Projet Gaya

GDF SUEZ

ÊTRE UTILE AUX HOMMES

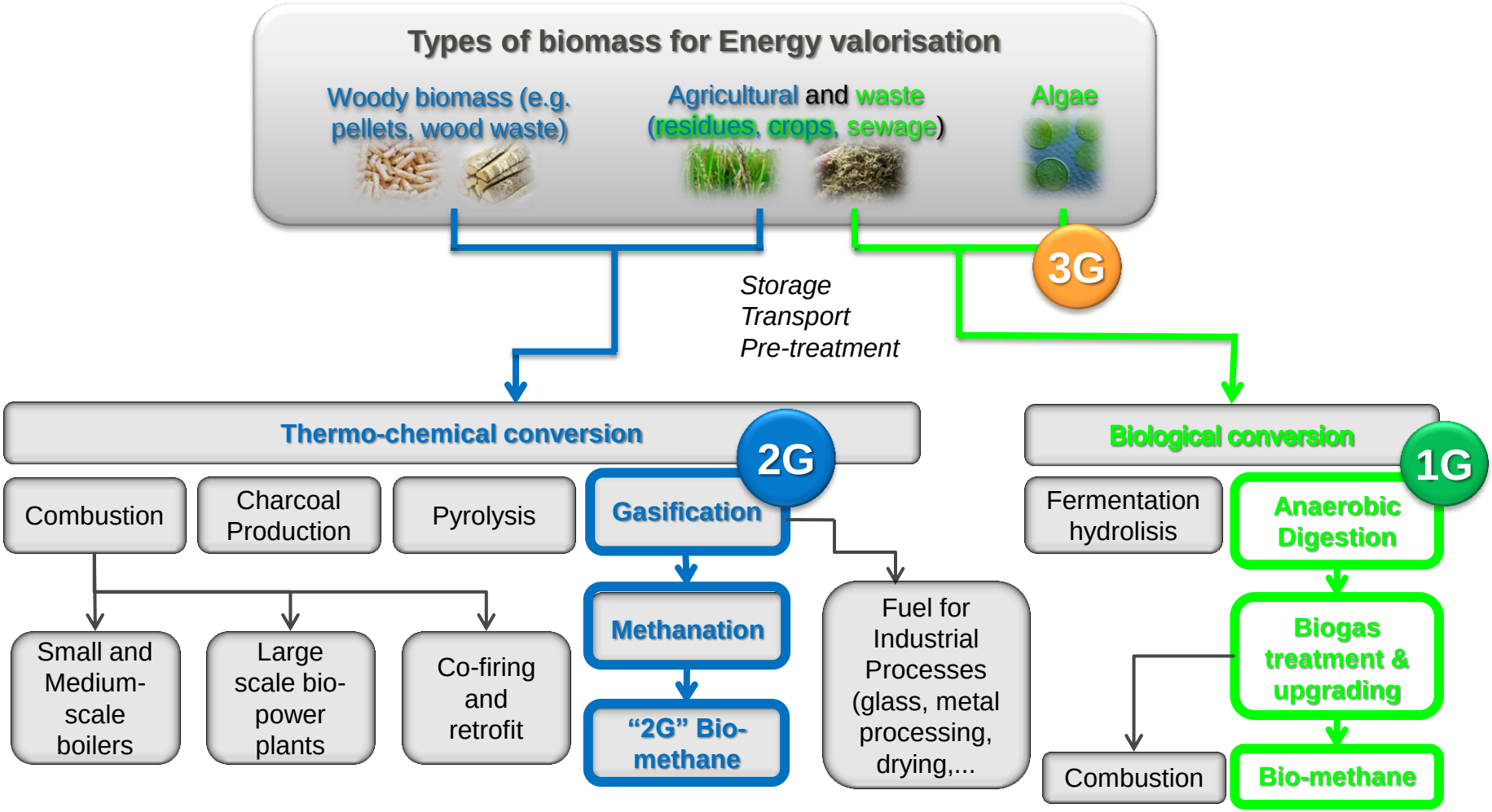
Optimisation territoriale de l'approvisionnement en biomasse pour des unités de production de biométhane de 2éme génération

Fondation Tuck – Think Tank Idées Biomasse
10 Février 2014

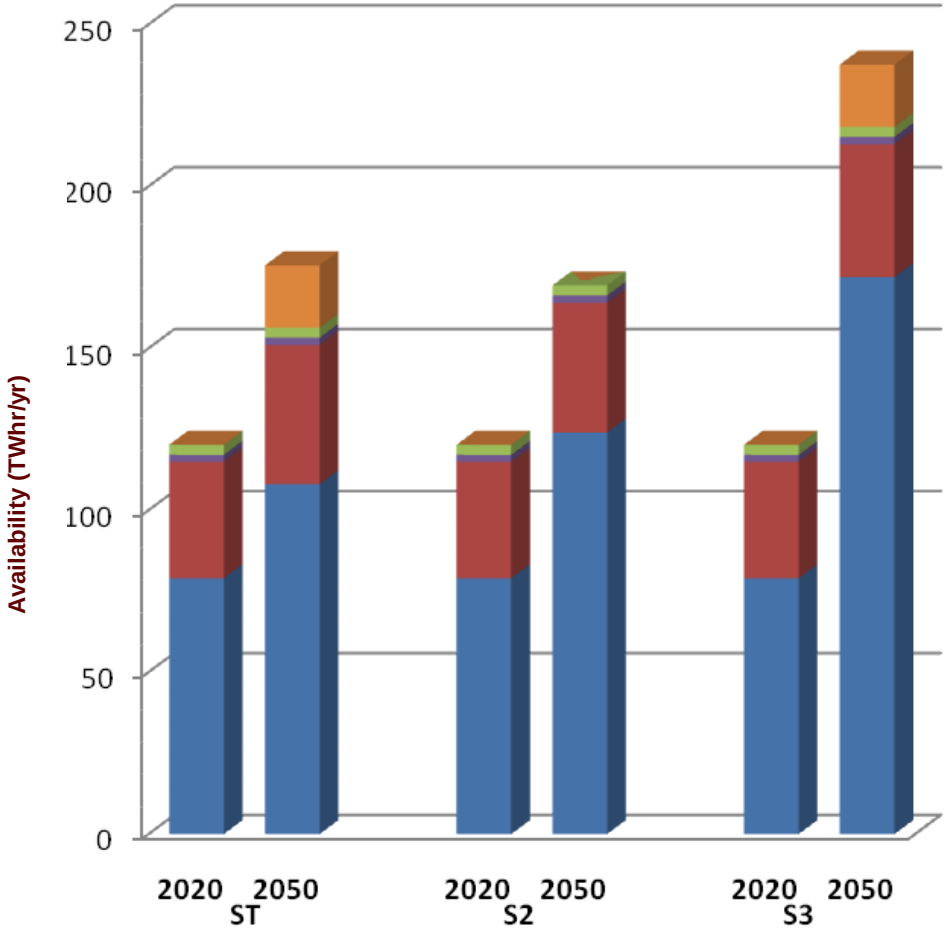
"crigen
Research Center on Gas & New Energies

RESEARCH & INNOVATIVE DIVISION

Biomass for Energy -

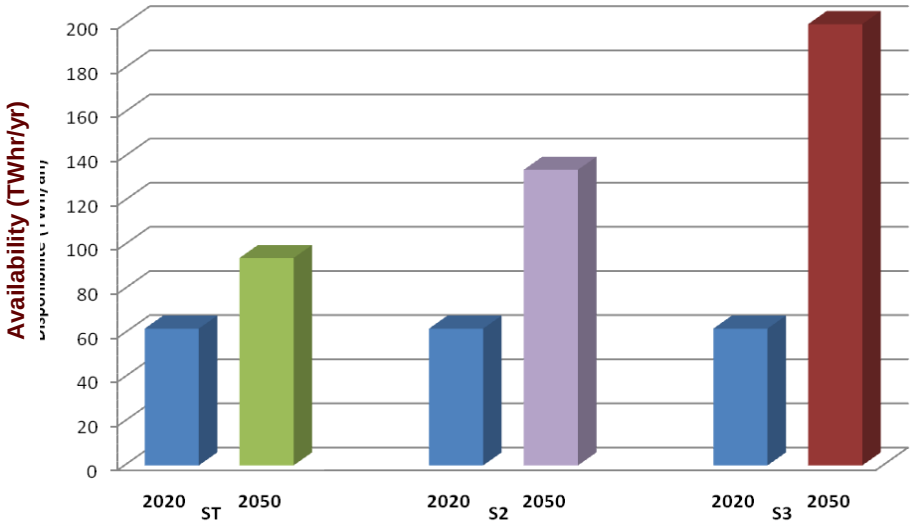


Biomass availability for biomethane production and biomethane production potential – *GrDF Study*



- Importations
- Food processing industry residues
- Wood wastes
- Agricultural residues
- Woody biomass

Energy crops



Biomass resource availability by 2020 and 2050

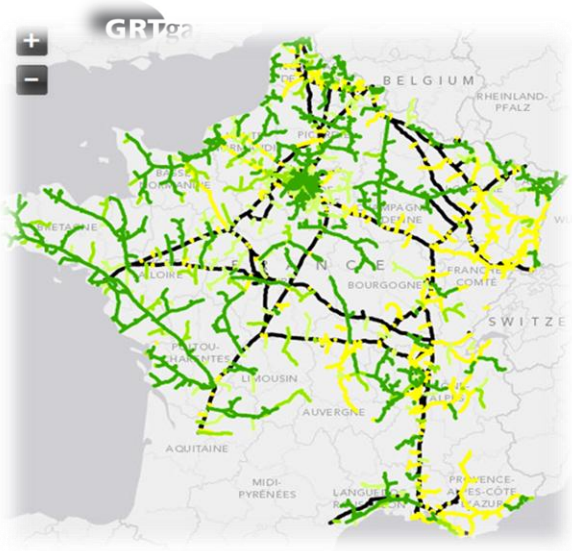
* *Studies from GRDF – 2013 – availaible at : Lien Web*

