Power and distribution transformer markets

Market values vs. market volumes

Market values

How do you estimate the current and future transformer market in any country, regional or global market? The answer is both very simple and extremely complicated.

The first issue to establish is the definition of what products are within the scope of power and distribution transformers. To a large extent this is dictated by two drivers: firstly, what the industry needs, and secondly, what categories are available from the national and international statistics sources. The most well-known and commonly used are sources such as the UN Comtrade database, the Eurostat database and the US Bureau of Economic Analysis, but there are many other national and international sources too numerous to include here.

Table 1 shows the trade classification for the transformer business from the UN database, and Table 2 presents the production data from the Eurostat database for the same business area.

As can be seen from Tables 1 and 2, in this case there is a high degree of compatibility, but

Matching and comparing production and trade statistics from national and international published sources in order to calculate market values can be problematical for researchers with less experience

this is not universally the case with all available datasets and a degree of manipulation is necessary in order to complete a final usable dataset. It is also worth mentioning here that these statistical series are generally expressed in values in either US dollar ($), European Euro (€) or other national currencies.

Goulden Reports have adopted a definition for power and distribution transformers that includes all transformers (oil filled and dry) greater that 16 kVA and with no upper limit. Static converters, inductors and parts are all excluded and are covered in a separate analysis.

Table 1. UN trade classifications

Classification 8504	Description Electrical transformers, static converters (for example, rectifiers)
850410	Ballasts for discharge lamps or tubes
850421	Liquid dielectric transformers - Having a power handling capacity not exceeding 650 kVA
850422	Liquid dielectric transformers - Having a power handling capacity exceeding 650 kVA <10,000 kVA
850423	Liquid dielectric transformers - Having a power handling capacity exceeding 10,000 kVA
850431	Other transformers - Having a power handling capacity not exceeding 1 kVA
850432	Other transformers - Having a power handling capacity exceeding 1 kVA but not exceeding 16 kVA
850433	Other transformers - Having a power handling capacity exceeding 16 kVA but not exceeding 500 kVA
850434	Other transformers - Having a power handling capacity exceeding 500 kVA
850440	Static converters
850450	Other inductors
850490	Parts

Source: Data from UN Comtrade database

Table 2. Eurostat production classifications

Eurostat classification	Description
27114120	Liquid dielectric transformers having a power handling capacity <=650 kVA
27114150	Liquid dielectric transformers having a power handling capacity >650 kVA but <=10,000 kVA
27114180	Liquid dielectric transformers having a power handling capacity >10,000 kVA
27114220	Measuring transformers having a power handling capacity <=1 kVA (including for voltage measurement)
27114240	Other transformers, n.e.c., having a power handling capacity <=1 kVA
27114260	Other transformers, having a power handling capacity >1 kVA but <=16 kVA
27114330	Transformers, n.e.c., having a power handling capacity >16 kVA but <=500 kVA
27114380	Transformers, n.e.c., having a power handling capacity >500 kVA
27115013	Inductors for discharge lamps or tubes
27115015	Ballasts for discharge lamps or tubes (excluding inductors)
27115023	Polycrystalline semiconductors
27115030	Rectifiers (excluding of a kind used with telecommunication apparatus, automatic data-processing machines and units thereof)
27115033	Accumulator chargers
27115035	Rectifiers
27115040	Power supply units for telecommunication apparatus, automatic data-processing machines and units thereof
27115053	Inverters having a power handling capacity <=7.5 kVA
27115055	Inverters having a power handling capacity >7.5 kVA
27115070	Static converters (excluding polycrystalline semiconductors, converters specially designed for welding, without welding equipment, accumulator char...
27115080	Inductors (excluding induction coils, deflection coils for cathode-ray tubes, for discharge lamps and tubes)
27116100	Parts suitable for machines of HS 8501 or 8502
27116203	Ferrite cores of transformers and inductors
27116205	Parts of transformers and inductors (excluding ferrite cores)
27116207	Parts of static converters

Source: Eurostat Prodcom

It is more useful and more accurate to calculate regional market values for transformers on a country-by-country basis than by using a top-down analysis approach

This effectively means 850421 to 850423, and 850433 and 850434 from Table 1; and 27114120 to 180, and 27114330 and 27114380 from Table 2 - all other classifications can be said to be "out of scope". However, there will be products smaller than 16 kVA that are included in headings 850421 and 27114120 that will have to be excluded from the total trade and production values.

The process involved in calculating the total global demand is done by the addition of the production and the import values and from this subtracting the export values, thus leaving the apparent demand or in other words the market; This equation holds true for transformers (and for that matter for any other product). In countries that produce no transformers the equation is even less complex; the market is simply the addition of the imports (less any re-exports). The only additional complication is to subtract from non-producing countries any products that are re-exported; and to extract from the production statistics of producing countries only data relating to transformer manufacture and not any other static or rotating machinery. This completes the first level of estimation.

