Renewable Power Generation from Biomass - Perspective from Essent

EOS-LT Conference
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Agenda

- **Introduction**
- Why biomass co-firing
  - The Dutch renewable target
  - Availability and sustainability
  - Climate & cost effectiveness
- Strategy and investments

10 years of investment and improvement have resulted in a substantial share of renewable energy from biomass mainly by co-firing

2005

2nd biomass mill Amer 9

Capacity: 83 MW

Bio-oil Claus A (test 2002)

Capacity: 92 MW

2004

Installation hammer mills Amer 8

Capacity: 96 MW

Logistical system

Type: silo's, conveyors

2003

Unloading facilities

Type: pneumatic discharger

1st biomass mill Amer 9

Capacity: 83 MW

2000

Gasifier Amer9

Capacity: 33 MW

Fuel type: waste wood

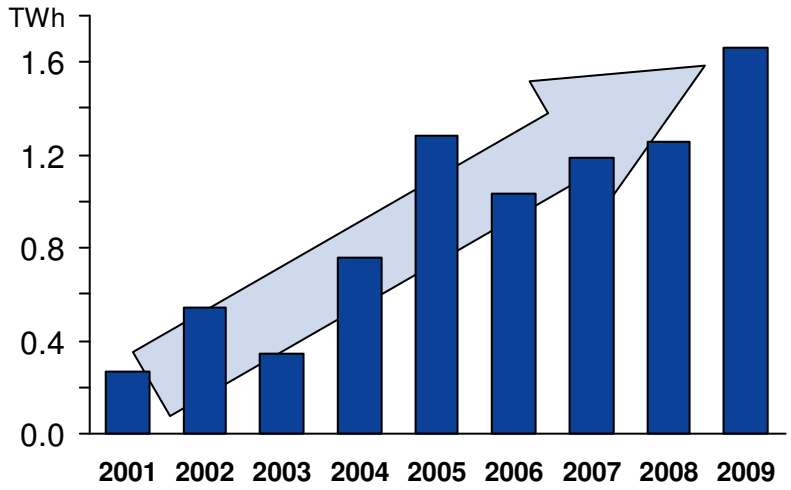
1999

Stand alone plant Cuijk

Capacity: 25 MW

Fuel type: forest residues

Start design: 1995



Facts & figures

- 130 mio Euro of investments, of which
- 60 mio Euro in gasification
- 1,5 TWh in 2009 from wood pellets alone
- 755 kton wood pellets out of 1 Mton biomass
- Co-firing capacity Amer 9 of 35% on a mass basis (short term ambition 50%)
- Savings of 1 million ton of CO2

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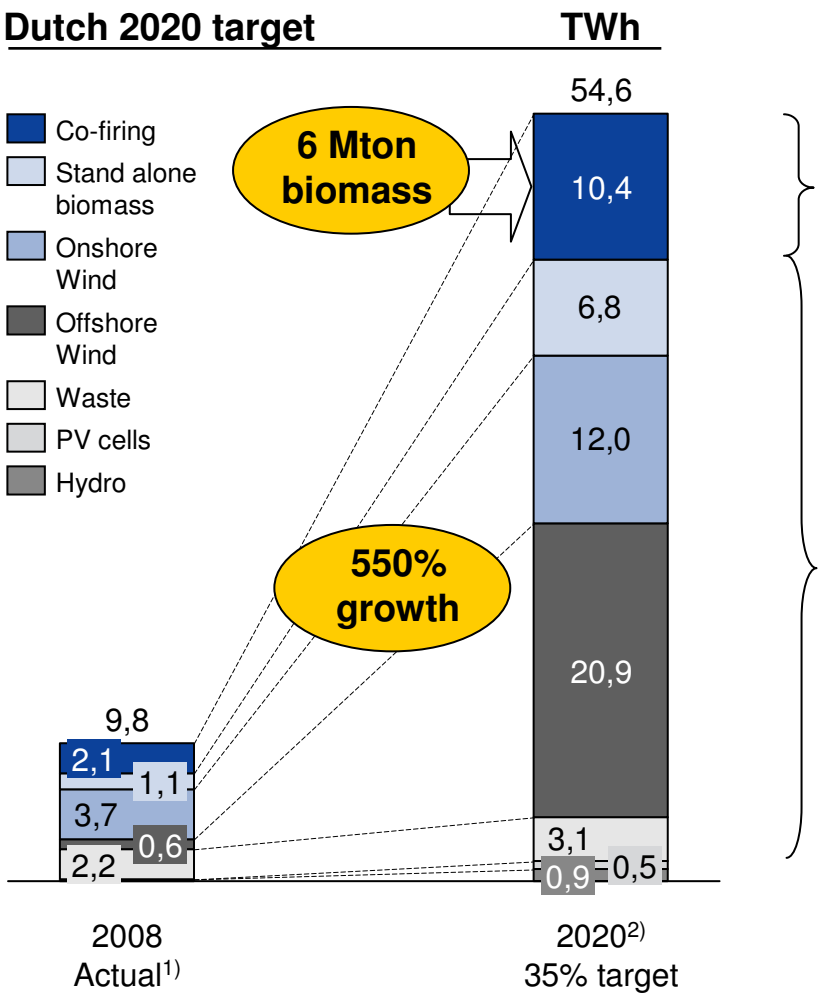
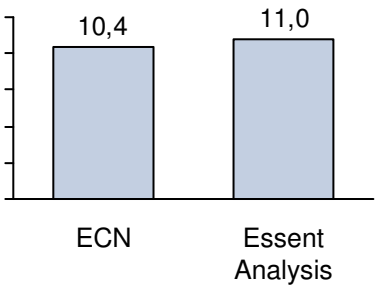
Within the Dutch 2020 target co-firing has a prominent role but more important it is the most feasible part in the overall solution



