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An integrated Dynamic Pricing Scheme for improving the smartness of off grid distributed generation

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***Abstract*— This paper presents an integrated dynamic pricing scheme (iDPS) developed for an off grid community in sub-Sahara Africa (SSA). This proposed model employs a neighbourhood approach in effectively determining the electricity units due to connected consumers based on their monthly contributions. Assuming base values, this model obviates the need for real time inputs from the users owing to the high illiteracy level in SSA and dynamically computes electricity price in real time such that below par paying consumers pay more compared to base or above base consumers. Additionally, the smart load distribution board employed ensures that electricity units are dispatched in quantized values demanding greater energy efficiency from the consumers. This model achieves economic accrual which guarantees the sustainability of the off grid DG project.**

***Index Terms*— iDPS, illiteracy, sustainability, distributed generation, off grid**

NOMENCLATURE

Subscripts

i, j	Respective household and public infrastructure (PI) index
m, n	Maximum household or PI number
k	Time (hourly) index
o	Maximum time count
p	Maximum quantization level

Symbols

H_i, PI_j	Household and public infrastructure nomenclature
U_i, W_j	Respective household, PI monthly contribution (in Naira)
S_k	Hourly available supply (in Watts)
D_{ik}, E_{jk}	Respective hourly household and PI demand (in Watts)
V, Q	Respective household and PI minimum monthly contribution (in Naira)
T	Total monthly accrual (in Naira)
B_{ik}, G_{jk}	(Transient) accessible electricity quantity (in Watts)
ηB_{ik}, ηG_{jk}	(Final) accessible electricity quantity (in Watts)
Hu_i, Pu_j	Per unit cost component for households and PI
F_k	Supply availability component
C_k	Combined households and PI hourly demand (in Watts)
Lu_i, Ju_j	Hourly dynamic price paid by households and PI (per unit)
CD_k, CE_k	Hourly respective combined demand matrix for households and PI
QL_p	Energy quantization level
RL_p	Energy quantization value (in Watts)
MQL_{ik}, WQL_{jk}	Respective Quantization loss for households and PI
Y_k	Combined hourly dispatch loss (in Watts)
MY_k	Total hourly loss (in Watts)
$SLB_{i,j}$	Smart load distribution board for households and public infrastructure

I. INTRODUCTION

AS we make the transition from meeting the objectives of the United Nations (UN) Millennium Development Goals (MDGs) to Sustainable Energy for All (SE4ALL), fully exploiting alternative energy sources especially renewable sources (RS) at load centres for direct supply to consumers becomes imperative. Though not listed as one of its objectives, energy has been opined to play a crucial role in fully meeting the objectives of the MDGs [1], [2]. Thus, the provision of electricity to residents of developing countries is an incentive for improved economic and social development [3-5].

With renewed and growing interests in alternative energy sources for energy and environmental sustainability [6], renewables have become a potent factor in the proliferation of distributed energy resources (DERs) and microgrids [7, 8]. As a means to reducing carbon emissions, attention has been turned to alternative energy sources especially renewables in displacing demand at load centres. Acknowledging the importance of energy access to development and the role of energy in alleviating poverty and influencing healthcare delivery, education, income and the environment [9] especially in rural communities, developing countries have been exploiting options such as isolated microgrids as transitional alternatives to grid based electricity in seeking to bring distant rural communities on grid through rural electrification projects. Such rural outreaches have been carried out in Tunisia [10], The Philippines [11], Brazil [12], Cameroon [13] and Nigeria [14]. These outreaches in rural communities seek to discover and utilize alternative means in generating electricity to offset their energy needs due to the huge costs incurred in grid expansion and also growing concerns about the viability of fossil based electricity generation [2, 15, 16]. Despite these investments in rural electrification projects, it has been observed that they rarely do support themselves financially due to faulty implementation strategies especially poor pricing and cost (investment) recovery strategies [17]. A scheme that would thus ensure that distributed generation (DG) projects in rural communities can be sustained via dynamic pricing (DP) is examined in this research work. In guaranteeing the sustainability of distributed generation projects in SSA, a case study is considered.

