

Status and future of Essent's biomass activities

Wim Willeboer
Essent



IEA Clean Coal 2nd Workshop

Cofiring biomass with coal .

Copenhagen

27 – 28 March 2012

Essent

- Essent is an RWE company since October, 2009
- Largest power company in the Netherlands
- 4 million customers for natural gas, electricity, heat and energy services
- More than 90 years of experience in production and supplying energy
- Producer of 2 TWh of sustainable energy in the Netherlands (20%)

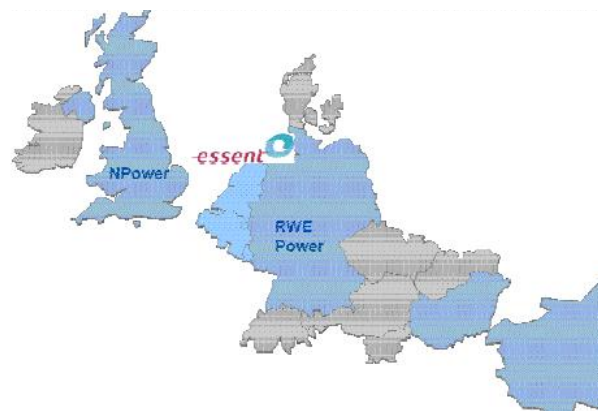
Essent = 100% RWE

RWE
The energy to lead



Essent locations

- Responsible for RWE activities within the BeNeLux
- Installed capacity 5 GWe
- 1200 MWe biomass co-fired hard coal plants
 - 1,6 TWh co-fired 2010
- 1560 MWe new build under construction



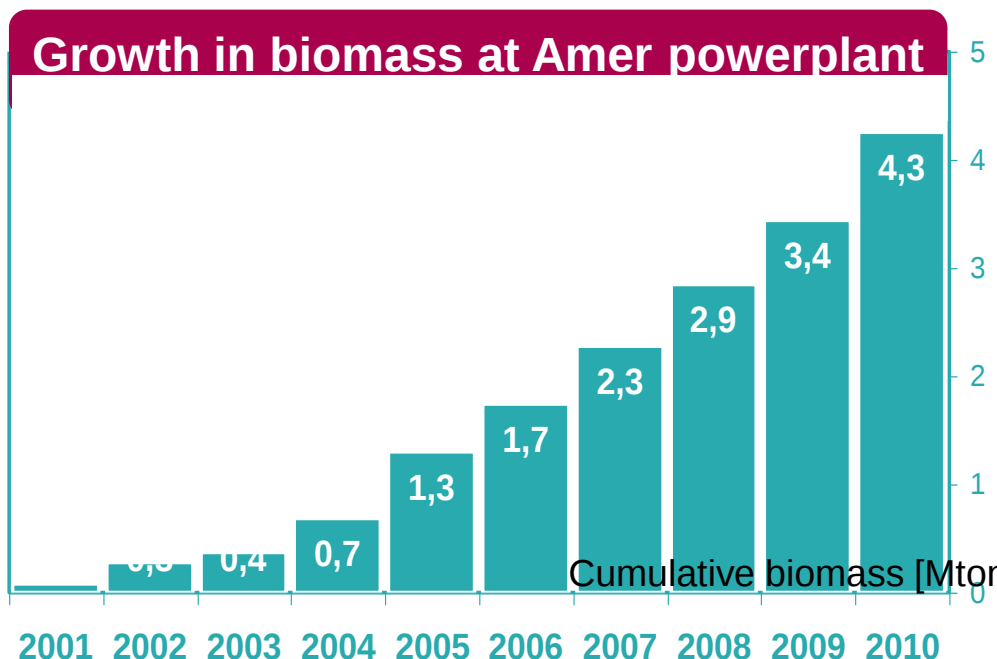
Essent's biomass activities

Part I: Present status



Essent is a frontrunner in biomass

- 130 million Euro of investments
- Saving more than 1 million ton of CO2 per year at Amer
- Leader in biogas and certification



