Research, Testing & Development Eskom

- 12th South African System Dynamics Conference

Assumptions, the bane of modelling

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Assumptions, the bane of modelling

OVERVIEW

- With advancements in data acquisition capabilities and the need for more quantitatively accurate analytical results, computer modelling has become essential.
- The availability of computer and software packages has accelerated the growth of model usage.
- Has become common for engineers and scientists of all disciplines to utilize these tools or some version of them. Risk of incorrect usage due to the increased complexity of models but also due to assumptions
- In this paper, the impact of assumptions on electric vehicle projections is explored and results presented. The models were developed using system dynamics modelling software.

TWO COMPONENTS OF ASSUMPTIONS

Basis for generating the model

- Influences what the model actually represents and predicts

Model implementation

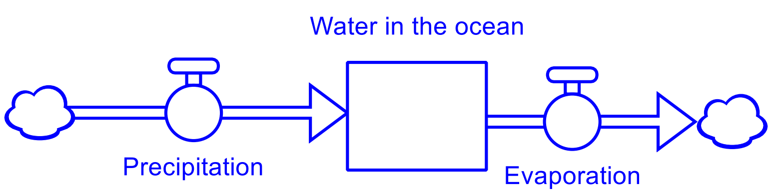
- Key role in evaluating the distortion incurred during the use of the models and in evaluating the appropriateness of a given model or models for a particular application

EV Forecasting

- Must fluently address a range of important uncertainties.
- Uncertainties include factors that affect sales most directly, such as policy (oil price, state zero emission vehicle mandates, electric vehicle tax credits, travel demand initiatives), consumer preferences (vehicle choice and usage), and vehicle technology; as well as other factors such as charging behaviour.

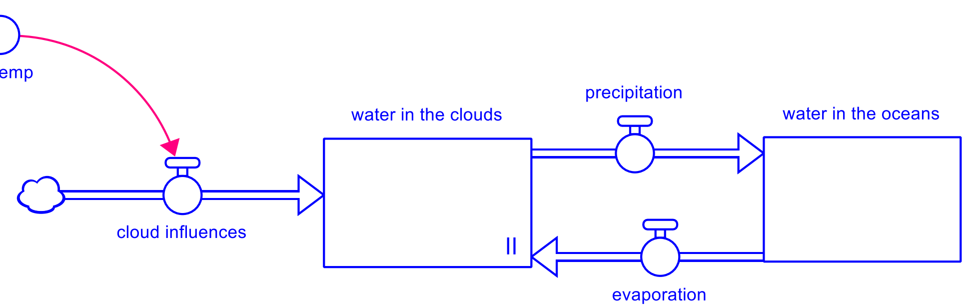
Methodology

- System dynamics



LINEAR MODELLING

SYSTEM DYNAMICS MODELLING



Applied System Dynamics Modelling

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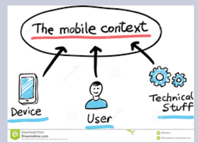
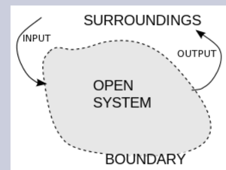
1. Project inception

