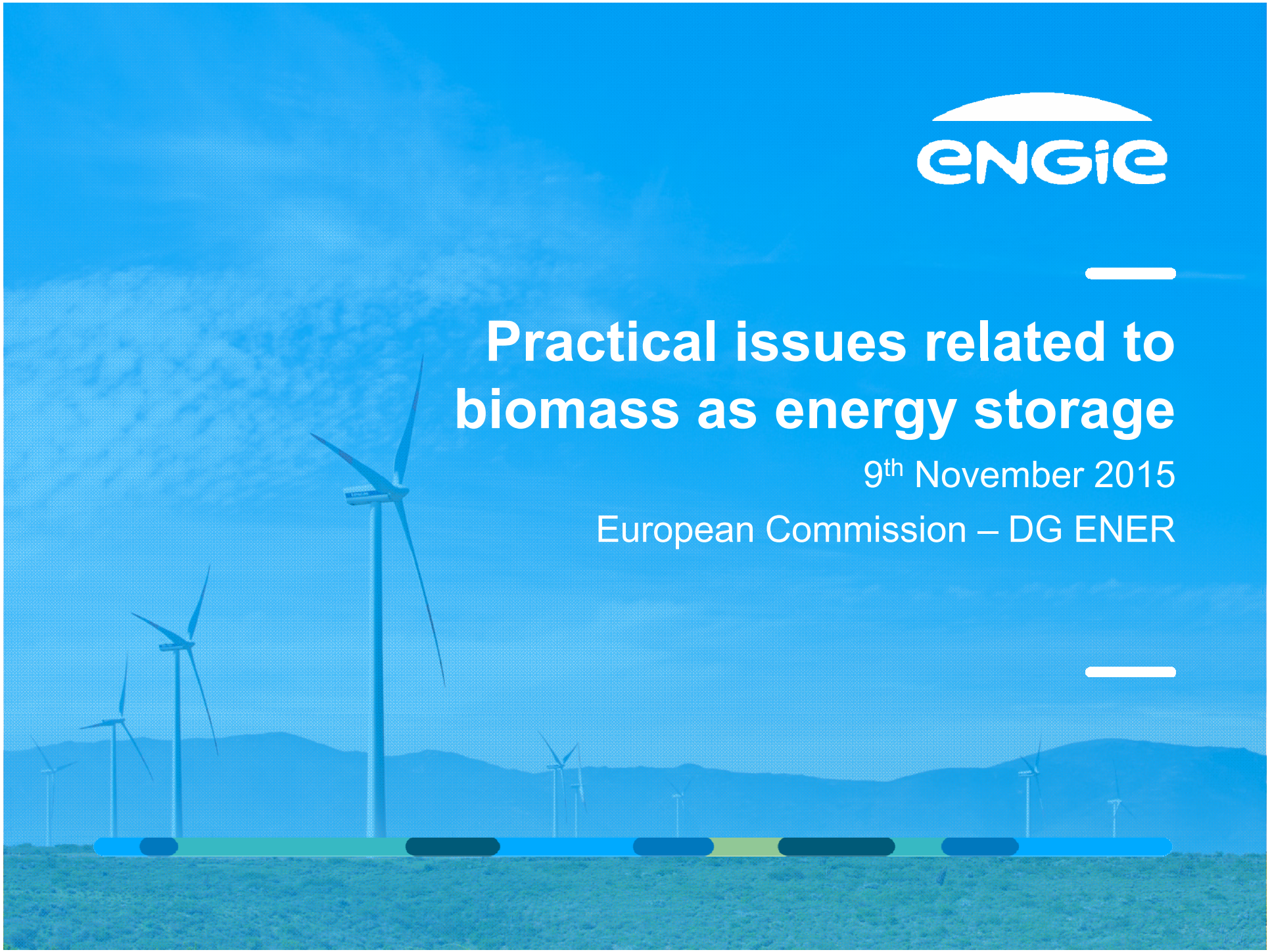

Practical issues related to biomass as energy storage

9th November 2015

European Commission – DG ENER

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01

Laborelec and ENGIE Introduction

LABORELEC
Identity kit

- Technical competence centre and laboratory
  - Experts in Electrical Power and New Energy Technology
  - Generation, Transmission, Distribution, Storage and Energy End-Use
- 240 researchers and technical specialists
- Offices in Belgium, The Netherlands, Germany, Chile and the Middle-East
- Applied research and technical expertise support
- Turnover € 48 M
- Contract research (40%) and services (60%)
- For shareholders (75%) and third-party customers (25%)
  Shareholders
  - GDF SUEZ ,ORES Assets, SIBELGA, Tractebel Engineering, Cofely Services , Intermixt

Electrical Power Research Center & Service provider of ENGIE

- **ENGIE is a global energy player, an expert in three businesses: power, natural gas and energy services.** ENGIE places responsible growth at the heart of its business model in order to tackle the major energy and environmental challenges: meeting energy needs, ensuring the security of supply, fighting against climate change and maximizing the use of resource.
- Its strategy is clear: **to be the energy benchmark for fast-growing markets** and **leader in the energy transition in Europe.**
- **Key figures for ENGIE as of December 31, 2014:**
  - 152,900 employees
  - €74.7 billion in 2014 revenues
  - Operations in 70 countries
  - €6-7 billion of gross investments over the period 2014-2016
  - 900 researchers and experts in 11 R&D centers

02

Laborelec and ENGIE Experience with biomass

Biomass use at ENGIE

Large & centralised 100% biomass, Large and centralised co-firing, medium & decentralised CHP. Vertical integration of 1 pellet fabric.

