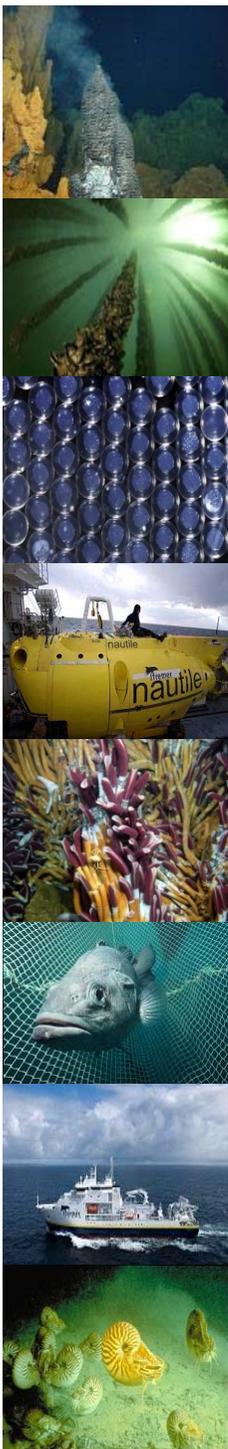


# Microalgues et énergie : des promesses, des défis et des obstacles

## Transition MicroAlgues

Jean-Paul CADORET  
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IDées - Fondation TUCK - In Principo  
Château de Vert-Mont – Rueil-Malmaison  
3 juin 2013