Feasibility check co-firing



- Old coal capacity included
- Learning curve for newcomers and new plants limits growth to 20%
- Co-firing in experienced plants to 30-50%
- Pre-treatment technologies not included

Feasibility other renewables in program

- Offshore Wind: technically capped by construction of 1000 MW/year (= 3,4 TWh/year)
- Onshore Wind: 4000 MW seems feasible. Additional 2000 MW strongly hindered by institutional and social resistance (= 12 → 8 TWh)
- Dedicated Biomass: 6.8 TWh is based on 100% utilization of the theoretical maximum of available feedstock in NL
- Waste to Energy: mainly capped by the availability of domestic waste
- Energy from Water & PV: only marginal contribution expected in the coming decades

1) Hydro 2008 = 102 GWh, PV 2008 = 38 GWh
2) ECN 'Verkenning Schoon en Zuinig', April 2009

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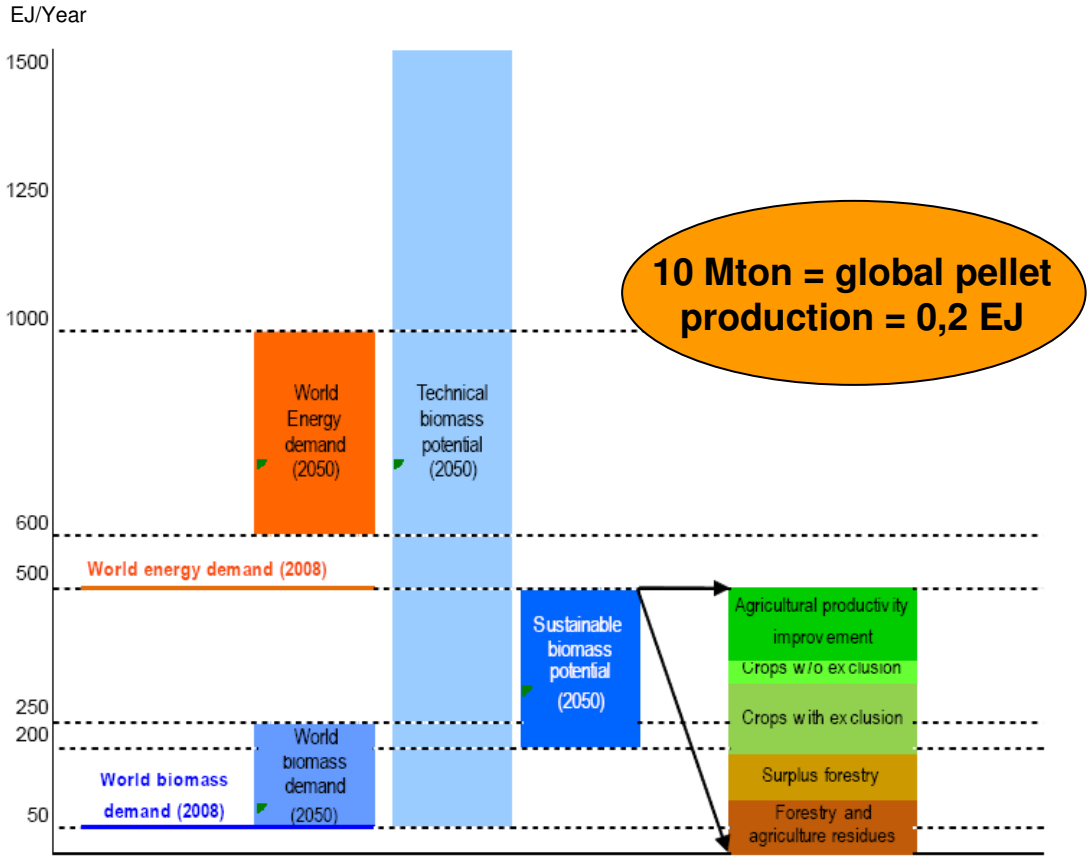
Wood is the preferred biomass feedstock for direct combustion in conventional power plants