1999

Stand alone plant Cuijk

Capacity: 25 MW
Fuel type: forest residues
Start design: 1995



2000

Wood gasifier Amer 9

Capacity: 33 MW
Fuel type: waste wood



2003

1st biomass mill Amer 9 and unloading facilities
Capacity: 83 MW, pellets

Hammer mills BS-12
Capacity: 100 MW



2004

Hammer mills Amer 8
Capacity: 96 MW, pellets

Logistical system Amer 8/9
Type: silo's, conveyors

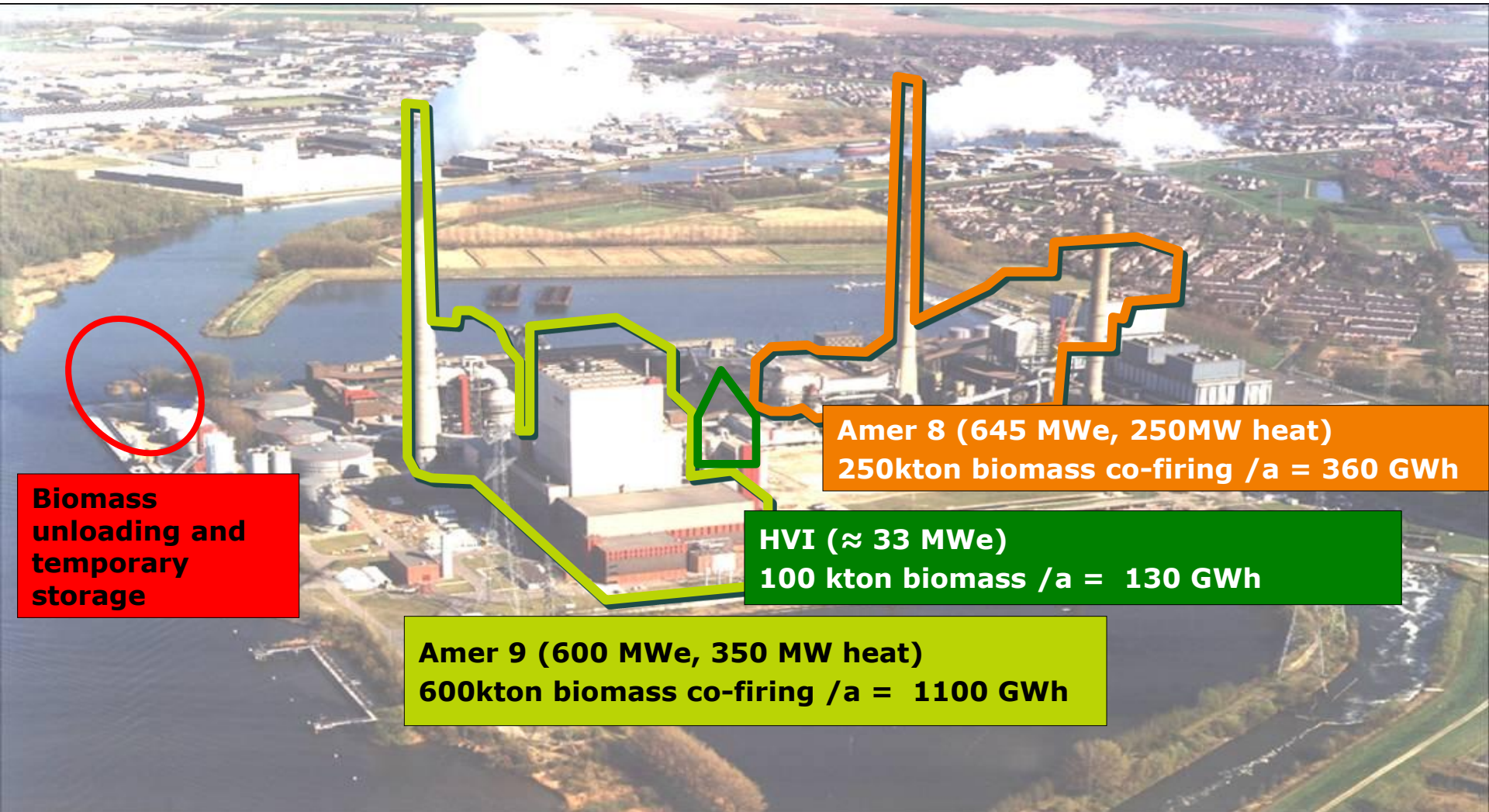


2005

2nd biomass mill Amer 9
Capacity: 83 MW, pellets

Bio-oil Claus A (test 2002)
Capacity: 92 MW, bio-oil

Amer co-firing: Amer 8: 75 MWe (250 kton/a) Amer 9: 160 MWe (600 kton/a biomass)



