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

SUCELLOG: IEE/13/638/SI2.675535

D3.2b Summary of the regional situation, biomass resources and priority areas of action in France

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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.

Project Coordinator

Project Partners

About this document

This report corresponds to D3.2 of the SUCELLOG project - Summary of the regional situation, biomass resources and priority areas of action in France. It has been prepared by:

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1. Introduction

SUCELLOG focuses on the implementation of biomass logistic centres into agro-industries as complement to their usual activity with minor investments. Agro-industry facilities can be utilised in their idle periods to handle and pre-treat biomass feedstock (mainly from their own residues or agricultural residues nearby) to produce solid biomass to be introduced into the market.

This document shows the results of the work carried out within SUCELLOG WP3-Regional framework and stakeholders' engagement in France. During this WP, four main actions were carried out in the project target regions (Auvergne, Centre, Champagne-Ardenne, Ile-de-France, Picardie and Rhone-Alpes):

- Allocate biomass resources.
- Evaluate with the stakeholders both the technical and the non-technical barriers of the implementation of SUCELLOG concept in the agro-industries.
- Determine the potential areas for the development of agro-industry logistic centres.
- Engage agro-industries to the project.

For the first action, an evaluation of the real potential of primary agrarian biomass has been carried out inside Task 3.1. The methodology selected corresponds to a "Resource focussed approach", as described by BEE standardised classification (project Biomass Energy for Europe), which starts with statistical data from agrarian inventories. This data has been complemented with the real availability indices (the share of biomass that is not currently being used for other aims including soil sustainability issues) gathered in the regional workshops with the agrarian sector during Task 3.3. As a first result, primary biomass resources have been firstly catalogued according to existing competitive uses and relevance in terms of current unused quantities. This assessment has been performed in by country level since no regional differences has been observed. Secondly, a map of real available primary resources and a table of the available tons per year in dry base were built per target region. Even though the use of agro-industry residues is a target of SUCELLOG, the data of the inventories was not sufficient to produce a reliable inventory of the biomass residues produced in the agro-industries processes. Therefore the maps and tables presented do not include this type of resources, which will be deeply assessed for particular cases of logistic centres monitored or audited during in WP4-WP6.

As a second action, an assessment of the barriers and opportunities for the development of logistic centres was carried out through personal interviews with each target sector in Task 3.2. Existing agro-industries from the potential sectors (those owning compatible equipment for the conditioning and storage of raw material) were asked about: idle periods, residues produced in their facilities and upstream in the crop cultivation, the economic situation of the sector and possible upcoming changes due to the Common Agricultural Policy, practical and legal incompatibilities in using

their facilities for the production of solid biomass, social barriers for the development of this new activity and, finally, opportunities detected. Section 2 presents the situation of the country since no regional differences were appreciated. After this analysis, target sectors were identified per region and specific agro-industry locations were included inside the biomass resource map.

To determine the potential areas inside each target region for the development of agro-industry logistic centres, it has been taken into account the diversity and quantity of available agrarian resources (both woody and herbaceous) and of agro-industries present in the region as well as the compatibility among them. Compatibility has been defined according to their seasonality (matching the months of biomass production with the idle period of the agro-industry) and their technical compatibility of use. Logistic issues such as good communication networks and proximity to consumption areas has also been taken into consideration. Potential areas have been identified per region and are shown in this document. However, it is important to highlight that the selection of a potential area does not mean that an agro-industry non belonging to it could not start a new activity and the opposite. The size of the future logistic centre has not been a limiting factor for the selection of the potential area (even if SUCELLOG target is a production of 10 kt/yr per centre) since no data of the total amount of biomass is available (agro-industry residues missing as mentioned before).

The following sections show the results obtained about the above mentioned issues (passing from a country to a regional perspective). A summary of the situation in France is included in the last part

As a last activity belonging to this WP, workshops and personal contacts were carried out with agro-industries in Task 3.3 with the aim of engaging them to the services offered by the project (technical and decision-making support to become biomass logistic centres). The result of this action is shown in “D3.1-Report on engagement actions”.

2. Agro-industries: profile, barriers and opportunities

The main potential agro-industry sectors to become a solid biomass logistic centre in France have been evaluated in the following lines, describing the equipment they usually own and their idle period, as well as the residues generated both in the agrarian practice and in the production process. Finally, the barriers and opportunities they would face when thinking to start this new activity have been identified. The information has been provided through interviews with representative industries of the sector and agrarian experts.

Forage dehydration:

Forage dehydration sector in France has an important idle period of 5 months (from November to April approximately) and owns compatible equipment for the production

of solid biomass (horizontal dryers, pelletisers and silos). From the 6 regions evaluated in SUCELLOG in France, it is mainly sited in the region of Champagne-Ardenne.

Usually installations are used all the year because they dry other material different from forage in order to diversify their activity (sugar beet, wine residues) or even are utilized to produce wood pellets. So the implementation of SUCELLOG concept is something that is already done in this sector. Since not all facilities work like this, the project will still consider this sector as a target for the development of biomass logistic centres.

The forage dehydration facilities do not produce any important biomass residue, either in the agrarian or processing phase, meaning that the raw material for the production of solid biomass should be acquired.

Dehydration sector passed by a difficult situation years ago so that diversification was the natural way to be still working. The evolution of European subsidies (PAC) could play an important role for this sector. The sector do think that there is no technical barriers to start this new activity within their installations, presents a high degree of professionalization and is able to invest.

Cereal dryers:

This sector shows an interesting potential to become a solid biomass logistic centre from a technical point of view, offering a long idle period of around 6 months (from January to July approximately and depending on the crop) as well as proper equipment such as vertical dryers, screening equipment and silos for storage.

Regarding the raw material available for a possible logistic centre, farmers supplying the grain to be dried in the facilities produce important quantities of straw which main market is the livestock feeding and biogas production. Depending on the year, a considerable amount of straw is not able to enter the market for animal feeding. Some studies consider that, one year out of three, the straw (of cereals, maize or rape) can be used for energy purposes, and that one third of the total amount of straw should be leaved on the soil.

The agro-industry itself produce residues such as the grain that for some reasons do not satisfy the quality/aesthetics requirements to be sold in the market or the silo dust, the spathes and the kernels (although normally are sold for animal feeding, biogas production or for combustion).

These industries see a good opportunity in making compatible their activity with the production of solid biomass although they think that a new line for drying may be required since not so many biomass formats are compatible with the dryers (only granulate material but no straw or chip). Otherwise their storage facilities and handling equipment could be used without any barrier. Economically, the sector has

in general a favorable economic situation and investments in new activities can be studied.

Sugar industry:

The sugar industry presents, on the one side, an important idle period of 7 months which goes from January to August approximately and, on the other side, compatible equipment for the production of solid biomass such as horizontal dryers and generally also pelletizers.

This equipment is used in the production of beet pulp cake, a by-product from the sugar production, which is highly appreciated by the livestock sector and commercialized in a pellet format. However in the last years, the use for biogas production has increased in such a way that, depending on market needs, some years is profitable to produce pellets and some others biogas. When biogas production is the predominant, pelletisers are not used.

The sector does not produce residues during the agrarian practice.

Nowadays, the industry has an important uncertainty due to the end of the quota in 2017 involving changes. For these reasons, it can be a good sector to implement the logistic centre as an opportunity for diversification.

Tobacco dryers:

The agro-industry of the tobacco remain open the whole year but their dryers have an idle period of 9 months per year (from October to July approximately) presenting a good opportunity to become a biomass logistic centre from the technical point of view.

The agrarian practice of the tobacco generates residues talks that currently are left on the soil because they have not found other use. They could be studied as a possible biomass source.

The sector is in a strong decline and restructuration. Therefore the production of solid biomass with reduced investments can become a good opportunity for them.

Wine sector:

The wine sector includes the cellars and the distilleries, the latter processing the residues obtained from the cellars. From both, it is only the distilleries the ones owning equipment (horizontal dryers) compatible with the production of solid biomass. The idle period of these dryers in the distilleries is from May to September/October.

It has been selected as a potential sector to become a logistic centre because of their easy access to the agrarian residues such as the pruning or to the agro-industry residues obtained during the wine and distillate elaboration.

Nowadays many of the by-products produced during the wine elaboration (grape marcs and grape stems) are already used as animal feeding or for methanization. Regarding the residues from the distillation process, they are sold for animal feedstock and biogas production. Vineyard prunings could be commercialised once chipped and dried in the same drier of the distillery or in a new production line implemented in the cellar.

Technically they do not see any trouble of initiating a new activity as logistic centre and investments could be studied.

Oil extraction industries:

The oil extraction industries are dedicated to rape and sunflower seeds mainly working all the year. The facilities count with pressers and driers.

Concerning the residues produced in the field, harvesting methods are not as efficient as for cereal straw. For this reason, the harvesting is only carried out when there is a lack of hay in the market for animal feed, being otherwise left in the soil as soil amendment. In the agro-industry production process, the cake from the seed pressing is really appreciated for animal feed although husks have not such a stable market.

They can be considered as a target industry for SUCELLOG if the production decreases and there is some line that it is not used.

Feedstuff producers

This sector has been identified as a potential one to become a solid biomass logistic centre. Even though it does not have idle periods, it counts with many proper equipment types that might be used for the new activity such as: pelletizes, silos for storage, screening and chipping machinery.

Additionally, the sector produces interesting amounts of residues not able to enter the market although some are already formulated feedstuffs which might content antibiotics. Therefore their use as possible solid biomass source needs to be study in order to produce no dangerous emissions for the environment.

The sector is facing a decrease in the market, making facilities oversized in some cases. The restructuration can be an opportunity to diversify with an activity to produce agro-pellets.

3. Evaluation of available resources

SUCELLOG has considered that the development of agro-industry logistic centre should rely on agrarian biomass coming both from the agrarian practices (like straw or prunings) and from the agro-industry process (for example distilleries residues). The fact is that, for the first case, agro-industries have already a network with farmers providing the raw feedstock to be processed. For the second case, the use of their own residues is the opportunity to reduce their fuel consumption or avoid the cost of disposal if there is no market for it. Quantifying the biomass resources up-stream and down-stream the agro-industry is the object of this section since it is strategic for establishing new commercial relations with usual providers and clients.

