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# Introduction on NL biomass policy and possible smart approaches

Biomass Torrefaction and co-firing:
Experience and future perspectives from the Netherlands

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# Dutch Energy Agreement for sustainable growth

- Broad support by industry, government, NGO's, unions, etc.
- Reduction in final energy consumption averaging 1.5% annually
- Increase energy generated from renewable sources to 14% in 2020 and 16% in 2023
- Create 15,000 full-time jobs
- Improve competitive position of Dutch companies
- Investment security and innovation support
- Decrease costs of energy for households (321 M€) and businesses (266 - 331 M€)
- Substantial investments between 2013 and 2020: subsidies (13 - 18 billion euro), infrastructure costs, private investments
- Max. 25 $PJ_e$ biomass co-firing per year (equivalent to 3.5 Mton white wood pellets), with 15% alternative streams

# Dutch co-firing incentives (1)

- <2003: RBE → tax credit on produced electricity
- 2003-2006: (OV)MEP
  - Project subsidy contracts per kWh (10 years)
- 2008-2010: SDE
  - Feed-in premium with competitive tendering between different renewable energy project proposals; without large scale biomass co-firing, only smaller than 50 MW
- 2010-now: SDE+
  - Feed-in premium with competitive tendering between different renewable energy project proposals
  - Proposals granted starting with cheapest cost price until total budget is allocated
  - Large scale biomass co-firing included in 2015 for duration of 8 years
  - Overall 2015 budget for all renewable energy subsidies: 3.5 billion euro
  - No co-firing proposals granted in 2015 call

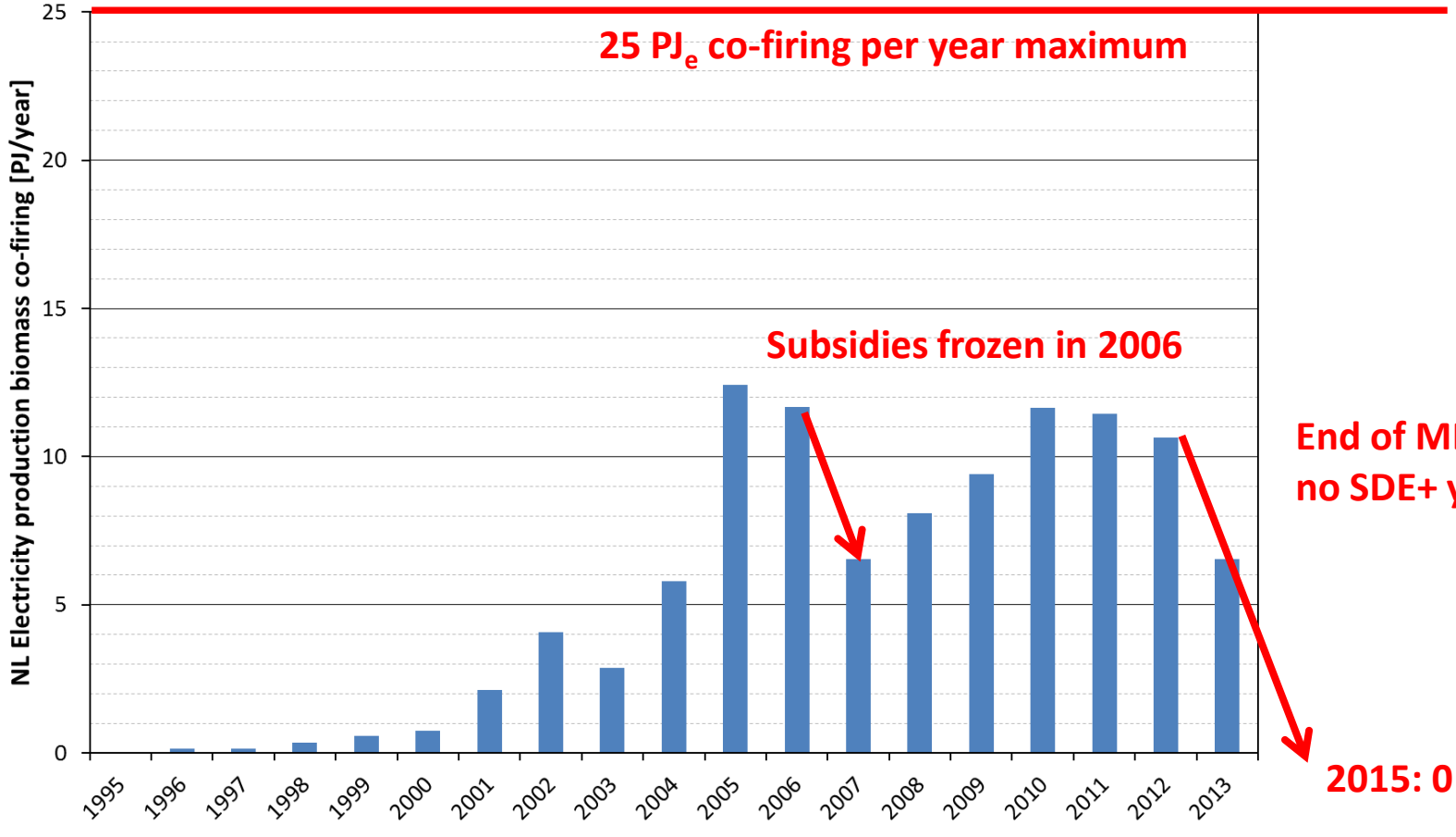
# Dutch co-firing incentives (2)

