

Table 1. Embodied energy in typical annual inputs for the Sunshine Farm.

Components	On-farm		Purchased		Total
	Feed, N ^a	Fuel ^b	Seed, fertilizer	Amortized capital	
----- GJ -----					
Animal production	57	18		41	116
Crop production	7 ^c	62	15	1	85
Tractors (2), combine, swather		2		32	34
Horses (2), fences, stalls, waterlines	18 ^d	2		2	22
Field implements and equipment		1		39	40
Pickup and dump truck				13	13
Buildings and bins				19	19
Photovoltaic array and prorated grid				34	34
Electricity (farm, not house) ^e		11			11
Phosphorus & potassium (simulate)			12		12
Legume N fixation (fossil fuel-equiv.)	58				58
Subtotal (no labor charge)	140	96	27	181	444
Total with labor as portion of					
Amish lifestyle					487
Average US rural lifestyle					574

^a N, nitrogen.

^b This was met by 85 GJ of biodiesel (Table 2) and the primary energy-equivalent of 11 GJ in electricity from the photovoltaic array.

^c Horse feed for work, not counting maintenance (footnote d).

^d Horse feed, 3 GJ for foal reproduction [41] and 15 GJ for maintenance [24], both for 2 workhorses.

^e This was primary energy displaced by electricity at the rate of 10.55 MJ (10,000 Btu) per kWh [27].

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Table 2. Gross energy in typical annual production from 20 ha of cropland on the Sunshine Farm.

Production	Gross energy (GJ)
Oilseed oil for biodiesel	85 ^a
Oilseed meal fed on farm	40
Oilseed meal marketed	240
Crops fed on farm	360
Crops marketed	200
Green manure legumes	140 ^b
Total	1,065

^a This value for the extracted oil also represents the gross energy in the methanol ester biodiesel, i.e., methanol esterification of triglyceride oil causes little change in gross energy. This was confirmed for soybeans and sunflowers.

^b Not harvested, but plowed down for soil fertility.

Table 3. Inputs and outputs per hectare and energy ratios for mixed crop and livestock farms.

Farms (C÷O)	Per hectare of cropland			Farm energy ratio (O÷I)	Energy ratio of marketed crops to outputs
	Marketed crops (C) ^a	All marketed outputs (O) ^b	All purchased inputs (I) ^c		
	----- GJ -----			----- unitless -----	
Sunshine Farm					
No labor charge	22.0	25.1	10.4	2.4	0.88
With Amish labor charge ^d	"	"	12.6	2.0	"
With US labor charge ^d	"	"	16.9	1.5	"
PA dairy farm [42] ^e	6.3	9.1	5.2	1.8	0.69
Groups of Amish farms^{e,f}					
2 groups (PA) [10]	1.8–2.3	7.3–17.2	8.6–24.5	0.7–0.8	0.14–0.25
4 groups (PA, WI, IL) [11]	---	5.5–13.2	3.4–13.6	1.0–1.6	---
Groups of conventional farms^{e,f}					
3 groups (PA) [10]	2.1–4.2	14.3–18.0	34.4–45.6	0.4 ^g	0.14–0.29
3 groups (PA, WI) [11]	---	7.0–12.8	21.6–25.5	0.3–0.6	---
Group with greatest marketed output (IL) [11]	28.4	48.0	24.0	2.0	0.59

^a Includes oilseed meal marketed from Sunshine Farm.

^b Outputs from crops, meal, and animals.

^c Includes all amortized capital for Sunshine Farm, but only equipment, machinery, and sometimes building repair for other farms.

^d Goods and services in lifestyle support were regarded as purchased inputs (see Methods).

^e PA, Pennsylvania; WI, Wisconsin; IL, Illinois.

^f Range of group averages.

^g The ratio was the same, by coincidence, for the three groups of farms defined by dairy herd size.

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