Why focus on Energy Demand?

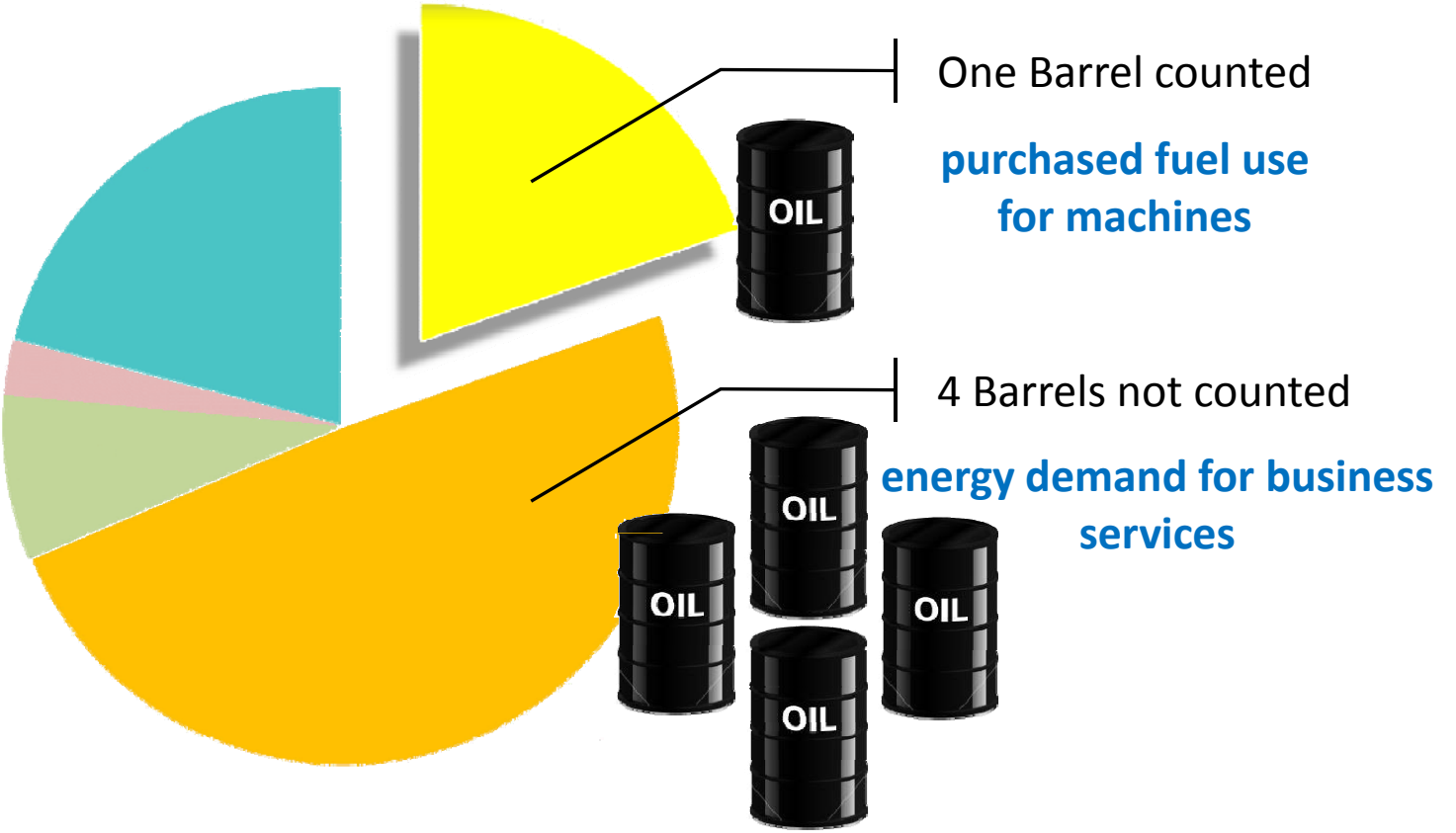
Systems Energy Assessment gives the total Economic Energy Demand of Businesses[1]

- Energy use is visible. Energy demand is larger, has the same effects, and is mostly invisible
- Impacts increase with constant dollar GDP, which measures units of constant product
- GDP increases faster with improving energy efficiency & uses of energy have bigger effects
- The harm of impacts increases as the environment suffers more impacts

Spending money requests economic services from around the world, all using energy

Why focus on Energy Demand?