Gas grid operators in France

Commitments in 2013 for implementing renewable gas

GRTgaz

Construisons le transport de demain

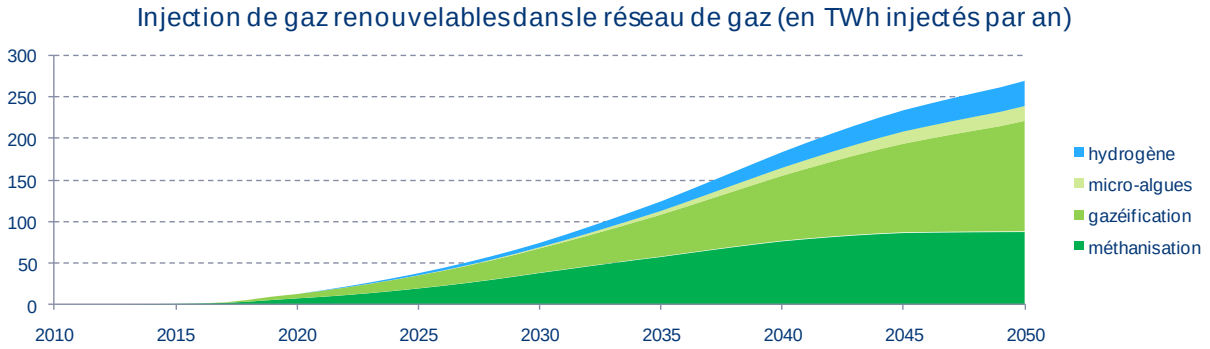


- **RESOVERT Tool**

  www.grtgaz.com

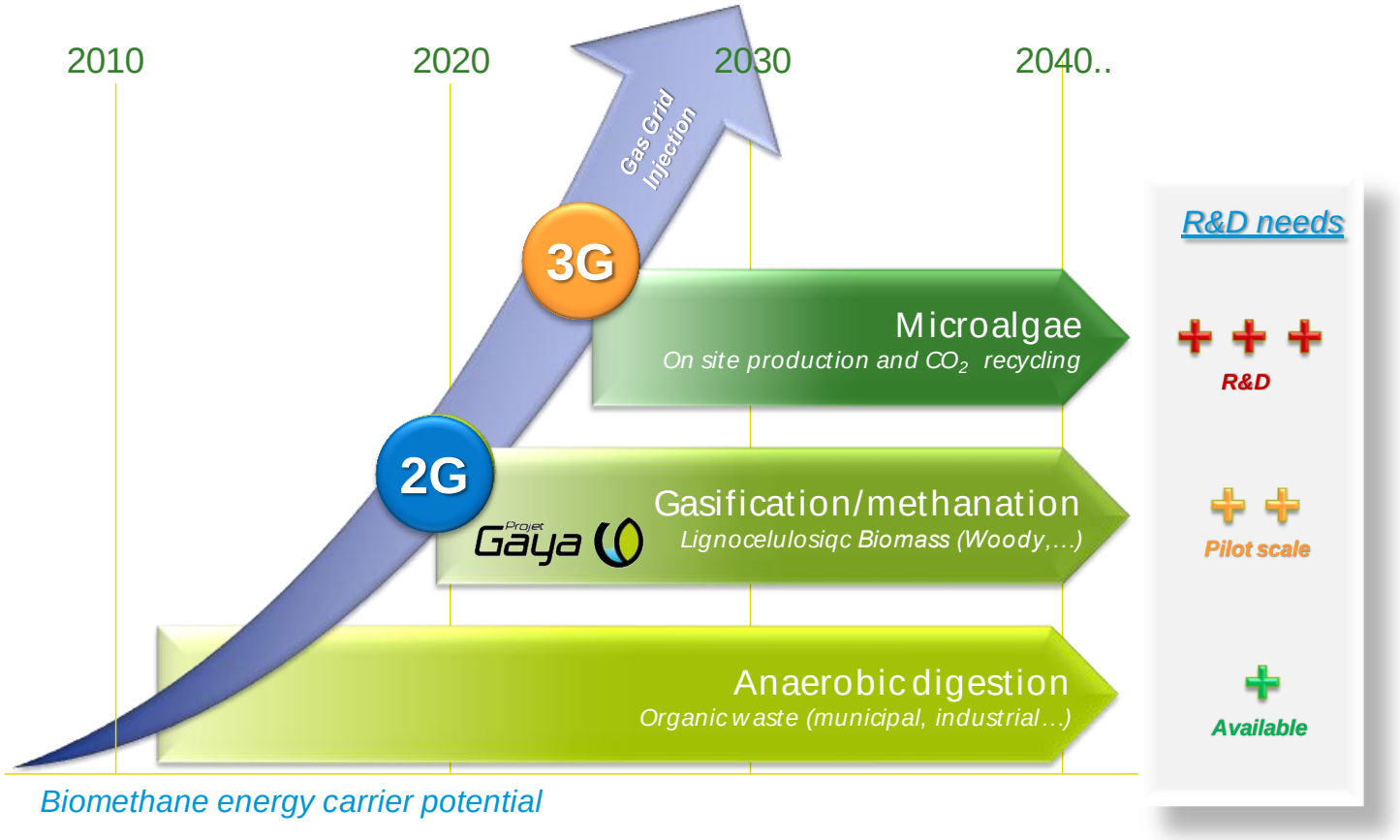
GrDF ROADMAP for green gases :

- *67% of green gases in 2050*
- *up to 133 TWh of BtG (24%)*



1 BioSNG energy carrier : 3 generations of technologies

Complementary pathways targeting different resources



Biomethane energy carrier potential

2G Max technical potential

- Today : 75 TWh
- *2020 : 100 TWh**
- *2050 : 185 TWh**

Raw potential 2050 ≈ **200** BioSNG units in France

* *Studies from GRDF – 2013 – availaible at : Lien Web*

The GAYA R&D Project : Towards industrialization of 2G

Enable the potential of 2G Biomethane

2011 **R&D** **Lab Concept**

2017 **R&D Pilot**

2020 **Industrialization**

Projet Gaya

400 kW_{bioSNG}

30 Nm^3/h

20 à 60 MW_{bioSNG}

2 000 - 6 000 Nm^3/h

- Validate at pilot scale **a integrated portfolio of technology solutions** to **support industrial deployment** and **secure some competitive advantages** for the GDF SUEZ Group

- A project with an **integrated vision of the pathway** *: "from biomass to injection in the grid"*
- Develop a **profitable industry** by 2017 → **need to reach competitive costs for 2G Biomethane**
- Support the development of a regulatory framework and an incentive context at European level

2G : 98 % injection feasibility with a local biomass procurement (< 50 km)

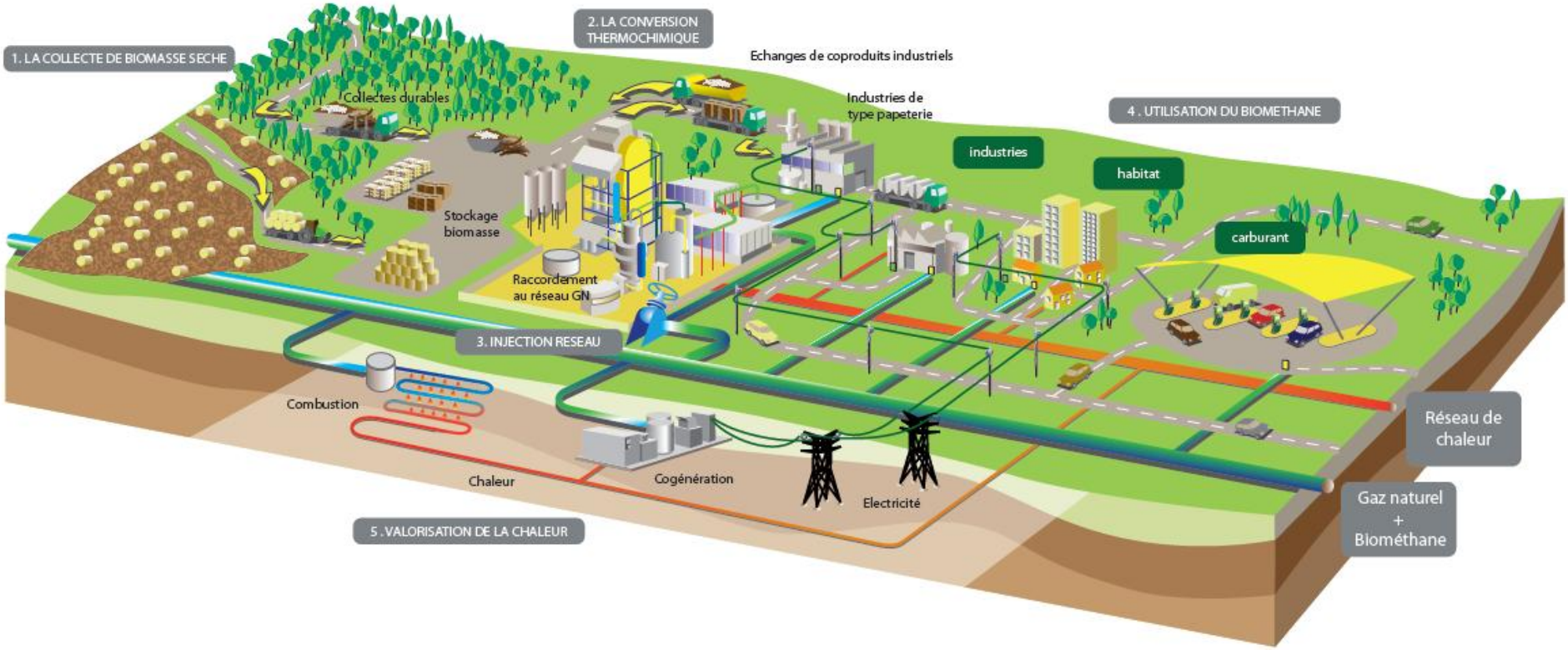
Table 27: Area coverage with different width of catchment radii around the French gas transport grid

	length of delivered gas grid [km]	Area coverage with different catchment radii						
		2 km	5 km	10 km	25 km	50 km	75 km	100 km
Alsace	1 330	30%	62%	85%	100%	100%	100%	100%
Aquitaine	1 247	16%	37%	61%	94%	100%	100%	100%
Auvergne	1 197	10%	24%	45%	81%	99%	100%	100%
Bourgogne	868	14%	31%	55%	93%	100%	100%	100%
Bretagne	2 019	15%	37%	65%	99%	100%	100%	100%
Centre	835	19%	44%	74%	100%	100%	100%	100%
Champagne-Ardenne	1 117	19%	44%	74%	100%	100%	100%	100%
Franche-Comte	1 126	15%	32%	55%	94%	100%	100%	100%
Ile-de-France	1 673	39%	77%	98%	100%	100%	100%	100%
Languedoc-Roussillon	664	11%	26%	45%	75%	97%	100%	100%
Limousin	617	11%	26%	46%	87%	100%	100%	100%
Lorraine	1 709	26%	57%	88%	100%	100%	100%	100%
Midi-Pyrenees	1 085	12%	27%	49%	90%	100%	100%	100%
Nord-Pas-de-Calais	1 022	34%	70%	95%	100%	100%	100%	100%
Normandie-Basse	1 797	18%	42%	72%	99%	100%	100%	100%
Normandie-Haute	1 374	26%	56%	87%	100%	100%	100%	100%
Pays de la Loire	497	20%	46%	74%	100%	100%	100%	100%
Picardie	1 869	23%	51%	81%	100%	100%	100%	100%
Poitou-Charentes	694	15%	34%	60%	99%	100%	100%	100%
Provence-Alpes-Cote d'Azur	821	12%	28%	47%	74%	95%	100%	100%
Rhone-Alpes	1 041	16%	36%	60%	86%	100%	100%	100%
Overall Metropolitan France [excl. Corse]		***17%***	***39%***	***64%***	***93%***	***99%***	***100%***	***100%***
Overall Metropolitan France [incl. Monaco, Corse]	***24 604***	***17%***	***38%***	***63%***	***91%***	***98%***	***98%***	***98%***

Source : Etude Deutsches Biomasseforschungszentrum (DBFZ) – GDF SUEZ - 2009

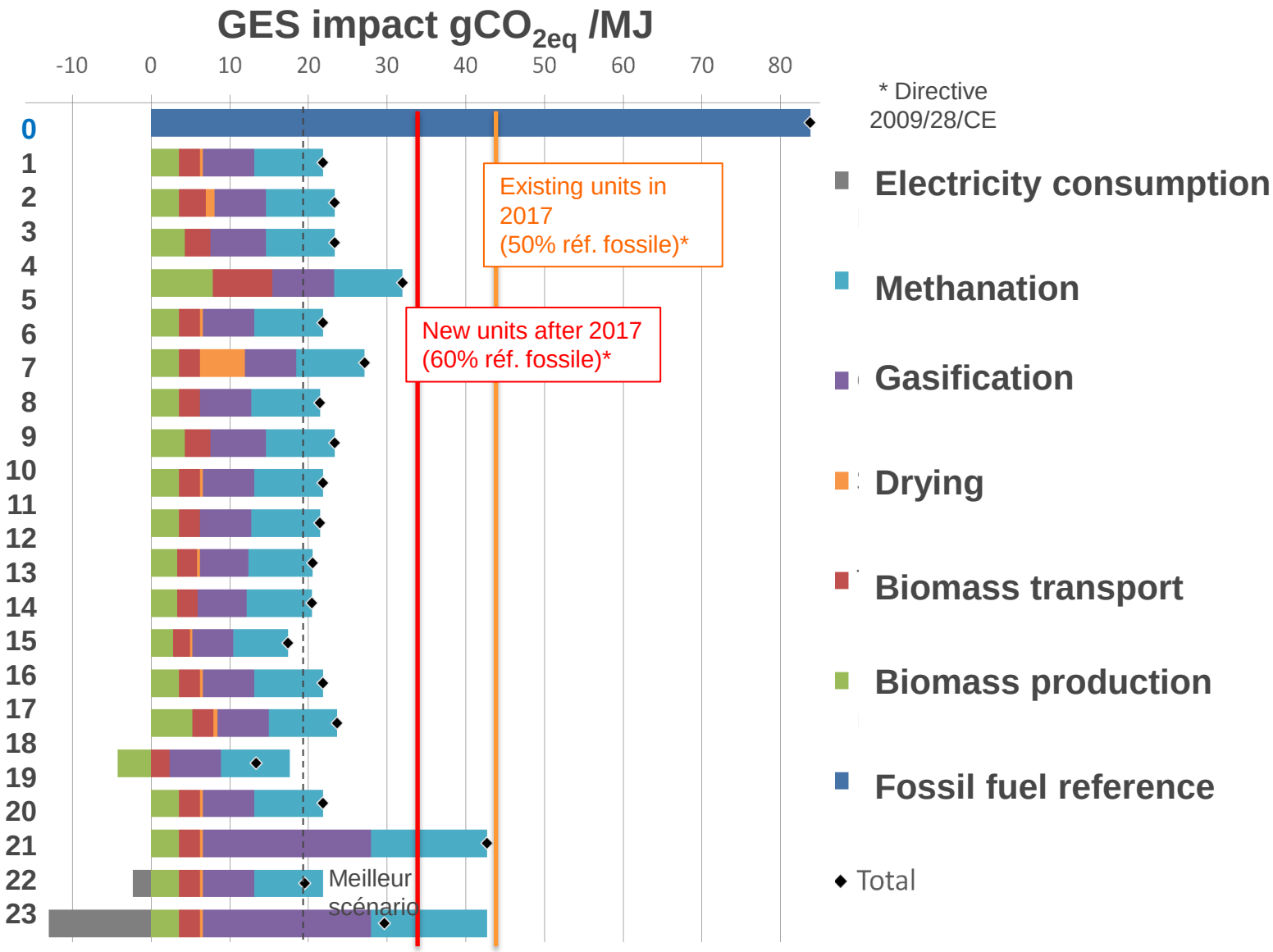
Decentralized production of biomethane 2G