Table 3 shows the global market value that has been calculated on that basis.

Because the data has been calculated at a country level and summarised into the regions shown in Table 3, it is straightforward enough to break out individual countries or to re-express the regions to suit any player's view of the global market segmentation. Whilst the macro level data shown in Table 3 is interesting and a very good acid test of the health of the transformer market in each geographical region, and also the trends over time; it is nevertheless not sufficiently detailed for many of the market players.

Most users need the data in a more granular form, segmented by size, by insulation material, possibly also by primary voltage level or design type, or indeed any combination of these.

The most logical method for a researcher to segment the data is to revert back the production and trade classifications shown in Tables 1 and 2 and disaggregate to those headings. The problem with this is that the segmentation is pretty much meaningless to the industry. Whilst it may be interesting to know the market in any country for liquid dielectric transformers up to 650 kVA, the market segment between 650 kVA and 10,000 kVA, the segment over 10,000 kVA and the segments for transformers without liquid dielectric less than 500 kVA and over 500 kVA, this is not how the manufacturers view the market.

There are three major segments used by most transformer manufacturers, which relate to the construction and production methodology as much as to market factors. These are: pole-top transformers, distribution transformers and power transformers. Clearly there are sub-divisions and refinements to these but the first, pole-top transformers, are almost commodity products that are produced in large numbers with a high degree of automation; the second, distribution transformers, are generally batch produced in lower numbers in

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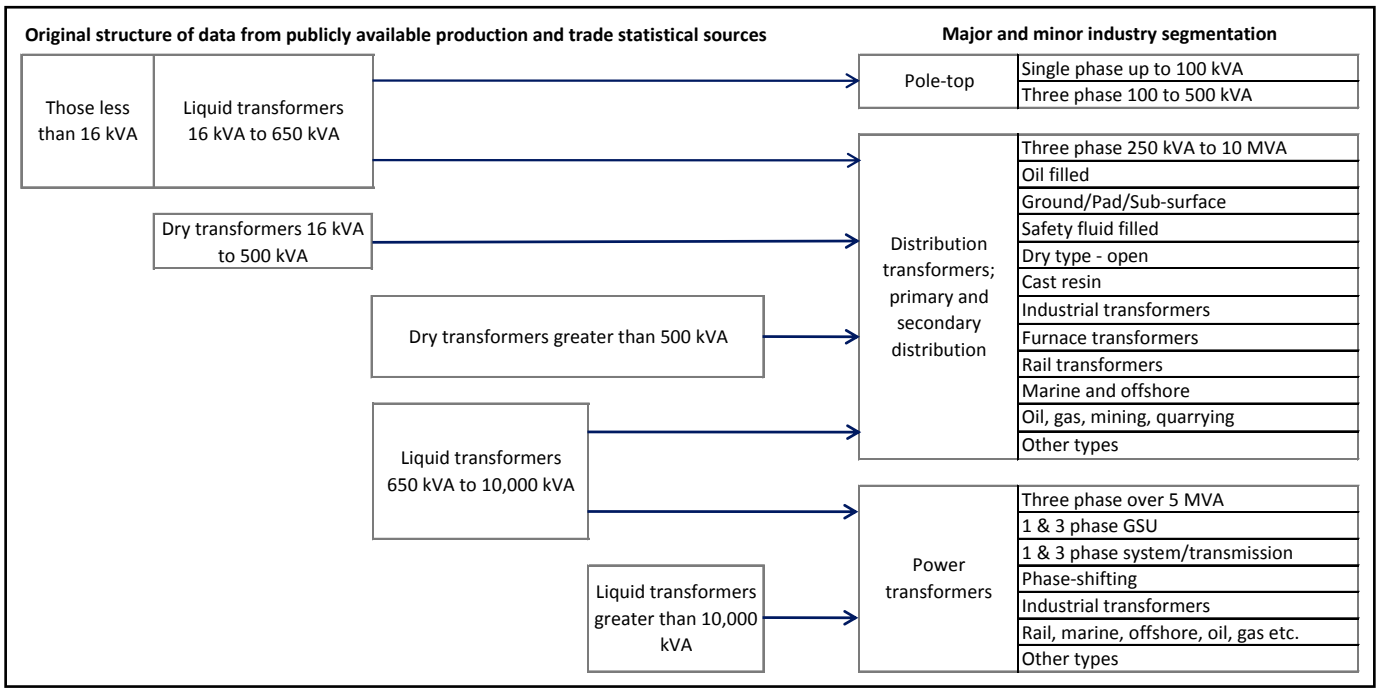
Table 3. Global market for transformers 2015 - by region $'000

