



Brasilia2016

Dr R. Wojcieszak

CNRS Researcher

Catalytic valorization of biomass.





UCCS: some key data...

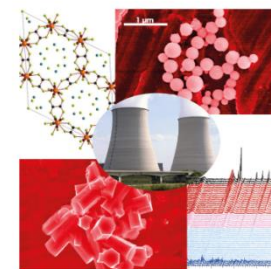
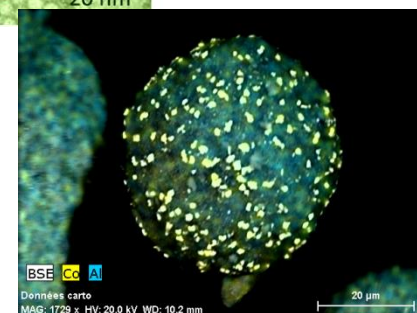
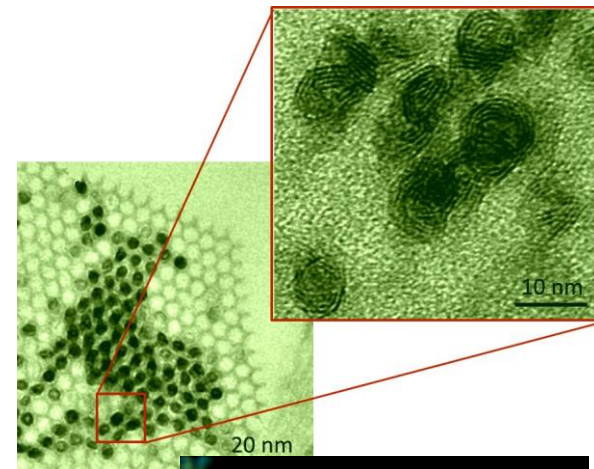
Unité de Catalyse et de Chimie du Solide
UMR CNRS 8181

- Staff: 135 (100 researchers, 35 technical staff)
- Students: 75 PhD
- Postdocs: 30

- 160 publications/year in international grade journals
- 200 communications/year

- Budget: 10M€/y (including salaries)
- 5M€/y funds: 70% private, 30% government

- Industrial partnerships: TOTAL, IFP, Air-liquide, ARKEMA, ADISSEO, AXENS, SOLVAY, RHODIA, ORIL, CELLIAL, LVM SA, ROQUETTE, SANOFI-AVENTIS, SNECMA, BRUKER, PSA, AREVA, CEA, Schneider, EDF, Arc-International, St Gobain,






