**3a. Management Energy**

Management energy refers to energy required to run farm equipment used in cultivation and will be a required component of Energy Use for all crops. This includes tillage, planting, harvesting, cover crop plant/kill operations. Depending on the NRCS LMOD template selected, this may also include energy used for applications of fertilizer and crop protectants.

Note that for alfalfa, currently RUSLE2 is not run, therefore management energy is calculated separately. The planting/establishment and harvest energy are described here. Since alfalfa is a perennial crop, the energy and GHG associated with planting is amortized over the expected life of the stand so that each year of production bears some of the ”fieldprint” required for establishing the crop.

ATTENTION: Note that the current use of LMOD templates creates the potential for double counting of energy in fertilizer and crop protectant applications in the current system. This is addressed in more detail in 3b Application Energy.

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| **User inputs (for RUSLE2):** |
| Tillage System |
| Climate Zone |
| Soil Texture |
| Slope |
| Slope Length |
| Management System |
| Yield *(Y, if irrigated use irrigated yield)* |
| Lat/Long |
| If crop = alfalfa, previous residue level, tillage and planned life of the stand (in years) |
| If crop = alfalfa, number of harvests in the Fieldprint year and harvest mode for each |
| PROPOSED CHANGE: Provide a data input option for user to indicate direct energy use total (for crop season). It is becoming more common for growers to know this directly (in the amount and type of fuel used); if entered directly, that would override the RUSLE2 energy calculation. |
| **Additional Info needed:** |
| BTU/gal fuel *(BF)*= taken from ”BTU” column of Table 1 based on fuel type selected. Examples and default are diesel fuel; data entry option to select other liquid fuel types should be available to the user. |
| Energy requirement for establishment of alfalfa (Table 15) (AEE) |
| Energy requirement for alfalfa harvest, by mode (Table 16) (AHE) |

NOTE: In the future, if RUSLE 2 output is not used for management energy directly, Table A1 (in a separate spreadsheet; derived from RUSLE2 documentation provided by Jack Carlson from CSU) can be used. These values will need to be multiplied by soil texture factors for any operation that disturbs the soil.

**Main Calculation:**

User inputs are sent to RUSLE2 which returns energy usage (in gallons of diesel fuel) of each operation in the management system template (e.g. “corn grain;FC,twist,disk,z16” is broken down into 7 operations, (Chisel plow, Fertilizer application, etc.). Each of these operations is given a diesel fuel usage value (in gallons)). These energy values are summed together and multiplied by Soil texture multipliers in RUSLE 2 and the management energy equation below is then utilized.

**Management energy (ME)** = = BTU/acre

**Example:**

A 200 bu/acre corn grower in northeast Indiana’s clay loam soils conventionally tills his or her land. The grower chooses a corn grain;FC,twist,disk,z16 management system which has 7 operations associated with it. RUSLE2 uses the user input data to determine energy usage for each operation and sums them (1.2 + 1.0 + 1.1 + .8 + .8 + .8 + .44=6.14 gal/acre total). Given this information from RUSLE2, determine the total energy associated with field management used by the grower.

The standard conversion factor for diesel fuel is 138,490 BTU per gallon (see Table 1).

Management energy (**ME**) = (6.14 x 138,490) = 850,329 BTU/acre

**MEy**  = ME/Y = 4,251 BTU/bu

**Alfalfa Calculation**:

Since alfalfa does not currently call RUSLE2, the management energy is calculated separately. The two components are establishment energy and harvest energy. NOTE: If RUSLE2 runs are adopted for alfalfa, this calculation will need to be reconsidered.

**Step 1: Alfalfa Establishment Energy**

Establishment energy is included in every year of an alfalfa Fieldprint even though the operation itself only occurs in the first year. The Yield used should be the yield for the year of the current Fieldprint.

**Calculation**: Establishment energy = AEE / (life of the stand) = BTU/acre

The AEE is selected from Table 15 based on location (state), residue of previous crop, and tillage type.

**Example**: For an alfalfa field in Arizona with a total annual yield of 5.4 t/ac and a 5 year expected life of stand, planted with low residue remaining on the field and using no-till planters, the establishment energy is calculated as:

Establishment Energy = 2024874/(5) =404,975 BTU/acre

Establishment energy per unit yield = 404,975 /5.4 = 74,995 BTU/ton

**Step 2: Alfalfa Harvest Energy**

Harvest energy is calculated separately for each cutting in the year, and based on mode of harvest. The value is drawn from Table 16

Calculation: Harvest Energy = (AHE1)+(AHE2) … + (AHEx)= BTU/acre

Where “x” is the number of harvests in the year.

Example: For an alfalfa field with two cuttings in a year, a first cut of Dry Hay round bales with a yield of 3.2 ton/acre, and a second cut of silage stored in bags with a yield of 2.2 ton/acre.

Harvest Energy = (360,594 BTU/acre)+(568,629 BTU/acre) = 929,223 BTU/acre

Harvest energy per unit yield = 929,223 / 5.4 = 172,078 BTU/ton

**Step 3: Total Alfalfa Management Energy**

**ME =** Establishment Energy + Harvest Energy = 404,975 + 929,223 = 1,334,198 BTU/acre

**MEy** = 1,334,198 / 5.4 = 247,073 BTU/ton