Création d'emploi

Environnement

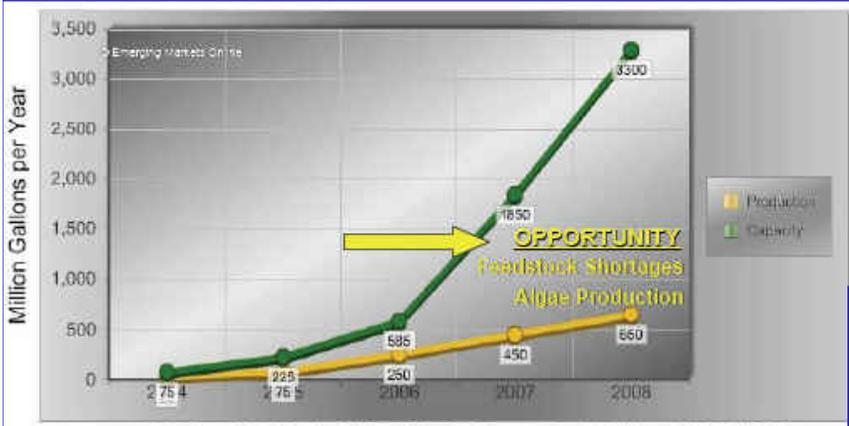
Pollution

Fiscalité

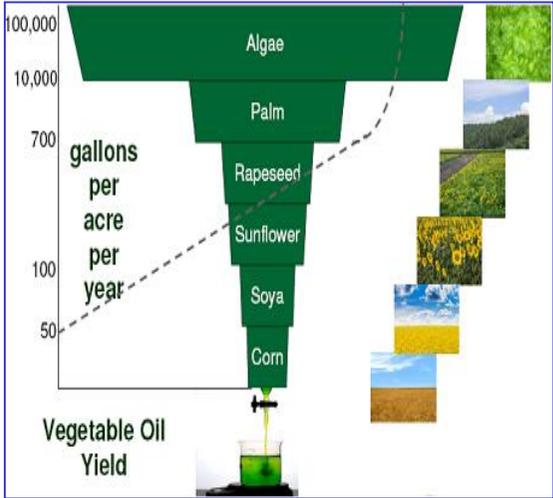
Politique énergétique

Indépendance énergétique

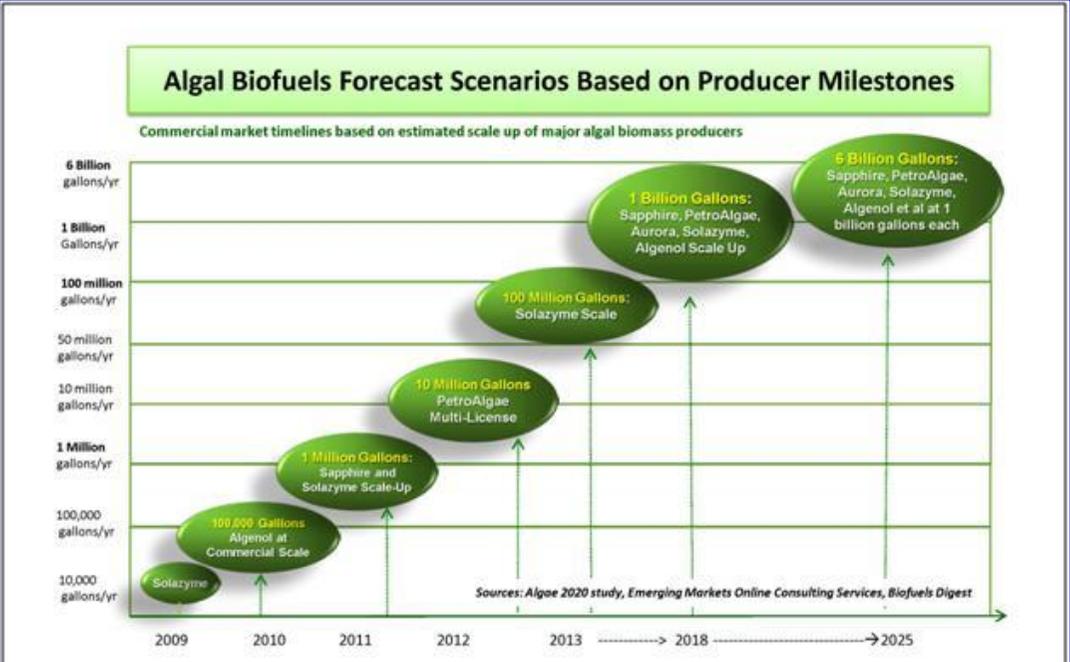
# Les promesses



sources Biodiesel 2020: A Global Market Survey 2nd Edition, NBB, USDA



Transition MicroAlgues Rueil-Malmaison 31 Jun 2013



**Algal biofuels pilot plant opens in Queensland**

April 10, 2013  
AlgaeIndustryMagazine.com



Queensland Premier Campbell Newman (L) officially launched the solar biofuel pilot plant on April 9, 2013. (AAP)

**P**remier of Queensland, Australia, Campbell Newman, has cut the ribbon on an advanced solar biofuels pilot plant designed to develop microalgae-based systems as a source of clean fuel and animal feeds. The \$3.5 million project had the potential, said Mr. Newman, to benefit regional and rural communities

**A.I.M. Interview: Sapphire Energy's CJ Warner and Tim Zerk**

October 21, 2012, by David Schwartz  
AlgaeIndustryMagazine.com

**S**apphire Energy's Green Crude Farm, in Columbus, New Mexico, is the biggest gamble on the table for commercial-scale algae to fuel. With over \$300 million in investments and loan guarantees, Sapphire is on course to bring algae cultivation technology and processing to the American farmer—at some point not too far down the road.



Sapphire Energy CEO and Chairman, CJ Warner

So now that we've all seen pictures of their prototypical New Mexico open pond algae farm, what is the real story behind it? What's it like operating the place? Where is it going from here?



Sapphire Energy Vice President of Corporate Affairs, Tim Zerk

At the recent ABS in Denver we had a chance to sit down with Sapphire's Chairman and CEO, CJ Warner, and VP of Corporate Affairs, Tim Zerk, to assess the progress of this phase of the Sapphire business plan. With CJ's background of over 20 years in the top ranks of Big Oil, and Tim's as a well-respected pundit of the algae industry to many Washington legislators, as well as a board member of the Algae Biomass Organization, this dynamic duo brings a large perspective to the conversation on

Algae's future... Check this out!

**Australia to build \$10m seawater pipeline for algae industry**

February 25, 2013  
AlgaeIndustryMagazine.com

**A**ustralia's State Development Minister Colin Barnett has announced a \$10 million government sponsored project for construction of a seawater pipeline to support the expansion of an algae industry at Karatha, in Western Australia. The pipeline would initially support Aurora Algae, a US-based algae technology and cultivation company currently investing \$50 million towards a Stage 1 production facility at Karatha.

Aurora Algae's pilot facility, close to Karatha airport, has already proved the technology to produce biodiesel, omega-3 oil, and protein-rich biomass for aquaculture and animal feed. As well as bringing jobs and economic diversification to the region, Aurora's production facility is intended to create new exports for the region, contribute to reducing the CO<sub>2</sub> emissions by the resource industry and support the local provision of diesel.

"This common user infrastructure will deliver benefits beyond encouraging the investment of Aurora Algae, with the seawater pipeline capable of supporting further investment by other industrial users in an algae industry. Aurora's proposed production facility is estimated to bring 170 jobs to the region."



Australia's State Development Minister Colin Barnett

3,5 M\$

**BioProcess Algae scaling-up to Phase Four**

March 31, 2013  
AlgaeIndustryMagazine.com



BioProcess Algae 'At Ground Zero' for algae production, in Shenandoah, Iowa

**P**hase Four in the commercial development of BioProcess Algae has begun. Bidding for this expansion is underway for the Shenandoah, Iowa-based algae cultivators, CEO Tim Burns said at the recent annual meeting of the Shenandoah Chamber and Industry Association.

