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Shrewd vehicle framework model with a streamlined informed approach for green transportation in smart cities

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ABSTRACT

Infrastructure is essential for the activity of a smart city in lighting framework, water conveyance system, smart monitoring infrastructure, and so on. Presently the transport framework is set at the task of such smart city by making smooth portability of the individuals and products, particularly with the probability of managing traffic clog, giving up-dated information and in time data from the open transportation client, creating green methods for transportation (bicycle and vehicle sharing for example), and so on. This paper is highly engaged in keeping up the shrewd vehicle framework model with a streamlined informed approach, which has been planned and created depending on the Smart City segment. This smart model vehicle framework has added to the structure and planning for a smart city by making it increasingly important with a superior utilization of offices, less noisy, free of accidents, progressively conscious of condition with web organized analysis for utilizing data from the clients for adjusting the transportation administrations. Further, the ability to serve the client by giving it to them with open transportation and increasingly interconnected stations moves towards urban areas inside the city.

1. Outline of the research and literature review

The primary source of power industry challenges energy shifting from fossil fuel to energy of the renewable sector. Then there are major problems such as

- How to convey the addition of the location to the remote at renewable energy to the load center.
- How variability of billet at point of loads in renewable energy sources.

A billet is a solid aluminum block (or materials) of various sizes depending on the size of the desired component. The smaller the section you want, the bigger the ticket. Unlike casting, ticket sections are made by extracting the additional material from the ticket. The element is made from solid aluminum.A grille is an aftermarket component used to update the original OEM grille's design or feature. OEM stands for the 'Factory of Original Equipment Manufacturer.' OEM automobile components are, for example, the authentic, official components manufactured directly by the manufacturer's vehicle. They are typically made of aircraft-grade aluminum billet, heavy bar stock, but some are made of CNC made from a solid aluminum sheet. Sustainable transport refers to any 'green' means of transport that have low environmental impacts. To balance our current and future needs, sustainable transport is still an issue. The technology of the energy developing storage (EST) can be a poorly established solution for the above two issues (Barton and Infield, 2004) for network application, which are classified into four types such as, electrical, thermal, mechanical, and chemical applications for (Chen et al., 2009) the storage of mechanical application, including solar thermal and oxygen of liquid or compressed air efficiency with the percentage ratio of 99.00% of storage capacity for the Global range. However, the strong location-based criteria hamper their ubiquitous transmission line software innovations.

The energy-based battery storage application (BES) in this technology represents the excellent, cost-wise approach. In (Koohi-Kamali et al., 2013; Divya and Østergaard, 2009) BES application, The technologies offer pollution with low-cost maintenance, high efficiency, and a long

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Terminologies in the intelligent vehicle framework model with a streamlined informed approach

Indication and sources

a, b	Indices of bus topology
Ab	Indices of curves in HEOM between junction a and b
C	Index of Batter based Efficient Energy Storing Framework (BEESF) transportation
D	Transmission path index
L	Period limit index
K	Index of time
I	Set of curves in a network of HEOM at a single period limit
I_i^+	Set of curves at a network of HEOM in the source junction i
I_i^-	Set of curves at a network of HEOM in the destination junction i
P	Set of Producing units
RJ	Buses with the smart green transportation system
K_s	Pair of Time in a period limit

Constants

E_c, ab	Price of transportation of c in curve ab of BEESF
SD_u	Downslope limit of a unit u
E_c, 0	The energy of BEESF c in the starting stage
E_c, FS	The energy of BEESF c in the destination stage
E_{high}, c	Highest capacity of stored energy in BEESF c
E_{low}, c	The lowest capacity of stored energy in BEESF c
A_k, a, 0	The starting point of c in BEESF injunction a
A_k, a, FS	Destination point of c in BEESF injunction a
FS	Number of period limit
FT	Number of Time
G_L, k	Full load at hour k
G_{high}, c	The high rate of exchange power at BEESF c
G_{high}, d	High capability of path d
G_{high}, u	High capacity of production of unit u
G_{low}, c	Low rate of exchange power at BEESF c
G_{low}, u	Low capacity of production of unit u
MR_k	Spinning acquisition rate at time k
K_{OFF}, u	Low OFF time at u
K_{ON}, u	Low ON time at u
SU_u	Upslope limit of a unit u

Variables

F_T, u	Fuel took by unit u
d_c, ab, l	Curve ab status of BEESF at period l
d_u, k	Unit commitment stage
G_c, a, k	The power utilized of BEESF at period k
G_d, k	Actual power flow at period k
G_u, k	Production of unit u
C_u, t	Closure price of the unit
MR_u, k	Spin reserve time of k
MR_c, a, k	Spin reserve of bus hub at k
SS_u, k	The initial price of unit u
Y_{OFF}, u, k	OFF period of unit u
Y_{ON}, u, k	ON period of unit u
Z_u, k	Initial index
W_u, k	Closure index

life cycle with a high response time. Further, in BES (Akhil et al., 2013; Dunn et al., 2011) has been considered as a most exciting innovation in the application of network storage (Shahidehpour and Khodayar, 2013; Parvania et al., 2014) with the variability of RES managing (Borba et al., 2012; Khodayar and Shahidehpour, 2013), for the stability of the transportation enhancing system (Yang et al., 2012; Han et al., 2010).

