Advantage
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Contents

FPJoule

Abstract

FPJoule is a web-based tool that can be used to evaluate the amount of energy contained in harvest residues according to their origin (species group and part of tree) and moisture content. The tool can also be used to quantify the financial advantages when using biomass as a fuel source compared to conventional fossil fuels. A more comprehensive spreadsheet model is also available to FPInnovations members. The latter version can be modified to match a particular facility, such as boiler efficiency.

Keywords

FPJoule, Biomass, Moisture content, Forest residues, Heating value, Conversion, Fuel, Energy cost, Savings, Boiler, Heating.

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Introduction

Harvest residues are an important potential source of renewable energy. With the increase in fossil fuel prices in recent years, the interest in the use of harvest residues as a renewable fuel is growing, depending on local availability. Traditionally, wood is assessed on a volume (m^3) or weight (odt = oven-dry tonnes, gmt = green-metric tonnes) basis, although these units do not accurately represent the amount of energy obtained by combustion (KWh = kilowatt-hour, MWh = megawatt-hour, GJ = Giga joules). To compare the economics of alternate fuel sources and determine their unit costs, it is essential to know their heat and energy values.

FPInnovations developed FPJoule to increase awareness among biomass users that quality, mainly moisture content, has a considerable impact on its value; and that forest biomass can be a financially advantageous alternative to fossil fuels.

Figure 1. FPJoule calculates the amount of usable energy in the biomass.

Description of tool

FPJoule allows the user to determine the cost of using a forest-origin feedstock, compare the results to several conventional fuel types, and print a report summarizing the results. FPJoule allows users to modify default parameters. References for the conversions, energy values and calculations are noted.

FPJoule calculates the energy value in biomass based on species group, tree component and moisture content. The energy value is a better parameter on which to base the price of biomass rather than on a green-metric tonne basis.

FPJoule utilities are accessed through four tabs: (1) **Energy Cost,** (2) **Economic Advantages,** (3) **Fuel Parameters,** and (4) **Report**.

1. The **Energy Cost** tab calculates the amount of energy available in the forest biomass according to the *Species group*, the *Tree Section*, and the *Moisture content* (green basis) (Figure 2). This energy value is used to convert the purchase price in weight or volumetric units to a cost per unit energy. Energy Cost (*Biomass Price* and *Equivalent value*) can be input and output as $/$m^3$, $/odt, $/gmt, $/MWh, ¢/KWh or $/GJ.

2. The **Economic Advantages** tab compares the cost of current fuel supplies *(Heavy Crude Oil* or *Light Crude Oil, Natural Gas, Anthracite Coal* or *Electricity)* to a biomass feedstock based on characteristics entered on the **Energy Cost** tab. The user has the choice of two calculation methods (Figure 3):

a) *Annual consumption.*
The user inputs the annual consumption for a defined current fuel type (light crude, heavy crude, natural gas, electricity and coal) and FPJoule outputs the amount and cost of biomass that would give the equivalent amount of energy.

b) *Boiler power capacity.*
The user inputs the biomass boiler thermal power capacity (MW_{th}) and the number of days per year and hours per day that the boiler is operating and FPJoule calculates the amount and cost of biomass to give the same output of energy.

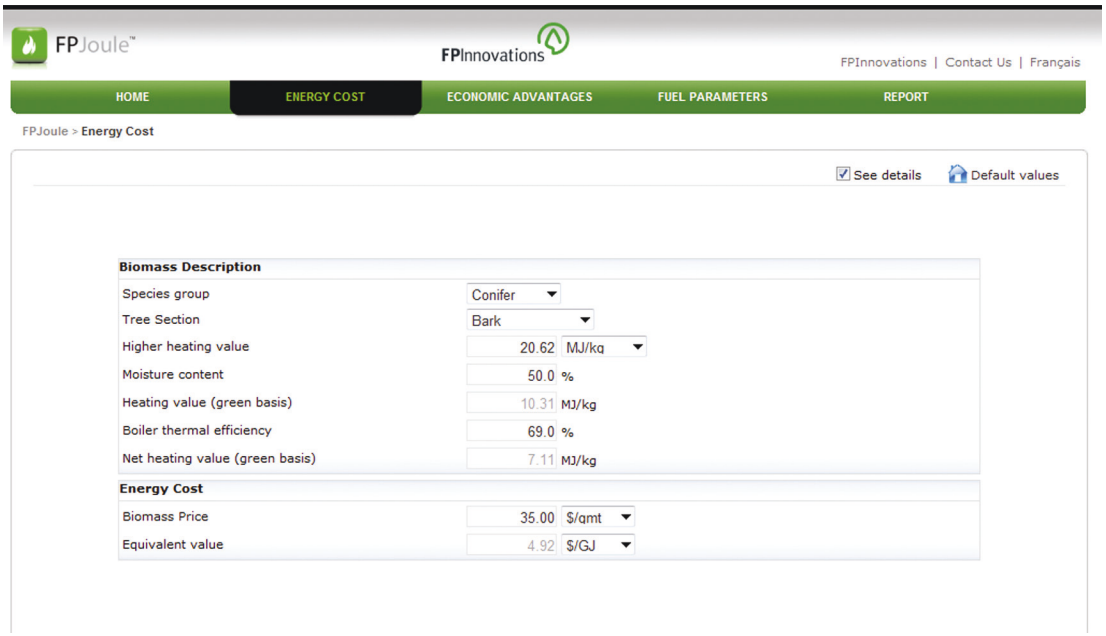

Figure 2. The **Energy Cost** tab calculates the amount of energy in forest-origin biomass and its cost.