Region	Production	Total Exports	Total Imports	Market
Western Europe	5,835,771	4,434,261	2,275,566	3,677,076
Eastern Europe	1,330,011	661,596	280,629	949,044
Former Soviet Union	1,856,324	543,729	911,752	2,224,347
Africa	1,182,049	61,193	1,173,396	2,294,252
Middle East	1,071,478	807,360	1,794,248	2,058,366
Indian Sub Continent	1,379,192	377,841	514,914	1,516,266
Asia	20,162,435	2,900,835	1,457,145	18,718,745
South & Central America	2,490,466	1,194,685	774,282	2,070,063
North America	4,114,150	856,639	2,459,611	5,717,121
Australasia	231,442	45,809	242,404	428,038
World	39,653,318	11,883,948	11,883,948	39,653,318

Source: Goulden Reports

less automated production lines; and the third, power transformers, are generally custom designed and built in a labour intensive manner with very little automation. For this reason, there are three distinct market segments, each having different business cycles, investment requirements, and in turn market information needs.

Chart 1. Data migration from published sources to actionable data



Market value data that can be derived from publicly available sources need to be translated and re-expressed into segments that are more user-friendly

The process of migrating data from what is available into what is of use to the industry is shown on the Chart 1.

The minor headings are not intended to be fully comprehensive but represent some types of segmentation that are commonly asked for.

The percentage of each publicly available source that is placed in each industry segment varies from country to country and from year to year, and additionally there is no hard-and-fast distinction between what constitutes part of the distribution market and what is part of the power market. A transformer that is viewed as a power transformer in a small country may well be viewed as a distribution transformer in a large country.

Market volumes

Many users have a requirement for transformer demand in volume terms in kVA or MVA. There are a number of ways to estimate the market volume for transformers - expressed in MVA.

- The first method is to survey all of the purchasers and sum their total purchases.
- The second method is to survey all of the suppliers and sum their sales.
- The third method is to convert from market values into market volumes using a $/MVA conversion factor.
- The fourth method is to calculate the demand based on modelling techniques.

Because of the impractical nature of the first two options, the most practical methodology is to use option 3 or 4; or a combination of both.

MVA demand modelling

If the installed capacity in a country has been increasing regularly at 4 % p.a. over the last 10 years, it is reasonable to assume that it may continue to increase at the rate of 4 % p.a. for the next 5 years; in which case the demand for generator step-up (GSU) transformers will be 4 % of the installed capacity each year, plus any generating capacity that is necessary to replace retired plant. This issue was touched upon in this column in the previous issue of Transformers Magazine and it does provide a firm benchmark from which to establish demand in any country. From this point, the demand for transmission transformers and distribution transformers can also be estimated. There is an industry rule of thumb which simply states that in any transmission and distribution network, for every MVA of generating capacity there will be a multiple of 1.1 times the MVA of GSU transformer capacity, 2.5 times the MVA of transmission or network transformer capacity and up to 5 times that for distribution transformer capacity.

There is some truth in this, but there is a large variation from country to country. A survey of a number of countries of differing size and state of development is presented in Table 4.

It is more accurate to state that the overall ratio is between 5 and 8, but the effects of network topography can be clearly seen. It is also evident that these figures relate to installed network not transformer orders. Overall, networks grow to fit this pattern, but at any point in time investment may be centred more on transmission than distribution or vice versa, and a further point that has been made before is that orders for distribution transformers can be phased back or forward for a few years with little or no detrimental effect on the network.

The conclusion must be that whilst it is possible to model the total MVA transformer demand in any country, the technique

An industry rule of thumb is that in any network, for every MVA of generating capacity there will be a certain multiple of the MVA of transformer capacity: a multiple of 1.1 times for GSU, 2.5 times for transmission and up to 5 times for distribution transformer capacity

Table 4. Installed transformer ratio to installed generator capacity in selected countries

MVA ratio to generator capacity	Cyprus	Kenya	Sri Lanka	Turkey	Mexico	South Korea	UK	France	Japan	India	Average ratio
GSU ratio	1.09	1.25	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
System/transmission ratio	3.10	2.15	2.70	1.98	3.07	2.62	2.10	1.82	2.84	3.80	2.77
Distribution ratio	2.68	4.65	1.65	2.30	1.27	2.22	4.20	4.20	1.15	1.69	2.17
Overall ratio	6.87	8.05	5.46	5.38	5.44	5.94	7.40	7.12	5.09	6.59	6.05

Source: Goulden Reports Estimates

described above will not provide results that are robust enough for analysis for any individual year, primarily because the purchasing vagaries of customers will not conform to a fixed pattern model. This technique will provide a good benchmark from which to track theoretical demand against what actually happens on the ground.

