Taking the LEAP in Uganda:

Reflections on Developing urban energy baseline and futures models for Kasese and Jinja municipalities

SAMSET Uganda: Research Report - January 2015

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List of Acronyms

EIA - Environmental Impact Assessment

ERA - Electricity Regulatory Authority (Uganda)

ERC - Energy Research Centre, University of Cape Town

GHG - Green House Gas

GVA - Gross Value Added

HEAT - Harmonized Emissions Analysis Tool

LEAP - Long-range Energy Alternative Planning

MEMD - Ministry of Energy and Mineral Development (Uganda)

SAMSET - Supporting Sub-Saharan Africa's Municipalities in Sustainable Energy Transitions

SEA - Sustainable Energy Africa

TRACE - Tool for Rapid Assessment of City Energy

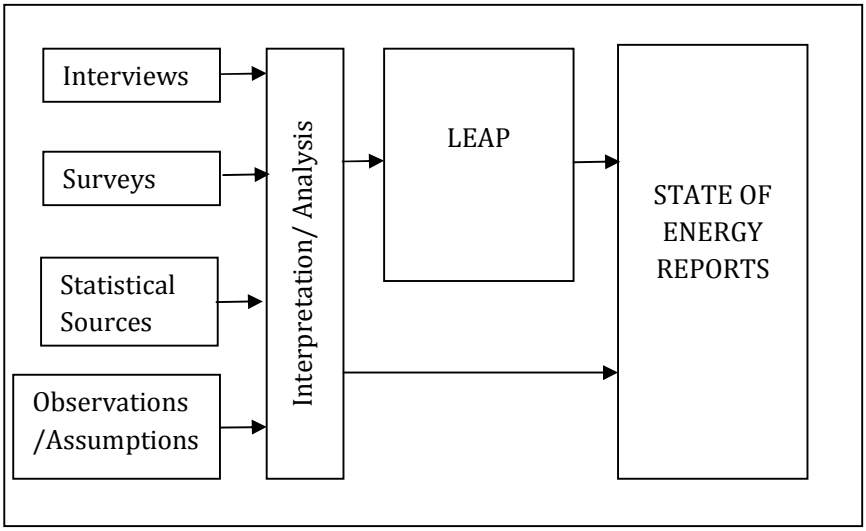
UMEME - Uganda Electricity Distribution Company

Contents

1. Introduction

The aim of the SAMSET project is to support municipalities in sub-Saharan Africa in modelling their energy systems, supporting scenario based planning work, skills training and knowledge transfer and ultimately to help instigate sustainable energy transitions across these urban areas. This report provides an evaluation by the SAMSET team in Uganda on the use of the LEAP (Long Range Energy Alternative Planning System) tool as part of the wider work being undertaken to create baseline data for energy planning in the municipalities of Jinja and Kasese.

Figure 1 - The SAMSET Uganda data collection and analysis process



LEAP has been developed and maintained by the Stockholm Environment Institute and is widely regarded as a useful integrated modelling tool to account for the energy usage and transformation throughout a defined economy, and also importantly the energy and non-energy sector Green House Gas (GHG) emissions resulting from a range of consumption patterns. Yet, examples of its use in urban, low income and data poor contexts is limited and generates the need to think about how such tools may be utilised and incorporated in existing energy planning processes across sub-Saharan African towns and cities.

The aim of the report is thus to reflect on how LEAP has performed as part of the data collection and interpretation process during the SAMSET project, how its functionality and use has been understood by the research team and project partners, its strengths and limitations working in a low-income context, how such work can be supported through other research methodologies, and finally, the challenges and successes of tailoring LEAP to Uganda, in view of the poor quality of data relevant to developing an urban energy baseline. It is hoped that the report will be valuable for a range of energy actors in Uganda, across the SAMSET project and - more widely - for both developers of LEAP and energy planners across other sub-Saharan/low income countries.

The report begins by providing a brief background to LEAP, the way it has been intended to be mobilised across the SAMSET project and the wider debates concerning this tool. This is then followed

by a review of the process by which further data was collected in the field to try and provide sufficient inputs for the modelling and the current status of the work. This is then followed by an evaluation of its strengths and limitations, together with recommendations, both for the SAMSET project and more generally about how such issues can be addressed as the project moves through its four-year cycle.

A number of methodology case studies have been included in Annex 2 of the report that reveal the ways that the team went about the collection of primary data in the field in order to provide sufficient inputs for LEAP. These case studies include reflections on the challenges being faced, and the issues involved during such visits that raise important and real learning examples in relation to using LEAP in Uganda.

2. Background

LEAP is an integrated modelling tool that SAMSET is using in all partner municipalities with the purpose of tracking energy consumption, generation, and resource extraction in all sectors of the economies of the partner municipalities. At the risk of oversimplifying, the tool can be thought of as an elaborate energy accounting program which has the ability to convert all energy figures into common fuel units (usually GigaJoules - GJ) which when multiplied by the number of actors of the municipal economy (i.e. households, factories, vehicles, etc.) will calculate the total amount of energy consumed in a year. Furthermore, LEAP can create future scenarios based on specific changes in public policy, economic shifts, and residential/commercial dynamics and behaviours.

The rationale for selecting the tool has partly been predicated on its use across South African municipalities (including the City of Cape Town) as part of over a decade of work undertaken by the SAMSET project partners Sustainable Energy Africa (SEA) and the Energy Research Centre (ERC) at the University of Cape Town. Other key determinants of the selection of LEAP included: the availability and open access of the software, the flexibility in the data being used especially important for the predicated gaps, the need to keep the data up-to-date throughout and beyond the SAMSET project (expected to be undertaken by academic partners, rather than municipalities) and the ability to import/export data into other software programs.