VALBIO FLAGSHIP PROJECTS







Eurobioref

Coordination ; 38 M€








Partenaire ; 10,6 M€





Coordination ; 8,7 M€ Projet startup

Inauguration début 2014




Picardie Innovations Végéta
 Enseignements et
 Recherches Technologiques

247 M€ ; Responsabilité WP3











Contrats partenariaux













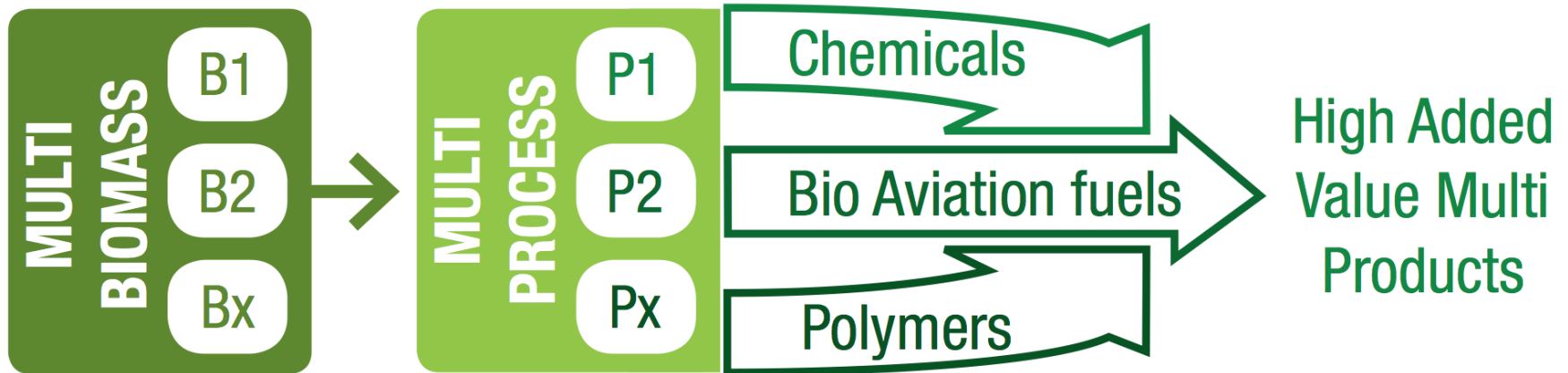

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Biomass valorization

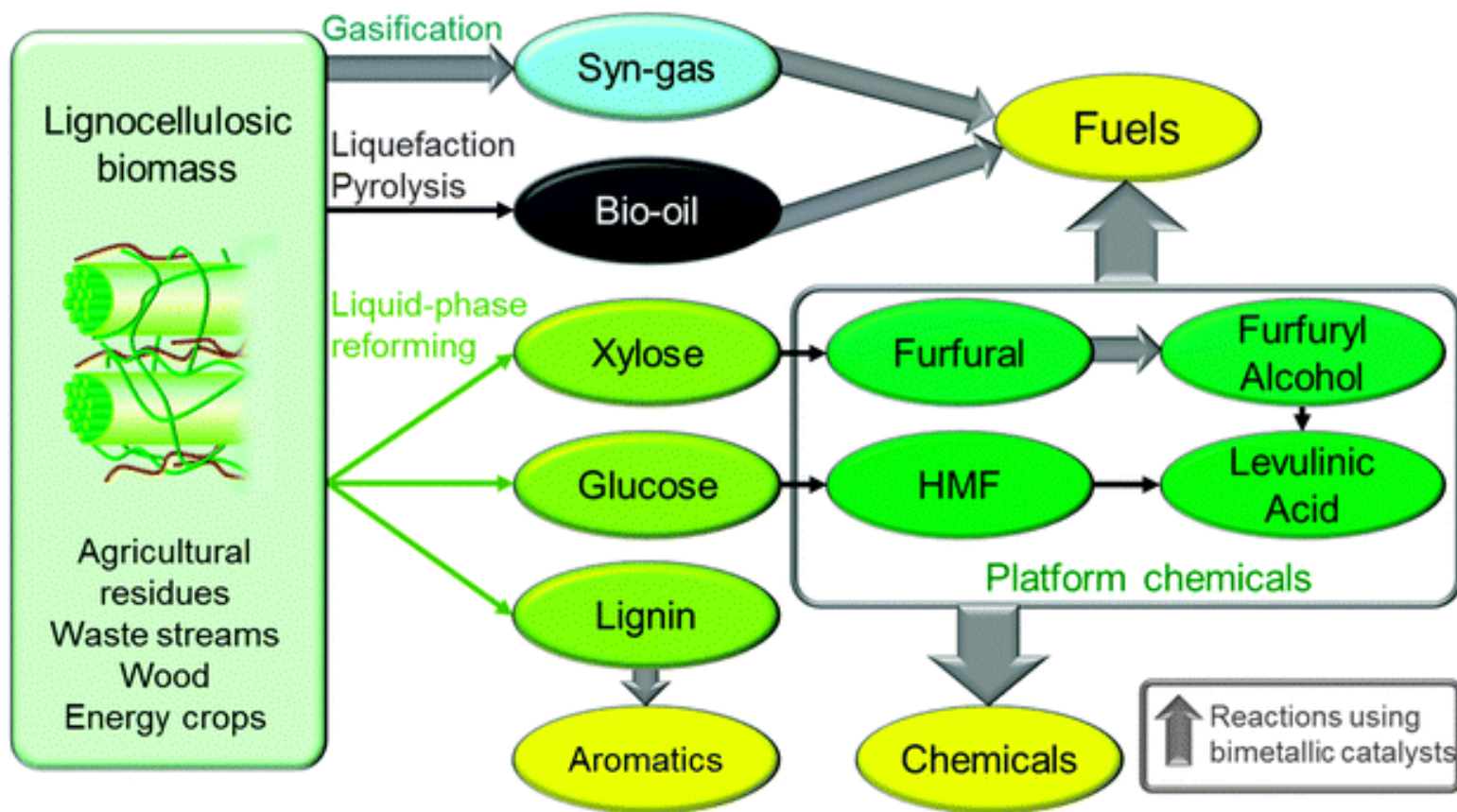
EUROBIOREF BIOREFINERY CONCEPT:
“M3BP2: MULTI BIOMASS-MULTI PROCESS-MULTI PRODUCTS”