2. Concept to context

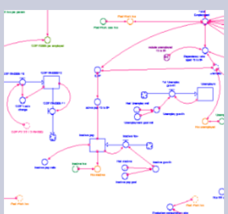


3. Boundary setting



4. System analysis

5. Model development and design

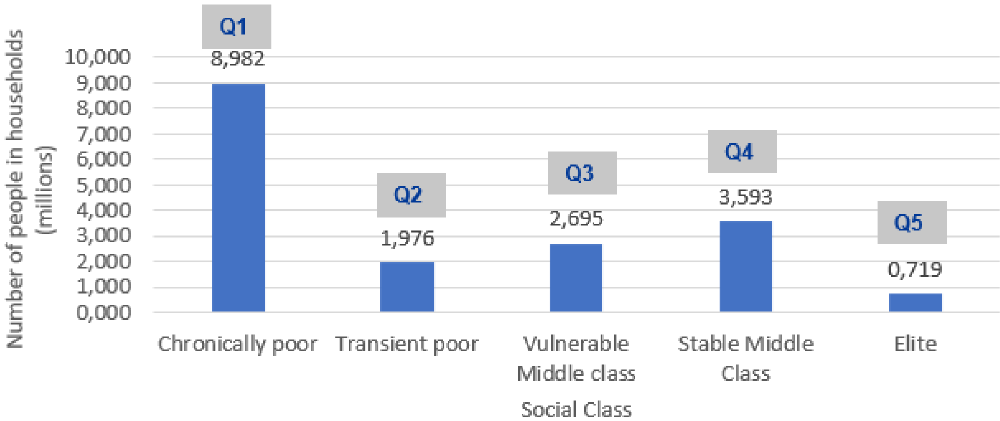


6. Validation and Policy insights

7. Model handover

8. Model maintenance and updates

NUMBER OF NATIONAL HOUSEHOLDS

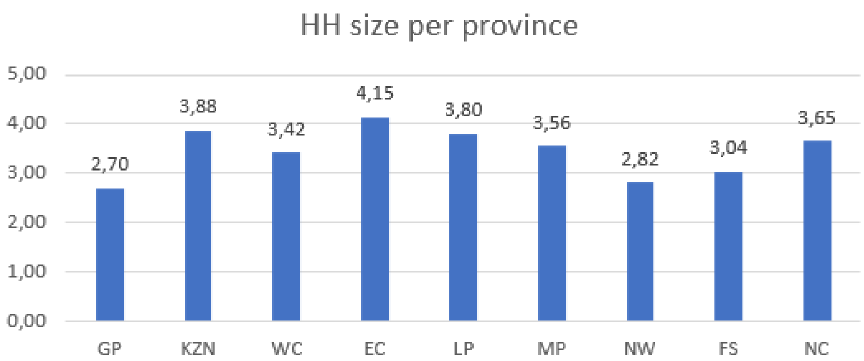


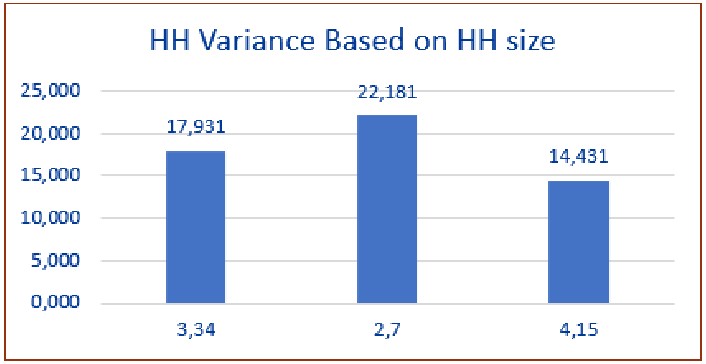
ASSUMPTION TEST: AVERAGE PERSONS/HH

Approximately 83.6% of all households live in formal dwellings South Africa.

The number of households was calculated based on 3.34 people per household.

The residential properties were not further broken down into freehold properties or sectional titles although it is noted that the tariffs would be higher for sectional titles.





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ASSUMPTION - DRIVETRAINS

Scenarios	EV market penetration %	Number of BEVs	Number of HEVs	Number of PHEVs	Total EVs
Scenario 1	0,15	1,404	9,010	853	11,267
Scenario 2	10	93,578	600,674	56,853	751,105
Scenario 3	20	187,157	1,201,347	113,706	1,502,210
Scenario 4	30	280,735	1,802,021	170,559	2,253,315

Results showing EV consumption in one year based on charging assumptions

Charging Profiles	Electricity Consumption in one year (TWh)
Hourly charging (7 hours every night, daily)	0.2
Charging to full capacity	12

