

# Geographical analysis for the integration of a microalgae production and biorefining unit in “Pays de la Loire”

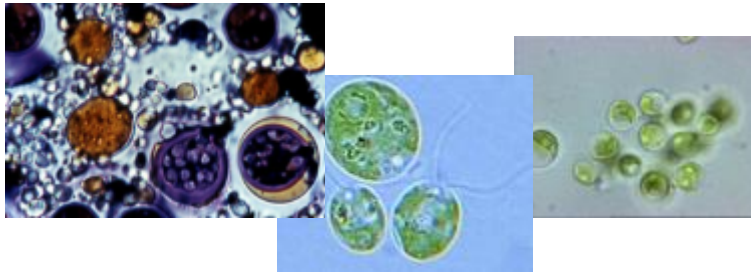
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Energy transition challenge  
2014-2017

# Industrial exploitation of microalgae

- Specific biomass: microorganisms... in

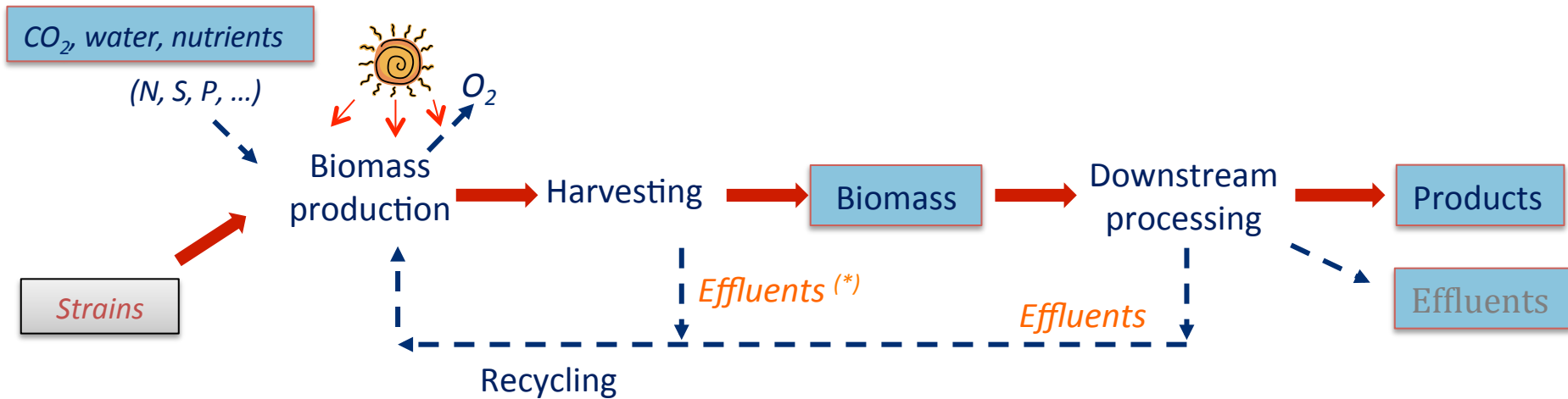


**New industrial resource**

**Proteins & pigments, Carbohydrates  
Lipids, Antioxidants**

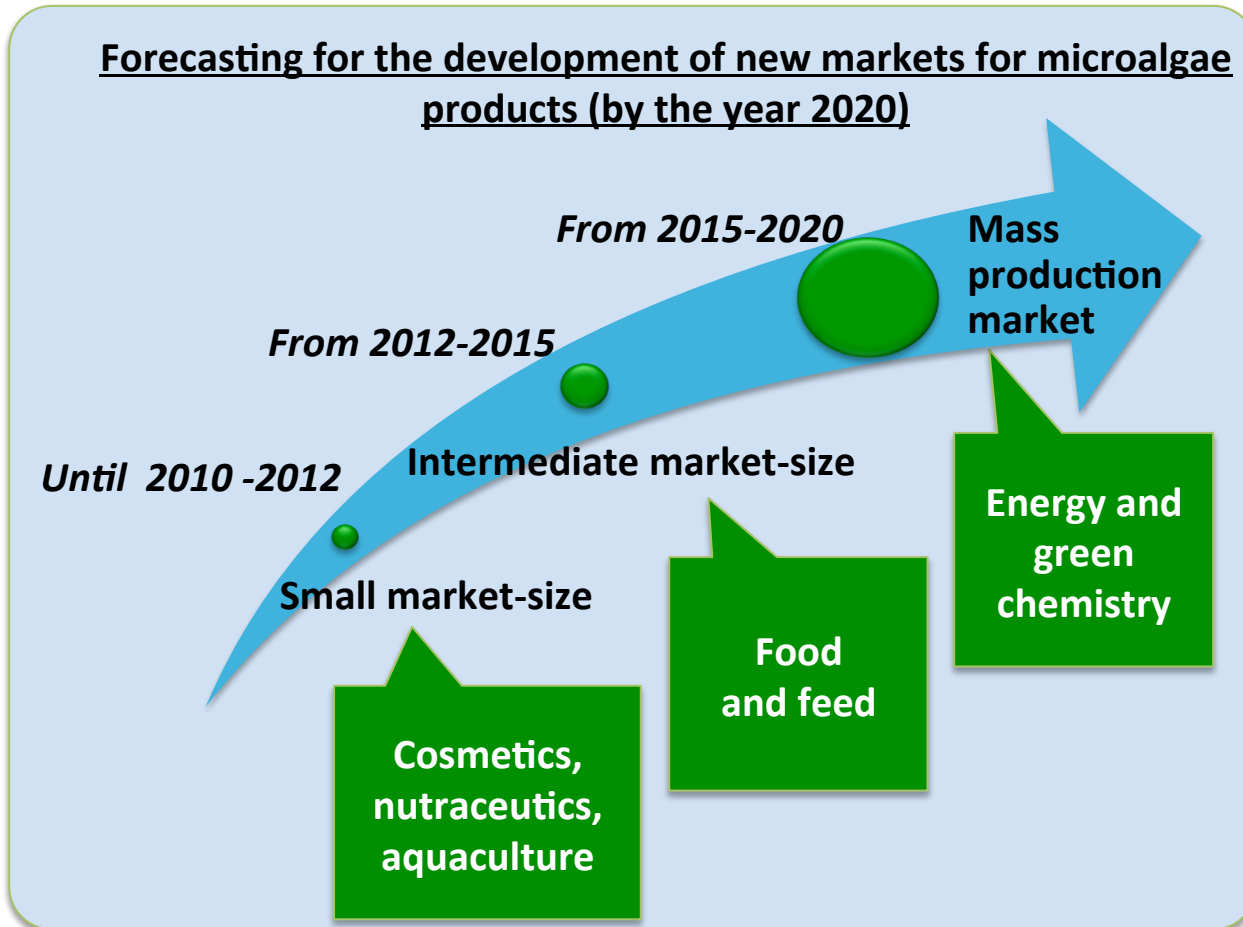
....

- Necessity of biological and engineering breakthroughs



# Industrial exploitation of microalgae – the markets

Potential uses in various sectors, and most are emerging...



**Proteins & pigments**

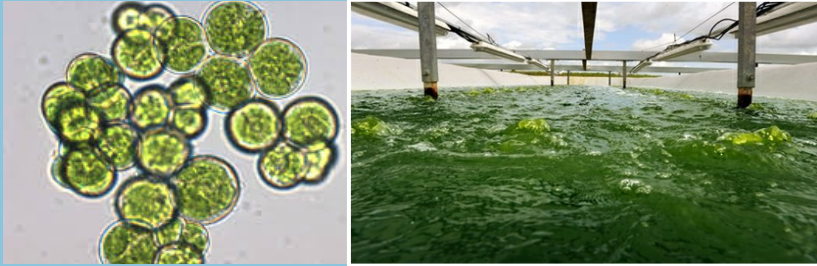
**Carbohydrates**

**Lipids**

**Antioxidants**

....

## Culture and harvesting



## Biorefining

Cells disruption

Fractionation

Esterification ...

## Biomolecules / Biofuel



WHERE  
are the suitable areas to  
build microalgae culture  
and biorefining plants?