The major contributions of this paper include the following:

i. Propose the development of a smart load distribution board with radio communication compatibility and quantized outputs.
ii. Develop an algorithm that intelligently quantizes consumers load and effects dispatch on consumer's smart load distribution board.
iii. Develop a two-stage dynamic pricing algorithm for connected consumers taking into consideration consumers' monthly contributions, their real time demand and available supply.
iv. Guarantee the sustainability and viability of DG projects by ensuring that generated contributions are able to offset maintenance and upgrades and that unused electricity unit are available at a premium to other vendors during peak hours.
v. Create a balance between demand and supply in real time by dynamically pricing electricity units based on monthly contribution.

The rest of the paper is organized as follows. Section 2 describes the case study and outlines the different load classifications and profiles of the different consumer classes; Section 3 reviews relevant literature; Section 4 describes the problem formulation and gives a general description of the smart load distribution board; Section 5 examines the results while Section 6 concludes the paper.

II. CASE STUDY

The 5 kW DG project is situated in Ojataiye Village in the suburbs of Oyo State, Nigeria. Eight (8) households with similar loads, one public primary school and one public health centre are the main connected consumers. The load audit of the considered consumers is shown in Table I while the classification and duration of use is shown in Table II. The household owners' occupations vary between farming, crafts and petty trading. The public primary school serves the village kids while the primary health centre renders basic first aid treatment and vaccination to the villagers. The typical income of the households in Ojataiye village on a monthly basis varies between ₦5000 (US$25 at ₦200/US$1) – ₦9000 (US$45) which implies an average daily income that varies between ₦133.33 (US$0.833) – ₦300 (US$1.50).

A critical observation of these statistics shows that the majority of the village residents are typically poor. The combined estimated daily load profile of all considered connected consumers is shown in Table III. A basic assumption for this research work is that the load profile follows the same trends both on week days and weekends.

A pricing scheme is thus needed that ensures that only a less significant part of the consumers income is spent on electricity while the contributed funds is able to meet the operations and maintenance (O&M) costs of the DG project. A scheme that integrates a community approach pricing scheme (CAPS) inherently and subtly implements a virtual dynamic pricing scheme (VDPS) is proposed alongside a smart load distribution board that ensures this.

III. literature review

The origin of the concept of using electricity prices in controlling power systems is reported in [18] while [19] highlights the importance of price as a key element of energy market behaviour and its close relationship to load control, energy management and consumption. With the rapid development in demand response (DR), DP has been considered as a viable approach in facilitating the integration of demand side with electricity markets [20, 21]. The area controller error (ACE) pricing scheme was extended by [19] where a pricing scheme that is robust against fluctuating power input was proposed while [21] also incorporated robustness against the uncertainties in renewable resources and price in arriving at scalable solutions. Three main kinds of rate structures of time varying prices were posited by [22] and further posited was the fact that the diffusion of DR was still low. The effect of dynamic pricing on consumers comfort was also studied in [23] where a dynamic demand response controller (DDRC) which adjusts set-point temperature to control HVAC loads in response to varying electricity retail price published every 15 minutes was proposed. The reasons for the application of DP vary from achieving a balance in power to managing energy markets and controlling loads [19, 24]. However, most of the schemes proposed require the broadcast of prices in near real time necessitating users to react to price changes instantly or through the use of smart devices that respond to price changes. The demerit of such system in the proposed DG unit in Ojataiye village (with general applicability in SSA and South East Asia) is the associated costs, handling and technicality of the smart devices which could pose a problem for rural dwellers due to the very low literacy levels in SSA compared to the organization for economic cooperation and development (OECD) countries and USA.

Table I: Load audit for the considered customers

	Category	Basic Electrical Equipment	No.	Watts/unit	Watts
1	House	Energy savings bulb Clock radio Phone charger(s) Table fan	4 1 1 1	16 2 12 70	64 2 12 70
2	Public Primary School	Energy Savings bulb Clock radio Table fan	10 2 1	16 2 70	160 4 70
3	Primary Health Centre	Energy savings bulb Sun frost DC refrigerator Table fan Clock radio	6 1 1 1	16 60 70 2	96 60 70 2

Table II: Load audit for the considered customers

	Category	Load classification	Description	Daily estimated hours of use (hrs.)	Watts (W)
1	House	RL1 RL2 RL3 RL4 RL5	Indoor light Security light Clock radio Phone charger Table fan	6 13 7 4 13	32 32 2 12 70
2	Public Primary School	PSL1 PSL2 PSL3 PSL4	Security light Indoor light Table fan Clock radio	12 2 3 8	48 112 70 4
3	Primary Health Centre	PHL1 PHL2 PHL3 PHL4 PHL5	Sun frost DC refrigerator Security light Indoor light Table fan Clock radio	16 13 13 16 14	60 32 64 70 2

