[2a] - Industry Specific Benchmark Metrics – Chemical Industry Compared to Other Industries

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Abstract:

This paper reports industry-wide composite metrics for the US chemical industry and specific comparison metrics for selected other US industries. Calculations are based up on publicly available data.

Design work and preliminary testing of indicators for energy and materials intensity by numerous companies and various organizations has been completed the author and others. That work yielded a good starting point for indicators and metrics of industrial performance. The major themes of those indicators efforts were energy and material use and pollutant dispersion. Metrics for energy efficiency - energy consumed per unit of output – were found to be readily and widely implementable and meaningful for individual large companies. Metrics for material intensity - materials consumed per unit of output – have also been found to be feasible, but are more applicable and relevant in some industry sectors than others. Comparable land use metrics were not developed until recently.

Now, three metrics have been calculated for land use: 1) land required to generate one dollar of annual sales, 2) full-time equivalent jobs generated per acre and 3) pollutants emitted per acre. And composite metrics for entire industries have been developed and calculated. Over 12,000 cases were examined and examples of the data for two land use metrics for job creation and revenue generation have been reported: land area per annual sales dollar and jobs created per unit land area. These are two “benefit metrics” in contrast to the typical “cost metrics”, e.g., material use, energy use, water use and pollutants emitted.

Composite industry-by-industry metrics are reported for use as benchmarks for entire industries (Ref. 1, 4, 6, 7).

Introduction

Issue identification mechanisms, metrics and other indicators must be established before government and industry can make rational judgments regarding industry site selection.

The conventional business model is to evaluate anticipated net revenues and compare that to cost for conducting the business over time. Different companies use various methods, e.g., incorporation of cost of capital, threshold periods for net present value calculations. This is graphically depicted by the following diagram.

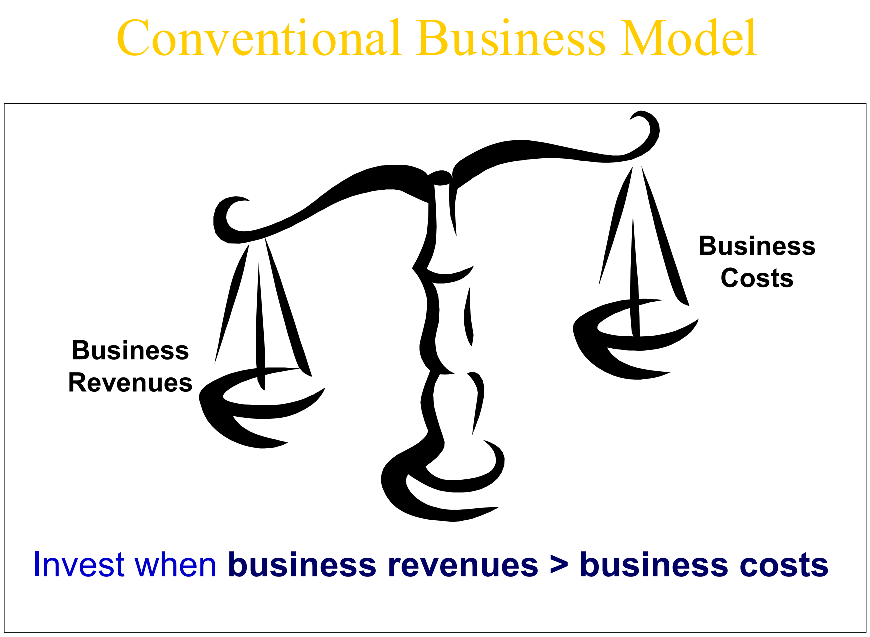

Figure 1. Conventional Business Decision Model

A few companies are incorporating estimated societal costs and societal benefits in the calculation. As estimation methods and their respective databases improve and expand the quality of the decisions improves (Ref. 2).

