REVIEW OF SOUTH AFRICA'S APPLIANCE ENERGY CLASSES AND IDENTIFICATION OF THE NEXT SET OF ELECTRICAL EQUIPMENT FOR INCLUSION IN THE NATIONAL STANDARDS AND LABELLING PROJECT: NEW ELECTRICAL APPLIANCES

Distribution Transformers Industry Stakeholder Workshop

4 April 2019

Energy Efficient Strategies

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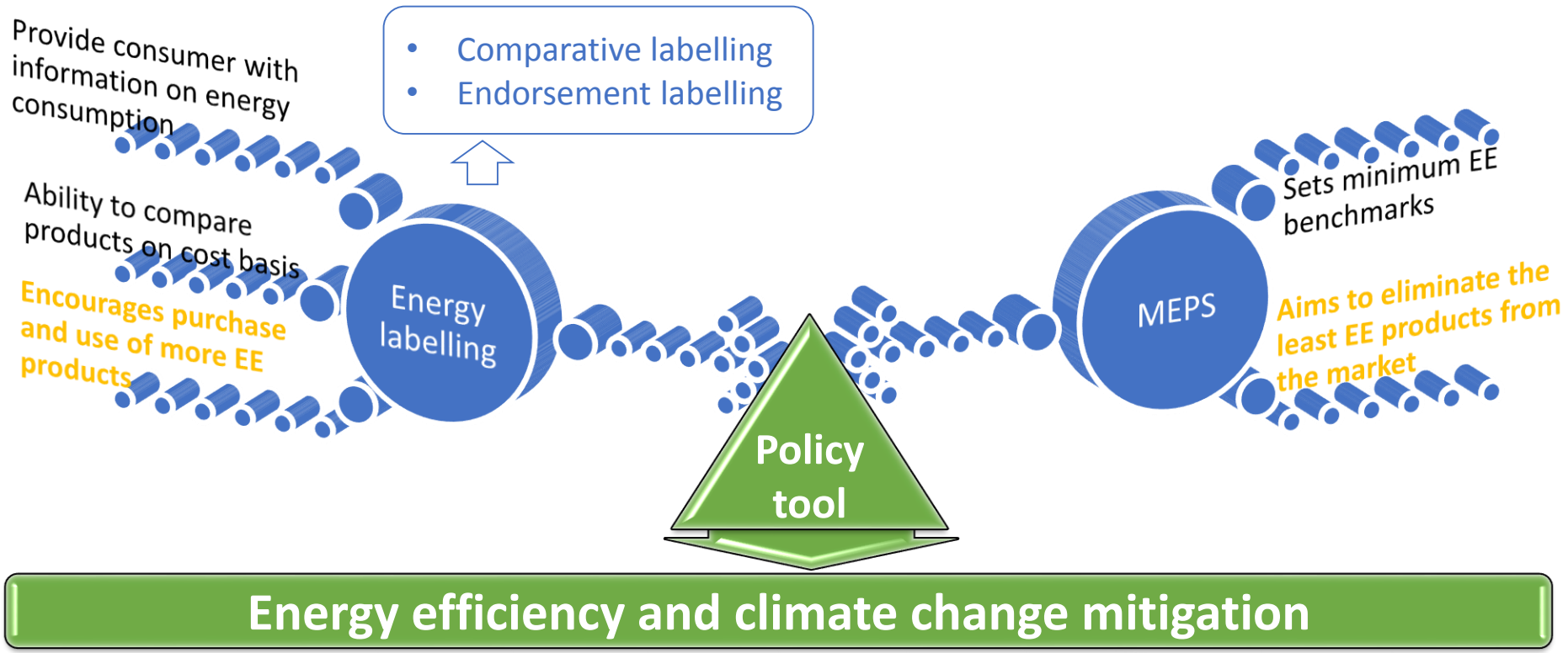
Agenda

1. Policy tools considered
2. Scope of work and boundaries
3. Screening process
4. Methodology
5. International MEPS trends
6. SA analysis
7. Recommendations
8. Open discussion

1. Policy tools considered

Energy labelling and MEPS



Policy options to improve energy efficiency

- Two main policy options considered are energy labelling and Minimum Energy Performance Standards (MEPS)
- These are typically enacted through government legislation and regulations
- When is labelling most effective?
  - When consumers purchase products and pay the energy bills
  - When products are on display at purchase and can be compared
  - Where there is a wide range of energy efficiency on the market
- Labelling creates *market pull* to encourage suppliers to offer more efficient products to the market

Policy options to improve energy efficiency

- When is MEPS most effective?
  - When product purchasers do not pay energy bills (can be different parts of a company, landlord and tenant)
  - When products are not on display for sale (purchased on specifications or from catalogues)
  - When there is a significant range of efficiency available (internationally) but this is not always present on the local market
- MEPS is a *market push* to ensure that all products offered for sale meet a minimum efficiency level

2. Scope of work and boundaries

Study objectives (as per TOR)

1. To identify a new set of electrical equipment (residential or commercial) to which compulsory minimum energy efficiency MEPS and/or labelling could be introduced
2. To recommend timelines for implementation of improved and new minimum energy performance levels for the next set of electrical equipment
3. To conduct an impact assessment analysis of the proposed mandatory requirements for each appliance on consumers, retailers, South African manufacturers, and importers
4. To quantify the potential energy and greenhouse gas emission savings that could be achieved through new MEPS and/or labelling over a 10 and 30-year period

Project Scope (UNDP and DOE)

1. **Purpose:**
   - Identify new electrical appliances that could be considered for a Standards & Labelling Programme
2. **Key considerations:**
   - 4-10 products (residential and commercial)
   - Must include distribution transformers
   - Main goal – reduce electricity usage and GHG emissions
3. **Approach:**