Table III: Daily hourly load classification profile

Hours	**22-4**	**4-5**	**5-6**	**6-7**	**7-8**	**8-9**	**9-13**	**13-16**	**16-17**	**17-18**	**18-19**	**19-21**	**21-22**
CRL1	0	0	1	1	0	0	0	0	0	0	1	1	1
CRL2	1	1	1	1	0	0	0	0	0	0	1	1	1
CRL3	0	1	1	1	0	0	0	0	0	0	1	1	1
CRL4	0	0	1	0	0	0	0	0	0	0	1	1	0
CRL5	1	1	0	0	0	0	0	0	1	1	1	1	1
PSL1	1	1	1	0	0	0	0	0	0	0	1	1	1
PSL2	0	0	0	0	0	0	0	0	0	1	1	0	0
PSL3	0	0	0	0	0	0	0	1	0	0	0	0	0
PSL4	0	0	0	0	0	1	1	1	0	0	0	0	0
PHL1	0	0	0	1	1	1	1	1	1	1	1	1	1
PHL2	1	1	1	1	0	0	0	0	0	0	1	1	1
PHL3	1	1	1	1	0	0	0	0	0	0	1	1	1
PHL4	1	1	0	0	0	0	0	1	1	1	1	1	1
PHL5	0	0	1	1	1	1	0	1	1	1	1	1	1
Total (W)	***1030***	***1046***	***1400***	***770***	***62***	***66***	***64***	***206***	***692***	***804***	***1572***	***1460***	***1364***

The proposed CAPS ensures that the VDPS generates electricity prices (per unit) for respective consumers relative to available supply and their monthly contribution. In doing so, consumers who match the minimum monthly contribution enjoy higher marginal benefits (in terms of dispatch) at a lower per unit price compared to below minimum paying consumers who have lower allocation at higher per unit price of electricity. The CAPS further ensures an appropriate quantization of respective consumers' allocation to constrained values.

IV. problem formulation

The variables used and their values are presented in Table IV. The objective function Z aims at minimizing dispatch by maximizing quantization loss and penalizing below minimum level paying consumers. While the proposed dynamic pricing scheme does not seek to elicit any reaction from the consumers, an illusion of DP is created via the VDPS to account for the variability in energy dispatch to the consumers. Nominal values are assumed for all variables.

The objective function is then defined as:

$$Z = [Min \ \sum_k [\sum_{i=1}^{m} (B_{ik} \ \ or \ \ \eta B_{ik}) + \sum_{j=1}^{n} (G_{jk} \ \ or \ \ \eta G_{jk})] + Max \ \sum_k [\sum_{i=1}^{m} U_i + \sum_{j=1}^{n} W_j] + Max \ \sum_k (\sum_{i=1}^{m} MQL_{ik} + \sum_{j=1}^{n} WQL_{jk})]$$

Subject to

1. Load-generation balance

$$S_k \geq \sum_k \left[\sum_{i=1}^{m} (B_{ik} \ \ or \ \ \eta B_{ik}) + \sum_{j=1}^{n} (E_{jk} \ \ or \ \ \eta E_{jk}) \right]$$

2. Minimum energy quantization dispatch

$$\forall k, \ \ if \ \ QL_{p-1} \leq B_{ik}, \ \eta B_{ik}, \ G_{jk} \ \ or \ \ \eta G_{jk} < QL_p$$

Then

$$B_{ik}, \ \eta B_{ik} \ \ G_{jk} \ \ or \ \ \eta G_{jk} = RL_{p-1}$$

$$T = \sum_{i=1}^{m} U_i + \sum_{j=1}^{n} W_j \qquad (1)$$

The first stage DP computes respective demand as follows:

$$B_{ik} = \frac{U_i}{V} * D_{ik} \qquad (2)$$

$$G_{jk} = \frac{W_j}{Q} * E_{jk} \qquad (3)$$

Such that

If $\sum_k (\sum_{i=1}^{m} B_{ik} + \sum_{j=1}^{n} G_{jk}) > S_k$

Then Let

$$Lt = \sum_k (\sum_{i=1}^{m} B_{ik} + \sum_{j=1}^{n} G_{jk}) \qquad (4)$$

$$\eta B_{ik} = \frac{B_{ik}}{Lt} * S_k \qquad (5)$$

$$\eta G_{jk} = \frac{G_{jk}}{Lt} * S_k \qquad (6)$$

The values B_{ik} and G_{jk} used in (5) and (6) are the resulting values obtained from (2) and (3). In evaluating the equivalent per unit electricity price for each connected consumer, 2 stages are involved.