Product		Kwalification
 Forestry	▪ Logs ▪ Thinnings ▪ Paper & pulp ▪ Residue	▪ High energy content ▪ Low ashes ▪ Large supply potential ▪ Sustainability is manageable
 Agro	▪ Conventional energy crops ▪ Grass, oil and rape ▪ Sugar and starch crops ▪ Lignocellulosic feedstocks ▪ Algae	▪ Medium energy content ▪ High ash content ▪ Energy vs. food problem
 Waste	▪ Agricultural waste ▪ Industrial waste ▪ Construction waste ▪ Sewage	▪ Low price ▪ Low energy content ▪ Medium ashes ▪ Regionally abundant

Global availability of biomass is sufficient to fulfill a major role in our ambition towards a more sustainable world

Global availability (EJ/year)



- By development of 2nd generation biofuels woody or fibrous biomass will eventually become a major feedstock for the biofuel sector as well
- When looking at the availability of biomass for energy purposes both biofuels as well as heat and power have to be taken into account
- Under those circumstances analysis by the IEA Task 40 (see figure) shows sufficient availability of sustainable biomass for the coming decades
- Half of the world energy demand in 2050 can be met by the total potential of sustainable biomass

potential is sufficient but how to deal with it?

Source: Technical biomass supply potentials, sustainable biomass potential, expected demand for biomass (primary energy) based on global energy models and expected total world primary energy demand in 2050. Adapted from Dornburg et al. (2008) based on several review studies.

Our current certification system offers a way to guarantee the sustainability of biomass all the way through the supply chain

Wood

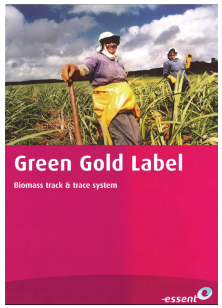
Independent audit on sustainability of the feedstock results in certificate (Control Union)

Pellet production

Certified biomass is tracked and traced throughout the supply chain

Transport

Power Plant



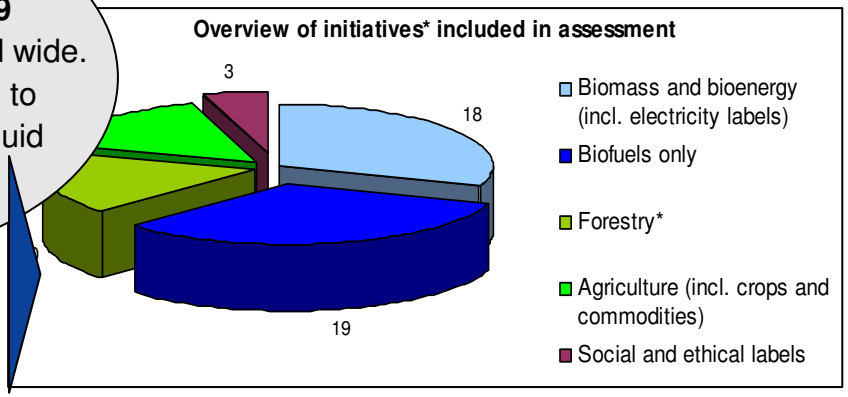
Biomass certificate received at power plant

Essent applies the **Green Gold Label** developed in 2000

Copernicus study shows that there are currently **59 sustainability systems** world wide. Harmonization is essential to enable growth towards a liquid market in biomass.

New Systems
- NTA8080 / 81 (NL)
- ISCC (Du)
- EU – RES directive
- GBEP (global)
- RSB (Round table sustainable biofuels, global)

Commodity specific
- RSPO (palm oil)
- FSC (wood)
- RTRS (soya)