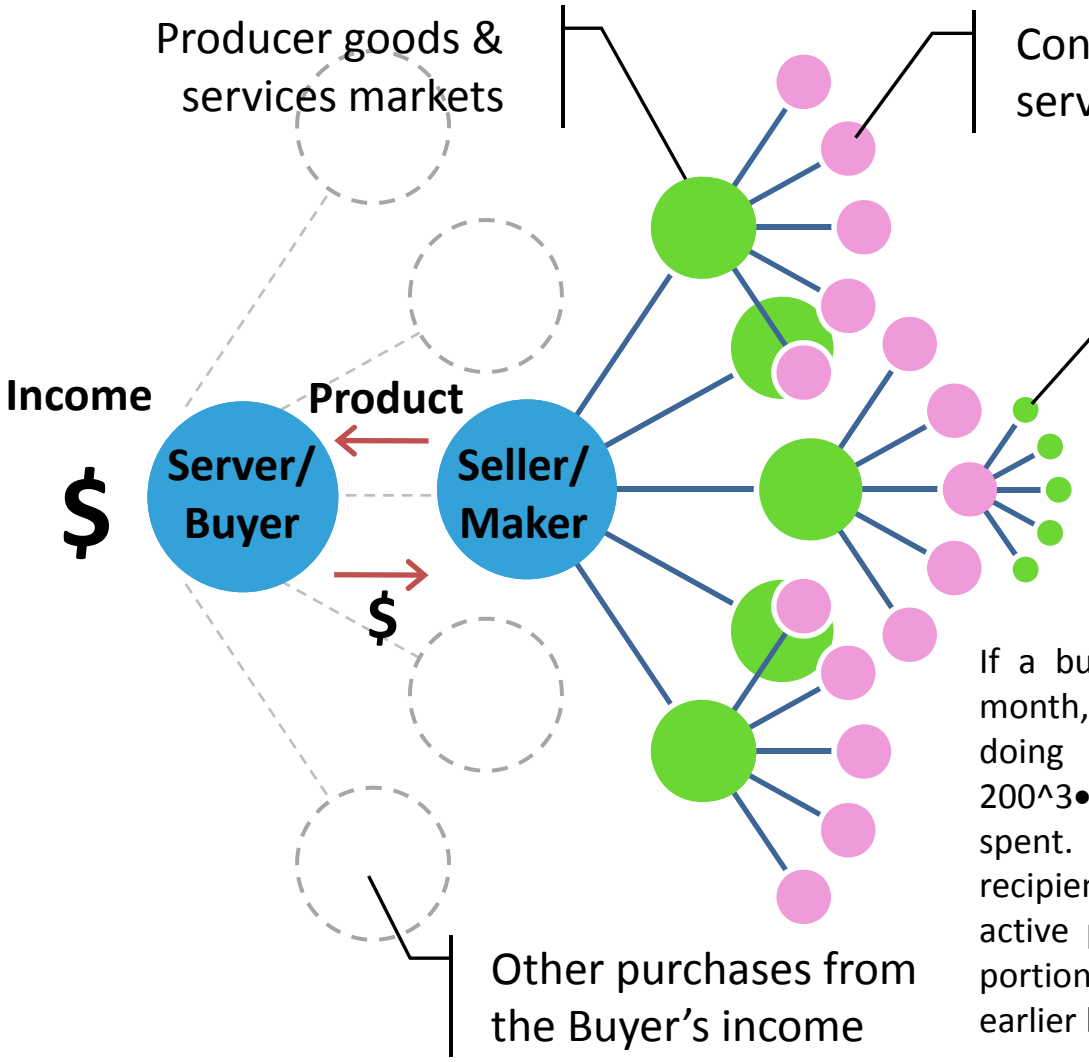
Counting only business fuel use, misses the energy demand of business services



Spending money requests economic services from around the world, all using energy

How Wide Spread is Energy Demand?

Server/Buyer -- Seller/Maker -- Server/Buyer 2 -- Seller/Maker 2



If a buyer pays 200 different businesses a month, that pay to 200 different people, doing the same, in three months 200^3•200^3 partial recipients of any dollar spent. As a cascade 6.4 • 10^13 end recipients are paid. For 5 billion economically active people on earth, each might receive portions of every dollar spent three months earlier by13 thousand different paths![1]

Money demands exceedingly diverse energy use

How Big is Energy Demand?