The developers suggest that "a key benefit of LEAP is its low initial data requirements... [and the fact that it is] well-suited to an iterative analytical approach: one in which the user starts by rapidly creating an initial analysis that is as simple as possible. In later iterations the user adds complexity only where data is available and where the added detail provides further useful insights into the questions being addressed in the analysis"[1]. Whilst the developers claim it has been used in a range of different geographic regions including China, USA, and Philippines (although often at a national, rather than SAMSET's municipal level) employing it within the Uganda context provides an important learning opportunity in thinking about how this system might be used in a series of new contexts such as low income countries that are often characterised by a lack of good quality, up-to-date,

[1] An introduction to LEAP www.energycommunity.org

disaggregated (to the municipal level) data. As such, the experiences of seeking to undertake such a task provide an important assessment of the potential for LEAP to be employed in a series of new contexts and geographic regions. As Tait, McCall and Stone (2014;5) suggest when considering the appropriateness of LEAP to the SAMSET research project, "[a]ttention was therefore given to the ease of use and skills levels required of various models as well as cost and accessibility to the software."

As already mentioned, LEAP is not the only tool that could be used for developing the energy baseline for the SAMSET project. Other systems include the World Bank's 'Energy Efficient Cities Initiative' developed Tool for Rapid Assessment (TRACE[2]) that looks at municipal-controlled energy (e.g. street lights, fleets etc). This is seen as somewhat of a streamlined tool compared to LEAP, yet includes a module to evaluate the potential of a municipality to instigate efficiency measures (i.e. the budgets and energy issues that towns and cities have control over), but perhaps doesn't provide the complexity and richness of data that can be generated through LEAP, nor does it account for the wider (private) spheres of the economy. It does, however, link up to a global database of the energy performance of cities that could be useful in benchmarking the SAMSET municipalities in relation to other urban regions. The SAMSET Uganda team is currently reviewing the potential of carrying out a TRACE exercise in one or both partner municipalities in the second quarter of 2015.

Figure 2 - The LEAP model (Source: http://www.energycommunity.org/)

Other tools that were assessed by the Energy Research Centre, University of Cape Town, but not considered suitable included; Harmonized Emissions Analysis Tool (HEAT), Energy-ENACT, the Municipal Services Financial Model (MSFM), and Energy PLAN. It is interesting to note that the Statistics Department of the Ugandan Ministry of Energy and Mineral Resources tracks the energy balance of the entire national economy using another tool, Energy Balance Studio (sic), developed by the International Atomic Energy Agency. All of these tools have specific strengths and weaknesses that have been considered in relation to their usefulness to the SAMSET project. The Uganda researchers agree with the final choice of LEAP as the primary tool to be used across all six SAMSET municipalities, though familiarity and perhaps even testing of the other platforms by research teams could be useful for professional development as well as lessons for the adaptation of LEAP to the local context.

[2] For further information on TRACE - http://esmp.org Other reports are also available of outputs that have been produced in Ghana.

3. Process/Current status

The LEAP software has been used in the work of the Uganda in-country team to classify the range of sectors that contribute to the energy status of Jinja and Kasese and to develop a current analysis of these dynamics. The use of LEAP to identify these current energy baselines for each municipality has been undertaken before the task of forecasting future trends and dynamics that will be developed with further engagement and consultations with key stakeholders during the next 30 months of the SAMSET project.

LEAP helped to give the team a sense of direction and understanding about the types of data required for developing crucial data on energy in both municipalities. The research was not constrained by the methods needed for LEAP but rather helped to create understanding about the requirements associated with energy modelling and forecasting. Whilst it was not the key determinant in the wider methodology employed to describe and analyse the current urban energy status in the municipal regions of Jinja and Kasese, it has been crucial in providing a guide for the researchers to enumerate and track the information as it is gathered.

Through the process of data entry and analysis into the software tool, the research team has been better able to identify and narrow in on the existing gaps in the current energy picture and to strategise and prioritise future efforts to fill those gaps. A number of surveys, questionnaires and assessments have been proposed to be carried out by the research team in conjunction with the relevant municipal staff members during the first and second quarters of 2015. These include informal household and enterprise energy profiling, a traffic counting survey, a tool for opportunistic electrification programme awareness raising, and rapid assessment for energy in city buildings, street lights, and fleet. See annex 3 for descriptions of each of the surveys.

The task of populating the LEAP model for each municipality has been conducted in parallel as part of the wider task of generating a "State of the Energy" report for both municipalities. Other research including the collection of data from the few existing secondary sources (government statistics, business registries, academic research reports), together with the series of field trips including a range of focus group discussions, observational visits to factories, households and businesses that sought to deepen the amount of data that could be included in the analysis of energy in both municipalities.

The Ugandan team was provided with training that focused on a brief orientation on the tool, rather than an in-depth course that would have led to an enhanced capacity to understand and operate the LEAP software. The expectation was that sufficient capacity to operate the programme would be achieved during the data gathering, entry and analysis processes. This orientation was undertaken during a trip by a member of the ERC who visited the country in April 2014 and including a series of conversations thinking about what types of data could potentially be included in the research. Accompanying the in-country team, a series of visits were undertaken with potential organisations who could provide data, but it was quickly realized that such data was not readily available (or may

not exist at all) in Uganda, especially in the disaggregated (i.e. municipal) level relevant to SAMSET. Following the visit by ERC, spreadsheets (i.e. 'data needs templates') were sent to the Ugandan team outlining all the data that would need to be collected, this included both the current production, consumption and transformation of the various fuels but also historical and forecasted trends in a range of categories:

i) socio-economic drivers (population, GDP etc),
ii) fuel types,
iii) demands from households, industry, commerce, transport, agriculture, local government, etc.,
iv) supply/ sources of energy - electricity/biomass/petroleum/geography of extraction,
v) household categorization (by income, level of electrification),
vi) historic data on commercial floor space (last 3 years), and
vii) informal economy (and types of fuel used)

Useful data sources for this information included:

i) National publications (including statistical reports e.g. MOE, NEMA),
ii) District level publications,
iii) Municipal level publications,
iv) Electricity distributors (e.g UMEME),
v) Associations (e.g. charcoal distributors, transport unions),
vi) International organisation publications (e.g. UN-Habitat), and
vii) Other research reports (e.g. from universities, architects, researchers)

Alongside examining, extracting, and interpolating data from these sources, a number of field trips were undertaken to fill the gaps in information left in many of the categories (e.g. municipality offices, factories, retail businesses, and households). The main method of collection during this phase was through qualitative interviews with municipal and utility company staff, business owners, operations managers, etc. These were useful in that they provided an improvised solution to the data poor landscape for municipal energy.