The upcoming phase consists of a 10-to-25 acre expansion, costing between \$10-15 million dollars. The

10-15 M\$

300 M\$

October 14, 2012, by David Schwartz  
AlgaeIndustryMagazine.com

**H**eliae is the 9th startup for CEO Dan Simon, and the company is finally at his favorite stage: "We are completing our charge through the Valley of Death," he says. Indeed, in 2012, Heliae grew their team to over 75 people, sold their first barrel of jet fuel, completed over \$30 million in private placements—\$18 million of which came from outside investors—and broke ground on their 20-acre production site in Gilbert, Arizona, on the outskirts of Phoenix.



Heliae CEO Dan Simon

Most people in the industry know that Heliae was founded by members of the Mars family, owners of Mars, Inc. "Mars is a hallmark private family business and they understand that new industries require a long vision," said Simon. "That said, we needed to diversify our ownership and, in May, we brought in our first outside investor, the Salim Group of companies. They are an exceptional investor for the same reasons as Mars, but with the added benefit of an immediate entry into Southeast Asia and Asia Pacific."

Heliae has now signed their first long-term off-take agreement, is in the final stages of signing a couple others worth multi-millions, and has expanded their IP portfolio from five to over 30 issued patents in the last nine months.

We spoke with Dan Simon, President and CEO of Heliae Technology Holdings, Inc., at the recent ABS about Heliae's progress and plans for the near future.

30 M\$

86 M\$

**Solazyme raises \$125 million, closes offering**

January 31, 2013  
AlgaeIndustryMagazine.com

**S**olazyme, Inc. has announced the closing of its offering of 6% Convertible Senior Subordinated Notes due 2018 (the "Notes") in a private offering pursuant to Rule 144A under the Securities Act of 1933, as amended. The issuance of \$125 million aggregate principal amount of Notes includes the exercise in full by Goldman Sachs & Co., sole book-running manager for the offering, of its option to purchase \$10 million aggregate principal amount of Notes to cover over-allotments.



Solazyme has received aggregate net proceeds from the sale of the Notes of approximately \$119.4 million after deducting discounts to the initial purchaser and estimated offering expenses payable by Solazyme. Solazyme intends to use the net proceeds of the offering to fund project related costs and capital expenditure and for general corporate purposes.



Ifremer

Milton Sommerfeld, co-director of the Arizona Center for Algae Technology and Innovation (ASCAT) at Arizona State University in the lab with samples of algae biomass, algae oil, residuals and other products from algae biomass.

**A.I.M. Interview: ASU's Dr. Milton Sommerfeld**

October 26, 2012, by David Schwartz  
AlgaeIndustryMagazine.com

**B**ig algae news in the state of Arizona is the \$15 million award by the Department of Energy to Arizona State University to establish a national algae science and technology testbed, dubbed the Algae

15 M\$

**Algae Energy to invest 75M€ in Serbian algae farm**

March 12, 2013  
AlgaeIndustryMagazine.com

**G**reek biomass-from-algae producer Algae Energy is ready to invest 75 million euro (\$98.4 million) over the next two and a half years in an algae farm in the southern Serbian town of Leskovac, Belgrade-based media has reported.

John Sporis-Antoniadis, the general manager of Algae Energy, has signed a memorandum of understanding with Leskovac's mayor Goran Cetvanovic, and said that his company will employ around 4,000, according to newspaper Blic ([www.blic.rs](http://www.blic.rs)).

The algae production will take place in the town's so-called green zone, formed last year on 100 hectares of land close to the old highway connecting the town with the southern city of Nis. The zone was planned to be production and distribution center of agricultural goods for southern Serbia.

Algae Energy is prepared to start the project as early as July this year.