Country	Power / pellet plant	Production	Plant Type	Biomass type
Belgium	3 sites, 3 plants, various stages	~340 MW	Dedicated & Co-firing	Wood pellets, wood chips and wood dust
Netherlands	1 plant, various stages	Stopped Q3 2012 *(~180 MW)*	Co-firing	Wood pellets
Germany	1 plant	~20 MW	Dedicated	Wood chips
Poland	1 plant various stages	~330 MW	Dedicated & Co-firing	Agri-pellets & Wood chips
Thailand	1 plant	~ 30 MW	Co-firing	Wood chips
Brazil	2 plants	~60 MW	Dedicated	Wood chips & Sugar cane bagasse
USA	7 power plants	~120 MW	Dedicated	Clean wood chips , waste wood chips & paper pellets
Canada	*1 pellet plant co-investment extension*	*~350 kton/yr production*	*Pellet plant*	*Wood pellet production*
France, GE, BE, NL	*Operating > 120 local bio installations*	*~ 200 MWth*	*District heating, CHP*	*Local waste wood, pellets etc.*







3 World premières of large scale biomass power plant.

LES AWIRS UNIT4 (Liège)
1967: 125 MW oil+gas
1982: 125 MW coal
2005: 80 MW full biomass

1st full coal to bio conversion

RODENHUIZE UNIT4 (Gent)
1979: 262 MWe
Fuels : hardcoal, blast furnace gas, fuel-oil A
2005: 55 MW= 30% wood pellets
2008: 110 MW= 60%
2011: 230 MW = 100% biomass
Lowest emissions ever reached: @6% O2
15 mg/Nm3 dust and 90 mg/Nm3 NOx

POLANIEC Poland
from 8 x 225 MW coal
to 7 x 225 MW co-firing +
Green Unit, 200 MW, full biomass, 37% efficiency, CFB
80% wood from forest thinning 20% agri-biomass

03

Key issues related to the use of liquid fuels

Liquid fuel storage

Flexibility versus restricted storage time due to instability of biofuel

- Follow-up of tests on liquid fuels in plants in France, Peru and the United States
- Specific case of FAME (Fatty Acids Methyl Esters) and biodiesel
- Maximum 3 to 6 months stability in storage (1 year for fossil diesel). Risk of acidification beyond.
- Specific measures required to increase the storage stability :
  - Avoid any contact with oxygen and water, limit exposure to sunlight
  - Clean storage tanks and reduced tank volume to increase the turnover, regular mixing
  - Use of additives, eg biocides
  - Use of specific coatings
  - Storage tank material choice (INOX is preferable). Avoid copper and alloys, zinc, lead, tin
- Viscosity and pour point are not specified in standards as those vary with locations. Engineering of the storage must be adequate to keep the temperature above the pour point. Additives are also available.
- Where there is no other choice than storage period > 6months, additives and coatings are required to avoid corrosion problems.

Use of liquid biofuels in gas turbines

Fuel	Technical	Storage	Market	Cost price	Turbojet P&W JT4	Westinghouse W251B	Heavy duty SGT5-2000E
Methanol	++	+	-	++-	-	+	++
Ethanol	+	+	++	-	-	+	++
Bio-diesel	+++	+++	++	-	+	++	++
RBD palm oil	+	++	++	+++	-	+	+
Free fatty acids	+	++	++	+++	-	+	+

- not feasible/not viable, + feasible with major changes, ++ feasible with some changes,
+++ feasible without changes/economically interesting

Laborelec, H. Laget, 2007

- Several restrictions today that prevent from using liquid biofuels in gas turbines
  - ‘Clean biofuels’ largely used by the transport sector – incentives, high fuel prices versus low electricity prices
  - The volumes of waste streams based biofuels are too restricted, compared to the quantities that would be required for power plants
  - ‘Dirty biofuels’ require modifications of the injection system material, preheating to reduce viscosity, …
  - Most of the bi-fuels gas turbines are today de-commissioned

Gaseous fuels as more realistic option for gas turbines

- Biogas or Syngas, Biomethane either from biogas or syngas
- Both anaerobic digestion and gasification require stable operations and thus the biogas or syngas needs to be stored, unless it is converted to biomethane and injected in the grid.
- Tests performed on co-combustion of biogas and natural gas in a GE-LM6000 (BE) showed :
  - Compression of the biogas from atmospheric to ~50 bar, higher fuel pressure needed
  - Temperature regulation to avoid sulfur deposition
  - Up to 25% of total fuel flow no major problems expected for operations (CO_2 content of the biogas could potentially impact the combustibility)

04

Turn-down ratio For Peak demand

Can we use the turn-down ratio of biomass fired boilers to increase output on peak demand ?

- Not valid for all technologies
- Circulating fluidized bed : 40% load is needed to have minimal circulation of the bed
- Pulverised fuel would deliver the most peak. Options to consider :
  - Start with liquid biomass
  - Plasma burners