Up to now, the research team has conducted two visits to each of the two municipalities as follows:
- Jinja, 16 - 18th July 2014
- Kasese, 17 - 19th September 2014
- Jinja, 27 - 29 October 2014
- Kasese, 3 - 5 November 2014

These interviews were supported with a series of site visits and tours of factory installations, shops, or warehouses in which the counting techniques (e.g. number of machines, of lights, of operations) were carried out. Much of this work was to create a sample/model for that type of business, households which could then be multiplied by the numbers in census statistics. See Annex 1 for a list of interviews conducted during each field visit.

Alongside these field trips to the municipalities, activities undertaken for data collection also included several visits to Ministry of Energy and Mineral Development (MEMD), mainly in search of national and district-level energy balances and an attempt to meet with staff from the Electricity Regulatory Authority (ERA). During each field visit, contact information of relevant plant managers, statisticians, and other well-informed individuals was gathered to allow easy follow-up when necessary to clarify or update data collected during the field visits to particular sites and factories and to support a longer term knowledge base.

Figure 3 - Table showing data collected and source

	Source		
Data Collected	Extrapolated from Existing Data	Data Collected in Field	No yet found/collected
Population and number of households	X (National Census)		
Gross Value Addition	X (Macro-Economic Stats)		
Fuel sources of cooking and lighting (district averages)	X (USAID National HH Survey 2012)	X (household observations, interviews)	
Appliance Usage		X (direct observations)	
Retail Petrol/Diesel Sales		X (interviews w/ select station managers)	
Wholesale Petroleum Product Sales (including HFO)			X
Number of passenger and freight vehicles on the road			X
Audits of largest industrial energy consumers		X (direct observations/ interviews w/ plant managers)	
Enumeration and categorization of medium and small industrial consumers			X
Energy audit of model commercial enterprises (esp. restaurants & hotels)		X (direct observations/ interviews w/ managers)	
Energy consumption data and enumeration of informal sector commerce			X

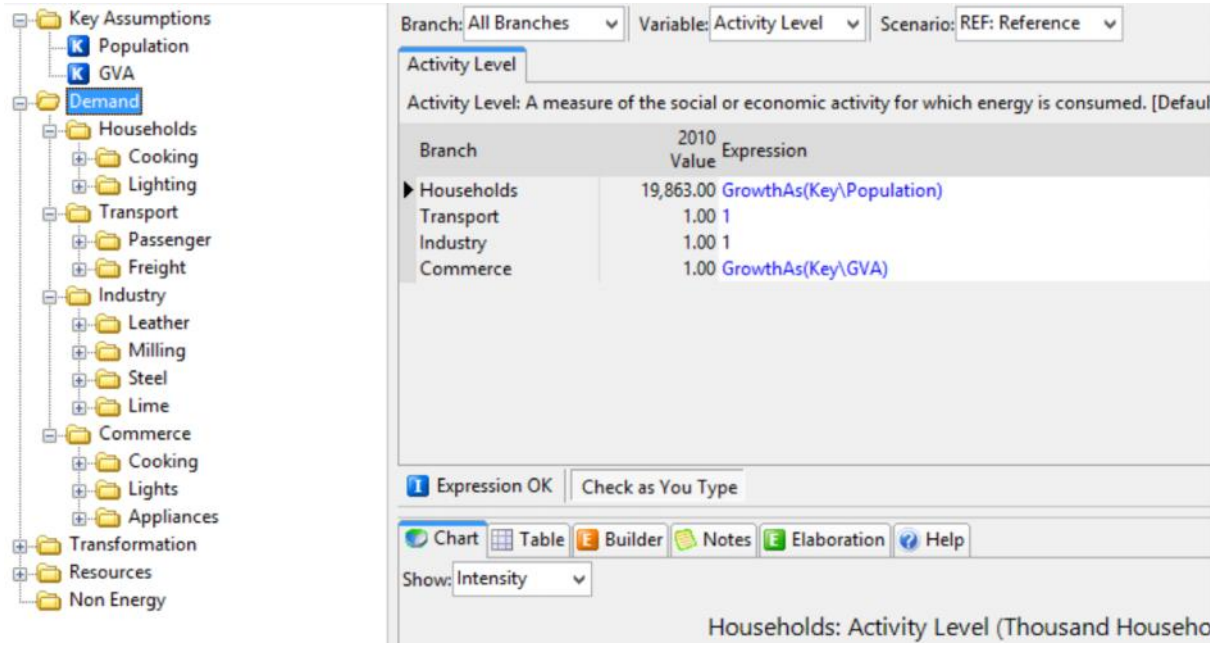
	Source		
Proxy multiplier for unaudited GVA			X
Energy transformation information (charcoal production)			X
Trends and projections for each sector		Limited (interviews with municipal econ. officer/ plant managers	X

3.1. Inputting Data into the model

In order to create a baseline model of the energy system in an area (be it a country, region, district, or municipality), it is first necessary to input the "Key Assumptions," namely the population level and Gross Value Added (GVA - a measure of economic output of the city, including central government subsidies). Census estimates for Jinja and Kasese districts are available from the Uganda Bureau of Statistics. The GVA has been estimated by ERC using national averages of economic output per person, a problematic assumption since urban dwellers tend to produce at higher rates, though must suffice for lack of any alternative disaggregated measures. Other socioeconomic and technological assumptions can also be integrated into the system and used to determine the rates of change of various energy consumptive or productive sectors.
As shown in figure xxx, the "Demand" tree for Jinja municipality has been categorised into 'Households' (denoting the whole of the residential sector), 'Industry', 'Commerce, and 'Transport', each with its various useful subcategories of consumption. It is important for any user of LEAP to comprehend the essential two sets of information necessary for any of these categories, those for energy intensity (i.e. the amount of a particular fuel consumed per unit of time or per unit of production; for example. how many units of electricity is consumed in the production of one tonne of steel?) and activity levels (i.e. the amount of production that occurs in one year; for example, how many tonnes of steel are produced throughout Jinja in 2014).