- Hidden energy demand from business services is ~4 times the energy uses recorded[1]
- All money ends as pay for people operating the businesses that pay them.
- Energy/$ for consumption is "about average" 8000btu/$ and .47kgCO2/$[1]
- So money measures hidden energy demand
- US municipal solid waste - 4.5 lb/person.dy[2]
- US energy demand CO2 – 110 lb/person.dy[3]

Total energy demand often 5 times the visible

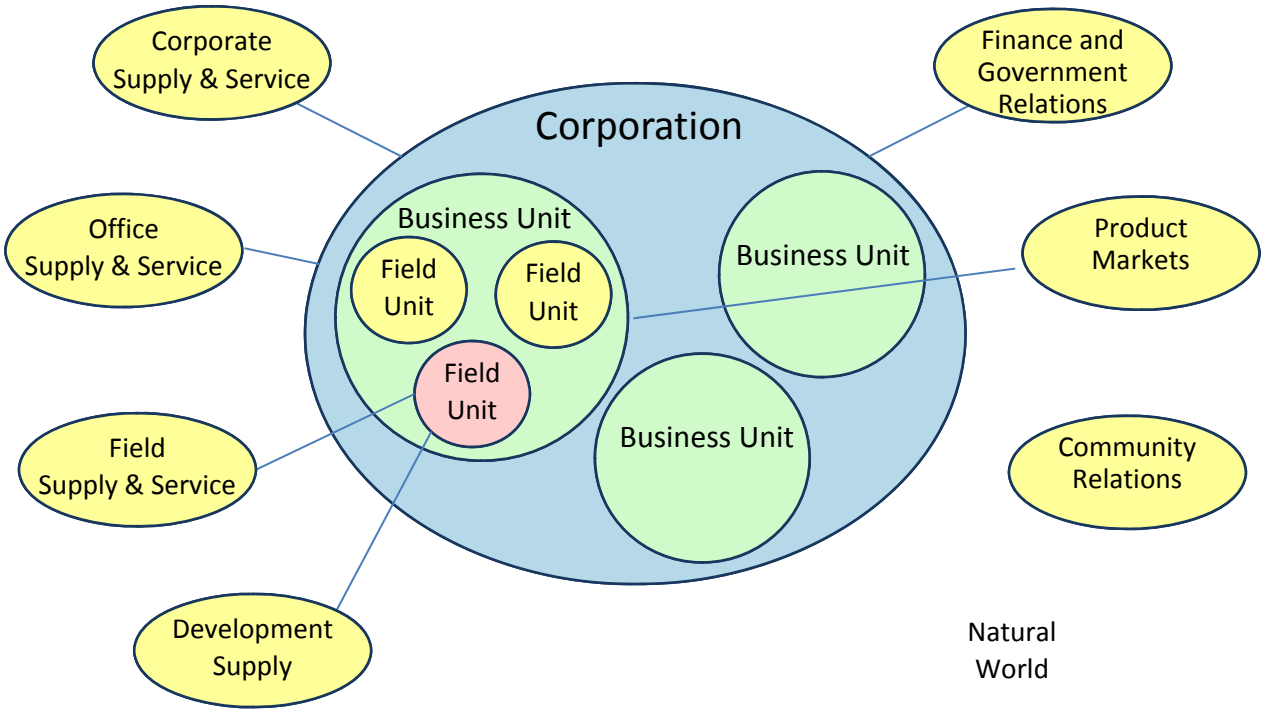
A business unit, at the point of sale

Parts that need to work together

Materials	•Natural Resources •Purchased Products
Tools	•Technology •Structures
Workplace	•Development •Real Estate •Organization
Workers	•Operators •Operation services •Managers
Environment	•Government •Finance •Society