98,4 M\$



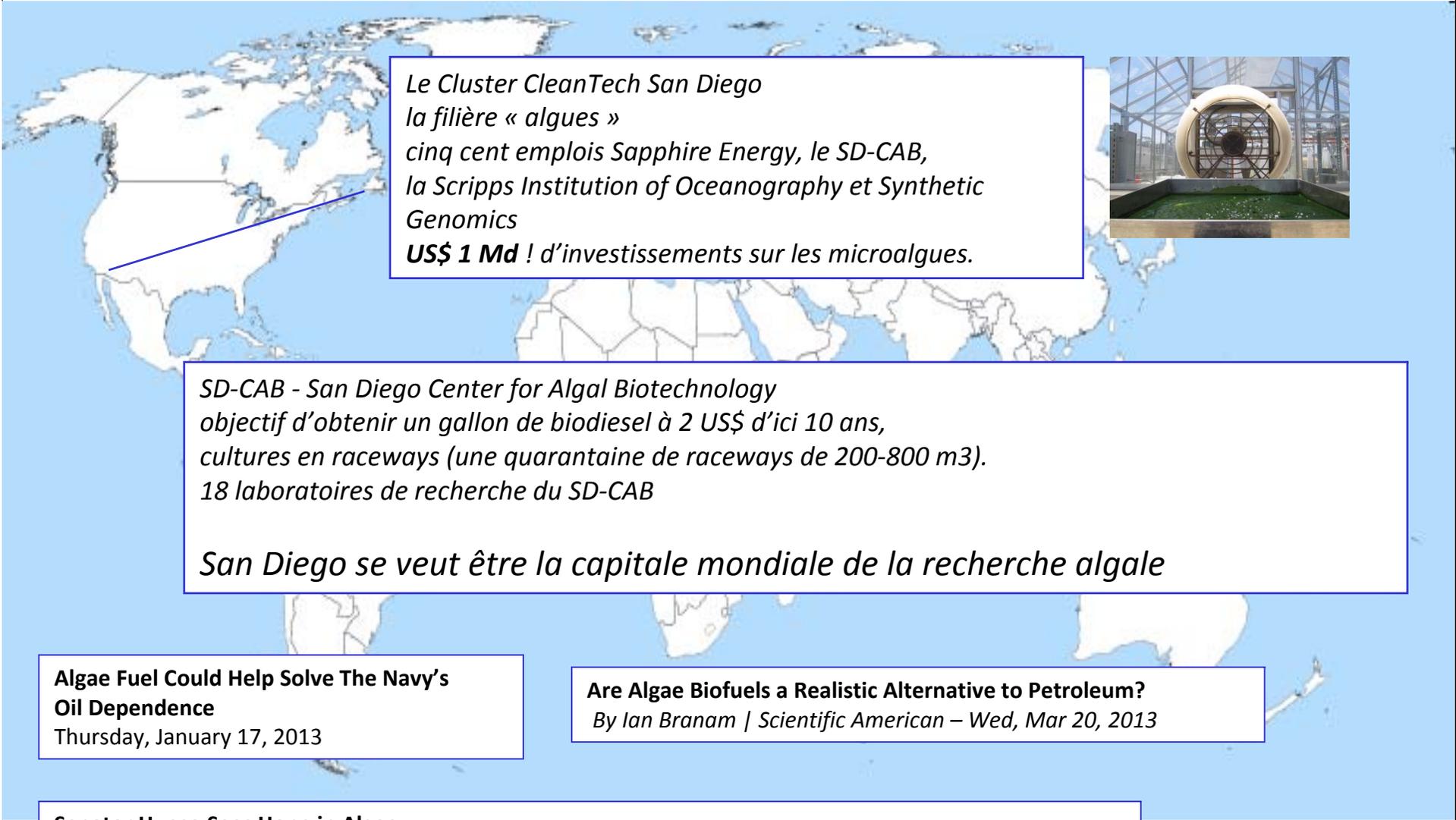
Officials of ENN Biomass Energy Technology Center and EADS/Airbus sign the agreement to develop and test algae-based aviation fuels.

**ENN, EADS/Airbus to Collaborate on Algae-based Aviation Fuels**

November 17, 2012  
AlgaeIndustryMagazine.com

**C**hina's ENN and Europe's EADS have signed a Memorandum of Understanding to co-develop microalgae-based aviation fuels. The agreement was made public at the China International Air Show in Zhuhai, Guangdong province.

Transition MicroAlgae Rueil-Malmaison 3 juin 2013



*Le Cluster CleanTech San Diego  
la filière « algues »  
cinq cent emplois Sapphire Energy, le SD-CAB,  
la Scripps Institution of Oceanography et Synthetic  
Genomics  
**US\$ 1 Md** ! d'investissements sur les microalgues.*



*SD-CAB - San Diego Center for Algal Biotechnology  
objectif d'obtenir un gallon de biodiesel à 2 US\$ d'ici 10 ans,  
cultures en raceways (une quarantaine de raceways de 200-800 m3).  
18 laboratoires de recherche du SD-CAB*

*San Diego se veut être la capitale mondiale de la recherche algale*

**Algae Fuel Could Help Solve The Navy's Oil Dependence**  
Thursday, January 17, 2013

**Are Algae Biofuels a Realistic Alternative to Petroleum?**  
By Ian Branam | Scientific American – Wed, Mar 20, 2013

**Senator Hueso Sees Hope in Algae**  
UC San Diego Visit Promotes Public-Private Collaborations for Energy, Economy, and Environment

# De très vastes pans de recherche sur la production

Ifremer

## 1 Biologie

- choix de organismes suivant un cahier des charges
- sélection variétale
- génomes et mutants possibles
- OGMs
- comportement en phototrophie/hétérotrophie
- contrôle des prédateurs
- risques pathologiques
- risques de dissémination
- prise en compte des co-produits
- propriété industrielle

## 2 Gestion des intrants

### 2.1 Eau

- approvisionnement en eau
- complémentation en eau des systèmes ouverts
- recirculation de l'eau
- traitement des eaux usées

### 2.2 Substrats et nutriments

- approvisionnement en CO<sub>2</sub>
- nutriments (optimisation des apports et des coûts)
- Bilan énergétique

## 3 Bioréacteur et procédé

- sélection de photobioréacteurs (mode d'éclairage)
- expertise de nouveaux matériaux
- transfert du CO<sub>2</sub> et élimination de O<sub>2</sub>
- optimisation du brassage
- contrôle et régulation des paramètres physico-chimiques
- définition des paramètres de conduite (temps de séjour...)
- automatisation du procédé
- modélisation

## 4 Bioraffinerie

- concentration de la biomasse algale
- extraction
- post traitements éventuels

5 ACV  
transversal

## Microalgae + Biofuel

## Microalgae + Biotechnology

**Authors** Refine Exclude Cancel

The first 100 Authors (by record count) are shown.