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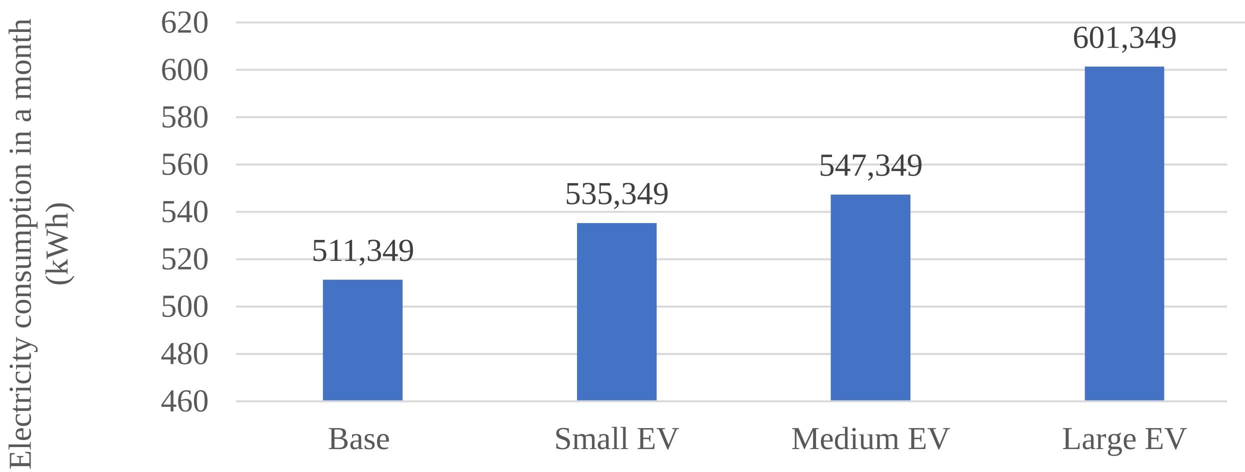
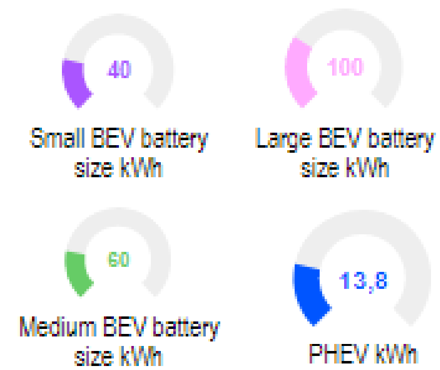
ASSUMPTION – EV BATTERY SIZE

Comparison in results when various EV battery sizes are assumed in calculating the additional electricity consumption. Daily charging is assumed with a Level 1 3.7 kW AC charger





