International Journal of Applied Research 2017; 3(5): 668-671

International Journal of Applied Research

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(5): 668-671
www.allresearchjournal.com
Received: 13-03-2017
Accepted: 14-04-2017

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Methodology to predict and save standby power in network enabled devices

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Abstract
In this paper I propose bottom up methodology to predict, estimate and save standby power and CO_2 emission in network enabled devices. Bottom up method is used; Bottom-up estimates are used to estimate either average standby per home or national standby power consumption [1]. This method is accurate for common appliances with a large number of measurements and with a known penetration.

Keywords: predict, estimate, consumption, measurements, penetration

1. Introduction

A Network is a group or system of interconnected things made up of individual devices, communication paths/links between the devices, and technologies for managing the communication and data flow. A link enables data to be exchanged between any two devices within the network, usually via one or more intermediate devices (nodes), link can be wired or wireless media. Internet is an example for computer communication network. The energy consumption of physical components of network depends on the actual implementation Fig 1. Network equipment connects Edge devices on LAN to WAN through network interface for providing network functionality.

- Establishing and maintaining a network link (physical),
- Establishing and maintaining a network connection (protocol),
- Utilizing the network connection (payload traffic)

The initiation (establishing) of a link or connection is bidirectional and requires energy for above conditions. With increasing network capability and possible number of network options i.e wired and wireless network, energy consumption is typically increasing as well [2]. Electronic Edge Devices are those devices where the main function is data. They may undertake any combination of acquire, process, store, transmit, or display information. Common types of electronic products are computers, printers, tablets, phones, set-top boxes, televisions, and other audio and video equipment. The dependence and level of integration of the network connection varies by product. Other Edge Devices, this category is potentially large and contains all appliances and equipment other than electronic devices, their primary function is not data. Includes lighting, kitchen and cooking appliances, washing machines, heating, cooling equipment and all types of commercial and industrial equipment. There are two important things to note about this category of products. First, today most do not have network connections and they can operate satisfactorily without a network connection. Second, the purpose of most network connections is to enhance some element of user interaction (such as remote control using a smart phone) or to provide response to the Smart Grid or optimization under real time tariffs. Stand-alone Devices, Historically, most devices were not connected to networks. However, it is likely that few products will fall into this category into the future. These products can be covered by stand-alone standby power policies if they have low power mode consumption of concern. Network infrastructure includes servers, data centers, data security systems, enterprise storage, data storage equipment, load balancers, they collectively manage and manipulate the data within the network as well as service application requests from edge devices. Networked devices draw at least some power most of the time. Technologies that enable Internet of Things are grouped into three categories Fig 2:

- "Things" to process contextual information,
- "Things" to acquire contextual information, and
- Improve security and privacy.

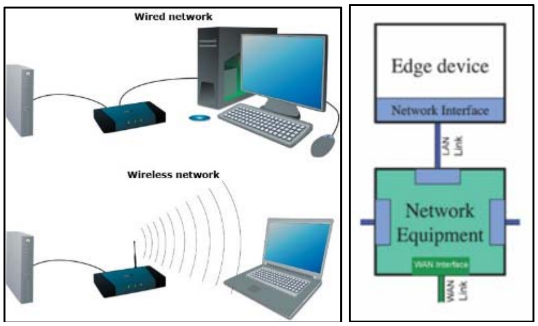

Fig 1: Network and Network Equipment.

Fig 2: Internets of Things Enabling Technologies.

The methodology to predict network standby consumption is divided into five parts. Fig 3.

- In the first part, data related with the electrical appliances in India households was collected with the use of BUENAS model.
- In second part projection of electrification and electrified households.
- In third part ownership of appliance is projected considering appliance with data.
- In fourth part, standby consumption of proposed system, BAT, existing appliance with standby reduction devices was measured.
- In the fifth part, network standby power consumption is analysed in order to predict consumer behaviour and patterns, market penetration of appliances.

Fig 3: methodology to predict network standby consumption.