A study about the available biomass resources has been performed, focusing in the agrarian biomass since it was not possible to have data about the production of agro-industries residues per region/country. When talking about availability of the residue, it is meant the amount of resources that do not have a market or that is not left on the soil to improve organic content, therefore having the opportunity to be used for energy purposes. Three examples to explain what availability is (see more detail about the methodology of work in section XX and availability percentage in Annex I):

- If a farmer, after taking the wheat grain, leaves the straw on the soil due to agrarian recommendations then availability should be considered 0%.
- On the contrary, if the farmer leaves the straw on the soil just because the cost for harvesting does not cover the value in the animal feed market then availability is 100%.
- It can also happen that in one region the 40% of the straw is commercialized for animal feed (so it has a market), a 20% is left on the soil as a recommended agrarian practice. Therefore, 40% of the straw is available for other uses like the production of solid biomass.

3.1. Agricultural residues:

Agricultural biomass resources can be catalogued in different groups according to next two criteria:

- Competitiveness: existing competitive uses.
- Amount of available biomass: relevance in terms of current unused quantities.

From this scope, agricultural biomass resources in French target regions can be catalogued in average as next:

Table 1: Classification of biomass resources in France.

Criteria		Biomass resources
Competitiveness	**Available unused biomass**	
Competitive uses make biomass unavailable for energy	None	Pulses and hemp stalks
Moderate to high competitive uses	Important part of the source still available	Cereal straw, maize stalks (depends upon region).
Some competitive uses	Important source still available	Rape straw and sunflower stalks (depends upon region).
Some or few competitive uses	Marginal local amounts (may play a role in a singular facility)	Tobacco stalks, other oilseed straw, permanent crop prunings.
Uncertain due to technical barrier to be collected	If logistics is solved, biomass is ready available	Linseed

As observed, in general, the resources with lowest risk derived from competitive uses are oilseed straw (other than rape), permanent crop prunings and tobacco stalks, practically unused. However, these biomass types are only relatively important in regional scale for the target regions selected. It is at more local scale in general when they become more interesting, that is, once the location for a potential distribution of biomass is selected.

There is a group of crops which residues are still available in a relevant share, and that in most regions can play an important role as source of biomass. They are rape straw and sunflower stalks, which are still not much used, and since France accounts with important areas for these crops, the available potential is in general quite high in most regions.

In general, maize stalks and cereal straw have more competitive uses than straw from rape and sunflower. Maize straw has still not much competitive uses in Auvergne and Rhône-Alpes, whereas in the rest availability is small or even very small (Centre and Picardie). In the case of cereal straw, all regions show medium to high competitiveness for this resources, used to be left on the soil or as cattle feedstock mainly. Wheat straw is a very particular case in Auvergne and Rhône-Alpes, where it is practically unavailable, whereas the rest of cereal straw is still available to certain extent.

According to this description, biomass mostly available in the French target regions are cereal straw, rape straw, and maize and sunflower stalks. This biomass can be collected and does not imply any risk in terms of accessing it in terms of logistics.

With respect to woody agricultural prunings, they can complement the production of solid biomass commodities, since practically the amounts available are insufficient for dedicated logistic centres. Therefore, this resource can be considered as a good complement when planning the supply, but not as the main biomass source. This is a general rule in France except for the province of Marne where the potential of vineyard prunings is very interesting. In fact is its woody structure usually with better quality in terms of quality composition and suitability for existing energy conversion systems compared to herbaceous residues. However, in the cases that the availability of woody biomass from prunings is high, it also involves the challenge to local farmers to start a new logistic chain.

Other feedstock types have not being quantified in the study, but may be a source of biomass relevant at local scale. A specific case is linseed, which is only partly utilised and the rest of stalks is left on the soil due to the harvesting costs, even though the natural degradation on the soil is not good, and there are areas where farmers are looking for a possible market to provide an outlet for it. Tobacco stalks have been reported to be unused feedstock, and so, they may be locally of interest.

Resources like pulses straw shall not be considered as a resource when setting the regional strategy as they are either integrated to improve soils or sold for animal feeding due to its nutritive properties. Hemp is totally used for the fiber market.

3.2. Other biomass resources

Even though in SUCELLOG a comprehensive list of agro-industries has been compiled by region, the data of the inventories was not sufficient to produce a reliable inventory of the biomass residues produced in the agro-industries processes. Agro-industry residues are interesting in the case of the oil and wine sector because of their amount, while in the case of the cereal and feedstuff sector, for example, these residues could be a complement in the production of the solid biomass since their production is not of significance in amount. The use of agro-industry residues is a target of SUCELLOG, but its actual use will be decided for the particular cases of logistic centres monitored or audited during WPs 4, 5 and 6. There, the local reality and capacity of neighbour facilities to become reliable biomass suppliers will be assessed.

With respect to forestry biomass, SUCELLOG has not carried out any specific assessment since the project is focused on fostering agricultural residues as a source of solid biomass. However, the feedback obtained from the target regions shows that forestry residues may be at the reach of future logistic centres, and can be an option in few provinces for upgrading the properties of biomass mixtures to be commercialised. Biomass directly from forestry exploitation for energy purposes has been considered as not a source for the short-time term in SUCELLOG.

An analysis performed by regions instead of by resources is carried out in section 0. Biomass assessment in the present work involves the study of 5 autonomous regions of Spain, adding a total area of 244.900 km^2, about 48% of the total area of Spain. For this scale of work the use of existing data from inventories was needed as an input data source. The aim of the approach is to provide a framework of the available sources in the region. It is not aimed to be the specific biomass assessment for a facility, which will be object of task 4.2, and which requires other type of approaches.

3.3. Methodology of work

The methodology selected corresponds to a "Resource focused approach", as described by BEE standardised classification (see project BEE). It starts with statistical data from agrarian inventories, and complemented with the availability indices and utilization for soil preservation leads to a technical potential, including soil sustainability issues.

The method followed is based on ratios of residual biomass production per hectare of cultivated area (tons of residue per hectare). The use of ratios is a widespread methodology for biomass assessments, appropriate for both large and small scale. The main issue is to account with reliable inventories and ratios. By multiplying the cultivated area (ha) by the ratios (t/ha) the theoretical potential is obtained:

$$\text{Biomass Potential [t]} = \text{Ratio [t/ha]} * \text{Area [ha]}$$

The methodology used here brings a step forward in the country analysis by including the competitiveness for biomass resources. For that purpose it is necessary to know the share of biomass that is currently being used for other aims, and that will be considered as not available for the present study. The availability index (I_{AV}) expressed as percentage is defined as next:

$$I_{AV} = 100 - I_{COMPET} - I_{SOILS}$$

Where :

I_{COMPET}: is the percentage of the total biomass in a region that other uses (power plants, cattle, industry) already are using.

I_{SOILS}: is the percentage of total produced biomass that remains in the soil. E.g.: if farmers prefer to leave part of the straw as soil organic amendment.

By using these indices it is possible to obtain the final biomass available by doing next operation:

$$\text{Available Biomass [t]} = \text{Potential Biomass [t]} * I_{AV} = \text{Ratio [t/ha]} * \text{Area [ha]} * I_{AV}$$

The data sources have been obtained as next:

- **Agricultural areas**: the biomass has been calculated on the base S2Biom project land areas (www.s2biom.eu) given by NUTs3 (Spanish provinces), in order to have same base units than ongoing referential projects like S2Biom is. Since NUTs3 is a too large scale for the purposes of the SUCELLOG work, the biomass obtained by NUTs3 has been downscaled at LAU2 (former NUTs5) geographical resolution (Spanish municipalities), by assigning each LAU2 unit a biomass share proportional to the area occupied by crop type.
- **Land distribution**: Corine Land Cover version 2010. Biomass previously downscaled to municipality level has been allocated to the corresponding Corine Land Cover spots, intersecting the municipality.
- **Ratios and availability indices**: a specific work has been carried out by region. For each region ratios have been obtained from direct contact with specialists and cooperatives, and in few cases, complemented with literature. The purpose of this effort has been to use ratios and availability indices representing the reality of the region, and not just ratios found in literature. The workshops done in task 3.3 have served to include the feedback from the sector to improve the final datasets. Ratio and availability percentage are shown in Annex I.

3.4. Results

Table 2: Most strategic resources by target region.

Region	Cereal straw	Maize + Sunflower straw	Rape and oil seed plant straw	Olive + Fruit + Vineyard prunings	Others
Auvergne	Partly Allier, Puy-de-Dôme	Allier and Puy-de-Dôme	Allier	---	---
Centre	ALL	ALL (Eure-et-Loire to a leser extent)	ALL	Indre-et-Loire, Loire-et Cher (also Cher to a lesser extent)	---
Champagne-Ardenne	ALL	ALL (but in general 1 magnitude order less than straw)	ALL	Marme and (to a lesses extent) Aube	---

Region	Cereal straw	Maize + Sunflower straw	Rape and oil seed plant straw	Olive + Fruit + Vineyard prunings	Others
Île-de-France	ALL (specially Seine-et-marne	Seine et Marme mainly	ALL (specially Seine-et-marne	---	---
	Metropolitan departments of Hauts-de-Seine, Seine-Saint-Denis and Val-de-Marne no biomass production.				
Picardie	ALL	---	ALL	Aisne (very locally)	---
Rhone-Alpes	ALL (as complement to maize/sunflower)	ALL	All (locally)	Drôme	---
	Ardeche, Haute-Savoie, Loire et Savoie are departments with insufficient available biomass to be considered, in principle, for distribution of agrarian solid biomass commodities				

4. Regional Framework of AUVERGNE

4.1. Identification of agro-industries in Auvergne

The interesting agro-industries to become a logistic centre in Auvergne are:

- **Cereal dryers**: the sector is very concentrated in the Limagne, the agro-industrial complex near Clermont-Ferrand but also in the North-Est and in the South. In these areas, more than 80% of the cooperatives in the region are sited.
- **Sugar industry:** there is only one industry which is currently closed and therefore it could be a good opportunity to be transformed into a biomass logistic centre.
- **Distilleries:** the area of wine is very reduce, limited in the center or Auvergne. There is only one distillery.

Apart from those sectors, the oil extraction industries could also be considered as target if they dedicate one line to the production of solid biomass. There are only two industries of this sector in the north.

All these agro-industries together with the cellars can be considered as suppliers of biomass resources.