Stage 1: cost component evaluation of Hu_i and Pu_j which can be determined as follows:

If $U_i = V$ or $W_j = Q$ *then,*

$$Hu_i = \frac{U_i}{V} \ \ per \ \ unit \qquad (7)$$

$$Pu_j = \frac{W_j}{Q} per \ \ unit \qquad (8)$$

If $U_i, \ W_j < V \ \ or \ \ U_i, \ W_j > V$ *then,*

$$Hu_i = 2 - \frac{U_i}{V} \ \ per \ \ unit \qquad (9)$$

$$Pu_j = 2 - \frac{W_j}{Q} \ \ per \ \ unit \qquad (10)$$

Proof:

If $U_i < V$

$$Hu_i = 1.0 + \frac{V - U_i}{V}$$

$$= 1.0 + 1.0 - \frac{U_i}{V}$$

$$= (2.0 - \frac{U_i}{V}) \ \ per \ \ unit \qquad (11)$$

Similarly,

If $U_i > V$

$$Hu_i = 1 - (\frac{U_i - V}{V})$$

$$= 1.0 - \frac{U_i}{V} + 1.0$$

$$= (2 - \frac{U_i}{V}) \ \ per \ \ unit \qquad (12)$$

The proof for the derivation of Pu_j for similar conditions follows (11) and (12).

Stage 2: supply availability component evaluation of F_k which can be computed as follows:

$$C_k = \sum_k (\sum_{i=1}^{m} D_{ik} + \sum_{j=1}^{n} E_{jk}) \qquad (13)$$

If $S_k \geq C_k$

$$F_k = 1 \qquad (14)$$

Else

$$F_k = 1 + (\frac{C_k - S_k}{C_k})$$

$$= 1 + 1 - \frac{S_k}{C_k}$$

$$= (2 - \frac{S_k}{C_k}) \quad (15)$$

$$Lu_i = Hu_i * F_k \quad (16)$$

$$Ju_j = Pu_j * F_k \quad (17)$$

Subsequently, the results can be written as:

$$CD_k = [D_{1k} \quad D_{2k} \quad D_{3k} \quad \ldots \quad D_{mk}] \begin{bmatrix} H_1 \\ H_2 \\ H_3 \\ . \\ . \\ . \\ H_m \end{bmatrix} (Watts) \quad (18)$$

$$CE_k = [\mathrm{E}_{1k} \quad E_{2k} \quad E_{3k} \ldots E_{nk}] \begin{bmatrix} PI_1 \\ PI_2 \\ . \\ . \\ . \\ PI_n \end{bmatrix} (Watts) \quad (19)$$

Table IV: variables and values

Variable	Value
M	8
N	2
O	24
V	N200
Q	N250
Hu_i, Pu_j	1 P. U

A. *Quantization*

The smart load distribution board ($SLB_{i,j}$) as shown in Figure 1 and proposed in this paper has five access points (P1 – P5) where access points P1 – P4 grant access to quantized electricity units with P5 acting as a cumulative draw point. The maximum electricity units that can be drawn from the points P1 – P4 are 20 W, 50 W, 100 W and 100 W respectively. 11 possible energy combination quantization levels exist as shown in Table V.

Quantization is done following the pattern described below:

$$Given \quad B_{ik}, \; G_{jk}, \; \eta B_{ik}, \; \eta G_{jk},$$

$$If \quad \exists \; B_{ik}, \; G_{jk}, \; \eta B_{ik} \; or \; \eta G_{jk}$$

$$Such \; that \; QL_{p-1} \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < QL_p$$

$$Then \; B_{ik}, \; G_{jk,} \; \eta B_{ik} \; or \; \eta G_{jk} = RL_{p-1} \quad (20)$$

