomass.

Drying the straw is not necessary because of the degree of dryness. Grain just harvested in dry state.

D. Knowledge on the bioenergy sector

Mr. Mayrhofer has a big knowledge and experiences in biomass fuels. He is engaged in producing biomass fuels and providing thermal heat for many years.

E. Biomass market in the region

In a short distance there are huge forest areas and so there is a big biomass offer. The sawmill of Mr. Mayrhofer produces a lot of by-products in his saw-mill.

The demand of wooden biomass in this region is well saturated.

Another problem is that at the moment there are no biomass-heating-plants which were technically and legally able to burn the straw.

2.18.3. Conclusions

The big advantage of Mr. Mayrhofer is that he already has huge experience in the production of solid biomass out of wood. There is also equipment available to process residues.

A problem is the availability of the residues. Straw already has competitive uses and for the rest it is better to leave it on the soil for humification. The problem with corn cobs is the missing harvesting technic, but Mr. Mayrhofer thinks that corncobs will become a growing importance.

2.19. Diagnosis of Ökoenerige Zauner Maximilian

2.19.1. Company description

The “Ökoenerige Zauner Maximilian” is owner of a biogas-plant and a biomass district-heating plant. With these plants he provides thermal energy for 20 customers (18 households and 2 companies)

The biogas plant uses waste materials from households and food industry. The company produces green electricity with 250 kW electrical power and about 280 kWh thermal-energy (waste heat) which is used for heating the households and for drying wood-chips, wheat and corn. The produced electricity is partly used for their own consumption. Surplus electrical power is sold to the specially founded stated-owned company OeMAG (Abwicklungsstelle für Ökostrom).

The company is located in Pettenbach, this is a region in the south part of Upper-Austria in the political district Kirchdorf. Pettenbach is a well wooded region close to the Alps. There are some biogas plants and biomass-district-heating-plants with above-average biomass-consumption in this region.

2.19.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

There are four main tasks of the company.

The first is the agriculture. Family Zauner cultivates grain and maize.

The second task is the forestry. They sell wood for the sawing and timber industry and wooden biomass for the own biomass district heating plants and for other customers.

The third task is the biogas plant. The production of green electricity out of waste materials. Financial income is generated by selling electrical and thermal energy on the one hand and on the other hand by disposal charge. The fermented material of the biogas-process is used as fertiliser for the agricultural fields. Most of the thermal energy is used for drying-service for their own wood and for payment (contract drying) of wood chips, wheat and corn.

Especially wood-chips of deciduous wood and bushes have to be dried.

The fourth task is to provide heat from their biomass district heating plant.

B. Type of biomass resources available

Available are straw of grain and rape, corncobs. There is a small potential of roadside woods (trees and bushes) from the public streets. This wood has to be cut back every three years. This wood can not be used or to be stored without drying. Actually the most of this wood is shredded and composted with high costs. The owner of this

residues are the road maintainers. This material is mostly available in the summer-months. The wood harvest and the transport are managed by the maintainers.

C. Existing equipment in the agro-industry and availability

A drying chamber powered by the waste heat of the biogas-plant.

The company has also tractors and trailers for drying with a capacity of about 20 m³ a day.

D. Knowledge on the bioenergy sector

The operators of the biogas plant/biomass district heating plant are owners of forests and agricultural lands and have a lot of experience with production and providing (logistic) of solid biomass fuels and selling electrical energy and thermal energy.

E. Biomass market in the region

In the region of Kirchdorf there are some other biomass-district-heating plants. In this region there are a lot of customers of solid biomass, like industries, district heating as well as private households. Especially private owners of heating plants prefer high quality wood chips. This means low moisture and quick drying directly after harvesting.

On the other side some big district-heating plants do not really need high quality wood-chips because there is a great offer of low priced biofuels in this highly wooded region.

2.19.3. Conclusions

The big advantage of Ökoenergie Zauner is that he already has huge experience in the production of solid biomass out of wood. There is also equipment available to process residues. Especially they have drying capacity and through their biogas plant they also have enough heat.

The problem currently is that there is a lot of wooden biomass on the market and Mr. Zauner sees currently not a big market, but he thinks that in future the market for agro-fuelswill increase.

2.20. Diagnosis of Wilhelm Weismann

2.20.1. Company description

Mr. Wilhem Weismann is a farmer in Roitham, a village in the center of Upper-Austria in the political district Gmunden. Roitham is an intensive farming area. In this region there is produced a lot of grain, wheat and corn.

The proportion of forest is very low with 20.5 %. 69,5 % of the district area is used for agriculture. In the political district Gmunden are some biomass-district-heating-plants.

2.20.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

Additional to the agriculture Mr. Weismann works as a harvesting machine contractor and provides drying services for payment (contract drying) of wood chips, wheat and corn.

The utilization rate of the drying plant can have strong fluctuations. This depends on the moisture of wheat and corn – drying is only necessary in rainy (wet) years

There could be a capacity for drying alternative biomass fuels.

B. Type of biomass resources available

Most of the grain straw of this area is used for bedding in livestock farming or is simply left on the fields for humification and fertilising the soil.

There is a large potential of corncob for Mr. Weismann. Mr. Weismann is harvesting maize for payment with his combine harvester. This machine was adapted to collect also the corncobs. He could buy the corncobs for about 5 to 7 € per ton in a distance of about 10 km from home. The own machinery for the logistic is available.

C. Existing equipment in the agro-industry and availability

The company owns a professional silo dryer and also a mill for shredding. Normally this mill is used for shredding wheat and corn but in this case the mill can also be used to shredder corncobs. The existing drying plant and the mill is actually not fully stretched – they are only used in the harvesting season.

Mr. Weismann considers buying a pellet plant to increase to using capacity of the pellet plant. He thinks about pelletizing dry food for livestock (hay of grass or Lucerne).

The company is owner of tractors and trailers so the transport logistic is no problem.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Dryer	x	x	x	x	x	x		x	x		x	x
Mill	x	x	x	x	x	x		x	x		x	x
RESOURCES												
Corn cob									x	x		

D. Knowledge on the bioenergy sector

Mr. Weismann has a lot of experience of producing solid biomass fuels and drying services. He is using about 25 tons of corncobs a year for heating.

E. Biomass market in the region

In this region there are some customers of solid biomass, like industries, district heating as well as private households. Especially private owners of heating plants prefer high quality wood chips. This means low moisture and quick drying directly after harvesting.

Also there are many owners of pellet-heating plants.

It is not easy to sell pellets made of corncobs to private customers. Therefore you need a transport logistic, a pump truck for filling the pellet storage. A professional marketing is also necessary. The price for pellets is depending on the oil and gas price.

The current low price of oil and gas allows not an economically corncob pellet production.

2.20.3. Conclusions

The big advantage of Mr. Weismann is that he already has a lot of equipment to produce agro-fuels and he considers to buy a pelletizer. He also has experience in the treatment of agro resources and solid biomass. Furthermore he own a harvester that also collects the corn cobs. Therefore he has access to the cheap residue.

3. Companies audited in Austria

3.1. Summary of the audit study to Alwera AG

3.1.1. Company description

The Alwera AG is a large Austrian agro-industry with about 220 employees. The agro-industry was founded in 1983. It's headquarter is Wollsdorf in the east of Styria, but Alwera AG has several different locations. For SUCELLOG study the location in Donnersdorf was analysed.

The company is a full logistic company in the field of corn, pumpkin and scarlet runner bean. Alwera makes the harvesting, drying and processing of the crops from contracted fields from farmers. Furthermore, they are selling the processed products into the market, being about 50 % of their production exported. Through their production process, Alwera has access to residues which are not being used at the moment.

The current main activities of the company at the location Donnersdorf are the following:

a. Corn harvest, treatment and trading:
   - Harvesting the corn from contracted fields acting as a logistic operator
   - Corn drying from the contracted fields (up to 1000 hectares per year)
   - Buying corn from other farmers and then selling it in the market
   - Commercialising the corn seeds
b. Pumpkin harvest, treatment and trading:
   - Harvesting and drying pumpkin and pumpkin seeds

At the location Donnersdorf, the Alwera AG already uses lose corn cobs to some extend in their boiler for the drying process. But the cobs are too dry for the company industrial boiler causing problems in the operation. Therefore, they are interested in producing corn cob grits with their cobs since they already have the desirable low moisture content that small scaled boiler for households or farms demand. The company is interested in creating a logistic centre at their location in Donnersdorf in the south-east of Styria.

3.1.2. Synergies to become an agro-industry logistic centre

3.1.2.1. Biomass resources availability:

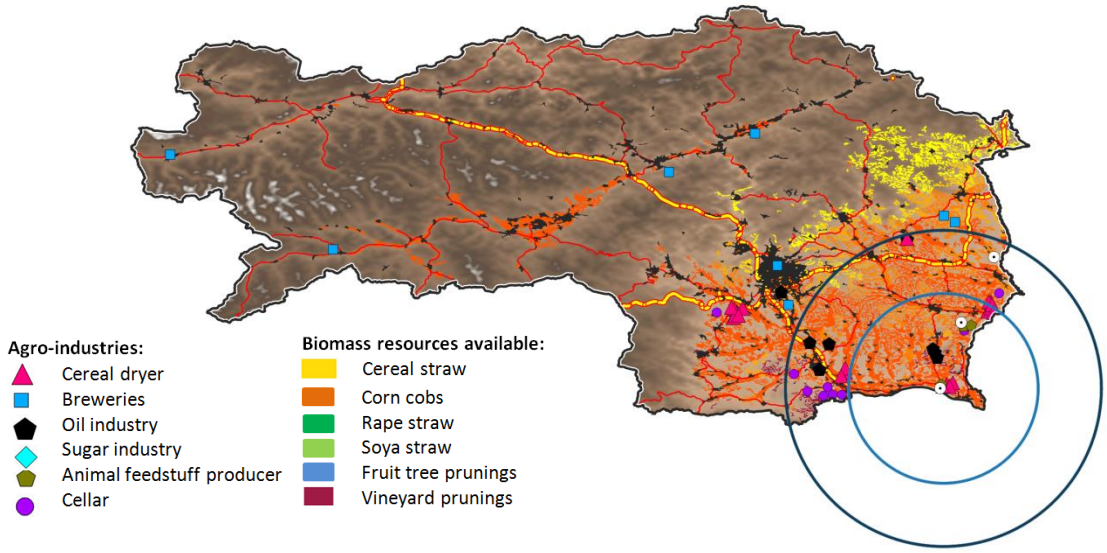

Figure 1: Resources around ALWERA AG (30 and 50 km radius)

Through its regular activity as an agro-industry, Alwera AG has annual access to 250 to 600 tons of corn cobs. Those corn cobs are a by-product of the corn seed drying activity. The company harvests the whole corn cob with seeds and dries both together in the drying boxes. After the drying process the cob and the seeds will be separated. Therefore Alwera AG has free, dry and loose corn cobs as a by-product of their regular activity available.

