



HM3 Energy Q & A

What has HM3 Energy done?

HM3 Energy has developed a proprietary process to turn biomass into clean fuel to replace coal in coal-fired power plants. Unlike standard pellets made from wood chips or sawdust, HM3 Energy's biomass pellets are produced using our proprietary TorrB™ torrefaction process. This gives TorrB™ pellets properties which allow utilities to burn them in existing coal-fired power plants without making any modifications to the plants, saving millions of dollars in retrofitting costs.

What does the fuel look like?

The TorrB™ solid biofuel (made from torrefied biomass) consists of an espresso-brown colored powder that is pressed into briquettes or pellets of various sizes, depending on the customer's needs.

What are the features of the HM3 Energy torrefaction process?

During TorrB™ torrefaction, biomass is dried and heated in the absence of air above 200° and below 320° Celsius for less than 30 minutes. When the biomass is properly torrefied, it is hydrophobic and is easily ground up to form pellets.

During heating, biomass releases volatile materials. If not completely combusted, these volatile gases are carcinogenic, just like smoke from forest fires and field burning. However, during our production process the volatiles are captured and completely combusted, and the heat from the combustion is used to dry the incoming material. The exhaust gases are then non-polluting and harmless to human health.

How much energy is required to produce torrefied biomass pellets?

In the TorrB™ process, all heat is provided by an average of 10% of the feedstock energy. In fact, the energy required to dry, torrefy and pelletize TorrB™ pellets is much less than that of producing standard wood pellets for two reasons:

- 1) Our TorrB™ drying and torrefaction processes use a small portion of the feedstock for energy needs, while traditional pellets need an external energy source for drying, and
- 2) Grinding and pelletizing of torrefied biomass requires considerably less energy than traditional pellet processing. Most size reduction is done after torrefaction, because biomass is no longer fibrous, but rather is brittle and easily crushed.

What are the primary features of HM3 Energy's torrefied biomass pellets?

HM3 Energy TorrB™ torrefied biomass pellets have many advantages over standard wood chips or pellets:

- They are completely dry and dense, therefore inexpensive to ship and store.
- They do not absorb water, so can be stored and shipped outside.
- They are easily pulverized, just like coal is before being burned in a power plant.
- They have a similar heating value to coal.
- Switching to HM3 Energy's TorrB™ torrefied biomass pellets requires no modifications to the existing coal-fired power plant.

How does HM3 Energy's torrefied biomass fuel compare in cost with coal?

Power utilities are already making assumptions about the future cost of carbon in their investment horizon. If limits on CO₂ emissions are imposed via a carbon tax or a cap-and-trade system, the operating cost of fossil-fuel based power plants will substantially increase. And since the burning of coal releases more CO₂ per unit of energy than any other energy source, coal-fired power plants would be hit the hardest. Using a carbon neutral source of energy such as torrefied biomass will permit utilities to continue operating existing power plants with no additional capital investment and with no worries about carbon tax or cap and trade. When this is taken into account, torrefied biomass compares very favorably with coal.

What feedstock does HM3 Energy use for its torrefied biomass?

HM3 Energy's TorrB™ technology creates clean energy using woody biomass and other ligno-cellulosic material as feedstock. This includes a wide range of residual materials, such as:

- **Agricultural residues**, such as corn stover, wheat straw, ryegrass straw, orchard prunings and similar material left after harvest
- **Woody biomass**, left as residual from harvesting or thinning conducted to improve forest or rangeland ecological health in overstocked forest stands, and also reduces the high risk of wild fires
- **Urban wood waste**, including construction and demolition debris, yard debris, and brush cleared from right of ways
- **Farmed energy crops** grown solely to be used for energy, such as fast growing poplar trees

HM3 Energy *does not use food sources*. We may use corn stover, but not corn. We do not plan to compete for feedstock with value-added manufacturers (such as lumber, wood chips for pulp

and paper, or mill residue used by fiber board manufacturers). We also require that our biomass feedstock be sustainably grown, harvested or gathered.

Isn't it expensive to haul forest waste out of the forest to a treatment facility?

Our process is unique because when we use forest waste as feedstock, we treat the forest waste and create dry and dense briquettes in transportable modular plants located right near the source of the forest waste, eliminating costly transportation costs. Furthermore, very little electricity is required on site to produce them.

Have you performed any test burns with torrefied biomass?

We have performed two test burns in which TorrB™ biomass material was blended with coal in a pulverized coal-fired boiler. Our most recent co-fire test was completed on February 25, 2010. Pulverized TorrB™ torrefied biomass material was blended 50% with coal, and fired in Westerb Research Institute's small pulverized coal combustion facility, which models the operation of large pulverized coal power plants. After we observed the steady-state combustion of the 50/50 blended feed for about two hours, we switched the feed to 100% of our pulverized TorrB™ biomass. It performed just as coal, with the exception that a feed rate of about 20% less was needed to maintain the same furnace temperature as with the coal. The test burn ran for more than two hours of steady-state operation before being terminated.