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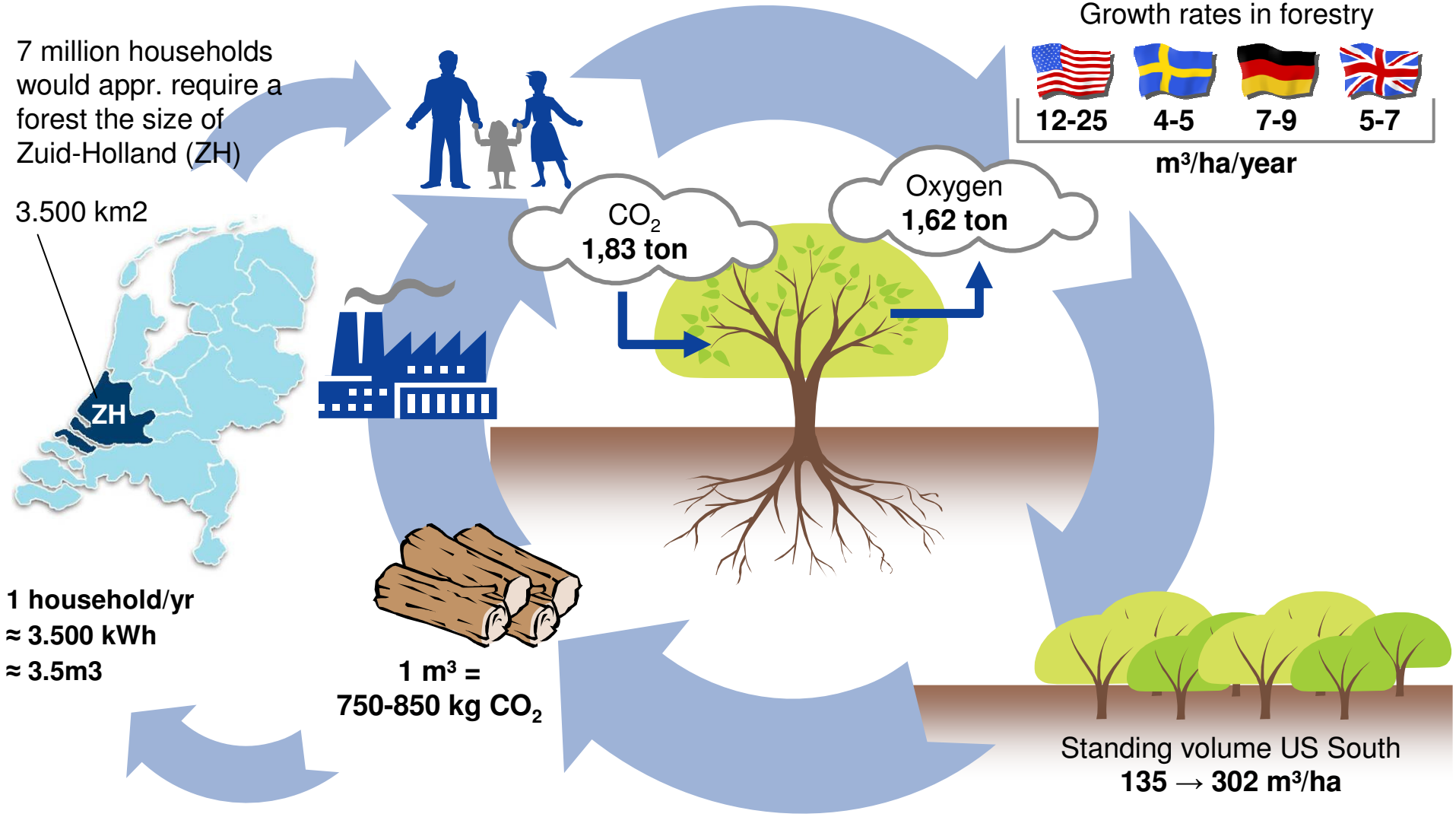
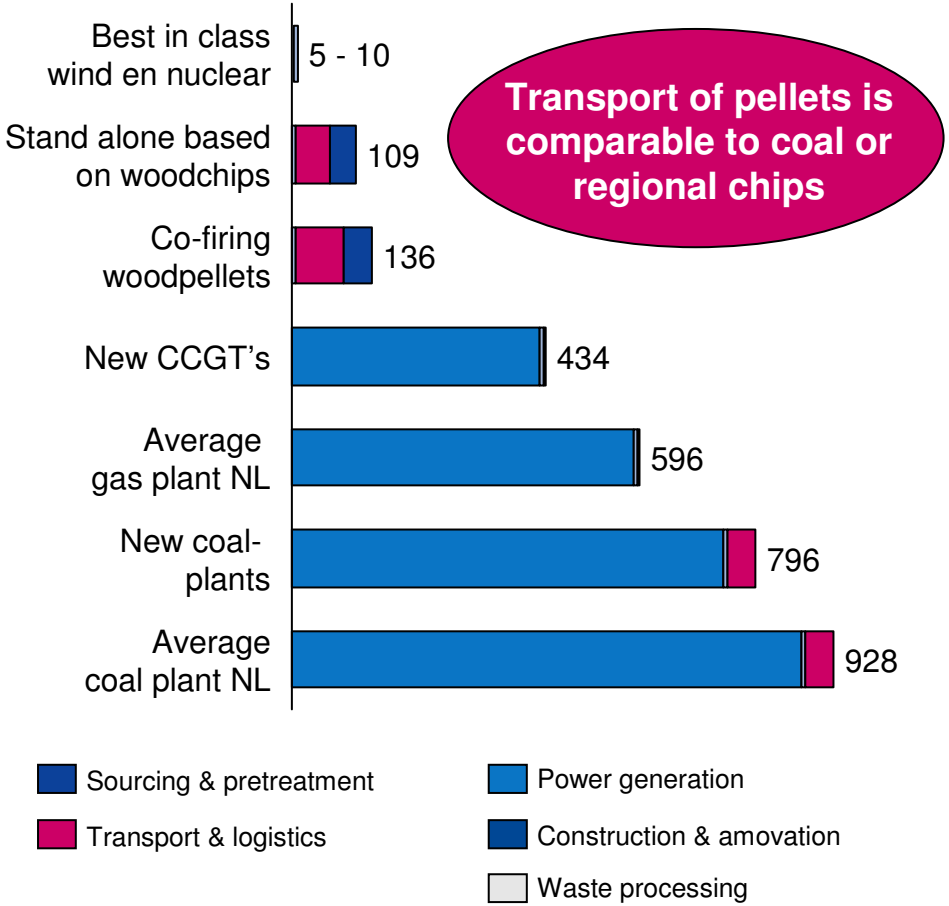
Woody biomass contributes to CO2 reduction by closing a continuous natural cycle and offering significant optimization opportunities