Additionally there are a lot of corn cobs available in the area around Donnersdorf. But just little of those are harvested at the moment. Most of them are left on the soil. However there is a small market were loose corn cobs can be bought and sold.

Furthermore, in the region there are large amounts of cereal straw and smaller amounts of soy and rape straw available. In order to further process the materials to thermal energy, the Alwera AG would need a pelletizer, which the company does not currently possess. For this reason, the residues mentioned above have not been considered in the study.

Also, in the area of Donnersdorf one will find considerable fruit and wine cultures, where tree and grapevine prunings accrue. However, no logistic harvesting technique has been developed for this type of residue and therefore prunings have not been considered for this study.

Table 2: Data on the available agricultural residues in a 30 km distance.

Type of residue	Quantity available t/yr	Moisture content w-% ar	Months of harvest	Purchasing price €/t
Corn cobs	27.150	20-35	Sept-Oct	40 (loose)
Cereal straw	6.300	15	July-Aug	70 (baled)
Soy straw	525	40	Sept-Oct	-
Rape straw	545	40	Juli-Aug	-
Fruit tree pruning	6.600	45	Feb-Mar	-
Vineyard pruning	1.800	45	Feb-Mar	-

3.1.2.2. Equipment and facilities available

As an agro-industry, the Alwera AG owns various kinds of equipment which can be used for a biomass logistic-centre. Alwera has sufficient drying capacity: The company owns several box dryers as well as a slanted floor dryer. The latter is currently used for the drying of corn grains. Additionally, for its current activities, the company is in possession of a weighbridge, which could facilitate the delivery and sale of agro fuels considerably.

The Alwera AG also has corn harvesting machinery. The company has worked on a specific harvesting method that allows the machine to harvest the whole corn cob with grains. The grains are not separated from the cob until the drying process is finished.

For the chipping of the cobs there is no equipment available at the agro-industry, but this pre-treatment could be done with a mobile chipper to be rented.

Considering the idle periods of the equipment available for the logistic centre and the months of production of the resources considered (**Table 3**), the production period is proposed to be in the months November to June.

Table 3: Seasonal availability of the biomass resources and the equipment.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Box dryer	x	x	x	x	x	x	x	x			x	x
Slanted floor dryer	x	x	x	x	x	x	x	x			x	x
RESOURCES												
Corn Cobs									x	x		

3.1.2.3. Bioenergy market potential

In the area up 30 km away from Alwera AG, 60 % of the heating demand is covered by solid biomass (forest biomass: chips, firewood or pellets), 30 % by oil and 10 % by electricity. The aim of the region is to substitute this 30 % oil with biomass but it is impossible with forest wood (they have to import a lot of wood chips from Romania, Hungary and Slovenia) so agrarian local biomass can be the key. The market is seasonal, 80% of the demand being from households and 20% from farms and industries.

It is expected that the main customers of the logistic centre will be farmers, which have on corn fields and use wood pellets for heating. They could bring their own corn cobs to the logistic centre, where they were processed to corn cob grits. The farmers can buy the grits back and use them for heating. Furthermore also private households currently using fossil fuels and wooden biomass are considered as possible target customers, as they get a quite cheap and local produced fuel from the logistic centre.

Here below is included a **Table 5** with the data of the competitors:

Table 4: Different types of solid biomass consumed in the area.

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Wood chips	72	0,018	≤ 3
Wood pellets A1	225	0,048	≤ 2

3.1.3. Feasibility of the new business line as agro-industry logistic centre

The company is interested in creating a biomass logistic-centre in order to produce and sell solid biomass fuels taking advantage of their own residues mainly. As already mentioned, at the Alwera AG between 250 and 600 t of corn cobs are available, depending on the number of contract fields.

At the moment those cobs are burned in industrial boilers for drying purposes. But as the cobs are too dry for industrial boilers, frequent irregularities and malfunctions are the consequence. But as the cobs are too dry for industrial boilers, frequent irrgeluarities and malfunctions are the consequence.

For this reason, it would be convenient that the dried cobs produced in the industrial facility are used to generate grits to sell in the market. In this case, the heating demands of the agro-industry would be covered with cobs with higher moisture content purchased in the market.

Two different scenarios were created, as shown below:

- Scenario 1: The first scenario takes only into consideration the corn cob which results from the own regular business activities of the company during contract harvesting. In this case the heat demand of the drying process is not covered with the own dry corn cobs. Corn cobs with higher moisture content are purchased in the market for this purpose. The purchasing cost of the new activity is therefore the cobs for heating. This scenario includes 3 sub-scenarios with varying annual amounts.
- Scenario 2: The second scenario can be seen as the extended version of scenario 1, in which additional corn cobs are purchased in the market, dried and turned into grits. In total, 1.600 t of grits should be produced annually. In this scenario, the purchased grits require a drying process.

None of these scenarios require investments, only renting cost of the chipper. The following **Table 5** presents the calculated production costs for each scenario. The purchasing costs are the same at each scenario as always fresh corn cobs will be bought on the market.

Table 5: Production costs of corn cob grits for each scenario.

Scenario	Produced quantity	Total costs			Production costs
		Purchasing costs	Processing costs	Personnel costs	
	t/yr	€/t	€/t	€/t	€/t
Scenario 1A	600	59,33	17,90	5,00	**82,24**
Scenario 1B	460	59,33	17,95	6,52	**83,81**
Scenario 1C	250	59,33	18,85	12,00	**89,99**
Scenario 2	1600	59,33	21,10	2,50	**82,93**

The distribution of the production costs can be observed in Figure 2.

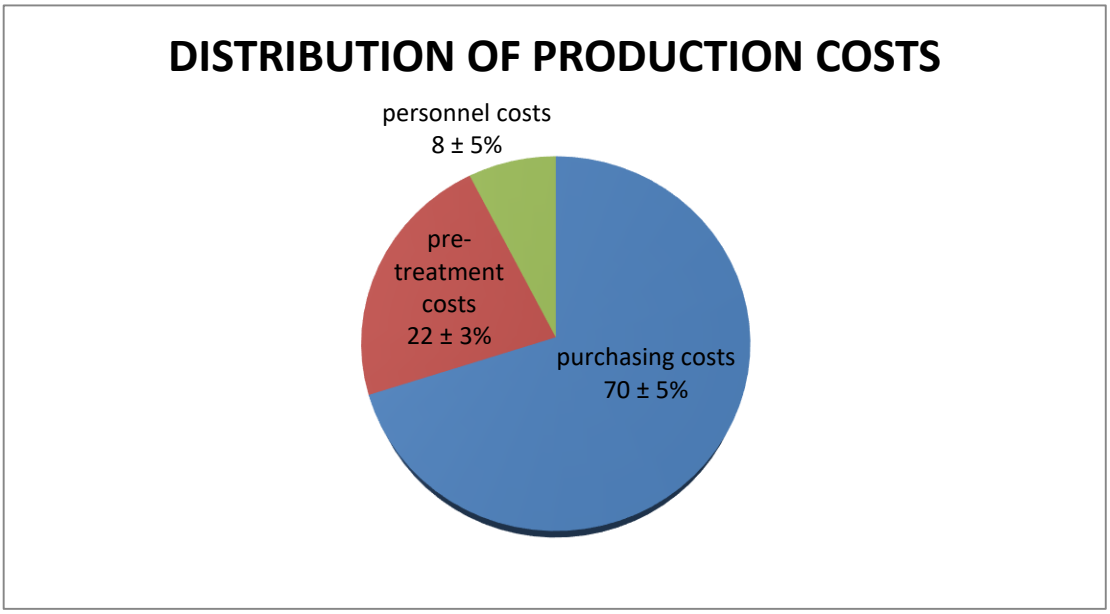

Figure 2: Allocation of average production costs for Alwera AG

The production costs of the corn cob grits are quite similar in each scenario. The expected market price of the grits is 135 €/t. Therefore the company should produce as much grits as possible, considering the demand from the customers. The market price of the grits is 3.2 c€ /kWh. Therefore they are considerably cheaper than the main competitor wood pellets, which cost at the moment 4,8 c€ /kWh. The content of ash (which is around 3 %, w-% db, according to bibliography) is higher than the wood products in the market and therefore presents a disadvantage to be solved increasing equipment maintenance.

3.1.4. Conclusions

The assessment of framework conditions (biomass resources and market) as well as operational conditions (equipment and management) provided the following results:

- The agrarian resources available for the biomass logistic centre are: cereal, soy and rapeseed straw, fruit tree and vineyard prunings as well as corn cobs. The latter represent the most interesting raw material amongst the ones mentioned above, as there is little competition with other uses, the logistics chain is already partially developed and further processing is possible in Alwera's existing plants.
- Farmers in possession of their own corn fields and who currently use wood chips for heating their houses and stables are expected to be the main consumers of biomass products. Also, households using woody pellets should be considered potential customers. Consequently, wood chips and wood pellets represent the most important competing products on the market.
- Regarding the equipment no further investments are required to develop the biomass logistic centre, since the company will be able to use its own drying plants (currently used for drying corn grains and pumpkins) as well as storage capacities, weighbridge and loader. For chipping of corn cobs in order to produce grits an external and mobile chipper will be rented.

The techno-economic feasibility study shows that corn cob grits can be produced in all scenarios examined below the market price in the area (135 €/t). Therefore, the company will be able to make a profit by selling corn cobs. Therefore the agro-industry should produce as much corn cobs as the market is able to absorb.

