

# 2G Ethanol

- Addressing energy security and creating high value economies from agricultural waste in the Philippines

Local Innovation Capacity



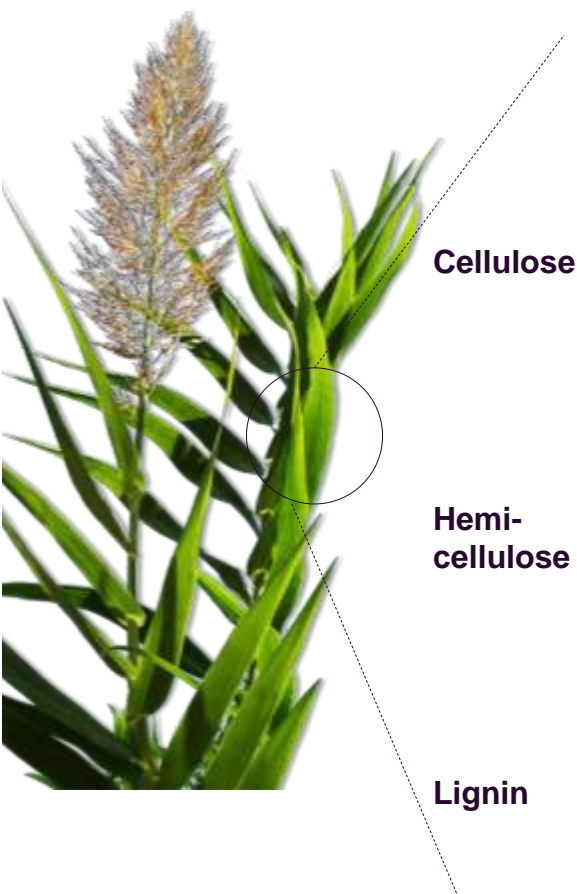
# Novozymes (NZ) is the world market leader in industrial enzymes and microorganisms - Dedicated 2G teams in China and Asia Pacific

## NZ snapshot

- Sales: EUR 1.5 billion
- 14% of revenue R&D reinvested
- Enzymes constitute >90% of turnover
- ~ 7,000 employees in 30 countries
- > 6,500 granted patents & pending patent applications
- More than 700 products used in 130 different countries in > 30 different industries
- Listed on the Nasdaq OMX, Nordic stock exchange
- Was founded almost 100 years ago and 'The Global 100 List' rank us to be around for another 100 years...
- ≈ 50% market share in supplies of enzymes for industrial use



# Enzymes enable the release of sugars from complex plant structures (lignocellulose) used in 2G ethanol production

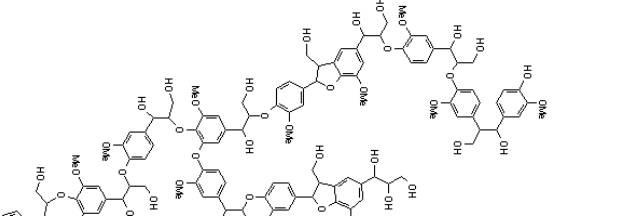
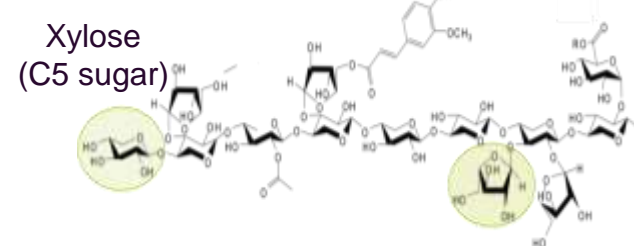
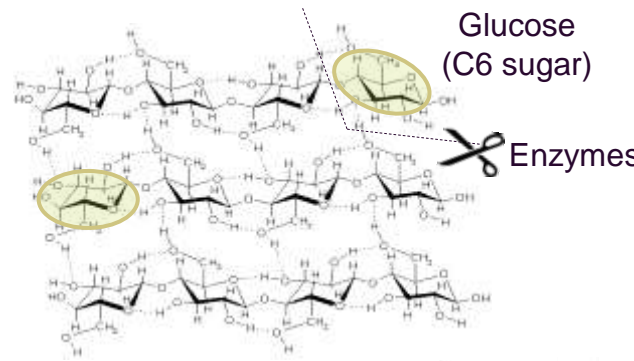