Derivation of hourly quantization losses MQL_{ik}, WQL_{jk}

The derivation of MQL_{ik}, WQL_{jk} precedes (20) as

$$MQL_{ik} = (B_{ik} \; or \; \eta B_{ik}) - \mathrm{RL}_{p-1} \quad (21a)$$

$$WQL_{jk} = (G_{jk} \; or \; \eta G_{jk}) - RL_{p-1} \quad (21b)$$

The evaluation of hourly dispatch loss is evaluated as follows:

$$Y_k = S_k - \sum\nolimits_k \Big[\sum\nolimits_{i=1}^{m} (B_{ik} \; or \; \eta B_{ik}) + \sum\nolimits_{j=1}^{n} (G_{jk} \; or \; \eta G_{jk}) \Big] \quad (22a)$$

Thus, the total hourly loss is evaluated as

$$MY_k = Y_k + \sum\nolimits_k \Big[\sum\nolimits_{i=1}^{m} MQL_{ik} + \sum\nolimits_{j=1}^{n} WQL_{jk} \Big] \quad (22b)$$

The CAPS algorithm is shown in Table VI with its flowchart showing the incorporated VDPS shown in Figure 2. The CAPS descriptive properties include:

(a) No preference is allocated to the residential customers, i or the public institutions, ***j***. This ensures that the monthly contributions, U_i or W_j for customers i or j respectively are sustained for continued supply.
Hence, if P_f denotes the preferential matrix, then $n(P_f) = 0$

(b) The un-quantized dispatch values $B_{ik}, \; or \; \eta B_{ik}$ and $G_{jk}, \; or \; \eta G_{jk}$ that can be drawn by the customers ***i*** and ***j*** respectively for every hour ***k*** is dependent on available supply S_k and respective individual monthly contribution U_i or W_j.

(c) $\forall k$ hours, quantized optimized dispatch values RL_{p-1} for customers i and j are based on $SLB_{i,j}$ permissible values.

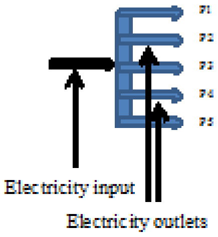

Figure 1: Proposed $SLB_{i,j}$

Table V: Quantization levels and range of values

QL_p	RL_p(W)	Range
1	20	$20 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 50$
2	50	$50 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 70$
3	70	$70 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 100$

4	100	$100 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 120$
5	120	$120 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 150$
6	150	$150 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 170$
7	170	$170 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 200$
8	200	$200 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 220$
9	220	$220 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 250$
10	250	$250 \le B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk} < 270$
11	270	$270 < B_{ik}, G_{jk}, \eta B_{ik}, \eta G_{jk}$

V. Results

The plot of supply surplus/deficit against the supply constant is shown in the Figure 3. It is observed from the Figure 3 that the contribution of the supply component to the overall electricity cost on an hourly basis is determined by the distance of the real time demand from the available supply. Therefore, a higher F_k arises for huge supply deficits. The DR ability of the proposed iDPS vis-à-vis its ability to match demand with available supply through an inherent (embedded) DP scheme is shown in Figure 4. It is observed from the Figure 4, that there is a near close match between final demand and available supply for the hours (except hour's 17 where the available supply far exceeds the combined final demand). It is further observed from the Figure 4 the total hourly losses (computed from unsold or non-consumed pre-allocated units) which could be sold at a higher per unit price to available local businesses. These businesses could range from phone charging to barbing salon etc.

Figure 5 depicts the energy profile for household 1 whose monthly contribution is at par with the minimum required. Meeting this minimum monthly contribution enables the house purchase electricity units at relatively lower prices leading to higher electricity units purchased for same load demand as other similar households. The inability however of the household 2 to meet the minimum monthly contribution means for the same demand as household 1, household 2 purchases electricity units at relatively higher prices hourly leading to lesser units purchased. A demerit of low monthly contribution means that final computed electricity units lie close to the 20 W or 0 W (for values less than 20 W) region on the smart load distribution board. The energy profile for the household 2 is shown in the Figure 6. The evaluation and computation of the per unit electricity price for the households and the public infrastructure is shown in Table VII. It is observed from the Table VII that for similar hours the different households and public infrastructures have varying price depending on their monthly contribution. This dynamic behaviour of allocating varying per unit of electricity price to consumers (even with similar loads) establishes the dynamic pricing ability of the iDPS which is capable of acting as a demand response (DR) tool.