A sustainable pathway with short supply radius and local heat valorization



- Biomethane plant size target : **20 à 60 $MW_{Biomethane}$** - **100 – 300 kT biomass** – Enlarge feedstocks base
- An opportunity to improve overall efficiency of **4 to 7%** with valorization of excess heat from methanation

LCA – A strong tool to pilot and highlight R&D priorities



Biomass R&D topics – 2 Drivers

30 - 40 % of operating costs of a 2G biomethane production unit are dedicated to biomass procurement

- **30 % of those costs are due to transport**

Prices and availability of biomass feedstock could strongly vary during the 20 years of life of a production unit

Biomass ressource assessment

GAYA Database

Scope :

- **France** – communal level with GPS localisation of feedstocks

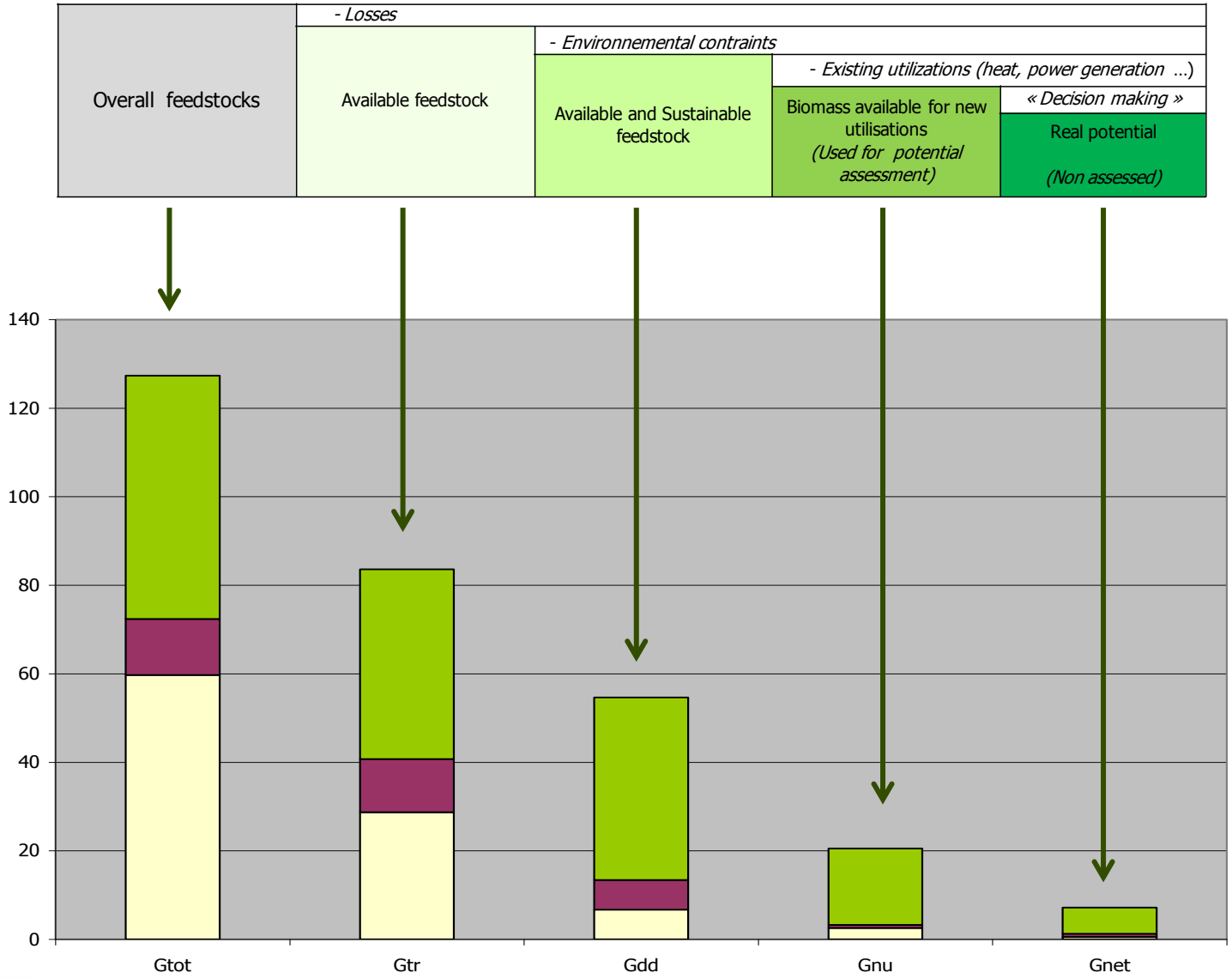
- **Europe** regional level on 10 countries (Pologne, Italie, UK, Espagne, Allemagne,…)

- **53 Biomasses**

- including some innovative types of biomasses (*torrefied*,…)

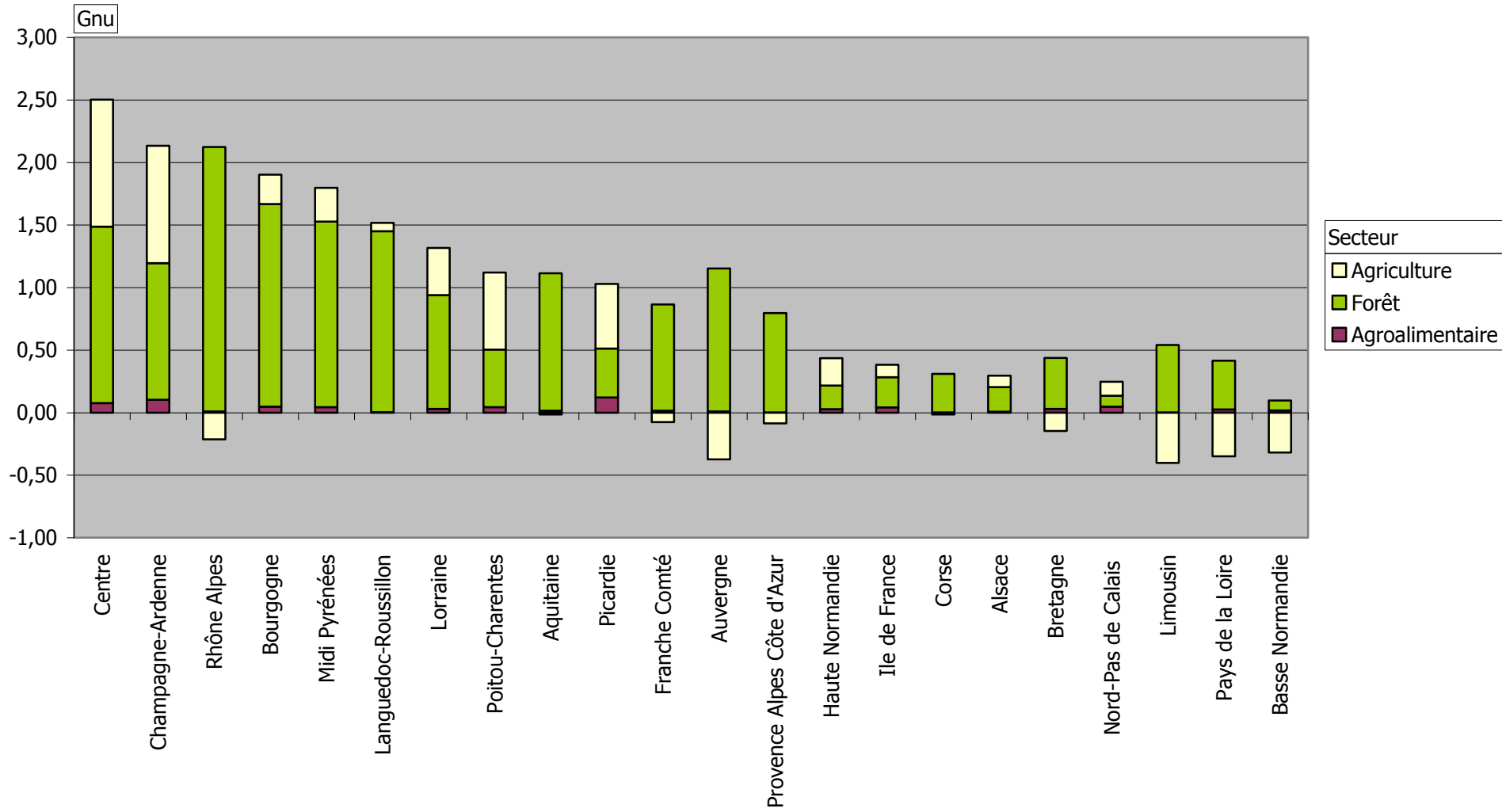
Biomass Origin	Category	Example
Forestry	Forest	*Stems (all types of wood) ; Residues (thinnings, all types of wood) ; stumps (all types of wood)*
	Wood processing by-products/residues	*Sawmill and pulp and paper by-products*
Agriculture	Residues	*Cereal straw, corn (straw and cane), Rapeseed (straw), Sunflower (straw), Vine shoot*
	Short rotation coppices Energy crops	*Poplar, willow, Eucalyptus*
Food and feed industries	Milk industry	*Buttermilk, whey (milk)*
	Sugar industry	*Pulp, Foam, molasses (sugar)*
	Starch industry	*Pulp; Bran; middlings; middlings (starch)*
	Meat Industry	*Cutting waste (meat)*
	Packing industry	*Waste processing (fish)*
	Wine industry	*Pulp, Seed, Grapevine rachis, dregs (wine)*
	Vegetal oil	*Rapeseed meal, Soybean, Sunflower, olive cake (oil)*

Assessment methodology : 5 steps



Focus on France 2011

France :
A global vision of biomass availability - Regional approach

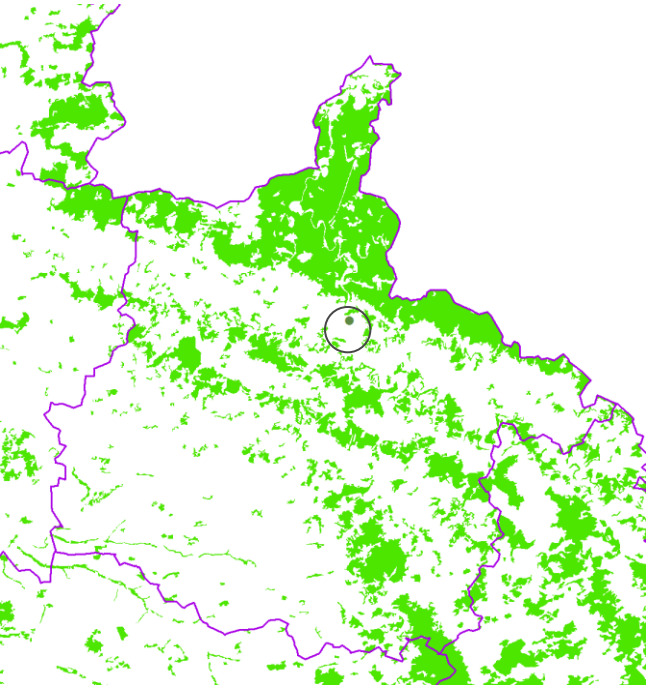


France :

