

System Dynamics Modelling of the Power Sector in Mauritius

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Abstract – A system dynamics model has been developed for the power sector of Mauritius, which captures a range of complex interactions between the economic, social and environmental aspects of the national economy, with deeper emphasis on the role of energy in these interactions. The model has been validated by replicating the historical trends of key development indicators, and its results were compared to the projections of the national utility company. The validation process shows that the model provides a faithful representation of the actual electricity sector of Mauritius, and can be easily adapted to the use of different assumptions. This paper describes the main characteristics of the model and its results as compared to electricity demand projections carried out by the Central Electricity Board to 2022. The results suggest that further analysis could be done to test alternative low carbon investment scenarios.

Keywords – System dynamics; electricity demand forecasting; power sector; Mauritius

1. INTRODUCTION

The international community has recognized Small Island Developing States (SIDS) since the 1992 Earth Summit for their particular vulnerabilities, including remoteness, narrow resource and export base, exposure to global environmental challenges and external economic shocks [1], [2]. The global scientific community has also classified SIDS as one of the groups most vulnerable to the adverse effects of climate change [3]–[5]. One might see this situation as hindering development, however we can also approach it as an opportunity to drive a reduction of vulnerability (risk mitigation), to build resilience (preparedness for impacts) and one which has the potential to position SIDS at the forefront of sustainable development.

At present, most SIDS highly depend on imported oil and other fossil fuels [6] to satisfy their energy needs. This reality has led to the observation that SIDS “would be well advised to continue their pursuit of efficacious sustainable development strategies such as the application of renewable energy and no-carbon technologies, which not only contribute to mitigation, but also save considerable foreign exchange used to purchase fossil fuels” [7]. While this prospect is attractive, a country’s existing structures and planning methods play an important role in the transition to low-carbon development. In the absence of long-term planning, short term demands are often met in ways that only maintain the status quo – replacing or adding fossil-fuelled generation equipment to meet electricity demand for example. Additionally, when long-term planning exists but is not actively followed, countries may fall short of their low-carbon objectives.

The methodology and findings described in this paper are inscribed in broader research on the low-carbon development of Mauritius, a SIDS of the Indian Ocean. This is being conducted

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through the use of system dynamics modelling with the central aim of providing additional capacity to inform long-term development planning. System dynamics is a rigorous method for modelling complex systems and building formal computer simulations, which allows us to observe the long-term behaviour (expected and unexpected) of systems under different conditions and future scenarios [8]. The method is highly relevant for sustainable development research, as it allows integration of different sector specific tools such as econometric models and ecosystem-based management in larger models. Recent studies using system dynamics models (SDM) range from quota allocation in fisheries, where policies for rebuilding fish stocks are tested [9], to management of energy consumption and emissions reduction across entire industries or regions [10]–[12].

This paper introduces a SDM which integrates the environment-society-economy system of the Mauritius, with a focus on the power sector and long-term power demand forecasting. We then compare our demand forecasts to those from the Integrated Electricity Plan 2013–2022 (IEP) of the national utility company, the Central Electricity Board (CEB) [13]. The benefit of this exercise is currently emphasized by the local context, where the demand forecasting methodology of the CEB has become prey to strong criticism following the publication of the IEP, stemming from public outcry against the addition of a 100 MW coal fired power plant in 2013. The public is opposing this capacity addition out of concern for the environment, public health, volatility of fossil fuel prices and dissatisfaction with progress in sustainable development in the country – a phenomenon that illustrates well the need for additional, robust and transparent planning models that are able to capture the interactions between the energy/electricity sector and the environment-society-economy system of a country in the long-term.

To date, research in the Mauritian power sector has been conducted on short term electricity demand forecasting techniques predominantly. Adam et al. [14] use a combination of Artificial Neural Networks (ANN) to predict temperature, hours of sunshine and humidity, and Genetic Algorithm (GA) to predict GDP, which in turn influence a non-homogeneous Gompertz diffusion process in modelling monthly peak electricity demand. ANN was also used in various studies for short-term load forecasting [15], [16]. For more information on these techniques, Suganthi and Samuel [17] propose a comprehensive review of energy models for demand forecasting. Elahee [18] proposed an alternative medium-term capacity addition scenario, based on a review of existing demand forecasts and successful demand side management conducted at the national level. For its 10 year forecast, the CEB treats electricity demand as the aggregation of demand arising from different customer categories. In the absence of long-term economic forecasts, the CEB assesses the performance of different economic sectors and sub-sectors through the application of statistical and econometric methods, combined with survey results and information gathered through meetings with key stakeholders segments [13].

Regarding the use of system dynamics, several authors designed SDMs for studying the evolution of electricity demand and generation expansion planning (GEP), particularly in liberalized power systems or competitive markets [19]–[22]. With varying degrees of complexity, these models essentially seek to guide investment decision making by helping to understand capacity and profitability cycles, as market forces imply feedbacks and delays between price, demand and supply [8]. In Hasani and Hosseini [21] model an electricity market with complementary capacity mechanisms (capacity payment and capacity market) is used to simulate investment decisions that maximize profit for generators while ensuring system reliability. To capacity payments Sanchez et al. [19] also add wind power subsidies and CO₂ price from an emission trading scheme into their model of a deregulated electricity market.