4.2. Identification of biomass resources in Auvergne

Biomass assessment carried out at regional scale indicates that available biomass, that not subjected to competitive uses, amounts for about 0.13 Mt yearly. Maize stalks are the main agricultural residues, whereas rape and cereal straw are of secondary importance, tough still of interest from a regional perspective. Allier and Puy-de-Dôme are the departments with relevant biomass resources, whereas Cantal and Haûte-Loire have quite scarce available biomass. Even though 0.1 Mt of yearly based biomass is not an important amount at regional level, by department and locally, several areas concentrate the productions.

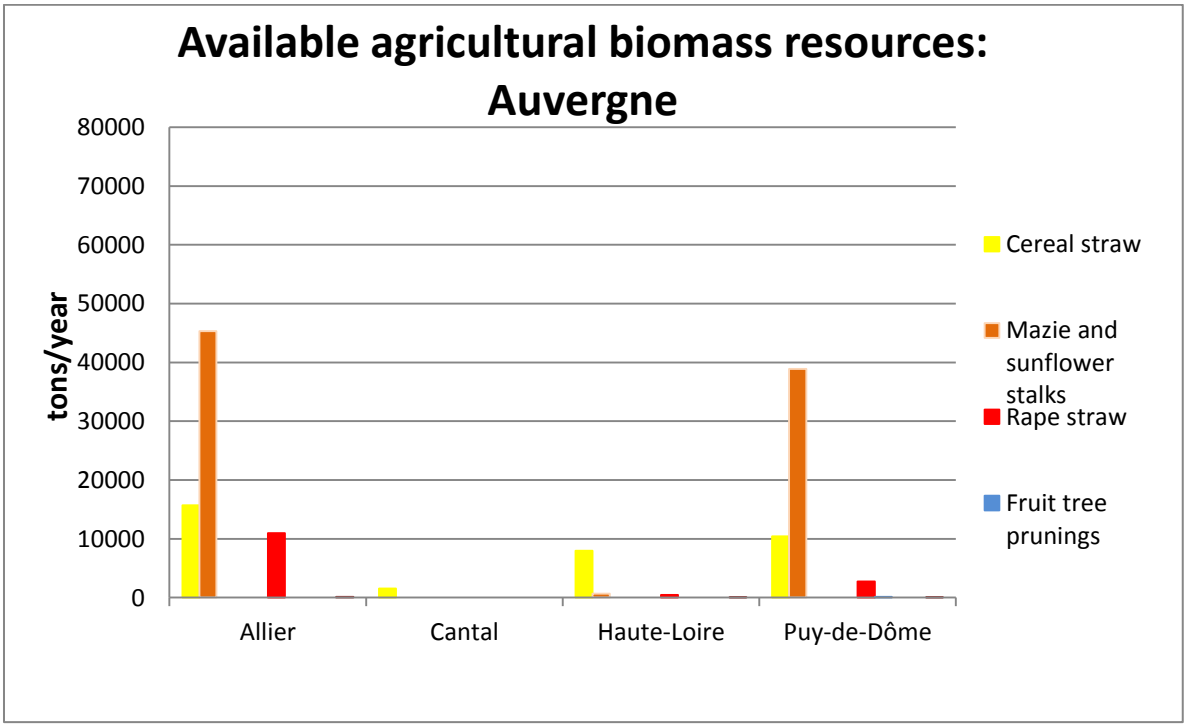

Figure 1: Summary of available agricultural biomass residues in Auvergne.

Main conclusions in Auvergne:

- The provinces of Allier and Puy-de-Dôme are the ones presenting the major variety of resources. On the other hand, Cantal seems to be not so interesting for developing a logistic centre of agrarian biomass.
- As in most of the French regions, the most extended crops are annual crop residues, in this case cereals and maize for Auvergne. The principal resource is maize stalks, available in large quantities and still with minor competitive uses.
- The straw of colza and grains is also of relevance and could be of importance especially in the province of Allier.
- Woody residues from vineyard prunings are not relevant at regional scale. However in very local scale, a facility might find some amounts of this woody residues. This fact has to be taken into consideration for local scale studies.

- Industrial by-products such us broken grain and dust (from cereal dryers), husks (from oil extraction industries), sugar beet pulp (from the sugar sector) and distillation production residues.

4.3. Localization of resources and agro-industries in Auvergne

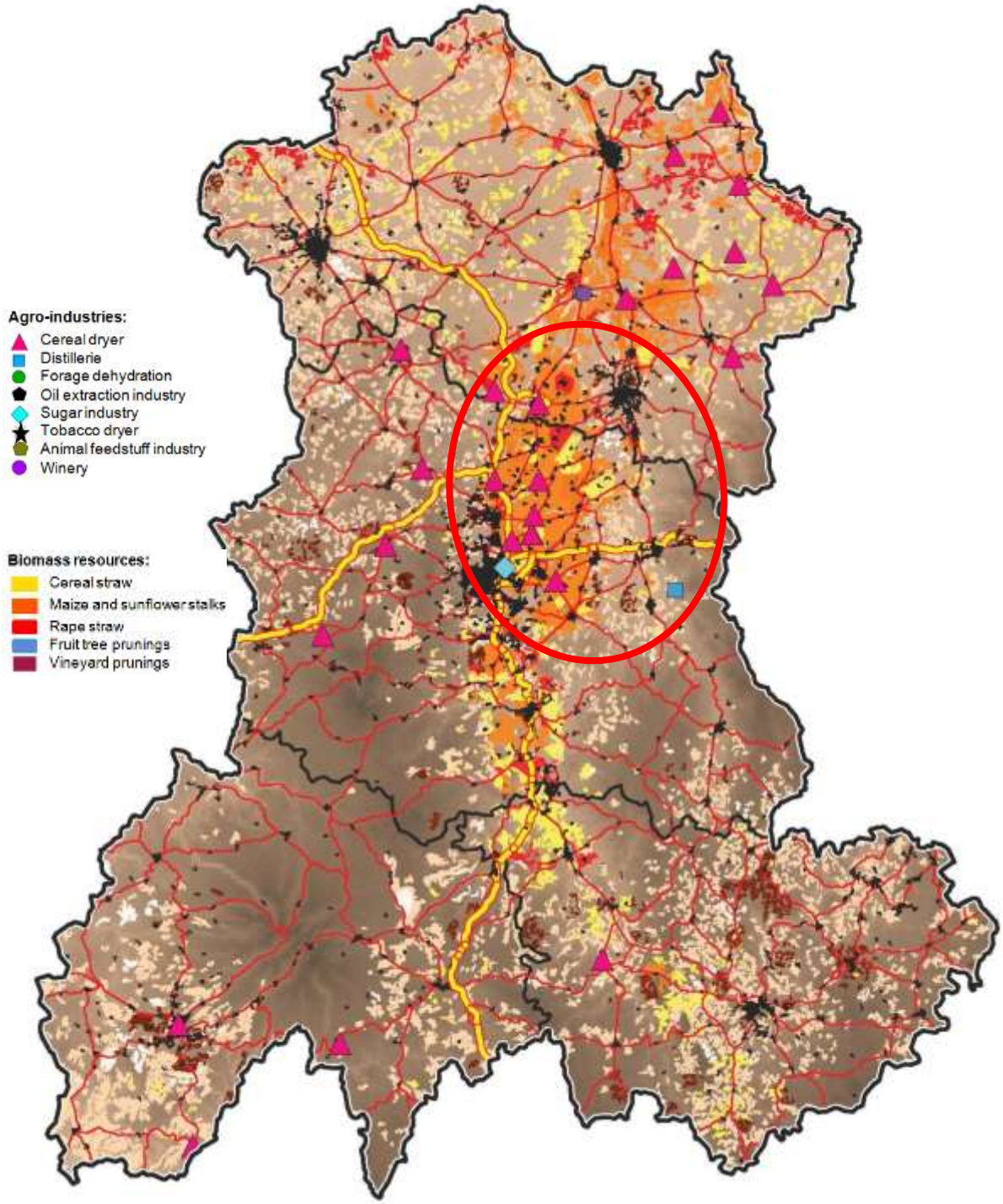

Figure 2: Localization and type of agro-industries and resources in Auvergne.

4.4. Priority areas in Auvergne

One potential area for the development of an agro-industry logistic centre has been detected in Auvergne and is shown in Figure 2. As already mentioned in the introduction, this area has been selected taking into account the diversity of resources (both woody and herbaceous) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 3, and their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also been taken into consideration.

Table 3: Availability of equipment and biomass resources in Auvergne.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cereal dryer												
Distillery												
Sugar industry												
Cereal straw												
Maize straw and cobs												
Rape stalks												
Husks and silo dust from cereal dryers												
Distillery residues												
Husks and residues from oil seeds												
Beet pulp												

In Auvergne there is only one potential area for the development of SUCELLOG, which has been selected for the following reasons:

- The high concentration of available maize straw and one potential industry able to pre-treat it and transform it into solid biomass: the sugar industry. This centre could also take the husks from seeds as a complement and specially rely on forest residues and sawdust from the wood industry to upgrade fuel characteristics.
- The seasonality of distillery is not compatible with maize straw and its long storage is complicated due to the high moisture content when harvested. However, the distillery itself could also process their own residues into solid biomass or sell the grape pits to the cereal industries to be dried in their facilities to achieve quality standards.
- The concentration of cereal dryers in the area (important biomass consumers) and the good infrastructure for transport logistics should also be highlighted.

5. Regional Framework of CENTRE

5.1. Identification of agro-industries in Centre

The interesting agro-industries to become a logistic centre in Centre are:

- **Cereal dryers**: about 500.000 tons of cereal straw every year on the region. The most important quantities are mobilisable in two agrarian area of Eure-et-Loire and Loiret.
- **Sugar industry:** there are only two cooperative groups in the region. The sugar beets crops are concentrated in the North of the region between Eure-et-Loire and Loiret.
- **Distilleries:** only one distillery in the region.
- **Forage dehydration facilities:** only one site in the North of the region.

Apart from those sectors, the feedstuff producers could also be considered as target for the implementation of a logistic centre if they dedicate one line exclusively to the production of solid biomass.

The agro-industries identified as biomass resources suppliers, apart from the ones above, are the cellars (vineyards are concentered in a line in the middle of the region, in Touraine and Sancerre).

5.2. Identification of biomass resources in Centre

Centre region is, with difference, the French target region accounting with the largest biomass available for energy uses. The total biomass is larger than 1 Mt, quite an important figure, specially whe accordingly to the evaluation done, it has no current use, that is, there are no competitive uses. Straw is the principal residue and contributes in all the departments with more than 80 kt. Beyond the predominant role of straw, rape has also important potentials in all departments. Only Indre-et-Loire has a larger amount of resiudal biomass from maize than rape straw.