In comparison, BES electric vehicles (EVs) and their movement's impact on energy network management (Liu et al., 2012; Krad and Gao, 2013; Hu et al., 2013; Khodayar et al., 2012; Khodayar et al., 2013; Zhou et al., 2011) have been thoroughly researched on the smart networks of smart cities.In this article (Liu et al., 2012), the deterministic system communication model was adopted to research the effect on BES's hourly thermal development cycle (consolidated EV fleets) and sustainable energy implementation. Power optimization is used while retaining its flexibility of electronic design automation systems to minimize (reduce) energy consumption in digital hardware such as an integrated circuit in a vehicle.

The secured constrained power optimization unit (SCPOU) based on combined-integer programming (CIP) was first used in (Krad and Gao, 2013; Hu et al., 2013) to research the plug-in hybrid effect of the EV on the planning of the thermal power reservation sector. It is also possible to install the mobile BES in shipping and railways, where its flexibility offers electricity transmission. Where the EVS flexibility in BES was studied using SCPOU in (Khodayar et al., 2012; Khodayar et al., 2013), showing that BES mobility can ease transmission interference or reduce everyday power generation costs; More analysis and execution would nevertheless be required because repetitive BES unloading/loading in vehicle-to-network (V2G) applications will dramatically reduce battery life. (Zhou et al., 2011).

BES flexibility will help a significant shift in the worldwide system of solar thermal development. Further, Large coal-fired power stations are liable to closure in the United States alone, and the Coal use is expected to decline to 14.7 trillion Kwh in 2040, equivalent to 18.7 trillion Kwh in 2011 (*Energy Information Administration*, 2013). Tripathy, A et al. (Tripathy et al., 2020) described the Cyber-physical mobility infrastructure in Smart Cities using the WeDoShare Ridesharing Framework. The biggest issues in the smart city are balanced urban mobility and pollution. The thesis suggests an IoT-based platform for real-time ride-sharing, WeDoShare, as an approach for addressing and quantifying carpoolers' challenges in terms of sustainability. Minglin Sun et al. (Sun and Zhang, 2020) discussed the low carbon emission and the green environment applying blockchain big data platform in the construction of a new smart cityA decentralised distributed peer to pair trust service framework is being constructed to create the latest trust model enabling multi-CA coexistence through blockchain technologies embedded in the existing PKI/CA security system. Hefei City should also boost environmental surveillance more and promote modern energy to protect the low-carbon atmosphere. Better administration has a positive effect on the development of smart Hefei. Harish Kumar et al. (Kumar et al., 2020) suggest the Smart City Transformation Framework(SCTF) for Moving towards smart cities. A community is an extensive and continuous human environment that gives its people many resources and opportunities. The results indicate a multi-dimensional grouping of resources and the requisite basic infrastructure growth. In addition, the Smart City Transformation Framework (SCTF) is proposed in the light of understanding and gaining more input into suggested clever strategies for building smarter communities by politicians, city planners, government officials, and service provided men.

Simultaneously, excess capacity will be required on passenger trains used to carry coal to nuclear power stations. Their cheaper use of passenger trains could provide the additional mobility power needed to supply the potential energy by flexible BES with the transportation route from either the rich wind power areas to higher potential position prices in the world. The energy storage in mobile BES mounted on freight trains can be transferred effectively through railroad to remote sites, equivalent to Vehicle to Grid (V2G) applications. The general classification of the energy storage system is shown in Fig. 1.