To conclude, it should be pointed out that the achievement of economic success is solely possible by using high-quality fuels. For this reason it is important to conduct a foregoing quality analysis (with due regard to moisture content, calorific value, ash content and chlorine concentration) of a representative sample of corn cobs, which will be used as a raw material in the biomass logistic centre.

3.1.5. Start-up support activities

In addition to carrying out the feasibility study, the SUCELLOG project also supports Alwera AG in the further development of a logistics center for agricultural residues. Therefore the most important needs have been identified, which are necessary for the construction. The SUCELLOG project supports the company in finding solutions for solving these needs.

The company is interested in the use of agricultural residues and in the production and sale of agricultural fuels. The residual corn cob should be the basis for these activities. The first goal of Alwera in the use of agrofuels is the self-consumption of corn cobs in the regular drying process. However, the cobs occurring in the regular operation are too dry for the company's industrial boiler, which is currently operated with wood chips.

For this purpose, either the boiler must be adapted in such a way that the dry cobs can be used or wet loose corn cobs must be purchased.

In addition to the own consumption of the corn cobs, the production of grits is also conceived, as long as a market and therefore enough customers are available. Therefore operations must be adapted. Additionally an external chipper must be organized for the corn cobs, since no own chipper is available.

The project SUCELLOG supported the Alwera AG in the solution of the above mentioned points. For the harvest season 2016, a solution was for the self-consumption of corn cobs was searched. Concrete activities for the production of corn-cob-grits are not conceived before 2017.

In order to ensure their own use of the corn cobs, a first step was to adapt the heating boiler for drying in such a way that the dry cobs can be used for this purpose. For this purpose, the SUCELLOG project has established contacts with various boiler experts. Their unanimous opinion, however, was that an economically sensible adaptation of the boiler to the dry spindle is not possible. The use would be associated with very high maintenance costs and a short boiler life.

Therefore, SUCELLOG has proposed to change the regular process so that the corn cob is no longer dried and wet cobs are available. However, this conversion would entail considerable costs in regular operations, which is why it was rejected by Alwera AG.

In a next step, Alwera talked with potential suppliers of wet corn cobs, and respectively with potential harvest logisticians.

Similarly, SUCELLOG project talked with farmers, about a possible delivery. In addition, the project has established a contact between Alwera and Tschiggerl Agrar. After it was planned initially to buy corn cobs at higher moisture content at Tschiggerl, the solution was found later that the cobs are exchanged. This results in a win-win situation for both companies. Alwera gets wet cobs, which can be used in their industrial boilers and Tschiggerl already gets dry cobs, which can be processed without drying to grits or pellets. At the beginning of October 2016, the cobs were exchanged. Since the middle of October, Alwera has been using the corn cob as a fuel for its own heat demand in the drying process.

3.2. Summary of the audit study to agro-industry Friedrich Rauer

3.2.1. Company description

Friedrich Rauer is the owner of an agro industry of the same name. The industry is situated in Bad Blumau, in Eastern Styria.

The company is a logistic operator in the corn, pumpkin and the runner bean domain. Since 2014, Friedrich Rauer processes and sells his products at his newly built site and sells them on the market. Through these regular production processes the company gains access to agrarian residues.

Rauer focuses on the following main activities:

- Corn harvest, treatment and trade:
  - Contract corn drying
  - Purchasing corn for farmers and selling it on the market
  - Contract harvest of corn as logistic operator
- Pumpkin and runner bean harvest, treatment and trade:
  - Harvest and drying of pumpkins and pumpkin seeds
- Bedding production and trade

The company is interested in finding a way to commercialize corn cobs. They already performed tests on switching from wood chips to using lose corn cobs for the drying process. Producing and selling agro-fuels is considered as a realistic option for the company.

3.2.2. Synergies to become an agro-industry logistic centre

3.2.2.1. Biomass resources availability:

As it can be observed in Figure 3 and Table 6, the main available resources are corn cobs.

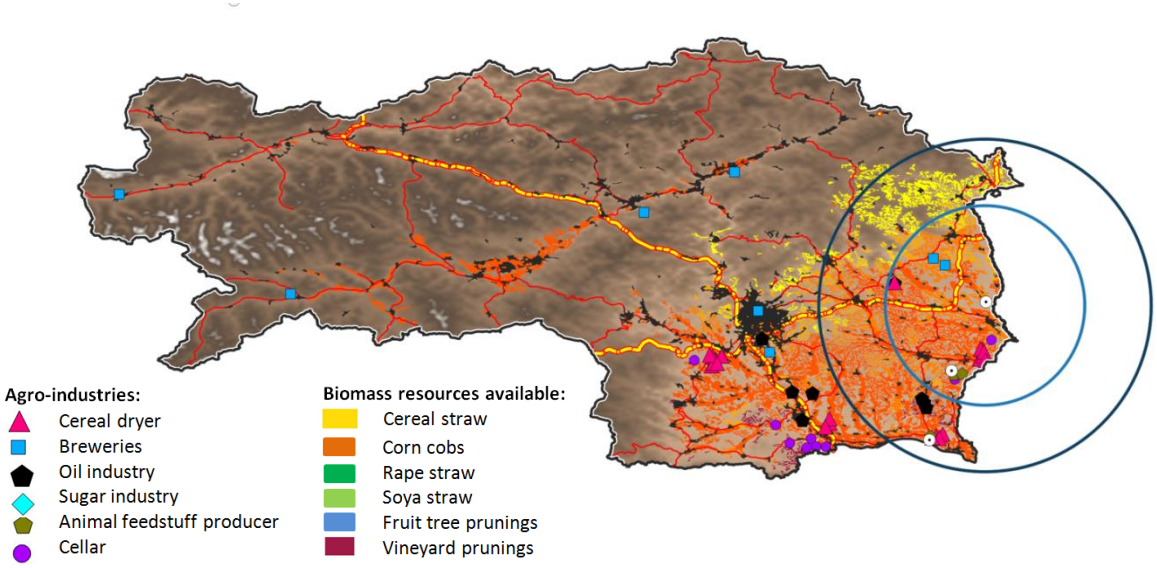

Figure 3: Resources around Bad Blumau (30 and 50 km radius)

Table 6: Data on the available agricultural residues in a 30 km distance.

Type of residue	Quantity available t/yr	Moisture content w-% ar	Months of harvest	Purchasing price (€/t)
Corn cobs	31.600	20-35	Sept-Oct	35 (loose)
Cereal straw	7.600	15	July-Aug	70 (baled)
Soy straw	625	40	Sept-Oct	-
Rape straw	650	40	July-Aug	-
Fruit tree pruning	590	45	Feb-Mar	-
Vineyard pruning	160	45	Feb-Mar	-

Additionally, in course of his regular business activity and especially by harvesting corn, Friedrich Rauer gains quite easy access to corn cobs. The company has purchased a harvesting machine, which allows Rauer to harvest corn grains and cobs in one step. In the region of Bad Blumau, corn cobs offer high potential, but up to this moment they have seldom been harvested, remaining on the soil. However, a small market has been developed in the last years, where lose corn cobs can be purchased and sold.

Furthermore, in the region there are quite large amounts of cereal straw and smaller amounts of soy and rape straw available. In order to further use these residues, the company would need a pelletizer, which Friedrich Rauer does not currently possess. For this reason, the residues mentioned above are not considered any further.

Also, in the area one will find smaller fruit and wine cultures producing wood prunings. These residues could be processed in Rauer's drying plant. However, at the moment no logistic harvesting technique has been developed for this type of residue and therefore have not been considered in the study.

3.2.2.2. Equipment and facilities available

The technical assessment will be performed based on the logistic components, which are available in the company and show the needs of the new business line. The logistic components include the following:

- Weighbridge
- Belt dryer
- Mill
- Storage Areas
- Harvesting Machine

Friedrich Rauer as an agro-industry owns different facilities and plants, which can be used for a biomass logistic-centre. For its current activities the company is in possession of a weighbridge, which would facilitates the delivery and sale of residues and agro fuels considerably. What is more, Rauer has sufficient drying capacity: his belt dryer is only used for 2 to 3 months per year. This burner of the belt dryer would be fed with loose cobs in order to decrease the consumption of wood chips which are purchased in the market.

In addition, the company owns a chipper, which can be used for chipping the corn cobs to be sold. Friedrich Rauer also possesses a corn harvest machine, which is capable of harvesting corn grains and cobs in one step.

Table 7: Seasonal availability of the biomass resources and the equipment.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Belt-dryer	x	x	x	x	x	x	x	x				x
Chipper	x	x	x	x	x	x	x	x				x
RESOURCES												
Corn Cobs									x	x		

The cobs that are harvested in September-October, can be used in the same facility in loose format for drying the corn in that period whereas the rest of the year the cobs can be sold in the market once dried and chipped into grits.

3.2.2.3. Bioenergy market potential

Within a radius of 30 km of the company, 50 % of the heating demand is supplied by solid biomass fuel (woody biomass: wood chips, firewood or pellets), 30 % by oil and 10% by electricity. The objective is to replace the use of fossil fuels with biomass. But it is not possible to supply the demand solely with firewood, as in this case large quantities would have to be imported from Rumania, Hungary and Slovenia. Fortunately, regional agrarian biomass could be the answer.

It is expected that the main customers of the logistic centre will be farmers, which have on corn fields. Most of these farmers currently use wood pellets or chips. In their boilers

they also could use corn cob grits. As the agro-industry has very good connections to local farms they are considered as the most promising customer group.

In the following **Table 8** the data of competitors is included:

Table 8: Different types of solid biomass consumed in the area.

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Wood Chips	72	0,018	≤ 3
Wood Pellets A1	225	0,048	≤ 2

3.2.3. Feasibility of the new business line as agro-industry logistic centre

The company is interested in creating a biomass logistic-centre in order to produce and sell solid biomass fuels. Friedrich Rauer would like to provide his dryer with corn cobs, requiring about 190 t/yr for this heating process. The burner owned by the company can work with loose cobs and for this reason no investment is foreseen.