# Approach: Coupling of complementary analyses

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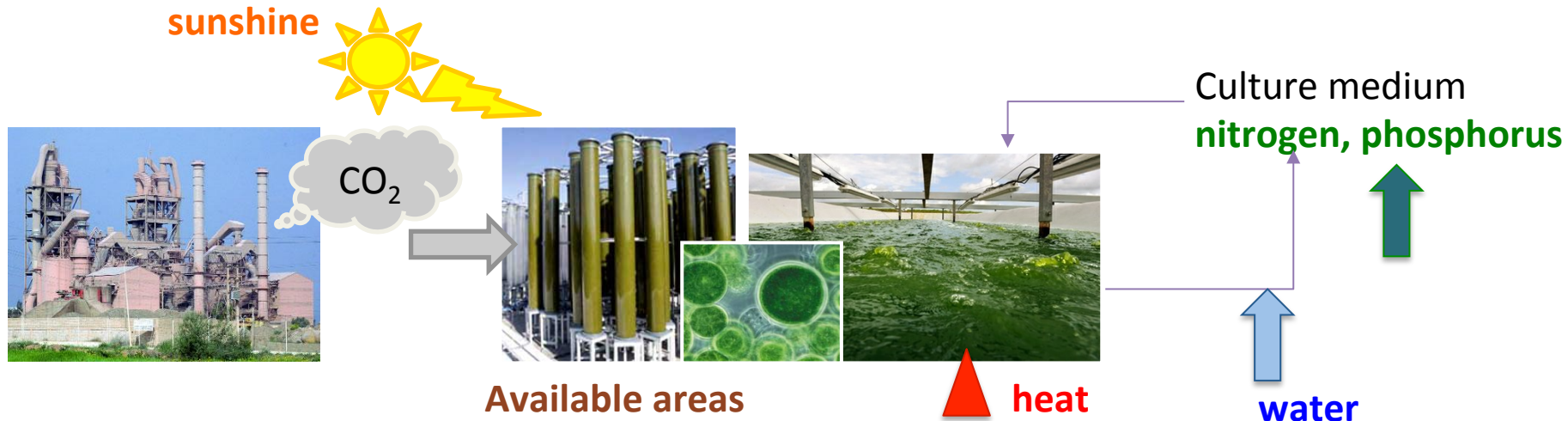
1. Definition of the physico-chemical constraints /needs
  
2. Methodology and main results
  - 2.1 Location of the areas allowing the access to the resources
  - 2.2 Analyse of the legislative framework : constraints?
  - 2.3 Social acceptability characterisation
  
3. Conclusion and perspectives

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# 1. Definition of the physico-chemical needs



	Area (ha)	CO <sub>2</sub> (T year <sup>-1</sup> )	Culture volume (m <sup>3</sup> )	Water needs (m <sup>3</sup> year <sup>-1</sup> )	Microalgae prod. (dry matter, T year <sup>-1</sup> )
Small unit	100	3,600	200 10 <sup>3</sup>	400 10 <sup>3</sup>	2,000
Medium unit	1,000	36,000	2000 10 <sup>3</sup>	4000 10 <sup>3</sup>	20,000
Large unit	10,000	360,000	20,000 10 <sup>3</sup>	40,000 10 <sup>3</sup>	200,000

**Arbitrary condition for the access to fluids: 10 km maximum**

Report ADEME « l'évaluation du gisement potentiel de ressources en algues pour l'énergie et la chimie en France à l'horizon 2030 » (2014)

