



# **67th AMEU Convention**

## **SUSTAINABLE CUSTOMER CENTRIC ELECTRICITY UTILITIES IN THE 4TH AND 5TH INDUSTRIAL REVOLUTION**

**Digital Distribution Transformers – A Smart and Economical  
way to manage the LV network**

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# Agenda

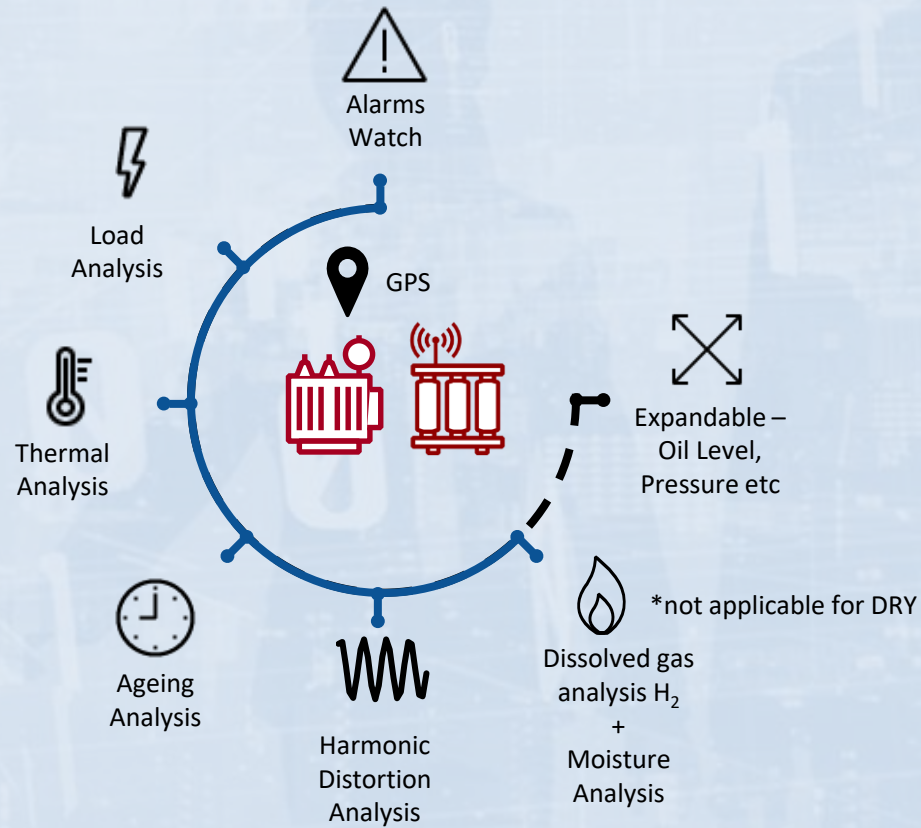
1. What is a digital distribution transformer?
  - Features and advantages
2. Why invest in digital distribution transformer?
  - From a purchasing policy perspective
3. Social cost of ownership of transformers
  - Differences between non-digital & digital transformers
  - Concept of Environmental Costs
4. Evaluating the social costs of 2 Digital Transformers with different losses