Amer 9

2005 - Amer 9

2nd coal layer => biomass (36m%)

2004 - Amer 9

Serious corrosion

tested

2003 - Amer 9

1st coal layer => biomass

2000 - Amer 9 (and Amer 8)

Up to 5m% co-firing (mixed with coal)

Biomass		Slagging / fouling
Olive kernel		Very strong
Cacao husks		Very strong
Citrus pulp		Strong
Palm kernel husks		Strong
Wheat semolina (Grieß)		Strong
Soya hulls		Strong
White wood		Low



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Amer 9 - Modified MPS Coal mills

- 1st measures:

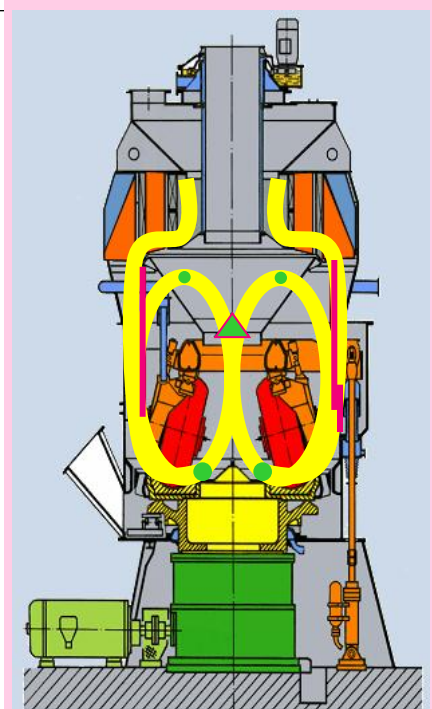
Cold air to bio mill: 110 °C
 Δp over mill $\Leftrightarrow$ choking
Explosion suppression

- 2nd stage - increase bio mass flow:

Construction of an inner plate
Closure of inner holes
Change of orientation of rolls

→ Biomass layers get more primary air
but no more secondary air:

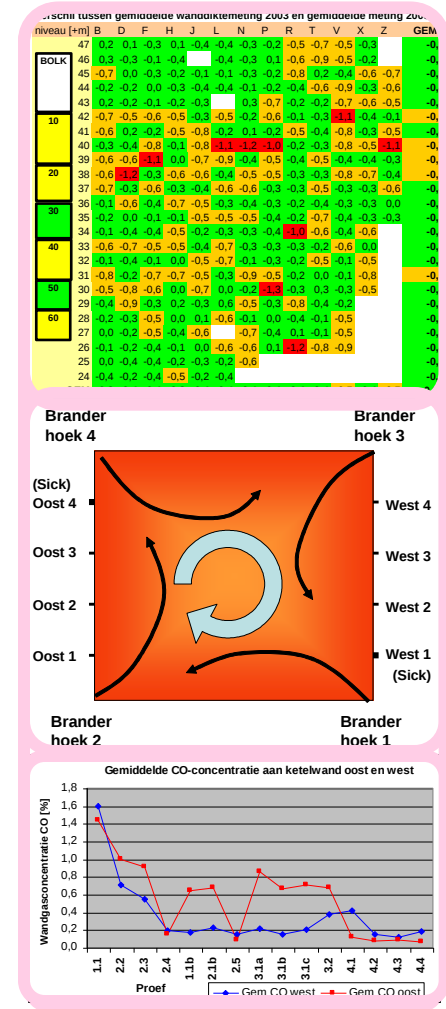
This leads to flame instability
And raises the chance for bad gas conditions on the
furnace wall



Testing program 2006/2007

Reason: serious furnace wall corrosion and super heater overheating

- Intensive wall gas condition measurements
- Air-to-fuel balance variations resulted in:
 - Bottom air: keep 100% open
 - Over fire air: Close as much as possible ⇔ NOx limit (automated)
 - 400 mg/nm3 before DeNOx (2008)
 - 500 mg/nm3 @ current operation
 - Trimm secondary air ...
 - Close SGR
- Much data-analysis
- Moving air to lower layers improved gas conditions on the wall (especially bottom air)