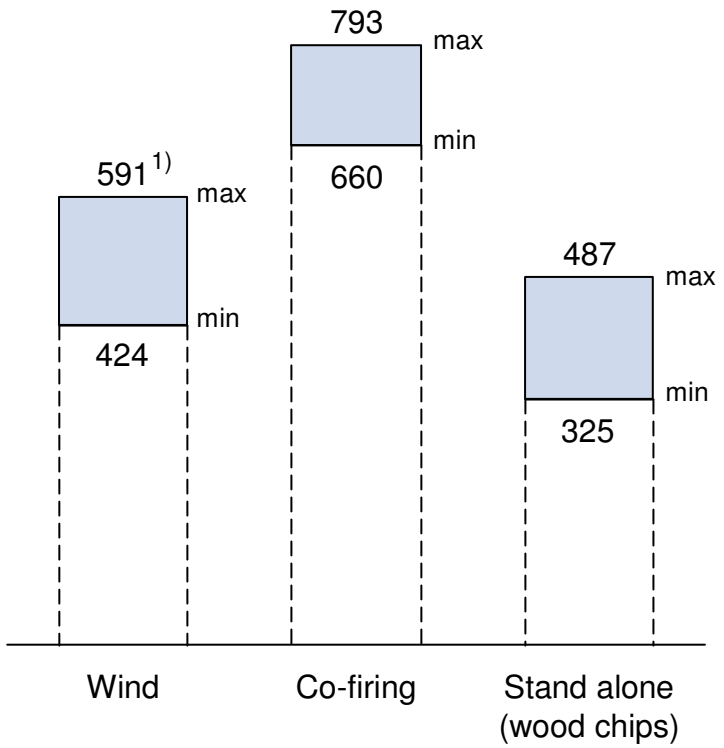


Co-firing performs well on carbon footprint compared to other techniques and even results in the highest net CO2 savings within the Merit Order

CO2 footprint by technique (gram/kWh)



Net CO2 savings in Merit Order (gram/kWh)

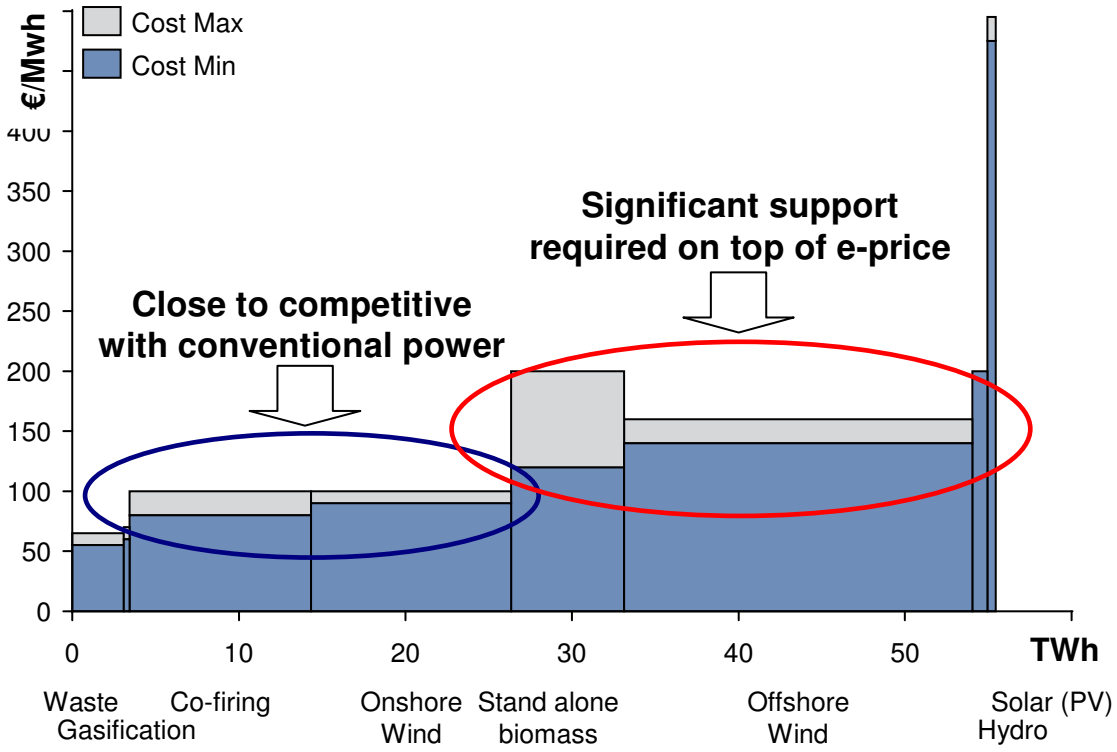


1) When wind capacity strongly increases it will also start replacing coal capacity at night