For households, the data for cooking was extracted from a national level survey of household cooking fuels, the ratio of which allows the researchers to extrapolate intensity levels per household. Lighting information gathered from household audits by the research team, though a better breakdown of household income levels would allow more precision in both cooking, lighting, and appliance consumption levels.

Figure 4 - LEAP model showing demand category tree for Jinja



The industrial and commercial sectors are the most difficult to estimate. In the case of Jinja's industry, the team visited what were assumed to be the largest energy consumers (all fuels considered) and attempted to a) comprehend and input into LEAP the energy intensity of the processes, the production levels of the industry in question, and create a municipality-wide activity level after speaking with factory owners and municipal staff familiar with that particular industry (i.e. what is the annual output of steel for Jinja in 2014?).

Ideally, the LEAP model should be fed data on consumption in all sectors and pricing of all fuels for several previous years in order to understand the trends and growth rates. Unfortunately, the team was not often able to collect such data.

For estimations of energy demand in the transport sector, the team started by gathering information on the quantity of liquid petroleum fuels sold within the designated municipal area. The team then worked backwards, basing on an approximate ratio of freight to passenger vehicles, to calculate the number of passenger-kilometers and tonne-kilometers travelled in an average year. Many tenuous assumptions support this calculation. It would be beneficial to review these numbers, as more accurate data is gathered. One very useful exercise would involve counting number and type of vehicles traveling through the municipalities busiest intersections (see next steps, section xxx). There is special need to determine the ratio and length of trips occurring within the municipal boundaries in question versus those vehicles that have filled their tanks but will consume the majority driving outside of the municipality.

A serious knowledge gap persists in the area of energy conversion especially a comprehensive understanding of the upstream of charcoal production. The team has collected most data and made most estimations on charcoal sales at the retail level and hence, has very little information on the amount of wood being converted to charcoal in the urban and peri-urban areas of Jinja and Kasese.

Figure 5 - SAMSET Uganda team using LEAP

As of early 2015, despite the limitations of "taking the LEAP" in Uganda outlined above, a significant amount of data has been inputted into the tool providing the basis for energy modelling and forecasting. Enthusiasm from the municipalities, together with the ability of the SAMSET team and partners to grasp a series of previously poorly understood energy dynamics suggests that LEAP has provided a useful tool for auditing and enumerating the energy economy in the municipalities. Filling the gaps in data has required a unique, flexible and at times improvised methodology which takes into account the deficiencies in written and catalogued sources, and hinges upon the ability of the field researchers to be resourceful and adaptable. As it stands there is sufficient data in the baseline models of Jinja and Kasese to provide a basis for building future scenarios of energy production, consumption, and transformation based on specific policy or macro-economic changes. Section xx describes the perceived next steps in the data collection stages, the outputs of which would allow an increase in the precision and accuracy of the energy economy.

4. Reflections on the LEAP

From the experience of gathering data for the LEAP model the team has been able to develop a sizable list of both challenges and strengths that must be overcome for the exercise to be useful that provide a wider reflection on the use of the tool in urban Uganda and wise lessons on similar contexts.

4.1. Challenges/ Limitations

The integrity of the model used to inform future policy changes will be limited by the quality of data inputted, and this, in turn, is limited by issues of accessibility, categorisation of economic sectors, logistics, communications, and resources available at the partner municipalities.

Data Access

- Shortage of micro-level data (municipal and household level): The SAMSET research team observed that much of the existing data is national level data that is only disaggregated to district level and not municipal level (an issue across sub-Saharan African countries). Moreover at the municipality level, there is very little data collection and record keeping and documents containing any required data for LEAP were hard to come across.

- Data held on business registries was not accurate for energy data extrapolation. The municipalities did have some degree of business registry although for purposes of tax collection. Therefore it was difficult to determine from the registry, the sizes of businesses, thus energy consumption. For example, two business of the same size, say a restaurant and supermarket might be in the same tax category yet consuming very divergent amounts of energy.

- Informal sector difficulty in accessing and quantifying; The informal sector takes up a significant part of the commercial sector of the municipalities in question especially Jinja and yet it has proved difficult to access and study due to the lack of data on the sector, reflecting wider research issues concerning informalities across sub-Saharan Africa.

- Reliability of data from National Census (September 2014) is questionable. The process of nation-wide data collection seemed rushed (10 days) and there were reports that the exercise was underfunded. Inevitably therefore, the generated census figures are questionable.

Categorisation

- Differentiating between various household income levels (low/middle/high); Households are not categorized into different income levels such as low, high or middle income making it difficult to determine the number of each house hold type existent in the different municipalities.

- Lack of data on scale of industrial sectors. The municipalities do have general data on the existing industries although that data was not categorized into low, medium and large scale industries thus making it difficult to estimate activity levels and energy consumption per category.

Communication

- The different timelines of SAMSET required outputs/presentations of the State of Energy draft reports before even modelling had been sufficiently done. This rush to beat deadlines can compromise the quality of data and perhaps reflects the different data context of Uganda compared to South Africa and the amount of work required to generate this information.

- Language barriers in collecting data (especially at household level and across informal businesses); By nature, energy data collection is technical and the research team faced challenges in translating some of the content into local languages during the interviews. For example some local people were

unable to interpret their electricity----Spell this out --(UMEME) bill and therefore unaware of their monthly electricity consumption.

- Translation takes time and resources; As a result of language and knowledge barriers encountered at household level data collection, the research team had to take time interpreting interview questions into local languages and translating energy concepts; which exercise takes time and resources.

- Complexity of the software creates a steep learning curve for new users, especially for non-technical researchers.

Logistics

- Long distances to visit municipalities. Kasese and Jinja Municipalities are located outside Kampala, the capital city and base of the project. Kasese being nearly 300km from Kampala meant that a high proportion of the allotted research time is spent on the road to and from the field, leaving little time for the actual research. This has proved costly and time consuming.