Additionally, the company would like to produce grits for selling in the biomass market. Since the company also owns a harvest machine for corn cobs, Rauer expects to be able to purchase the residues at a convenient price. Also, most fields are located within 10 to 15 km, which keeps transport costs at a low level.

Three different scenarios have been considered, as shown below:

- Scenario 1A: 500 t/yr of corn cob grits are produced. The raw material will be purchased at prices indicated by the agro-industry owner.
- Scenario 1B: 500 t/yr of corn cob grits are produced. The raw material will be purchased at prices which have been calculated according to other agro-industries' experience.
- Scenario 2: 1000 t/yr of corn cob grits are produced. The raw material will be purchased at prices indicated by the agro-industry owner.
- Scenario 3: 1000 t/yr of corn cob grits and 500 t of corn cob pellets are produced. The raw material will be purchased at prices indicated by the agro-industry owner. This scenario requires an investment in a pelletizing line.

All scenarios consider that drying is performed with loose cobs purchased in the market. The following

Table 9 indicates the minimum selling at which all costs of raw material purchase, production, transport as well as investment are covered. A risk margin has also taken into account in this price.

Table 9. Minimum selling price

Scenario	Quantity produced	Minimum selling price
	t/yr	€/t
Scenario 1A	500	**96,26**
Scenario 1B	500	**107,18**
Scenario 2	1000	**90,90**
Scenario 3:		
Grits	1000	**88,04**
Pellets	500	**189,09**

The distribution of costs is shown in Figure 4.

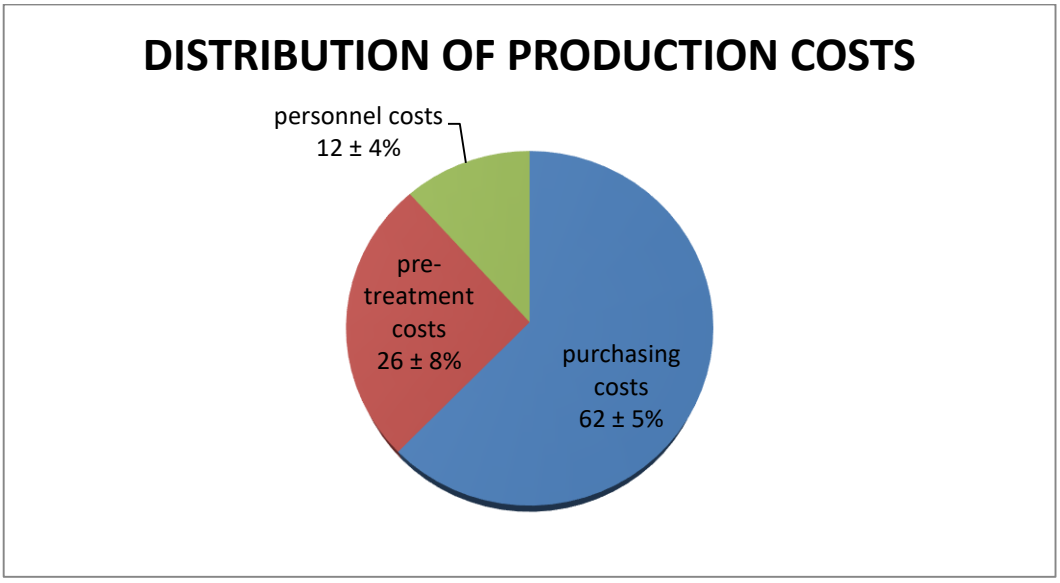

Figure 4: Allocation of average production costs for Rauer

The figure above shows the distribution of the production costs of the agro-industry Rauer. The costs are quite similar in all scenarios. The biggest difference can be seen in scenario 3. Through the production of pellets are the pre-treatment costs much higher.

Comparing the 2 type of products, the most promising one resulting from the study is the corn cob grits. The expected market price of this grits is 135 €/t. Therefore, the company should produce as much grits as possible, considering the demand from the customers. The expected market price of corn cob pellets is about 185 €. This price covers the purchasing, production and transport costs, but not fully covers the risk margin stated by the agro-industry. Therefore, the investment in a pelletizing line would be a risk for the company.

The main competitors for grits are wood pellets and chips. The current market price for wood pellets in the area of the agro-industry is 4.8 c€/kWh. The price for wood chips is 1.8 c€/kWh while the price for corn cob grits is 3.2 c€/kWh. It is clear that the grits are highly competitive against wood pellets. In comparison with wood chips at a first

sight, it seems that grits are not competitive in the market, but it should be highlighted that the cob suppliers are the same than the cob consumers. This target segment should understand the savings that they would have in their facilities due to the fact that a new business line has been built around their residues that previously were left on the soil. Furthermore, the boiler technology necessary for grits is much cheaper than wood chip boilers. This cost advantage in the investment could outweigh the more expensive fuel costs.

The ash content of the corn cob products is higher compared to the current products in the market, which is a risk to be considered when marketing the product.

3.2.4. Conclusions

The assessment of framework conditions (biomass resources and market) as well as operational conditions (equipment and management) provided the following results:

- The agrarian resources available for the biomass logistic-centre are: cereal, soy and rapeseed straw, fruit tree and vineyard prunings as well as corn cobs. The latter represent the most interesting raw material amongst the ones mentioned above, as there is only very little raw material competition, the logistics chain is already partially developed and further processing is possible in Rauer's existing plants.
- Farmers in possession of their own corn fields and who currently use wood chips for heating their houses and stables are expected to be the main consumers of biomass products.
- The production of corn cob grits does not require any further investment, since the company will be able to use its own drying plant (currently used for drying corn grains and pumpkins) as well as their chipper, the storage capacities, weighbridge and loader for the biomass logistic-centre.
- The production of agro-pellets does require the acquisition of a pelletising plant. This investment can yield a profit, but would also entail significant levels of risk.

The techno-economic feasibility study shows that corn cob grits can be produced in all scenarios examined offering a competitive price in the current market. Therefore, the company will be able to make a profit by selling corn cobs. As profits increase with the number of units sold, higher amounts of grits as possible should be produced and sold. In reality, the quantity depends on customer's demand.

In spite of the investment in a pelletising plant, corn cob pellets can be produced profitably. Unfortunately, the profit margin is very low and highly sensitive to small changes in prices of raw materials, production or competing products. Furthermore, the customer demand has to be taken into account by all means. In case slightly fewer pellets are sold than expected, the production would not be economically feasible.

To conclude, it should be pointed out that the achievement of economic success is solely possible by using high-quality fuels. This is important especially for corn cob

pellets: In case the pellets cannot meet the chlorine content as stipulated by the quality standard ISO 17225-6 class A, the company will not make any profits. For this reason it is important to conduct a foregoing quality analysis (with due regard to moisture content, calorific value, ash content and chlorine concentration) of a representative sample of corn cobs, which will be used as a raw material in the biomass logistic centre. Previous tests in the equipment of potential customers would help to ensure their satisfaction.

3.2.5. Start-up support activities

In addition to carrying out the feasibility study, the SUCELLOG project also supports the agrarian company Rauer in the further development of a logistics center for agricultural residues. Therefore the most important needs have been identified, which are necessary for the construction. The SUCELLOG project supports the company in finding solutions for solving these needs.

The first goal of the company is the supply of the own regular drying operation with corn cobs. As Mr. Rauer has a harvesting machine for corn cobs, the raw material supply is given. However, the existing wood chip boiler has to be adapted for the use of corn cobs. There is still too little know-how about this use of residual material in operation. Likewise, Rauer can imagine producing corn cob grits as well. For this purpose the drying and chipping should be adapted. The most important requirement for Rauer is, however, the existance of a sales market.

The project SUCELLOG supports the agrarian company in the implementation of the self-supply and for marketing. In order to ensure their own use of the corn cobs, the general information on the properties and the quality of corn cobs as fuel was passed on to the company. The SUCELLOG project has also established contacts with various boiler experts in order to inform the company about the necessary adaptations to the existing boiler. Information about the sharing of corn cobs and wood chips was also given. In addition, the contact to the logistics center Tschiggerl was established, in order to profit from their knowledge of using own corn cobs and about the sales market. Additionally a contact to the biomass logstic center in Fürstenfeld was established to find a sales market. This biomass logistic center might possibly be able to offer the corn cob products of Rauer for sale.

3.3. Summary of the audit study to LW Genossenschaft Klagenfurt, St. Veit, Rosental

3.3.1. Company description

The Agricultural cooperative Klagenfurt St. Veit Rosental (Landwirtschaftliche Genossenschaft Klagenfurt St. Veit Rosental) is a cooperative with different business activities. The main location is in Klagenfurt , but there are also branches in other locations.

One important business activity is the trade in agricultural inputs. However, the cooperative is also an essential partner for the farmers in the sale of grain and corn. For this business activity, the cooperative has a grain drying plant and storage capacities. The grain drying plant is currently operated with fuel oil, but they would be interested in the future, to operate the drying plant with their own residues. They are planing a new location in Blintendorf for a new grain drying plant. In SUCELLOG feasibility study the new location was analised to get information if the production of corn cob grits and the creation of a logistic centre is feasible.

3.3.2. Synergies to become an agro-industry logistic centre

3.3.2.1. Biomass resources availability:

The type of resources available in the area can be observed in the next Figure 5.