- 2016 SDE+ budget 8 billion euro with two calls in March and October 2016
- March call:
  - 4 Phases based on maximum cost price level (Phase 1: < 0.09 €/kWh, Phase 2: <0.11 €/kWh, Phase 3: <0.13 €/kWh, Phase 4: <0.15 €/kWh)
  - 2 Co-firing proposals for existing plants in Phase 2
    (cost price: 0.107 €/kWh for max. 5839 full load equivalent hours per year, 8 years)
  - 2 Co-firing proposals for new plants in Phase 3
    (cost price: 11.4 €/kWh for max. 7000 full load equivalent hours per year, 8 years)
  - Total available budget: 4.0 billion euro
  - Requested budget: 8.15 billion euro
    - Phase 1: 2049 M€, Phase 2: 2774 M€, Phase 3: 2983 M€, Phase 4: 344 M€
- Likely 1 or 2 co-firing proposals in Phase 2 granted
- Provisional correction amount in 2016 (to be deducted from cost price):
  0.039 €/kWh → net premium 0.068 or 0.075 €/kWh (existing or new, resp.)

# Biomass sustainability requirements

- Biomass use must lead to substantial reduction in GHG across value chain in comparison with fossil fuels (min. 70% reduction, max. 56 g $CO_{2eq}$/MJ)
- Soil quality must be maintained and where possible improved
- Production of raw biomass may not result in destruction of carbon sinks
- Use of biomass may not result in a long-term carbon debt
- Biomass production may not result in Indirect Land Use Change (ILUC)
- Several requirements for sustainable forest management
- Chain of Custody (CoC) must be in place that covers entire chain
- Certification system requirements

# Co-firing experience in the Netherlands



# Dutch lessons learned; your JPY earned?

- Fluctuations and uncertainties in support schemes do not contribute to continuous biomass co-firing in power plants
- Certainty warrants biomass co-firing by utilities
- Utilities applied for a feed-in premium of 0.068 €/kWh (or 8.5 JPY/kWh) for a total duration of 8 years and 5839 full load equivalent hours per year
- This suggests that biomass co-firing is commercially viable at this premium

- Japanese feed-in tariff of 24 JPY/kWh for 20 years duration offers a lot of certainty (you are living our dream)
- Co-firing of white wood pellets likely requires hardware modifications
- Co-firing of torrefied wood pellets is business-as-usual: simply substitute coal

