

Table 1. Inputs and outputs per acre and energy ratios for mixed crop and livestock farms.

Farms	<u>Per acre of cropland</u>			Farm energy ratio (O/I)	Energy ratio of marketed crops to outputs (C/O) unitless
	Marketed crops (C)	All marketed outputs (O) <sup>a</sup> million Btu	All purchased inputs (I) <sup>b</sup> million Btu		
<b>Sunshine Farm</b>					
Without photovoltaic array	5.5	5.8	3.4	1.7	0.95
With photovoltaic array	5.5	5.8	3.3	1.8	0.95
<b>Pennsylvania dairy farm<sup>i</sup></b>	2.4	3.5	2.0	1.8	0.69
<b>Groups of Amish farms<sup>c</sup></b>					
2 groups (PA) <sup>ii</sup>	0.7-0.9	2.8-6.6	3.3-9.4	0.7-0.8	0.14-0.25
4 groups (PA, WI, IL) <sup>iii</sup>	—	2.1-5.1	1.3-5.2	1.0-1.6	—
<b>Groups of conventional farms<sup>c</sup></b>					
3 groups (PA) <sup>ii</sup>	0.8-1.6	5.5-6.9	13.2-17.5	0.4 <sup>d</sup>	0.14-0.29
3 groups (PA, WI) <sup>iii</sup>	—	2.7-4.9	8.3-9.8	0.3-0.6	—
Group with greatest marketed output (IL) <sup>iii</sup>	10.9	18.4	9.2	2.0	0.59

<sup>a</sup> Outputs from crops and animals.

<sup>b</sup> Inputs for crops, animals, and things used on the farm.

<sup>c</sup> The reported data are averages for individual groups, not unaveraged numbers for individual farms, and are given as ranges of averages. States are indicated in parentheses.

<sup>d</sup> The ratio was the same, by coincidence, for the three groups of farms defined by dairy herd size.

Table 2. National energy ratio of marketed outputs to purchased inputs for farming in the US and UK<sup>1</sup> and in other countries.

Country	Year(s)	Energy ratio
US	1940	2.3
	1970	0.9
	1974	1.0
UK	1950	0.4
	1972	0.3
Israel	1969-70	0.3
Netherlands	1964-65	0.5
France	1970	0.7
China	1978	1.2
New Zealand	1978-79	1.4
Egypt	1972-74	1.8
Pakistan	1977	2.9
Australia	1965-69	3.1 <sup>a</sup>

<sup>a</sup> A ratio of 2.8 has also been calculated.<sup>v</sup>

Table 3. Energy ratio of output to input for various energy sources.

<u>Energy source</u>	<u>Energy ratio</u>
<i>Nonrenewable fossil fuels</i> <sup>vi</sup>	
Oil & natural gas (US wellhead)	
Discoveries – 1940s	>100
– 1970s	8
Production of earlier discoveries – 1970s	20
– 1980s	10
Coal – 1950 (US mine)	80
– 1970 (US mine or strip)	30
<i>Renewable fuels</i>	
Ethanol (grain, sugarcane, crop residues) <sup>vi</sup>	0.7-1.8
Methanol (tree plantation) <sup>vi</sup>	2.6
Vegetable oil (precursor to biodiesel) <sup>vii</sup>	1.8-4.6
Biomass tree crops (fertilized) <sup>viii</sup>	6-13
Biomass herbaceous crops (fertilized) <sup>ix</sup>	11-12
Biomass crop, then gasification <sup>viii,x</sup>	2-5
Anaerobic digester biogas (8 countries) <sup>xi</sup>	1.5-3.1
Solar flat-plate collectors (heat) <sup>xii</sup>	2-5
<i>Non-solar electricity production</i> <sup>vi</sup>	
Coal-fired, US average	9
Western surface coal – no scrubbers	6
– scrubbers	2.5
Natural gas-fired <sup>xii</sup>	2.3
Nuclear light-water reactor	4
<i>Solar-related electricity production</i>	
Photovoltaic arrays <sup>vi</sup>	1.7-10
Parabolic-thermal collectors <sup>xiii</sup>	3-8
Wind turbines <sup>xiv,xv</sup>	3-18
Conventional or small hydroelectric <sup>xvi</sup>	10-12
Biomass-fired (plus crop production) <sup>viii,x,xvii</sup>	3.3-3.7
With advanced cogeneration <sup>viii,xviii</sup>	8-9
<i>Energy conservation</i>	
Double-pane windows <sup>xix</sup>	136
Ceiling insulation <sup>xix</sup>	61
Passive solar housing <sup>xii</sup>	10-25

## Notes for Tables 1-3.

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- <sup>vi</sup> C.A.S. Hall, C.J. Cleveland and R. Kaufmann. 1986. *Energy and Resource Quality: The Ecology of the Economic Process*. John Wiley, New York.
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- <sup>ix</sup> A.F. Turhollow and R.D. Perlack. 1991. Emissions of CO<sub>2</sub> from energy crop production. *Biomass and Bioenergy* 1:129-135.
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- <sup>xi</sup> M. Demuyck, E.J. Nyns and W. Palz. 1984. *Biogas Plants in Europe: A Practical Handbook*. D. Reidel Publishing Co., Dordrecht.
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- <sup>xv</sup> B. Sørensen. 1995. History of, and recent progress in, wind-energy utilization. *Annual Review of Energy and Environment* 20:387-424.
- <sup>xvi</sup> M.W. Gilliland, J.M. Klopatek and S.G. Hildebrand. 1981. Net energy: Results for small-scale hydroelectric power and summary of existing analyses. *Energy* 6:1029-1040.
- <sup>xvii</sup> D.M. Gates. 1985. *Energy and Ecology*. Sinauer Associates, Sunderland, MA.
- <sup>xviii</sup> R.H. Williams and E.D. Larson. 1993. Advanced gasification-based biomass power generation. Pp. 729-785 in: T.B. Johansson, H. Kelly, A.K.N. Reddy and R.H. Williams (eds.). *Renewable Energy: Sources for Fuels and Electricity*. Island Press, Washington, DC.
- <sup>xix</sup> B. Hannon. 1981. The energy cost of energy. Pp. 81-107 in: H.E. Daly and A.F. Umaña (eds.). *Energy, Economics, and the Environment: Conflicting Views of an Essential Interrelationship*. Westview Press, Boulder, CO.