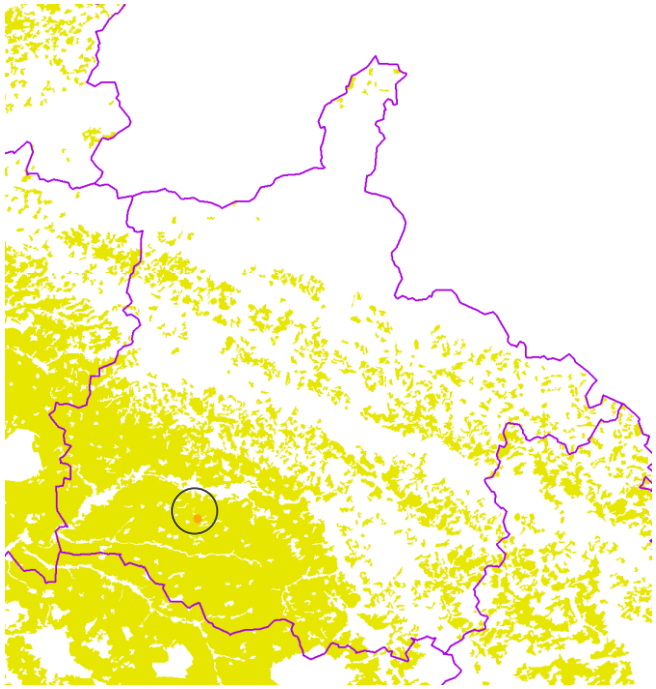
Department scale – Split the biomass resource inside a department

On solution: barycentre

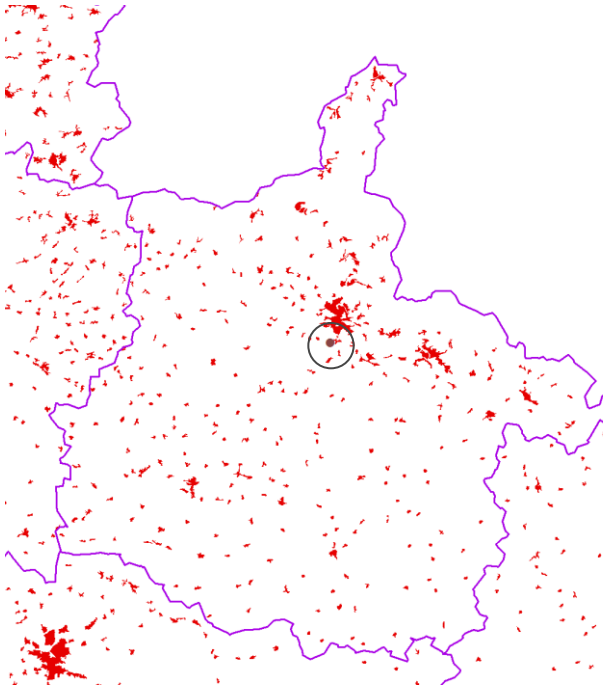
Forest



Agriculture



Urban (wastes)



→ Average origin to calculate distance of transport

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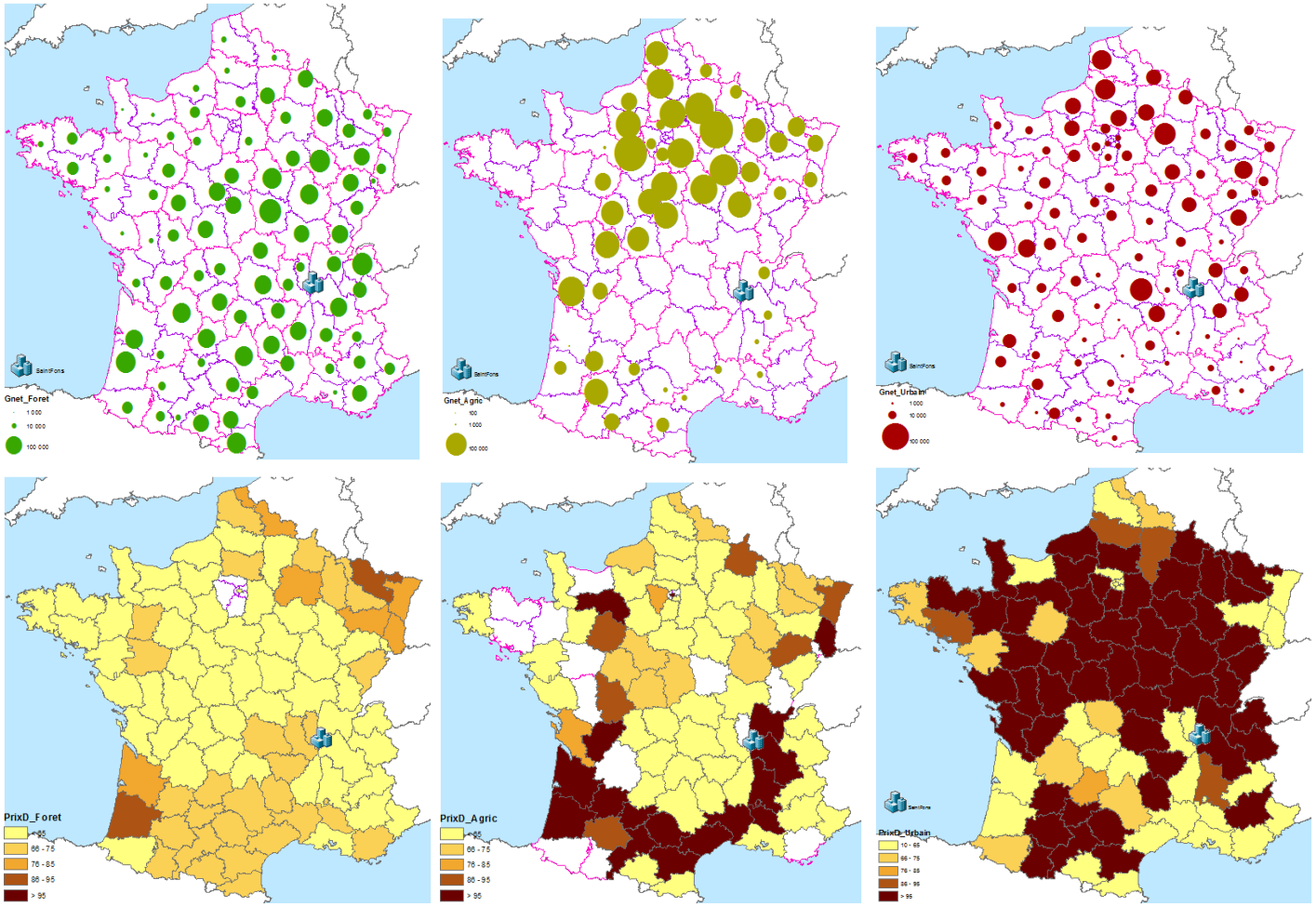
Forest

Agriculture

Urban (wastes)

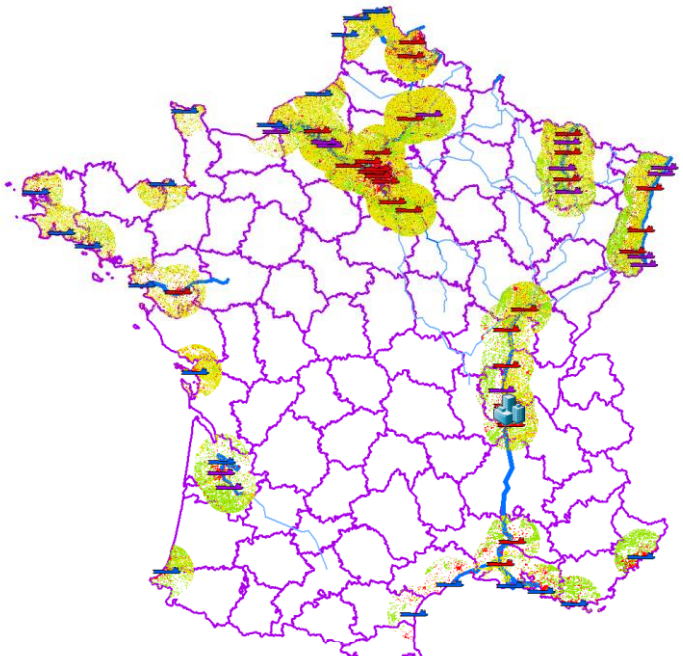
Q based on CLC

P based on CLC

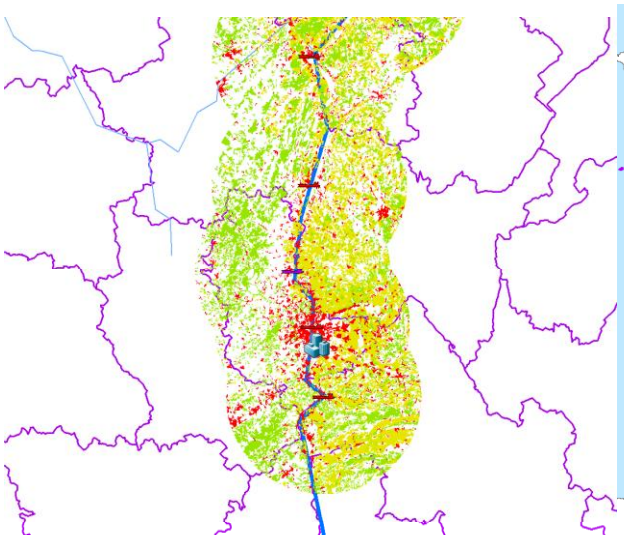


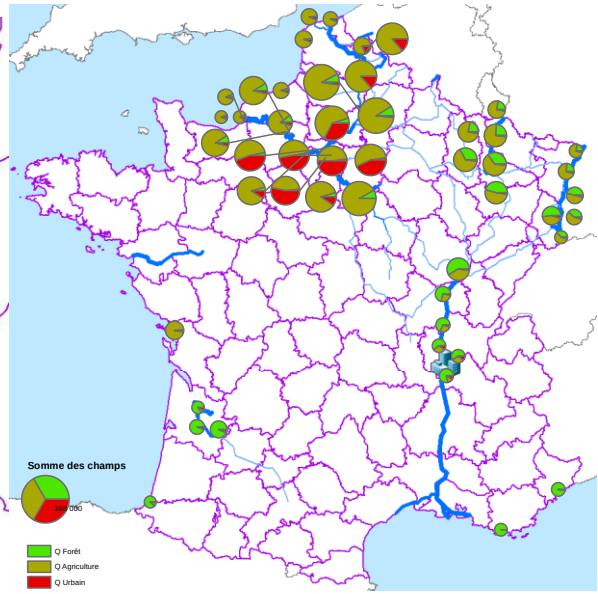
Freight stations and ports :

- Their potential f°(resources in a “reasonable area ”around)
- Reasonable area: road transport that do not impact to much the interest of a mix of transport modes



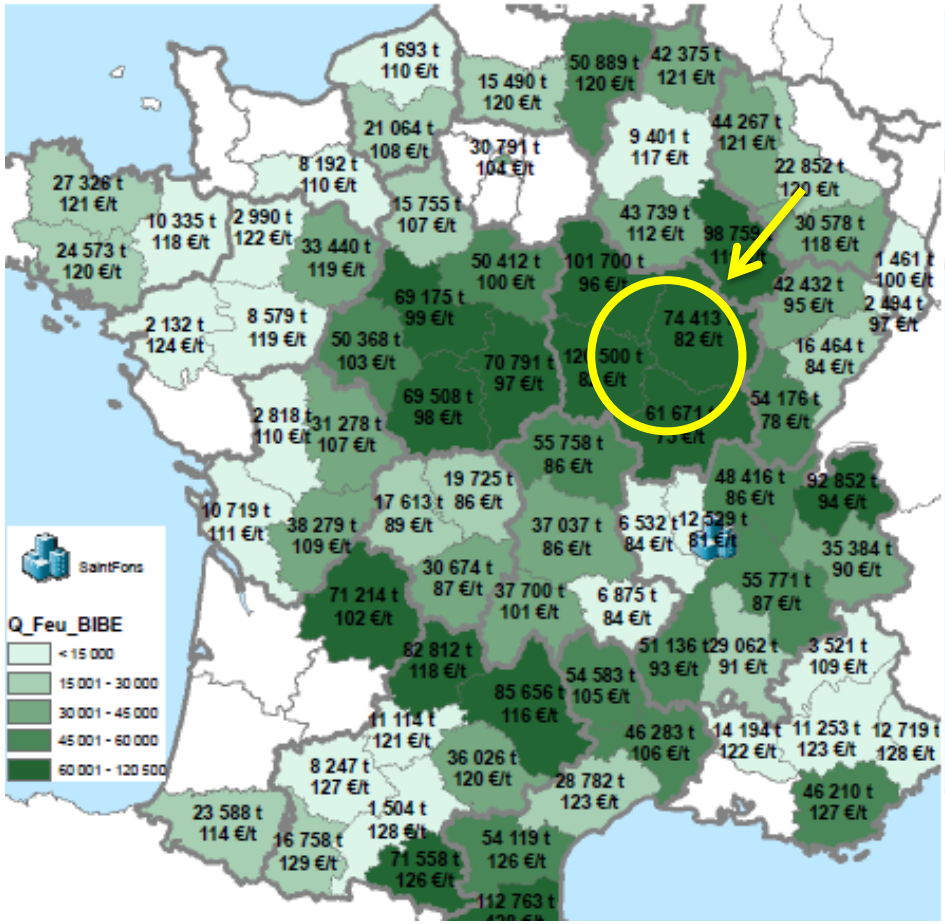
Ports potential (double counting possible)



