

Economy of Scale

Cost does not grow linearly with size. For instance, the *square-root rule* of inventory consolidation allows a company to estimate savings in inventory investment as a result of warehouse consolidation (Ronald H Ballou 1999). The *square-cube law* is a mathematical principle first described in 1638 by Galileo Galilei. Such Economic Order-Quantity (EOQ) Models have several applications. In the starch- and glucose industry the square-root rule is applicable.

The square-root rule, however, does not fit well to inventory growing in numbers and not in size as is the case with a steam reformer. Both catalyst quantity and catalyst tube numbers grow linearly with capacity and the reformer being the most expensive single item out-rides the square function in this case.

Due to the high cost of engineering several sizes an EOQ-model with just two qualified fix-points is figured out. With the well-engineered ESØ-factory as the one point and published data for the 230 times larger Louisiana factory as the second point a power equation is fitted.

With no neat geometric rationale it appears that big plants are markedly labor-saving too.

	ESØ	South Louisiana Methanol
Size factor	1	230
Capacity MTD – methanol t/day	21,7	4.931
Capacity – methanol MJ/day	434.000	98.620.000
Capacity – methanol MBTU/day	411	93.401
Capacity – methanol liters/year	10.000.000	2.272.350.230
Cost USD	25.800.000	1.300.000.000 ¹
Manpower, staffing	10	85
Salaries, USD per year	1.290.000	5.652.500 ²
Gas consumption, MBTU per day	840,7	180.000 ³
Gas consumption, kWh per day	246.575	52.793.500
Energy conversion, Efficiency %	49%	52%
Depreciation over 20 years DKK/l	0,71	0,16

The effect of size is illustrated by depreciation in DKK per liter using a power equation with the parameter of: $1,5 * \text{MTD}^{-0,265}$ and linear depreciation over twenty years. The fit is adapted to bring it in good accordance with a manual estimate once made for an Ukraine factory for 30 million l methanol per year. The fit is actually based on two qualified points and one manual estimate. After a look at well-known costs of our hydrogen plants offered for

¹ <http://www.lca.org/resources/news/south-louisiana-methanol-announces-1.3-billion-investment-in-st.-james-pari/>

² The average salary does not grow with number of employees because white colors does not increase significantly

³ <http://zeep.com/projects/south-louisiana-methanol/>



sorbitol manufacturing - where the reformer is also the most costly part - the selected fit makes perfect sense.