3. Screening

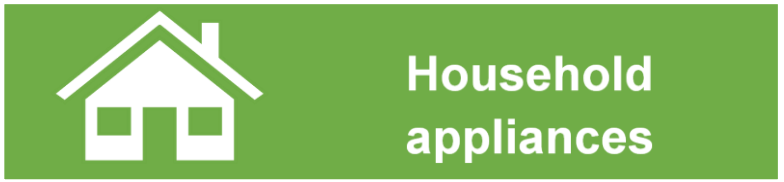
Screening process

All lights, appliances	• **List all lights and appliances products** • MEPS and labelling in 75 countries	**96**
0. Scope	• **Boundaries - Remove products out of scope** • Products covered by MEPS in SA already • Remove any non-electric products	**72**
1. MEPS elsewhere	• **Globally regulated products** • At least two countries/economic blocks • EU MEPS/Ecodesign counted as one	**24**
2. Energy Savings	• **Likely future energy savings from new MEPS** • Efficiency range, sales, usage levels and power • Relative significant future potential energy savings	**9**
3. Ease of adoption	• **Check for adoption, implementation and operation issues** • Relevant test procedures in place, ideally SAN (or IEC, ISO) • MVE issues, especially any verification issues	
4. Other barriers	• **SA appropriate - technical or other barriers** • Technologies, increased purchase costs, rate of market change, local manufacturing impacts	

Shortlisted electric equipment

Heating and cooling equipment

Chiller systems



Household appliances

None

Office equipment and electronics

Computers
Televisions
External Power Supplies

Other equipment (mostly commercial and industrial)

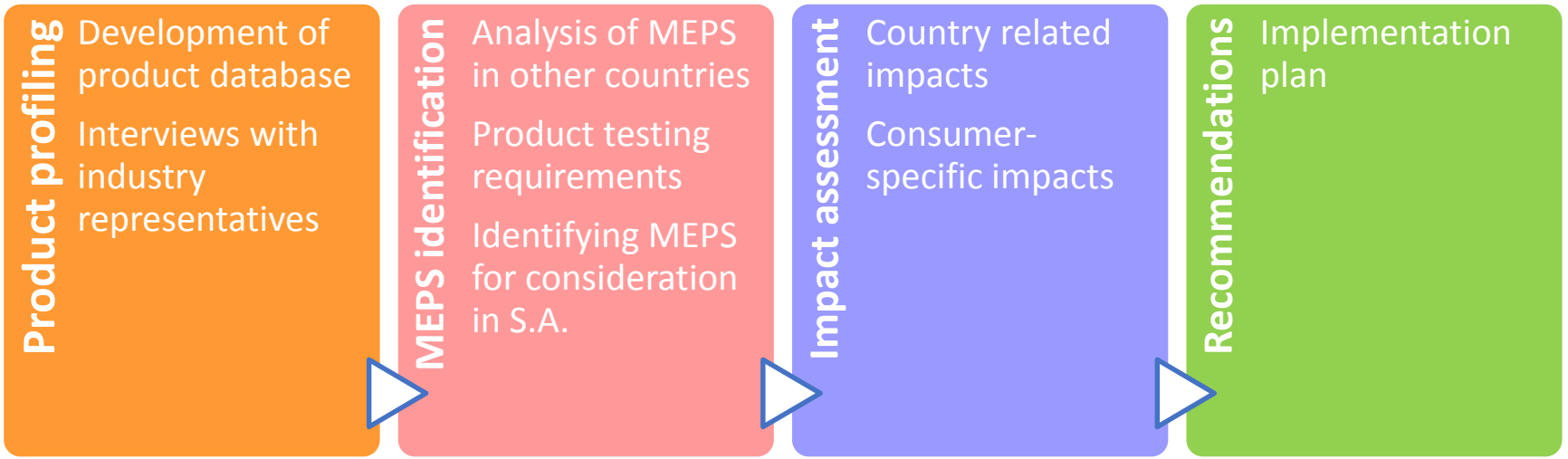
Motors - 3 Phase
Pool Pumps
Refrigerators – Commercial
Distribution Transformers

Note: Large ACs (>7.1kW) to be covered in a separate study

4. Methodology

Methodology

1. Data sources:
   - In-house developed database of electric appliances (web crawling, brochures, etc.)
   - Interviews with the industry representatives
2. Approach:



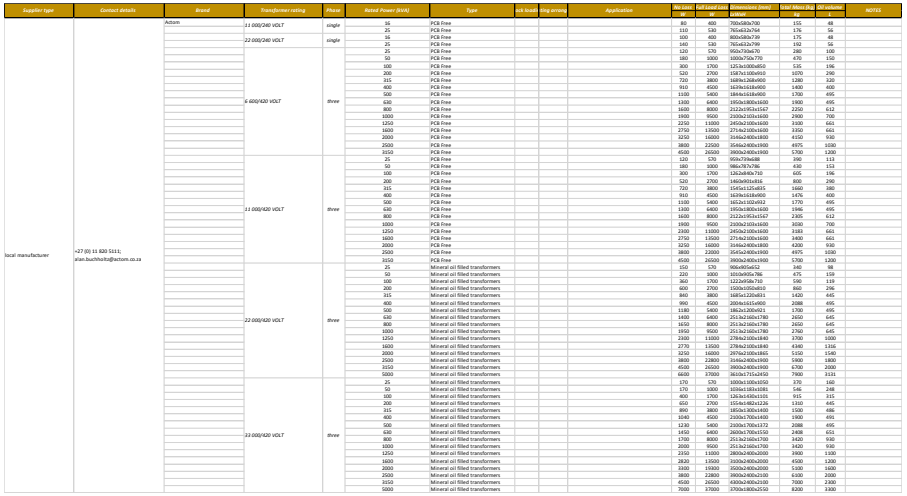
Data sources

- Who owns whom (WOW) 2017 Report
- International MEPS programs covered
- Stakeholder engagement
- Information from Eskom

- Field data collection

In-house product database:

- 17 Suppliers
- 178 DT models
  - Supplier type
  - Type, rating, phase, rated power
  - Dimensions, mass
  - Oil volume
  - No loss, full load loss