Installed capacity-based MVA modelling techniques are useful in tracking market trends and directions, but are not sensitive enough to map year-on-year demand

The final technique to convert from value to volume is to use $/MVA conversion factors. This will provide usable results with two major caveats. The sales price in $ per MVA will vary with:

- market conditions, and
- component commodity costs

Other than these two factors, the major driver that effects the $ to MVA ratio is the size of the transformer in MVA.

Table 5. Average size of transformers installed in selected countries

Average size of unit installed	Cyprus	Kenya	Sri Lanka	Turkey	Mexico	South Korea	UK	France	Japan	India	Average ratio
GSU - MVA	61.1	46.7	28.8	128.2	82.3	115.9	127.4	283.4	57.5	69.4	81.0
System - MVA	22.7	20.1	38.5	80.6	73	78.3	146.6	182.2	118.6	16.4	41.2
Overall power - MVA	**27.1**	**25.4**	**35.1**	**92.9**	**75.3**	**86.6**	**139.4**	**210.6**	**91.4**	**19.8**	**47.9**
Ground distribution - kVA	535.5	390.2	527.3	693.6	466	1,075.70	631.7	916.4	1,028.60	127	460.3
Pole-mounted - kVA	90.4	92	89	117	66.7	63.2	237.1	344	167.7	29.9	70.3
Overall distribution - kVA	**241.5**	**234.2**	**237.7**	**312.7**	**158.3**	**80.5**	**419.6**	**649.3**	**180.6**	**76.2**	**182.8**
Overall - kVA	611.2	402.7	772.6	727.7	674.1	214.8	737.5	1,097.80	792.9	293.8	504.9

Source: Goulden Reports Collated

Table 6. The world market for transformers, by region, by function type 2015 (MVA)

Region	Generation transformers	Transmission transformers	Distribution transformers	Total
Western Europe	34,390	43,552	110,849	188,790
Eastern Europe	9,085	8,660	22,661	40,406
Former Soviet Union	30,250	29,799	33,847	93,896
Africa	27,682	52,420	40,210	93,310
Middle East	34,617	30,047	30,587	95,251
Indian Sub Continent	14,053	16,070	28,373	58,496
Asia	167,332	273,060	342,757	783,149
South & Central America	29,351	25,126	34,683	89,161
North America	55,773	114,160	117,654	287,587
Oceania	4,806	5,384	11,701	21,891
World	407,338	571,277	773,322	1,751,937

Source: Goulden Reports

The global market for transformers in 2015 is estimated at about 1,750 GVA

Generally, the larger the transformer, the lower the price per MVA. During the period 2003 to 2008, raw material prices, particularly oil, steel and copper, all increased dramatically and so did transformer sales prices, peaking at north of $45.00 per kVA for some small transformers in some parts of the world. By 2015 rates had fallen back from this due to lower demand and lower raw material prices. However, for example, if a particular country distribution transformer market was known to be worth $100 million in 2015, this could equate to a low of 2,800 MVA and a high of 4,000 MVA depending on how large or small the average transformer was in that market. Similarly, power transformers may vary between $15 and $30 per kVA depending on design and market conditions.

This demonstrates how critical it is to establish as accurately as possible the average size of transformer, particularly in the distribution market segment where there is such a large spread of cost per kVA.

The data in Table 5 shows the average size per unit of different sizes of transformers in some selected countries. This data has been collected over time and does not relate to any one specific year. Also, in some countries there is a degree of estimation; however, this data serves as a good illustration. The average size of GSU units at first appears surprisingly low, given that some of these countries have 300 MW base-load generators within their network and indeed the most up-to-date figures may be even lower due to the increase in the number of relatively small-sized wind, solar and other renewable units recently commissioned throughout the world.

Using this technique of modelling to establish the overall anticipated size of the global market for transformers in MVA and by analysis of the necessary conversion factors from value to volume, the global market for transformers in MVA by region in 2015 is shown in Table 6.

Conclusion

There will always be a difference between the statistics collected for the purposes of national and international planning and the type of data needed by companies and engineers for the purpose of production and commercial planning, but it is possible with some insightful analyses to convert one set of statistics into usable market data. The process will always involve a degree of estimation and inevitably include making some assumptions, but by breaking the problem down into the smallest possible elements and then aggregating the results from these detailed estimates, usable data can be assembled.

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Steve Aubertin is the Managing Director of Goulden Reports and following a first career in electrical engineering has spent the last 30 years researching and reporting on the global market for electrical products in both published and in the form of tailored research for specific clients.