Integrated EuroBioRef Biorefinery Concept





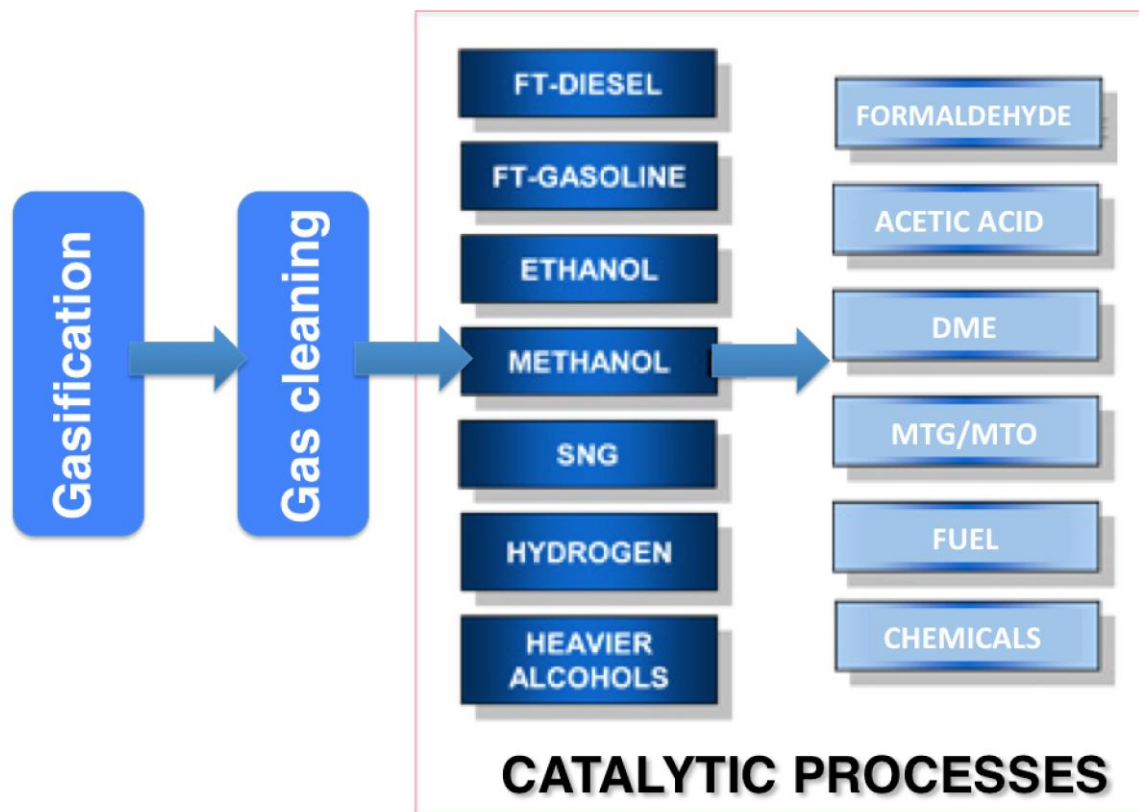
Field of interest: Hybrid catalysis for biomass conversion!