In contrast, the Mauritian power sector is centralized and regulated: the CEB assesses and manages power demand and supply respectively and evaluates power generation options with

respect to the timing of their constructions and retirements within the national resources. As such, the CEB and existing Independent Power Producers do not compete to supply the demand in a competitive market. In section 2 we outline the main characteristics of the power sector of Mauritius, with consideration given to power generation actors and power consumers which are reflected in the SDM described in section 3. In section 4 we present our demand forecast results in comparison with CEB forecasts before concluding with section 5.

2. THE POWER SECTOR OF MAURITIUS

This section outlines the main characteristics of the power sector of Mauritius, with consideration given to power generation actors and power consumers which are reflected in the SDM described in section 3.

2.1. Electricity Producers

Electricity generation in Mauritius is generally separated between three categories: the public Central Electricity Board (CEB), Independent Power Producers (IPP) and Small Independent Power Producers (SIPP). Each operates several power plants with different types of generation technologies. The CEB predominantly produces electricity from thermal power plants using Heavy Fuel Oil (HFO) and Gas, and hydroelectricity in smaller amounts (see Table 1). IPPs rely essentially on thermal power plants using coal and locally sourced bagasse from sugar cane harvested and milled. All fossil fuels consumed in Mauritius are imported. SIPPs are decentralized, small scale production units relying on renewable energy technology such as solar PV, wind and mini hydro. These are not considered for the purposes of this paper, as their relative generation capacity is negligible. It is worth mentioning that in 2014 IPPs also generated grid electricity from PV (22.7 GWh) and landfill gas (21.3 GWh), which represented 1.6 % of all electricity generated in Mauritius [23]. All electricity generated is sold to the CEB for distribution through the national grid.

Fig. 1 shows that the share of IPPs in national electricity production has significantly increased over the past decades; from 17 % in 1991 to 43 % in 2001 to 55 % in 2011 to 58 % in 2014. This is the result of the restructuring of a former pillar of the country's economy, namely the sugar industry (now the "cane" industry) of the country under the Multi-Annual Adaptation Strategy (MAAS). With 36 % decrease in the selling price of sugar to the European market from 2004, sugar producers embarked on a diversification programme leading to the addition of electricity production from coal to their existing production from bagasse, the biomass "left-over" from sugar cane after it is crushed for sugar extraction.

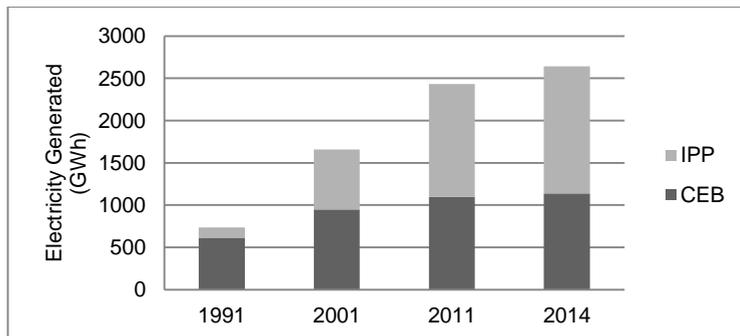


Fig. 1. Breakdown of electricity production by main producer categories [25].

It is worth noting that in 1991, IPPs exported only 52 % of their electricity production to the grid, increasing gradually to 84 % in 2011 (85.4 % in 2014). Additionally, IPPs send steam to nearby sugar factories and therefore do not realize the full electricity generation potential of the fuels consumed. Table 1 gives a breakdown of the currently available generation capacity of Mauritius.

TABLE 1. EFFECTIVE GENERATION CAPACITY OF MAURITIUS [13]

Power Plants	Fuel Type	MW
CEB		445.5
Fort George	HFO	134
Saint-Louis	HFO	71.4
Fort Victoria	HFO	107
Nicolay	Kerosene	75
Hydro Plants	Hydro	58.1
IPPs		215
CTSav	Coal/Bagasse	74
CTBV	Coal/Bagasse	62
CTDS	Coal	30
FSPG	Coal/Bagasse	27
CEL	Coal/Bagasse	22

At present, the base energy is primarily supplied by the IPPs and the CEB's 134 MW power plant. Semi-base energy is provided by the 71.4 and 107 MW (Saint Louis and Fort Victoria) power stations, while the demand for peak energy is met by the 75 and 30 MW (Nicolay and Champagne – hydro) power stations.

Although electricity from renewable sources is already generated in Mauritius from bagasse (thermal) and hydro, wind and solar electricity potential is not yet exploited in large scale. In the case of hydro, the CEB assumes only 25 MW as firm power due to climatic uncertainty.

2.2. Electricity Consumers

Consumption of electricity in Mauritius has traditionally been split into four categories: Domestic (households), Commercial (non-manufacturing), Industrial and "Other", which includes public lighting, traffic lights and irrigation [24].

Over the last decades, population growth and economic development have driven an increase in the construction of buildings and infrastructure in both residential and commercial sectors. In comparison, Manufacturing and textile industries have slowly decreased their share of the total electricity consumption. However, their absolute electricity demand has increased from 265.4 GWh in 1991, to 546.8 GWh in 2001 to 711.1 GWh in 2014.