- Difficulty of getting authorisation from head offices in Kampala (e.g. UMEME). Field offices require authorisation from their head offices in Kampala which process is lengthy and bureaucratic.

- Data needs document difficult to understand for municipal staff. Because the municipal officers are not trained in energy issues, it was difficult for them to appreciate the data required for modelling which necessitated frequent field visits as opposed to a potentially cheaper option of liaison via email or phone. (not trained in energy issues).

Municipality Resources

- Poor documentation and evidence base at municipality; The research team found that there is very little compilations of data at municipalities in form of hard copy documents or electronic systemic resources, again a problem experienced across sub-Saharan countries. Therefore much of the data was passed on by word of mouth in estimates which can affect the accuracy of data and eventual models.

- Difficultly for sustained involvement by municipal staff due to multiple time constraints and pressures in their official designations at the municipality. Therefore they could not devote ample time to SAMSET field work and data collection.

- Several posts in municipalities are vacant, meaning individuals having to cover several areas of work, multi task and thus time pressured. The amount of time they are able to dedicate to the SAMSET research, whilst also undertaking multiple other task has therefore been limited.

- Changing boundaries, forms and institutions of governance structures (e.g. Kasese municipality established in 2010) meaning these institutions are often still setting up processes, data,

responsibilities and such like. In Kasese for example, a major chunk of the originally rural area was annexed to the urban area and therefore still undocumented and characterised by high degrees of informality.

4.2. Strengths

Despite the limited availability of readily useable data, the LEAP model and the methodology employed by the research team performed well on a number of levels that suggest it has value as a tool of energy planning across Kasese and Jinja and importantly other low income, urban and data poor contexts. In relation to the SAMSET projects aims to ultimately support sustainable energy transition, ultimately dependent on understanding current and future energy dynamics the LEAP tool has been able to perform an important role in supporting municipalities to begin to engage with energy issues, to create a data baseline and to think about future scenario. This is particularly important in the context of Uganda a country in which energy planning has previously been undertaken at a national level. Providing the ability to engage and equip municipalities to think about energy in a new field of action, policy and strategy development, drawing in a range of actors with little experience of energy matters has provided challenging, yet the ability of the LEAP tool to create momentum and enthusiasm ha been central part of the wider process.

LEAP Model

- The LEAP software is a flexible tool that does not require a complete data set to begin analysis of the energy demand and supply and allows for easy visualization of shares of the economy and fuel demand and supply. This is vital in relation to the SAMSET work in Uganda and provides an important example of how LEAP can be used in low income, data poor and urban contexts.

- Enabled the research team to analyse and prioritise data gaps for subsequent iteration of field interviews and production process audits. Whilst sufficient secondary data was not available in Uganda LEAP helped to prioritise the most important data types to be collected during limited fieldwork.

- The draft models and accompanying print-outs facilitate discussion with municipal authorities and are considered a tangible output of the project.

Current Methodology

- The improvised methodology described herein has yielded good data on types of households and businesses that has then been scaled up as representative for estimating.

- Field work rather than desk-based analysis has helped create better understanding of the realities on the ground for the municipality and project team and perhaps created better synergy amongst the larger SAMSET project stakeholders.

- Some data sets in Uganda are very accessible and up-to-date (e.g. population, municipal household categories and statistics, industrial applicants to EIA, some interesting statistics on the informal settlements, etc.). The ERC was able to extrapolate national data to represent urban situation (i.e. using national-level per capita averages and multiplying by number of population to yield estimated figures that could then be cross-checked with ground-level collected data).

5. Conclusion

5.1. Taking the LEAP

This report has provided an evaluation of the activities undertaken as part of the SAMSET project's objective of developing a robust and effective amount of data in order to use the LEAP tool for effective energy modelling and forecasting for the municipalities of Kasese and Jinja.

As part of this reflection the report has suggested a series of strengths/limitations linked to the LEAP tool and its effective operation in the urban Uganda context. The aim of this reflection has been two-fold. Firstly, to reveal important lessons and experiences on how LEAP might work in an urban, low income and data poor context. Secondly, to reveal the methodologies and strategies that can be employed to navigate the outlined limitations.

A series of recommendations have been suggested that are orientated around the needs of the SAMSET project over the next 12 months, together with longer term considerations for the LEAP developers, researchers and practitioners involved in municipal energy planning across sub-Saharan Africa and municipal partners in municipalities (see figure x below). Further work will be undertaken by the Uganda SAMSET team and after the modelling and forecasting stage of the work to undertake another evaluation taking the LEAP in Uganda.

5.2. Recommendations

The energy models developed under the SAMSET project using LEAP and the above methodologies are works in progress which will be modified, refined, and added to as more data is collected. Efforts by the ERC and Ugandan research team have yielded an approximate picture

LIMITATIONS	**What SAMSET can do**	**LEAP into the future**
Limited prior training	Organize intensive training at ERC for core SAMSET team(1-2 weeks)	Effective evaluation at the beginning of project to ascertain the skills and training needs required to undertake work associated with LEAP in new context

Lack of user friendliness		-Try alternative modeling tools such as TRACE which are more focused on municipal development although this has limitations; to buildings and national-level situations
Not sensitive to low income, data poor situations	Development of methodology in data poor countries to generate required data (see examples from Ugandan team)	Engage with LEAP developers to understand how LEAP can be applied to urban-rural, low income, data poor situations
Lack of context sensitivity	Carry out workshops in-country partners lead by ERC to assimilate LEAP in the local situation	
Poor record keeping at municipal level	Facilitate Municipalities in keeping books as an exercise to prepare for the data collection and modeling exercise	
Data poor situations/ data not tailor-made to LEAP requirements	Create templates for municipalities to infill data	
Not well documented informal sector	Create parallel surveys to support LEAP as an inlet into the informal sector	

5.3. Proposed Next Steps

Considering the lessons learned over the past 16 months of SAMSET implementation with the LEAP tool and accompanying methodology, the team envisions a robust action plan for the immediate to medium-term which includes intensive training and additional data gathering.