<input type="checkbox"/> DAS KC	<input type="checkbox"/> ZHOU WENQUANG	<input type="checkbox"/> BARBOSA MJ	<input type="checkbox"/> LU YH
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## Microalgae

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## Microalgae

Countries/Territories

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<input type="checkbox"/> IRAN		

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DISCOVERY STARTS HERE

# Forces Nationales

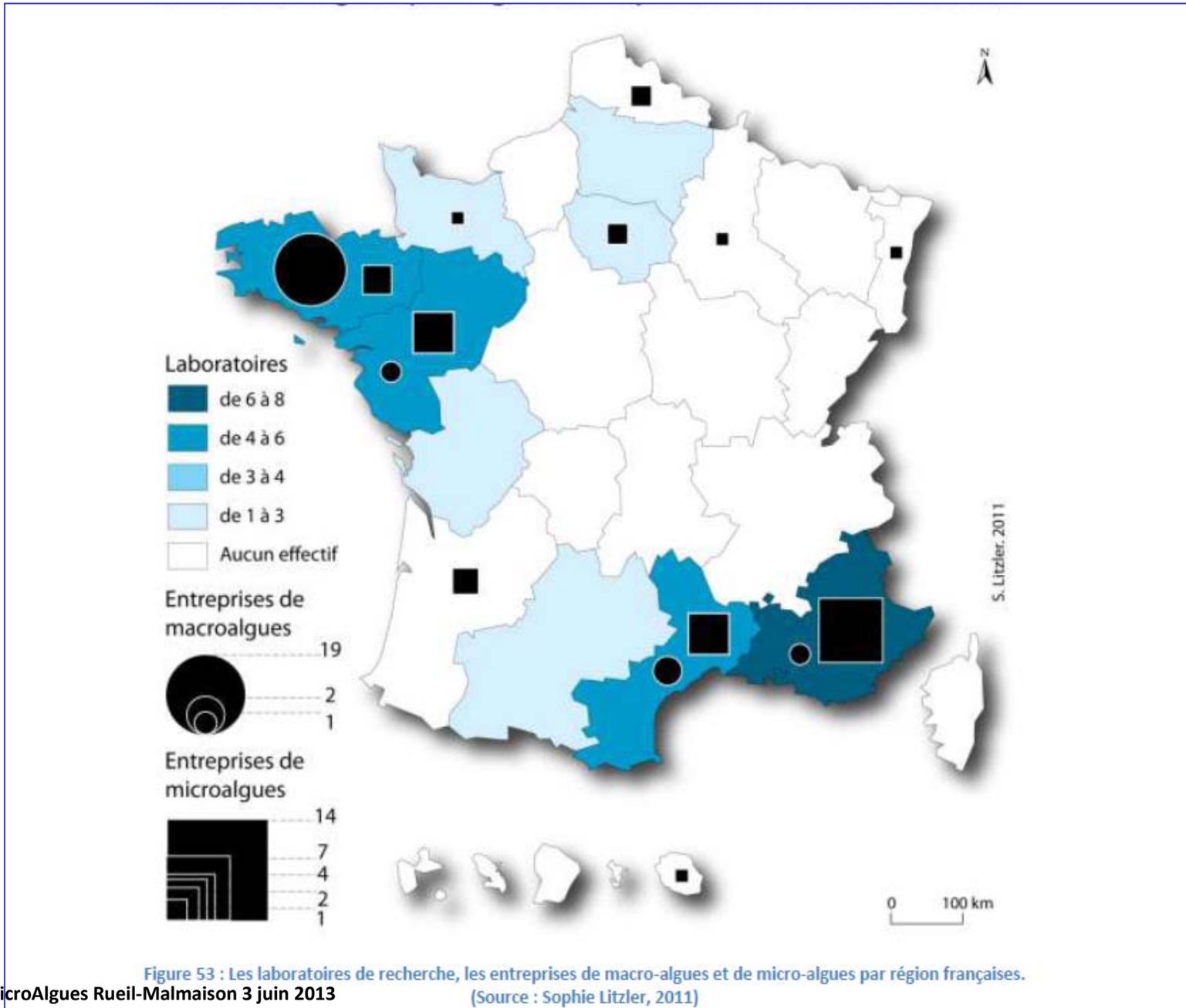


Figure 53 : Les laboratoires de recherche, les entreprises de macro-algues et de micro-algues par région françaises. (Source : Sophie Litzler, 2011)