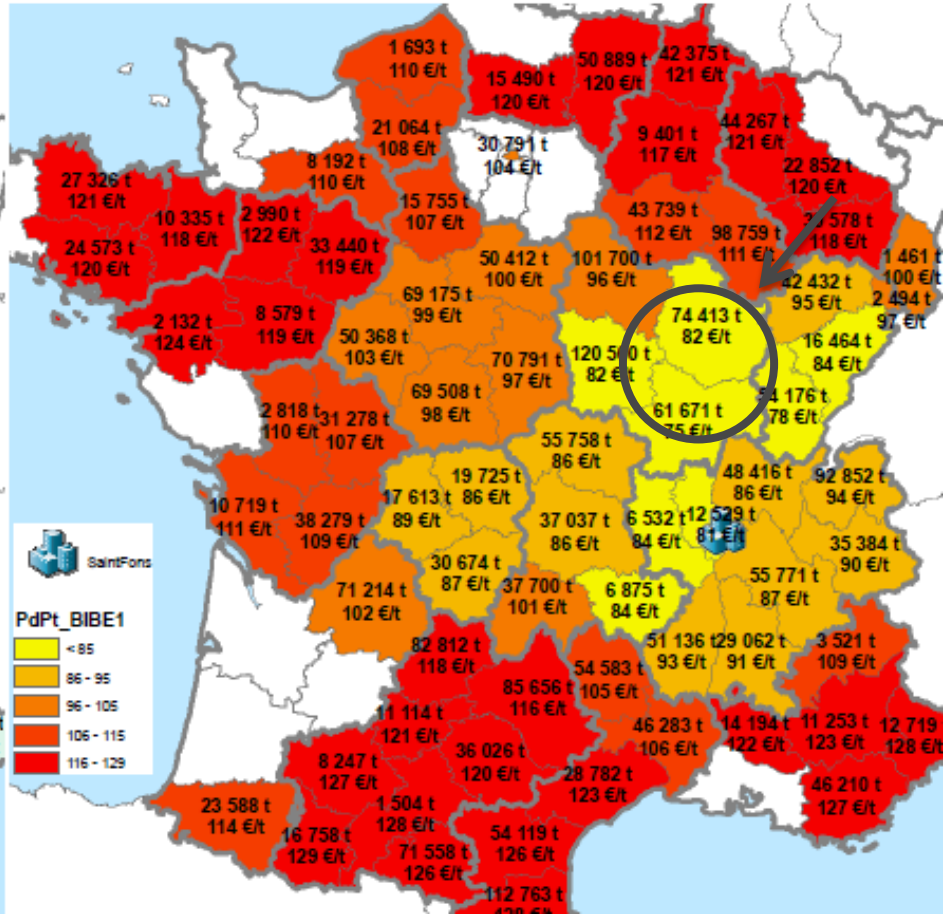


Results – Point out key clusters for deployment of 2G industrial units

Net feedstocks for wood – France 2012



Results available for 5 european countries



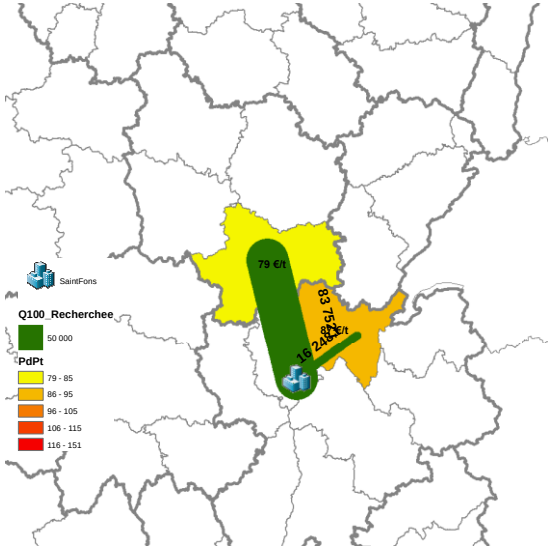
Positioning optimisation of industrial units -
Access to a diversified Biomass mix with lowered transport costs

GDF SUEZ

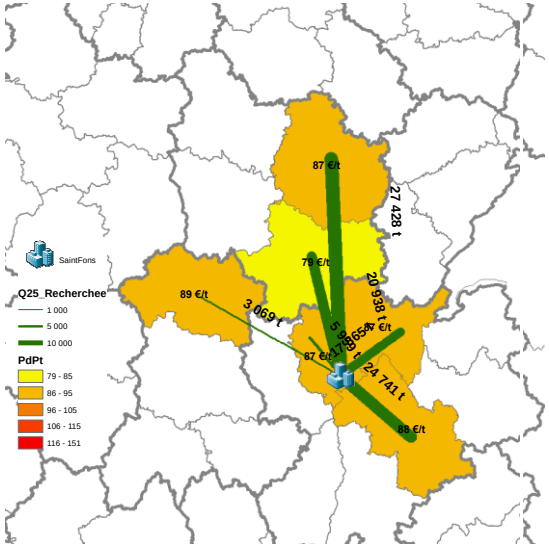
FCBA INSTITUT TECHNOLOGIQUE

Mobilisation rate

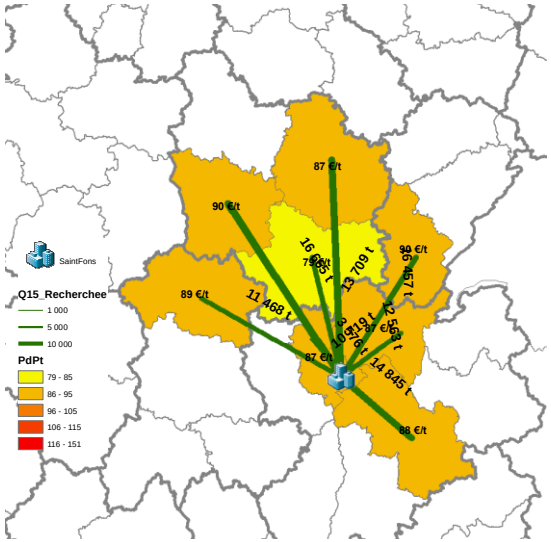
100%



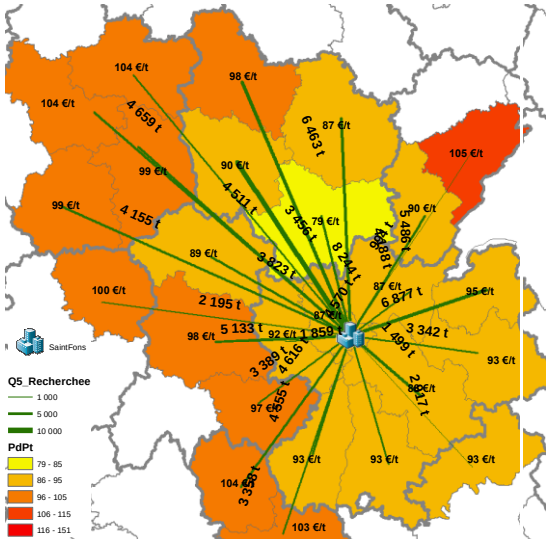
25%



15%



5%

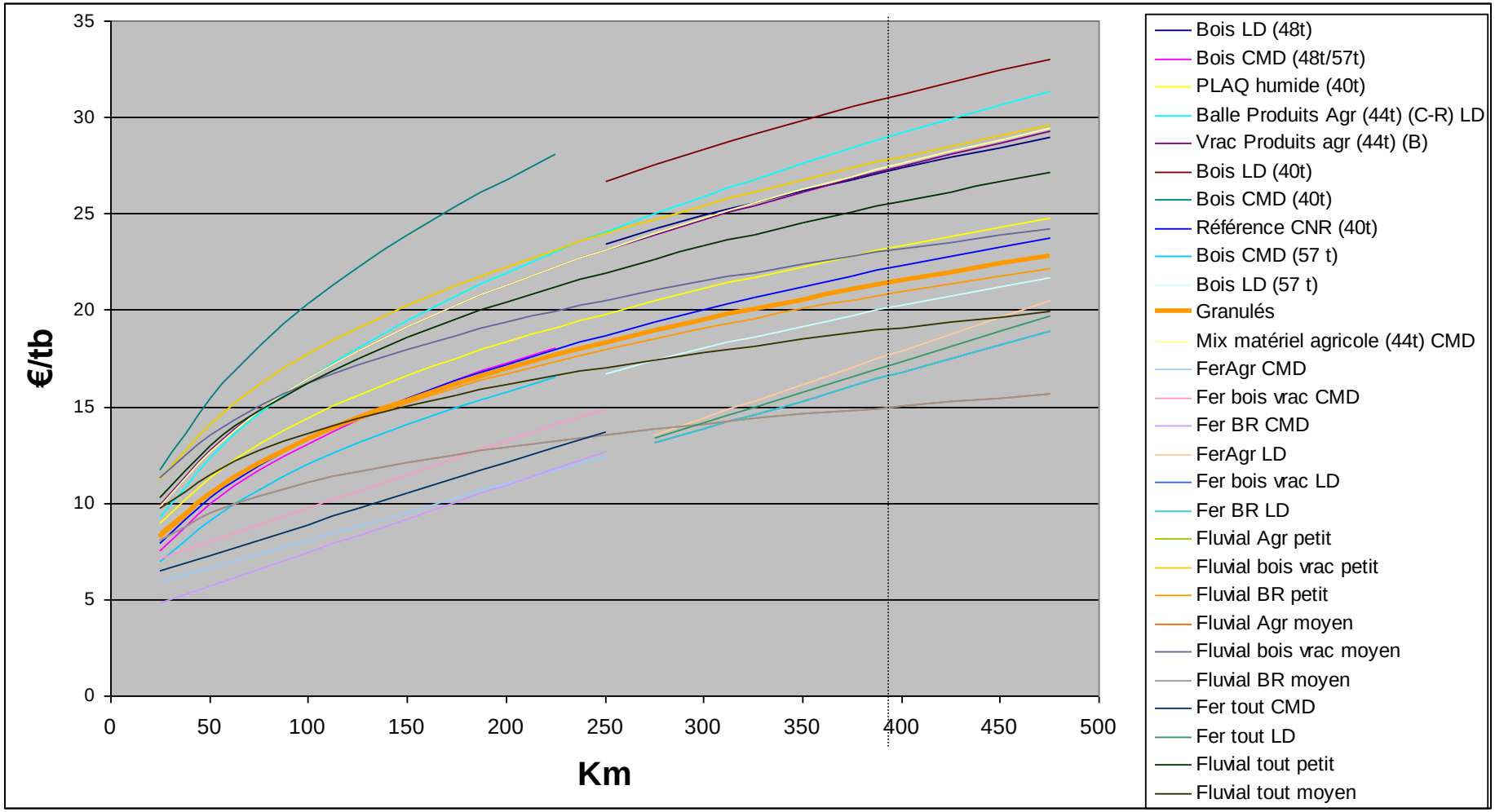


GAYA R&D objectives :

1. Access to a detailed database for biomass in France with GPS localization (woody, straw, recycle wood, organic dried waste...)
2. Develop advanced tools to optimize positioning and biomass procurement of a BioSNG Unit