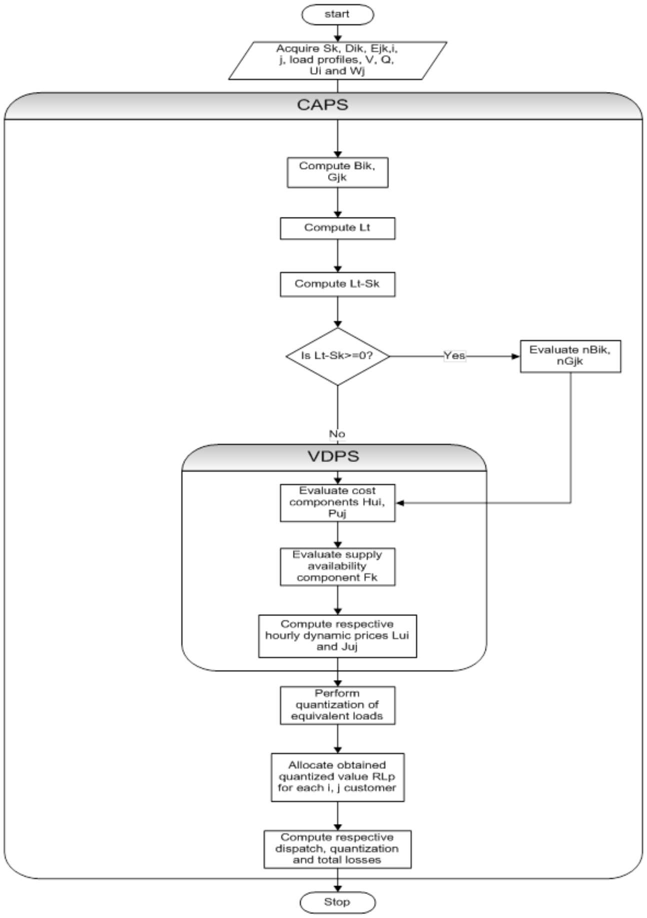

Figure 2: The flowchart of the CAPS incorporating the VDPS

Table VI: Quantization levels and range of values

```
Algorithm 1: CAPS Algorithm
Input:
$S_k$, $D_{ik}$, $E_{jk}$, $i$, $j$ load profiles, $V$, $Q$, $U_i$ and $W_j$
Start
  Evaluate first stage demand $B_{ik}$, $G_{jk}$ (see (2) and (3))
  Perform check
    $Lt = \sum_k (\sum_{i=1}^{m} B_{ik} + \sum_{j=1}^{n} G_{jk})$
    $If\ \forall k,\ Lt \le S_k$
      Then,
        Go to **
        Else
          Evaluate second stage demand $\eta B_{ik}$, $\eta G_{jk}$ (see (5) and (6))
            $Lt = \sum_k (\sum_{i=1}^{m} B_{ik} + \sum_{j=1}^{n} G_{jk})$
            Go to **
        End if
    **Evaluate hourly individual electricity unit price (see (16) and (17))
    Evaluate combined hourly demand for households and public infrastructure (see (18) and (19))
    Perform quantization (see (20))
    Evaluate hourly dispatch, quantization and total losses (see (21a), (21b), (22a) and (22b))
Stop
Output: $RL_p$ value for each connected customer
```

