



Business Models for LBG production

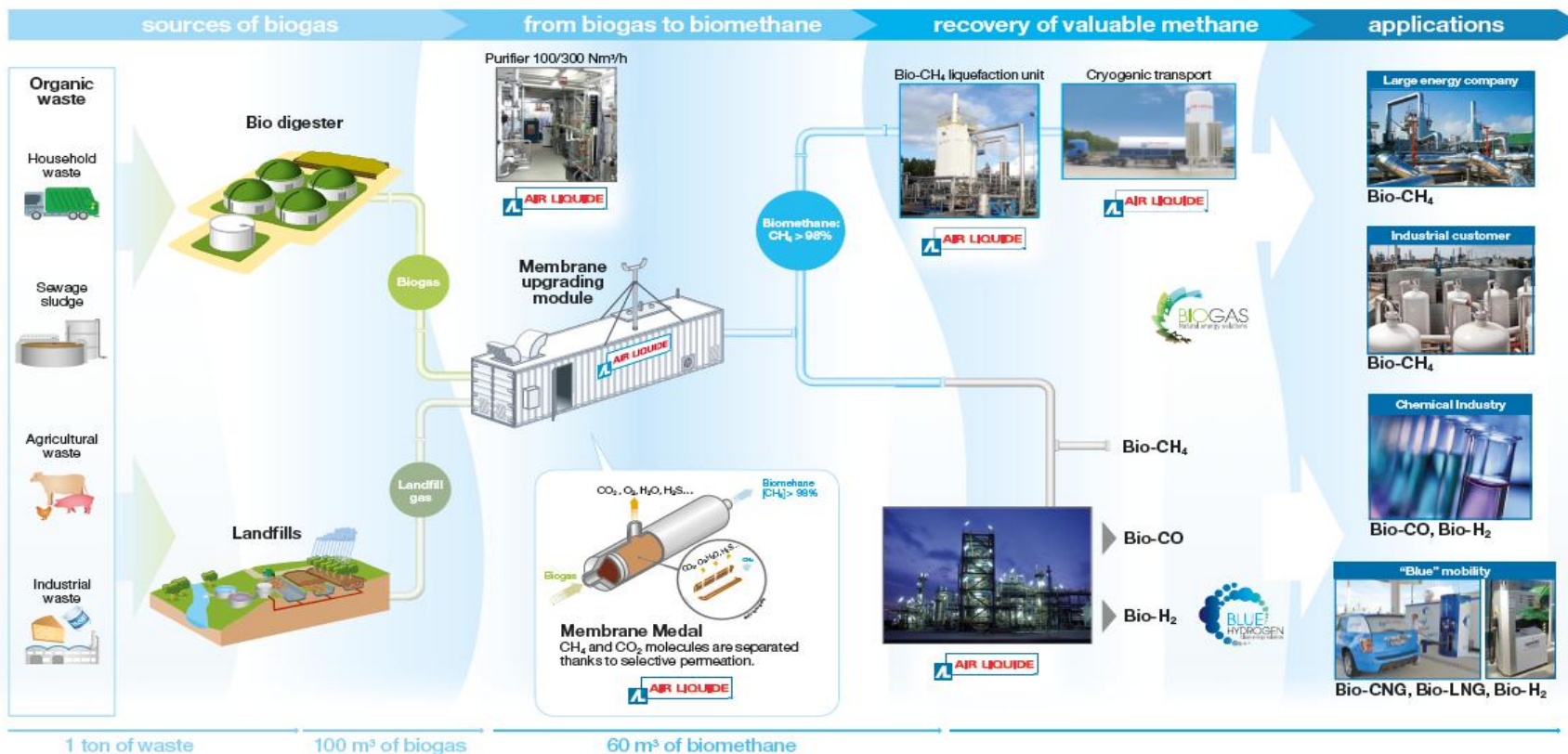
Presentation to Go LNG

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Air Liquide - Biogas Activities

Biogas technologies: from waste to renewable gases



10

Nearly 10 years of experience in biogas upgrading

100,000

Air Liquide, world leader in biogas purification, with a capacity of 100,000 m³/h

1,000 to 3,500 TW.h

Market potential

Air Liquide : References

UK:

10 biogas upgrading units
(**2** operated by AL)

2013 – 2015

1000 Nm³/h raw biogas

3 CNG&LNG fueling
stations

+3 to be started during 2017



Denmark:

1 Biogas
upgrading for
grid injection

2015 - Denmark

900 Nm³/h raw biogas

Sweden :