Results after measures

- 100 % bottom air
- Fire lower in boiler
- Fire earlier in good shape
- Temperature instabilities gone
- Saving
 - Reheater injection cooling 5 kg/s lower
 - Material temperatures lower
- NOx decreased
- Result: good wall conditions
- Loss of ignition hardly went up

	oost4	oost3	oost2	oost1
laag10	matig	goed	goed	goed
laag30	goed	matig	goed	goed
laag50	slecht	slecht	matig	matig
laag60	slecht	slecht	slecht	slecht

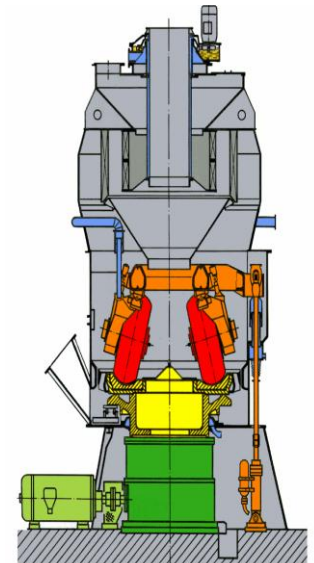


	oost4	oost3	oost2	oost1
laag10	goed	goed	goed	goed
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Technical possibilities of biomass (1)

Looking back: challenges we had to face:

- Fuel problems: dust, fineness, durability
- Fuel: biomass yes/no mixing with coal
- Fuel logistics: risk of fire and explosions
- Fuel storage: risk of self ignition
- Milling biomass: capacities, mill types, conversion of coal mills, particle size
- Pneumatic conveying of grinded biomass
- Unconverted biomass in bottom ash system ('green soup')
- Sparks in convective boiler parts
- Rapid furnace wall corrosion
- Overheating in superheater parts → load limitation



→ **step-by-step development, solutions found -> Essent patent**

Some experiences/lessons learned:

- Well balanced, dedicated distribution of air-to-fuel ratios over the furnace is essential
- Milling mixtures of coal and biomass impossible for low NOx boiler
- Efficiency reduction below 0.3 % points (35 % m/m co-firing)
- No dust explosions, no big fires, no self ignition
- High quality fly ash, C < 3 %
- The combination of biomass and coal is more attractive than pure 100 % biomass firing for several reasons:
 - Better process temperatures, efficiencies and capacities
 - Corrosion and fouling can be limited
 - Better by product quality
- Biomass is not an easy fuel → complex processes and installations → economy of scale is necessary

Essent's biomass activities:

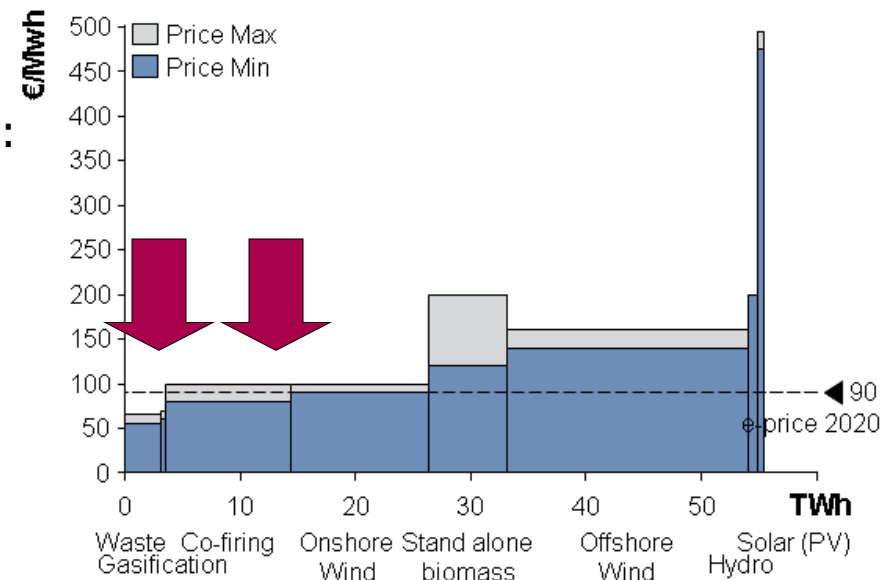
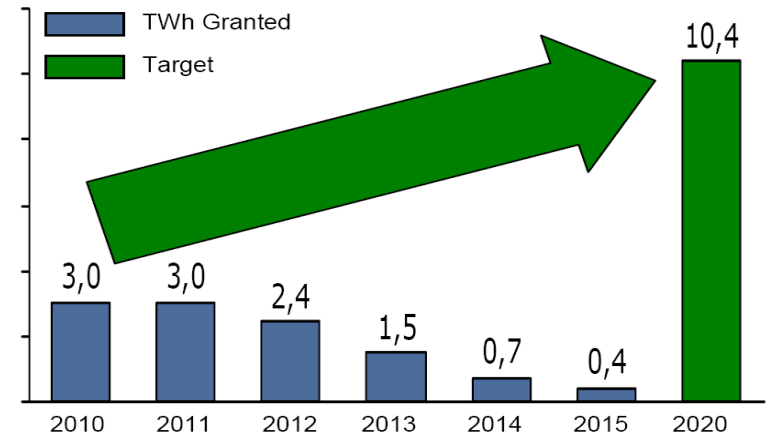
Part II: Future