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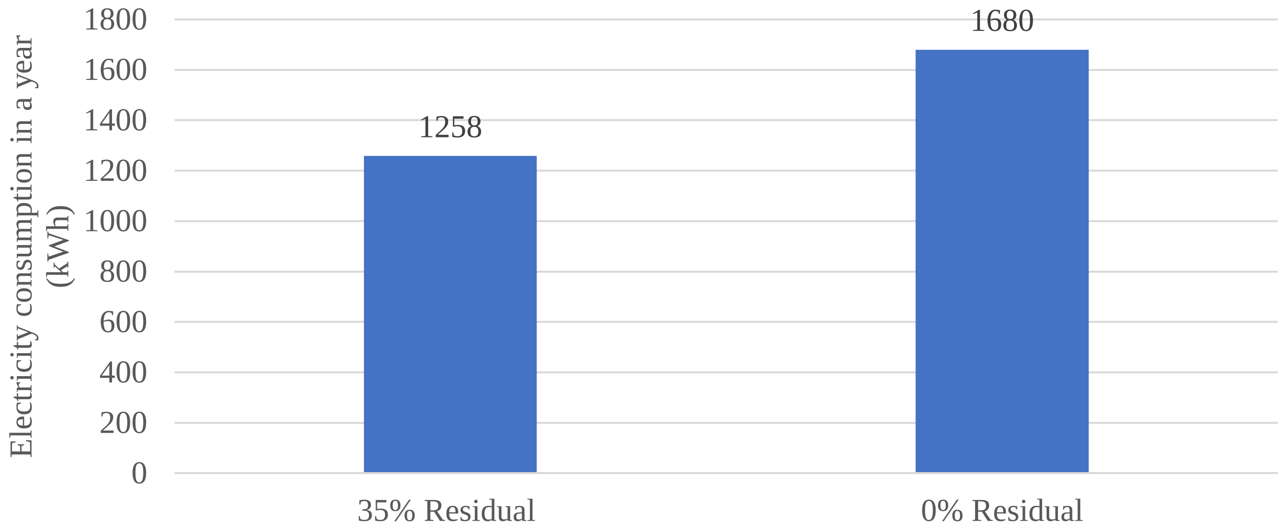
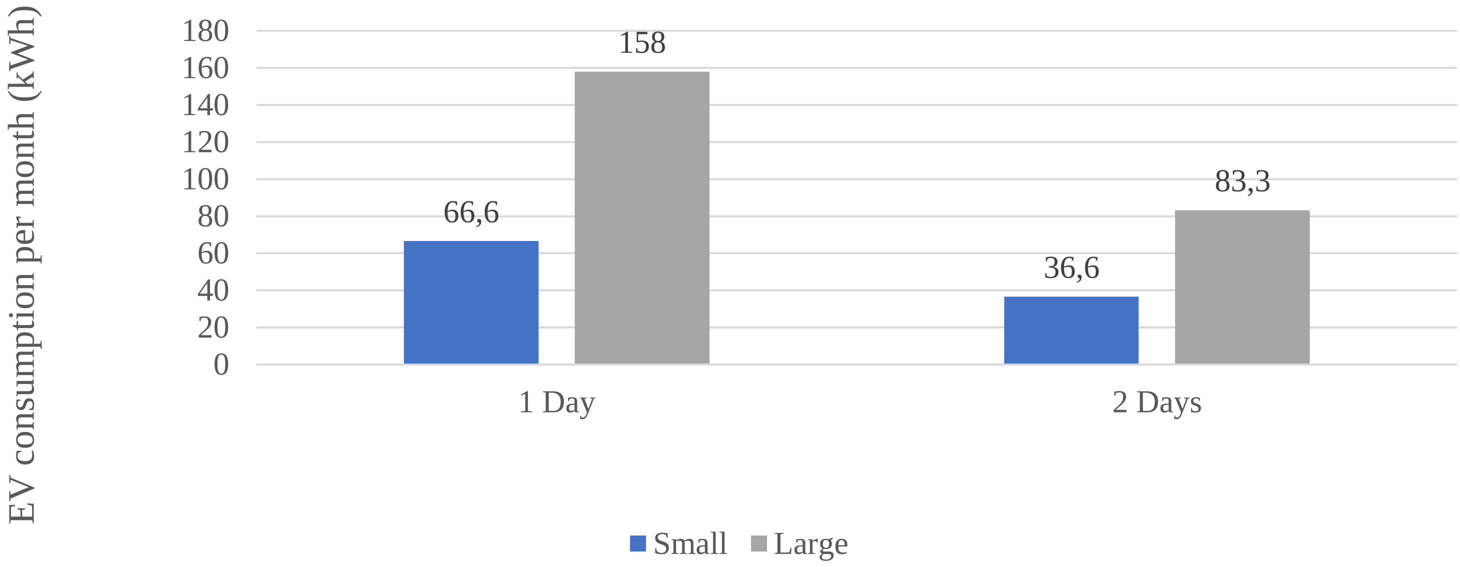
ASSUMPTION – RESIDUAL CAPACITY

Comparison in results when different residual capacities are used in the calculations to determine the additional electricity consumption (in a single household)