# Approach: Coupling of complementary analyses

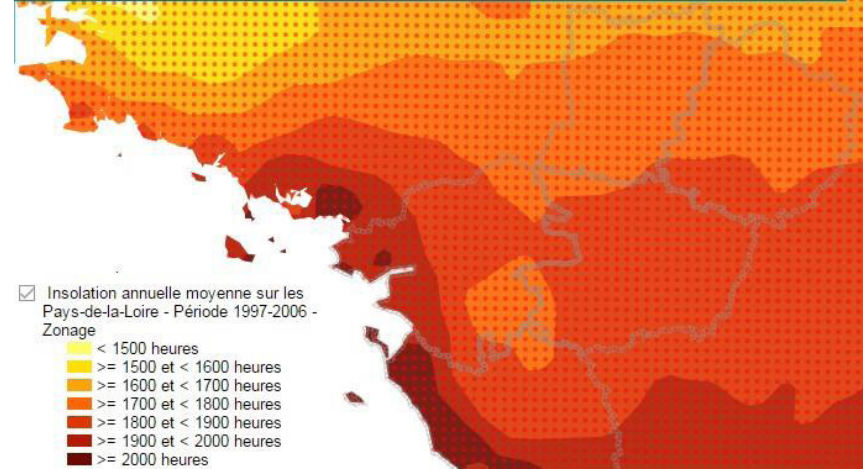
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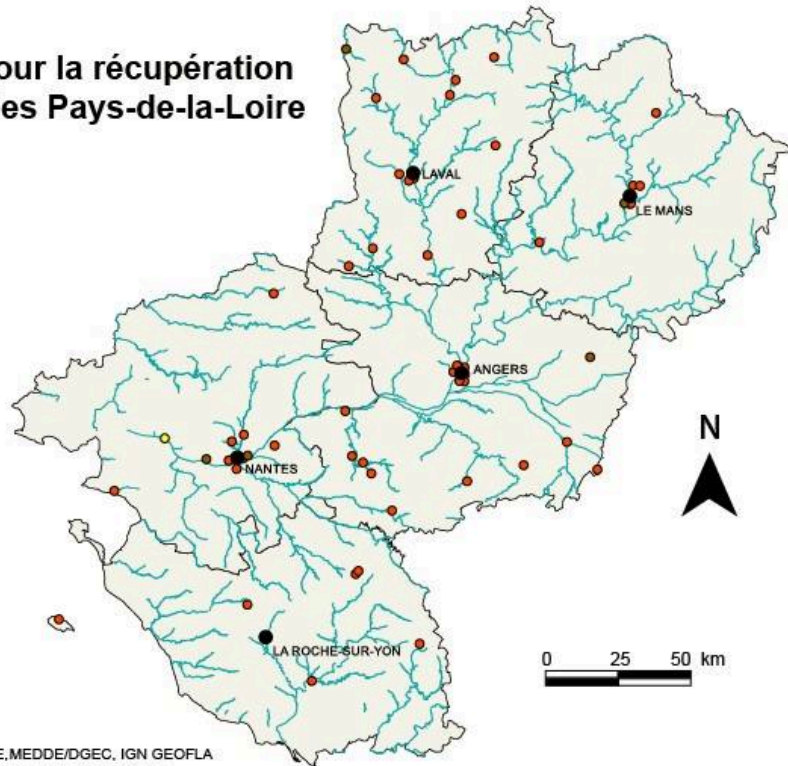


## Sunshine (photosynthesis)

Insolation moyenne annuelle - Période 1997-2006



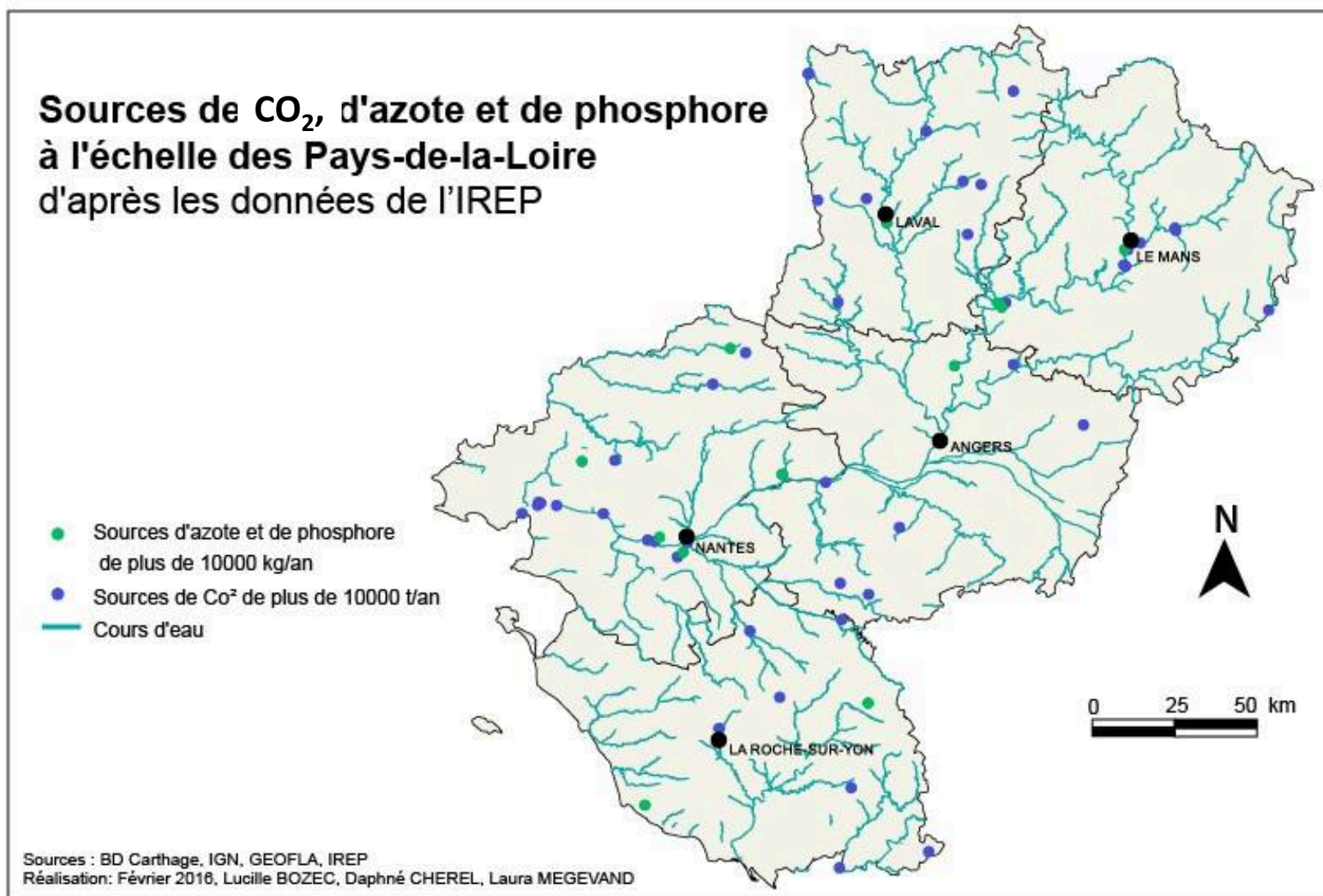
## Sources potentielles pour la récupération de chaleur à l'échelle des Pays-de-la-Loire