# The added value of torrefied pellets

- Torrefaction combined with densification enables energy-efficient upgrading of biomass into *commodity solid biofuels* with favourable properties in view of logistics and end-use
- Favourable properties include high energy density, better water resistance, slower biodegradation, good grindability, good “flowability”, homogenised material properties
- Therefore, cost savings in handling and transport, advanced trading schemes (futures) possible, capex savings at end-user (e.g. outside storage, direct co-milling and co-feeding), higher co-firing percentages and enabling technology for gasification-based biofuels and biochemicals production
- Applicable to a wide range of lignocellulosic biomass feedstock and residual streams

# Torrefied pellet properties in perspective

| | Wood chips | Wood pellets | Torrefied wood pellets | Charcoal | Coal |
|---|---|---|---|---|---|
| Moisture content (wt%) | 30 – 55 | 7 – 10 | 1 – 5 | 1 – 5 | 10 – 15 |
| Calorific value (LHV, MJ/kg) | 7 – 12 | 15 – 17 | 18 – 22 | 30 – 32 | 23 – 28 |
| Volatile matter (wt% db) | 75 – 84 | 75 – 84 | 55 – 80 | 10 – 12 | 15 – 30 |
| Fixed carbon (wt% db) | 16 – 25 | 16 – 25 | 22 – 35 | 85 – 87 | 50 – 55 |
| Bulk density (kg/l) | 0.20 – 0.30 | 0.55 – 0.65 | 0.65 – 0.80 | 0.18 – 0.24 | 0.80 – 0.85 |
| Vol. energy density (GJ/m$^3$) | 1.4 – 3.6 | 8 – 11 | 12 – 19 | 5.4 – 7.7 | 18 – 24 |
| Hygroscopic properties | Hydrophilic | Hydrophilic | (Moderately) Hydrophobic | Hydrophobic | Hydrophobic |
| Biological degradation | Fast | Moderate | Slow | None | None |
| Milling requirements | Special | Special | Standard | Standard | Standard |
| Product consistency | Limited | High | High | High | High |
| Transport cost | High | Medium | Low | Medium | Low |

Abbreviations:
db = dry basis
LVH =Lower Heating Value

sources: ECN (table, fig.1, 3), Pixelio (fig. 2, 5), OFI (fig. 4)





# ECN in co-firing and torrefaction

- 20+ years experience in biomass co-firing R&D, identified the potential of torrefaction and played a pioneering role in torrefaction development since 2002
- ECN's torrefaction technology proven on pilot-scale and demonstration scale; Andritz ready for market introduction
- ECN offers complete portfolio of risk mitigating tools/solutions that are tailored and validated for co-firing of white and torrefied pellets in pulverised coal fired power plants

*ECN 50 kg/h torrefaction pilot-plant*

# Black pellets: Services and Technology

- Efficient biomass torrefaction technology with reliable product quality
- Technology to convert biomass with high moisture and/or ash content (grass, agricultural residues, etc.) into solid bioenergy carriers: TORWASH
- Lab- and pilot-scale torrefaction and densification equipment to assess feedstock behavior and produce test batches
- Know-how and infrastructure to test black pellet behavior during logistics, storage, handling and conversion (validated against industrial operations)

Torrefaction


Pelletisation

# NUON/Vattenfall Buggenum experience*

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# DONG Studstrup-3 experience

- Two units with total capacity of 714 $MW_e$ and 986 $MW_{th}$
- Dedicated milling on MPS roller mill adapted for either coal or white pellets
- 200 tons of Andritz/ECN torrefied spruce pellets during 8 hours trial in March 2014
- Co-firing share: 33 wt%; 100% on one mill
- Observations:
  - No dust formation during unloading
  - High durability; no issues with dust formation in chain conveyors
  - Normal Minimum Ignition Energy (MIE) → no additional explosivity risks compared with white wood pellets

- ECN conducted lab-scale characterisation of pellets

# DONG Studstrup-3 experience

# Thank you for your attention

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