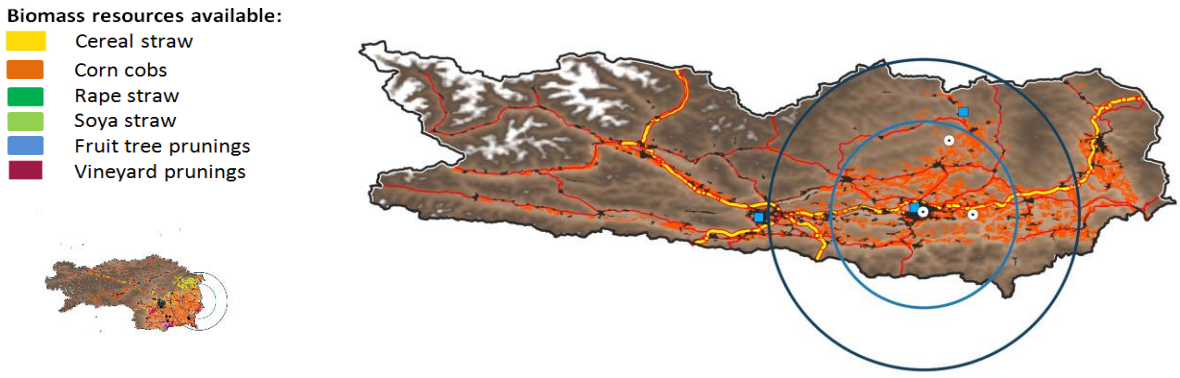

Figure 5: Biomass resources in Carinthia (30 and 50 km radius from Klagenfurt)

The cooperative has among its members and cooperating farmers large extensions of fields producing of grain and corn, and would therefore have a good access to plant residues. Approximately 70 % of land within 35 km are owned by farmers who have a business relationship with the cooperative. At present plant residues are cereal straw, corn cobs, soy straw and rape straw. However, some of these residues are hitherto used for other purposes: cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable lands.

Table 10: Data on the existing agricultural residues in a 30 km distance.

Type of residue	Quantity available t/yr	Moisture content w-% ar	Months of harvest	Purchasing price €/t
Cereal straw	5.501	15	July-Aug	75 (baled)
Corn cobs	11.514	20-35	Sept-Oct	40 (loose)
Soy straw	1.378	40	Sept-Oct	-
Rape straw	27	40	July-Aug	-

The most interesting plant residue is corn cob. For using the other plant residues (soy and rape straw) as solid biofuel it is needed a pelletizer. The Landwirtschaftliche Genossenschaft Klagenfurt doesn´t have a pelletizer and an investment at the moment is not forseen. Because of this, as a first approach the other plant residues have not been considered in the feasibility study and only corn cobs will be taken into account. As said previously, cobs will be used to cover their own heating demands and produce a solid biofuel to be sold in the market.

3.3.2.2. Equipment and facilities available

The cooperative possess a grain drying system composed by a belt dryer, a weighbridge and a storage place, which could be used for the logistic centre.

There is no equipment at the agro-industry for chipping of the cobs into grits but it would be rented.

As can be seen from the following Table 11 the drying facility idle period is from January to June, in September and December. The operational period for the proposed logistic centre would be from December on. Meanwhile the cobs would be stored under roof, drying naturally.

Table 11: Idle period of the equipment and availability of the resources

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Belt dryer	x	x	x	x	x	x			x			x
RESOURCES												
Corn cobs										x	x	

3.3.2.3. Bioenergy market potential

In Carinthia 54 % of the heating demand is covered by solid biomass (forest biomass: chips, firewood and pellets), 7 % by electricity and 39 % by oil and gas. The aim of the region is to substitute the fossil energy sources by renewable energy sources. Most important in Carinthia is the wood biomass but possible is also the using of plant residues.

The type of solid biomass in the market of the region and their characteristics are the ones included in the following Table 12:

Table 12: Data of the competitors

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Wood chips	72	0,018	≤ 3
Wood pellets A1	225	0,048	≤ 2

The potential consumer group of the proposed biomass logistic centre are farmers which manage their own corn fields and currently heat their houses and barns with wood chips. However, also the households which currently use wood pellets or fossil fuels, considered as potential new customers when they get by the biomass centre an access to cheaper and regionally produced biomass fuel.

3.3.3. Feasibility of the new business line as agro-industry logistic centre

The Landwirtschaftliche Genossenschaft Klagenfurt is interested to start a new business line as agro industry logistic centre. They will produce 500 t/yr of corn cob grits and therefore 583 t/yr of corn cobs are required and will be purchased to farmers. The cobs will be dried in the existing belt drier and chopped by the rented machinery.

In Table 13, the calculation of the production costs can be observed:

Table 13: Calculated production costs

	Production quantity	Total costs			Production costs
		Raw material purchasing costs	Pre-treatment costs	Personnel costs	
	t/yr	€/t	€/t	€/t	€/t
Conr cob grits	500	59,33	25,47	12,00	**96,80**

According to the study, the production cost rise up to 97 €/t. However, the minimal selling price stated by the company for the corn cob grits has been 125 €/t (3 c€ /kWh). Therefore they are considerably cheaper than the main competitor, the wood pellets, which cost at the moment 4.8 c€ /kWh. The content of ash (which is around 3 %, w-% db, according to bibliography) is higher than the wood products in the market and for that reason the price offered is more competitive.

In comparison to wood chips, the grits are slightly higher in price. An aggressive marketing policy, highlighting the fact that the logistics centre is offering an indigenous product, in contrast to imported wood from Eastern countries, should be carry out.

In any case, corn farmers who are consumers of biomass (both wood chips and wood pellets) should also consider that the marketing of grits generate an income also to them, so in turn their expenses on their fuel would be reduced considerably.

The main risk of the proposed business line is the fact that corn cob grits are new product and the standard heating systems should be tested in order to ensure the

correct performance. Quality guarantees should be therefore offered by the agro-industry.

3.3.4. Conclusions

The assessment of conditions (biomass resources and biomass market) and operational conditions (equipment and management) have shown following conclusions:

- The resources available for the biomass residues include: cereals, soya and rape straw and corn cobs. The corn cob is the most interesting raw material of the above, because there is very few competition in its use, the logistics is already partially established and a processing with the existing systems is possible.
- A belt dryer for grain and corn can be used in the production period for drying the corn cobs. The storage capacity, weighbridge and other equipment for the biomass plant are available. For the chipping of the cobs there is no equipment at the agro-industry available, but the chipping could be done with a rented mobile chipper.
- It is expected that the main consumers of biomass products will be farmers which own cornfields and currently use wood chips to heat their houses and barns. Also households which use wood pellets are considered as potential consumers. Wood chips and wood pellets thus provide the most competitive products on the market.
- The price of the product is competitive, but there are many risks to get in the market. The main is that corn cob grits are new product and for that reason quality guarantees should be given to consumers. It is also recommended to test the product in regular combustion equipment existing in the area in order to ensure the correct performance.

3.3.5. Start-up support activities

In addition to carrying out the feasibility study, the SUCELLOG project also supports the agricultural cooperation Klagenfurt St.Veit Rosental in the further development of a logistics center for agricultural residues. Therefore the most important needs have been identified, which are necessary for the construction. The SUCELLOG project supports the company in finding solutions for solving these needs.

The company is principally interested in opening up a logistics center for agricultural fuels. In the field of agrofuels, the focus will be on corn cobs. The cooperative has a very good sales network with some sales outlets, which can be reached especially from small and medium-sized customers, such as households, farms or heating plants. If there is demand for fuels out of corn cobs from these customers, the cooperative can also reach them. However, a fuel must be produced according to customer and quality requirements. For production, however, it is first necessary to establish a logistics chain

for the harvesting of corn cobs, since these are not harvested in the region of the cooperative. Furthermore, one has to worry about the shredding of the spindles. There is no machine at Blintendorf, but the cooperative has the necessary equipment at other sites. In addition, the cooperative is considering the conversion of heat generation for dryer at other plant sites from oil to corn cobs. However, the company has no experience in this field.

The project SUCELLOG supported the cooperative mainly in the construction of a logistic chain. In a first step, information on the different possibilities and the costs of the corn cob harvesting was forwarded to the company. In addition, discussions with several corn-cob-harvest-logistics-companies from the region about the possibility of harvesting corn cobs were made. A contact was also established with the company Tschiggerl Agrar, so that the cooperative could exchange information with the latter about its development of the logistics chain and the harvesting system.

In a further step, the project has forwarded information on industrial heating boilers, which can be fired with corn cobs to initiate a possible use of corn cobs for drying. In this case, experiences with regard to maintenance, dust filtration and ash disposal were exchanged. The cooperative has also been informed about the applicable emission regulation for such boilers.

3.4. Summary of the auditing study of Agro Entrepreneur Rainer

3.4.1. Company description

The agro-industry Rainer is a producer of corn, cereals as well as a provider of logistic services. One important business activity is the trade of agricultural products. For this business activity, the cooperative has a grain drying plant and storage capacities. Drying is also available for other companies as a service.The grain drying plant is currently operated with wood chips, but they would be interested in the future, to operate the drying plant with corn cobs.

3.4.2. Synergies to become an agro-industry logistic centre

3.4.2.1. Biomass resources availability:

The Agro entrepeneur Rainer is interested to become a biomass logistic centre to take advantage of their own residues. The type of resources available in the area can be observed in the next figure.

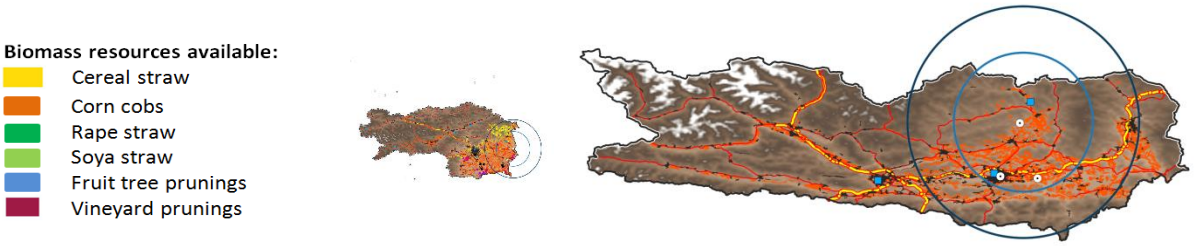

Figure 6: Biomass resources in Carinthia (30 and 50 km radius from Mölbling)

In the region there are many farmers which are cooperating with Rainer. Because of this he has a good availability to plant residues. At present plant resources are cereal straw, corn cobs, soy straw and rape straw. However the resources are hitherto used for other purposes: Cereal straw is used as bedding for animals and corn stover remains an important fertilizer and humus supplier on arable lands. Soy and rape straw are normally processed to animal feedstuff in small amounts.

Table 14: Data on the existing agricultural residues in a 30 km distance.