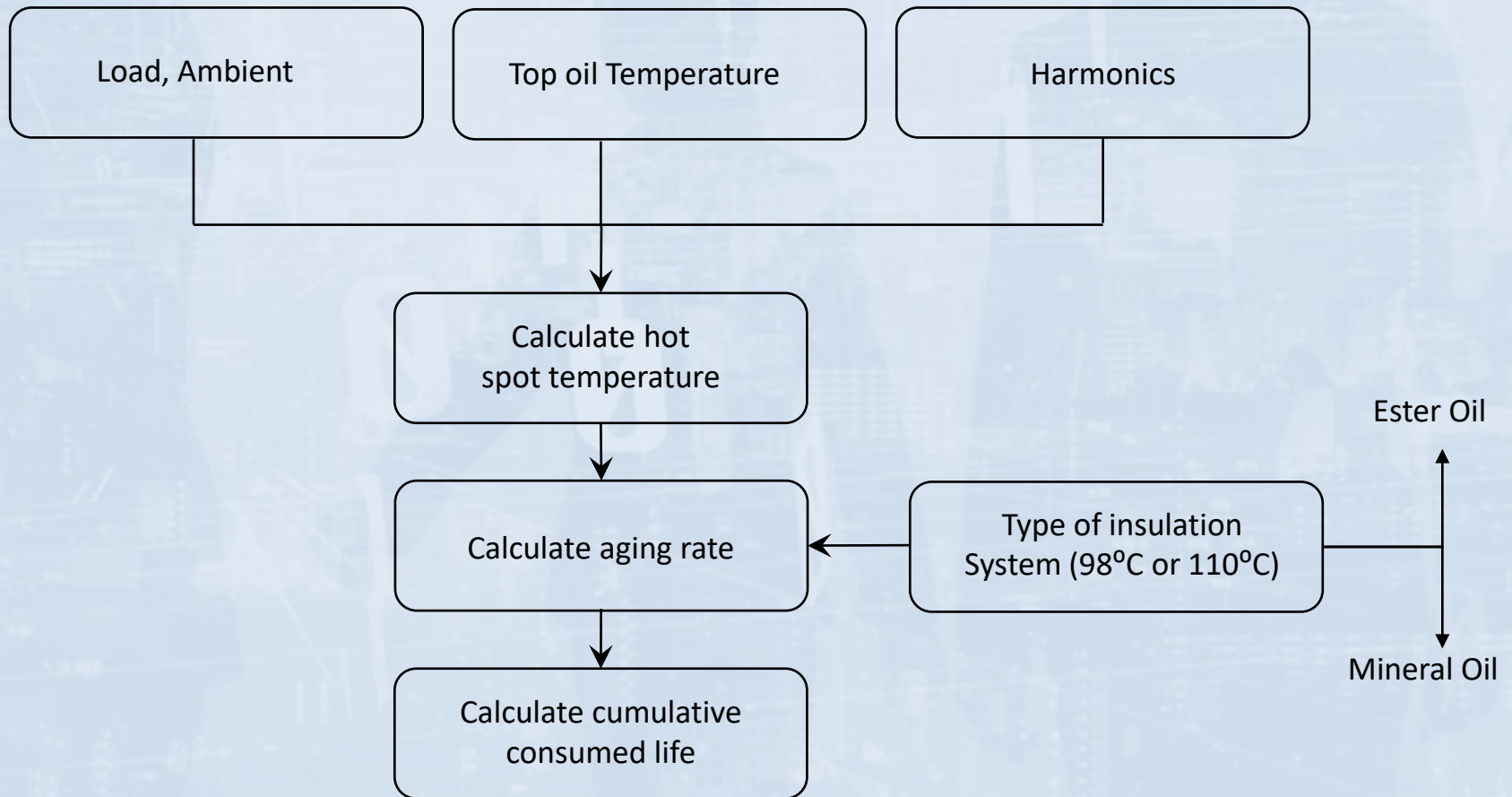
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# What is a Digital Distribution Transformer?



# Ageing Analysis in Digital Distribution Transformer?





## Social Cost of Ownership of Transformers

- The social cost of carbon (SCC) translates the future harm inflicted by the release of one additional ton of carbon dioxide into a present monetary value (e.g., \$50 per ton of carbon dioxide emissions).
- It answers the questions: How much damage will a ton of carbon dioxide emissions released today cause in the future?
- And how can those damages be weighed against the costs and benefits of actions taken today?
- Transformer specifiers and owners should assume these environmental costs as losses directly correspond to the additional energy that must be generated by the existing generation mix of the power system of that country.