Supplier type	Contact details	Brand	Transformer rating	Phase	Rated Power (kVA)	Type	tick boxes	long series	Application	No load loss (W)	Full Load Loss (W)	Dimensions (mm) (H x W x D)	Total Mass (kg)	Oil volume (L)	NOTES
		Adcom	11 000/240 VOLT	single	16	PCB Free				80	480	700x580x700	155	48	
					25	PCB Free				110	530	765x612x764	176	56	
			22 000/240 VOLT	single	16	PCB Free				100	400	800x580x739	175	48	
					25	PCB Free				140	530	765x612x799	192	56	
					25	PCB Free				120	570	950x703x670	280	100	
					50	PCB Free				180	1000	1000x750x770	470	150	
				three	100	PCB Free				300	1700	1253x1000x650	535	196	
					200	PCB Free				520	2700	1587x1100x910	1070	290	
					315	PCB Free				720	3800	1689x1268x900	1280	320	
			6 600/420 VOLT		400	PCB Free				910	4500	1639x1618x900	1400	400	
					500	PCB Free				1100	5400	1844x1618x900	1700	495	
					630	PCB Free				1300	6400	1950x1800x1600	1900	695	
					800	PCB Free				1600	8000	2123x1953x1567	2250	612	
					1000	PCB Free				1900	9500	2309x2103x1600	2990	700	
					1250	PCB Free				2250	11000	2456x2103x1600	3100	661	
					1600	PCB Free				2750	13500	2714x2103x1600	3350	661	
					2000	PCB Free				3250	16000	3146x2400x1800	4150	930	
					2500	PCB Free				3800	22500	3546x2400x1900	4975	1030	
					3150	PCB Free				4500	26500	3903x2400x1900	5700	1200	
					25	PCB Free				120	570	959x739x688	390	113	
					50	PCB Free				180	1000	986x787x796	430	153	
					100	PCB Free				300	1700	1262x840x710	605	196	
					200	PCB Free				520	2700	1460x901x816	800	290	
					315	PCB Free				720	3800	1545x1125x851	1060	380	
					400	PCB Free				910	4500	1639x1618x900	1476	430	
					500	PCB Free				1100	5400	1852x1102x912	1770	495	
			11 000/420 VOLT	three	630	PCB Free				1300	6400	1950x1800x1600	1946	695	
					800	PCB Free				1600	8000	2123x1953x1567	2306	612	
					1000	PCB Free				1900	9500	2309x2103x1600	3030	700	
					1250	PCB Free				2300	11000	2456x2103x1635	3183	661	
					1600	PCB Free				2750	13500	2714x2103x1600	3400	661	
					2000	PCB Free				3250	16000	3146x2400x1800	4200	930	
local manufacturer	+27 (0) 11 820 5111, arlan.buchholz@actom.co.za				2500	PCB Free				3800	23000	3545x2400x1900	4975	1030	
					3150	PCB Free				4500	26500	3903x2400x1900	5700	1200	
					25	Mineral oil filled transformers				150	570	906x905x652	340	98	
					50	Mineral oil filled transformers				220	1000	1010x905x786	475	119	
					100	Mineral oil filled transformers				360	1700	1222x958x710	590	119	
					200	Mineral oil filled transformers				600	2700	1503x1050x810	860	256	
					315	Mineral oil filled transformers				840	3800	1685x1220x831	1420	445	
					400	Mineral oil filled transformers				960	4500	2054x1615x900	2088	695	
					500	Mineral oil filled transformers				1180	5400	1862x1200x921	1700	695	
					630	Mineral oil filled transformers				1400	6400	2513x2160x1780	2650	645	
			22 000/420 VOLT	three	800	Mineral oil filled transformers				1650	8000	2513x2160x1780	2650	645	
					1000	Mineral oil filled transformers				1950	9500	2513x2160x1780	2760	645	
					1250	Mineral oil filled transformers				2300	11000	2784x2100x1840	2700	1000	
					1600	Mineral oil filled transformers				2770	13500	2784x2100x1845	4340	1316	
					2000	Mineral oil filled transformers				3250	16000	2974x2100x1865	5350	1540	
					2500	Mineral oil filled transformers				3800	23800	3546x2400x1900	5900	1800	
					3150	Mineral oil filled transformers				4500	26500	3903x2400x1900	6700	2000	
					5000	Mineral oil filled transformers				6600	37000	3610x2715x2450	7900	3131	
					25	Mineral oil filled transformers				170	570	1000x1100x1050	370	160	
					50	Mineral oil filled transformers				170	1000	1038x1183x1081	546	248	
					100	Mineral oil filled transformers				600	1700	1263x1430x1101	915	315	
					200	Mineral oil filled transformers				650	2700	1554x1462x1226	1310	445	
					315	Mineral oil filled transformers				890	3800	1850x1300x1400	1590	486	
					400	Mineral oil filled transformers				1040	4500	2100x1700x1400	1900	495	
					500	Mineral oil filled transformers				1230	5400	2100x1700x1372	2088	695	
					630	Mineral oil filled transformers				1450	6400	2600x1700x1550	2408	651	
					800	Mineral oil filled transformers				1700	8000	2513x2160x1700	3420	930	
					1000	Mineral oil filled transformers				2000	9500	2513x2160x1700	3420	930	
					1250	Mineral oil filled transformers				2350	11000	2800x2400x2000	3900	1100	
					1600	Mineral oil filled transformers				2820	13500	3100x2400x2000	4500	1200	
					2000	Mineral oil filled transformers				3350	19300	3600x2400x2000	5100	1600	
					2500	Mineral oil filled transformers				3800	22800	3900x2400x2100	6100	2000	
					3150	Mineral oil filled transformers				4500	26500	4300x2400x2100	7000	2300	
					5000	Mineral oil filled transformers				7000	37000	3700x1800x2550	8200	3300	