Together with onshore wind co-firing will remain the most cost efficient sustainable solution towards 2020 and beyond

2020 Estimate

2020 integral cost based on the 54 TWh Dutch renewable program



Source: ECN 2009, Essent Team Analysis

Innovation and optimization of the supply and value chain will contribute to further reduction of cost and CO2

Forestry

- optimized plantation management will increase output
- modern harvesting technology
- fast growing trees and energy crops
- Species optimized for energy purposes

Pelletization

- micro chipping → homogenous product facilitates further process
- using logging remains for drying purposes (avoid CO2 emissions due to rotting)

Pre-treatment

- develop industrial scale continuous processes to facilitate
  - improved grinding
  - storable (hydrophobic, no biological activity)
  - commodity capable

Logistics

- special pellet vessels will reduce cost and CO2
- large potential in storage and handling
- logistic chain is key to further cost reduction

Power Plant

- boiler behavior with co-firing above 35% mass
- CFD modeling
- Reduce efficiency losses
- Improve availability of mills and reduce stops

Stable investment climate driver for long term investments and innovation

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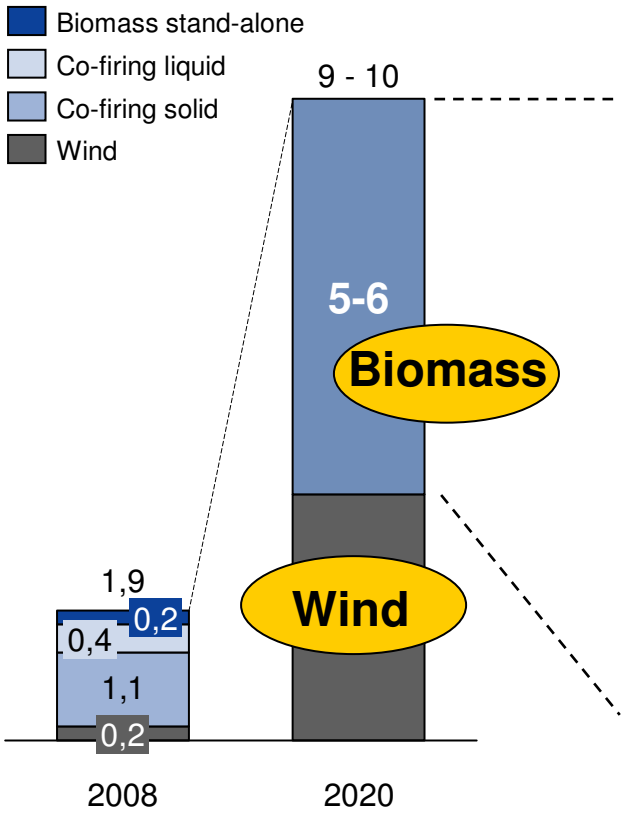
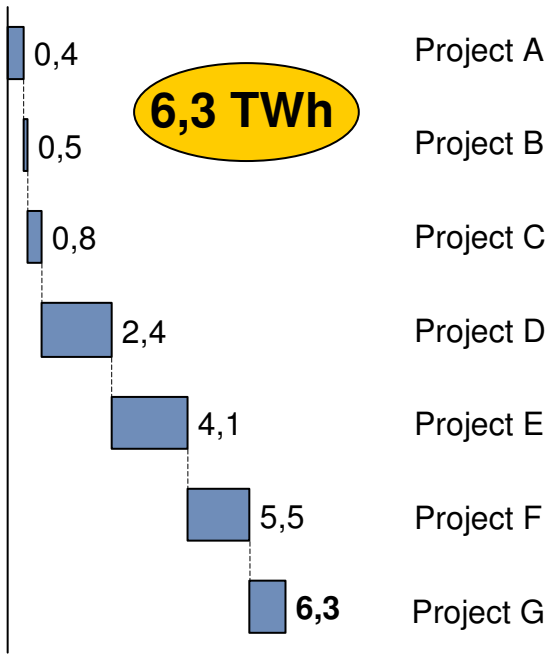
Essent has the ambition to expand its renewable portfolio to 10 TWh for which it has a well positioned co-firing pipeline

INDICATIVE

Essent renewable ambition (TWh)