Cellulose

Hemi-cellulose

Lignin

## Lignocellulose structure



Enzymes are key to effective and cost efficient ethanol production, releasing C5 and C6 sugars from the biomass

C5 and C6 sugars are the main inputs to producing cellulosic ethanol

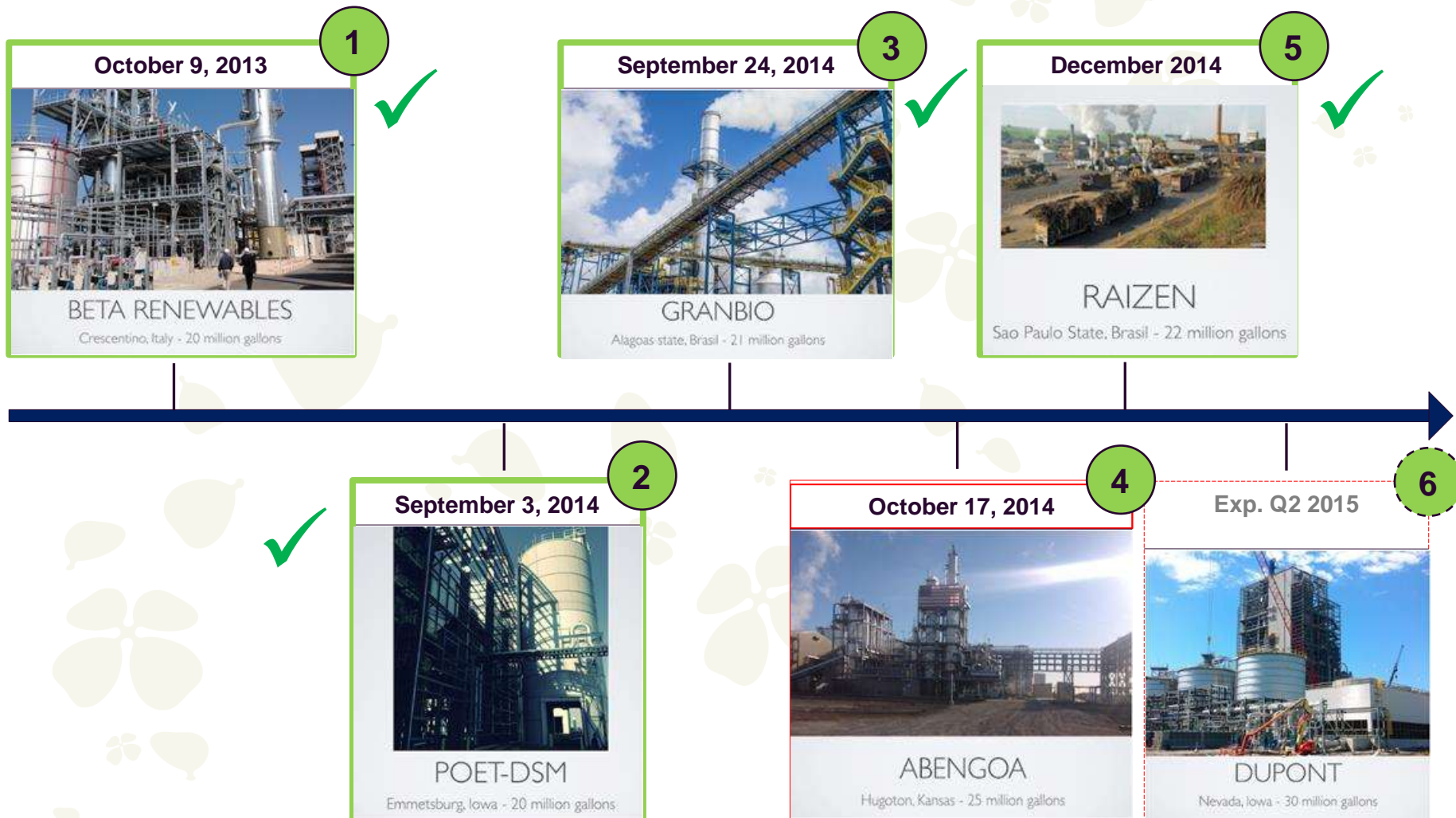
During the fermentation process, yeasts convert the sugars into ethanol