5. International MEPS trends

Product scope

3-phase distribution transformer

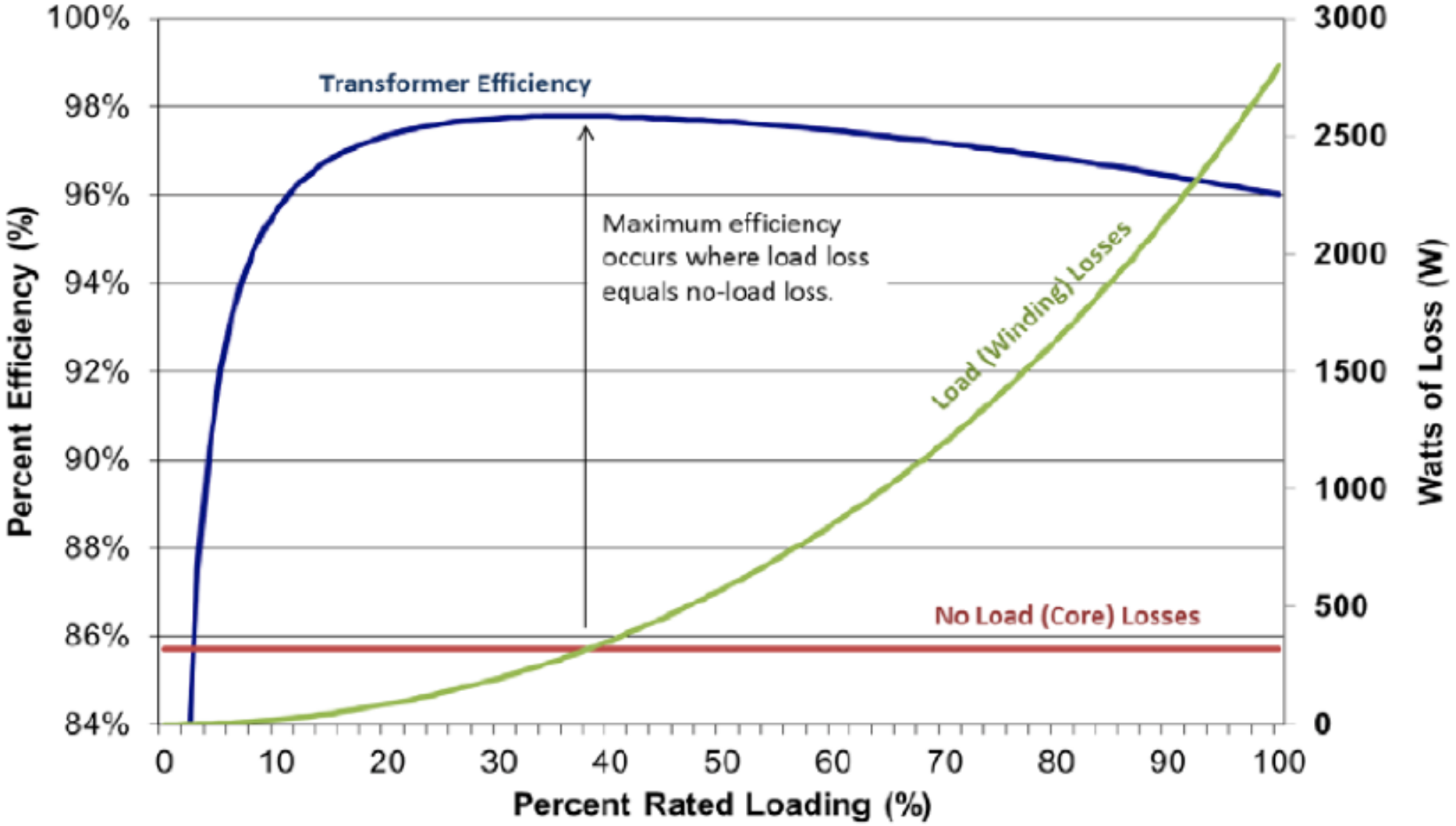
Single phase distribution transformer

Oil and dry type

Product Overview

- Huge numbers globally, very long lifetime (40+ years)
- Are integral to all electricity systems
- Focus on systems with high side voltage input of 6kV to 36kV
- Small differences in efficiency, large savings as in continuous operation, average efficiency already quite high ~98%
- Some differences in efficiency depending on type and phase

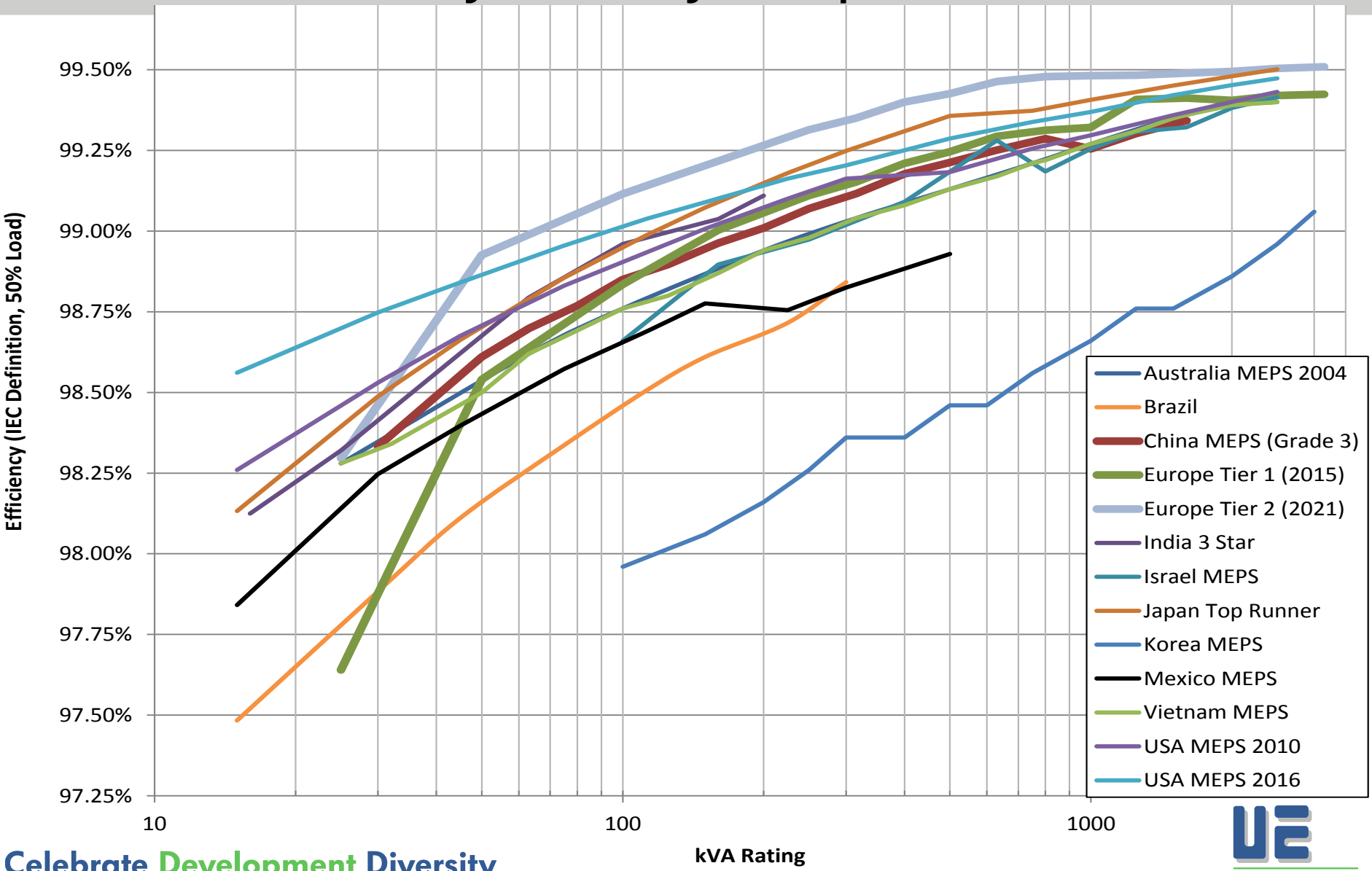
Typical losses vs loading for transformers