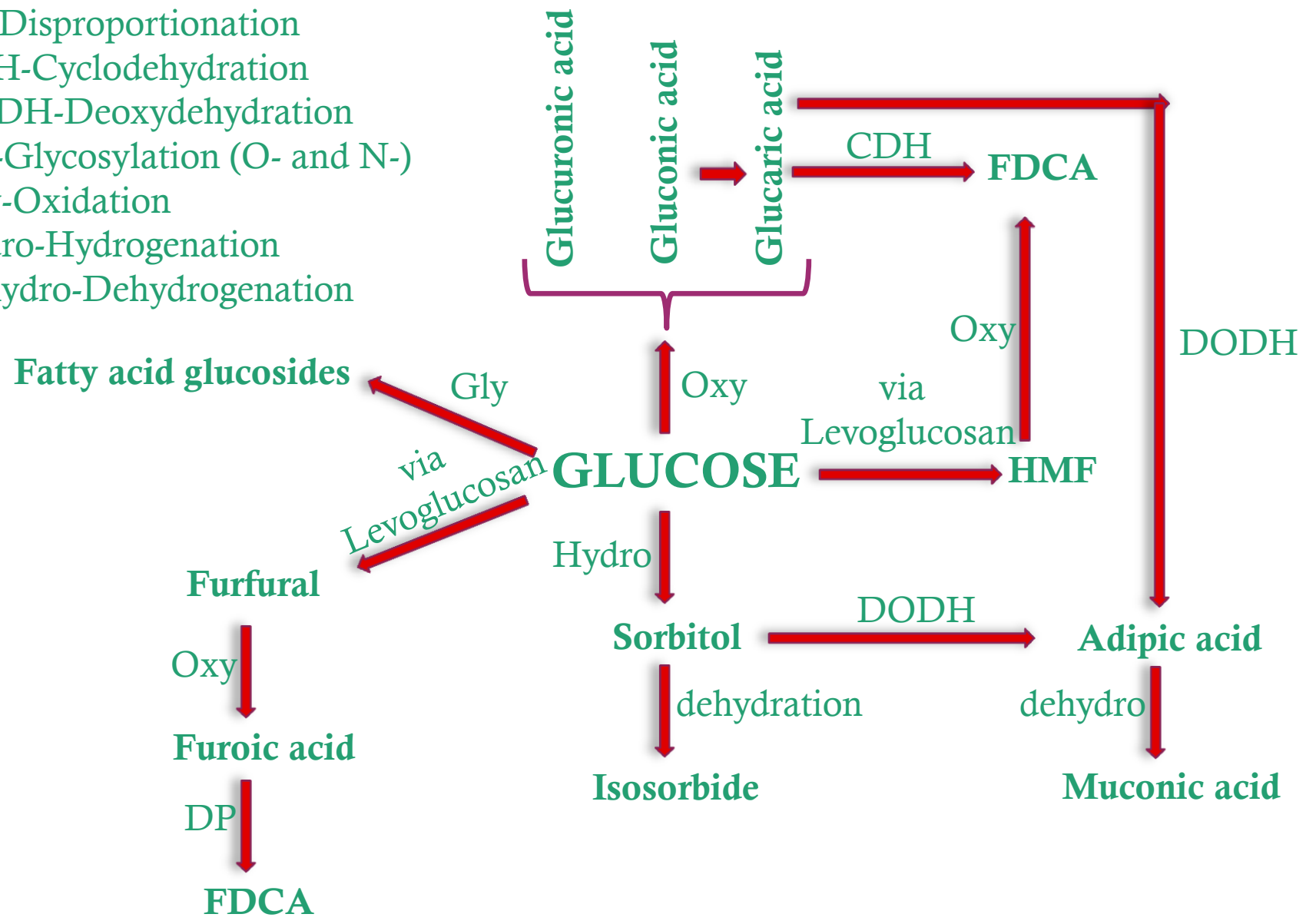
Biomass valorization

Gasification route to products



Simplified scheme of the main processes addressed by the project

- DP-Disproportionation
- CDH-Cyclodehydration
- DODH-Deoxydehydration
- Gly-Glycosylation (O- and N-)
- Oxy-Oxidation
- Hydro-Hydrogenation
- Dehydro-Dehydrogenation