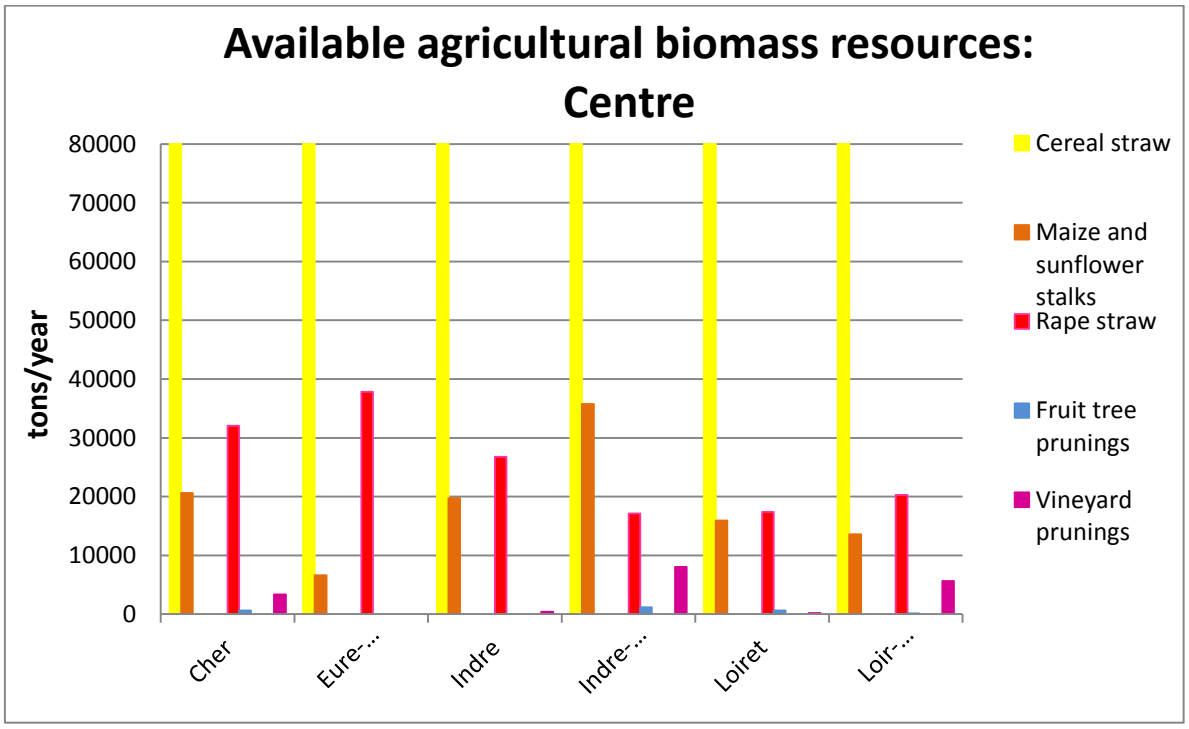

Figure 3: Summary of available agricultural biomass residues in Centre.

Main conclusions in Centre:

- The most important resource in Centre is cereal straw, adding more than 0.8 Mt/yr of biomass available. Even though this is the main resource, maize and rape contribute to the available biomass with very important amounts in all departments. Centre is the region with more production of rape after Champagne-Ardenne.
- Vineyard prunings in the central part of the region could be a good woody resource for an upgrading of the solid biomass quality. This fact is relevant for decision making in the strategy when starting a new logistic centre. Biomass from fruit tree prunings can play a similar role locally in the department of Indre-et Loire.
- Residues from the agro-industry of the cereal dryers, sugar industry, feedstuff producers and wine sector should also be considered.

5.3. Localization of resources and agro-industries in Centre

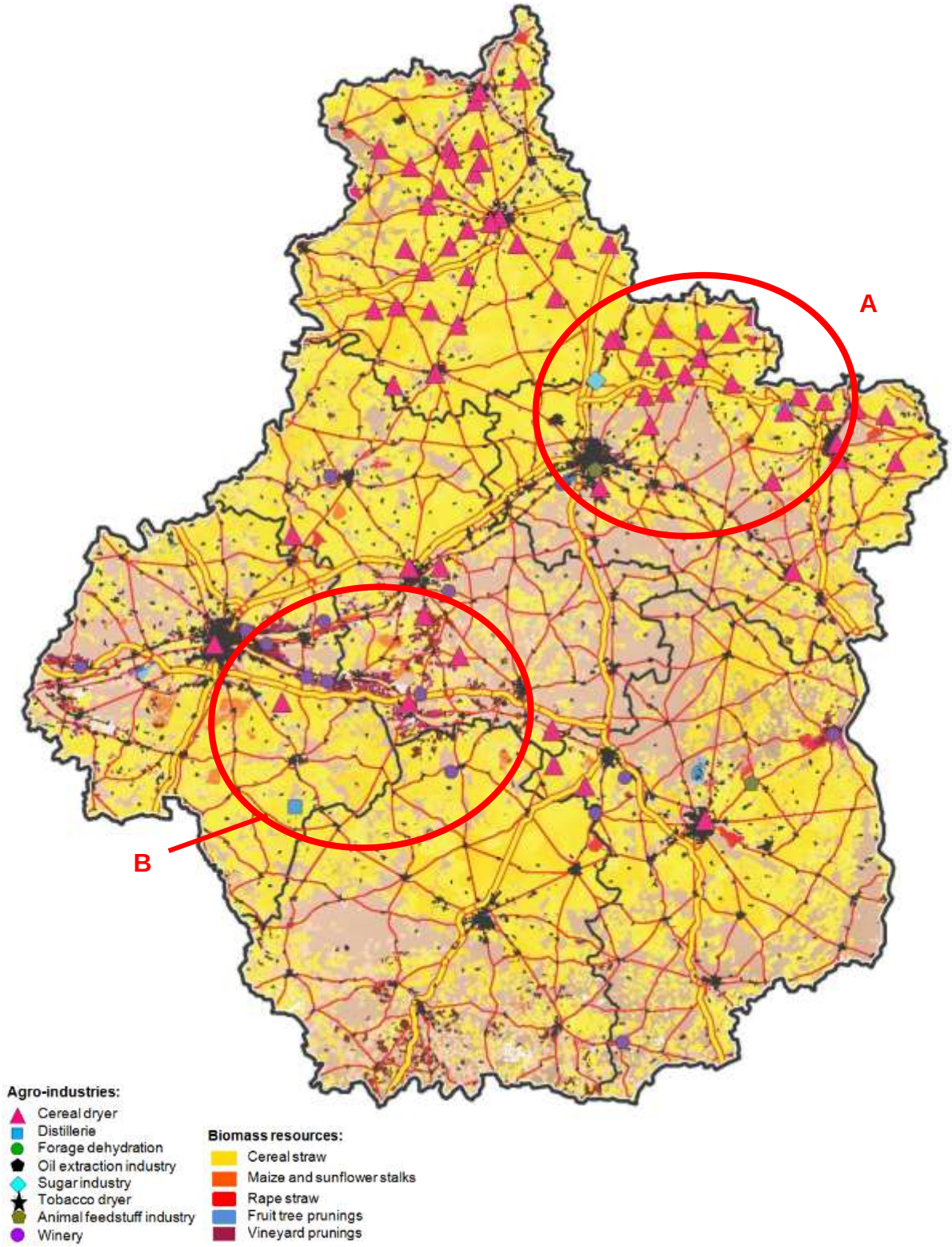

Figure 4: Localization and type of agro-industries and resources in Centre.

5.4. Priority areas in Centre

Potential areas for the development of an agro-industry logistic centre have been detected in Centre and are shown in Figure 4. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both woody and herbaceous) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 4, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 4: Availability of equipment and biomass resources in Centre.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cereal dryer												
Distillery												
Sugar industry												
Forage dehydration												
Cereal straw												
Maize straw and cobs												
Rape stalks												
Husks and silo dust from cereal dryers												
Grape marc and stems												
Distillery residues												
Beet pulp												
Permanent crop prunings												
Feedstuff residues												

The potentiality of the areas selected is described below:

- Area A: this area is interesting due to the high amount of straw resources available that could be processed in the forage dehydration industry or even in the sugar industry after a larger period of storage. Husks and other residues from cereal dryers could be used as a complement but especially woody residues from forest industry should be required to upgrade the quality.
- Area B: this area presents availability of vineyard prunings, together with the grape stem, which could be conditioned in the cellar if a new line is installed for this purpose.

6. Regional Framework of CHAMPAGNE-ARDENNE

6.1. Identification of agro-industries in Champagne-Ardenne

The interesting agro-industries to become a logistic centre in Champagne-Ardenne are:

- **Cereal dryers**: specially located in south of Marne and North of Aube.
- **Forage dehydration facilities:** Champagne-Ardenne is a very good region for this sector which is very represented in an important part of the territory. The most important part is in Marne and Aube.
- **Distilleries:** la Montagne de Reims is a very concentrated area with lots of wine cooperatives and the distilleries in the region. The area of Rosé des Riceys is also of importance for wine production although no distilleries are sited.
- **Sugar industries:** sugar beet can be found in all the department of Marne, in the South of Ardennes and the north of Aube.

Apart from those sectors, the feedstuff producers and the oil extraction industries could also be considered as target if they dedicate on line to the production of solid biomass.

The agro-industries identified as biomass resources suppliers, apart from the ones above, are: cellars (vineyards are concentered in a line in the middle of the region, in Touraine and Sancerre) and animal feedstuff producers.

6.2. Identification of biomass resources in Champagne-Ardenne

The profile of Champagne-Ardene is similar to Picardie or Centre regions in terms of the profile in biomass availability. Straw is the main resurce, which amounts fo important quantities available still without other competitive use. Whereas straw adds a total og 250 kt of biomass available per year, rape contributes with 150 kt. The profile of all departments is quite similar, being in all of them rape the second source of agricultural biomass in importance.