International Review of MEPS for transformers

- EU and 10 other countries have MEPS
- Different test methods, but most regions now use IEC60076
- US method is equivalent, but slightly different
- Several possible approaches to efficiency for MEPS:
  - Separately limit core losses plus coil losses at defined load OR
  - Separately limit no load losses and losses at rated capacity
  - Limit efficiency at 50% rated capacity (most common efficiency metric used, closest to typical operation)
  - Can also define a minimum value for peak efficiency (typically occurs at 30% to 40% loading)
- **Efficiency metrics are complex** due to influence of type, phase and frequency
- SEAD have done a lot of work defining global efficiency metrics and levels, so the hard work is done

MEPS levels by country – 3 phase oil filled

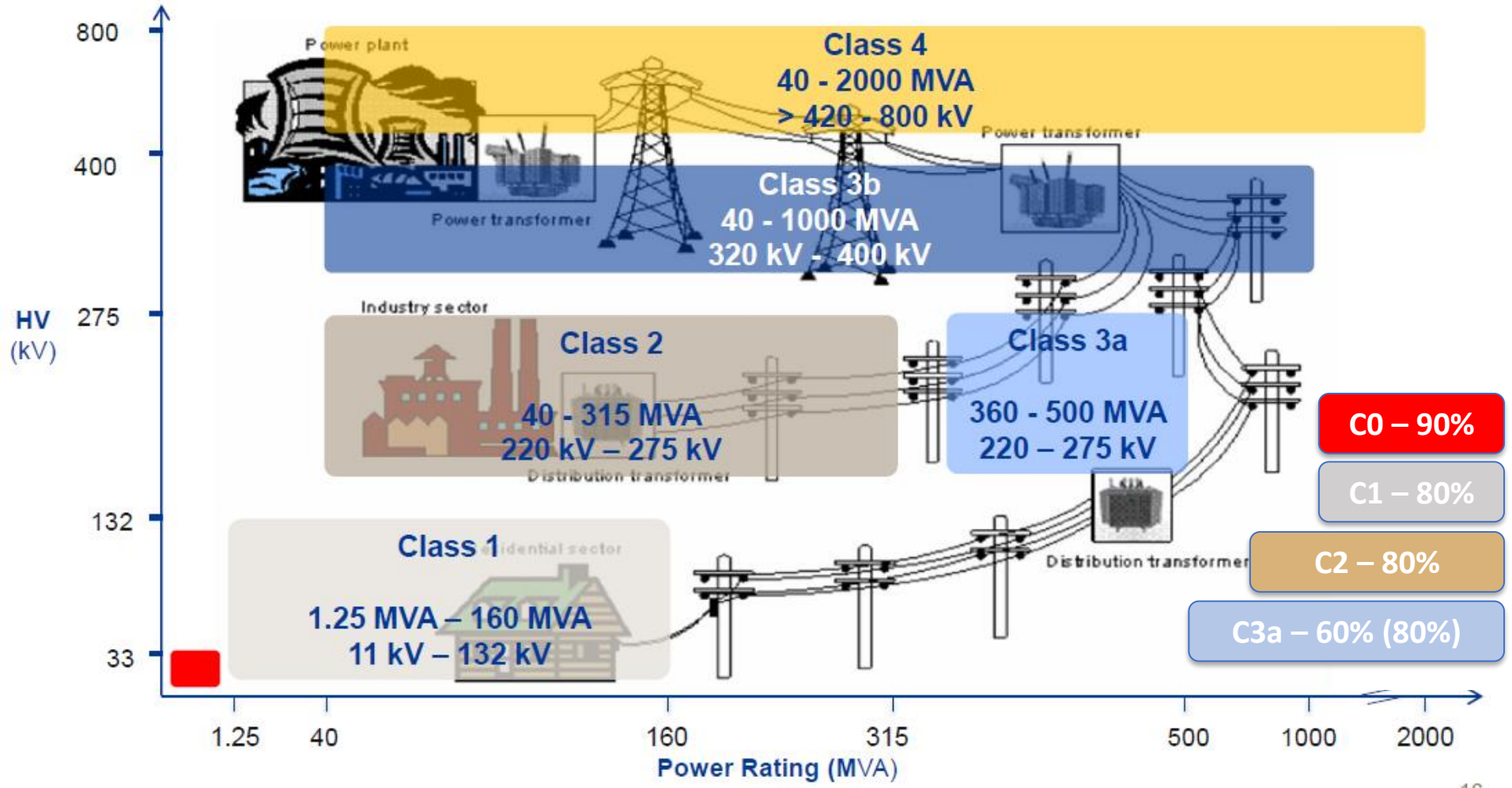


6. SA Analysis

Market Overview

- Transformer specifications found in SA:
  - Oil and dry types
  - Typical rated power range: 16 kVA to 5,000 kVA
  - Customised transformers also available (>5,000kVA)
  - Weight range: 150 kg to 29 t
  - Mounting: pole, pad and ground
- Local presence: Actom, WEG, Powertech, ABB, and Siemens
- It is a designated product and utilities are required to purchase locally produced products