Table 2 shows the distribution of total electricity sales in 1991, 2001, 2011 and 2014, illustrating the changes in demand over this time period.

TABLE 2. ELECTRICITY SALES DISTRIBUTION IN MAURITIUS [23], [25]

	1991	2001	2011	2014
Electricity Sales (GWh)	737.196	1,657.08	2,433.20	2,452.196
% Residential	35	35	32	33
% Commercial	24	28	36	36
% Industrial	36	33	30	29
% Other	4	4	3	2

Electricity prices in Mauritius are not completely cost-reflective since tariffs for industrial activities are cross-subsidised. In the absence of an independent power utility regulator, tariffs are set by the CEB. So far the implementation of Time-Of-Use (TOU) tariff and quarterly billing measures, among others, remain unimplemented. For these reasons, least-cost production is an important criterion of the CEB when considering capacity expansion.

3. MODEL DESCRIPTION

3.1. Background

System dynamics modelling is based on a stock and flow representation of existing systems. At the country level, critical stocks include population, capital, land-use categories and installed energy production capacity. The dynamics of demography (particularly the labour share of the population), investment, land-use, infrastructure development and associated parameters all interact to affect the state of stocks – and thereby the state of the system – at any given time.

This SDM therefore integrates the environmental, social and economic spheres of development to provide a holistic tool for analysing the response of a system when interventions are made that modify its structure or dynamic interactions. New policies, investment plans and development strategies are such interventions. In this respect, a significant value added of the SDM is its inherent ability to capture the feedbacks, delays and non-linearity existing in real systems, thus providing insights on long-term and cross-sectorial responses [26].

3.2. Structure of the Model

The structure of the model is based on four spheres: society, economy, environment and energy. The social sphere represents population dynamics, with demographic parameters, access to health care, and employment by primary, secondary and tertiary production sectors. Production is at the centre of most systemic interactions, as it draws on natural resources, investments, energy, labour and regulations, while depending on consumption. Therefore, production is calculated in the economy sphere through a Cobb-Douglas production function, integrating land, labour, capital and total factor productivity. In the environment sphere, land is divided into urban, agricultural, fallow, forest and desert, with agricultural land being integrated in the production function of the economy sphere. The environment sphere tracks fossil fuel emissions, and is therefore linked to population dynamics and economic activities through power generation, transportation and thermal uses. These parameters in turn pertain to the energy sphere, and naturally tie all spheres together.

The following describes the energy sphere in further details. It is composed of 22 modules, including energy and electricity demand and supply by sector, investments, energy imports and bill, and power generation cost and price, all reflecting the current status and future development

planning in the energy sector. For the purpose of this paper, we leave out non-power energy aspects, and use the causal loop diagram (CLD) in Fig.1. to describe model structure for the power sector specifically. We start with GDP and power demand, through the rest of the diagram in anti-clockwise direction to come back to the effect of the power sector on GDP.

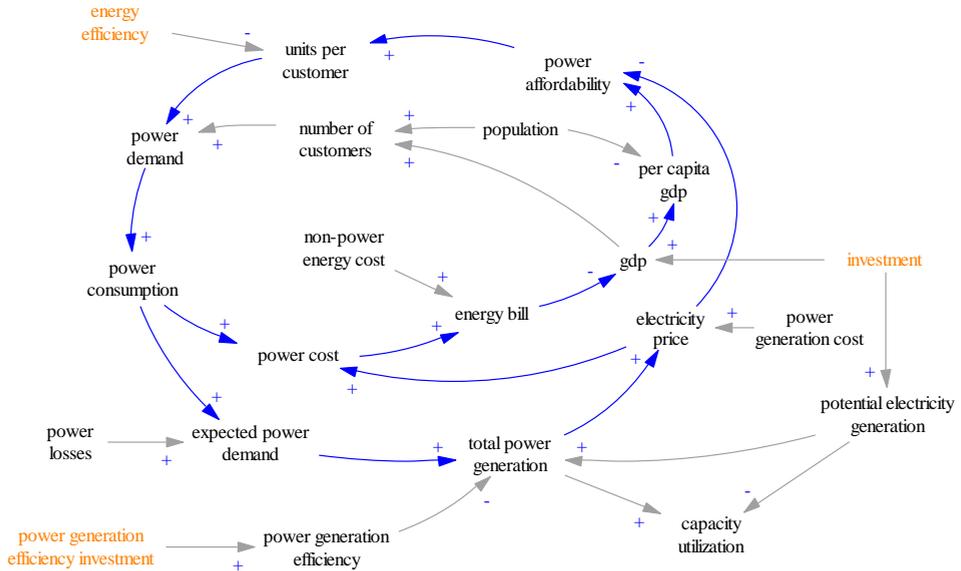


Fig. 1. Causal Loop Diagram for the power sector.