1 biomethane
liquefaction plant
operated by AL

2012 - 800 Nm³/h bio-CH₄

48 (Bio)-CNG & LNG
fueling stations

FordonsGas

Germany, Austria,
Hungary:

6 biogas upgrading
units using AL
membranes

2007 - 2015

6 – 1 500 Nm³/h

China:

2 biogas upgrading for
vehicle fueling (CNG)

2015 - 2016

1000 – 1500 Nm³/h

USA:

16 biogas upgrading units

Landfill gas

2006 - 2014

2350 - 20 000 Nm³/h raw biogas



France:

8 biogas upgrading units (**3**
operated by AL)

2012 – 2015

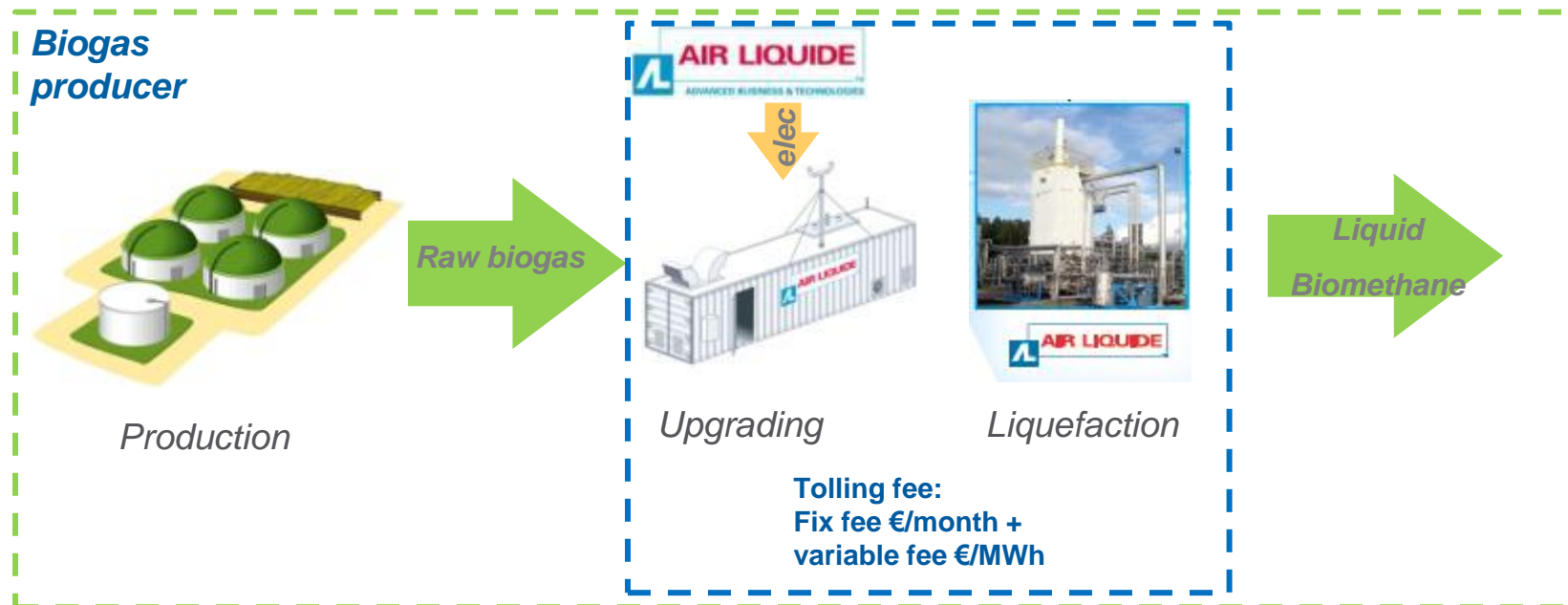
100 – 1 000 Nm³/h raw biogas

3 CNG&LNG fueling stations

+9 to be started during 2017



Business model #1: tolling



- AL builds, owns, operates biogas upgrading & liquefaction units
- In this model, the biogas producer owns the molecule all the way: Air Liquide does not buy the raw biogas. The biogas producer has a free choice to decide how to value the bio-LNG on the market.