DT transformers classes



Impact Analysis – Assumptions

- Annual transformer sales - 67,200 (ESKOM estimate)
- Share by type (based on database):
  - 80% oil type
  - 20% dry type
- Efficiency varies by size, voltage, type and phase so the most common sizes across for both single phase and three phase products were selected to model the energy impact
- Sales share per category - based on Eskom buying patterns
- A uniform loading profile was assumed for all products
- Efficiency tiers by type are derived from SEAD Distribution Transformer Report Part 3 (Super Efficient Appliance Deployment under the Clean Energy Ministerial of G20)

Impact Analysis – Assumptions

- Representative sizes and types selected to undertake impact analysis
- All product sales are allocated to one of these categories

Category	kVA	Sales share	Loading	Year hours	Efficiency at 50%			
					Tier 0	*Tier 1*	*Tier 2*	*Tier 3*
Single phase	16	18%	50%	8760	97.54%	97.92%	98.29%	98.54%
Single phase	32	16%	50%	8760	97.92%	98.24%	98.55%	98.76%
Single phase	64	4%	50%	8760	98.24%	98.51%	98.77%	98.95%
Three phase	25	13%	50%	8760	97.67%	98.00%	98.33%	98.57%
Three phase	50	19%	50%	8760	98.01%	98.29%	98.58%	98.78%
Three phase	100	22%	50%	8760	98.31%	98.55%	98.79%	98.96%
Three phase	200	7%	50%	8760	98.56%	98.76%	98.97%	99.11%
Three phase	315	1%	50%	8760	98.70%	98.88%	99.07%	99.20%
Three phase	500	1%	50%	8760	98.83%	99.00%	99.16%	99.28%

Impact Analysis – Energy Savings

$$Per\ annum\ energy = \left(\frac{Rated_{kVA} * Loading}{Efficiency}\right) * Year_{hours}$$

Type	Typical kWh/per year				MEPS Savings kWh/year	Annual sales	Savings GWh/year
	Tier 0	Tier 1	Tier 2	Tier 3			
	BAU	-	-	MEPS			
Single phase 16kVA	71 845	71 571	71 298	71 120	725	11 827	8.57
Single phase 32kVA	143 136	142 676	142 219	141 919	1 217	10 573	12.87
Single phase 64kVA	285 344	284 570	283 801	283 296	2 048	2 430	4.98
Three phase 25kVA	112 116	111 737	111 360	111 091	1 025	8 857	9.08
Three phase 50kVA	223 442	222 801	222 163	221 707	1 735	12 943	22.46
Three phase 100kVA	445 549	444 463	443 382	442 607	2 941	14 594	42.93
Three phase 200kVA	888 836	886 994	885 160	883 846	4 990	4 822	24.06
Three phase 315kVA	1 397 882	1 395 277	1 392 682	1 390 823	7 058	598	4.22
Three phase 500kVA	2 215 914	2 212 208	2 208 513	2 205 867	10 047	556	5.59
Total						**67 200**	**135**

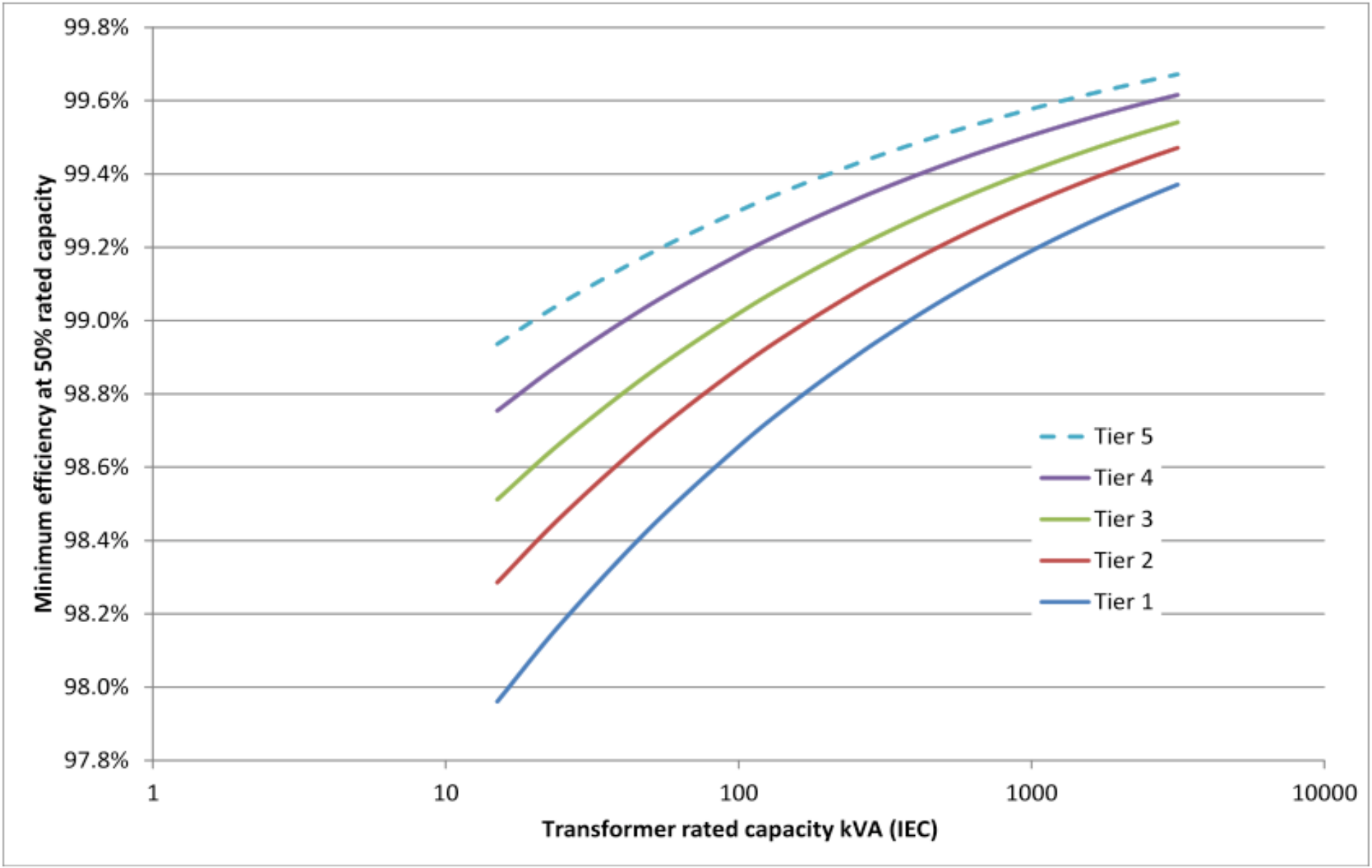
- Adopting Tier 3 MEPS for South Africa could yield estimated annual total energy savings of around 135 GWh from a base of Tier 0