Power demand is calculated using (1) population and GDP to define the number of customers, with GDP being used as a proxy for personal income indicating that the higher GDP, the higher is the number of customers, in terms of organizations and companies; (2) the units consumed by each customers, which uses energy efficiency and GDP, as proxy of the affordability of electricity (or expanded commercial/industrial operation), through a non-linear function that relates it to consumption (i.e. there is a limit to electricity consumption, regardless of its affordability). This dynamic is modelled for each customer category or sector then aggregated to represent total power demand. Demand then drives consumption (with these two quantities being the same if supply matches demand) and future expected power demand, factoring in power losses in the system.

Total power generation is in turn governed by *expected power demand*, *power generation efficiency* and *potential electricity generation* (from existing capacity and planned additions). The model accounts for the following electricity generation options for the different actors: CEB – hydro, wind, gas turbine, HFO, coal and waste; IPP – hydro, cogeneration, coal, waste, solar, wind, geothermal and landfill gas. Demand for production (*expected power demand*) is shared among CEB and IPP using a base load demand factor (since IPP are mostly equipped with base load plants, their potential supply are limited by the patterns of demand). In terms of the hierarchy of supply among plants, the running cost as well as the type of technology used are the main defining factors: renewable energy is firstly used (hydro, wind, solar, geothermal, waste, landfill gas and bagasse), dedicated coal precedes coal used in cogeneration plants for the IPP, while coal and HFO precede the use of gas turbines for the CEB. Fig.2. shows an example of the model structure for coal electricity generation by IPPs.

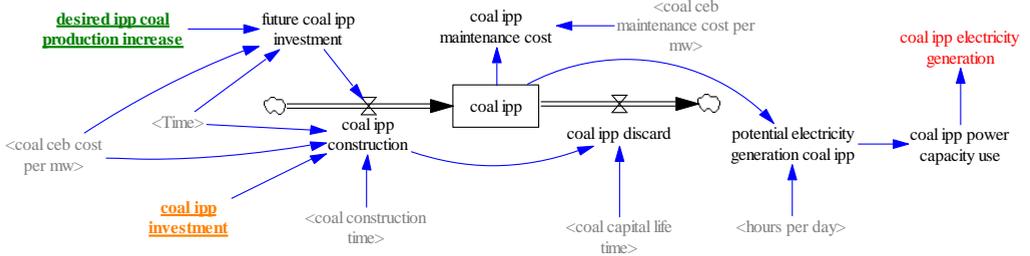


Fig. 2. Stock and flow diagram of coal electricity generation.

For the sake of clarity, not all the variables affecting *coal ipp electricity generation* are represented here. Additional variables however ensure the hierarchy of supply described above is followed, in this case defined by the Eq. (1):

$$\begin{aligned}
 \text{Coal ipp electricity generation} = & \max(0, \min((\text{electricity demand ipp gwh} - \\
 & \text{hydro ipp electricity generation} - \text{solar ipp electricity} - \\
 & \text{wind ipp electricity generation} - \text{bagasse ipp electricity generation} - \\
 & \text{waste ipp electricity generation} - \text{geothermal ipp electricity generation} - \\
 & \text{landfill gas ipp electricity generation}), \text{coal ipp power capacity use})
 \end{aligned}
 \tag{1}$$

The *min* function ensures *coal ipp electricity generation* is no greater than the difference between ipp electricity demand and all the other electricity generation listed, while the *max* function ensures no negative value is used in the model, as it would obviously not represent reality.

In this example, *coal ipp construction* is calculated with an *IF-THEN-ELSE* function where historical *coal ipp investment* is used prior to 2012, then *future coal ipp investment* defined by *cost per MW* and *desired production increase*. This is the case for all electricity generation options, for which each *desired production increase* is given by the generation plan of the IEP. For each option, specific capital costs, construction times and capital lifetimes are assumed based on project-specific information.

Electricity (production) price is calculated as follows. The model calculates average electricity production cost from the share of total generation and cost of each power source. This average is divided by a historical initial average to provide a relative average, which is then multiplied by the actual average electricity price of 2012 to provide onward yearly prices. Prior to 2012, the model uses a historical series. The electricity price affects demand in the different sectors directly through elasticity of units to price, simplified as *power affordability* in Fig. 1 (affordability is estimated by comparing the relative growth of GDP to the growth of energy expenditure; in other words, if energy expenditure grows, but GDP grows faster, affordability actually improves). Power consumption and electricity price result in the total power cost per year, which is added to non-power energy costs to provide the national *Energy Bill*. The relationship between energy bill and GDP shown in Fig. 3, and is established through the *effect of energy price on gdp*, impacting the *total factor productivity* and thus *relative production*.

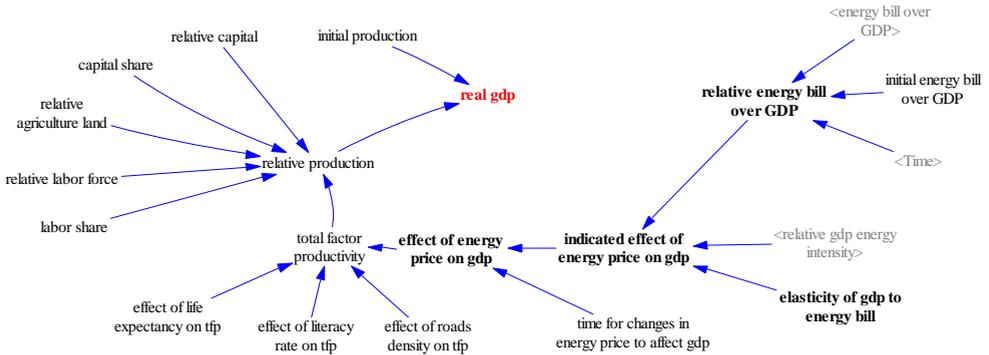


Fig. 3. Causal links between Energy Bill and GDP.