Lignin is typically used for generating steam and power

Novozymes enzymes

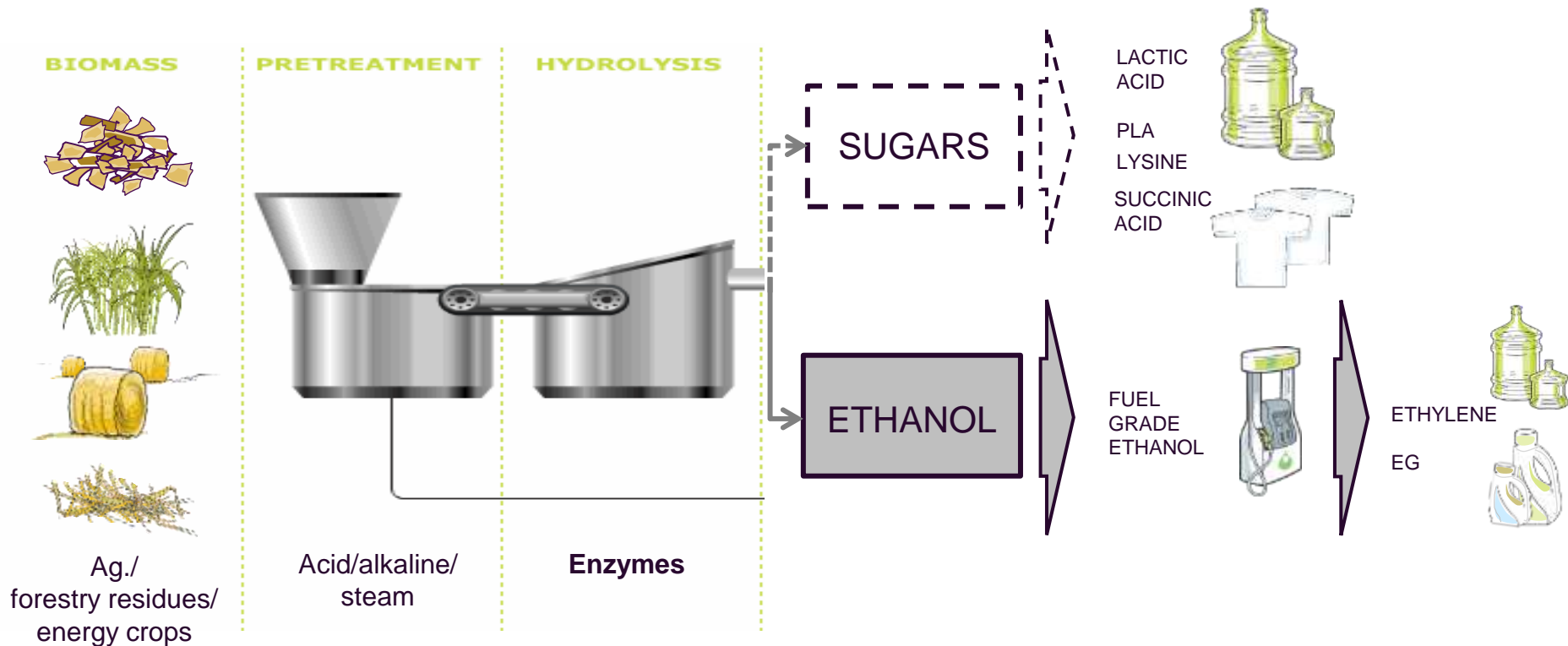
# Commercial-scale 2G (ethanol) production started in Italy more than a year ago, so reduced technology risk

Enzymatic hydrolysis is now the technology of choice for all currently commercial 2G operations






\*Currently 5 commercial-scale plants are operating worldwide

# The pre-treatment process for 2G Ethanol is the same as for 2G sugars



\* The process to have commercially viable fermentable sugars at acceptable purity levels at scale is estimated to take another 3-5 years