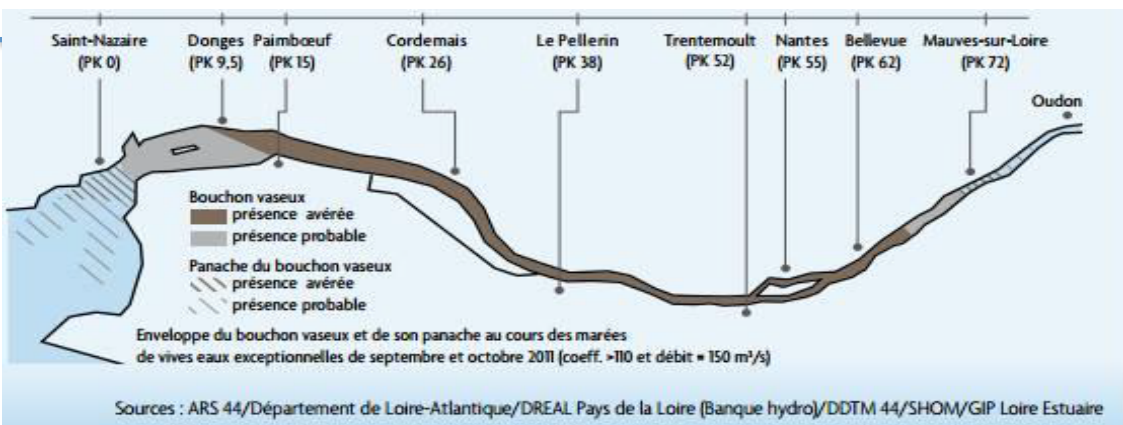
## Heat recovery resources identified by CEREMA :

- Domestic waste
- incineration plants
- Power plants producing more than 20 GWh per year
- Cogeneration units, District heating

French Pollutant Emission Register, (IREP) : **Carbone dioxyde - Nitrogen / phosphorus**