## Loading Estimation

100 kVA (<12kV)	No- Load Loss (W)	Load Loss (W)
SANS 780 Specification	300	1700

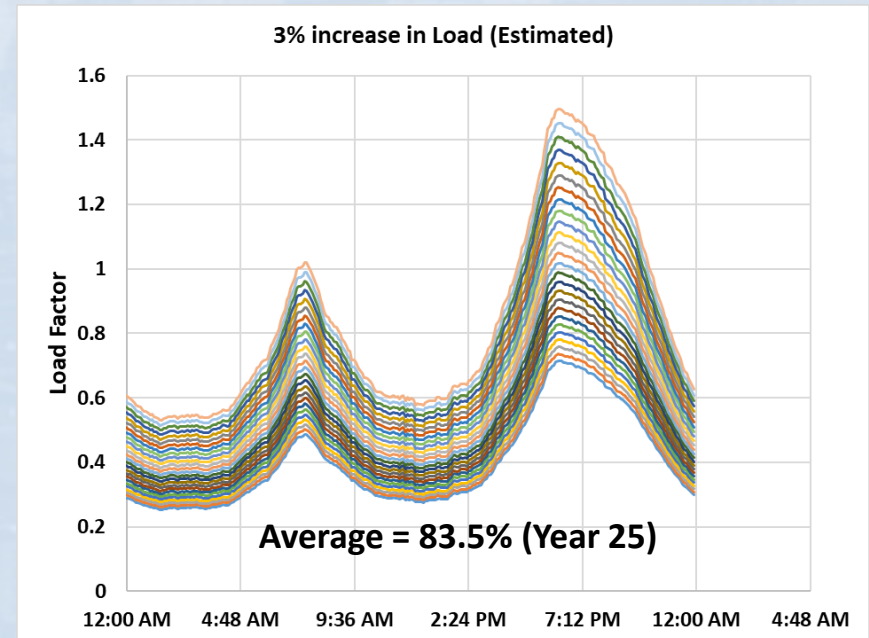
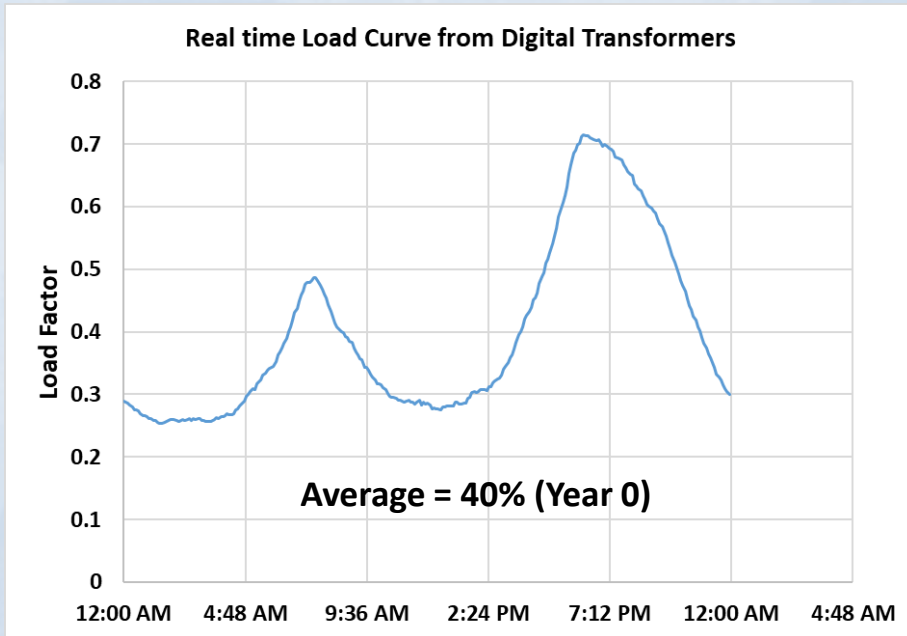
Total Capitalized Cost = Purchase cost +  $F_{NL} \times P_{NL} + F_L \times P_L$   
 Where  $F_{NL} = 31,200$  R/kW and  $F_L = 6700$  R/kW for 25 years

