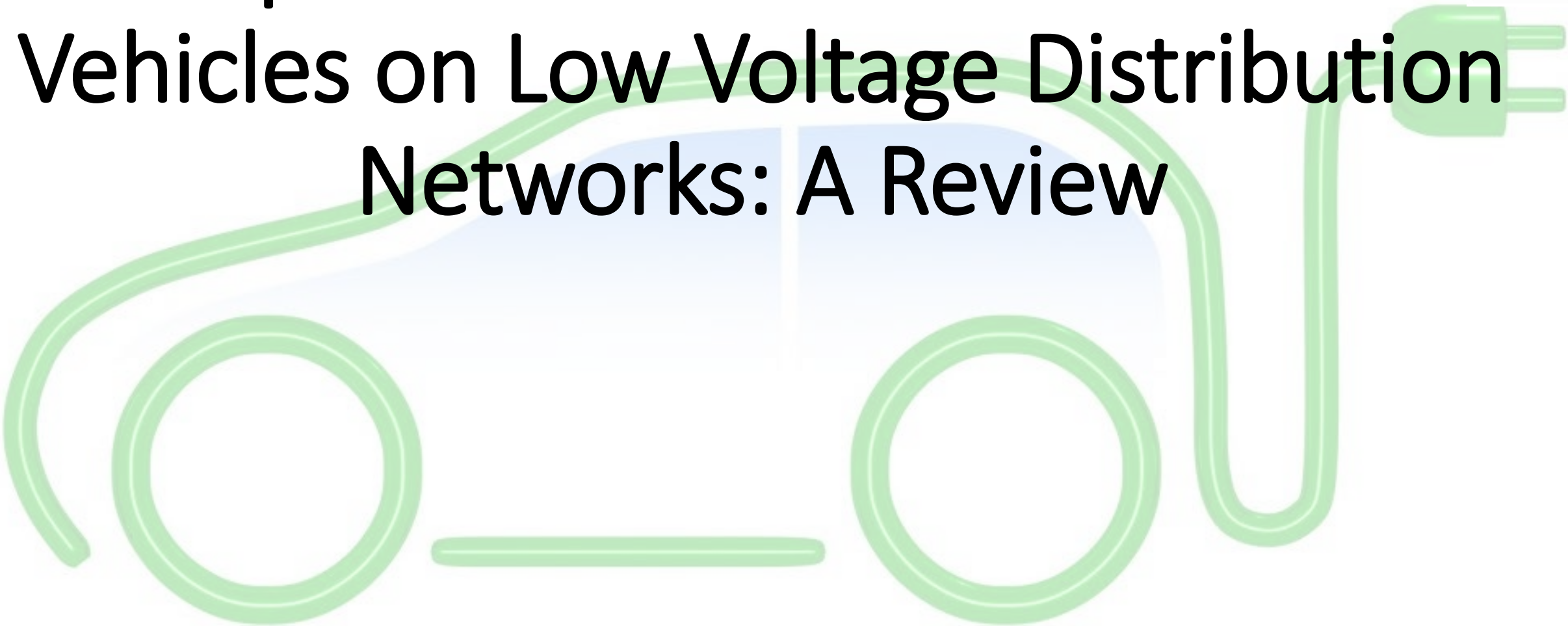
Impact Assessment of Electric Vehicles on Low Voltage Distribution Networks: A Review