Type of residue	Quantity available t/yr	Moisture content w-% ar	Months of harvest	Purchasing price (€/t)
Cereal straw	4.833	15	July-Aug	75 (baled)
Corn cobs	10.257	20-35	Sept-Oct	40 (loose)
Soy straw	1.237	40	Sept-Oct	-
Rape straw	35	40	July-Aug	-

The most interesting plant resource is corn cob, but the agro-industry has to buy this resource as they do not have a harvesting equipment. For using the other plant resources (soy an rape straw) as solid biofuel, it is needed a pelletizer. The Agro entrepeneur Rainer doesn´t have a pelletizer and an investment at the moment is not forseen. Because of this, the other plant residues (rape and soy straw) have not been considered in the feasibility study.

3.4.2.2. Equipment and facilities available

The Agro entrepreneur Rainer possess a grain drying system composed by a drum dryer, a weighbridge and storage place which could be used by the logistic centre.

In the Table 15, it can be seen that the drying facility idle period is from January to June, as well as September and December. However, the cobs are produced in October and November. The operational period for the proposed logistic centre would be from December on, therefore the cobs should be stored and dried naturally until that moment. .

Table 15: Idle period of the equipment and availability of the resources.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drum dryer	x	x	x	x	x	x			x			x

RESOURCES												
Corn cobs										x	x	

There is no equipment at the agro entrepreneur for chipping of the cobs into grits but it would be rented.

3.4.2.3. Bioenergy market potential

In Carinthia, 54 % of the heating demand is covered by solid biomass (forest biomass: chips, firewood and pellets), 7 % by electricity and 39 % by oil and gas. The aim of the region is to substitute the fossil energy sources by renewable energy sources. The most important solid biomass in Carinthia is the wood biomass but possible is also the using of plant residues like cobs.

The type of solid biomass in the market of the region and their characteristics are included in the Table 3:

Table 16: Data of the competitors

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Wood chips	72	0,018	≤ 3

Wood pellets A1	225	0,048	≤ 2

The potential consumer group of biomass logistic centre are farmers which manage their own corn fields and currently heat their houses and barns with wood chips. However, also the households which currently use wood pellets or fossil fuels, are considered as potential new customers since, by the implementation of the logistic centre, they could have access to cheaper and regionally produced biomass fuel.

3.4.3. Feasibility of the new business line as agro-industry logistic centre

The Agro entrepreneur Rainer is interested to start a new business line as agro industry logistic centre. He plans to produce 250 t/yr of corn cob grits, targeting farmers as final customer. For the production of this amount 297 t/yr of fresh harvested corn cobs are required.

Currently, the drum dryer uses 200 t of wood chips to dry the corn grains. In future they will use 230 t corn cobs. The calculation of the heating costs savings by using corn cobs we see in the Table 17:

Table 17: Heating cost savings by using corn cobs

	tons	**Price in €**	**Euro**
Cost of woodchips	200,00	72	14.400,00
Cost of corn cobs	230,00	50	11.500,00
Yearly heating costs savings			**2.900,00**
additional maintenance costs			2.000,00
Yearly costs savings			**900,00**

In the Table 18 the calculation of the production costs can be observed:

Table 18: Calculated production costs

	Production quantity	**Total costs**			**Production costs**
		Raw material purchasing costs	**Pre-treatment costs**	**Personnel costs**	
	t/yr	€/t	€/t	€/t	€/t
Szenario	250	59,33	23,88	13,44	**96,65**

The production costs of the corn cob grits are 97 €/t. However, the minimal selling price stated by the agro entrepreneur for the corn cob grits has been 135 €/t (3.2 c€/kWh). Therefore they are considerably cheaper than the main competitor, wood pellets, which

cost at the moment 4.8 c€/ kWh. The content of the ash (which is around 3 %, w-% db, according to bibliography) is higher than the wood products in the market and for that the reason the price offered is more competitive.

But there are many risks to get in the market. The main is that corn cob grits are new product and by the standard heating systems they cannot be directly used. At the initial phase we have to expect additional persuasion, these costs are not included in this calculation.

3.4.4. Conclusions

The assessment of conditions (biomass resources and biomass market) and operational conditions (equipment and management) have shown following conclusions:

- The resources existing for the biomass residues include: cereals, soy, rape straw and corn cobs. The corn cob is the most interesting raw material of the above, because there is the slightest competition for other markets, the logistics is already partially established and a processing with the existing systems is possible.
- A drum dryer for grain and corn can be used in the production period for drying the corn cobs. The storage capacity, weighbridge and other equipment for the biomass plant are available. For the chipping of the cobs there is no equipment at the agro entrepreneur available, but the chipping could be done with a rented mobile chipper.
- It is expected that the main consumers of biomass products will be farmers which own cornfields and currently use wood chips to heat their houses and barns. Also households which use wood pellets are considered as potential consumers. Wood chips and wood pellets thus provide the most competitive products on the market.
- The price of the product is competitive, but there are many risks to get in the market. The main risk is that corn cob grits are new product and for that reason quality guarantees should be given to consumers. For this reason, it is recommended to test the product in regular combustion equipment existing in the region in order to ensure the correct performance.

3.4.5. Start-up support activities

In addition to carrying out the feasibility study, the SUCELLOG project also supports the company Rainer in the further development of a logistics center for agricultural residues. Therefore the most important needs have been identified, which are necessary for the construction. The SUCELLOG project supports the company in finding solutions for solving these needs.

The company is principally interested in opening up a logistics center for agricultural fuels. In the field of agrofuels, the focus will be on the corn cobs. The biggest question

still to be clarified in this field is the harvesting logistic in the region of the company Rainer. In this region, there are sufficient corn cobs as a by-product of the corn harvest activity, but these are not harvested. Currently, there are no machines in the region that can be used to harvest the cobs. Therefore, building a logistics chain is the ultimate goal. Likewise, the company has to think about solutions for chipping.

The SUCELLOG project supported the agricultural company Rainer in setting up a logistics chain. In a first step, information on the different possibilities and the costs of the corn cob harvesting was forwarded to the company. A contact was also established with Tschiggerl Agrar to enable Rainer to exchange information with the latter about the development of the logistics chain and the harvesting system. In addition, information on different chipping systems was forwarded and a contact was established with companies which could possibly take over the chipping. In addition, the project SUCELLOG provided information on the costs of a mill for purchase.

3.5. Summary of the auditing study of Agro Entrepreneur Mayrhofer

3.5.1. Company description

The Mayrhofer family owns a farm since many generations. This farm is located in Upper Austria in the district of Kirchdorf. Since years they are working as an agro-industry. The farm is an agricultural and forestry family farm. The main crops are maize, rape and various types of cereals. Forestry is also an important part of the farm. In addition to the sale of wood, there is a small sawmill on the farm, where a part of its own wood is converted into lumber and sold to end customers. Wood which is not suitable for the sawmill industry, are further processed into wood chips and sold to customers. Furthermore grain and wood chips are dried at the plant with the same equipment. Agricultural residues are not yet used but he would like to study this option. Through its regular production processes, Mayrhofer has access to agricultural residues.

3.5.2. Synergies to become an agro-industry logistic centre

3.5.2.1. Biomass resources availability:

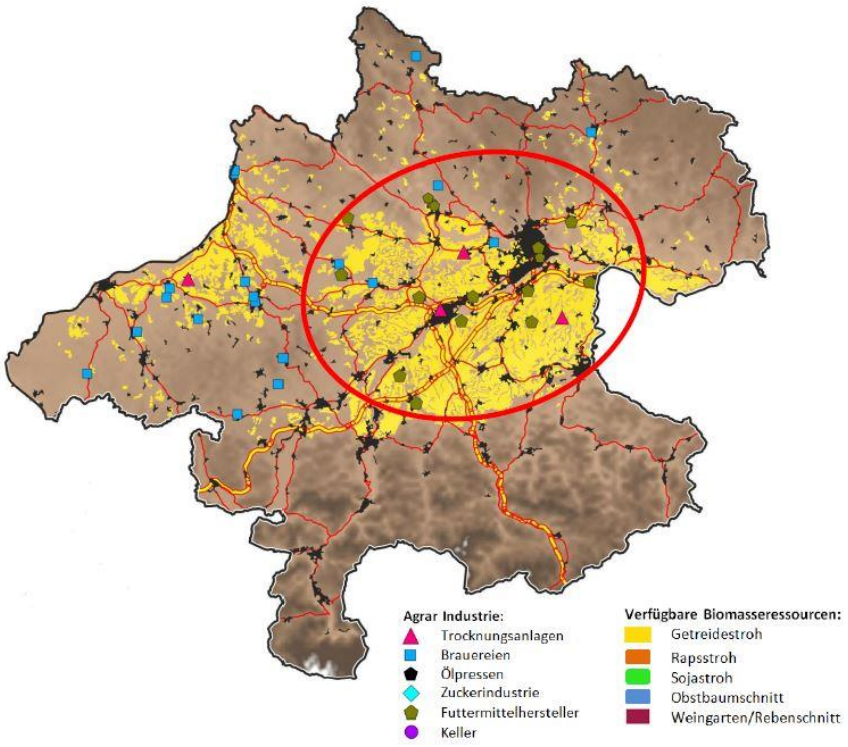

Figure 7: Types of resources available within 30 km.

Main available biomass resources (including their water content, harvest months and purchase prices excluding transport costs) can be read from the following table.

Table 19: Data on available agricultural residues within 30km

Type of residue	Quantity available t/yr	Moisture content w-% ar	Months of harvest	Purchasing price €/t
Corn cobs	20.765	20-35	Sept-Okt	
Cereal straw	31.950	15	Juli-Aug	70 (baled)
Soy straw	5.131	40	Sept-Oct	
Rape straw	5.904	40	Juli-Aug	
Fruit tree pruning	0	45	Feb-Mar	
Vineyard pruning	0	45	Feb-Mar	

The main crops of the fields are grain and corn. The cereal straw is partly used for cattle and mainly left on the soil. The corn is mostly threshed. So far there is no market in the region where loose corn cobs can be bought and sold.

An interesting alternative are soybeans and rapeseed straw which currently remain predominantly on the field, but there are certain amounts of those resources in the region. However, for further processing into an agro-fuel needs a pelletisation, and Mayrhofer does not have equipment for this process. Therefore, these residues are not considered.