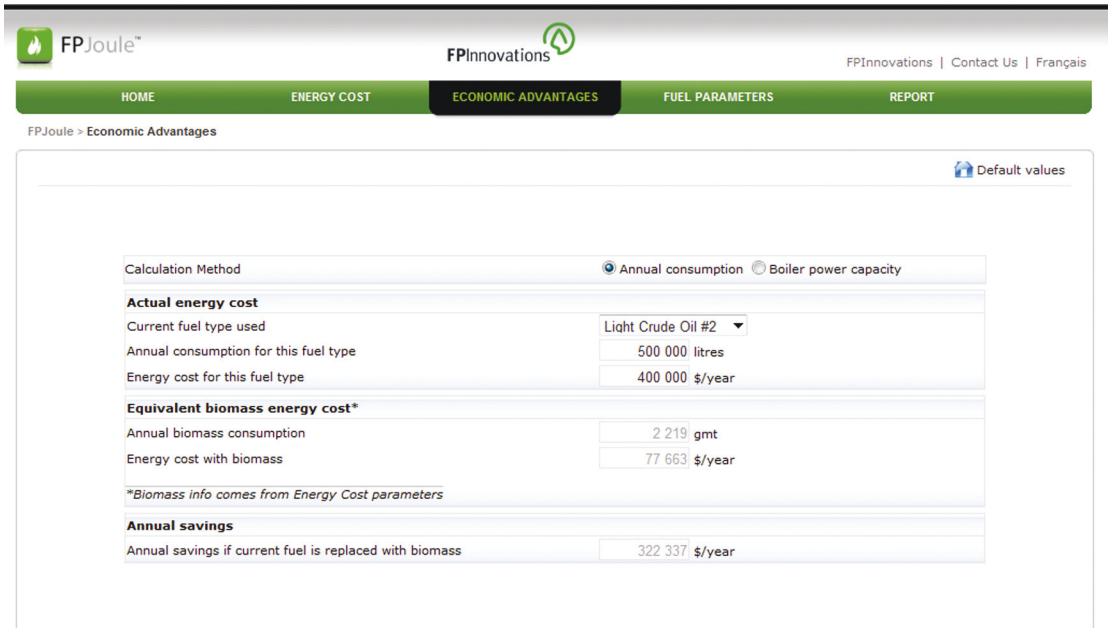

Figure 3.
The **Economic Advantages** tab calculates annual potential savings based on the current annual consumption and cost of energy.

Both calculation methods project the annual savings or any additional cost if the current fuel is replaced with biomass.

3. The **Fuel Parameters** tab shows the default values for higher heating value, boiler yield and unit cost or the user may input local values (Figure 4). The *Reference* menu item lists the information sources used in FPJoule.

4. The **Report** tab summarizes the results of an analysis that can be printed (Figure 5). The outputs for energy costs in $/GJ allows a comparison of costs between fuel types and the identification of potential annual savings if the current fuel is replaced with a forest-origin feedstock.

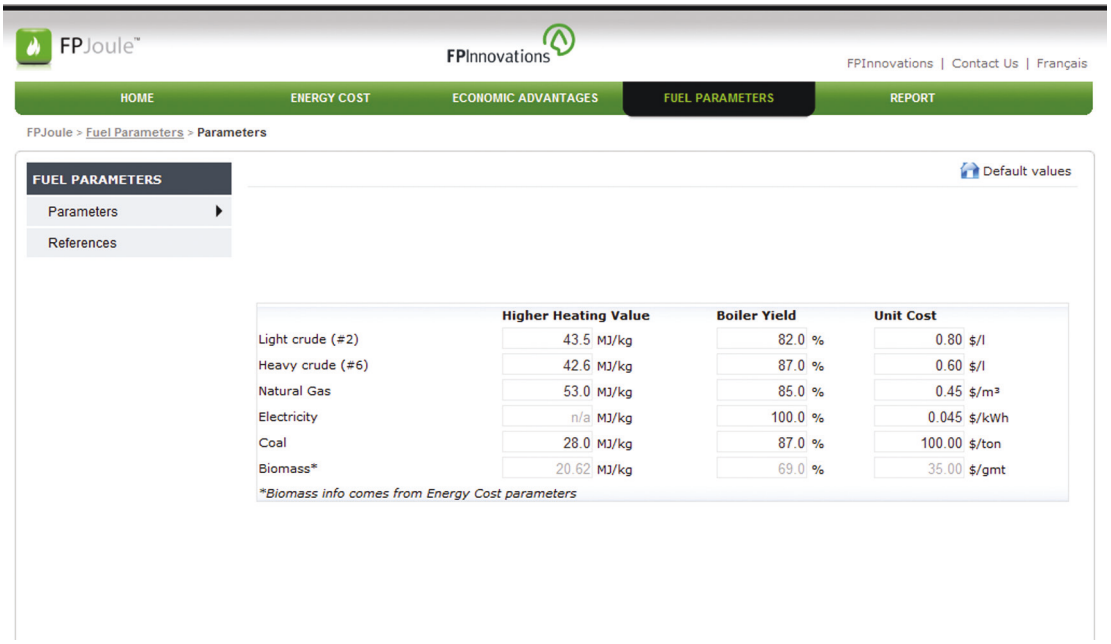

Figure 4. The **Fuel Parameters** tab provides default or user-defined values.