Results – Biomass transport costs database - multimodal

France case – multimodal transport considered : road, fluvial and rail



Results – example of a detailled mapping of wood feedstosck

Roundwood
Chips 50 (P50)
Chips 30 (P30)
Chips 25 (P25)
Chips 20 ¨(P20)
Pellets

Districts: 6655

Railway stations: 244

Ports: 5

BioSNG unit : ST FONS, x=7959, y=20820

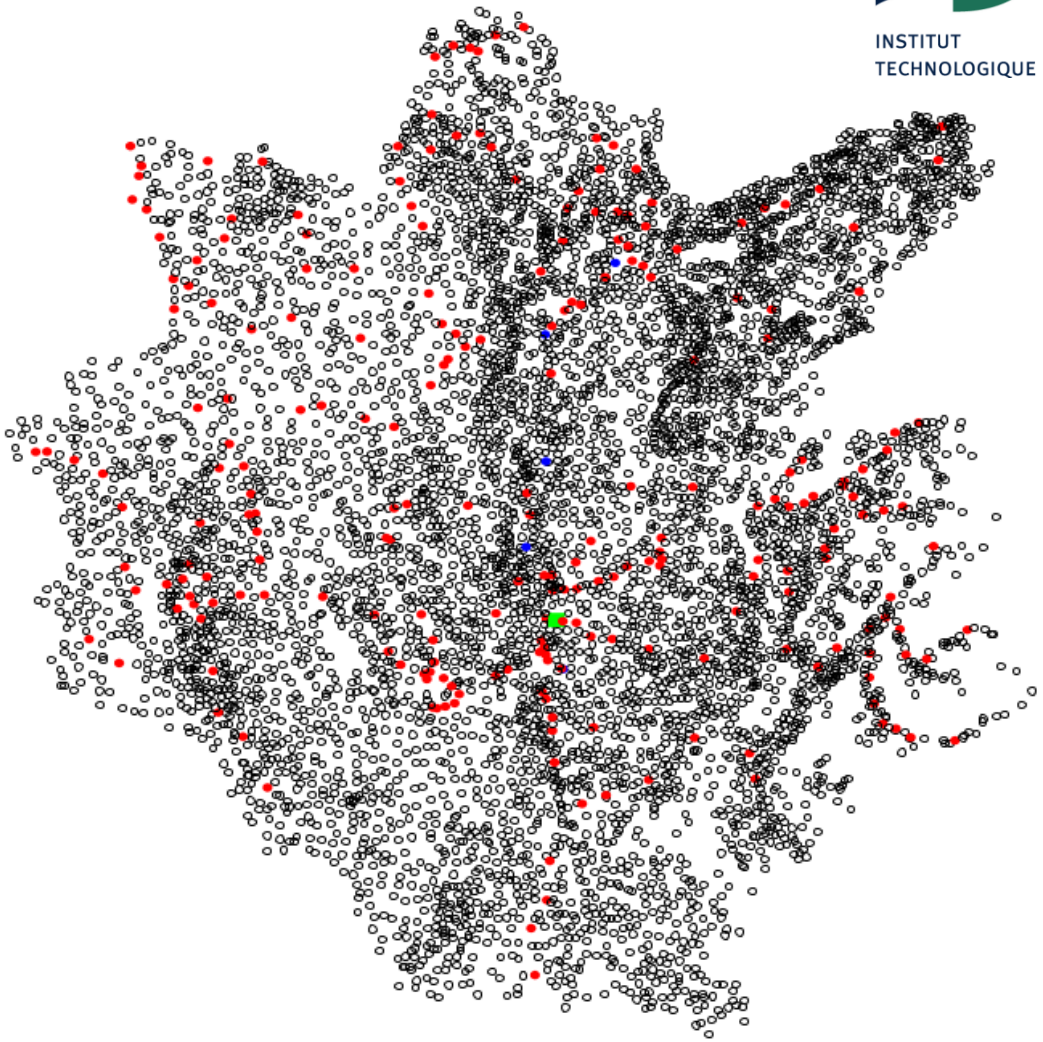
Max distance origin-unit: 331,5km

Total available RW (Gnu) = 9 Mts

Total available M50 (Gnu) = 1.7 Mts

District with RW or P50: 6390

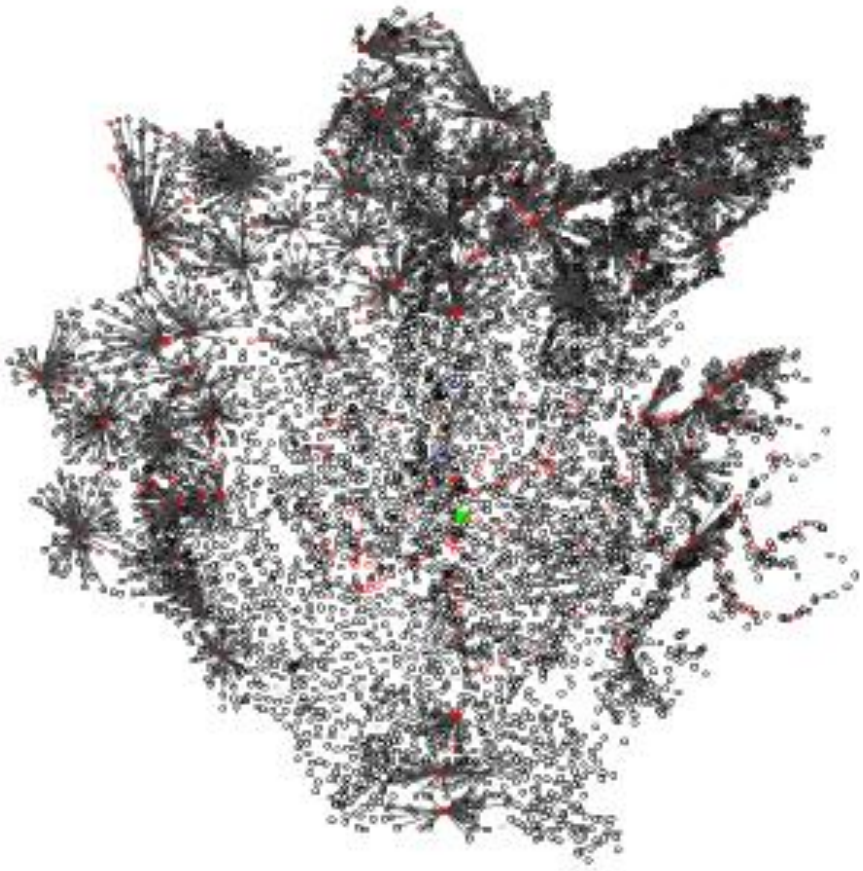
Demand (200000 ts) = 1,8% totat Gnu



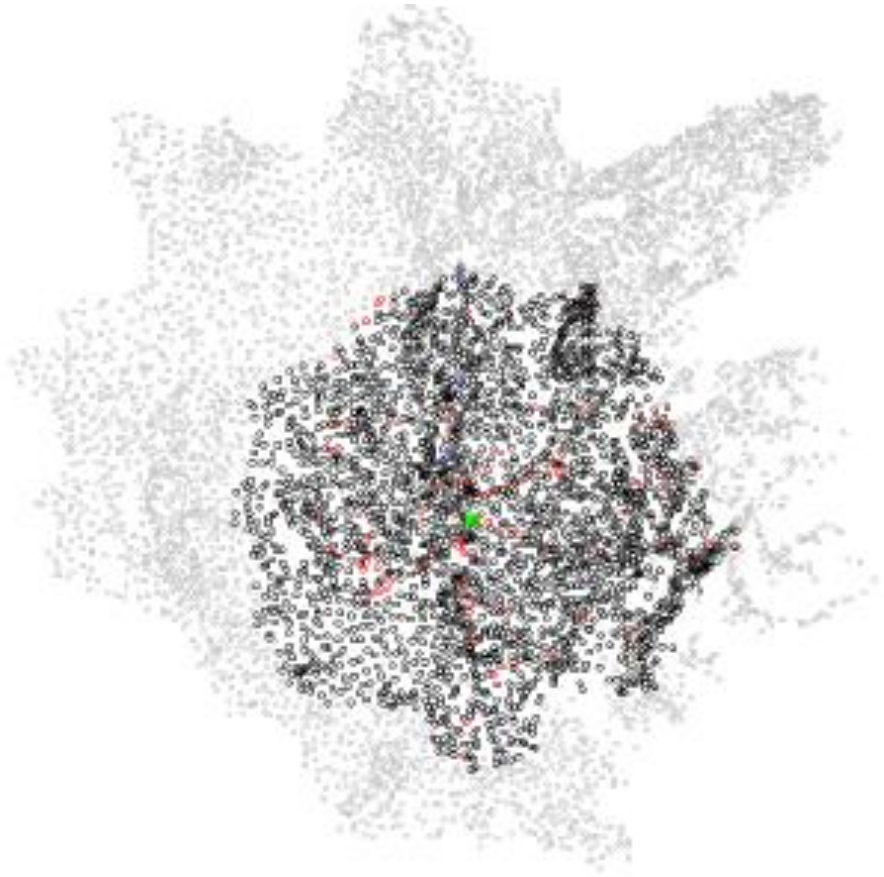
Results – Mobilization rate and impact on biomass procurement

Multimodal approach (rail, road, fluvial)

→ the variation of the % of available biomass in a region have a strong impact on the procurement area and relative interest of the railways stations



(a) Ressource 1.859%

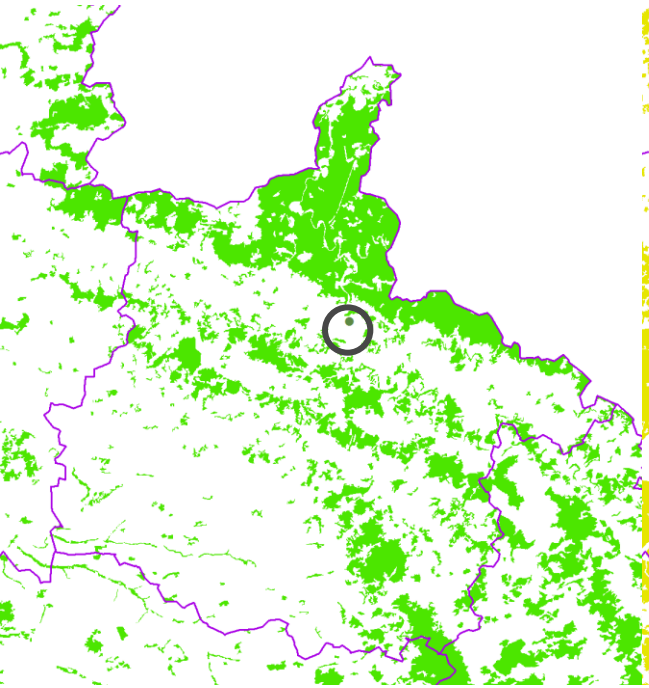


(d) Ressource 5%

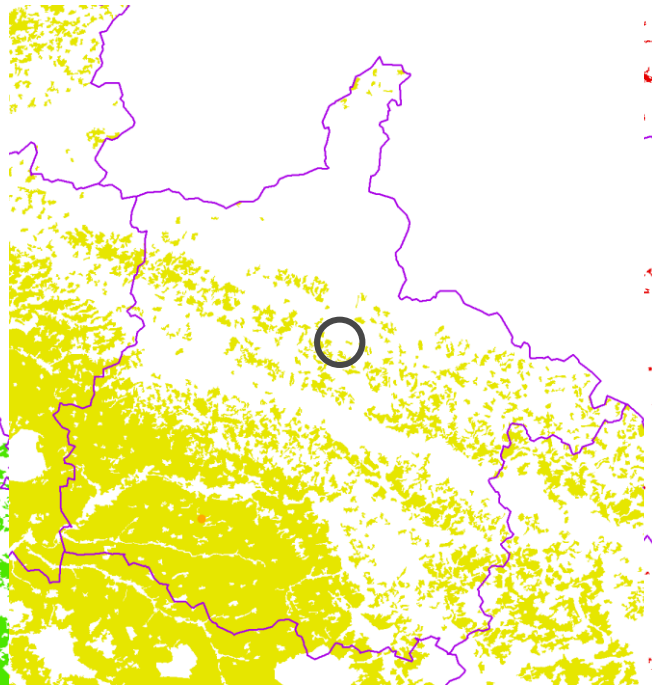
Results – case study for biomass procurement of energy production units

Mapping and analysis of feedstocks economicaly available for a 2G industrial units near St Fons (banlieue Lyonnaise)