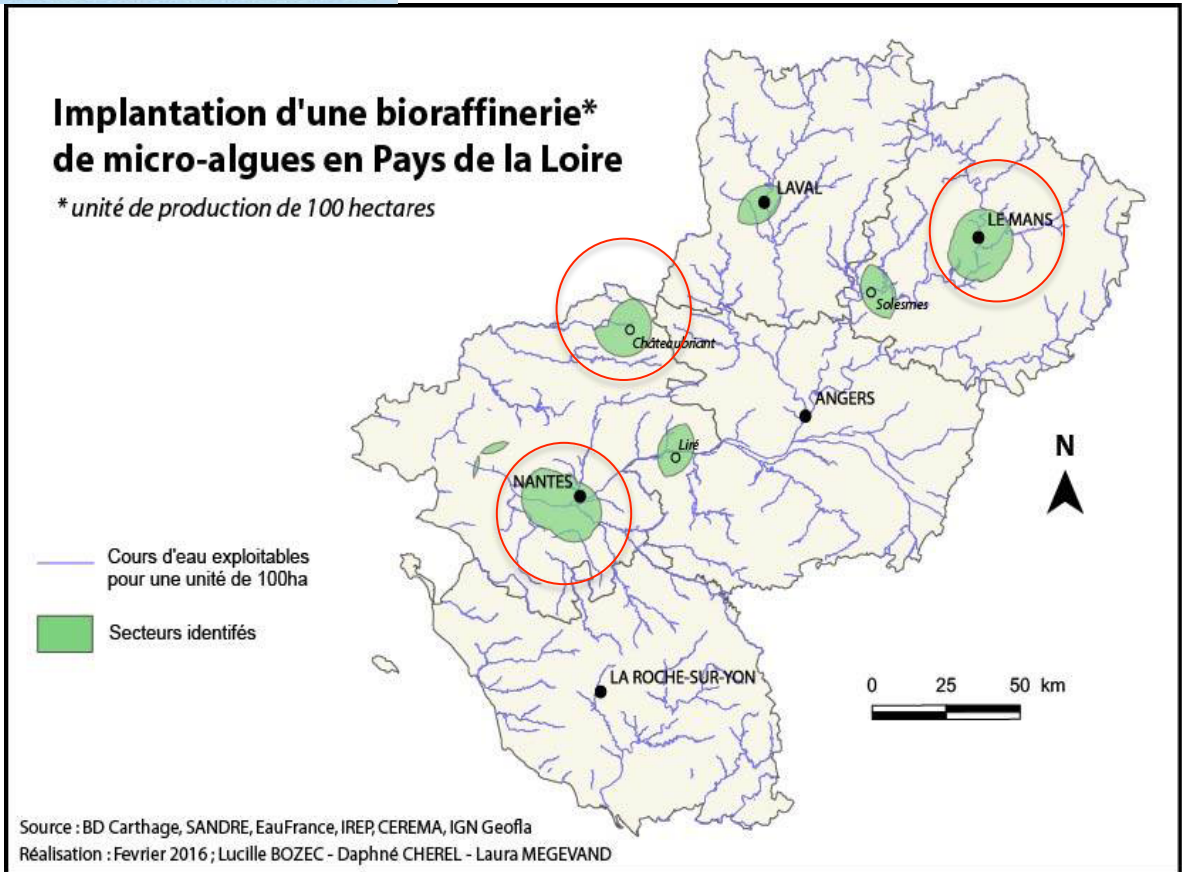
# 2.1. Access to the resources



## Water (quantity / quality)

### Results : ressources analysis

- Small units 
- Medium units 
- Large units : no place





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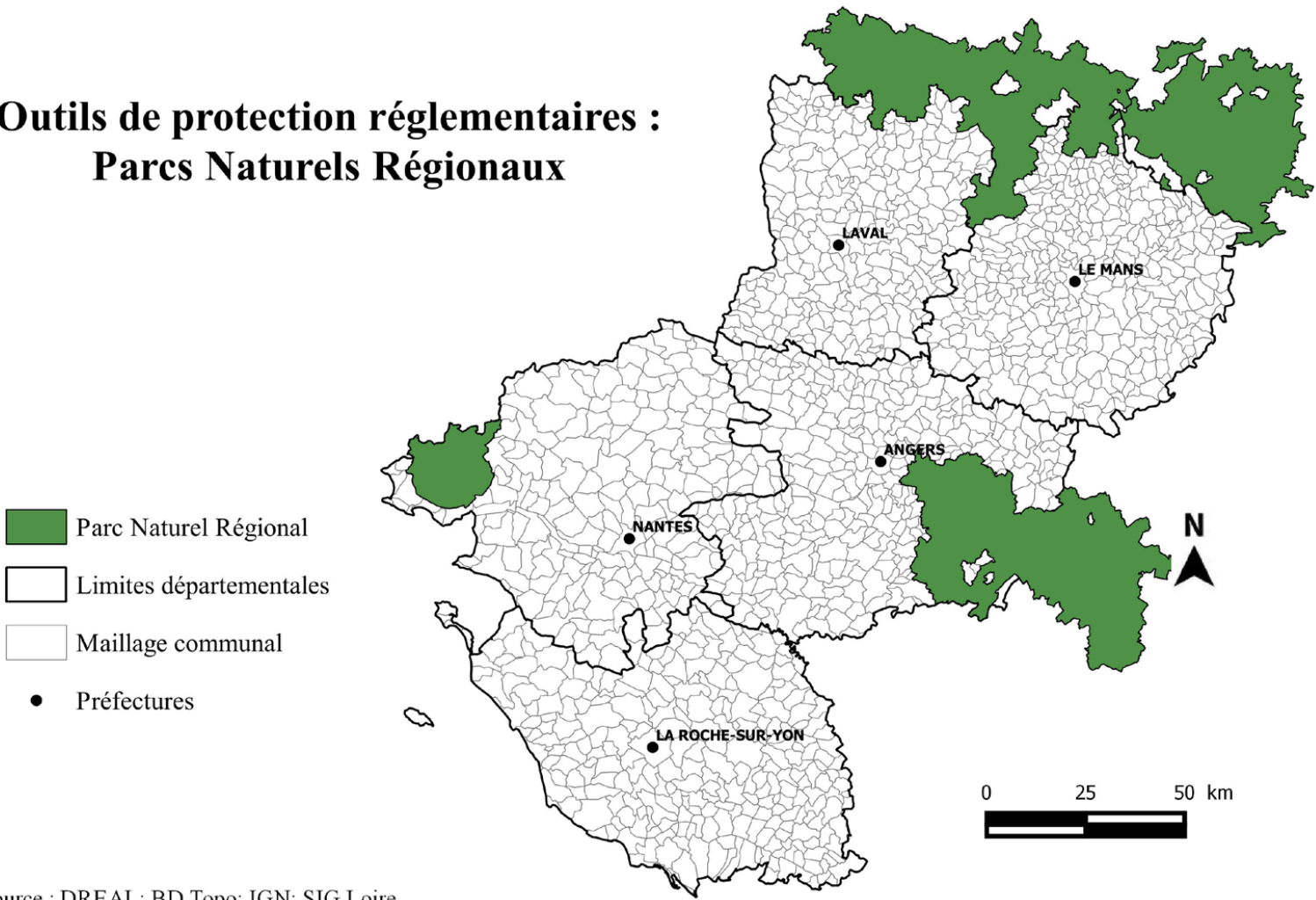
## 2.2. The legislative constraints: a/ The protection areas





	Restrictions	Low	High	prohibited
Europe	RAMSAR Convention (wet lands)	X		
	Natura 2000 network	X		
France	Coastal law (1986)		X	
	Coastline conservation authority			X
	Regional Nature Park		X	
	Heritage registered site	X		
	AVAP – ZPPAUP (Heritage)	X		
	Sensitive natural areas		X	
	Wild fauna and hunting territories	X		
	Biological reserves		X	
	Prefectoral order for biotope protection			X
	Inventory of natural areas of ecological, faunistic and floristic interest	X		

## 2.2. The legislative constraints: a/ The protection areas

### The regional nature parks: example of high restrictions

**Outils de protection réglementaires :  
Parcs Naturels Régionaux**



-  Parc Naturel Régional
-  Limites départementales
-  Maillage communal
-  Préfectures

Source : DREAL; BD Topo; IGN; SIG Loire  
 Réalisation : Février 2016; BIZARD Amandine-CHIQUET Lucien-DILASSER Julien-MOUSSAVOU Joe-Stan-TRUS Mathieu