- Further training in LEAP led by ERC either in the municipalities or at the offices in Cape Town. This would provide the opportunity to develop a comprehensive understanding of and ability to use LEAP and help to establish long term capacity building around energy planning in Uganda.

- Plan more time exchanging data with the Statistics Office of the Ministry of Energy and Mineral Development

- Finish and circulate a template for municipal officials to infill regarding current and projected energy usage and economic activity;
- Seek formal introductions from head offices of utilities and major stakeholders (e.g. UMEME) in order to facilitate formal partnerships, ease of access to data sets and establish opportunities for more municipal level action.
- Develop and carry out some robust, quantitative and parallel surveys into the transport, commercial and informal sectors.
- Review national census data as soon as this is released; and
- Conduct a series of LEAP and associated energy planning workshops at municipality level.

Annex 1 - SAMSET Uganda Field Visits and Interviews

Jinja
16-18th July 2014
- Interview with manager of Bridgeway Guesthouse (small hotel)
- Interview with manager of Source of the Nile (large hotel)
- Interview with cafe owner (30 seats)
- Interview with head of medium income household
- Interviews with workers at informal welders workshop
- Small energy audit on small supermarket (1000 square foot)
- Interview with managers of x 3 petrol stations
- Interview with head teacher of primary school
- Interview and tour of large brewery
- Visit to large appliance retailer (focused on new domestic appliances)
- Interview with municipal physical planner and surveyor
- Visit to casino (focused on leisure businesses)
- Interview with matutu driver (Jinja to Kampala line)
- INterview with motorcycle taxi drivers
- Energy audit on hair salon
- Interview and tour of large lime production factory

Kasese
17-19th September 2014
- Visit of large cement factory; discussion with Industrial Ecology Coordinator
- Visit with municipality staff
- Visits to municipal solid waste composting site, city abattoir, and coffee hulling enterprise\
- Meeting with the mayor of Kasese
- Interview of recent national census enumerators
- Interview with municipal finance officer
- Meeting with Deputy Town Clerk/Economic Planner
- Field visit to Mobuku III Hydropower station

Jinja
27-29 October 2014
- Meeting with Town Clerk and Environment Officer to discuss initial data picture (created from LEAP) and objectives of the mission
- Brief unsuccessful visit to Jinja UMEME electricity distributor offices
- Visit to large tannery and interview with plant manager and process manager
- Meeting with members of Jinja Municipal Development Forum and Environment officer
- Visit to eco-friendly materials workshop set up by Slum Dwellers International
- Presentation of Policy Case Study to Municipal Engineer, Planner and Deputy Town Clerk [postponed due to other commitments of participants]
- Visit to steel mill and discussion with Electrical Manager
- Brief meeting with municipal councilors, town clerk, and District Chief Administrative Officer

- Meeting with Uganda Sustainable Construction Association to discuss alternatives to energy-intensive baked brick construction

Kasese
3-5 November 2014
- Meeting with Town Clerk and Community Development Officer to make a plan of action
- Presentation of case study to Municipal technical staff
- Visit to UMEME office
- Interview managers x 2 supermarkets (large and small)
- Interview managers x 2 petrol stations
- Visit to Kilembe Mines (incl. informal settlement)
- Visit to Margherita Hotel (37 rooms, small audit on energy)
- Visit to Kayanja (fishing village, off grid, solar micro-grid project)
- Final meeting with Town Clerk and Community Development Officer

Annex 2 - CASE STUDIES

Case Study 1: Formality Vs Informality

When it comes to LEAP interviews, formality versus informality is a key choice as can be seen in following two interviews at the UMEME offices in Jinja and Kasese municipalities. Like with other interviews before, the research team set out with an intention of going about it informally, which as we have discovered is the easiest way of getting information especially in potentially bureaucratic systems. The official from Jinja Municipality who went with us for the interview suggested a more formal approach which, being a government employee is what he is used to. He therefore drafted out a letter on headed government paper, indicating that the visit was authorized by the Town Clerk's Office. That letter turned out to be the bane of our interview because the manager took one look at the letter and acquired a very formal stance, ordering us to send a copy of it to the head office seeking permission from there to carry out any interviews. She remained unyielding as far as volunteering information and said that the process of acquiring the said permission would take from a fortnight to one month after which we would have to travel back to Jinja and carry out the interview.

A similar but quite informal interview in Kasese went in a completely opposite direction. The team approached, impromptu with no letter or formal introductions, just "making a courtesy call" for informal discussion on electricity distribution in Kasese. The officer offered us seats and out of duty not necessity called his area manager informing him of our visit. He was more skeptical but only because as we had been informed by the officer, was new to the job and eager to do due diligence with every activity. Therefore, like the Jinja Manager, he requested clearance from the head office, which the team agreed to. However, we then shared our experience so far in Kasese ; the visit to Mobuku dam and Hima cement and seconds later he joined in volunteering information about electricity distribution in Kasese, For example from him we learnt about the OBA project, the main consumers of electricity in Kasese and other valuable tit bits. Needless to say, an informal approach proved beneficial under the circumstances.

Lessons Learnt

The essentiality of improvisation and building relations as an in-root to collecting data from potentially difficult interviewees
-The need to acquire all the necessary permission from head offices before heading out to the field, although sometimes it is difficult to ascertain all the required permission. (Josephine)

Case Study 2: Breaking Down the UMEME Bill

One old lone figure on the verandah of an aging post-colonial house is watching the road, her maize cobs spread out in the sun to dry in the large compound of her daughter's estate- the daughter who lives in Kampala but pays the bill monthly; utility and satellite TV bills, the latter without fail so that her twin daughters, the old woman's grand children can be entertained hourly, daily, weekly and monthly.