In the region around Nussbach there are no fruit and wine cultures in which trees or pruning are produced. These residues are therefore not considered in this audit.

3.5.2.2. Equipment and facilities available

Mayrhofer has an agricultural and forestry farm with different types of inventory and equipment, which can be used for the logistics center.

To dry the raw materials, it is currently used the set dryer with oblique hole rust from the company Cona. This is mainly driven by solar heat. But there is also the possibility to operate the dryer through a wood chip boiler. A new acquisition is a mobile trailer dryer. This also has a wide field of application. Furthermore, Mayerhofer has over the winter months free drying capacities and also storage space for the products.

Table 20: Idle period of the equipment and availability of the resources.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Set dryer with oblique hole rust	x	x									x	x
mobile trailer dryer	x	x	x	x							x	x

RESOURCES												
Corn cobs										x	x	

There is no equipment at the agro entrepreneur for chipping of the cobs into grits but it would be rented.

3.5.2.3. Bioenergy market potential

In Upper Austria, the heating demand in the residential sector is covered by 28 % district heating (large part, renewable district heating), 22 % biomass solid fuels (wood biomass: wood chips, firewood or pellets), 17 % of oil and 17 % covered by natural gas. The goal is to replace those about 17 % covered by oil through biomass and reduce the share of natural gas also in the long term. However, it is difficult to meet this demand alone through forest wood, as this further timber mobilization would take place or wood would have to be imported. For this reason, regional agricultural biomass could be the solution. On the seasonal market constitute 80 % of the demand households, while the remaining 20 % of farms and industry exist.

The type of solid biomass in the market of the region and their characteristics are included in the Table 3:

Table 21: Data of the competitors

Type of residue	Price		Ash content
	€/t	€/kWh	w-% db
Wood chips, low Quality	72	0,018	≤ 3
Wood chips, high Quality	110	0,028	≤ 2
Wood pellets A1	225	0,048	≤ 2

3.5.3. Feasibility of the new business line as agro-industry logistic centre

Burning corn cobs in conventional biomass boilers can lead to problems. Corn cobs have a lower ash melting point than wood chips. The boiler must be converted for that fuel. One way to prevent this, is the addition of wood chips to cobs. Experiments have shown that an admixture of 20 % is possible without problems. In larger biomass boilers (starting about 1 MW) and higher blends of up to 40 % by slightly changing the combustion parameters without any problems is possible.

Due to the amount currently sold to wood chips and an admixture of 20 to 40% it would be possible to sold about 50 to 200 tons corn cobs annually.

Table 22: Produced products

Type of fuel	Production amount t/yr
Corn Cobs for mixture	50-200

Two scenarios were considered. In both scenarios it is assumed that the fresh corn cobs are available on the market since there are companies which harvest the cobs.

• Scenario 1: The corn cobs are purchased on the market, with the existing drying capacity it will be possible to dry every year 50 tons.

• Scenario 2: The corn cobs are purchased on the market. There are annually 200 tons dried. For this additional amount a hanger dryer is purchased.

In the table 5 the calculation of the production costs can be observed:

Table 23: Calculated production costs

Scenario	Produced quantity	Production costs costs			Transport costs	Depreciation	Total costs
		Purchasing costs	Processing costs	Personal-costs			
	t/yr	€/t	€/t	€/t	€/t	€/t	€/t
Scenario 1	50	68,40	8	5	5	0	86,40
Scenario 2	200	68,40	8	5	5	4	90,40

The price for the mixture of corn cobs and wood chips with the expected Quality will be 105 € per ton. In this table, it can be easily seen that the production of wood chips from roadside can be feasible, but the final product has to be of high quality. In comparison to low quality chips, the production prices are not feasible. Furthermore the cost of the investment has to be kept in mind.

3.5.4. Conclusions

Farm Mayrhofer is already a flagship company, operating both in the agriculture as well as in the forestry area. The use of corn cobs would fit well into the concept.

The assessment of the basic conditions (biomass resources and market) as well as operational conditions (equipment and management) has shown:

- The agricultural residues theoretically available for the biomass farm include: cereal, soya and rape straw and corn cobs. Corn cobs represent the most interesting raw material of the above since there is no market competition and the pre-treatment costs are lower. Additionally, its removal from the fields leads to advantages in agriculture. Processing with the existing systems of Mayrhofer is possible.
- It is expected that the main consumers of the biomass products will be heating plants and farmers who use wood chips for heating the heating plant or their houses and stables. Wood chips and wood pellets therefore represent the most important competing products on the market.

- In the first step, no investments are to be made for equipment and machines, as the company can use its drying plants (currently for drying wood chips and grain) as well as storage capacities and loaders for the biomass farm.

The technically feasibility study has shown that corn cobs and a mixture of corn cobs with wood chips can be produced at a market price or slightly below it in all scenarios. In real operation, the volumes will mainly depend on the demand from the customers as well as on the availability of the raw material.

However, a sticking point is the harvest of corn cobs themselves. In this region there are no vendors and little experience. The assumed rates are based on other regions or to studies that have been created on this topic. But logistic companies are interested in harvesting the corn cobs, if there is a reasonable demand. The prices for the product itself, harvesting and transport are therefore most likely still subject to fluctuations. Before it comes to invest in this sector, intensive discussions and a detailed cost accounting must be made here, in any case again.

In conclusion, it must be pointed out that an economically successful operation is only possible with high quality fuels. Therefore, a prior quality analysis (in particular the determination of water content, calorific value, ash content and chlorine content) of a representative sample of the corn cobs used as a raw material for the biomass farm is strictly recommended. This analysis should be carried out before the biomass farm is built. Also combustion experiments with the respective target boilers represent a good way to test the product (for example, evaluation based on slag formation).

3.5.5. Start-up support activities

In addition to carrying out the feasibility study, the SUCELLOG project also supports Mayrhofer in the further development of a logistics center for agricultural residues. Therefore the most important needs have been identified, which are necessary for the construction. The SUCELLOG project supports the company in finding solutions for solving these needs.

The company is principally interested in opening up a combined logistics center, where both woody and agricultural fuels are produced and sold. In the field of agrofuels, the focus will be on the corn cobs. The biggest question still to be clarified in the field is the harvesting logistic in the region of the company Mayrhofer. Currently the corn cobs are left on the field. Harvesting companies do not have the machinery to harvest the corn cobs. In order to ensure the establishment of such a logistic chain, there must be a corresponding demand for these products. Therefore, in a first step especially larger customers like heating plants, industry and agrarian companies need to be convinced.

In order to build up a logistics chain, the project supported the company in a first step, in sharing information about various corn-cobs-harvesting-systems with Mayrhofer. Additionally a contact with Tschiggerl Agrar was established to enable the exchange of information about their harvesting system and raw material logistics.

Since Mayrhofer regularly operates in the production of wood fuels, the company is hardly connected to the agricultural sector. Therefore, in a next step, contacts were established with Upper Austrian maize harvesting companies. These were used to discuss the possibility of corn cob harvesting, as well as the delivery of these.

However, the interest of the companies in the conversion of their harvesting machines is not available without the fixed acceptance of larger quantities. This is why Mayrhofer is looking for potential customers such as heating plants or industrial companies in order to sell larger quantities. The project also supports the company in these steps. For example, Mayrhofer was informed about the fuel properties and quality as well as the current market prices of corn cobs. This allows Mayrhofer a better approach to potential customers.

3.6. Summary of the auditing study of BIOS 1

3.6.1. Company description

BIOS 1 is a local green power producer (biogas plant) and a disposal company. The company is located in Lower Austria in Untergrafendorf.

The company was founded 1995. And has at the moment 17 employees. In addition to the biogas plant, farming is also carried out. Also is Mr. Schmied is the owner and manager of 20 hectares of farmland.

Figure 8: Location BIOS 1 GmbH Untergrafendorf (Quelle: Google Maps)

7000 tons of organic waste are collected annually. The biogas manure is sufficient to fertilize 280 hectares of farmland. Further the company dries different wet raw material for farmers.

3.6.2. Synergies to become an agro-industry logistic centre

3.6.2.1. Biomass resources availability:

The following maps shows the type of resources and agro-industries in the area of the agro-industry. The Table 24 shows the existing resources in an area of 30 km, from which a biomass logistic centre could be based.