7. Recommendations

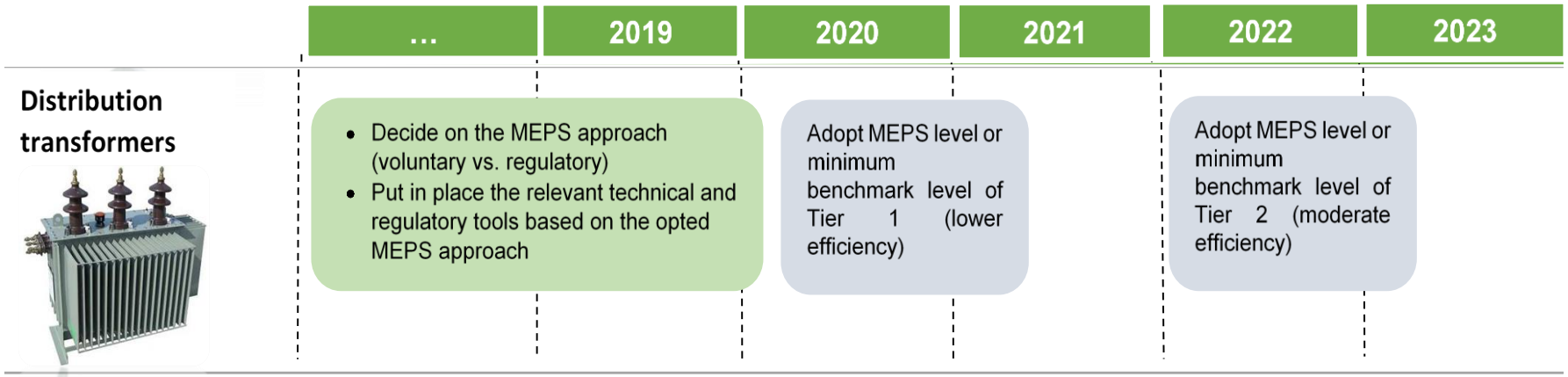
Recommendations for transformers

- Recommended scope for MEPS in South Africa
  - Input voltage from 11 kV to 33 kV (high side) – Class 0 and 1
  - Oil filled:
    - three phase from 25 kVA to 2500 kVA
    - single phase from 10 kVA to 200 kVA
  - Dry type:
    - three phase from 25 kVA to 2500 kVA
    - single phase from 10 kVA to 200 kVA