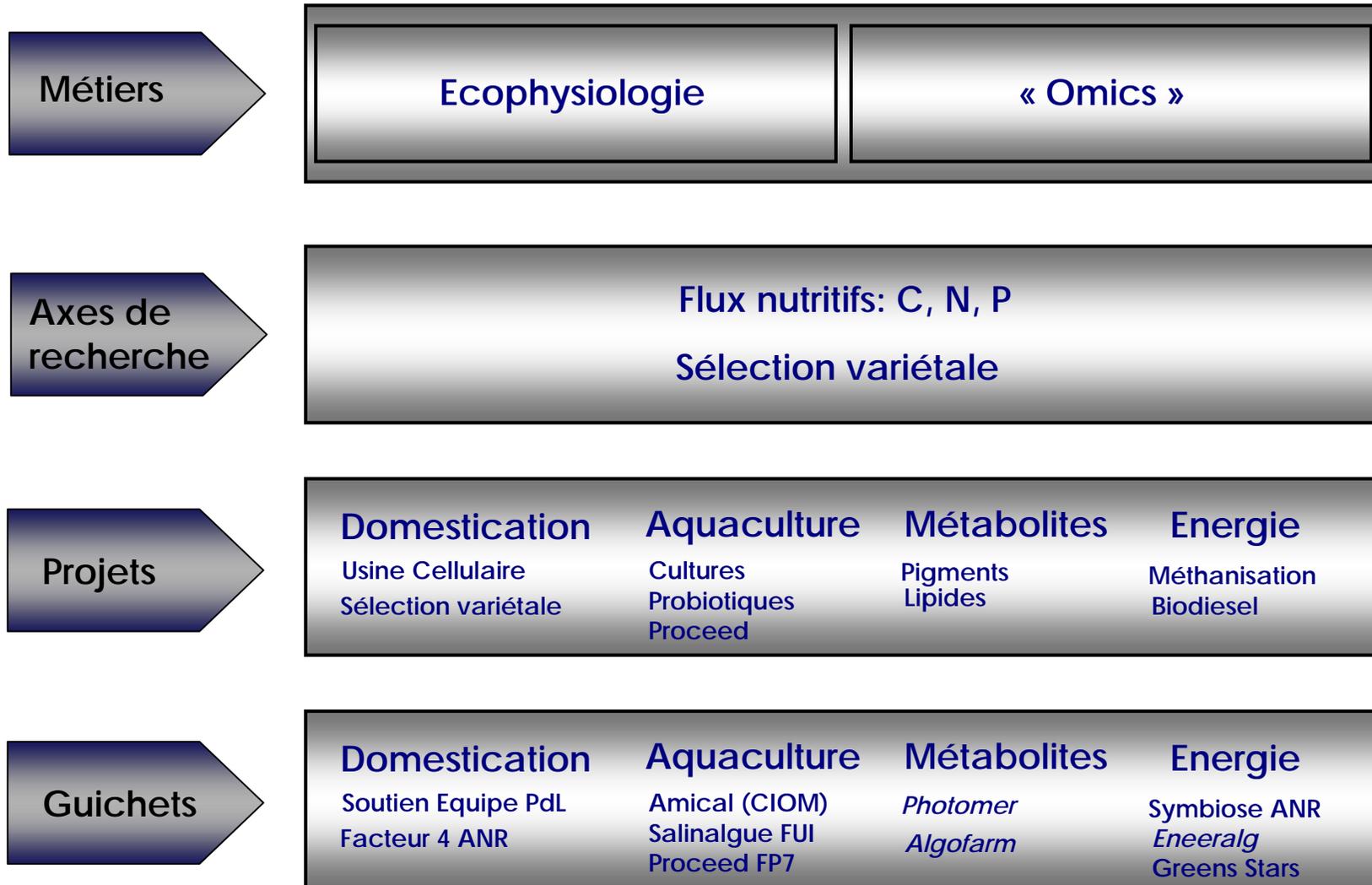
# Laboratoire Physiologie et Biotechnologie des Algues

Ifremer

## PBA-Ifremer-Nantes



PBA-Ifremer-Nantes



PBA-Ifremer-Nantes

Projet Alimentation



Action alimentation animale:  
Mollusques  
Poissons

Action alimentation humaine:  
DHA, EPA

Projet Santé



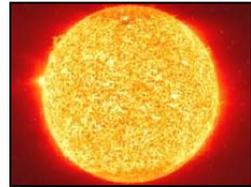
Action Usine Cellulaire  
Molécules recombinantes

Action Photomer:  
Pigments et Cancers

Action Polysaccharides  
Bioconversion

Action AntiOxydants  
Pigments

Projet Energie



Action Biodiesel  
Shamash  
*Safe Oil*

Action Méthane  
Symbiose

Action facteur 4

Action Phycover

Action Organics

Projet Industrie



Action Reacteur Pilote  
Collaboration S3D

Action Expertise  
Geme

Action Filière  
Amical, Nouvelle Calédonie

Projet Environnement



Action Démonstrateur  
Salinalgue

Action Démonstrateur  
Collaboration Guyane

Métiers

Ecophysiologie

« Omiques »