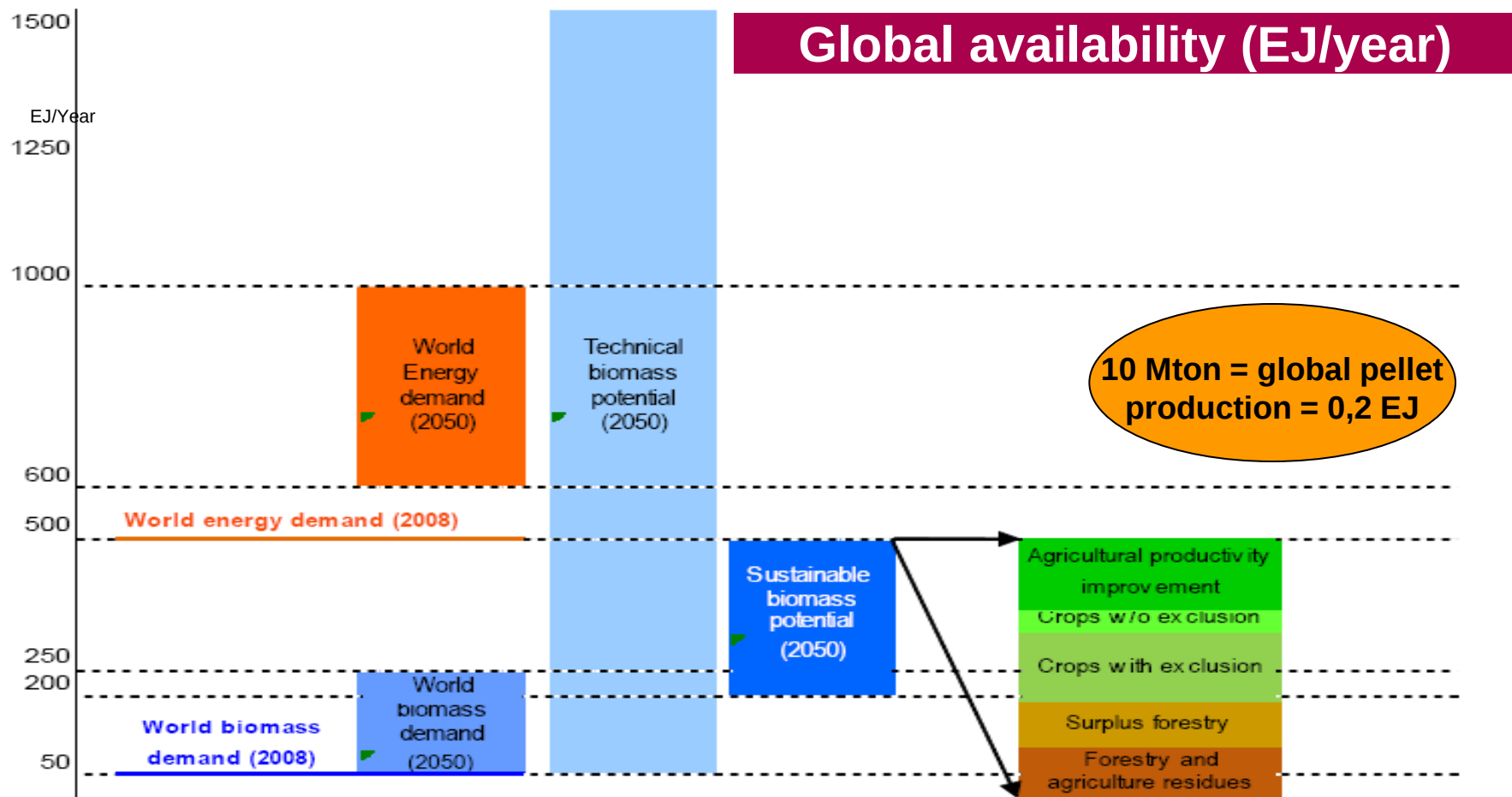
Why increasing biomass co-firing in NL?