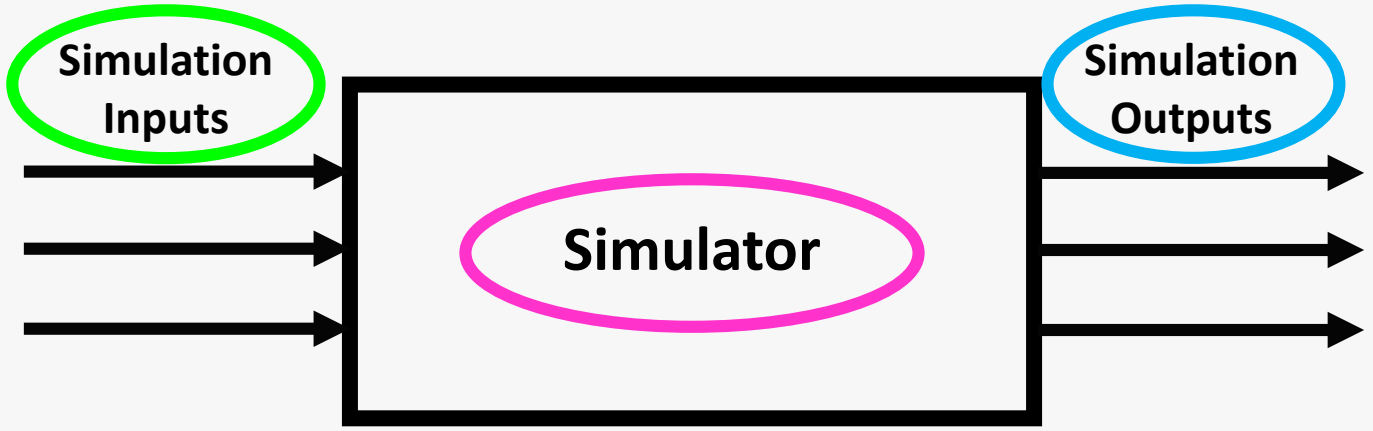
Presented by C. Rhoda

Electric Vehicle (EV) Uptake

- South Africa currently has 3 brands on EVs on its roads
  - ✓ Nissan Leaf
  - ✓ BMW i3 and i8
  - ✓ Jaguar Land Rover I-Pace and Range Rover plug-in hybrid
- Significant increase in EV uptake around the world
- Eskom said that EVs and hybrid EVs will account for approximately 30% of all vehicles sold by 2025

Overview

- Technical impacts of EV penetration
- Simulation inputs to an impact assessment
- Assessment simulation analysis approach



Technical Impacts of EV Penetration

- **Supply of electricity is regulated through QoS standards**
- **Expected that major effects will be experienced at LV level**
- **Uptake of EV lies outside of the control the utility**
- **Technical Issues:**
  - ✓ **Feeder voltage level**
  - ✓ **Thermal limits of cables and transformer windings**
  - ✓ **Voltage unbalance**

Technical Impacts of EV Penetration

- **Detailed impact studies needs to be done in order to investigate the extent of these technical issues at various EV penetration levels**

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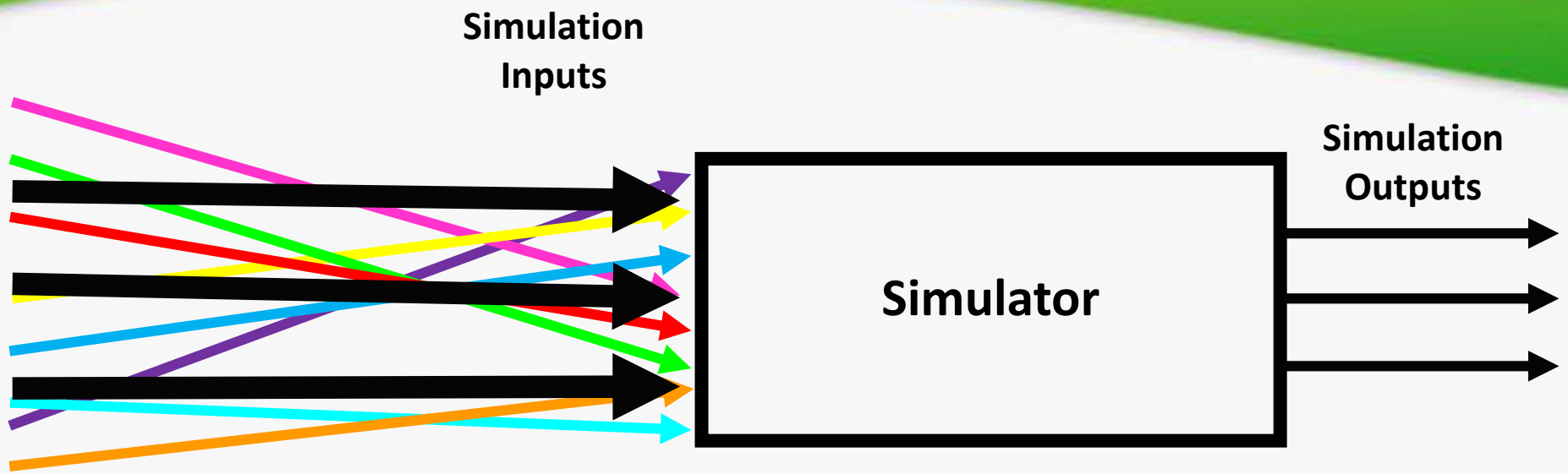
Impact Assessment Simulation Inputs