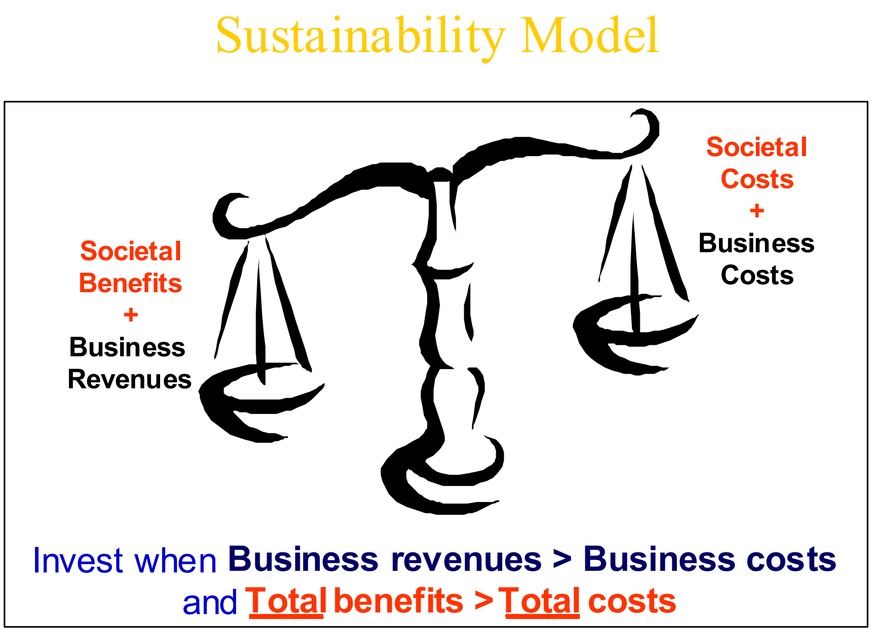

Figure 2. Sustainable Business Decision Model

Governments and civil governing bodies are constantly faced with decisions regarding site selection and business selection. Rhetoric often overcomes reason, with "jobs" and future tax revenues being the factors cited to voters and bond issuers. Tax increment financing is often sought and obtained to provide "preferred employers" with incentives for many projects. Often this leads to leveling existing residential areas, older businesses, agricultural land and undeveloped areas. Little consideration or voice is given to the increase in services required or the widespread exodus of business activity when incentives expire.

Government entities and the public would be well-served to consider the net present value of both costs and benefits for the alternatives they assess and select.

Sustainability Model for Government

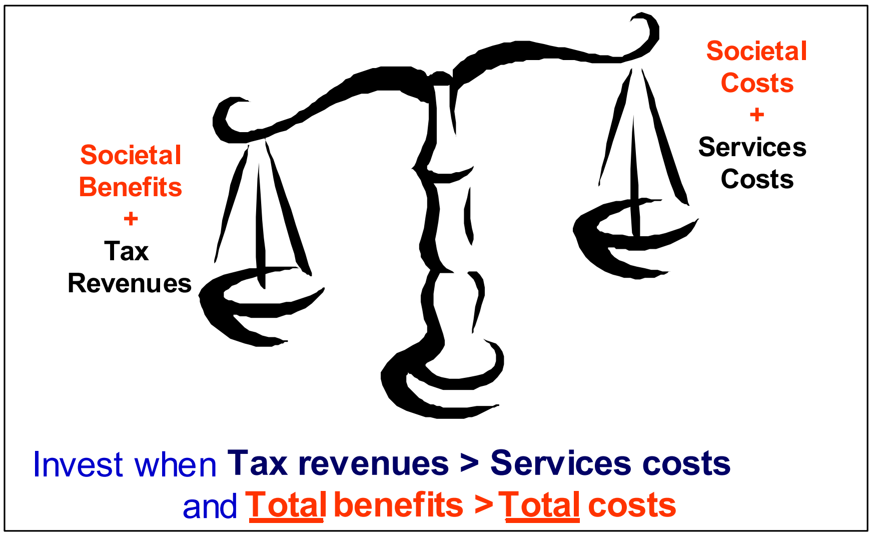

Figure 3. Sustainable Government Decision Model

Earlier design work and preliminary testing of indicators for energy and materials intensity by twenty companies took place under the auspices of the National Roundtable on the Environment and the Economy (Ref. 7) and the Center for Waste Reduction Technologies (Ref. 9, 10). That work yielded a good starting point for indicators and metrics of industrial performance. The major themes of those indicators efforts were energy and material use and pollutant dispersion. Metrics for energy efficiency - energy consumed per unit of output – were found to be readily and widely implementable and meaningful for individual large companies. Metrics for material intensity - materials consumed per unit of output – have also been found to be feasible, but are more applicable and relevant in some industry sectors than others. However, land use metrics were not developed.

Land Use Metrics

Now, three metrics have been calculated for land use: 1) land required to generate one dollar of annual sales, 2) full-time equivalent jobs generated per acre and 3) pollutants emitted per acre. Over 12,000 cases were examined. Examples of the data for two land use metrics for job creation and revenue generation are shown below. The values were calculated from the USDOE Industrial Assessment Center database. While that database was not intended originally for this purpose, the wealth of data and its classification by SIC gives a well-spring of information. In the example shown below for SIC Code 3524, more a dozen sites were characterized. Land area per annual sales dollar and jobs created per unit land area are shown. These are two “benefit metrics” in contrast to the typical “cost metrics”, e.g., material use, energy use, water use and pollutants emitted.

$ Sales	FTE Jobs	Land Area	Products
$5.0 M	38	40 k sq. ft	Lawn Vacuum
19.8 M	65	52 k	Wire
2.0 M	150	63 k	Mowers, ditchers
60.0 M	120	78 k	Garden Equipment
30.0 M	260	100 k	Drive components
88.0 M	289	128 k	Lawn Mowers
200.0 M	360	160 k	Lawn Mowers
220.0 M	800	180 k	Lawn Mowers
75.0 M	415	210 k	Lawn & Garden Equip.
200.0 M	137	240 k	Garden Care Equip.
630.0 M	700	250 k	Weed Eaters & Blowers
340.0 M	697	375 k	Lawn Mowers
1750.0 M	750	1740 k	Lawn & Garden Equip.