Coordinated parts that all take energy to deliver

Businesses as environmental systems

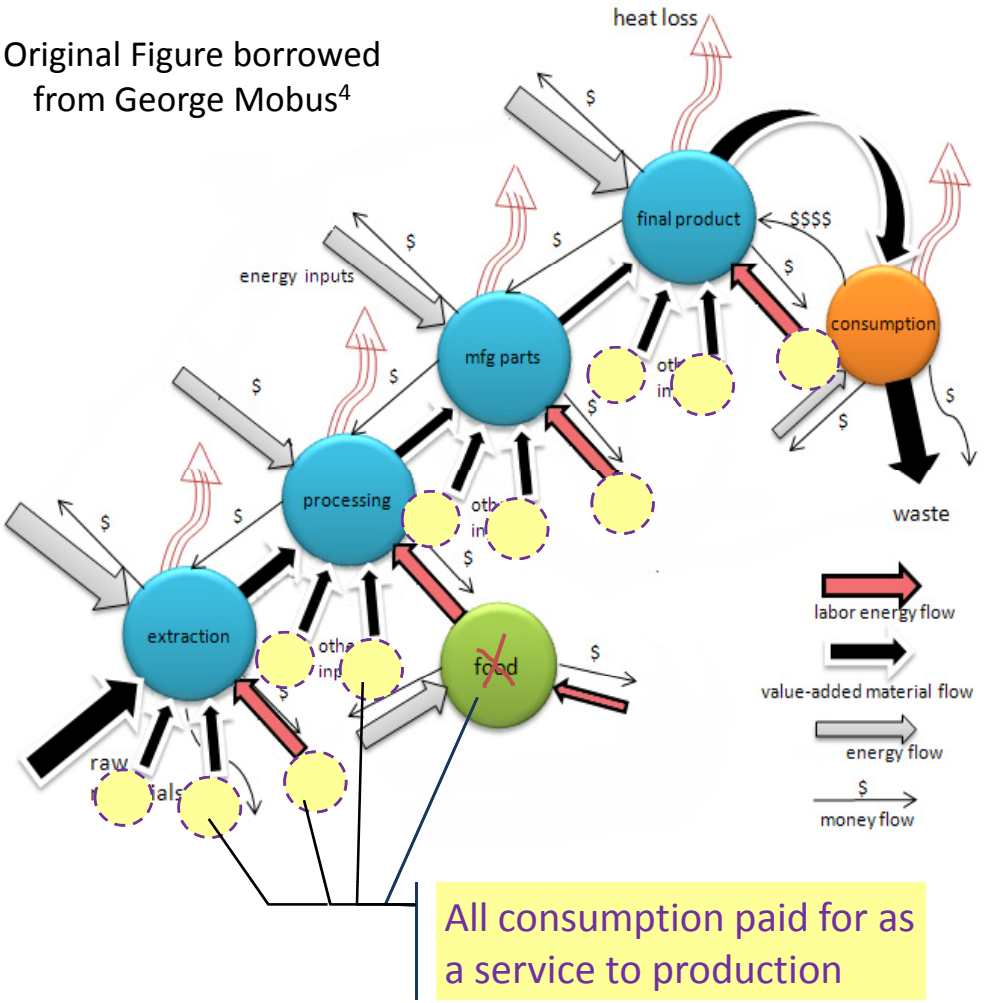


- Systems are environments for their parts
- Matched active and passive parts work as Organized Units
- Cells, Organisms, Businesses, Cities, Cultures, Economies
- Growth starts with local resources and a seed of design
- Growing control of their environment ends in a stable relationship with it, or runs out.

Systems are market places with all your stuff

Adjusting the way of counting energy use

Original Figure borrowed from George Mobus[4]



All consumption paid for as a service to production

Counting material energy + demand

- Energy uses are now traced from resource extraction to product use.
- Energy need of material processes counted, but not needs for services.
- Food as material input to labor, and material energy inputs to food, may be counted.
- Energy demand created by paying labor and other services for running the business is not counted.
- Energy demand from services is ~80% of total business energy need

Original Figure was simplified for reduction here, adding yellow circles and note to represent the addition the energy demand of business services. The model of counting only the material energy uses of the material chain of production is typical of H.T. Odum and others, such as the LCA world standard for business energy accounting