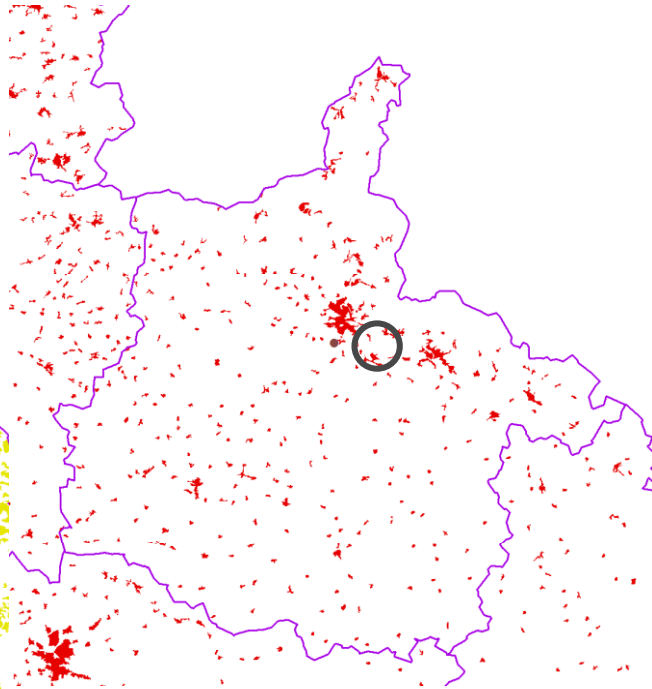
Forest



Agriculture

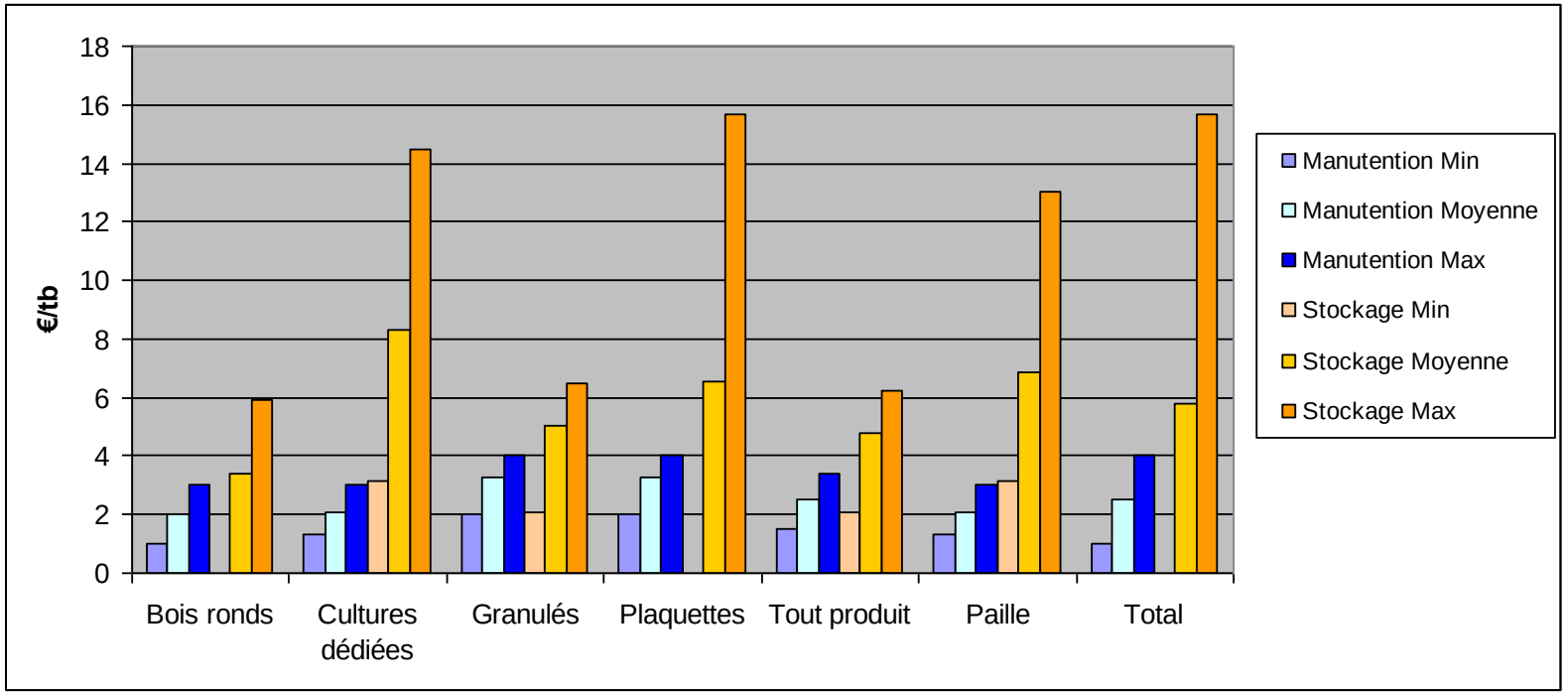


Urban (wastes)



Results – Cost analysis on storage and pretreament function for biomass (pelletization, milling, torrefaction,…)

		Storage	Handling	Other process
Agriculture	Straw	5 options	4 options	Pelletisation
	Dedicated coppices	5 options	4 options	Pelletisation
Forest	Bulk	10 options	4 options	Drying Pelletisation
	Roundwood (id. SRC)	8 options	4 options	Chipping
Others	Pellets	4 options	4 options	
	Others	2 options	4 options	

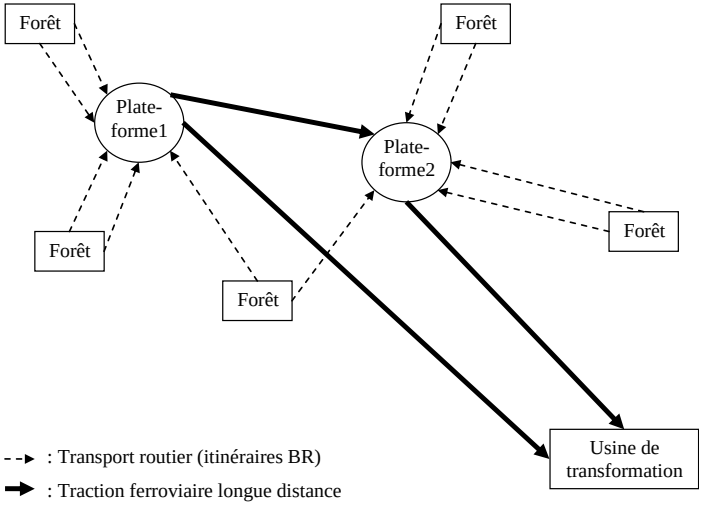


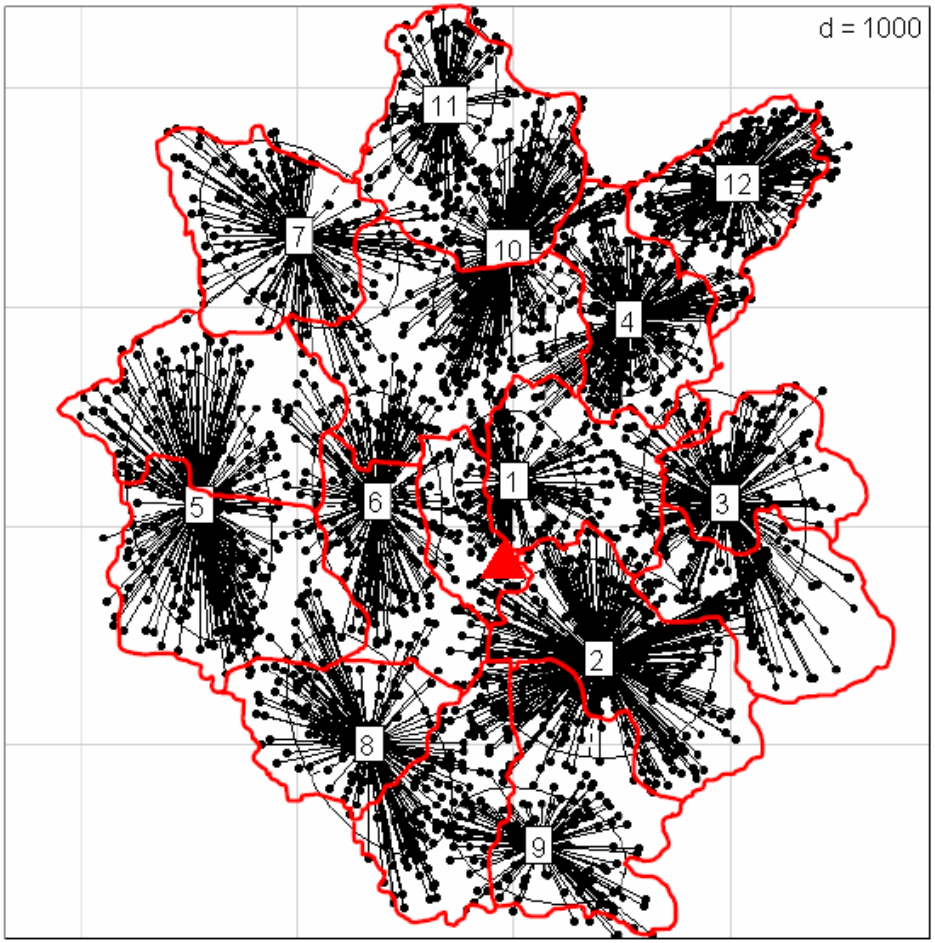
Results – Complete logistics optimization

Tool : G-Scope – *Univ Grenoble & Torronto*

MultiDimentional Scaling (MDS)

- Step 1: Proximity analysis based on the chosen criteria (if it is the transit time, then need to get a time matrix done by GIS tool)
- Step 2: Principle Component Analysis (PCA) with weighed units by quantities
- Etape 3: Ascending Hierarchical Classification done on the PCA axes (WARD method)





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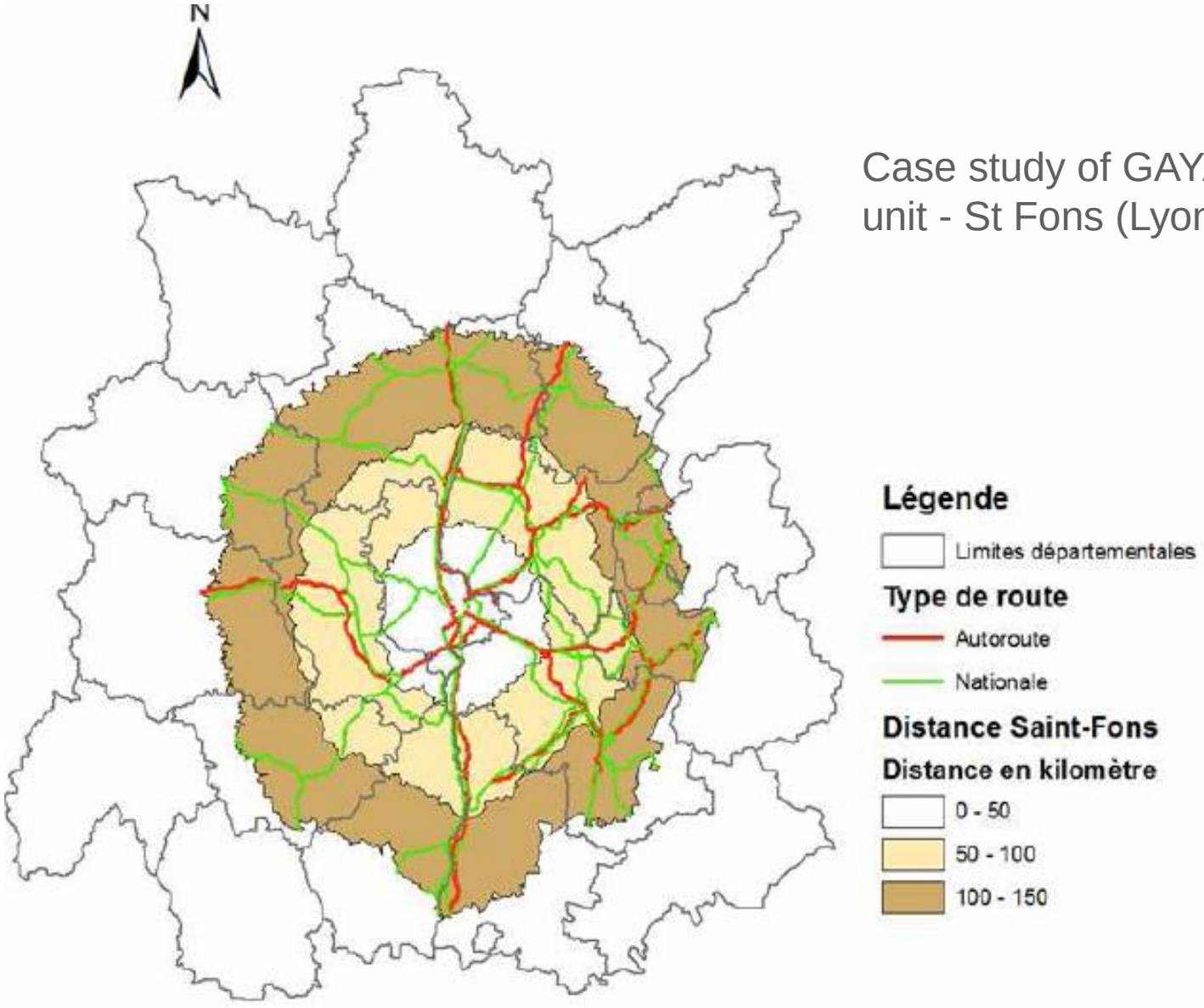
	100%	25%	15%	5%	100%	25%	15%	5%	100%	25%	15%	5%	100%	25%	15%	5%
Nbre Dpts	9	46	Q<	Q<	12	45	76	Q<	3	6	12	37	3	7	11	30
Rayon (km)	149	270			157	301	368		139	169	166	252	110	127	142	219
Prix appro (€/ts)	72,5	84,5			113,4	123,7	110,4		77,9	84,5	86,0	96,0	108,0	110,9	114,0	130,0
Coût appro (€)	7 249 722	8 447 639			11 337 089	12 368 904	13 061 438		7 788 872	8 445 241	8 649 233	9 552 575	10 300 000	11 002 521	11 423 258	13 001 064
Variation coût appro	0%	17%			0%	9%	15%		0%	8%	11%	23%	0%	8%	11%	26%
Variation coût appro	0%	17%			56%	71%	80%		7%	16%	19%	32%	42%	53%	58%	79%