$274 Average Annual Sales per sq. ft.
57 FTE Jobs per Acre

Table 1. Land Use for Lawn Equipment Production (SIC Class 3524)

If a governing entity or land-owner has a strong interest in area job growth, data from the Industrial Assessment Database can be used to evaluate businesses in various SIC Codes based on the number of jobs likely to be created if a given type of manufacturing facility is developed and located on the property.

Values for more than 100 SIC Codes have been calculated for this study. Decision rules for the study are, in part, dictated by the database itself. Jobs are full-time equivalent positions, but do not include jobs created in the supporting infrastructure including suppliers and contractors. The purpose of the IAC database dictates that at a minimum the land area values include areas that require energy use, e.g., areas under roof or enclosed. Often values for parking, laydown and support infrastructure are also included.

Calculations for SIC Codes with less than five entries were not considered because of possible variability.

SIC Class	Products	Jobs	Annual Sales, $M
2893	**Ink Chemicals & Ink**	**62.8**	**29**
3011	**Rubber Goods**	**53.3**	**36**
3089	**Plastic Parts**	**58.9**	**32**
3354	**Aluminum Extrusions**	**54.6**	**10**
3398	**Heat Treating**	**42.6**	**5.1**
3498	**Pipe, Tubing**	**15.1**	**2.3**
3519	**Turbines**	**65.4**	**6.2**
3524	**Lawn Equipment**	**56.8**	**13**

Table 2. Job Creation and Sales Revenue per Acre

It appears from the sample above and a broader spectrum examined that some manufacturing industries provide a higher combination of employment benefits and tax revenues than others, e.g., ink, rubber goods and plastic parts versus pipe & tubing.

SIC	SALES	FTE	AREA	PRODUCTS	ft2/$	Jobs/ft2	PROD'N
2812	12000000	50	68000	Bleach, Chlorine			12000
2812	6000000	55	140000	Swim pool & hygiene			6000000
2813	3500000	6	10000	liquid CO2, dry ice			70000
2813	3500000	15	13400	Liquid CO2			60000
2813	3800000	3	40000	Industrial gases			95762
2816	16000000	31	27550	specialty metals/oxides			2400000
2816	10000000	32	50000	Polymer Colorants			3360000
2816	12000000	35	125937	Pigments			40000000
2816	6000000	60	150000	Textile dyes			14000000
2816	35000000	100	210000	Iron Oxide Pigments			38000000
2816	33900000	185	360000	Textile finishing products			29800000
2816	65000000	138	552000	Hydrated SiO2			120000000
2819	12000000	23	9375	Calcium Carbonate			600000
2819	3000000	9	10000	Powdered Metals			50000
2819	10000000	18	10000	Na, Mg, NH4 bisulfites			9000
2819	22000000	28	16700	Liquid Sodium Cyanide			60000000
2819	20000000	100	20000	Activated carbon			30000000
2819	75000000	15	30000	Sodium Silicate			36500
2819	13000000	50	40000	Bleach			3650000
2819	120000000	224	50000	Cr-based chemicals			200000000
2819	24000000	76	50740	Lithium Products			13000000
2819	25000000	30	55000	Oilfield chemicals			1680
2810	**24122727**	**58**	**92668**	**Metrics -- >**	**0.00384**	**0.00063**	**25506588**
	Average	**Average**	**Average**		**sqft/$**	**Jobs/sqft**	**Average**

Table 3. A sample (SIC Class 281) of 143 sites within US Chemical Industry

Based upon earlier work and the Industrial Assessment Center Database, calculations can be made to represent the impact of locating an average chemical plant on a given piece of land.

Total Emissions per dollar revenue	**0.0069 pounds**
Total Emissions per acre per year	**24,900 pounds**
Greenhouse Gas equivalents per dollar revenue	**2.52 pounds CO_2**
Greenhouse Gas equivalents per acre per year	**4558 tons**
Revenue per acre per year	**$3.6 M**
FTE jobs per acre	**8.7**

Table 4. Emissions metrics for the US Chemical Industry
(based on data for 53 product/process combinations – Ref. 1,4)

Calculations for other industries are not complete as of this writing.

Conclusions

- A simple set of metrics can be used to make decisions regarding impacts of various types of businesses which might be located on specific pieces of land.
- Useful metrics can be computed from publicly available data such as the Industrial Assessment Center Database.
- There is a wide variation in number of jobs created, revenue generated, emissions and tax base for industries and simple calculations can represent those factors.

Future Work

Future work will focus on 1) refining the emissions choices and computing those values for the SIC Codes, 2) calculating service costs, and 3) estimating value-added by various business types.

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