It is worth noting that Neeliah and Deenanaray [27] have found that unidirectional short-run causality exists from electricity consumption to GDP for Mauritius, meaning that an increase in electricity consumption leads to an increase in real GDP, despite the service-driven nature of the Mauritian economy. This is the electricity required to run capital in the first year of operation, before profits are accrued. In a growing economy therefore it can be observed that electricity consumption may grow sooner than the growth of GDP, although this amount is small relative to total electricity demand. This further supports the rationale employed here, with the explicit representation of customers and physical capital (as stock) to influence electricity consumption in the residential, commercial and industrial sectors. The dynamics behind non-electricity energy costs will however be described in a subsequent publication.

3.3. Assumptions and Scenario Design

The above description shows that the SDM is built to respond to changes in electricity generation capacity over time. Hence, to model a baseline scenario which reflects the currently planned developments in the power sector, the schedule of capacity additions outlined in the IEP is applied to the SDM. In order to provide relevant observations on the IEP demand forecasts however, we are able to switch GDP growth rate to constant values and search for the growth rates that yield demand trends that match the IEP projections under three scenarios: base, low and high. We are then able to compare the consistency of obtained GDP growth rates and assumptions of the CEB.

An important consideration in the commercial sector is the number of visitors to Mauritius, which directly influence consumption. While the national Tourism Development Plan targeted 2 million arrivals per year by 2015, actual figures have nearly stagnated between 2011 and 2012 at around 965,000 [28], due to the economic crisis affecting Europe, the long-dating main customer base of the Mauritian tourism industry. While the sector is increasingly opening itself to the African and Asian markets and has embarked on a series of stimulation measures, it can be expected that adaptation to this new context will take time [29, 30]. Hence, we have assumed in our model that the 2 million target will be achieved in 2020 rather than 2015.

4. SIMULATION RESULTS AND ANALYSIS

4.1. Model Validation

Fig. 4 and 5 below show real GDP and GDP growth rate trends from simulation and historical data. The average difference between simulation results and the historical series for real GDP is of 0.2 %. It can be noted from Fig. 5 that the SDM is not apt at replicating short-term fluctuations; however the simulation trend matches the long term evolution of the variable.

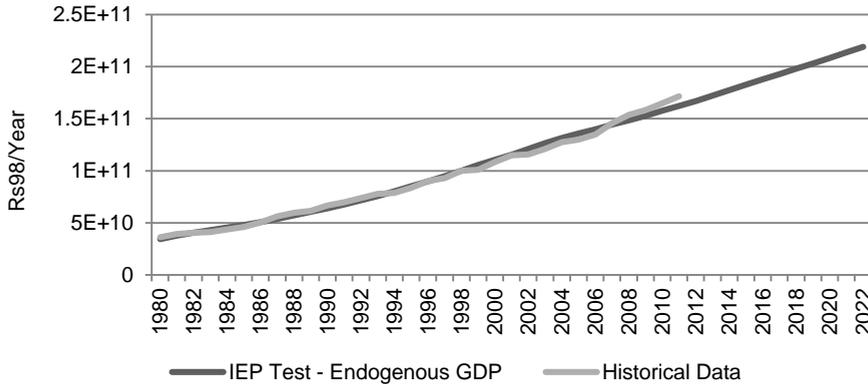


Fig. 4. Real GDP, simulation and historical data (GDP is expressed in local currency, Mauritian Rupees (Rs), in constant 1998 prices).

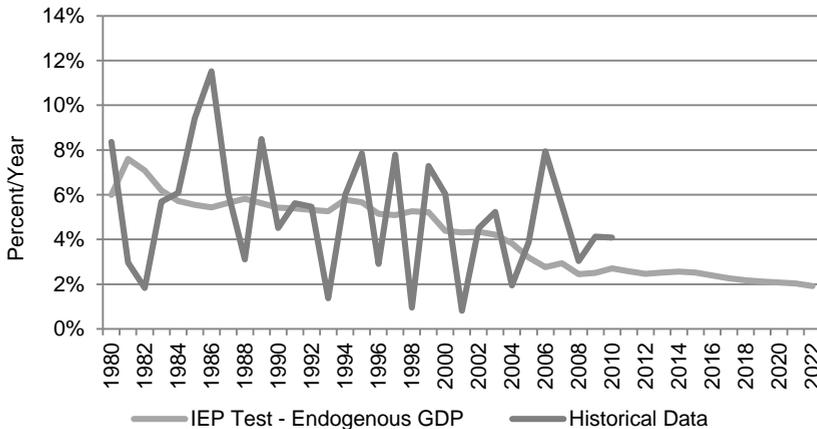


Fig. 5. Real GDP growth rate, simulation and historical data.