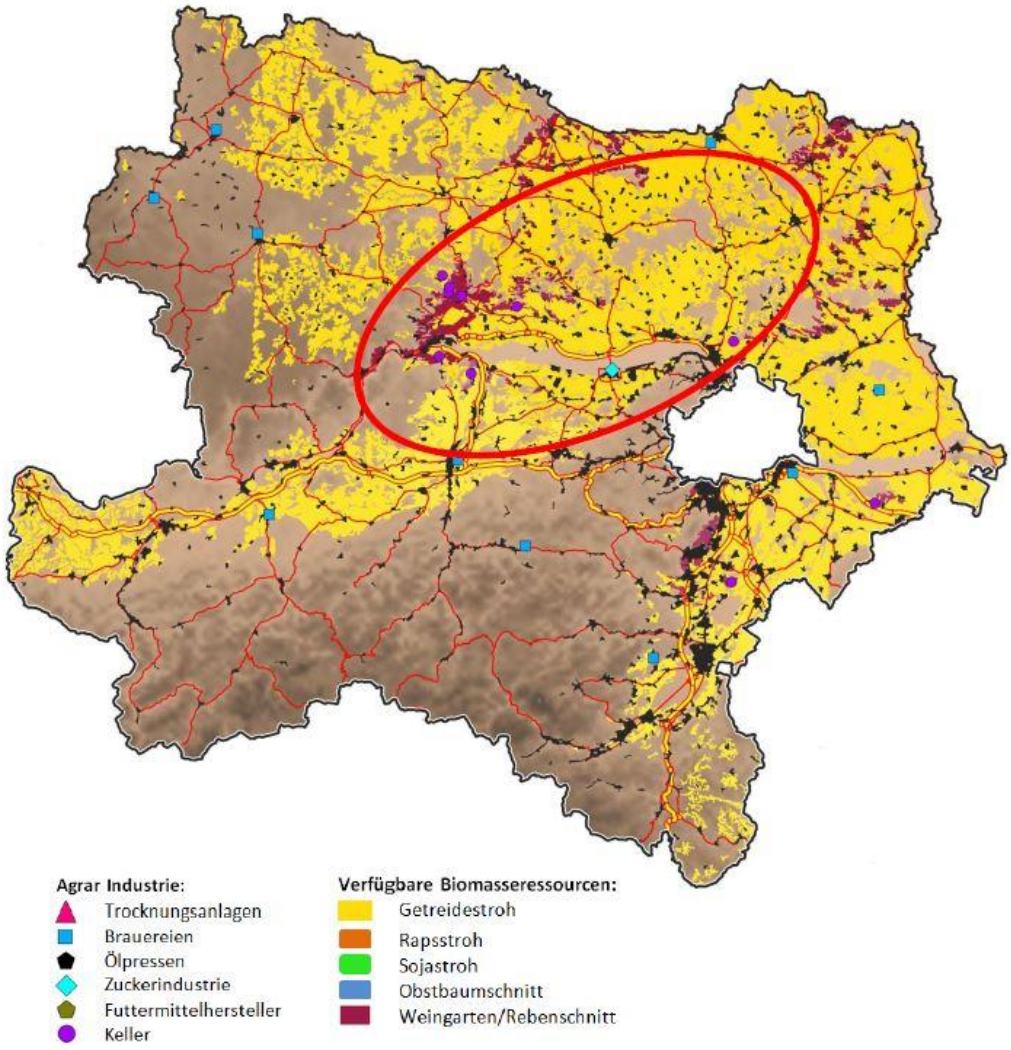

Figure 9: Types of resources and agro-industries available

Table 24: Data on the existing agricultural residues in a 30 km distance.

Type of residue	**Quantity available** t/yr	**Moisture content** w-% ar	**Months of harvest**	**Purchasing price** €/t
Corn cobs	28.912	20-35	Sept-Oct	
Overlaid maize silage	1.500	70	July-Sept	65
Cereal straw	61.410	15	July-Aug	70 (baled)
Soy straw	1.542	40	Sept-Oct	

Rape straw	8.131	40	July-Aug	
Fruit tree pruning	806	45	Feb-Mar	
Vineyard pruning	10939	45	Feb-Mar	

From all this resources, BIOS 1 is interested to produce pellets from maize subproducts, more concreately the residual part from the silage that cannot be used for animal feeding (called overlaid maize silage in this document). In that sense, a capacity from 100 to 250 tons per year is possible.

Furthermore the company is interested in produce corn cobs grits.

3.6.2.2. Equipment and facilities available

The green power company owns various kinds of equipment which can be used for a biomass logistic-centre. Bios1 has sufficient drying capacity: The company owns a box dryer. The dryer is currently used for the drying of corn grains, wood chip or other wet organic matter.

Additionally, for its current activities, the company is in possession of a weighbridge, which could facilitate the delivery and sale of agro fuels considerably.

Also the company has a small pellet plant with hammer mill, different stockrooms, a filling device and waste heat.

Table 25: Seasonal availability of the biomass resources and the equipment.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Box dryer	x	x	x	x	x	x	x	x			x	x
Stockrooms	x	x	x	x	x	x	x	x			x	x
Heat from biogas	x	x	x	x	x	x	x	x			x	x
Pelletiser	x	x	x	x	x	x	x				x	x
Mill	x	x	x	x	x	x	x	x	x	x	x	x

RESOURCES												
Overlaid maize silage							x	x	x			
Corn cobs									x	x		

3.6.2.3. Bioenergy market potential

In the area up 30 km away from BIOS 1, 35 % of the heating demand is covered by solid biomass (forest biomass: chips, firewood or pellets), 31 % by gas 16% by oil and 10 % by electricity and 11% other heating systems. The aim of the region is to substitute this 16 % oil and 31% gas with biomass but it is impossible with forest wood so agrarian local biomass can be the key.

It is expected that the main customers of the logistic centre will be farmers, which have corn fields and use wood pellets for heating or district heating companies. In the case of the grits, farmer could bring their own corn cobs to the logistic centre, where they were processed to corn cob grits. The farmers can buy the grits back and use them for heating. Furthermore also private households currently using fossil fuels and wooden biomass are considered as possible target customers, as they get a quite cheap and local produced fuel from the logistic centre.

Here below is included a table with the data of the competitors:

Table 26: Different types of solid biomass consumed in the area.

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Wood chips	100	0,02	≤ 3
Wood pellets A1	185	0,039	≤ 2

3.6.3. Feasibility of the new business line as agro-industry logistic centre

The company is interested in creating a biomass logistic-centre in order to produce and sell solid biomass fuels taking advantage of their own residues mainly.

As already mentioned, at the BIOS1 about 250 ton pellets or 500 tons of corn cobs grits are available, depending on the number of farmeland which could be harvested.

Four different scenarios were created, as shown below:

- Scenario 1: 250 tons of pellets from overlaid maize silage, considering that cost of the infrastructure of the agro-industry are proportionally included.
- Scenario 2: 250 tons pellets from overlaid maize silage, without capital depreciation and payment of interest.
- Scenario 3: 500 tons corn cobs grits considering that cost of the infrastructure of the agro-industry are proportionally included.
- Scenario 4: 500 tons corn cobs grits without capital depreciation and payment of interest.

Table 27: Production costs of pellets from overlaid maize silage and corn cob grits for each scenario.

Scenario	Produced quantity	Total costs			Production costs (taxes excluded)
		Purchasing costs	Processing costs	Personnel costs	
	t/yr	€/t	€/t	€/t	€/t
Scenario 1	250 (W13)	56,67	86,73	6,00	**149,70**
Scenario 2	250 (W13)	24,86	53,51	6,00	**84,40**
Scenario 3	500 (W10)	60,00	43,74	3,00	**106,70**
Scenario 4	500 (W10)	60,00	26,56	3,00	**89,60**

The production costs of the overlaid silage pellets and the corn cob grits are in scenario 2 and 4 quite similar. The expected market price of the pellets or grits is 111 €/t. The market price of the overlaid silage pellets or cob grits is 2,76 c€ /kWh taxes included (2,31 c€/kWh net, taxes excluded). Therefore they are considerably cheaper than the main competitor wood pellets, which cost at the moment 4,12 c€ /kWh taxes included. However, the content of ash (which is around 3 %, w-% db, according to bibliography) is higher than the wood products in the market and therefore presents a disadvantage to be solved increasing equipment maintenance.

3.6.4. Conclusions

The assessment of framework conditions (biomass resources and market) as well as operational conditions (equipment and management) provided the following results:

- The agrarian resources available for the biomass logistic centre are: cereal, soy and rapeseed straw, fruit tree and vineyard prunings as well as corn cobs and overlaid silage. Corn cobs and overlaid maize silage represent the most interesting raw material amongst the ones mentioned above, as there is little competition with other uses, the logistics chain is already partially developed and further processing is possible in BIOS 1 existing plants.
- Farmers in possession of their own corn fields and who currently use wood chips for heating their houses and stables are expected to be the main consumers of biomass products. Also, households using woody pellets should be considered potential customers. Consequently, wood chips and wood pellets represent the most important competing products on the market.
- Regarding the equipment no further investments are required to develop the biomass logistic centre, since the company will be able to use its own drying plants as well as storage capacities hammer mill. Small pellet plant, weighbridge, loader and waste heat. For chipping of corn cobs in order to produce grits an external and mobile chipper will be rented.

The techno-economic feasibility study shows that corn cob grits and whole plant pellets can be produced in scenario 2, 3 and 4 examined below the market price in the area (111 €/t net). Therefore, the company will be able to make a profit by selling corn cobs.

To conclude, it should be pointed out that the achievement of economic success is solely possible by using high-quality fuels. For this reason it is important to conduct a foregoing quality analysis (with due regard to moisture content, calorific value, ash content and chlorine concentration) of a representative sample of corn cobs, or whole plant maize which will be used as a raw material in the biomass logistic centre.

3.6.5. Start-up support activities

In addition to carrying out the feasibility study, the SUCELLOG project also supports BIOS 1 in the further development of a logistics center from agricultural residues. Therefore the most important needs have been identified, which are necessary for the construction. The SUCELLOG project supports the company in finding solutions for solving these needs.

The company is interested in opening up a logistics center, where agricultural fuels are produced and sold. In the field of agro-fuels, the focus have been on using the residues from silage which cannot be used for animal feeding because of mold. Addionally, BIOS 1 also plans to use corn cobs for grits production, but the main focus is production agro-pellets out of maize silage. The advantage of the pellets is that they have a higher density and therefore can easliy be stored at the facility, on contrary to corn cob. They have a low density which means that they need a lot of storage space which exeeds the current capacity of BIOS 1.

For the production of agro-fuels BIOS 1 owns a pelletising line, but the agro-industry has very little experience in pelletising solid biomass. This is why there is a need to increase their know-how in this field. Furthermore it is necessary to adapt the existing equipment to the new raw material (overlaid maize silage). There is also a need to implement a logistic chain for the raw material supply, as BIOS 1 neither harvests the biomass nor has access to the raw material from their regular business activity as agro-industry. In addition it is also important and necessary to find a sales market for this new solid biomass fuel out of agrarian residues.

The SUCELLOG project supported BIOS 1 in finding solutions for the above mentioned issues. In a first step support activities for the creation of a supply logistic chain were provided to the company. Contacts were established with maize harvesting companies and with farmers using maize silage. After a first talk with those, they showed their interest in a possible collaboration. Furthermore the project provided information to BIOS 1 about properties of different kinds of raw materials as well as about quality requirements and standard for agro-pellets.

In a next step the SUCELLOG project supported the agro-industry in the building of know-how for the production of solid biomass pellets and for the adaption of existing equipment. For that purpose, information was provided on the one hand and contact to wood pelletising company was established. Furthermore contacts to the logistic centre Tschiggerl Agrar and the association Heu & Pellets were established. BIOS 1 also visited those two last meantioned companies to learn from their experience about pelletising solid biomass, about the logistic supply chain and about the logistic centre

in general. In order to find sales markets,information about boilers for agrarian residues was provided as well as contacts to boiler manufacturers established.