Perspectives – Case study



Case study of GAYA demonstration unit - St Fons (Lyon)

Conclusions & perspectives

1

-Tension forte sur certaines biomasses
- besoin d'évolution des modèles d'affaire

2

- Enjeux majeur sur une gestion territoriale de la biomasse
-Gestion raisonnée des importations
-Besoin fort de structuration des filières de production forestières

3

- Flexibiliser les technologies
- garantir la durabilité des approvisionnements
- Développer des outils d'optimisation logistique multimodaux
- Développer la chaine de la valeur sur les filières biomasses (Bioraffinerie)

Thank you for your attention !

http://www.projetgaya.com

Contact : olivier.guerrini@gdfsuez.com

Le CRIGEN est le
Centre de recherche et d'expertise
opérationnel du groupe GDF SUEZ
dédié aux métiers du gaz,
aux énergies nouvelles et
aux technologies émergentes.

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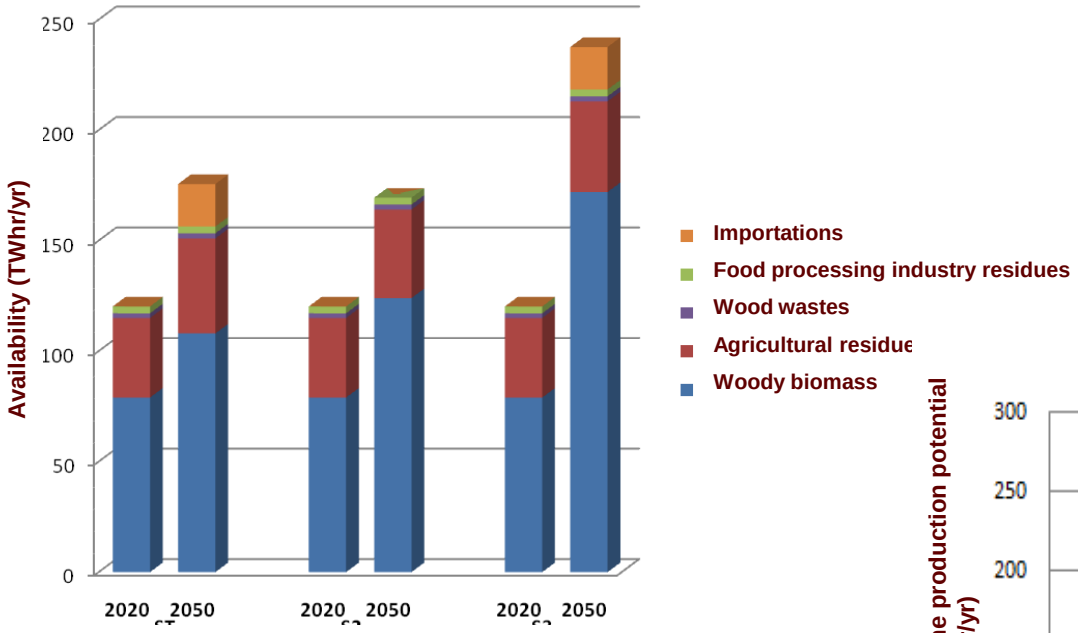
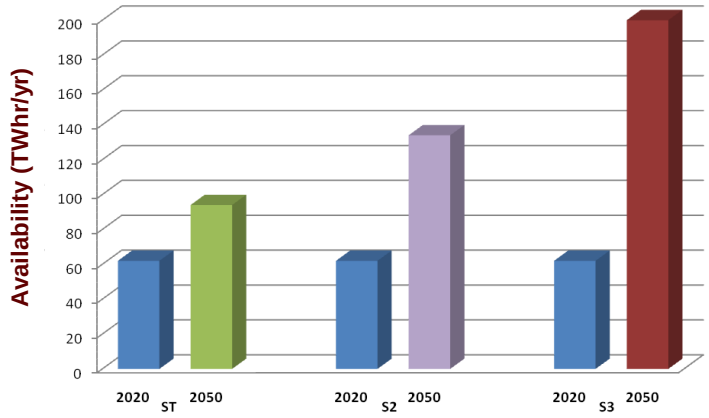
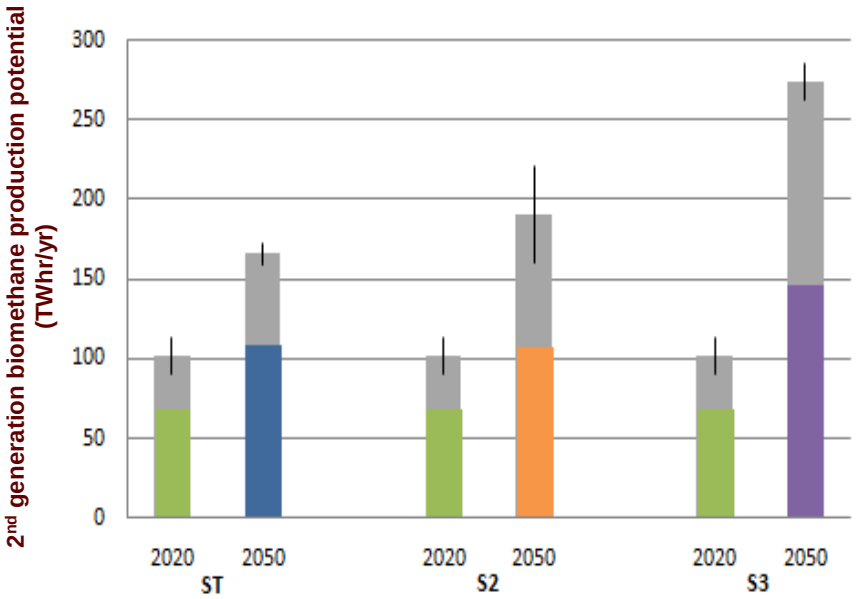
Results: biomass availability for biomethane production and biomethane production potential

Biomass resource availability by 2020 and 2050





2nd generation biomethane production potential



Main conclusions of the study and perspectives

2nd generation biomethane production potential range:

From **100 TWhr/an** by 2020 to **250 TWhr/an** by 2050

(2011 French natural gas consumption: 400 TWhr)

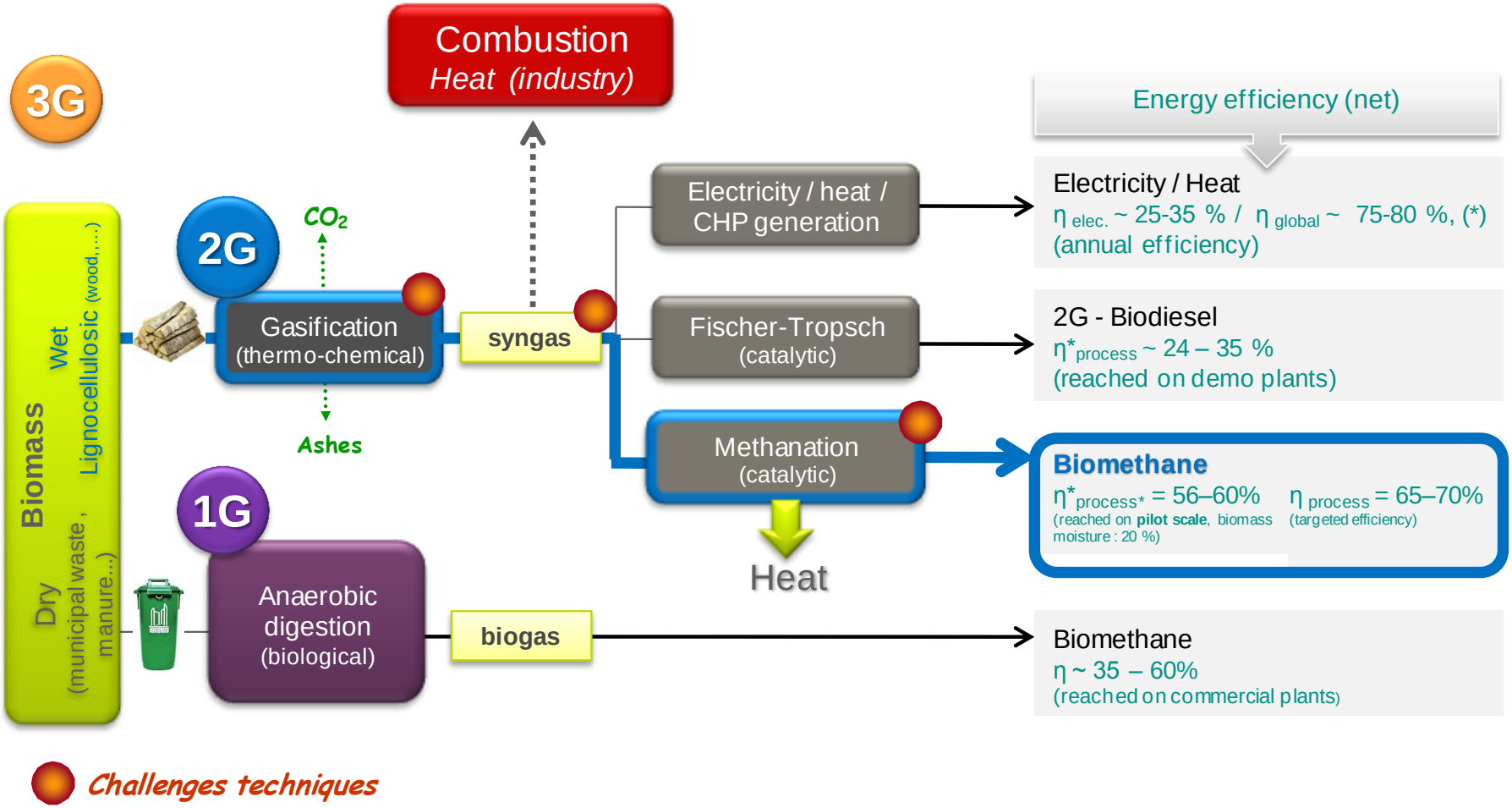
- High production potential coming from:
  - High energy efficiency of the production process (45% < η < 65% without heat recovery)
  - Heat valorization allows to reach even higher energy efficiencies
- Energetic crops have been presented separately because their development is still uncertain
- **By 2020 and 2050, woody biomass resource will still be the main part of the feedstock supply plans for the production units**

Perspectives:

- The **willingness of the forest and land owners** to sell their biomass should be studied
- **Competition between energetic valorization pathways** of biomass resources should be taken into account and quantified
- The 3 scenarii could be modified to be more accurate and to offer a better view **of the range of possible** of the socio-economic situation by 2050
- A study to determine the best use of available arable lands (crops for biogas or biomethane production, micro-algae cultivation…)

1 BioSNG energy carrier : 3 generations of technologies

Complementary pathways targeting different resources



**Estimations basées sur un scénario validé à partir de la centrale de Güssing*