With GDP calculated endogenously, we also observe that the electricity demand trend matches the historical trend, as shown on Fig. 6 – the average difference between the trends is of 1.5 %. As described in section 3.2, the total power demand is an aggregate of power demand from the different sectors. In the *domestic*, *commercial*, *industrial* and *other* sectors respectively, the SDM simulation results match historical trends with 0.6 %, 0.6 %, 2.2 % and 4.9 %.

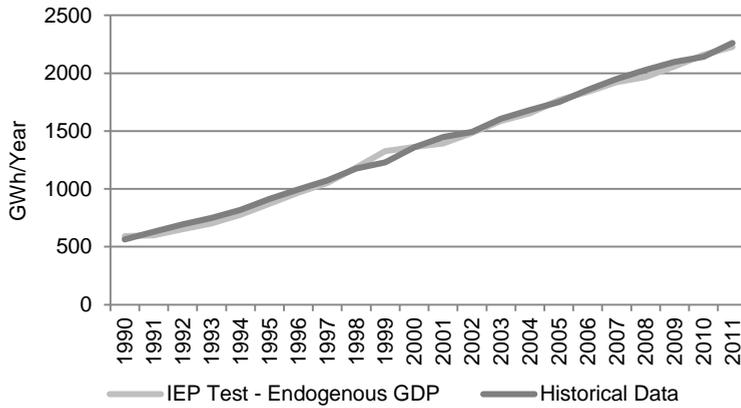


Fig. 6. Total power demand, simulation and historical data.

These results give confidence in the ability of the model to represent the real dynamics of the system. It must be noted however that the recent increase in GDP is not directly explained by the SDM in its current form, as it does not capture the dynamics of the finance sector. Further refining of the model will seek to incorporate this aspect of the economy sphere.

4.2. Electricity Demand Forecasts

As described in section 3.3., different scenarios were simulated with exogenous GDP growth rates, which coincide with the CEB projections for power demand. Fig. 7. shows the CEB and SDM simulation curves for each scenario.

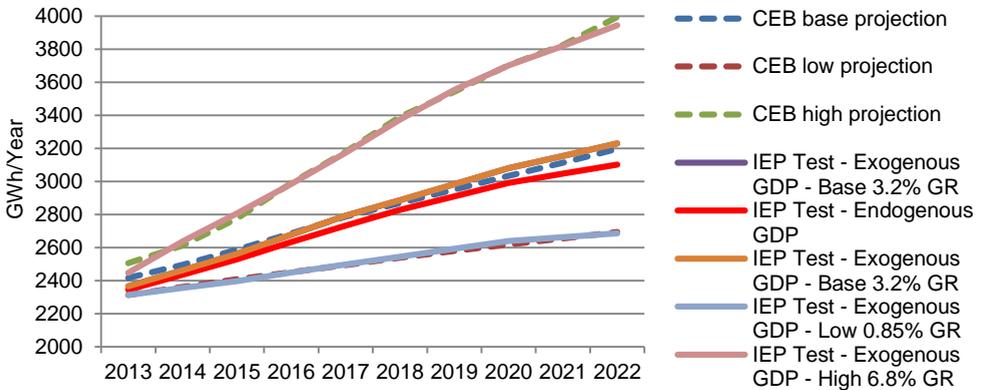


Fig. 7. Power demand projections, CEB and SDM simulations.

Fig. 7 indicates that a GDP growth rate of 6.8 % per annum over the forecast period is required for the CEB high scenario to materialize. We can also expect the CEB base scenario to be realized with a constant GDP growth rate of approximately 3.2 %, however despite an average difference of 0.1 % between the two curves, our simulation curve displays a steeper slope than the CEB curve. With endogenous GDP simulation, the average difference between our simulation and the CEB projection is only in the order of 2 % (58 GWh). Finally, for the CEB low scenario to be realized, a constant GDP growth rate of 0.85 % would have to be

maintained. In order to compare methodologies in more detail, we now analyse the CEB and SDM projections by sector, under each scenario.

4.2.1 Base scenario

The IEP base scenario is one where growth for the forecasting period will reflect the trend of the last decade. Table 3 shows the IEP assumptions for the domestic, commercial and industrial sectors. Assumptions and results for other minor sectors are discussed in section 5.

TABLE 3. BASE SCENARIO IEP ASSUMPTIONS

Domestic Sector	Customers are expected to move progressively to higher consumption brackets, as the distribution of national income and per capita GDP increases satisfactorily*. Consumption is expected to grow at a decreasing rate, due to the adoption of energy conservation and efficiency practices, higher market penetration of efficient appliances, and increases in electricity price. The consumption growth rate is assumed at 1.5 %.
Commercial Sector	Requests for power supply by medium and large customers are made prior to construction periods in this sector, hence electricity demand is known 2 to 3 years in advance. For medium and large, as well as small customer categories, demand growth in the planning period is assumed due to enhancement of business facilitation policies.
Industrial Sector	Power demand in the small customer category (1.31 % of total electricity sales in 2011) is assumed as random in the planning period, due to its high vulnerability to changing economic conditions. Medium customers are expected to expand production for the regional market, hence consumption will continue growing – at a slower rate due to the adoption of energy efficient technologies. Similarly to the commercial sector, the CEB is informed of upcoming industrial projects 2–3 years in advance. In this case no major projects were identified and consumption is assumed to grow at a decreasing rate, since large enterprises also tend to invest in renewable energy technology to meet their own needs.