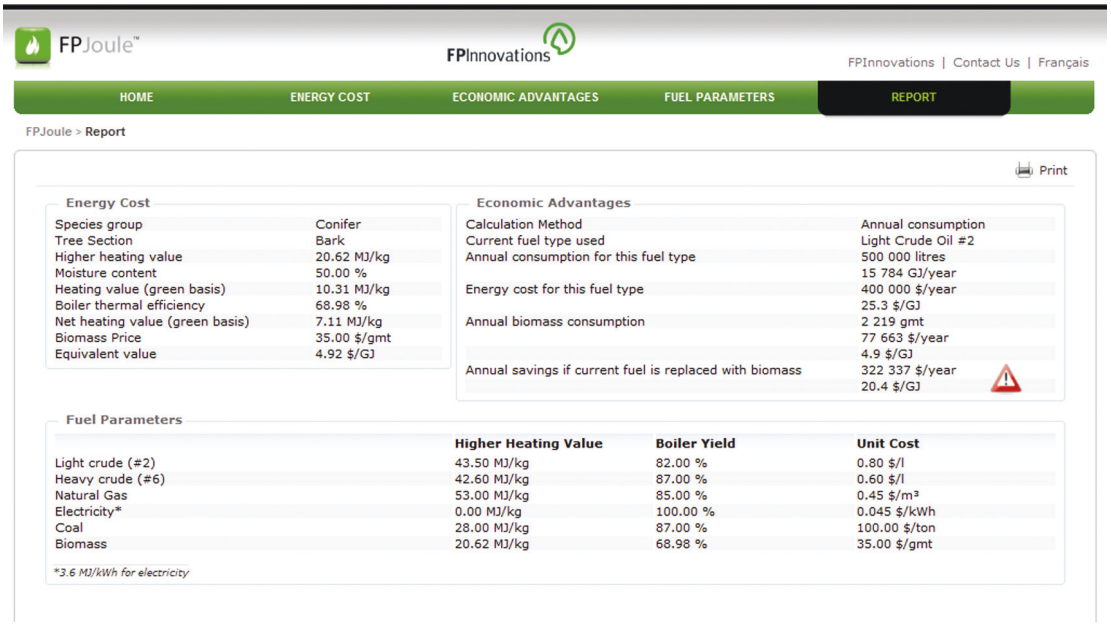

Figure 5. The **Report** page shows an overview of the analysis.

Application example

Paying $35/gmt for bark at 50% MC or $40/gmt at 40% MC?

Prior to undertaking an analysis, it is recommended to check the **Fuel Parameter's** values to verify that they represent the scenario.

A hospital has made the switch from an oil heating system to a biomass boiler. The hospital has a choice between two biomass suppliers. The first source can supply bark at 50% moisture content for $35/gmt, while the second source is able to supply bark at 40% moisture content for $40/gmt.

FPJoule shows the impact of moisture content on the energy cost of biomass and demonstrates the importance of paying for biomass by its energy content and not on a green-tonne basis.

To compare the energy values of each source, the user will first select/input the characteristics of the biomass supply in the **Energy Cost** tab ('Conifer' for *Species Group*, 'Bark' for *Tree Section*, '50.0' for **Moisture content**, and '35.00 $/*gmt*' for Biomass Price). Referring to the **Report** tab, the Equivalent energy value is given as **4.92** $/GJ. When the biomass characteristics are changed to a *Moisture content* of 40.0 % and the *Biomass Price* to 40.00 $/gmt, the resulting Equivalent energy value is **4.40** $/GJ. This comparison indicates purchasing the bark at 40% moisture content for $40/gmt will be 11% cheaper than purchasing the bark at 50% for $35/gmt.

Conclusion

FPJoule can be used to assist users in identifying:

1. The value of forest-origin biomass based on its heating value;
2. The most cost-effective sources of biomass given differences in moisture content and delivered price;
3. Potential savings in heating costs when converting from conventional fuels to forest-origin biomass;
4. Converting weight-based and volumetric units of biomass to energy units.

FPJoule availability

FPJoule is available to all web users at: www.fpinnovations.ca/fpjoule. An Excel spreadsheet version of FPJoule with additional features is available for FPInnovations members only. The spreadsheet version can be tailored to suit the needs of our members. FPInnovations members requiring the spreadsheet version should complete the Contact Us page on the FPJoule website indicating their desire for the spreadsheet. The development team can also be accessed through the Contact Us page if additional information on the web version is required.

Acknowledgements

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