ASSUMPTION – EV CHARGING FREQUENCY

Impact of varying the charging frequency on calculations



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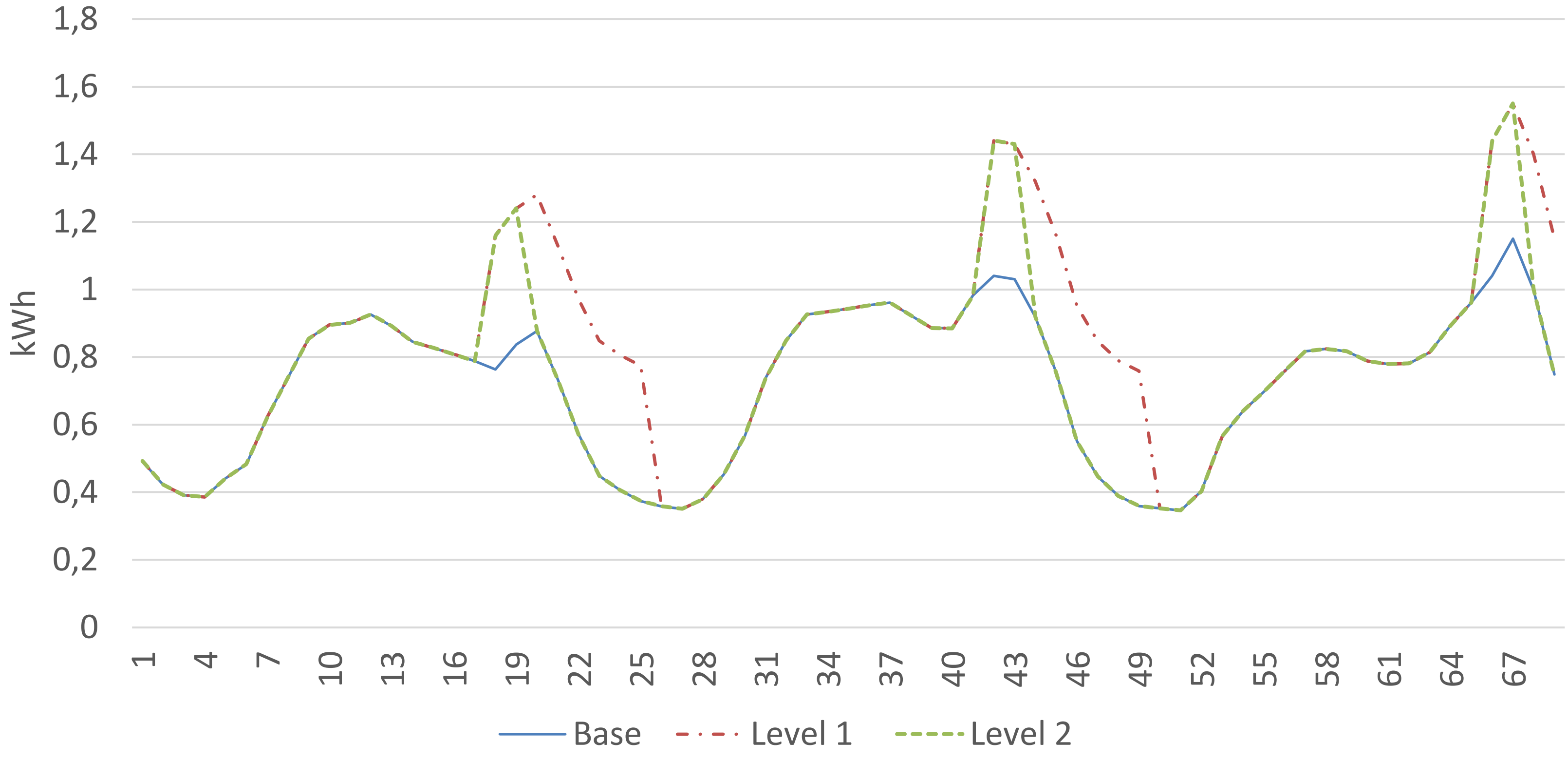
LEVEL 1 & LEVEL 2 CHARGERS



CONCLUSIONS

- The accuracy of a model is affected by the model boundary, availability of data, and how many qualitative variables are modelled; but it is also significantly affected by assumptions.
- Hourly charging versus annualized modeling of electricity demand as a function of annual distance driven could yield a large variance in results, as could the charging frequency, and the battery capacity used in the calculations.
- It is also important that when it comes to EV forecasting, in calculating volumes, HEVs are included but in calculating electricity consumption HEVs should be excluded.