



# Cost of Unserved Energy in South Africa

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# Cost of Unserved Energy

- The COUE is the value (in Rands/kWh) that is placed on a unit of energy not supplied due to an unplanned outage of short duration.
- Typically, a power system planner would balance the total COUE against the cost to supply the energy not served in order to make optimal planning decisions.

# INTRODUCTION

South African Grid Code and Distribution Code prescribe Cost of Unserved Energy as: “a key economic parameter that shall have a NERSA- approved process of establishment”.

- During 2015 the COUE methodology proposed by Eskom was approved by NERSA
- It was agreed that Eskom would **annually** update the COUE results with the latest available economic data (as released by StatsSA) and electricity sales data
- The COUE results are always dated 2 years prior to the current year e.g. for 2016 the results are indicated as 2014
  - Methodology makes use of Supply-and-Use tables published by StatsSA 2 years later.
  - The 2014 tables were released during October 2016



# Purpose of COUE... Regulation

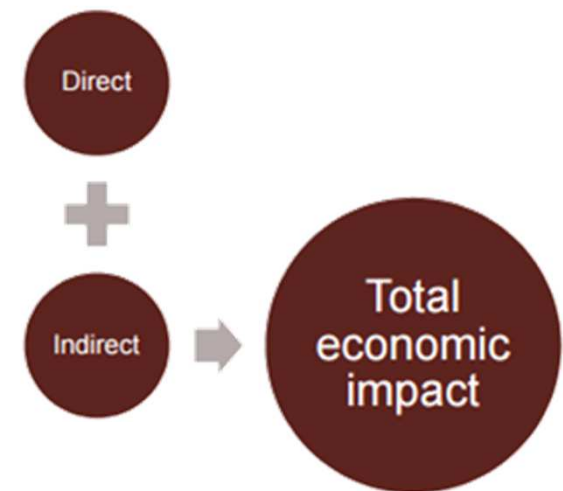
- Investment in and planning for reliability:
  - Department of Energy (2010): “**Optimal planning decisions** would result from the power system planner balancing the total COUE against the incremental cost to supply the energy not served
  - Distribution Network Code (2007): (Section 7.2 **Network Investment Criteria**) “ ... The following key economic and financial parameters shall be determined by a NERSA approved process: (a) Discount rate (b) Customer interruption cost (cost of unserved energy) (c) Other parameters, such as tariffs and additional economic parameters.”
  - Enable Grid Code compliance (new projects as well as refurbishment); ensure that DX **invests at the optimum** level i.e. optimising COUE
- Investment prioritisation, options planning

# Methodology: total economic impact

- The impact of an economic event on local, regional, and national economies is greater than the total of the direct size of the event. This is because the money spent/not spent is again spent/not spent by the recipient local businesses and employees – multiplier effect.
- Special models exist with which to measure multiplier effects (I-O, SAM, etc..)

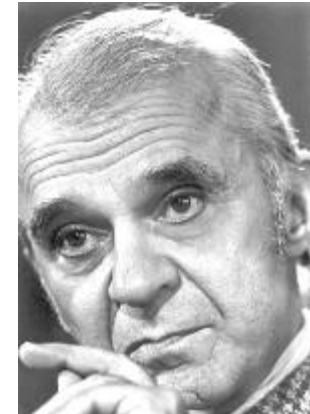
Direct: expenditures associated with events that constrain or enable a production sector(s) (first order)

Indirect: expenditures that result from suppliers and customers who transact with the first order affected sectors



# Methodology: input-output approach

- **Input-output model** is a quantitative economic technique that represents the interdependencies between different sectors of a national economy. Wassily Leontief (1906–1999) developed this type of analysis and earned the Nobel Prize in Economics (1973) for his development of this model.



$$x_i = a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n + d_i,$$

$$x = Ax + d$$

$$x = (I - A)^{-1}d :$$

		Intermediate Demand						Final Demand		Totals				
		(I)	(I)	(III)	(IV)	(V)	(VI)	Households (y)	Exports (e)					
National Economy	Monetary Input-Output Table	Agriculture (I)												
		Forestry (I)												
		Energy supply (III)												
		Paper Industry (IV)										z		
		Manufacturing (V)										y	e	x
		Services (VI)												
		Imports (m)	Imports						m <sup>hh</sup>	e <sup>t</sup>	m <sup>t</sup>			
		Value Added (K)	Capital											
		(L)	Labor											
		(R)	Rent								v			
Total Output (X)	x								x'					

# Methodology: Household impact

- Electricity dependent lifestyle expenditure / discomfort / nuisance
- Key data considerations:
  - Household access to electricity
  - Household ownership of electrical appliances
  - Lifestyle activities (television and other leisure, Internet, communication, personal care, home care, education, working from home)
- Data
  - Statistics SA / Quantec
  - Statistics SA Household expenditure survey
  - 14.2% of household expenditure on electricity
  - Disaggregated to a municipal level

# COUE 2014 Results: Economic Sectors

Economic Sector	Direct Effect (R/kWh)	Total Effect (R /kWh)
Agriculture	11.55	42.21
Mining	13.06	54.05
Manufacturing	5.84	54.64
Electricity and water supply	7.7	29.31
Construction	204.1	385.55
Trade	108.65	136.9
Transport and communication	87.29	348.64
Finance	105.77	400.22
Community services	159.39	319.37
General Government	66.62	80.33
<b>Total Economy COUE</b>	<b>23.81</b>	<b>84.16</b>





# COUE 2014: Household Effect

Residential impact (Utility of electricity OR Discomfort value of outage)

- Household expenditure on electricity dependent goods and services

<b>COUE: Household Effect</b>	<b>Residential</b>
<b>Electricity utility (R HH Expenditure/kWh)</b>	<b>6.77</b>

# NERSA Proposal

Eskom's COUE model used as the basis for COUE for all licensed distributors in South Africa i.e. **municipalities**

- Has been tested & accepted by NERSA
- Munics don't need to develop complex economic models
- provides a common basis for decision-making across power supply chain in South Africa

# Reasoning

- The macro-economic method used by Eskom to determine the COUE is appropriate for vertically integrated utilities and **uses publicly available data**;
- Eskom COUE methodology has been **approved** by NERSA and **implemented in the country IRP, Eskom transmission and distribution network planning**;
- Direct economic costs for 257 municipalities is derived in Eskom's COUE model, including the 174 municipal distributors licensed by NERSA;
- The economic sector direct costs for all local municipalities are derived in the current model and **can directly be used** in the distribution planning;
- The residential COUE is also derived from the Eskom's COUE model.



# COUE Model Outputs

## **COUE Model provides a range of values:**

- National aggregate total COUE
- National aggregate direct COUE
- National sectoral total COUE (according to 10 economic sectors)
- National sectoral direct COUE (according to 10 economic sectors)
- Municipal aggregate direct COUE
- Municipal sectoral direct COUE (according to 10 economic sectors)



**Which one to use when?**

Electricity Supply to Africa and Developing Economies: Challenges and Opportunities

# Things to consider

- Where on the network is the investment taking place? Gx, Tx, Dx, Munic
- Is the customer mix known? Where is it relevant?
- What are the project types to which COUE is applicable? How are these defined?
- Complexity and other issues

# Project types

- Refurbishment
- Strengthening
- Reliability
- International connections
- Statutory
- Strategic
- Reliability
- Premium customer connection