* The IEP does not provide additional details on this statement.

Fig. 8 and 9 show the sectorial demand forecast from both methodologies, where the SDM simulations are ran with an endogenous calculation of GDP (it is the same simulation which provided the curves of Fig. 4, 5 and 6) and with GDP growth fixed at 3.2 % per annum respectively. It can be seen that the 2013 CEB and SDM values for each sectors are typically not matching – this is partly due to the absence of published data for the year 2012, and partly due to the different assumptions and calculations of each methodology.

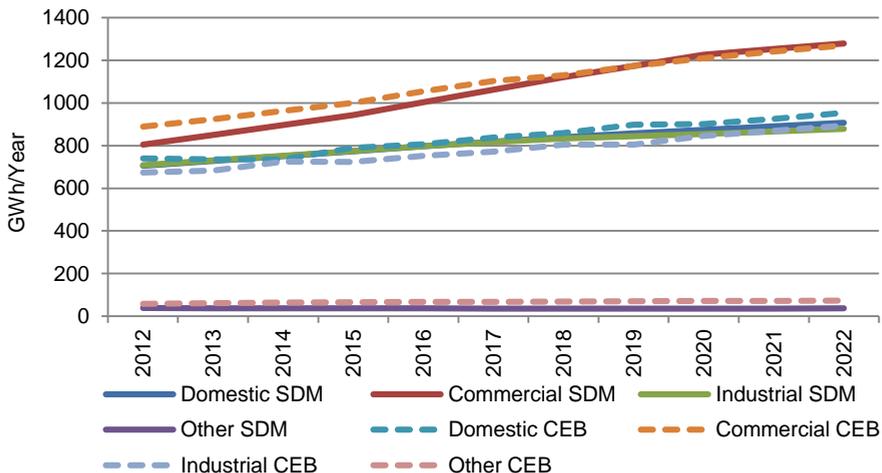


Fig. 8. Sectorial demand projections, SDM simulation (endogenous GDP calculation) and CEB.

The average difference between CEB and SDM (with endogenous GDP) results by sector are as follows: 2.5 % in the domestic sector, 3.3 % in the commercial sector, 3.9 % in the industrial sector, and 44.4 % in other sectors. For other sectors, the larger difference is explained by the classification of irrigation electricity consumption in this category by the CEB, whereas the SDM incorporates irrigation as part of the industrial sector. Correcting this allocation in the SDM changes the difference between CEB and SDM results to 0.8 % and 10.3 % in the industrial and other sectors respectively.

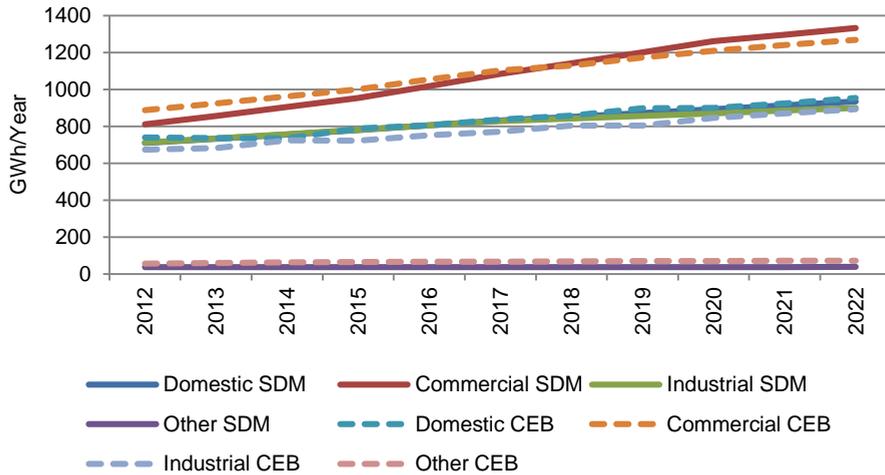


Fig. 9. Sectorial demand projections, SDM simulation (fixed 3.2 % GDP growth rate) and CEB.

With a fixed GDP growth rate of 3.2 % in the SDM model, where total power demand simulation results best approach the CEB projections, the average difference between CEB and SDM results by sector are as follows: 1 % in the domestic sector, 1.3 % in the commercial sector, 5.3 % in the industrial sector, and 43 % in other sectors.

4.2.2 High scenario

For its high scenario, the IEP assumes rapid economic growth in the short term, providing a sustained momentum in the medium to long term. In the domestic sector, this translates into a 3.6 % consumption growth rate is assumed over the planning period. Specific assumptions of this scenario are not presented for the commercial sector. Industrial customers are expected to diversify and increase production capacity as well as automation. Fig. 10 shows the sectorial projections for power demand, where the SDM results are obtained by fixing GDP growth rate at 6.8 % (see Fig. 7 for total power demand).