Our arrival is greeted with wariness; the team of two who could be anything from walkers who have lost their way, door-to-door evangelists or bill collectors but certainly not researchers into that which eludes her on a monthly basis; the green and white UMEME bill she cannot read because it has no Luganda or Lusoga translation. However, once they introduce themselves as SAMSET researchers, enquirers into Long Range Energy Alternatives; planners with a vested interest in her energy future, the bill becomes a prop that sets us on common ground. the twosome is the old woman's dream come true; a magnifying glass to help her make sense of what is eating up the largest chunk of the allowance her daughter sends monthly. She, on the other hand is the bane of LEAP's existence; a single micro entry with no records to enter into a statistical sheet. But the researchers take the chairs she excitedly offers, retrieve their pens, magnifying glasses and Luganda vocabulary because for the next hour they shall translate kilowatt-hours, amps and appliance types.

"Aaaah!" it finally dawns on her after no less than an hour; the revelation that the electricity bill has been accurate all along. "But what can I do to keep it down?" The old woman enquires, not sure which would be wiser; switching off the fridge and forfeiting ice-cold water or denying her adorable granddaughters two hours of Cartoon Network a day. That the team leaves to her discretion and armed with a table of calculations and statistics; the copy they quickly made after she requested an original she couldn't read, they head off into the sunset in search of more homes to invade.

Lessons Learnt

-LEAP gets significantly slowed down in situations where translation of energy issues is part of the data collection process

-The model is enriched by interviews as opposed to merely garnering statistics and overall data figures

-Every situation is unique

(Josephine)

Case Study 3: Informal Industrial Visits- Understanding the Lime Process

While driving near the municipal market, the researchers spotted a billowing smoke stack a few blocks away and so directed the driver down a dirt track towards the obvious sign of combustion-oriented industrial activity. From the outside, it would be difficult to ascertain the name or exact nature of the business since African Minerals, Ltd lacked any signage, but with the numerous large dump trucks full of stone and rough-cut wood sitting outside, the team knew this was a large operation.

A quick inquiry at the guard shack brought the site engineer out with a warm greeting. Introducing themselves as researchers with a Ugandan university interested in Jinja's energy sector seemed to elicit an openness to ask any question we needed. So, beginning in the shipping container head office, the team began asking questions about electricity consumption, input and output of product, wood and charcoal burning processes. Eager to show his work, the engineer gave a tour of the entire factory explaining the machinery and future plans for expansion, refurbishment, or discontinuations of particularly low margin products.

As it turned out, this site was but the humble beginnings of African Minerals, Ltd, and soon the researchers were being whisked away to a much larger lake-side factory a few kilometers away. Here the company had designed and was constructing a new Heavy Fuel Oil-powered kiln which would greatly increase output while reducing the energy consumed per tonne. By soon transferring all production to this site next to Lake Victory, the company planned to begin shipping raw material in and finished product out via newly purchased and refurbished ships at a newly created dock thereby greatly reducing the transport costs and embodied energy of their product.

The daily consumption of wood is measured in scores of tonnes, which adds to the humor of the engineer's account. One day he arrived to work to find the laborers wielding machetes heading for the small stand of towering palm trees next to the main building. When asking their intention, they informed him that the supply of wood for the kiln was nearly exhausted and they would fell these last remaining trees to get just a couple more hours of production. Appreciating the initiative, he quickly ordered them to stop. The next dozen years of shade, he explained to them, was more important that an extra hour or two of output. This was yet another example of the engineer's keen interest in Long-range Energy Planning.

The researchers exchanged contact information with him and expressed their wish to be updated on the progress of the company's progress on it ambitious goals. It turns out that African Minerals, Ltd is one of the two largest lime manufacturers in the country, but yet there is no proper signage nor any avenue through which the team could understand the energy dynamics its production line; an almost accidental visit to the site and a discussion with the friendly engineer was the best way to obtain the data. Incorporating all of the current and projected data into the LEAP model would be an excellent learning process for the researchers once back on campus. (David)

Annex 3 - DATA GAP FILLING SURVEYS

The research team has gathered a significant amount of energy-related information from secondary sources and stakeholder interviews in each municipality. However, there persist gaps in the data which can only be filled through large-scale primary data gathering. It is therefore recommended that the team focus attention on conducting the following surveys in each municipality:

1. Informal Household and Enterprise Energy Profiling
2. Traffic Counting Survey
3. Tool for Opportunistic Electrification Programme Awareness Raising
4. Rapid Assessment for City Energy

The above shall be implemented in each municipality over the course of the first quarter of 2015. The final report of each shall constitute, in addition, "Energy Research Reports" for inclusion amongst the outputs of the SAMSET project; they may also be published in other audiences inside or outside Uganda.

1. Informal Household Energy Profiling

Research has been carried out through the World Bank ESMAP project to profile the energy sources in the informal domestic sector. Specifically, our partners in Ghana can rely on information gathered in 2011 by the KNUST Centre in the Scoping Study done in three urban slums around Ghana[3]. The data gathered is very important in trying to understand the energy options of a large number of urban dwellers. As far as we know, such information does not yet exist for Uganda.

Research Questions:
Households - What is the availability of energy supply in the slums? Which types of energy are households using for various domestic purposes including cooking, lighting and powering appliances, and what are their unit prices? What is the household income and how much do they spend on the various energy types per day/week/month/? What are the household's attitude towards and preference for modern energy fuels and quality of electricity/LPG, etc. as well as their ability and willingness to pay for them?
Enterprises - What are the preferences or choices of energy for various services (e.g., lighting, cooking, etc. at household and enterprise levels)? What is the cost and quantity of energy input for the business/enterprise compared to alternative modern energy fuels? What price per energy-service (kilo-lumen hour of lighting) by different energy types? How is the availability and regularity of energy supply?

Methodology:
A simplified version of the survey done by KNUST with a narrower scope and shorter questionnaire, etc.

[3] Brew-Hammond et al. (2011); Energy Access and Productive Uses for the Urban Poor. Energy Sector Management Assistane Program (ESMAP), The World Bank; Final Report on the Ghana Scoping Study.

2. Traffic Count at Major Intersections

One of the major gaps in project data involves number and types of cars on the roads of the partner municipalities and the trips taken by such vehicles. The data we currently use in the LEAP model is a fairly educated but wild guess based on retail fuel sales. One simple way of gathering more accurate estimates is to count cars, motorbikes, and trucks as they move on the roads.