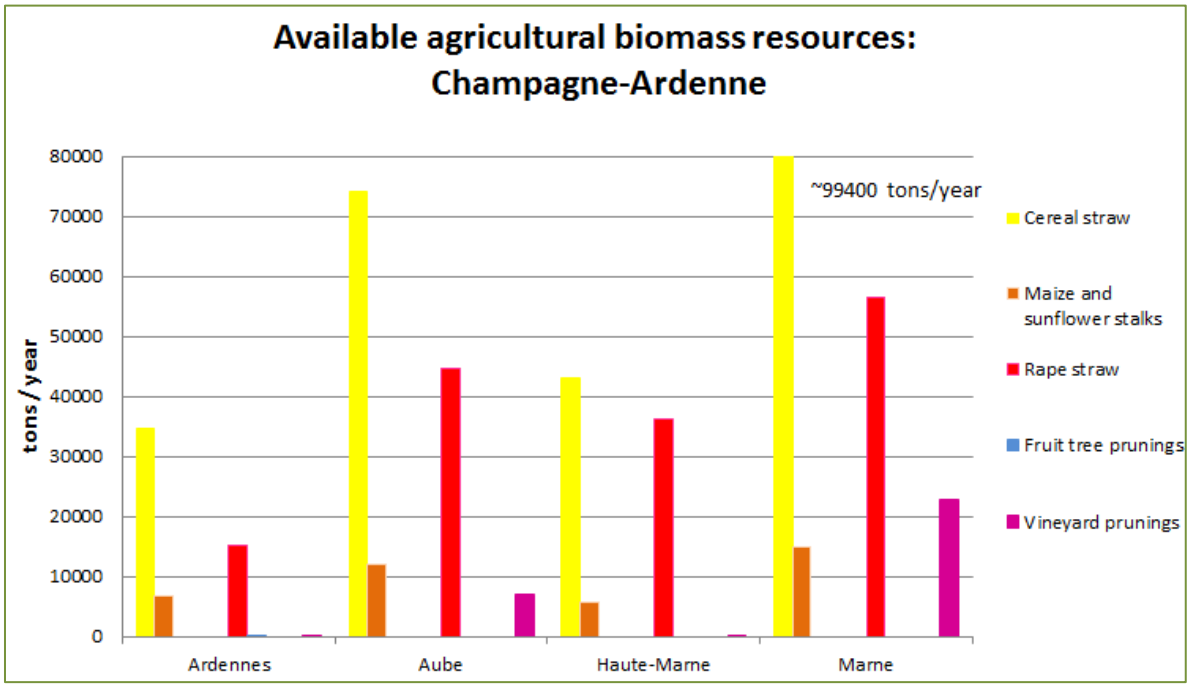

Figure 5: Summary of available agricultural biomass residues in Champagne-Ardenne.

Main conclusions in Champagne-Ardenne:

- In Champagne-Ardenne, residues from herbaceous crops (straw from cereals, maize and rape) are the main source to be considered. Straw from cereals is the prevailing residue, even though the straw from rape, as second resource in most departments, is very. More than 290 kt per year is the total available potential of the annual crop residues. All departments account with a significant amount.
- The provinces of Aube and specially Marme present also an interesting availability of prunings from vineyard, a woody material very appreciated for the production of solid biomass. Marme accounts with a potential available of more than 20 kt, which is a fact to be considered for any energy planning.
- Agro-industry residues from cereal dryers mainly but also from the sugar industry and the distilleries should also be considered as complement for mixed pellets.

6.3. Localization of resources and agro-industries in Champagne-Ardenne

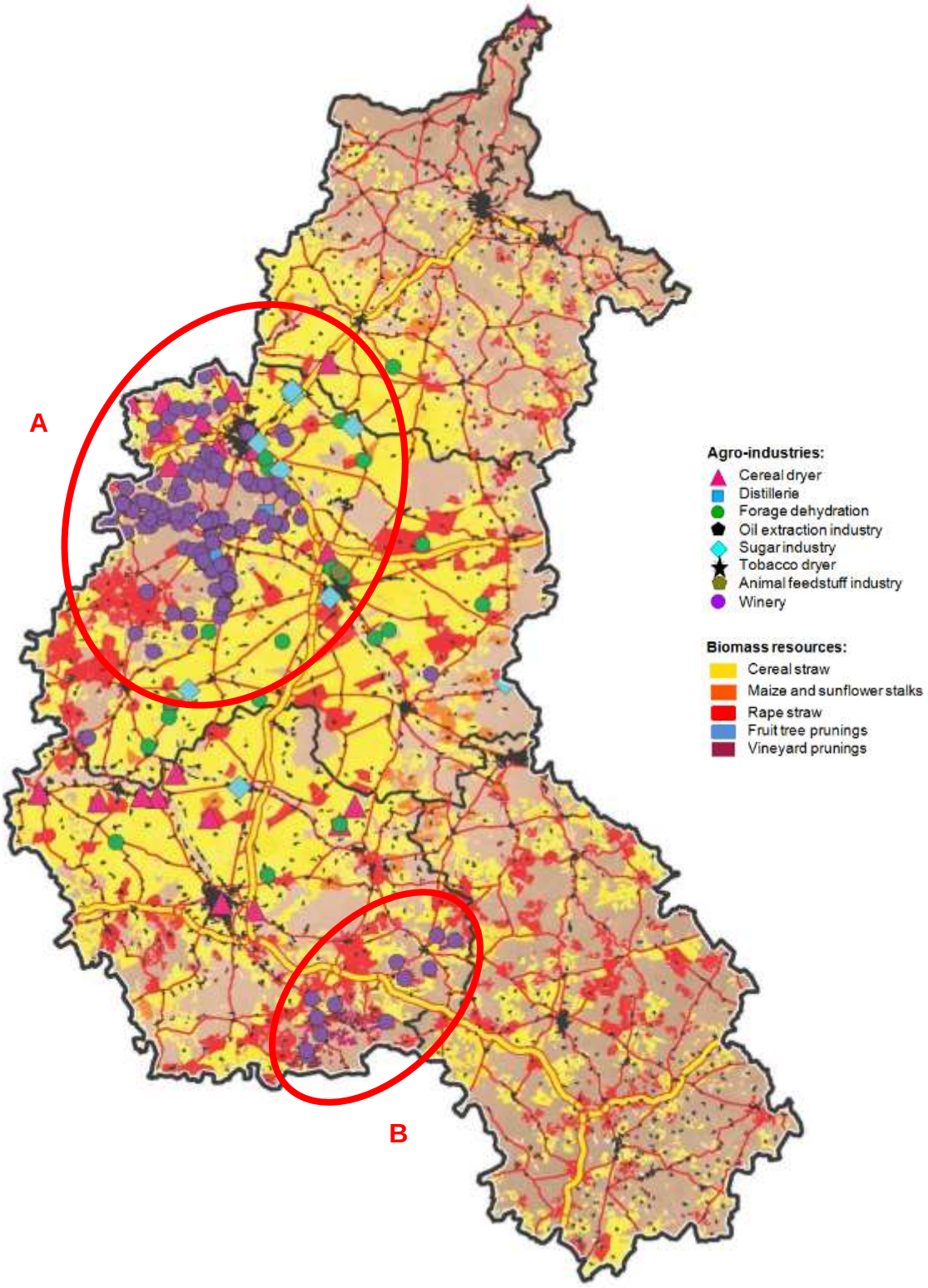

Figure 6: Localization and type of agro-industries and resources in Champagne-Ardenne.

6.4. Priority areas in Champagne-Ardenne

Potential áreas for the development of an agro-industry logistic centre have been detected in Champagne-Ardenne and are shown in Figure 6. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both woody and herbaceous) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 5, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 5: Availability of equipment and biomass resources in Champagne-Ardenne.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Forage dehydration												
Cereal dryer												
Distillery												
Sugar industry												
Cereal straw												
Maize straw and cobs												
Rape stalks												
Husks and silo dust from cereal dryers												
Grape marc and stems												
Distillery residues												
Husks and residues from oil seeds												
Beet pulp												
Permanent crop prunings												
Feedstuff residues												

The situation could be summarised as follows:

- Area A: the potentiality of this area lies on the different agro-industry sectors available, together with the amount of woody residues from the important vineyard cultivations. Among all, the most interesting synergy in this region would be the forage dehydration and sugar industry facilities processing the prunings from the vineyards existing in the area. Cereal and rape straw together with the residues from cereal dryers, distillation process and feedstuff industries could be used as a complement for the production of a mixed pellet.

  Cereal dryers could also become logistic centres if a new dryer is installed for this purpose, using the storage and handling facilities of their regular activity.

  The concentration of agro-industries makes this area an important centre for the consumption of the solid biomass produced in the logistic centre.

- Area B: this area has been defined as potential due to the amount of vineyard prunings available that could be the raw material of possible logistic centres implemented in the cellars (a new line for this purpose should be constructed).

7. Regional Framework of ILE-DE-FRANCE

7.1. Identification of agro-industries in Ile-de-France

The interesting agro-industries to become a logistic centre in Ile-de-France are:

- **Cereal dryers**: important concentration of cooperatives just in the border with Yonne (Bourgogne), Loiret (Centre) and in the area of East of Seine et Marne.
- **Sugar industries:** sited in the area of Paris.

These agro-industries can also be considered as biomass resources suppliers.

7.2. Identification of biomass resources in Ile-de-France

Île de France presents a disparity among the departments. The urban predominant profile of the departments which from part of the metropolitan area of Paris have no agrarian production, and therefore, no residues available. The rest of the departments have straw as principal residue available, and rape as second in importance. Maize is only present with relevance to be mentioned at regional scale in Seine-et-Marne department. The total biomass available, that is, the biomass evaluated as not having competitive uses, adds a total of 192 kt/yr.