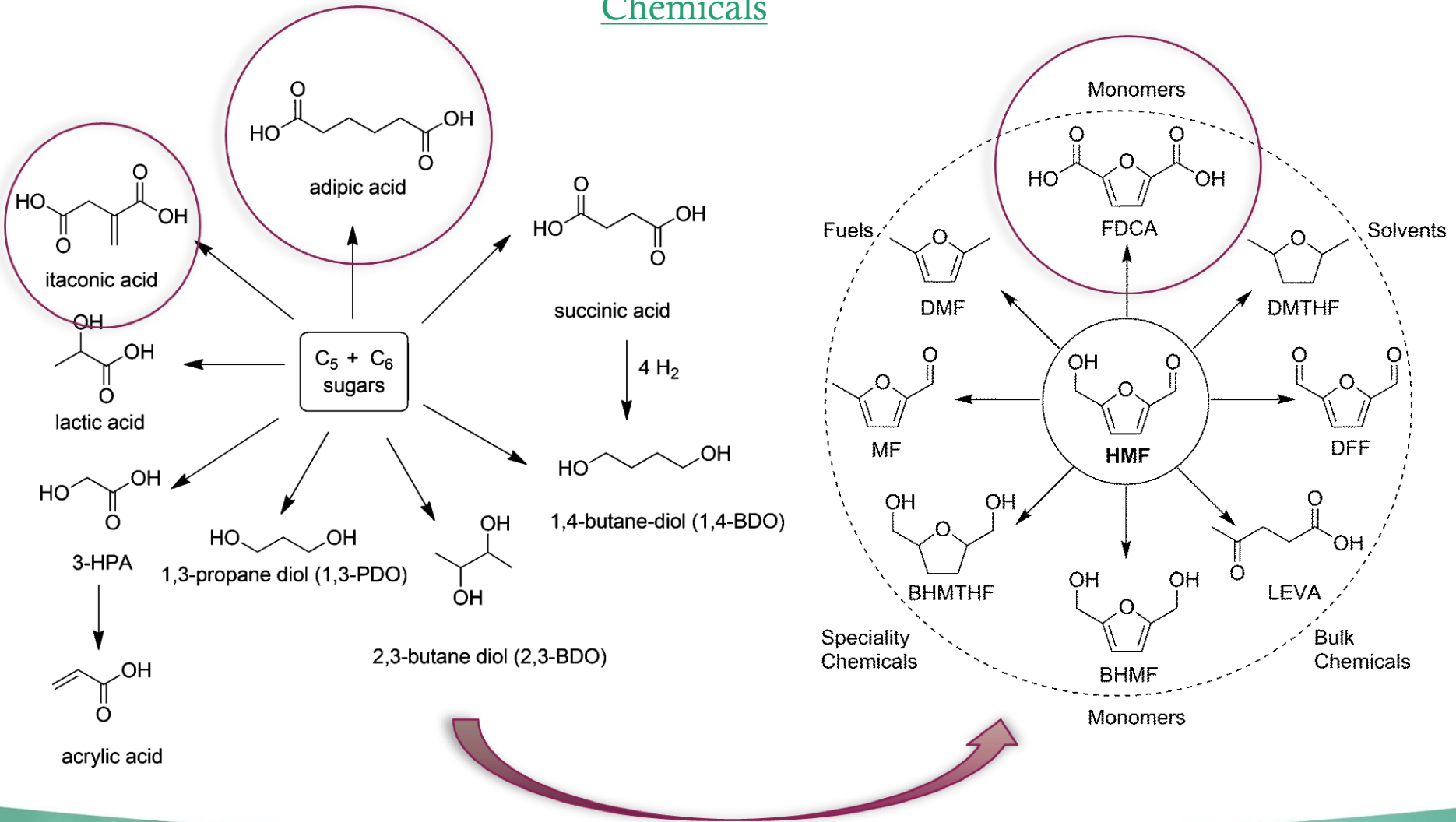


Glucose (levoglucosan) valorization via catalytic reactions



BIOMASS valorization to fine chemicals

Chemicals



**Projet scientifique Laboratoire International Associé
franco-brésilien**

ENERGIE et ENVIRONNEMENT

dans le champ des Sciences de l'ingénieur

Contexte:

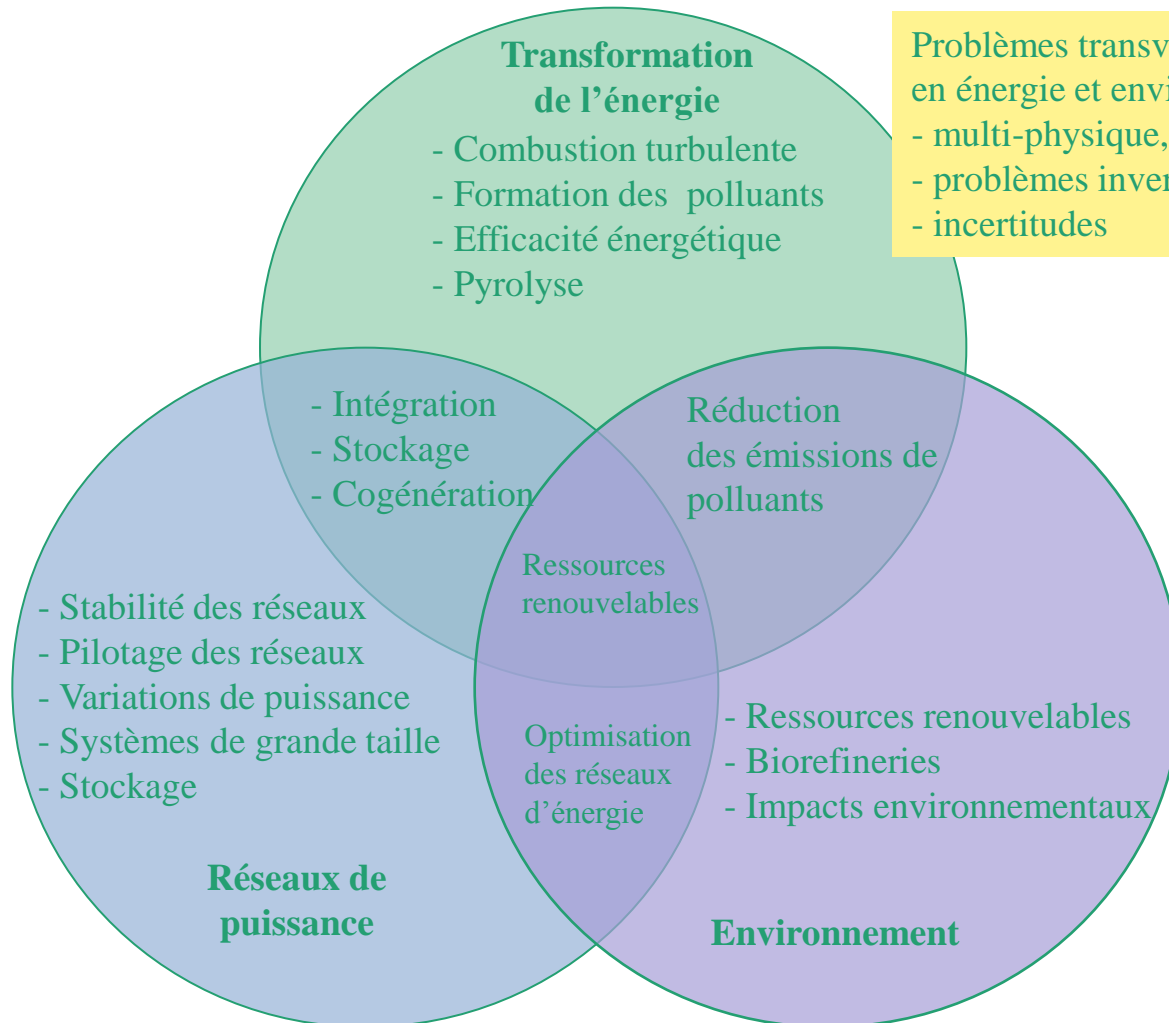
Les 5 Ecoles Centrales – de **Lille, Lyon, Nantes, Paris** et **Marseille** – constituent depuis plus de dix ans un réseau avec six grandes universités brésiliennes : Université de São Paulo (**USP**), Université de Campinas (**Unicamp**), Université Fédérale de Rio de Janeiro (**UFRJ**), Université Catholique de Rio de Janeiro (**PUC-Rio**), Université Fédérale du Rio Grande do Sul (**UFRGS** – Porto Alegre) et Université Fédérale du Ceara (**UFC** – Fortaleza)

Enjeux:

En utilisant les données récentes de l'Agence internationale de l'Energie, on peut estimer que la consommation annuelle d'énergie au Brésil pour l'industrie et les transports équivaut à 20 fois la production du barrage d'Itaipu (8,5 Mtep), dont 90% en combustion.