Counting observed energy use, not energy demand

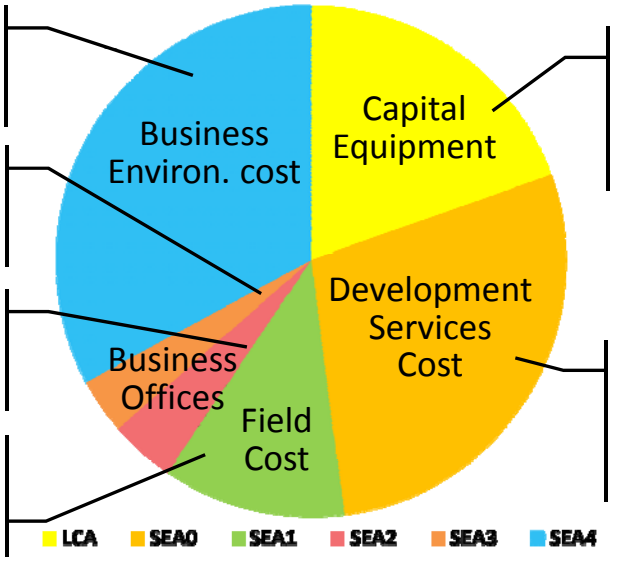
Life Cycle Energy For a Model Wind Farm

32% dSEA4 – Services of government and finance

4% dSEA3 – Service of corporate management

4% dSEA2 – Service of business management

13% dSEA1 – Service of field operations



19% – Material costs of wind farm technology, 1/5 of the total

28% dSEA0 – Service cost of wind farm technology

Adding up the total for each scale of system organization, working as a unit

Systems Energy Assessment (SEA)

Money paid to people creates ~4 times the energy use as material costs of machines

Adding up Total Energy Demand

Combining Purchased Fuel use and Economic Energy Demand	$ Cost	Fuel Factor	Fuel use	Demand Factor	Energy Demand	Total
	$	Tii	TE	Eii	EE	kWh
Equipment Investment	$71.63		0.00	1.5	64.35	64.35
Physical Plant Development	$24.15		0.00	1.5	67.66	67.66
Field Operation technology	$18.12	0.51	17.20	1.5	24.98	42.18
Field Operation fuels	$0.27	12.17	6.15	1.0	0.51	6.65
Field Business Services	$0.20	-		0.9	0.34	0.34
Field employees	$2.75	-		0.9	4.62	4.62
Business Office technology	$0.25	0.51	0.24	1.5	0.34	0.58
Biz Office Fuels	$0.54	12.17	12.29	1.0	1.01	13.30
Business Office services	$1.50	-		0.9	2.52	2.52
Business Office salaries	$1.54	-		0.9	2.59	2.59
Corporate technology	$0.10	0.51	0.09	1.5	0.14	0.23
Corporate Fuels	$0.05	12.17	1.14	1.0	0.09	1.23
Corporate operations & services	$0.50	-		0.9	0.84	0.84
Invest Land & Local Taxes	$3.00			0.9	5.04	5.04
Invest Fees & Insur	$5.34			0.9	8.97	8.97
Finance cost estimate	$69.92	4 to 8		1.0	130.60	130.60
Cost of Government estimate	$13.25			0.9	22.28	22.28
Total	$213.12					464.87

- Each business expense is assessed for fuel use and economic demand
- Energy intensity adjustment, Tii and Eii, times average intensity E_E cost = energy use and demand
- The world average energy intensity, EiW= 1.883kWh/$,
- There is the simple quick way and the long complicated wau
- The total cost times EiW is quick, $*EiW = 401kWh, 86% of 465kWh
- The old way, counting only material energy uses is off by 500%

Money is a far more accurate measure of energy use than energy uses

Notes

1. *Symbols: Tii = tech fuel use rate factor; Eii =* econ demand rate factor; Tii and Eii *adjust the world average economic intensity EiW to give the total energy demand per dollar of cost.*
2. *Symbols: TE = tech fuel use total,* EE = econ fuel use total; *$T = economic value added for TE using 1/EiW; $E is either the actual cost or = the economic value added for EE using 1/EiW*
3. World Average GDP energy intensity, EiW from EIA = 1.883kWh/$, declining at ~1.24%/yr.
4. Tax rate on net revenue is 36%, approximating the ratio of US combined local, state and federal government costs to GDP, from http://www.usgovernmentrevenue.com/yearrev2008_0.html
5. New Discussion, links and updates might be found at the Systems Energy Assessment web page, www.synapse9.com/pub/SEA

References

1. P.F. Henshaw (2011) System Energy Assessment (SEA): Defining EROI for Energy Businesses as Whole Systems, for Sustainability MDPI and in Cornel physics archive arXiv:1104.3570v1
2. US EPA (2008) Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008 http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2008rpt.pdf
3. based on $40,584/yr US per capita income, times .47kg/$, the world average production of CO2/$ of GDP
4. George Mobus Feb 6, 2011 blog post "Yet another look at cost inflation" http://questioneverything.typepad.com/question_everything/2011/02/yet-another-look-at-cost-inflation.html