SEAD MEPS levels – 3 phase oil filled 50Hz

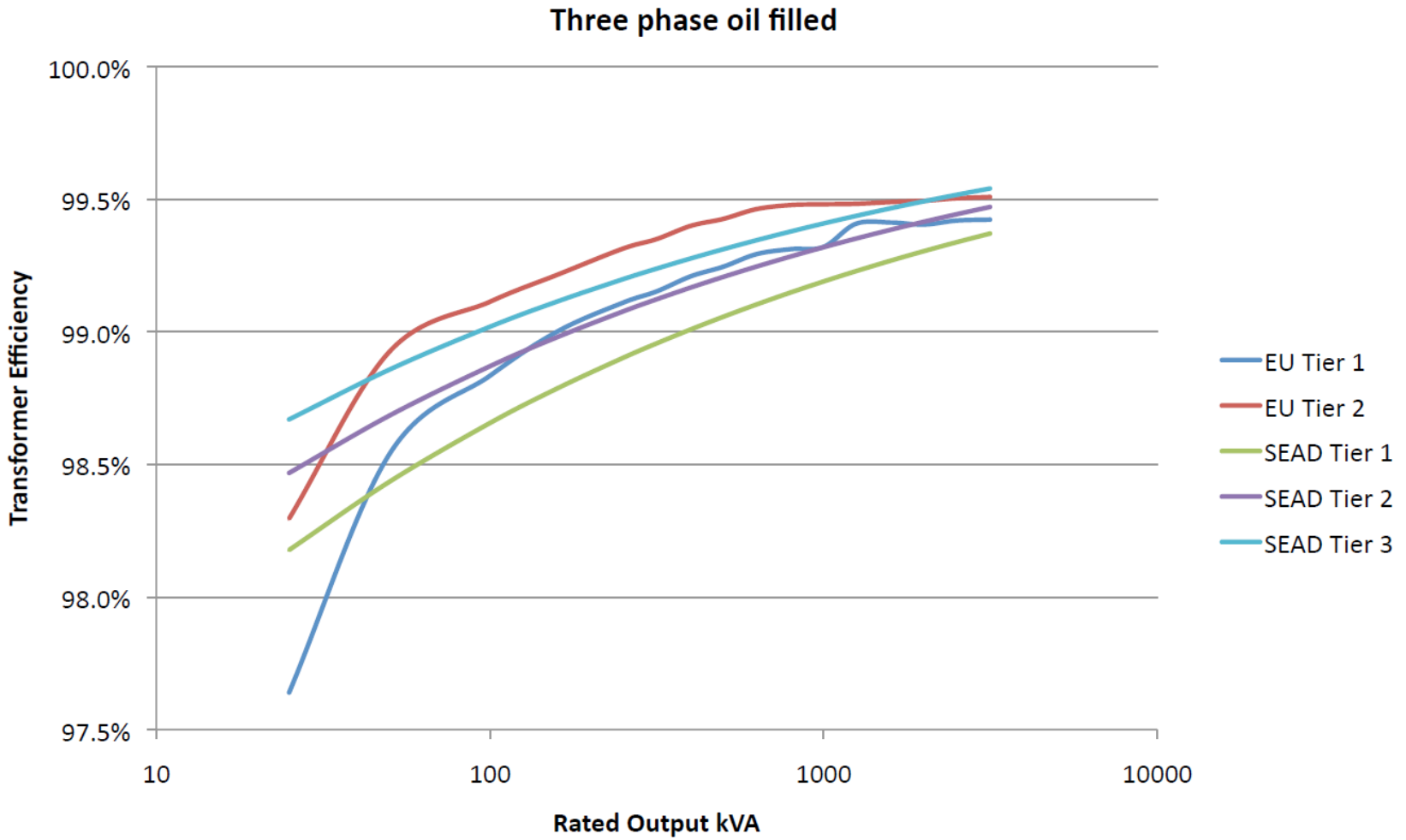


Recommendations for transformers

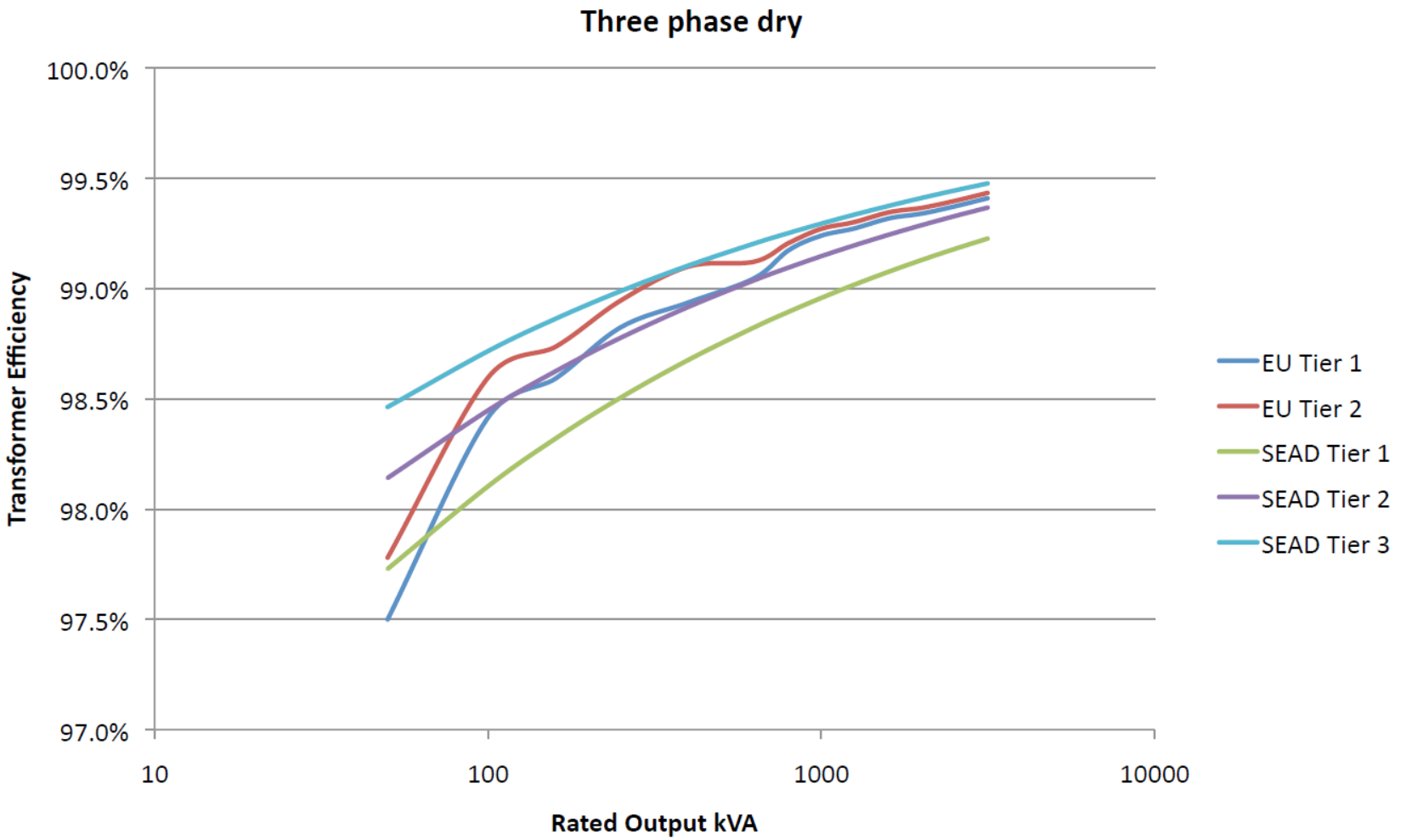


- Recommended MEPS levels for South Africa
  - SEAD Tier 1 by 2020 (lower efficiency)
  - SEAD Tier 2 by 2022 (moderate efficiency)
  - SEAD Tier 3 by 2030 (high efficiency)
- Will bring South Africa in line with best practice
- These are specified in IEC60076-20
- **Alternative** implementing strategy:
  - Include equivalent MEPS in SABS 780 (quick-win)
  - Make provision for dry type

Three phased oil filled - MEPS tiers



Three phased dry – MEPS tiers



8. Discussion

Thank you

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