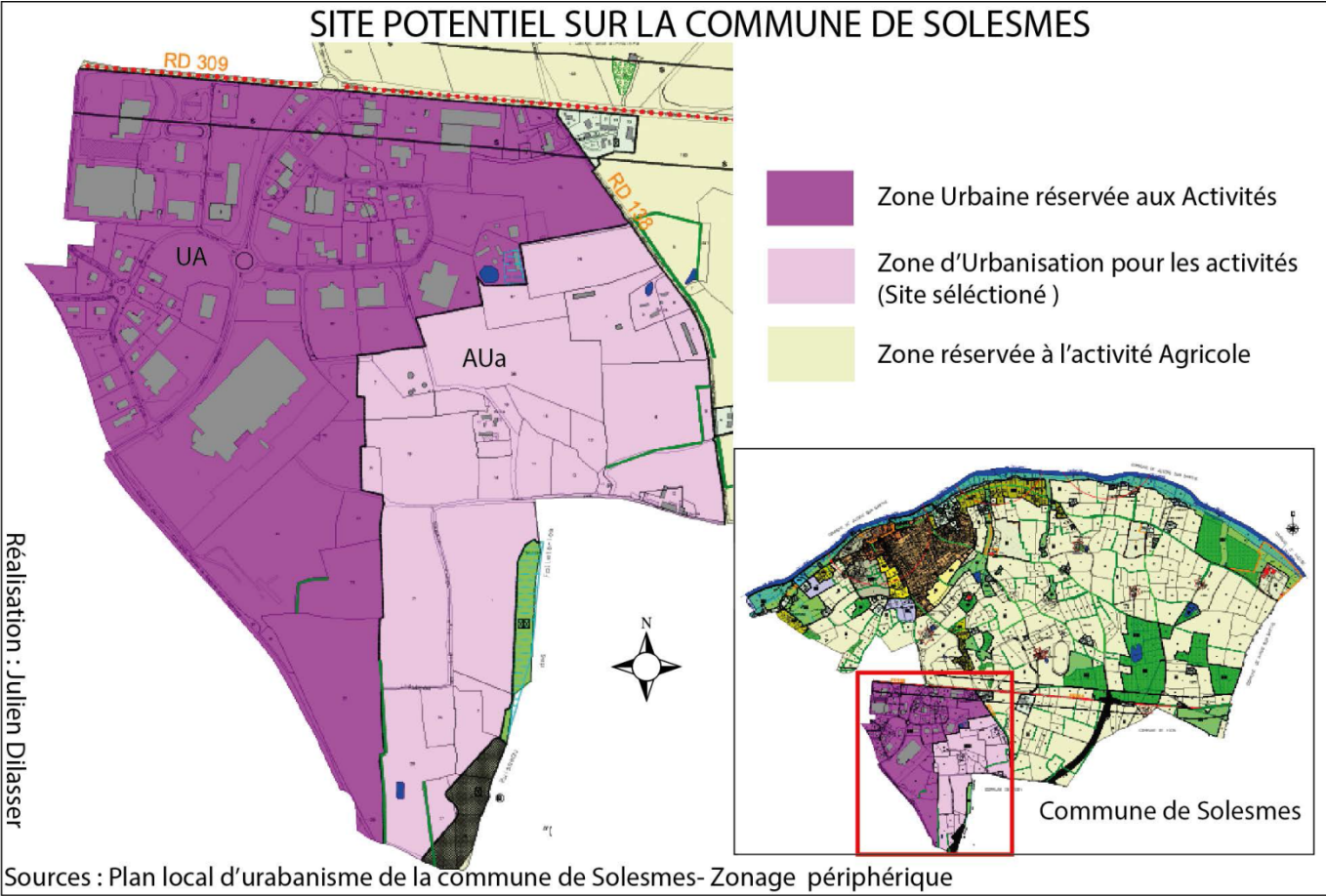
## 2.2. The legislative constraints: b/ The local urbanism plan

### Opportunity to build a biorefining plant vs the Local urbanism area

	Yes	No
Urbanised	X	
To be urbanised	X	
Agricultural		X
Natural and forest		X

## 2.2. The legislative constraints: b/ The local urbanism plan

Townships: the urban areas allow a biorefining plant building





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## 2.3. Social acceptability characterisation

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A preliminary study : the interest of a cost / benefit analysis

Some societal postures encountered :

- the NIMBY syndrome
- neither here nor elsewhere

Methodological issues :

- Can the acceptability be measured concretely ?
- How to define the majority in this type of project ?
- Which criteria favored ?
- At which scale ?

## 2.3. Social acceptability characterisation

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What influences the social acceptability ?

Which steps for the social acceptability of a project?

- analysis of the socio-economic context of the territory
- contact with future local employees
- quickly inform people of the territory envisaged about the project
- Project implementation phase

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### 3. Conclusion and perspectives

Availability of the resources (sunshine, H<sub>2</sub>O, CO<sub>2</sub>, N, P, heat, <10Km )

+

Analysis of the legislative framework



#### culture and biorefining plants in Pays de la Loire

100 ha

1,000 ha

10,000 ha



Good opportunity for the production of microalgae: small and medium markets (cosmetics, nutraceutic, feed, food)

Larger markets (Energy, chemistry)

Adapted strategy  
Multisite production  
Centralised biorefining



...Primary results obtained with students' team

Future objective:

To carry on a more detailed study (master training intership, PhD) ...  
→ new financial support ?

Questions to be deepened:

-ressources: distance criteria and more precise quantification of the  
ressources; integration into an industrial ecosystem

-lands availability

-social acceptability (local politicians, population, etc) : investigations



To be continued ...