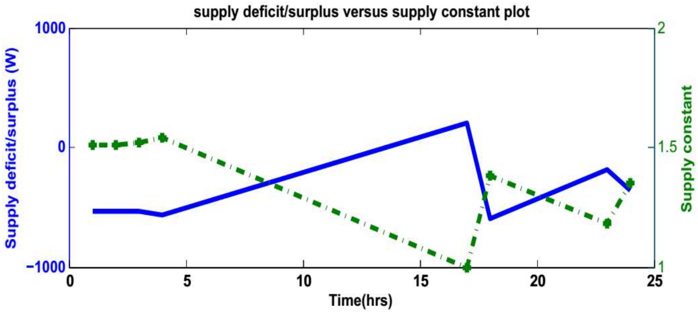

Figure 3: Supply deficit/surplus versus supply constant plot

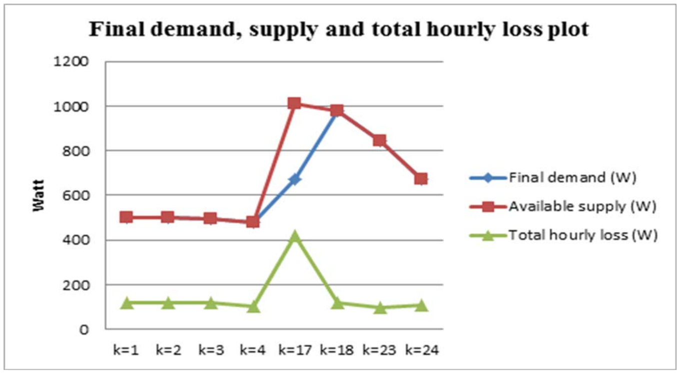

Figure 4 Hourly final demands, supply and total loss plot

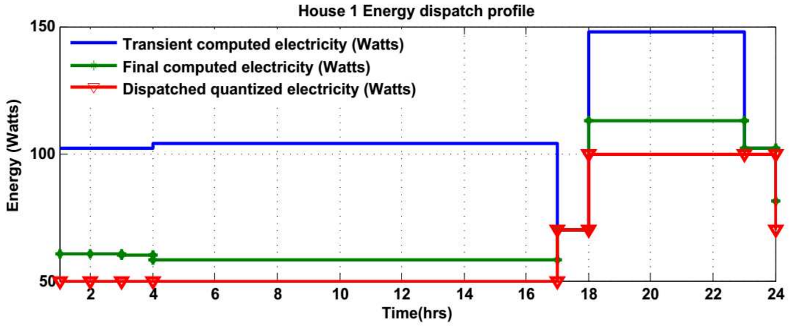

Figure 5: Energy dispatch profile for house 1

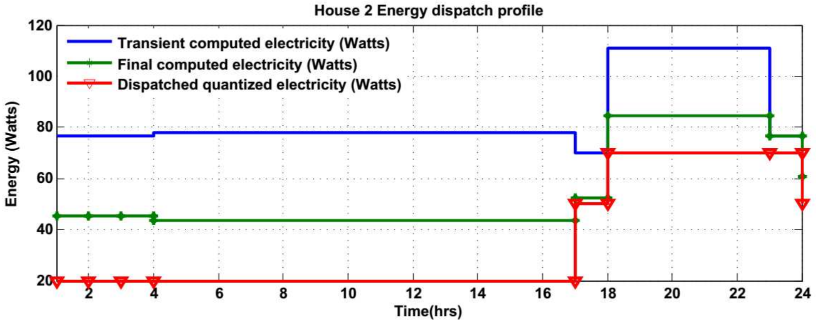

Figure 6: Energy dispatch profile for house 2

Table VII: Hourly per unit electricity price for households and public infrastructure

H_i, PI_j	Lu_i, Ju_j							
	Hr. 1	Hr. 2	Hr. 3	Hr. 4	Hr. 17	Hr. 18	Hr. 23	Hr. 24
H1	1.51	1.51	1.52	1.54	1.00	1.38	1.18	1.35
H2	1.89	1.89	1.90	1.93	1.25	1.73	1.48	1.69
H3	1.66	1.66	1.67	1.69	1.10	1.52	1.30	1.49
H4	1.51	1.51	1.52	1.54	1.00	1.38	1.18	1.35
H5	1.51	1.51	1.52	1.54	1.00	1.38	1.18	1.35
H6	1.51	1.51	1.52	1.54	1.00	1.38	1.18	1.35
H7	1.89	1.89	1.90	1.93	1.25	1.73	1.48	1.69
H8	2.27	2.27	2.28	2.31	1.50	2.07	1.77	2.03
PPS	1.81	1.81	1.82	1.85	1.20	1.66	1.42	1.62
PHC	2.11	2.11	2.13	2.17	1.40	1.93	1.65	1.89

VI. CONCLUSION

This research has targeted a 5 kW solar powered inverter system at Ojataiye village in Ibadan and proposed a DP scheme that is virtual (inherent), individualistic and guarantees the sustainability of the proposed DG system. Alongside a proposed smart load distribution board, the iDPS dynamically allocates unique per unit electricity prices to each connected consumer (household or public infrastructure) based on their monthly contribution thus penalizing below minimum paying consumers. As a DR tool, iDPS has been able to match the hourly available supply with demand by dynamically reconfiguring the demand through a dynamic price regime.

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