$$k = \sqrt{\frac{6700}{31,200}} = 46.34\%$$

## Evaluating Social Cost from Specification

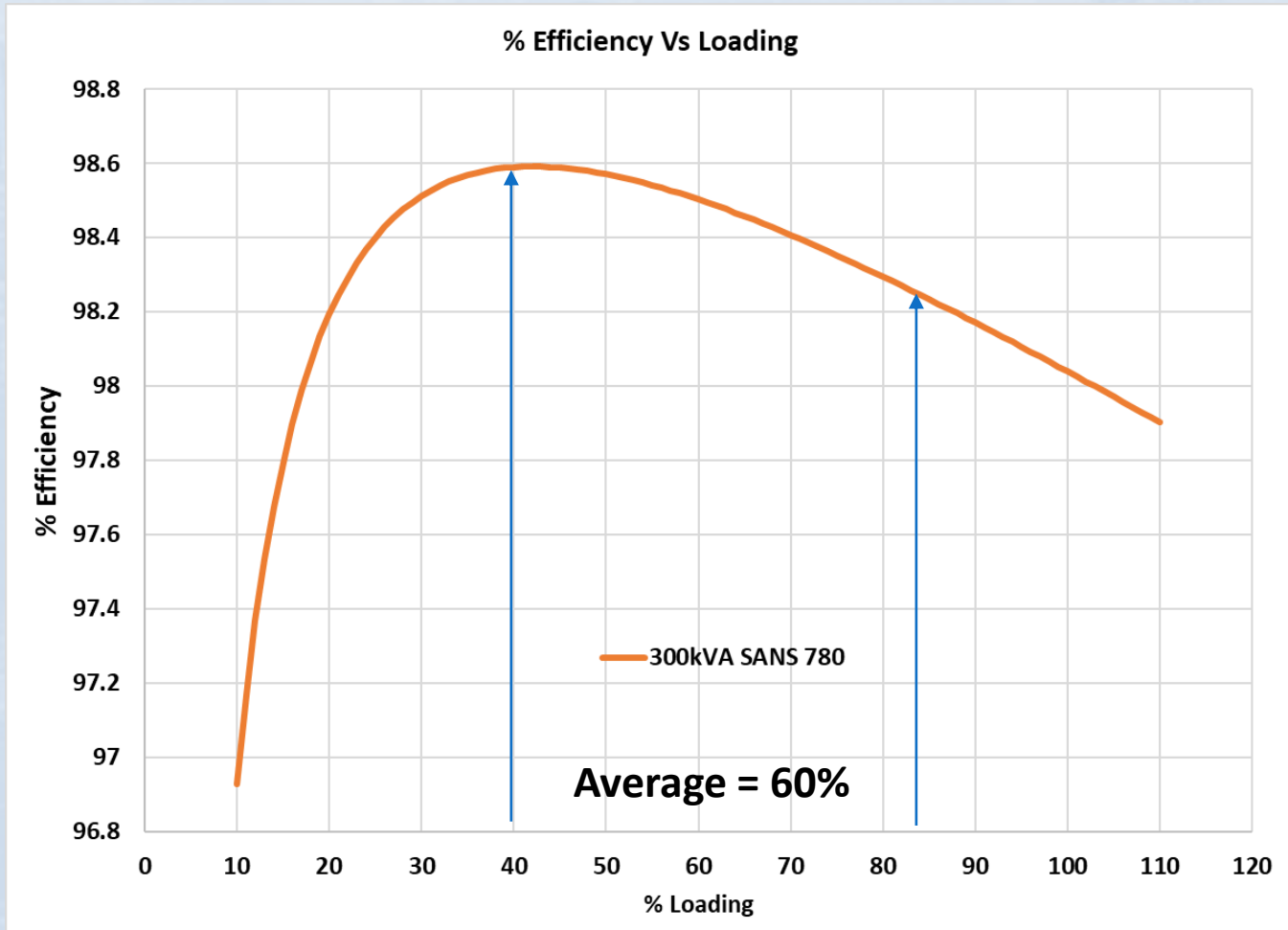
100 kVA	MWh	tCO2/MWh	tCO2	SCC	Env Cost
Total Loss in 25 years	145.64	0.97	141	USD 50/tCO <sub>2</sub>	US\$ 7,050

# Loading Analysis from Digital Transformers





# Loading Analysis from Digital Transformers



## Loading Analysis from Digital Transformers

100 kVA	With Estimated Data	With Real Time Data from Digital Transformers
MWh	145.64	228.25
tCO2/MWh	0.97	0.97
tCO2	141	221.404
SCC	USD 50/tCO <sub>2</sub>	USD 50/tCO <sub>2</sub>
Env Cost	US\$ 7,050	US\$ 11,070