# Southeast Asia has become the 'last frontier' for 2G commercialization

-  In operation
-  In construction
-  NZ supply

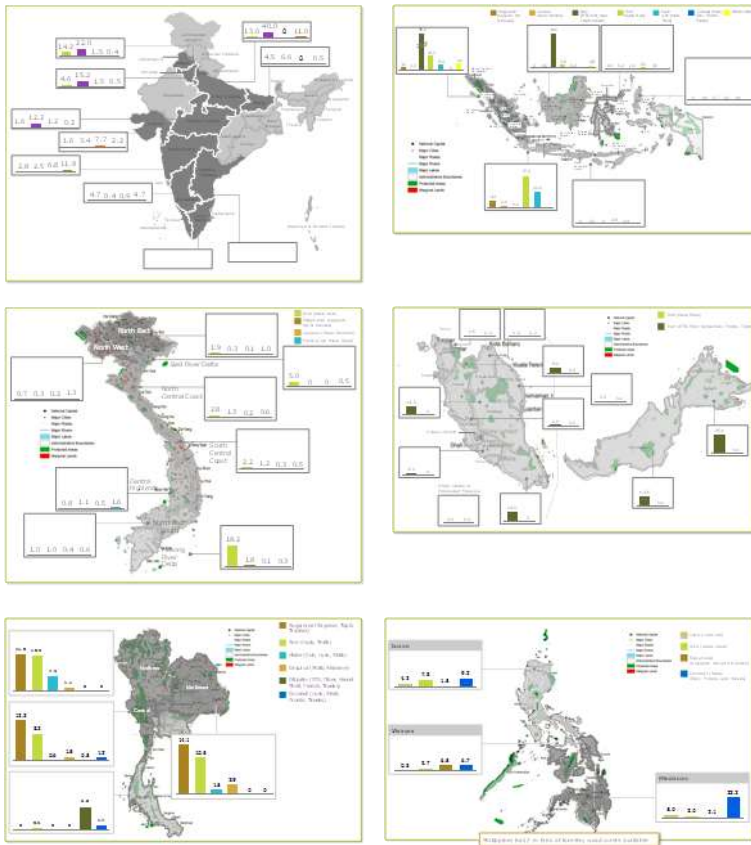
Commercial-scale 2G ethanol plants in operation or under construction by region (2014)



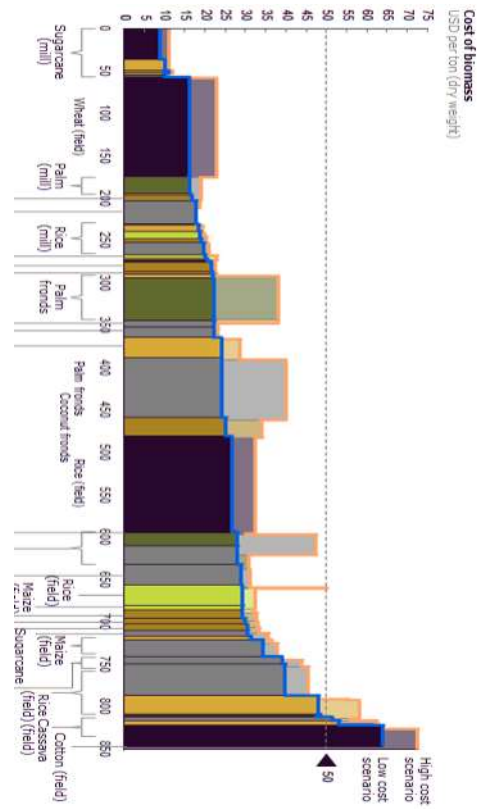
Another 20-25 concrete projects worldwide await investment decisions within the next 12 months

# Despite an abundance of biomass in Asia, feedstock security of large volumes will eventually attract downstream industry to partner and invest