Les orientations du LIA s'intègrent fortement dans l'Agenda Stratégique France-Europe 2020, dont la proposition principale est de « Mobiliser les acteurs de la recherche sur les grands défis sociétaux », et en particulier sur celui de l' « Energie propre, sûre et efficace »

Les thématiques du LIA



Participants académiques français:

EM2C, UPR 288 (CNRS, CentraleSupélec)

Coordinateur (EM2C): Nasser Darabiha, Professeur des Universités,
Ecole CentraleSupélec

Nasser.Darabiha@centralesupelec.fr

4 chercheurs CNRS,
5 Enseignants-chercheurs

UCCS, UMR 8181 (CNRS, Université de Lille 1, Centrale Lille)

Coordinateur (UCCS) : Sébastien Paul, Professeur Ecole Centrale Lille
sebastien.paul@ec-lille.fr

4 chercheurs CNRS,
4 enseignants-chercheurs

L2S, UMR 8506 (CNRS, CentraleSupélec, Université Paris-Sud)

Coordinateur (L2S) : Didier Dumur, Professeur CentraleSupélec
didier.dumur@centralesupelec.fr

4 chercheurs CNRS,
6 enseignants-chercheurs.

| Thématique | Coordinateur français | Coordinateur brésilien |
|--------------------------|--|----------------------------------|
| Transformation d'énergie | Dominique GOBIN (CentralSupelec) | Luis Fernando da SILVA (PUC Rio) |
| Environnement | Robert WOJCIESZAK (CentraleLille) | Alexandre KAWANO (Poli-USP) |
| Réseaux de puissance | Bruno FRANÇOIS (CentraleLille) Raul DELECERDA (CentraleSupelec) | Rogerio SANTOS (UNICAMP) |
| Modélisation | Laurent STAINIER (CentraleNantes) Abdel ZINE (CentraleLyon) | Philippe DEVELOO (UNICAMP) |

UCCS est responsable de l'axe ENVIRONNEMENT

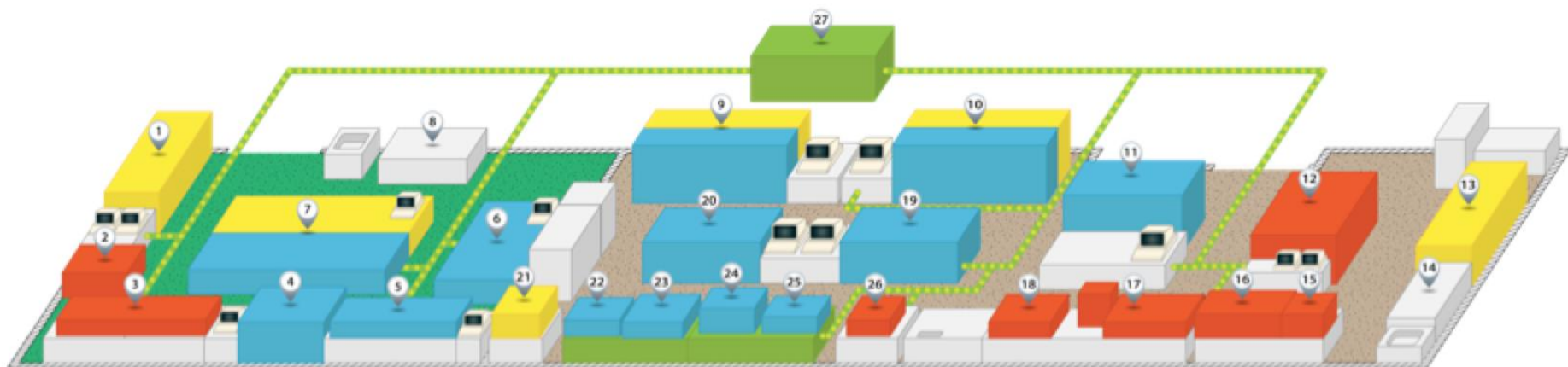
Cet axe concerne la valorisation de la biomasse:

- production de matériaux, énergie et molécules d'intérêt à partir de végétaux; en particulier, la bioraffinerie;
- traitement des eaux usées (par méthodes mécaniques, catalytiques, chimiques ou biologiques);
- gestion des sous produits issus de la fabrication des biocarburants (valorisation de glycérol, de la lignocellulose, de CO₂, CO et H₂).



REALCAT platform

Brings catalysis over lightspeed



XRD, ICP, XRF, RAMAN, IR, UHPLC-MS, GC-MS,
MALDI-TOF, LC-TOF, Colonypicker, Chemspeed,
CatImpreg, Flowrence...



REALCAT platform

What is REALCAT?

A collaboration between 4 laboratories:

- Unit of Catalysis and Solid State Chemistry (UCCS)
- Laboratory of Bioprocesses, enzyme and microbial engineering (ProBioGEM)
- Laboratory of Fundamental Computer Science of Lille (LIFL)
- Laboratory of automatic control, Computer Engineering and Signal (LAGIS)

Funded by the French government in the frame of the PIA “Plan d’Investissements d’Avenir” – EQUIPEX

- Global budget: 8.7 M€ for 10 years
- Equipment: 6.5 M€
- FEDER: 0.7 M€

Location: UCCS; Ecole Centrale de Lille, Villeneuve d’Ascq, France



REALCAT platform

HT tools for synthesis

- 2 fully automated Chemspeed platforms for co-precipitation, impregnation and hydrothermal synthesis
- Glove-box
- Robot for HT synthesis of biocatalysts by cell culture
- Robot for HT synthesis of biocatalysts by technology of directed evolution of proteins

HT tools for characterization

- XRD
- IR spectrometer
- Raman spectrometer
- ICP
- Fluo-X
- BET



REALCAT platform

HT tools for catalytic testing

1. 3 Flowrence units from Avantium for gas phase testing
 - 16 reactors each with on-line GC analysis
 - 2 units equipped with cold traps
2. Free Slate SPR reactor
 - 24 reactors, up to 400°C/60 bar
3. Chemspeed platform equipped with 8 reactors (autoclaves) for liquid phase testing at high pressure (250°C/100 bar)
4. Chemspeed platform equipped with 36 reactors for liquid phase testing at ambient pressure
5. Microplate based fermentation system with on-line monitoring of pH, dissolved oxygen and biomass
6. Robot for HT screening of biocatalytic properties



REALCAT platform

HT tools for offline analysis

- 1 Fast-GC (2 channels: FID/FID)
- 1 Fast-GC (2 channels: FID/MS)
- 1 HPLC-MS simple quad for light molecules
- 1 HPLC-MS triple quad for heavy molecules
- 4 standard HPLC
- 1 MALDI-TOF
- 1 GPC for polymers



Field of interest: Hybrid catalysis.

TWO DIFFERENT WORLDS

Heterogeneous Catalysis

Fast reactions

High temperature reactions

Selectivity is an issue

Flow-type reactors

High productivity possible

Predator



'Biotech'

Slow reactions

Reactions at low temperature

Very selective reactions

Batch reactors

Productivity limited by inhibitors



Alien



Field of interest: Hybrid catalysis.

ELABORATING THE HYBRID

Heterogeneous Catalysis



Predator



'Biotech'



Alien



Hybrid Catalysis



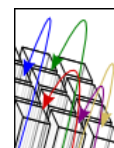
Predalien

DISCUSSIONS BETWEEN SPECIALISTS OF BOTH FIELDS
ADOPTION OF A COMMON VOCABULARY
SETTING OF NEW CONCEPTS
TRAINING/EDUCATION OF PEOPLE IN BOTH FIELDS



Acknowledgments

Financial support



INANOMAT



Thank you for your attention!