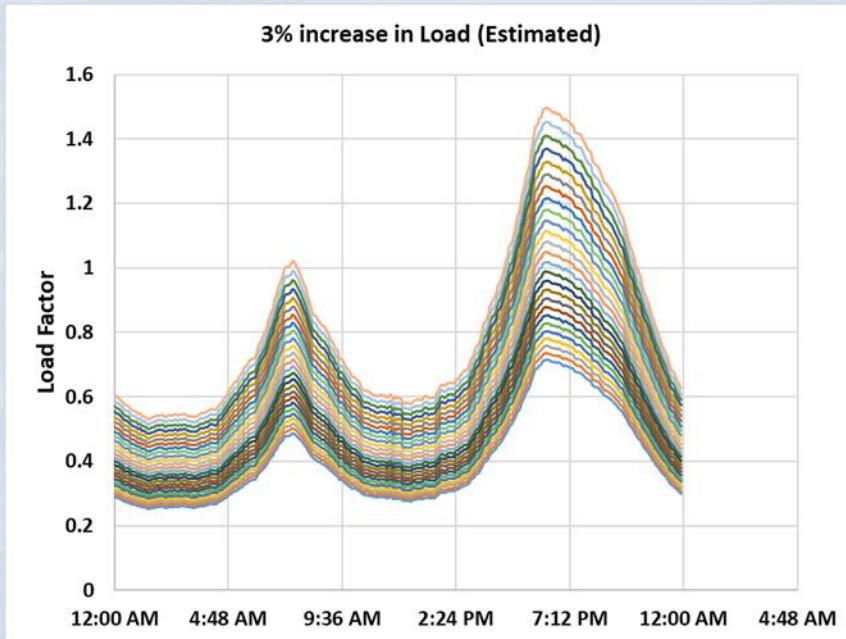
Total Capitalized Cost = Purchase cost +  $F_{NL} \times P_{NL}$  +  $F_L \times P_L$  + **Environmental Costs**



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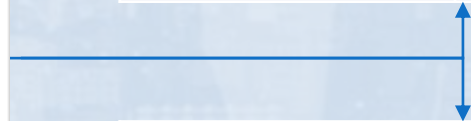