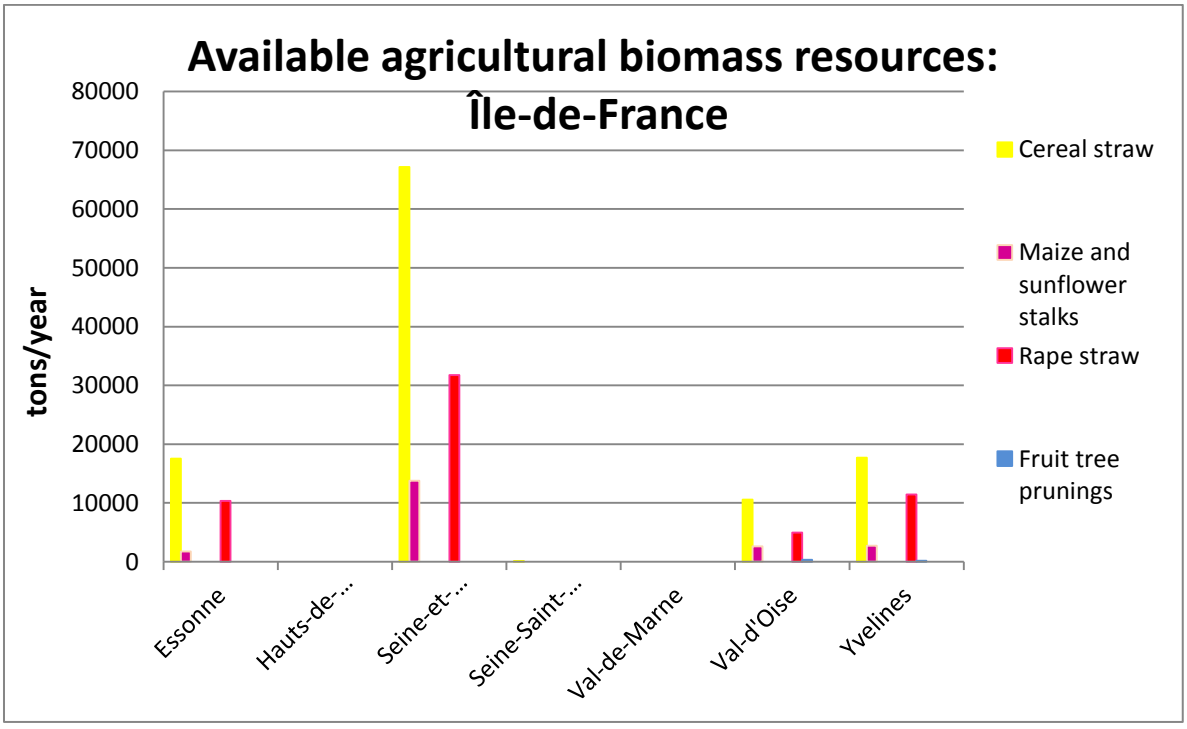

Figure 7: Summary of available agricultural biomass residues in Ile-de-France.

Main conclusions in Île-de-France:

- The provinces to take into account in the region of Ile de France, from the point of view of biomass resources, are Essone, Seine-et-Marne, Val-d'Oise and Yvelines.
- As in all France, in these provinces, the main resources available come from herbaceous crops straw (cereal, rape and maize/sunflower). The main source of biomass still available is cereal straw, even though rape straw is also important source. Maize and sunflower stalks can contribute as complement biomass source in rest of departments. Only can be a source of biomass for logistics centres on its own in Seine-et-Marne.
- No woody crops from agriculture are present in this region and therefore forest residues should be considered if wood is needed to improve the quality of the biomass to be commercialised.
- Residues coming from cereal dryers and sugar industry can also be a complement for the existing resources to produce a mixed pellet.

7.3. Localization of resources and agro-industries in Ile-de-France

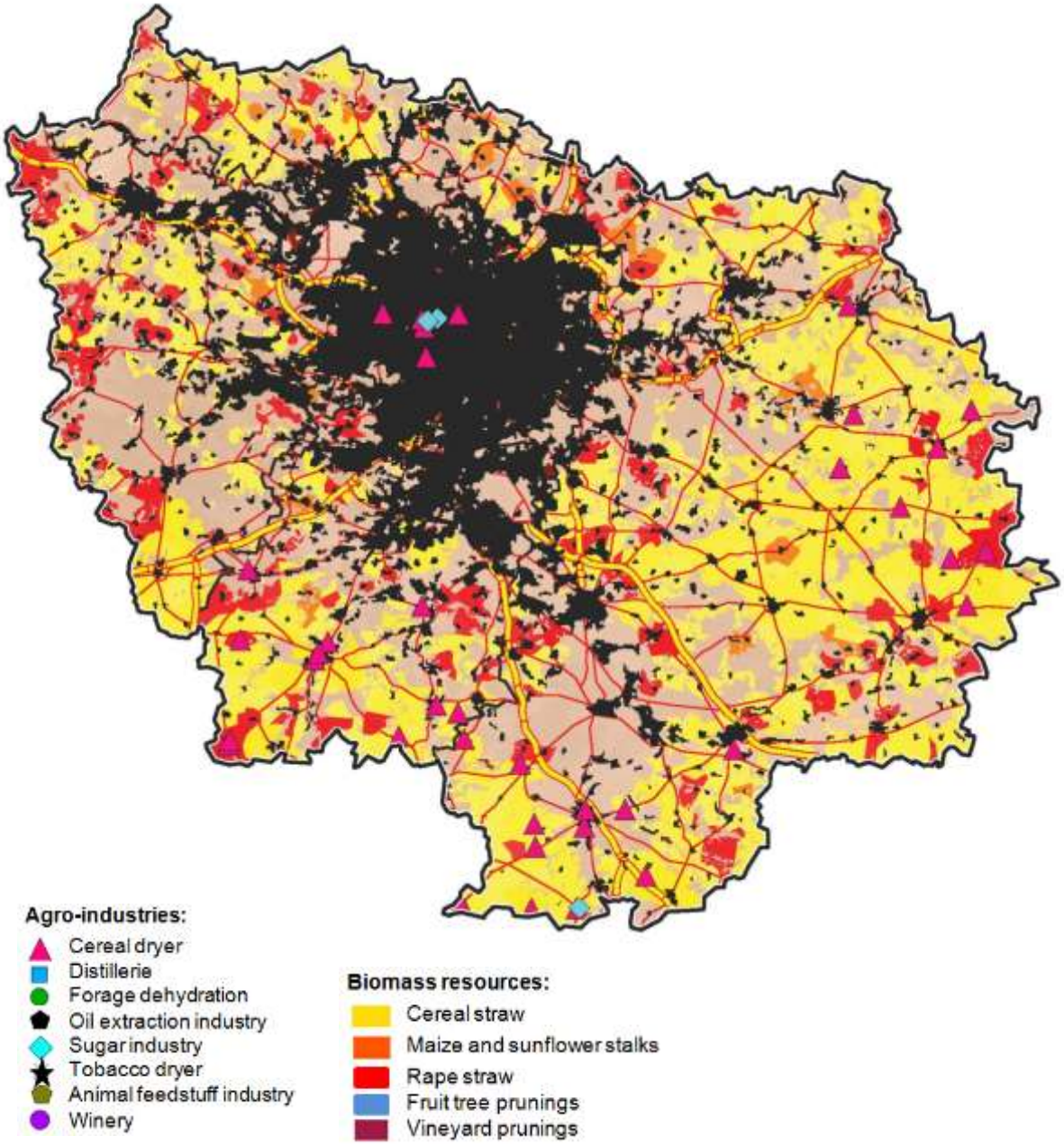

Figure 8: Localization and type of agro-industries and resources in Ile-de-France.

7.4. Priority areas in Ile-de-France

No clear potential areas for the development of an agro-industry logistic centre have been detected in Ile-de-France. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources and agro-industries (both woody and herbaceous) as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 6, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 6: Availability of equipment and biomass resources in Ile-de-France.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cereal dryer												
Sugar industry												
Cereal straw												
Maize straw and cobs												
Rape stalks												
Husks and silo dust from cereal dryers												
Beet pulp												

The region presents an important population area, Paris, which takes a great part of the total surface. Although the industrial area of the city can be considered as an important consumer market, there are not so many agro-industries where to implement the biomass logistic centre. No clear potential areas have been detected.

In any case, if an agro-industry logistic centre wants to be developed, forest residues and sawdust should be an important complement to the available straw (cereal and rape). A new line for processing the raw material should be implemented either in the sugar or in the cereal dryers.

8. Regional Framework of PICARDIE

8.1. Identification of agro-industries in Picardie

The interesting agro-industries to become a logistic centre in Picardie are:

- **Cereal dryers**: The most important quantities of cereal production can be found in a triangle formed between Amiens, Beauvais, Compiegne. Around 50 facilities can be found in the region mostly located in the central part.
- **Sugar industries:** a quite important sector with 6 facilities in the region.

Apart from these two sectors, the additional agro-industries identified as biomass resources suppliers are: cellars (in the south of Aisne, around Chateau Thierry with 2.400 ha cultivated).

8.2. Identification of biomass resources in Picardie

Among the target regions of SUCELLOG in France, Picardie is the second region in importance when the availability of agrarian biomass resources is the question of analysis. The available biomass has been evaluated to be over 650 kt/yr, mainly produced as straw from cereal and rape plantations. Cereal is predominant with respect to rape, which still is quite abundant from the perspective of implementing new logistics centres. The profile is similar to Champagne-Ardenne and Centre, with the difference that here wood from permanent crops can be only obtained in very limited amounts in Aisne department.

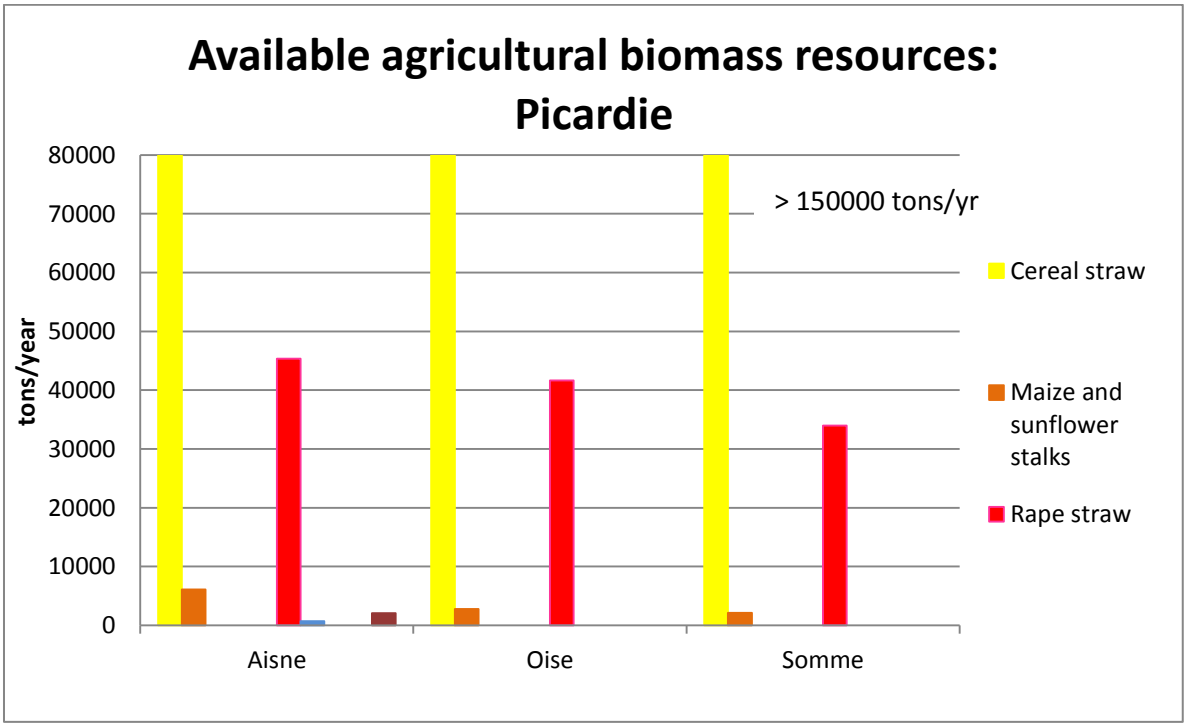

Figure 9: Summary of available agricultural biomass residues in Picardie.