## There is an abundance of feedstock in the APAC region

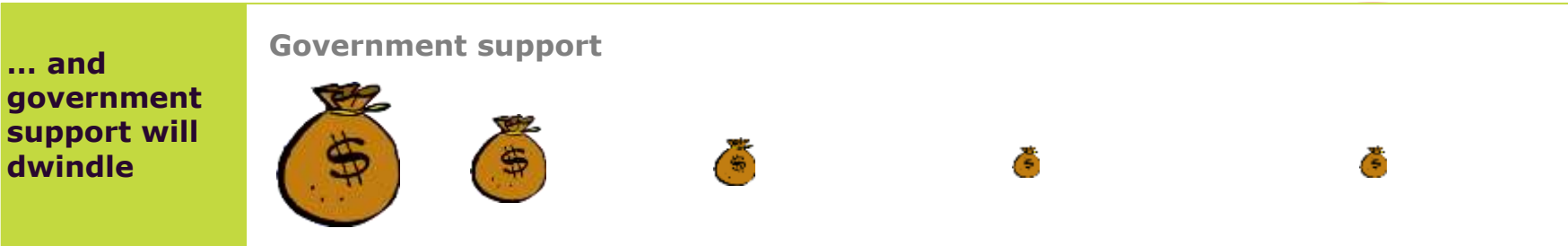
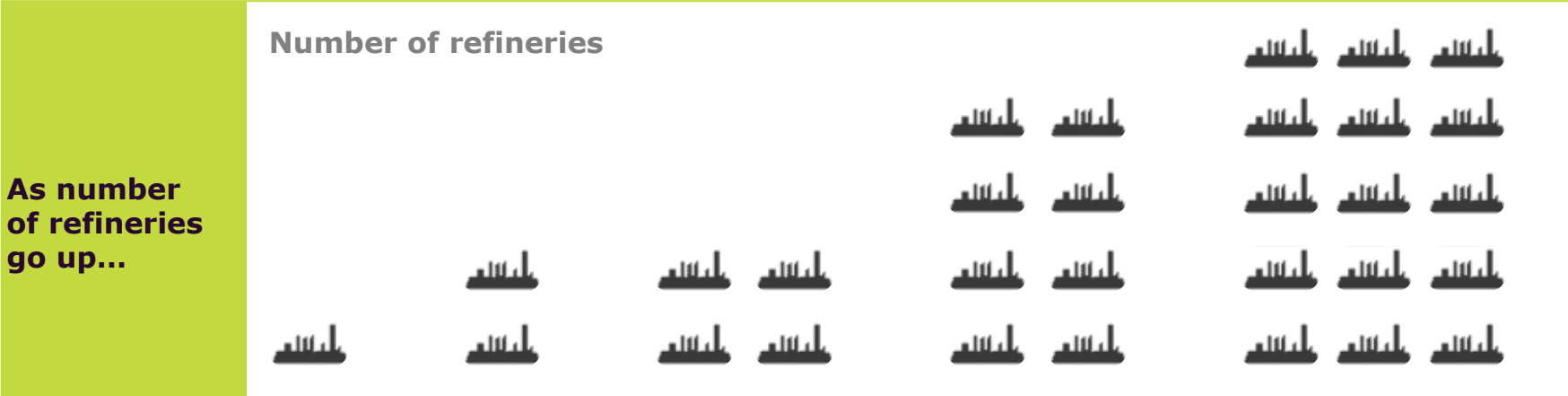


## Mobilization costs vary based on many factors



# Biomass access and security are the most critical enablers for downstream investment

ILLUSTRATIVE





# Biomass mobilization challenges present an opportunity in each market for 'local innovation capacity' to deal with supply chain & logistics