Biomass project pipeline Essent

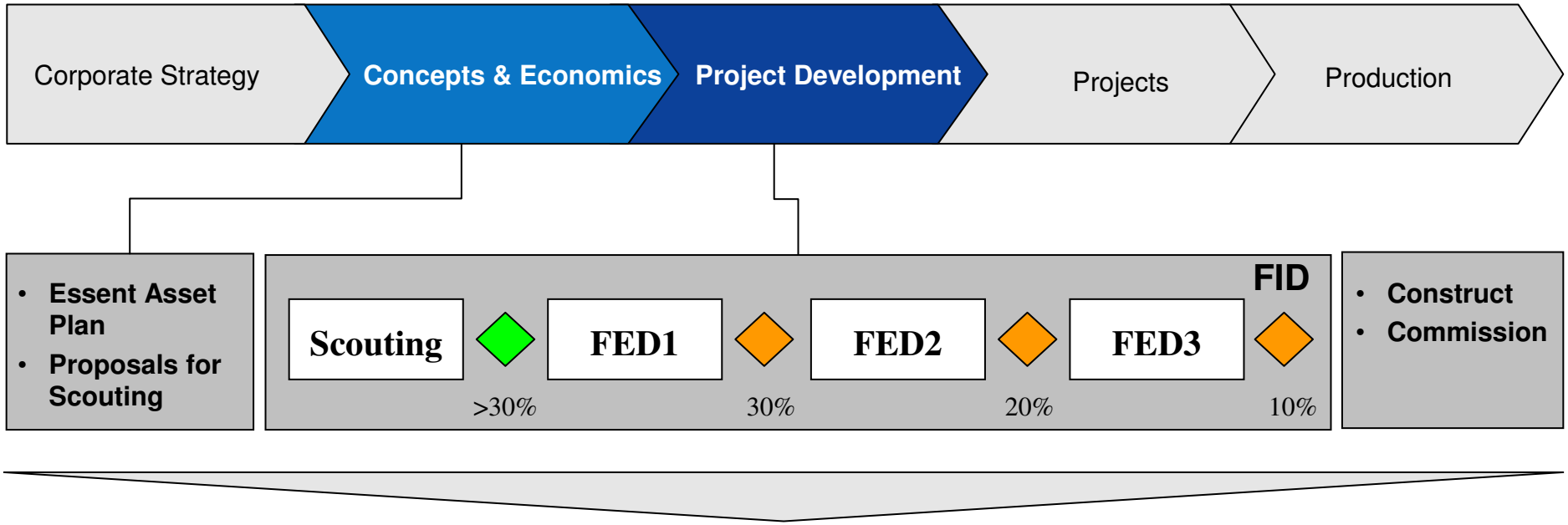


2020 assumptions:

- Wind: ~ 40%
  - 1.200 MW installed (on-/ offshore)
  - pending successful application for subsidies and permits
- Biomass: ~ 60%
  - Dependent on development wind portfolio
  - Stand alone Cuijk will phase out
  - Waste to Energy will be not part of portfolio (0.5 TWh in 2008)

A successful project takes 3 – 4 years from idea to implementation passing several critical design stages and Final Investment Decision along the way

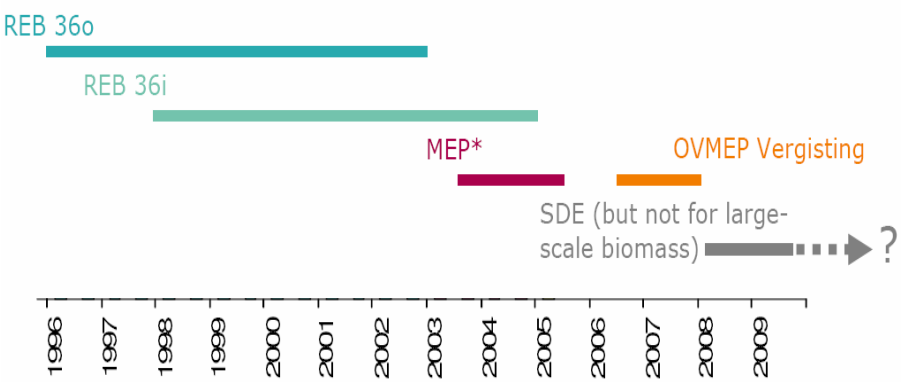
Project Development Pipeline



Average project takes 3 - 4 years and implementation is often dependant on plant revision stops

The Netherlands are still looking for an alternative support system as current subsidies are phasing out forcing project development to a halt