- Dutch **2020 target**:
 - 35% renewable electricity (55 TWh)
- **Subsidies** for co-firing **will stop** by 2015
- **Green Deal** between government and E-companies:
 - Co-firing level stable till 2015
 - **Suppliers obligation** for x % sustainable electricity (from 2015 on)
 - x will grow to 35 overall in 2020
- Onshore wind and co-firing are and will remain the **most cost efficient** sustainable solution
- Wood is the **preferred biomass feedstock**:
 - High energy content
 - Large supply potential
 - Low in ash content
 - Sustainability = manageable

Dutch co-firing target



Is there enough biomass?



Adapted from Dornburg et al. (2008) based on several review studies.

Conclusion: there is enough potential for sustainably grown biomass!

- Half of the world energy demand in 2050 can be met by the total potential of sustainable biomass

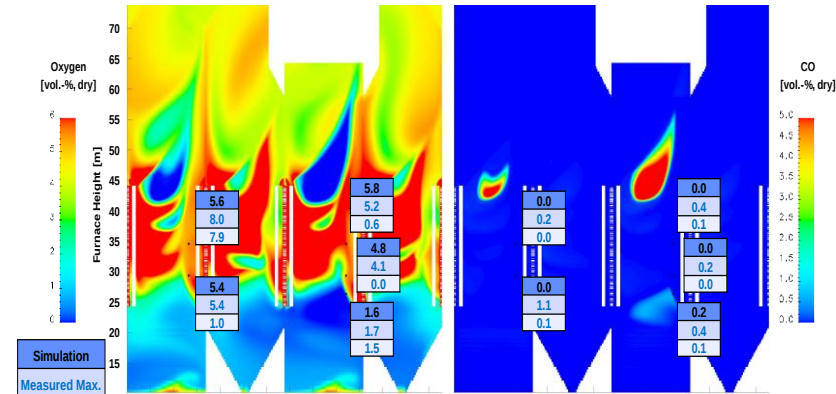


- → there is enough sustainable biomass for electricity and heat generation at very large scale all over the world

Current developments:

- Extension of biomass co-firing at Amer 9 up to 50 % (m/m) is being prepared. Fly ash certificate, emissions and efficiency are O.K. No load reduction.
- Higher share of biomass (> 50%) is considered to be possible; fly ash certificate is however still unsure (EU rules have to be changed)
- Torrefaction pellets to be tested
- Optimisation of the complete biomass chain (tree to kWh) with LCA
- **Today, technical aspects are no limitation for further increase in biomass application for energy,**

However,



Challenges still left:

- New coal fired units (generation 2010+): step-by-step development of co-firing is necessary, **each step can take years**
- Required increase of flexibility
- Sharper emission limits (IED)
- Fly ash quality certificate for > 50 % biomass (EU rules)
- In BBE: lower grade biomass products or biomass rest products:



Essent's Biomass Future: plans

- **Cuijk** (24 MWe stand alone biomass): Aim is to re-open.
Fuels: low-grade local feedstock: cascading application of natural resources. Partnerships, Biobased Economy
- **Amer**: increase of Amer 9 to 50 % m/m (= 40 % e/e) is being prepared.
Realization depends on Green Deal details and time schedule
- **Eemshaven**: 15 % biomass input is in the original concept (but not yet proven). Further increase will need step-by-step development. Realization depends on Green Deal details and time schedule
- With **Georgia Biomass** pellet production facility RWE/Essent controls the complete biomass based production chain → chain optimization on economy and ecology

Essent's Biomass Future - conclusion

- Biomass is necessary
- Enough biomass available
- Essent has the know-how
- '2010+ coal technology' requires (again) step-by-step co-firing development
- However, a political framework is required

→ **Based upon a stable political framework, Essent will be able to expand its biomass co-firing capacity in the coming years and keep and enforce its front runner position in this field**