Research Questions:
How many vehicles of each type are moving on the major roads of the municipality each day? In which direction are these vehicles moving during specific times of day? What is the average number of riders in each vehicle for each trip? From these counts and interviews with drivers we can infer the annual passenger-kilometers and tonne-kilometers for each municipality.

Methodology:
Manual observation is a very traditional method involving placing observers at specific locations to record vehicle or pedestrian movements. At its simplest, observers use tally sheets to record numbers, but there are also mechanical and electronic counting boards available that the observer can punch in each time an event is observed. It can record traffic numbers, type and directions of travel.

p.s. Could also include a travel diaries[4] for municipal employees which could be good sources of information as well as the basis for future "energy efficiency contests".

3. Tool for Opportunistic Electrification Program Awareness Raising (TOEPAR)

Introduction

A new programme, known colloquially as 'OBA'[5], was launched in late 2014 by the Ugandan government in partnership with international donors to assist low-income households to connect to an electrical grid in the immediate vicinity of their residence. It is assumed by the programme designers that the predominant reason for which a household has not made a connection to an electrical line despite the close proximity is because of a lack of capital to invest in the fees for connection and installation of a pre-paid meter. This Electrification Programme subsidizes 100 per cent of the of cost of the connection with a goal of xxx number of connections throughout the xx -year life of the programme. It stands separate from the various projects to extend the grid to previously un-electrified areas mostly managed through the Rural Electrification Authority (REA).

The Kasese area with its high number of hydroelectric schemes has a large surplus of electricity and hence, has good potential for this project. For the national grid as a whole, sizeable losses are suffered in the transfer of power hundreds of kilometers away to areas of higher demand (e.g. Kampala or Mbarara); a more efficient arrangement would be for the households and businesses in Kasese to consume that power. The idea is to increase demand in this region to soak up the existing and planned surpluses of electricity produced locally.[6]

[4] soliciting respondents to keep a diary of the trips undertaken, times, purposes, modes etc.; extremely useful instrument constrained largely by the number of people willing to complete such a detailed inventory.
[5] OBA stands for Output-Based Aid which is a global programme of the World Bank which has many project around the world. It is assumed that a more specific title for the Ugandan electrification project will be announced soon.
[6] An additional 10 small hydro project are in various stages of planning and construction in the Rwenzori region.

Households wishing to qualify for the subsidised connection will need to pay for the wiring of at least one room of their home by a certified electrician and get the agreement of all neighboring owners through whose land the connecting wire will pass. The details such as cost and procedural steps of such requirements will need to be explained.

Purpose

The intervention of the SAMSET team proposed herein would be to support the staff of Kasese Municipality to increase community awareness of the programme and the socioeconomic benefits of electrification. The outputs of this intervention are three-fold: 1) a brief geographical assessment of priority neighborhoods, 2) the communication tools to be used by the staff when making home visits, and 3) a simple evaluation tool to assess progress.

As a public servant, the staff member is in a good position to advise the householder and warn against malicious practices by electricians or other "middle-men" who may overcharge and/or provide shoddy work. Moreover, municipal staff such as community development officer, is often in the community for other purposes

Step 1 - Geographical Assessment

The first step would be a visit to the local office of UMEME (retail electricity distributor) to source a map of the eligible low-voltage electrical lines within the municipality. The GIS unit of UMEME in Kampala may also have this information as well as cadastral maps of all connected homes and businesses. These can then be digitized and overlayed (or simply drawn onto) a satellite image of the municipality. Color codes can be used to identify priority areas where the appropriate power lines are present, however few residential structures are connected.

Step 2 - Communication Tools

Using materials procured in through the KfW[7] and the REA, SAMSET staff shall design two simple posters: one explaining the benefits of electrification, and one explaining the process of qualifying for a connection and the billing cycle (e.g. monthly fees, unit costs, etc.). In addition, a brief brochure shall be designed with the above plus relevant contact information (including nearly certified electricians) which could be left with the householder after the discussion with the municipal staff member.

Step 3 - Evaluation Tool

It is important to track the number of households contacted, followed up with, and ultimately, the number that get connected through the 'OBA' programme subsidy. Tracking statistics and compiling qualitative stories can provide an excellent motivation for the staff and eventually lead to publication and distribution of "best-practices" (e.g. number of follow-ups needed, socioeconomic data, additional barriers, quality of life improvement, benefit of municipality-led awareness raising campaigns). Ultimately, additional funding may become available from government or the very same donors financing the electrification programme.

Indicative Timeline

Item	**In Charge**	**Timeframe**

[7] The German Development Bank, co-funder of the programme.

Step 1 -Mapping	SAMSET	Week 1 – 4
Step 2 - Communication	SAMSET/Municipality	Week 2 – 5
Implementation	Municipality	Week 6 – 14
Step 3 - Evaluation	Municipality/ SAMSET	Week 4 – 16

4. Rapid Assessment of City Energy

The municipalities have expressed interest in understanding better the consumption of energy in day-to-day operations as well as the potential practices and behavior changes which could bring about efficiencies. TRACE is a computer programme[8] providing an interesting step-by-step methodology for carrying out a rapid assessment of the above and comparing against other cities in the world. As with the other surveys described herein, this one is designed to incorporate the assistance of the municipal staff and authorities in the collection of data and the choice of energy-reducing strategies.

Research Questions

How much energy is being consumed in each municipal function? How much of the city budget in being used for petrol and electricity? Do municipal authorities have the mandate (or motivation) to tackle these expenses or are they central government concerns? How do Jinja and Kasese municipalities compare with similar-sized cities around the world in terms of energy consumption? What technologies or behavior changes can be introduced and in which order of priority?

Methodology

From the programme: TRACE contains a database of sector specific Key Performance Indicators (KPIs) and each of the data points that make up these KPIs, as well as a range of city specific contextual information. This will be collected, with the help of the City, prior to the application of TRACE.

Screenshot

[8] Downloadable for free at http://esmap.org/