2. Modelling Residential & Commercial Energy Use (from Demand to Supply)

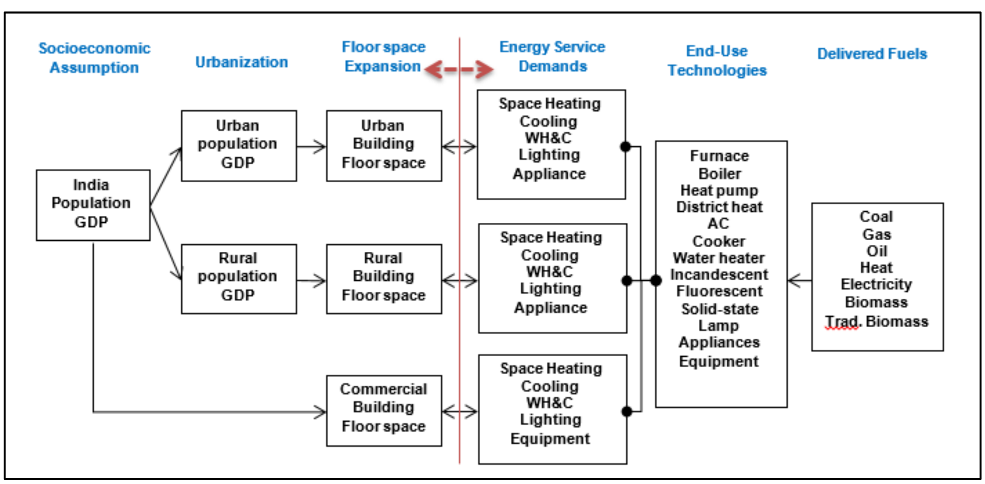

Fig 4: Proposed Energy Demand Model Frameworks for Residential & Commercial Energy Use.

Bottom-Up Energy Analysis System (BUENAS) is a bottom up approach modelled for energy service demand projection through various types of energy consuming end-use technologies which are installed at residential and commercial buildings, Fig 4. This global model aims at projecting efficiency improvements for technical assessment of proposed, current or possible policies [3]. The end-use approach examines the household electricity consuming devices, ownership and the impact of other geographical (e.g., rural/urban and regional/state dummies), economic (GDP growth, prices), demographic (population growth, urbanization) and factors and considers efficiency scenarios from an engineering way, as opposed to econometric approach. India is in the middle of a demographic shift that is expected to drive growth. India's population is changing in three main ways: urbanization, high income and the proportion of working age people is growing due to declining fertility rates.

The following appliance groups are covered:

- Residential End use: Space Heating and Water Heating & cooling, Light, Washing Machines, fridge, AC, Fans, Standby Power, Televisions, Electric Ovens,
- Commercial Building End use: Ventilation, Lighting, Refrigeration, Office Products, Air Conditioning, Space Heating and Water Heating,
- Industrial End use: Electric Motors, distribution transformer.

National energy demand of each end use is constructed according to the following modification of the Kaya identity [4].

$$\text{Energy Demand} = \frac{Activity\ X\ Intensity}{Efficiency} \quad (2.1)$$

In this equation, Activity refers to the size of the operating stock (number of fans, bulbs in home). Intensity is usage and capacity of each unit, the hours of use of a room air conditioner. Efficiency is the technological performance of the equipment and can be affected by government policies.

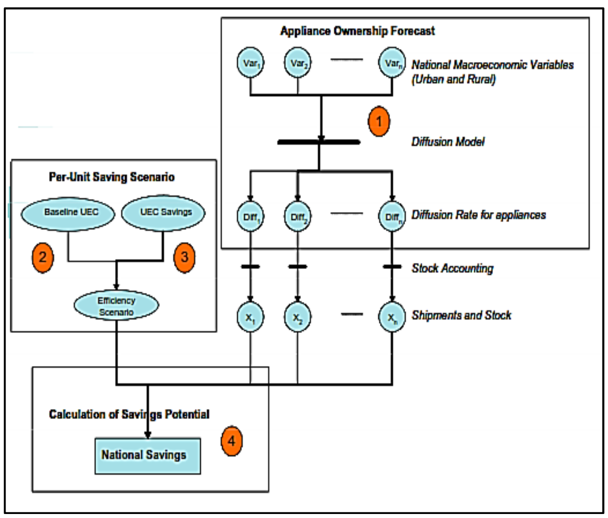

Fig 5: Buenas Model.

2.1 Equations for calculating potential savings

CO2 Emissions Mitigation

$\Delta CO2(y) = \Delta E(y) \times fc(y)$ (2.2)

$\Delta CO2(y)$ = CO2 emission mitigation in year y

Δ E(y) =Final Energy Savings in year y

Fc = carbon conversion factor (kgCO2/kWh or kg/GJ) in year y KgC/kWh = 0.27 x (kgCO2/kWh)

Final Energy Savings

Final energy savings (electricity or fuel) is calculated by comparing Efficiency Case (EFF) energy demand and Business as Usual (BAU) energy demand:

$\Delta E(y) = E_{BAU}(y) - E_{EFF}(y)$ (2.3)

2.2 Residential Sector Activity Equations

Final energy demand is calculated according to unit energy consumption of equipment sold in previous years:

$E_{BAU} = \sum_{age} Sales(y - age) \times UEC_{BAU}(y - age) \times Survl(age)$ (2.4)

Sales (y) = unit sales (shipments) in year y

UEC (y) = unit energy consumption of units sold in year y

Survl (age) = probability of surviving to age years

Stock Turnover

Sales (y) = Stock(y) –Stock (y-1) $+\sum_{age} Ret(age) \times Sales(y - age)$ (2.5)

Stock (y) = Number of units in operation in year y

Ret (age) = probability that a unit will retire (and be replaced) at a certain age

Survival age and retirement age are related by:

Survl (age) = 1 - $\sum_{age} Ret(age)$ (2.6)

Stock

Stock (y) = Diffusion (y) × HH(y) (2.7)

Diffusion (y) = Number of units (owned and used) per household in year y

HH (y) = Number of households in year y.

If sales data are not available, then appliance diffusion (ownership) rates are used. In turn, diffusion rates are generally not given by input data, but are projected according to a Macroeconomic model:

$$\text{Diffusion (y)} = \frac{\alpha}{1+\gamma\times exp(\beta 1\times I(y)+\beta 2\times U(y)+\beta 3\times E(y))} \quad (2.8)$$

I (y) = household income (GDP per household) in year (y)

U (y) = urbanization rate in year (y)

Elec (y) = electrification rate in year (y)

$\alpha, \gamma, \beta 1, \beta 2, \beta 3$ = model parameters

2.3 Commercial Sector Activity Equations

$E_{BAU} = \sum_{age} Turnover(y - age) \times uec_{BAU}(y - age) \times Survl(age)$ (2.9)

Turnover (y) =equipment floor space coverage added or replaced in year y.

uec (y) energy intensity (kWh/m2) of equipment installed in year y.

Turnover is motivated by increases in floor space, and replacement of existing equipment occupying floor space.

$Turnover = F(y) - F(y - 1) + \sum_{age} Ret(age) \times Turnover(y - age)$ (2.10)

F (y) =total commercial floor space in year y.

When floor space is not given by direct data inputs, it is modelled as the product of two components:

F(y) =N_{SSE}(y) ×f(y) (2.11)

In this equation, N_{SSE} is the number of service sector employees and f is the floor space per employee. N_{SSE} Is the product of the economically active population PEA and the service sector share SSS:

N_{SSE}(y) = PEA × SSS(y) (2.12)

Floor space per employee is modelled in a similar way to residential appliance diffusion:

$$F(y) = \frac{\alpha}{1+\gamma\times exp(\beta''\times i(y))} \quad (2.13)$$

I(y) = GDP per capita in year (y)

$\alpha, \gamma, \beta', \beta''$ = model parameters

2.4 Industrial Sector Activity Equations

E(y) BAU = GDP(y) IND × ε×p (2.14)

GDP (y) IND=GDP value added of industrial sector in year (y)
e = electricity intensity per unit of industrial GDP
p = percentage of electricity from electric motors
Total energy use is expressed in this formula, which is a factor of population, floor area per person, and power per m2.
Total Energy Use = Size of Population x floor area per capita x kWh per m2 (2.15)

Total energy use is driven by cultural factors (on buying), social trends (Household size, floor space per capita and energy consumption per person), shift in population (Economic conditions), climate (demand for energy services), building design and equipment (level of energy required). It is important to understand factors that drive the demand for energy:

- Population Growth,
- GDP growth,
- Urbanization,
- Per capita income,
- Per capita floor space,
- Access to electricity,
- Appliance ownership,
- Electricity consumption.

3. Conclusion
This can be implemented successfully on any electronic device which enters into standby mode; it becomes one of the most feasible products to the user. The reduces standby power, which in turn reduces demand and in turn controls the supply which leads to economic benefits and reduction in CO_2.

4. References
1. Meier A. Research recommendations to achieve energy savings for electronic equipment operating in Low power modes. Lawrence Berkeley National Laboratory LBNL, 30, 2002. Can be downloaded at http://www.standby.lbl.gov/.
2. BIO IS. List of Technical Standards for Equipment Connected to Energy Using Networks, BIO Intelligence Service, Paris, prepared for the IEA 4E Standby, 2011.
3. Mundaca L *et al*. Evaluating Energy Efficiency Policies with Energy-Economy Models. Annual Review of Environment and Resources. 2010; 35:305-44.
4. Kaya Y. Impact of Carbon Dioxide Emissions on GNP Growth: Interpretation of Proposed Scenarios, Intergovernmental Panel on Climate Change, Response Strategies Working Group, 1989.