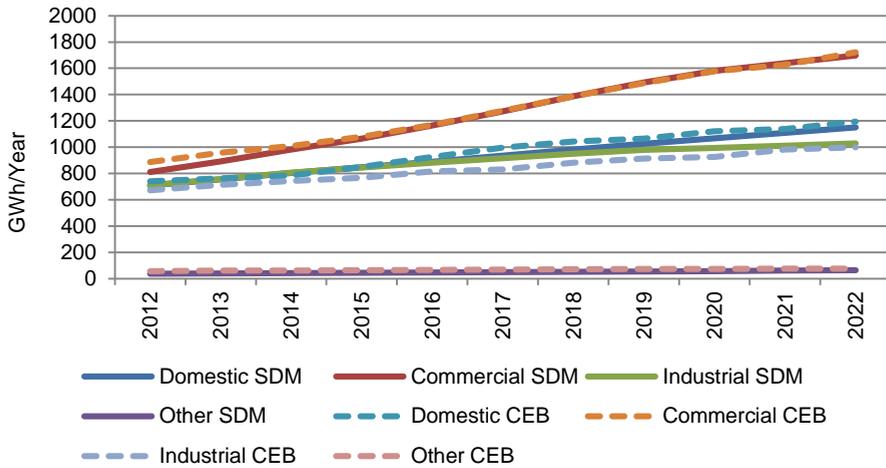


Fig. 10. Sectorial demand projections, SDM simulation (fixed 6.8 % GDP growth rate) and CEB.

Average difference between CEB and SDM results by sector are as follows: 3 % in the domestic sector, 1.9 % in the industrial sector, 7 % in the commercial sector, and 26.5 % in other sectors.

4.2.3 Low scenario

This scenario is one of a near-stagnant economy. Household income will not grow and improving energy efficiency will become an imperative. The industrial sector will face tough competition with imported products and the number of industrial customers may decrease in some categories. Fig. 11 shows the CEB sectorial demand projections, and SDM simulation results with a 0.85 % GDP growth rate over the planning period.

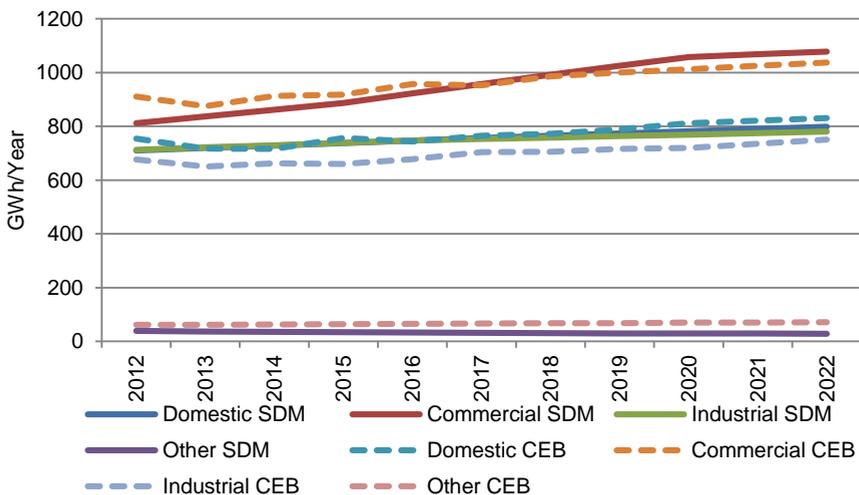


Fig. 11. Sectorial demand projections, SDM simulation (fixed 0.85 % GDP growth rate) and CEB.

The average difference between CEB and SDM results are as follows: 1.9 % in the domestic sector, 1.1 % in the commercial sector, 7.8 % in the industrial sector, and 50.5 % in other sectors.

5. DISCUSSION AND CONCLUSION

This paper described the use of a system dynamics methodology to forecast electricity demand in Mauritius, under a baseline scenario which includes planned generation capacity additions in the next decade. We showed that the SDM is able describe the specific structure and operation of the power sector of the country, and is able to replicate historical trends with an endogenous calculation of GDP, a key variable within feedback mechanisms of the environment/society/economy system, including investment, disposable income, and power demand.

Results show that the IEP and SDM projections are very close in the base scenario, which gives confidence in the CEB methodology. The alternate scenarios of the IEP may however be subject to more analysis, since GDP growth rates of both 6.8 % and 0.85 % in high and low cases respectively are difficult to justify as constants in the upcoming decades. The GDP growth rate for Mauritius was of 4 % in 2014 and such drastic increase and decrease cannot be explained in the one to two year timeframe.

As described in section 3.2, the SDM allows us to input different *desired production increases* for each power generation options of both production actors – CEB and IPP. Hence, various combinations are possible, which incur different costs and effects on the wider system, including electricity demand. These scenarios would allow for the analysis of alternative futures, for instance in relation to low carbon development. As a result, by allowing for the creation of a detailed power sector model, and its integration in a more integrated cross-sectorial model, SDM represent a very good tool for policymakers in that it allows them to test the outcomes of policy interventions across social, economic and environmental variables without necessarily losing the granularity required to inform the formulation and assessment of specific policy provisions.

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