Main conclusions in Picardie:

- Picardie region is notable for the production of cereal and rape straw and therefore is a territory where this kind of resources could be used for the production of solid biomass commodities.
- The prunings from permanent crops (vineyards and fruit tree) are also present in a very specific area of the region of Aisne, where they could be considered as a local biomass source.
- Agro-industry residues coming from the cereal dryers and sugar beet pulp could also be of interest as a complement to other sources.

8.3. Localization of resources and agro-industries in Picardie

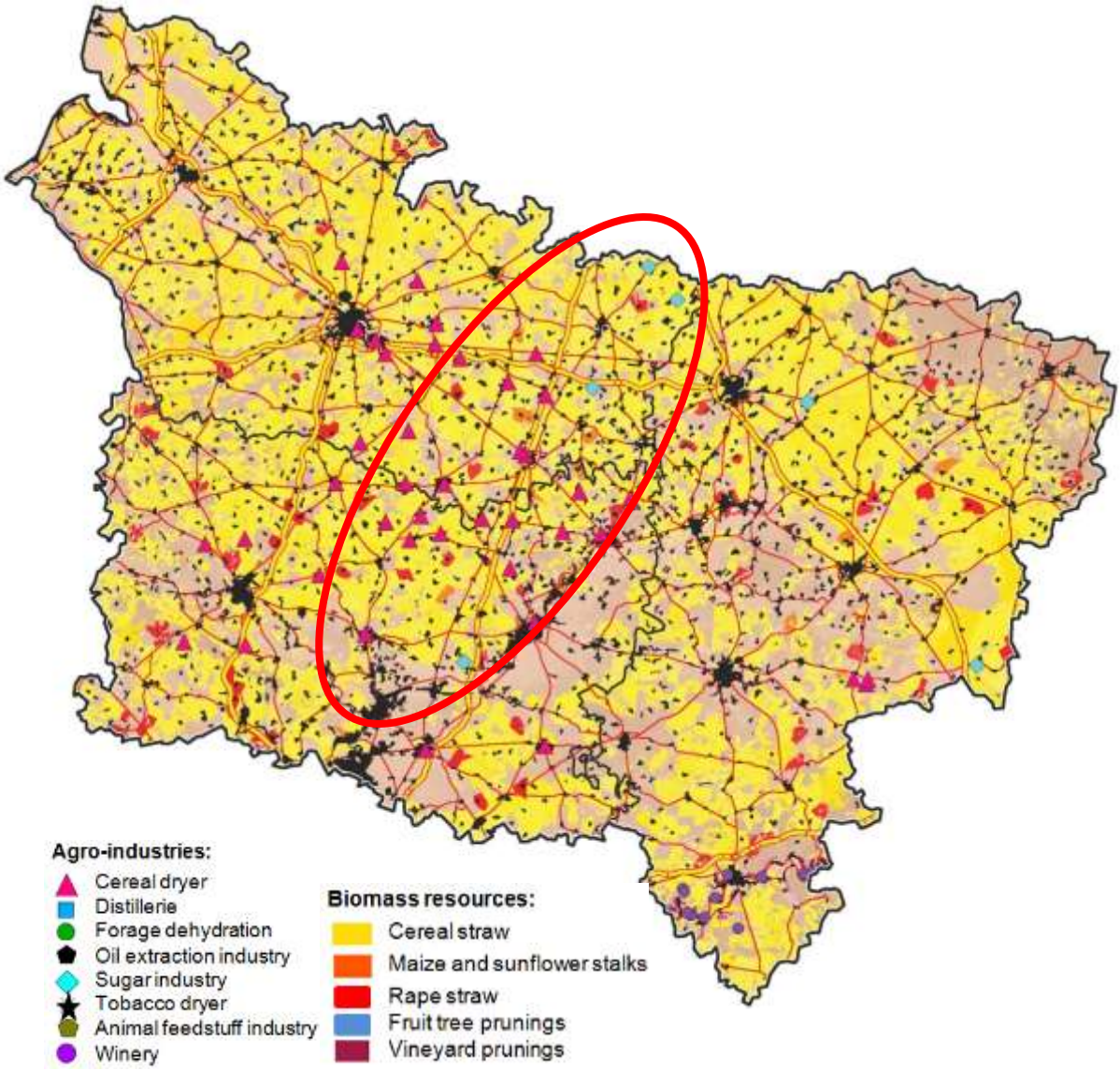

Figure 10: Localization and type of agro-industries and resources in Picardie.

8.4. Priority areas in Picardie

As already mentioned in the introduction, the criteria to select potential areas takes into account the diversity of resources (both woody and herbaceous) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 7, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 7: Availability of equipment and biomass resources in Picardie.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cereal dryer												
Sugar industry												
Cereal straw												
Maize straw and cobs												
Rape stalks												
Husks and silo dust from cereal dryers												
Beet pulp												
Permanent crop prunings												

The creation of the logistic centre in Picardie will rely on the supply of forest residues and sawdust as a quality complement for the herbaceous crops present in the region (straw from cereals and rape) since no agricultural woody resources of relevance are available.

One potential area has been detected to allocate an agro-industry logistic centre (see Figure 10). It presents sugar industries able to process the straw and forest residues producing solid biomass to be consumed in the large amount of cereal dryers present in the area.

9. Regional Framework of RHÔNE-ALPES

9.1. Identification of agro-industries in Rhône-Alpes

The interesting agro-industries to become a logistic centre in Rhône-Alpes are:

- **Cereal dryer:** the major part of agro-industries is placed along the Rhône/Saône river with an important area of corn cultivation. Along the Upper Rhône River it can also be found some cereals suppliers in this region, but only little cooperatives.
- **Distilleries:** one of the bigest is in Ardèche (South).
- **Tobacco industries:** 3 tobacco industries are sited in the region.

Apart from those sectors, the feedstuff producers and oil extraction industries could also be considered as target if they dedicate one line exclusively to the production of solid biomass.

Other biomass resources suppliers are: cellars (most of the wine industries are in the Saône/Rhône valley since vineyards are concentred in this part of the territory).

9.2. Identification of biomass resources in Rhône-Alpes

Rhône-Alpes, similar to Auvergne, is a region where the principal available biomass by-product is composed by maize and/or sunflower stalks. This type of biomass is quite abundant in Ain, Drôme and Isère. In the rest of departments this type of biomass is also predominant, but, however, from the perspective of starting a new logistic centre on biomass, it is unsufficient. These departments have limited residues produced by agrarian activities.

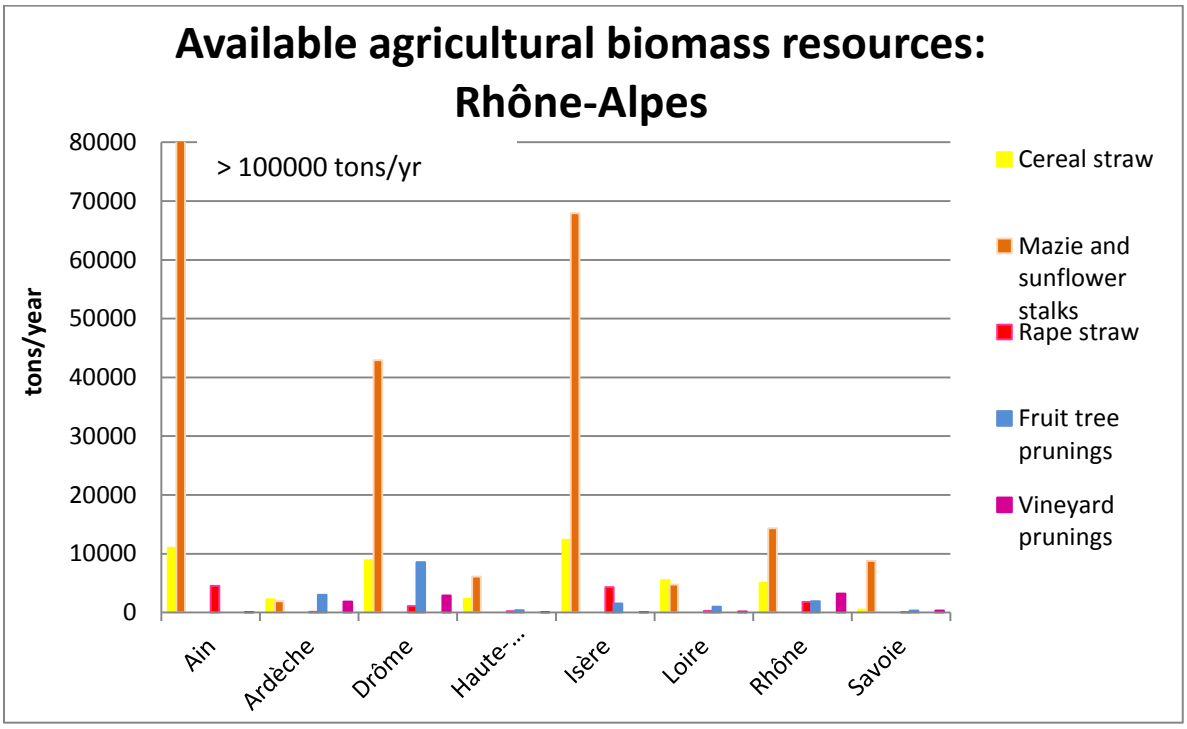

Figure 11: Summary of available agricultural biomass residues in Rhône-Alpes.