## La face optimiste

Une recherche française de haut niveau

Une recherche qui couvre tous les aspects

Génomique

Génie des procédés

Modélisation

Physiologie

Biochimie

Algothèques/taxonomie

Des marchés colossaux et des places à prendre

La possibilité de s'intercaler dans la recherche internationale

Il est encore temps

## La face pessimiste

Une quête de la diminution des coûts

Une balance énergétique défavorable

Une compétition internationale inégale

Finances pour les USA

Règles différentes (ex Chine)

Une culture de la valorisation à créer

Une communication confuse (énergie vs alimentation)

Des financements supplétifs

Un risque fort d'être « suiveurs »

La France producteur en énergie ?

La course aux brevets est déjà lancée

Les collaborations dans un contexte économique ?

## Et la suite ?

Potentiel extraordinaire : Diversité biologique, manipulabilité

Concurrence internationale très importante: des niveaux d'investissement énormes

Une survente médiatique: les coûts sont ignorés, difficulté d'accès à la biomasse minimisée

Mais:

Une place à prendre dès à présent:

Au plan académique

Par un effort de recherche coordonné

La création d'une filière de formation dédiée

Au plan commercial

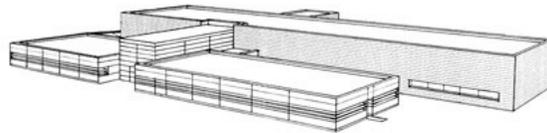
Une place dans le savoir-faire

Urgence de se protéger (brevets)

# Laboratoire Physiologie et Biotechnologie des Algues

## Projet Institut des Microalgues

### INSTITUT DES MICROALGUES



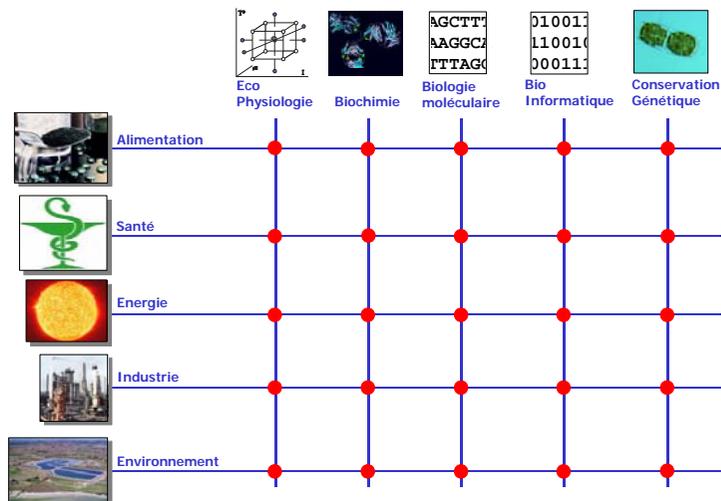
un outil de recherche, de développement et de valorisation dans une compétition internationale

### INSTITUT DES MICROALGUES

#### Un modèle économique flexible adapté

Type de modèle	Offre	Rémunération
1. Service de recherche	Sélection de microalgues et de leurs biomolécules répondant spécifiquement à un besoin industriel	ETP (forfaitaire, fonction de l'effort de recherche – sur devis)
2. Co-développement de produits ou de procédés	Collaboration de R&D (investissement partagé) sur des microalgues et leurs biomolécules avec « co-exploitation » des résultats, chacun sur son domaine d'intérêt en exclusivité	ETP + redevances
3. Concession de licence sur produits ou procédés propriétaires	Sur certains domaines sélectionnés par l'IMA, développement de produits ou procédés propriétaires à forte VA (sur fonds propres)	Licence ou vente de brevet/savoir-faire et/ou prise de participation dans une entreprise essaimée de l'IMA

### INSTITUT DES MICROALGUES

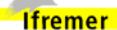


### Laboratoire Physiologie et Biotechnologie des Algues



Audit Cabinet TKM

#### Laboratoire Physiologie et Biotechnologie des Algues



*ils ont une très grande crédibilité : au niveau français c'est évident, au niveau européen aussi. c'est l'Ifremer qui a, jusqu'à aujourd'hui, capitalisé les connaissances dans le domaine des microalgues. le PBA a eu la grande qualité de ne jamais perdre de vue qu'il y avait certes de grandes potentialités avec les microalgues*

*mais sans se laisser emporter par cette frénésie type bulle spéculative.*

Daniel Thomas (UTC)

*Je connais Mr Cadoret depuis quelques années et pense que c'est un très bon laboratoire*

René Wijffels (Wageningen)