- Garbage in = Garbage out
- Many, many, MANY simulation inputs possible
- Selection and modelling of these inputs determines the accuracy of results obtained

Impact Assessment Simulation Inputs

- **Network model**
- **Modelling the customer as a load**
- **Modelling the EV as a load**
- **Usage pattern of the EV**
- **EV placement**
- **Quantification of EV penetration percentage**

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Assessment Simulation Analysis Approach

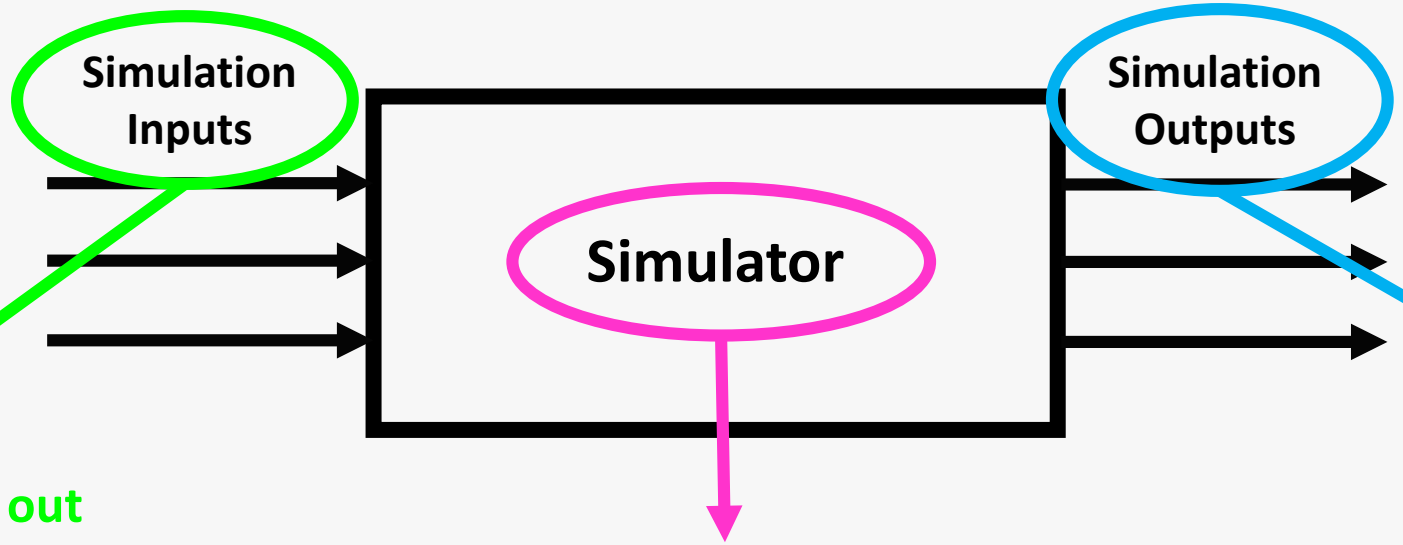
Deterministic

- Input parameters are set
- Load and power generation are predetermined as defined as specific values
- Does not take uncertainty into account
- Accuracy dependant on knowledge of input parameters
- Snapshot approach

Probabilistic

- Accounts for uncertainty and variability in power generation and loads
- Two approaches to a PLF
  - Monte-Carlo Simulation Method
  - Herman-Beta extended
- A combination approach is possible
  - MCS – stochasticity in inputs
  - HB extended – uncertainty and variability in loads and generation

Recap



Garbage in = Garbage out
Selection and modelling of input parameters determines accuracy of conclusions made

Appropriate load flow analysis method accounting for the nature of the inputs, loads and generations is important

Purpose of the impact assessment will influence which parameters one chooses to record during simulation

Thank you