Tolling vs. purchase of equipment

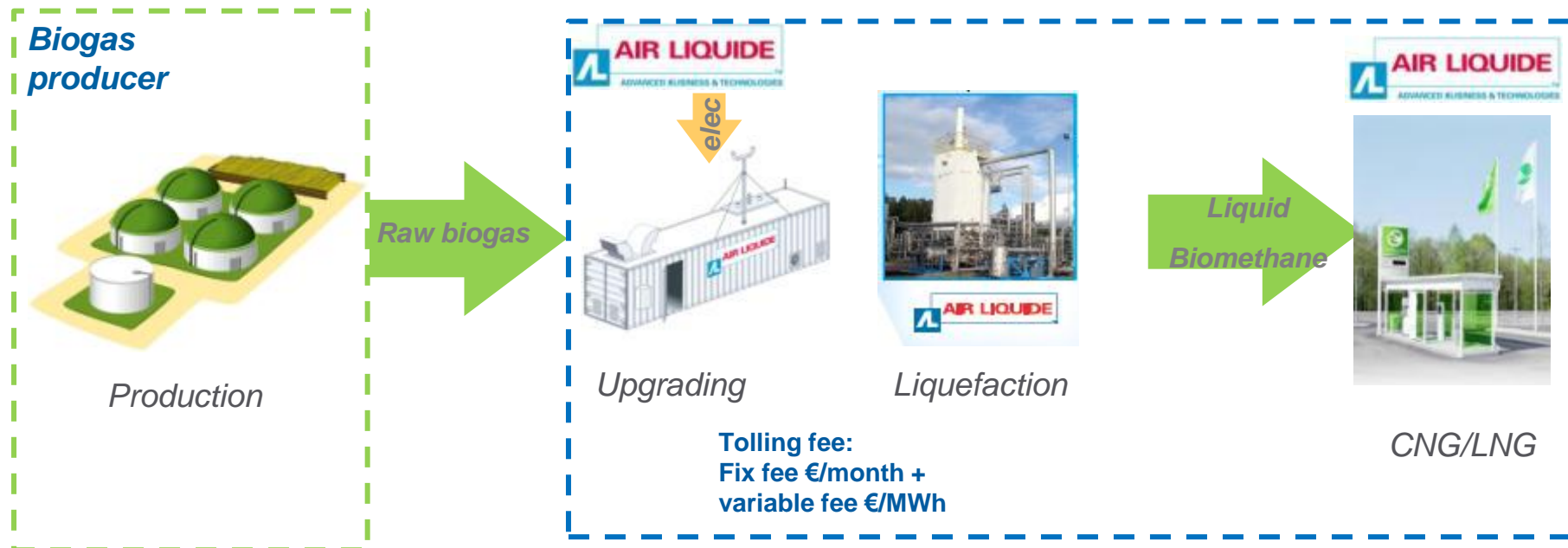
	Equipment purchase	Tolling offer
Project balance sheet	Biogas Producer (BP) responsibility	Decrease of overall project risk thanks to strong guarantees
Investments	Needs for equity	Limited to no investment for biogas producer <i>Transfer of the investment risk</i>
Installation performances	BP responsibility Guarantees at <u>commissioning</u> Limited level of liability by the equipment manufacturer	Guaranteed by AL <u>over 15 years</u> Start-up time Extraction rate / losses Specific energy consumption Replacement of faulty material <i>Transfer of the industrial risk</i>
Operation and maintenance	Hiring and training of operators for the biogas producer Support by the equipment manufacturer but no continuous monitoring!	AL operators trained and shared between several AL plants Distance monitoring & control <i>Transfer of the industrial risk</i>



Advantages of the Air Liquide tolling solution

- Membrane and liquefaction: two AL proprietary technologies
 - Largely used in AL Group on several gases
 - Experts and R&D continuously improving technology or for troubleshooting
- Integration and cost optimization
 - Only one manufacturer for both technologies responsible for the full package ensuring optimal integration of the two units
 - Improved CAPEX through process optimization (heat recovery)
 - Improved OPEX through synergies on operation and maintenance
- Knowledge of operations
 - Membrane and liquefaction of biogas operation knowledge
 - Local knowledge on liquefier built up at Lidköping
- Transfer of the industrial risk to an experienced gas player
 - Guarantees on start-up, on upgrading extraction rate, on energy consumption

Business model #2: raw biogas purchase



- AL builds, owns, operates biogas upgrading & liquefaction units
- Air Liquide purchases the raw biogas from the producer. The biogas producer has a guaranteed revenue; Air Liquide takes the market risk.

Advantages of the purchase of raw biogas solution

- On top of the tolling model

- Financing
- Performance guarantee

- AL takes the **market risk**

- Capacity to value the bio-LNG on stations for trucks / industrial customer / marine market
- Providing the best value for the bio-LNG through access of
- Guaranteeing a stable revenue for the biogas producer over 15 years
- Fully interested to run the plant to its highest availability

- Key challenge of liquefaction project

- Discrepancy between the need to invest for long period 15-20 years and ability to generate stable revenue

Thank you
for your attention