## **Biomass ownership throughout Asia is typically very fragmented and dispersed**

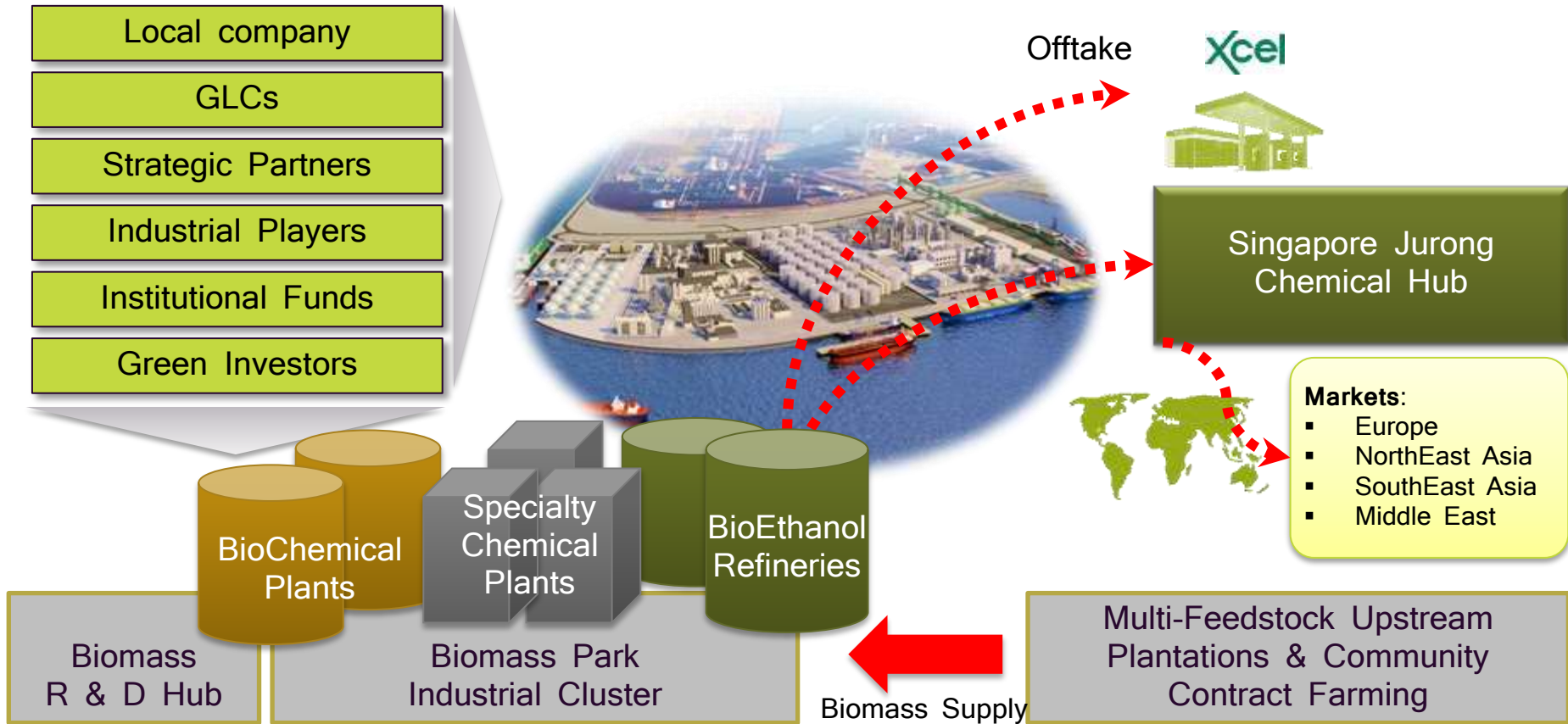
- The agricultural industry is extremely fragmented, predominantly made up of small holders where mechanization is not very common
- Rice, wheat, palm oil mills are usually owned by families or individuals and produce only a small % of required biomass volumes for a 2G plant
- To aggregate sufficient volumes, multiple mill owners would need to collaborate, within a 50km radius and near infrastructure
- Experiments with cooperatives in the past have largely failed, as farmers have been unwilling to invest for the longer term
- There is a strong short-term/cash preference for farmers, not really thinking 5 years in the future

## **Infrastructure can be very challenging**

- Road networks in rural areas are often not well developed, access and transport to 'aggregation hubs' could be challenging
- Often 1-20km of narrow dirt track between villages and the nearest road, and these tracks are only accessible by ox-cart or hand-pulled cart
- Trucks are often overloaded and have a high risk of tipping over or otherwise being involved in accidents, blocking single access roads.