*Le PBA a un rôle important dans la biologie et biotechnologie des algues, ils sont bien appréciés pour cela en Europe en tout cas, peut être aussi dans le monde.....ils sont bien reconnus : leur force : maîtriser la culture des microalgues.*

Win Vyverman (Univ Gent)

*C'est un très bon laboratoire dans son domaine..... leur reconnaissance dans le domaine est importante*

Mario Tredici (Univ Florence)

## IEED Greenstars

### Institut d'Excellence sur les Energies décarbonées

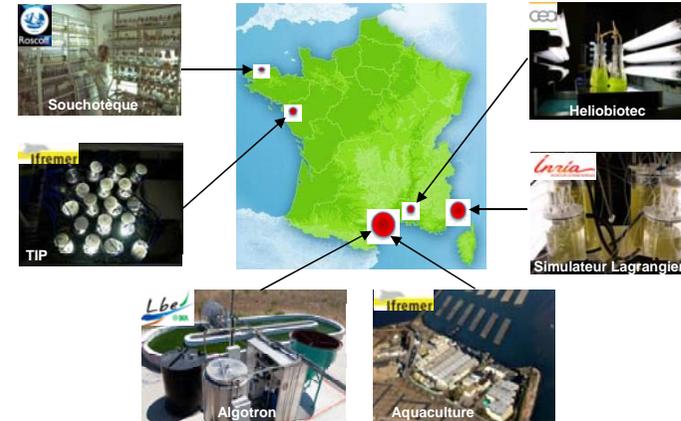


**L'innovation pour l'industrialisation de la bioraffinerie des microalgues:  
Vers une nouvelle génération de bioproduits et de biocarburants !**



### GreenStars: Plate-formes d'exploration

Outils expérimentaux novateurs et le plus souvent uniques au monde, propres à lever les verrous, à apporter une forte plus-value, à différencier les résultats de l'existant au niveau international et à accélérer les ruptures scientifiques et techniques.



### Le concept fondateur de GreenStars

#### Société de Recherche Collaborative

**Apporter une plus value et accélérer des projets prometteurs**

Chaque année, 2 à 5 projets porteurs de rupture technologique seront identifiés, puis hébergés et accompagnés au sein de la structure

- Ils bénéficient d'une expertise locale pour accélérer les innovations
- Ils sont appuyés par un réseau de laboratoires et de plateformes technologiques
- Ils ont accès à des équipements de pointe

**Construire le maillon manquant  
entre recherche académique et industrialisation**

#### Un actionariat équilibré (1/2)

3 Groupes, 9 PME, 9 établissements de recherche et 3 pôles

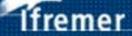


#### Des soutiens publics pérennes



# Physiologie et Biotechnologie des Algues

Le futur de la biotechnologie des microalgues

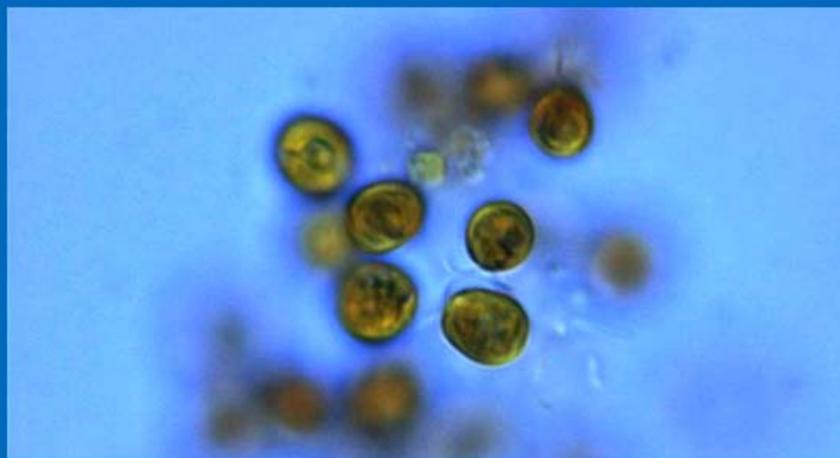


- Présentation
- Programmes
- Projets
- Expertises
- Equipes
- Moyens
- Publications-Ouvrages-Brevets

## Contact

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## Zoom



## Sélection variétale



## Nos partenaires

Le laboratoire est  
membre du réseau  
de plates-formes  
Biogeuouest



ATLANPOLE  
Land of innovation

Il bénéficie des conseils  
d'ATLANPOLE,  
technopole de  
Nantes-Atlantique

## Recherche générale

Terme à rechercher

Sur ce site  
Sur tout Ifremer

## Nos rubriques

- Accueil
- Présentation
- Programmes
- Projets
- Expertises
- Equipes
- Moyens
- Publications-Ouvrages-Brevets

## Vos Espaces

- Professionnels de la Mer
- Médias

## Edition

- ☰ Responsable éditorial : Jean-Paul CADORET
- ☰ Responsable technique : Nathalie SCHREIBER
- Mentions légales
- Plan du site

<http://wwz.ifremer.fr/pba>