Various stimulation systems applied in NL



* In 2006 the MEP was revised and the subsidy was lowered

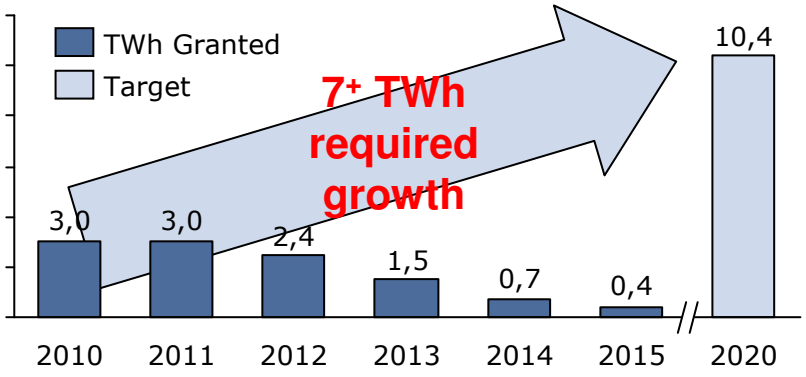
REB = Regulating energy tax

MEP = Subsidy for environmental quality of electricity production

OVMEP = Transition measure for digesters

SDE = Stimulation renewable energy production

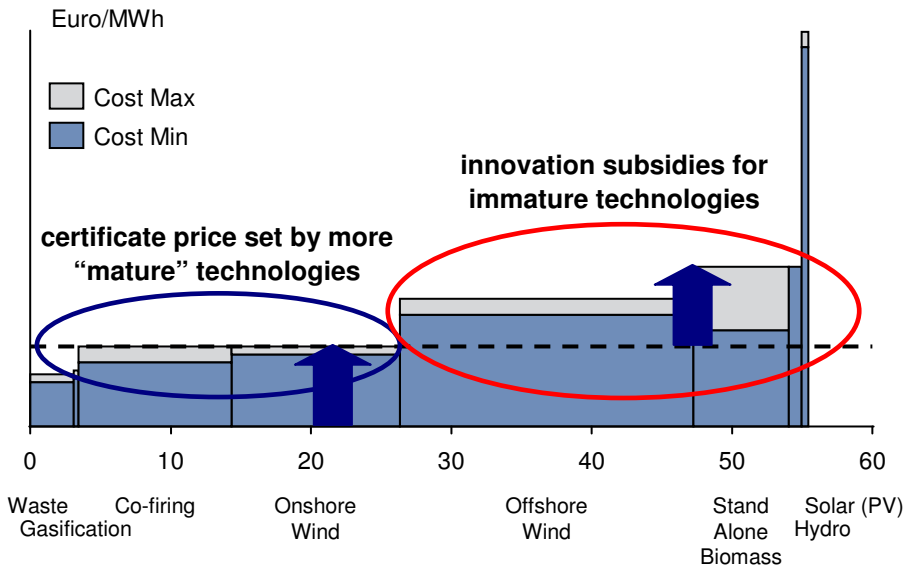
Dutch co-firing target is under pressure



- Granted 10 year subsidy schemes (2003-2005) for co-firing are phasing out
- No new basis for investments in place to date
- Average project takes 3 - 4 years from start to implementation
- Plant revision takes place only every 4 years
- Separately 6 million tons of biomass have to be secured for which production facilities need to be erected

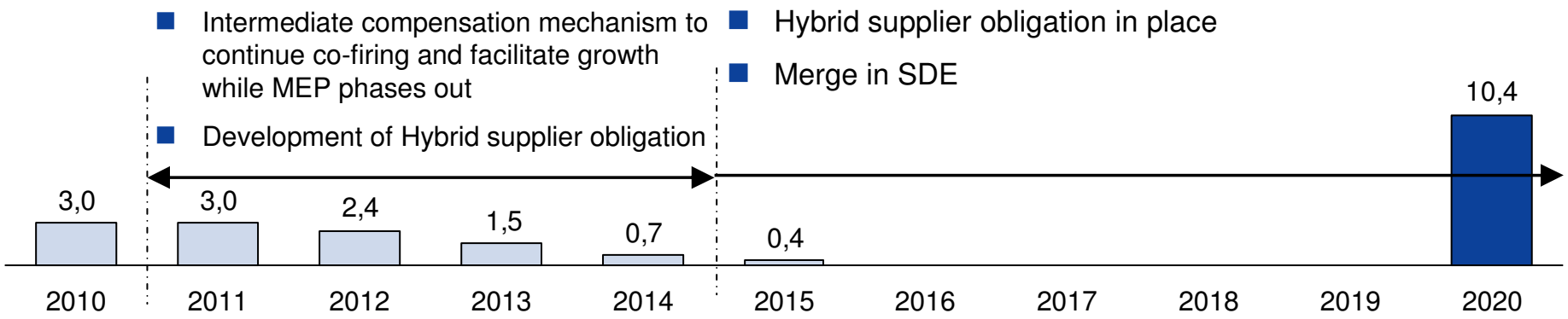
We see the hybrid supplier obligation as a solution for a stable market based system with an impulse to drive technology and secure targets

Certificate System



Support system criteria

- Level playing field ✓
- Environmental effectiveness (2020 targets) ✓
- Cost effectiveness ✓
- Affordability ✓
- Compatibility ✓
- System stability ✓
- Stimulate innovation ✓



Key Messages

Why Co-Firing

1. Large scale co-firing is crucial in achieving the 20% sustainable energy goals of the government in 2020.
2. It is the most cost effective solution for society
3. It has the highest CO2 reduction potential
4. Large volumes are sustainably available world wide without competition for food

Next steps

Hurdles

- Development of a professional biomass supply chain / scale economics
- An effective (international) regulatory framework
- Consolidated (international) environmental sustainability standard