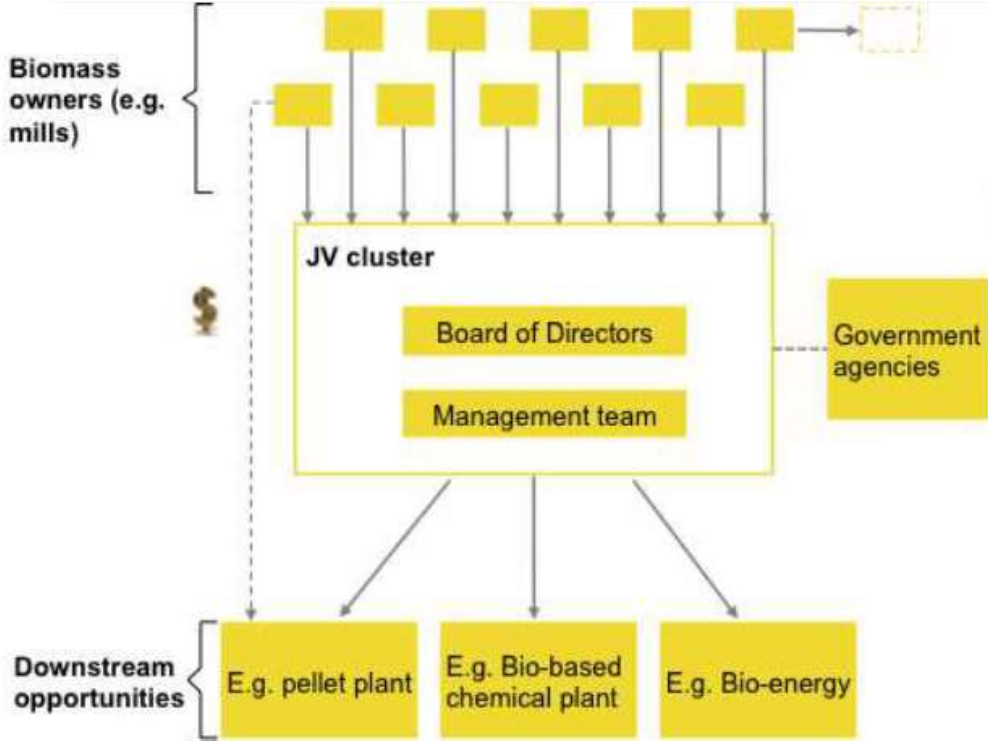
# In Sarawak, Malaysia, a local company has devised a strategy to secure downstream partnerships by providing biomass feedstock security

**EXAMPLE**



# In Sabah, Malaysia, a Biomass JV Cluster was launched by small and medium sized mills to secure and mobilize large volumes of biomass

**EXAMPLE**



A18 **THE BORNEO POST** Friday, May 23, 2014 **BUSINESS**

## Lahad Datu Biomass JV Cluster launched

**SANDAKAN:** The Lahad Datu Biomass JV Cluster was officially launched by Deputy Chief Minister cum Minister of Industrial Development, Datuk Raymond Tan Sui Kiah.

The Lahad Datu Biomass JV Cluster Berhad was formed by plantation companies whose oil palm mills produce empty fruit bunches, the biggest component of oil palm biomass which include, from the plantations, fronds and trunks and, from the mills, EFB, mesocarp fibres, palm kernel shells and palm oil mill effluent (POME).

The plantation companies are Golden Estate Sdn Bhd, Bell Corporation Sdn Bhd, Kelawira Sdn Bhd and Teck Guan Group.

The capital to be injected into the JV is in the form of EFB. The aggregation of biomass from the participating mills generates volumes desired by manufacturers of pellets, bio ethanol and bio chemicals.

Speaking at the ceremony, Tan explained that because oil palm mills were stakeholders, the JV circumvented the problems of biomass pricing and supply contracts.

"These two problems were the main obstacles to a biomass downstream sector materializing in Sabah earlier, and finally we have a mechanism for aggregating our biomass and able to tell our investors to come invest with confidence because we have secured for them the supply," he said.

Five off-taker companies (those intending to buy and use the biomass from the JV) namely, Global Green Synergy Sdn Bhd, Future NRG Sdn Bhd, Mercu Sutera Sdn Bhd, PMT Industries Sdn Bhd and Eco Star Global Sdn Bhd had signed letters of intent at the 6TH PALMEX Malaysia 2014 conference here yesterday.

The conference, held at the Four Points by Sheraton focusing on biomass, had presented seven papers namely 'National Biomass Strategy', 'Mapping Innovation in Bio-based chemicals value chain', 'Investment opportunities in palm-based biomass', 'A Teck Guan Model for 'capitalizing on oil palm biomass', 'A commercial experience in development and operation of EPB Pellet Plant', 'Development in the commercialization of oil palm biomass and 'Biodiesel implementation in Malaysia'.

PALMEX Malaysia 2014 is a two-pronged event comprising of an exposition and a business conference, both supporting the government's effort in developing the state's palm oil industry as well as related vertical and horizontal business activities.



Tan (second, left) at the launching of the Lahad Datu Biomass JV Cluster Berhad yesterday.

# ...all with the same objective: to catalyse biomass clusters that create high-value activities and good job opportunities (in rural areas)

## EXAMPLE



Energy Pellet Plant

Biochemical Plant

Bioethanol Refinery

Biosugars Plant

THANK YOU