Main conclusions in Rhône-Alpes:

- Maize and/or sunflower stalks is definitively the main biomass to be considered for starting a new activity in the distribution of solid biomass products. This is particularly true for Ain, Drôme and Isère departments, which account with important resources. Rest of departments have biomass available under 10 kt/yr, which is unsufficient for starting new logistic biomass centres.
- Prunings from fruit trees and vineyard can be an option to be considered when aiming to develop a logistic centre of solid biomass. The amounts available of relevance at regional to be mentioned correspond to Drôme. In some other departments woody biomass from prunings may play a role locally, even though these departments do not account with sufficient biomass resources from the agrarian sector, and so, are quite in principle not targets for SUCELLOG logistics centres.
- Residues from the wine and cereal dryer sector could also be taken into account.

9.3. Localization of resources and agro-industries in Rhône-Alpes

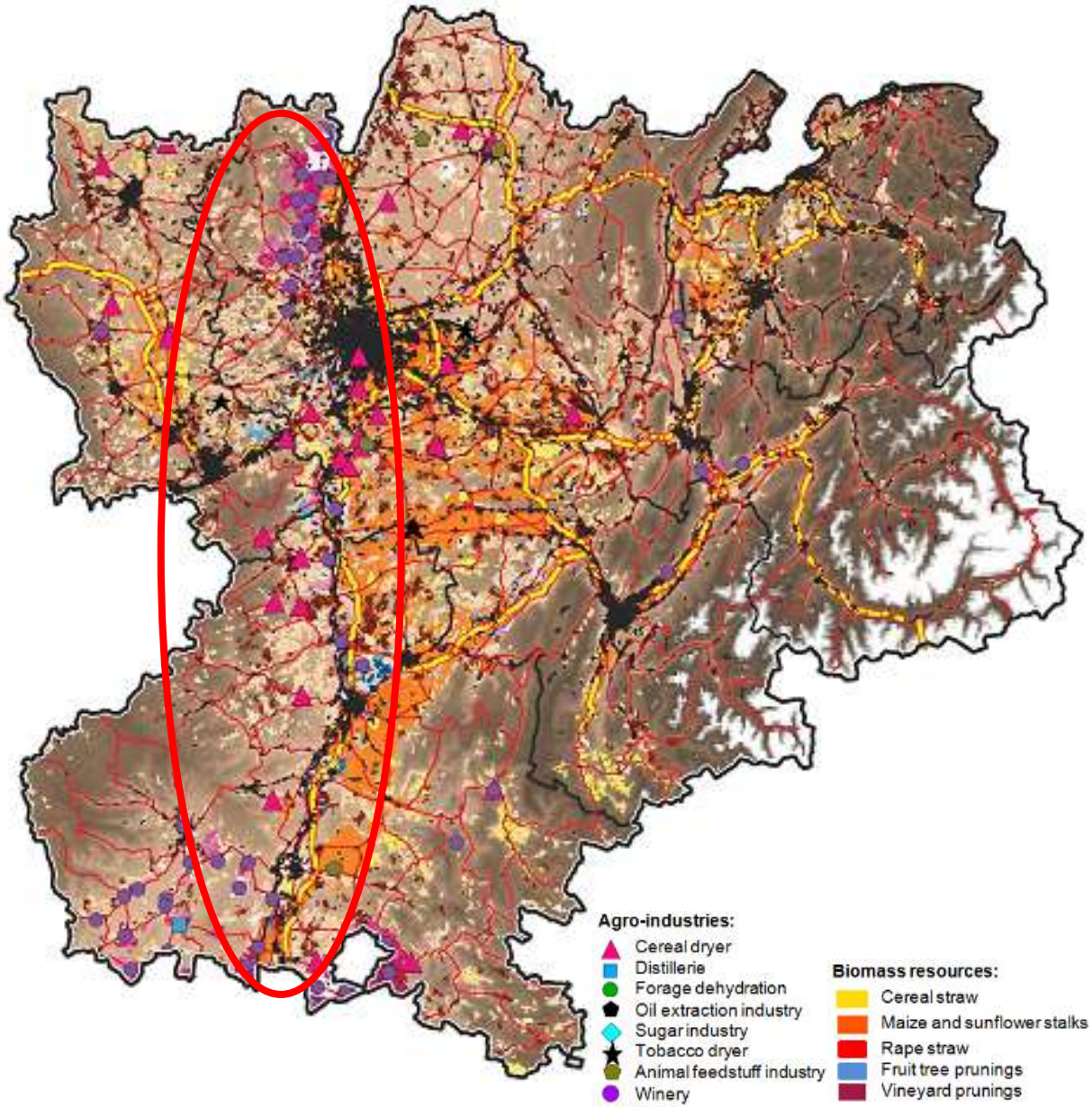

Figure 12: Localization and type of agro-industries and resources in Rhône-Alpes.

9.4. Priority areas in Rhône-Alpes

One potential area for the development of an agro-industry logistic centre has been detected in Rhône-Alpes and is shown in Figure 12. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources and agro-industries and the compatibility among them. Compatibility has been defined according to their seasonality, see Table 8, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 8: Availability of equipment and biomass resources in Picardie.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cereal dryer												
Distillery												
Tobacco dryer												
Cereal straw												
Maize straw and cobs												
Husks and silo dust from cereal dryers												
Grape marc and stems												
Oil extraction residues												
Tobacco residues												
Permanent crop prunings												
Feedstuff residues												

The potential area in this region covers mainly the Saône/Rhône Valley. The production of biomass could be focused on the use of maize straw and fruit tree/vineyard prunings as a complement. Logistic centres could be hosted in the cellars or in cereal dryers where a new line for drying and pelletising should be implemented. Residues from the cereal dryers and feedstuff producers can also serve as a complement for mixed pellets.

The distillery present in the south could diversify its activity acconditioning their own residues to fulfill solid biomss standards.

10. Summary of the situation in France

SUCELLOG project has evaluated the six target regions in France (Auvergne, Centre, Champagne-Ardenne, Ile-de-France, Picardie and Rhône-Alpes) in terms of agrarian resources and agro-industry sectors for the development of biomass logistic centres.

Regarding the quantity of available resources, the straw from herbaceous crops (cereal, rape and maize) is the most interesting resource to be taken into account in France. However, to be able to upgrade the quality of the resulting fuel, a woody source should be acquired, being in some regions possible to come from agrarian sources (prunings from vineyards) but in others only forest residues would be available. Residues from the agro-industry could be a complement for a mixed pellet although they do already have a market, which in some cases is even bioenergy (biogas production from sugar or distillery process residues for example).

Concerning the agro-industry sectors, the ones evaluated within the project in France have been: forage dehydration facilities, cereal dryers, sugar industry, distilleries, tobacco dryers, cellars, oil extraction industries and feedstuff producers. All of them have been considered target for the project except the last two, since the extraction industries and the feedstuff producers, even if they have compatible equipment for the production of solid biomass, do work during the whole year having no idle period for this new activity, unless a new line is installed or their current production decreases due to market issues. From the rest, forage dehydration facilities are already a very integrated industry, working in many cases as logistic centres to diversify their activity for the production of animal feed or even to produce woody pellets coming from forest sources. Cereal dryers, due to their vertical drying system, are not really compatible with the majority of available residues in France (with no granulated format) and therefore their strength as logistic centre rely on their handling and storage equipment. In the case of the cellars, they have been included as target, even if they do not own compatible equipment but their easy access to an agrarian woody residue (vineyard prunings) and the interest shown by the sector, makes this particular case interesting for the project.

Potential areas for the development of logistic centres have been identified in all regions except in Ile-de-France which does not imply that it could be not placed in that region. Association among nearby industries should be promoted in France in order to take advantage of the different idle periods and equipment and it won't be a barrier since the agrarian sector is used to it.

For further details please see the document in French "D3.2- Analyses régionales : ressources en biomasse et aires d'action prioritaires en France" prepared by CIRCE in deep collaboration with Services Coop de France.

Annex I: Table of ratios y availability percentage per region

Table 9: Ratios of biomass production (t/ha) in FRANCE per region.

Crop	Auvergne	Centre	Champagne-Ardenne	Ile-de-France	Picardie	Rhône-Alpes
Wheat	3,5	3	3,3	3,3	3,5	3,5
Rye	1	1	1	1	1	1
Barley	3	3,64	3,3	3,3	4	3
Oat	1	1	1	1	1	1
Maize	5	5,9	3,3	3,3	5	5
Rice	2	2	2	2	2	2
Pulses	1	5	2,6	2,6	4,5	5
Tobacco	2,5	-	-	-	-	2,5
Hemp	-	-	-	-	-	-
Rape	2	1,2	2	2	2,5	2
Sunflower	1	2,5	2,5	2,5	2,5	1
Soya	2,7	2,7	2,7	2,7	2,7	2,7
Lineseed	1	1	1	1	1	1
Seed_other	1	1	1	1	1	1
Fruit_temp	1,5	1,5	1,5	1,5	1,5	1,5
Fruit_subtrop	1,5	1,5	1,5	1,5	1,5	1,5
Berry	-	1,5	1,5	1,5	1,5	1,5
Nuts	-	1	-	-	-	1,1
Citrus	-	-	-	-	-	-
Olive	-	-	-	-	-	-
Vineyard	3,5	1,5	1,8	-	1,5	1,5

Table 10: Percentage of availability of biomass in FRANCE per region.

Crop	Auvergne	Centre	Champagne-Ardenne	Ile-de-France	Picardie	Rhône-Alpes
Wheat	5	30	14,4	14,4	30	5
Rye	30	30	14,4	14,4	30	30
Barley	30	50	14,4	14,4	30	30
Oat	30	50	14,4	14,4	30	30
Maize	50	5	17,4	17,4	5	50
Rice	-	-	-	-	-	-
Pulses	-	0	0	0	0	0
Tobacco	90	-	-	-	-	90
Hemp	-	0	-	0	-	-
Rape	50	50	50	50	50	50
Sunflower	50	50	50	40	50	50
Soya	70	70	-	-	-	70
Lineseed	-	75	75	80	75	
Seed_other	75	75	75	75	75	75
Fruit_temp	90	90	90	90	90	90
Fruit_subtrop	-	-	-	-	-	-
Berry	-	90	90	90	90	90
Nuts	-	90	-	-	-	90
Citrus	-	-	-	-	-	-
Olive	-	-	-	-	-	-
Vineyard	20	90	90	90	90	20