The analytical data of the TorrB™ material shows that the sulfur content was 0.03% versus 0.79% for coal on a dry basis; furthermore the mercury concentration in TorrB™ torrefied material was below detection. Notably, the furnace operator observed that the slag build up near the burners after this test burn was in the normal range experienced with burns of 100% coal.

Are any utility companies interested in using torrefied biomass to replace coal?

Currently four major utility companies serving the western United States are following our progress: Portland General Electric, TransAlta, PacifiCorp and Duke Energy. As soon as we build and start operating a small scale commercial plant, they would like to perform two-week test burns blending our torrefied biomass pellets with coal. They would be able to perform these test burns easily without making any modification to their plants, as they can directly mix our clean fuel directly with the coal they have on hand.

Our TorrB™ biomass pellets appeal to them because they can be stored outside just like coal. They also can be ground up and have roughly the same Btu value as coal. Finally, by using these briquettes in place of some of their coal, they can eliminate the need to install costly scrubbers to eliminate toxic emissions.

Isn't biomass already being used in power plants?

Yes, especially in Europe, but the biomass is in the form of traditional wood pellets or hog fuel that requires the plants to spend time and money building a separate handling and firing system.

Is there enough biomass for this new clean energy application to be feasible?

Yes. According to the Oregon Department of Energy, in 2003, approximately 1.5 million dry tons of agricultural residue was available from farming activities in Oregon. The energy content of this resource was about 27 trillion Btu. In 2004, the Oregon Department of Energy estimated that 3.3 million bone dry tons of forest biomass residue was generated from timber harvest activity in Oregon alone. There is also a large amount of urban waste wood in Oregon, where 320,000 dry tons of urban wood were recovered in 2004.

Recent nationwide studies by government agencies have analyzed the amount of biomass that could be available for bio-energy on a sustainable and economical basis. The "Billion Ton Study" (Oak Ridge National Laboratory, USDA and DOE) analyzed biomass supply in 2005. Adjusting their estimates what HM3 Energy considers incremental supply that is sustainable and at economical cost for power production, produces the following national biomass supply estimate:

BIOMASS FEEDSTOCK AVAILABILITY

Source	Dry Tons/Year
Fuelwood	17,000,000
Urban wood residues	20,000,000
Logging slash & site clearing	41,000,000
Restoration & fuel treatment	15,000,000
Increased forest residual	65,000,000
Annual crop residues	286,000,000
Perennial crops	156,000,000
Agricultural process residues & manure	84,000,000
Total	684,000,000

Is wood energy "clean?"

There is no simple answer to this question, as there are a number of different wood energy technologies using woody biomass from a number of different sources. For example, when traditional wood pellets or hog fuel is burned, the first thing that comes out of the burning wood are volatiles contained in hemicellulose. When not completely combusted, these volatiles will produce carcinogenic smoke. This is also what happens during forest fires and the burning of

slash piles after logging or thinning operations. Rather than leave the slash behind on the forest floors, which would provide potential fuel for catastrophic forest fires, the slash (which has no commercial value) is burned in place.

HM3 Energy believes that instead of burning the slash (and releasing carcinogens, particulates, carbon monoxide and such into the air), we should harness the energy contained in the slash to generate electricity. The TorrB™ process HM3 Energy uses to create our torrefied biomass briquettes/pellets a) uses only sustainably gathered woody biomass which has little or no commercial value, such as forest slash, dead stands from beetle kill and forest thinnings, b) is energy efficient in both the gathering of the woody biomass and creation of the solid biofuel, and c) creates no harmful emissions during production of the fuel.

Our TorrB™ pellets are specifically designed to immediately reduce the CO₂ and other greenhouse gas (GHG) emissions of coal-burning power plants. As a renewable alternative to coal that is CO₂ neutral, it is a clean burning high BTU biomass fuel that can be mixed in any ratio with coal. When the life cycle of biomass based fuel is taken into account, the fuel is carbon neutral. Replacing ten or twenty percent coal would result in an immediate reduction of CO₂ generated by coal emissions by that percentage. Other harmful emissions such as mercury, sulfur, and nitrous oxides would also be substantially reduced.

Are there any other uses for these torrefied biomass pellets?

Yes. They could be used as alternative fuel in any coal-fired boilers, such as those used by cement factories. In addition, they can be used in co-generation facilities instead of hog fuel.

Will producing these torrefied biomass briquettes/pellets create jobs?

Yes—initially many in rural Oregon. Jobs created include those for initial pilot plant design and construction, with ongoing construction work throughout Oregon to create the plants, followed by permanent staff for each plant. We anticipate needing approximately 30 permanent staff for each of the 20+ facilities throughout Oregon to run around the clock. Furthermore, when using forest waste as a feedstock, there will be 40+ forestry workers collecting, grinding and transporting the forest waste biomass to our plants. As we expand to other parts of the country, even more such jobs will be created.