

There is an abundant amount of biomass available in the world, but the majority of it has properties that make it unsuitable for co-firing in coal plants or for gasification. This concerns wet, fibrous material with a high mineral content. Without pre-treatment, co-firing these types of biomass may lead to many problems in coal-fired power plants (e.g. fouling, slagging, corrosion, etc.) coupled with significant investments to retro-fit existing installations. ECN has developed and successfully tested a hydrothermal treatment, 'Torwash' that solves all these issues.

*Keywords: bioenergy, biomass pretreatment, biopellet, wet biomass, fibrous biomass, torrefaction, anaerobic digestion, fermentation*

## Description

- Torwash is a hydrothermal process to convert biomass into biopellets and biogas (methane) or bioelectricity. These pellets have a high caloric value and combustion properties similar to coals such as lignite and brown coal.

## New and innovative aspects

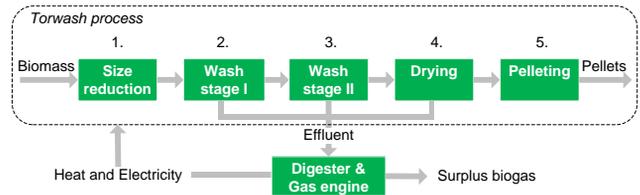
- Combination of low temperature pre-wash step and pressurized high temperature 2<sup>nd</sup> wash step.
- First technology able to convert a wide range of biomass streams in valuable biopellets (c.\$100-150/ton). Many of these biomass streams are currently only composted or left as mulch and sometimes even have a negative value.

## Main advantages of its use

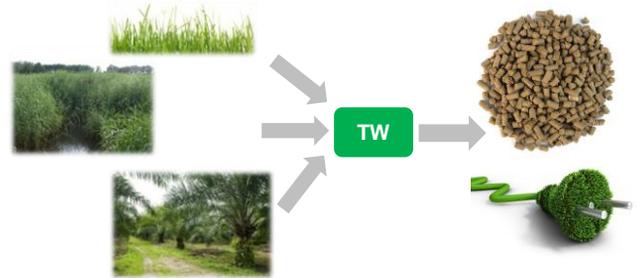
- Highly efficient due to heat integration, press-dryable biomass and optimal use of biomass by digesting the effluent.
- Optimized conditions for each type of biomass, resulting in high caloric pellets and an effluent that hardly contains indigestible elements.
- Works with different feedstocks allowing flexible operation (e.g. changing feedstock depending on seasonal availability and market conditions).
- Self-supporting installation, suitable for off-grid remote locations, near the source of the biomass.
- Much lower costs of logistics compared to unprocessed biomass. Pellets have a much higher energy density and can be stored outside without any protection from the elements.

## Specifications

- The process consists of 5 steps (fig 1.) A shredder is required for most feedstocks (step 1).
- Core of the process is a two-staged hydrothermal treatment (step 2 and 3) to dissolve the minerals that cause difficulties in coal-fired power plants (e.g. Cl, K,) in water and to change the fibrous structure of the biomass. Step 2 uses a mild temperature (< 100°C), at step 3 the biomass is pressurized to up to 30 bar and heated up to 230°C. After this, the 'biopulp' has become brittle and can easily be press-dried (step 4) after which it can be pelletized (step 5).
- Part of the biomass is washed away (effluent) and digested to create biogas.



▲ Fig. 1: Schematic overview of the Torwash process



▲ Fig. 2: Torwash enables the conversion of many different types of biomass in pellets and biogas or green electricity

- Part of the biogas is combusted to create heat & power for the Torwash process, the rest can be sold as electricity or upgraded to bio-SNG.
- The equipment required for step 1, 4, 5 and the digester/gas engine are all existing technologies, which are readily commercially available.

## Potential applications

- Already successfully tested on: roadside grass, miscanthus ("elephant grass"), straw, reed, bamboo, palm oil residues (palm leaves, empty fruit bunches, fruit kernel shell) and coffee pulp.

## State of development

- Proof of concept, demonstrated on bench scale

## Transaction type and partner profile

- Preferred transaction: license agreement
- ECN is interested to get in contact with:
  - Potential license partners (e.g. entrepreneurs, EPC's, etc.) willing to invest in the further development (pilot/demo) and capable of successfully commercializing Torwash.
  - Owners of significant biomass streams interested in pilot or demo projects.

## Publications and IP

- [WO2013162355](#) (patent pending)
- [Torwash Proof of Principle](#)