# Loading Analysis from Digital Transformers

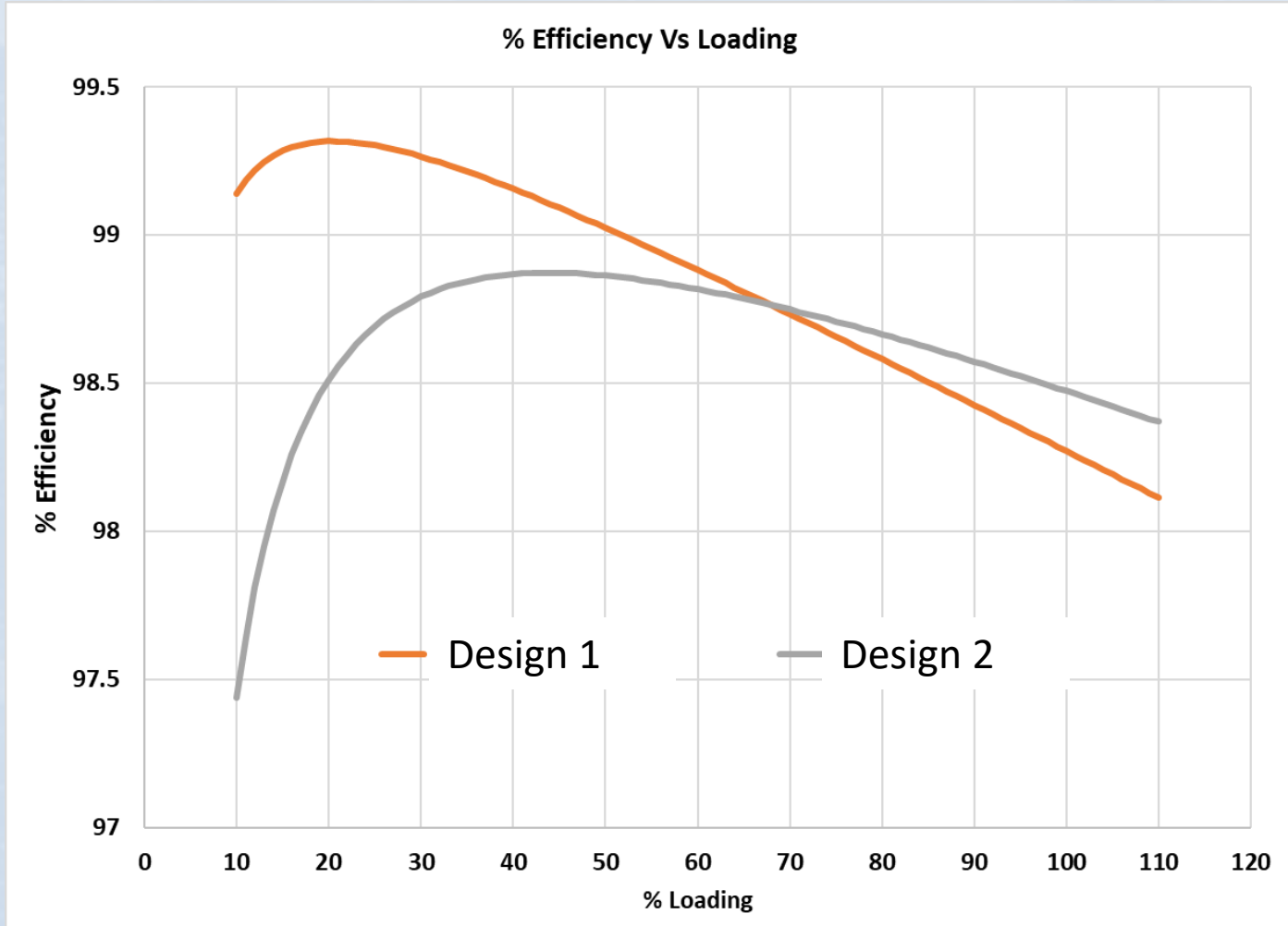


Design 1	
No- Load Loss	Load Loss
250W	1300W

Design 2	
No- Load Loss	Load Loss
70W	1650W



# Characteristics of 2 Designs



## Loading Analysis from Digital Transformers

100 kVA	Design 1	Design 2
MWh	179	171.16
tCO2/MWh	0.97	0.97
tCO2	173.85	171.16
SCC	US\$ 50	US\$ 50
Env Cost	\$ 8692	\$ 8301

Without the loading analysis from Digital Transformers, it is difficult to estimate the actual environmental costs of operating transformers

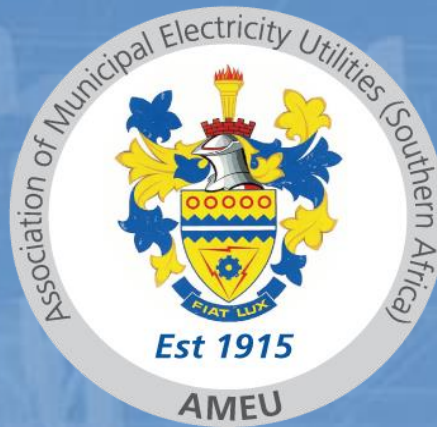
## Conclusion

- **Digital Distribution transformer** allows maximum load possible, based on real time measured transformer temperatures, condition, and load.
- Instead of “flying blind” when operating close to the limits, digital distribution transformer provides timely and accurate information as to what the real thermal limit is at any point in time.
- **Digital Distribution transformer** helps in optimizing capital expenditure on new transformer purchases and helps in accurate estimation of social cost of transformer operation.
- **Digital Distribution transformer** helps in correct formulation of the total costs of ownership formula.
- **Digital Distribution transformer** permits significant savings in deferred capital expenditure and failure rate reduction and other economic benefits.



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**Thank you**

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