The comprehensive use of mobile BES will explain five basic

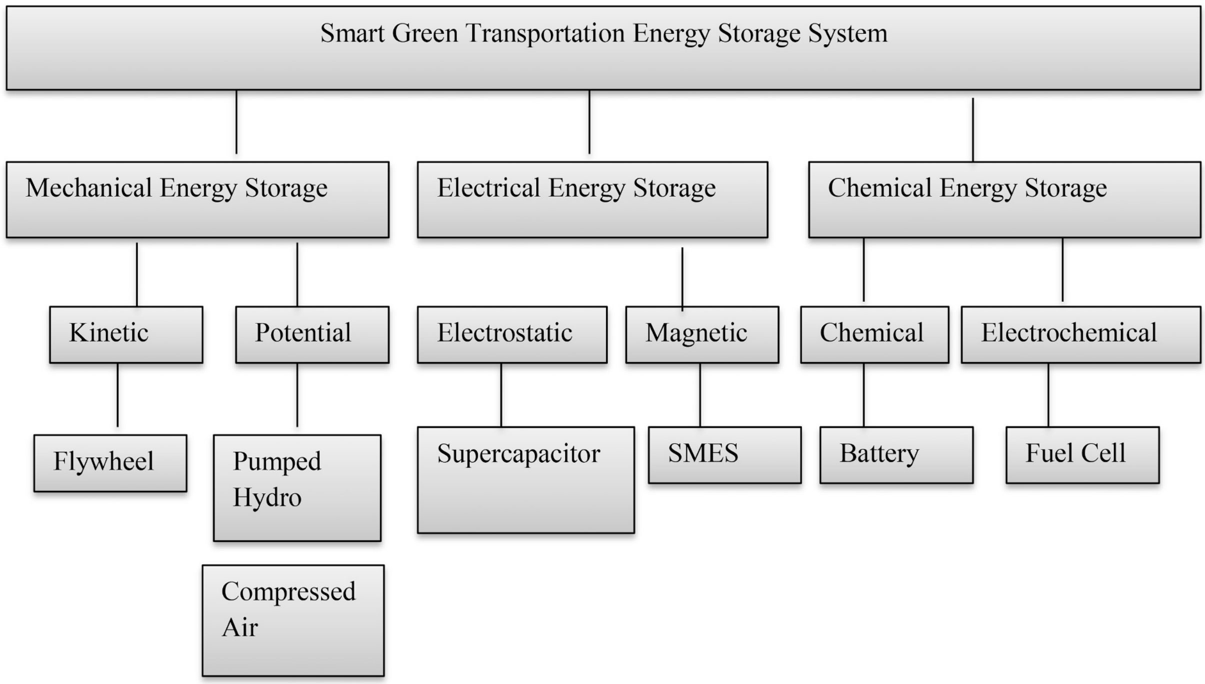


Fig. 1. Basic diagram of the Smart Green Transportation Energy Storage System. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

objectives:

1. Optimizing the operation of the power network at a nationally authenticated sector to deliver the excess power to many other positions where it is most necessary for the localized maximum flossing;
2. Enhancing the reliability of the transmission system by providing fast railway transport energy to natural disaster-induced areas of the country;
3. Accelerate the large-scale improvements in power transfer networks through the use of BES flexibility or mobility;
4. Capture the adjustable renewable power and distribute it to regions with the highest network development of capability;
5. Assist members of states in meeting renewable resource conformity requirements and emissions at the regional level;

This paper has proposed a hybrid energy optimization model (HEOM), which implements the BES transportation using the smart transportation application of the Vehicle to Grid (V2G)-type. The solution of SCPOU has been provided on an hourly basis, and the discharging/charging schedule of the BEESF system of power is a minimum of operational cost. The constraints of thermal units have taken the BEESF application of the SCPOU. Further, the constraints of the power transmission, constraints of BEESF discharging/charging, and constraints of BEESF Transportation have been considered In this paper, which is listed as follows,

- The SCPOU model with TSN-based BEESF is integrated and combines with electrical transportation constraints to operate optimal smart green transportation and electrical power system.
- This proposed model can study the BEESF on the schedule generation per hour of thermal power stations' units.
- In this proposed model, we can analyze the station base and cost of smart green transportation on the mobility of BEESF.

Finally, the entire model of SCPOU with BEESF is given by section 3 and section 4, which are in detail with mathematical proof. The conclusion will be drawn from this article in section 5.

2. BEESF model

The main and complicated transportation sector and usable and accessed transportation facility are the smart green transportation system's major aims. Every day a large number of people travel through trains and other transportation systems. To reduce the transportation price, the rail workers list the transportation system using a conventional solution problem known as Vehicle Routing Technique. In this work, the timely rechargeable timeline called BEESF is interfaced with the Secure Constraint Power Optimization Unit (SCPOU). The time-based SCPOU provided a good solution for the optimization of the routing problem. The HEOM model is used in this paper for optimizing the routing work, whereas the same has been implemented in airline routing. The defined route for the aircraft operating at specified minimum altitudes among certain ground locations. The exact route to be flown specifies the ground distance traveled, while the air distance to be flying is specified by winds along that route. The rules on flight speeds can be different in each interval-point section of an airline route. It also extends its usage in large hub bus stations and queue of vehicle scheduling optimization.

A) HEOM based model of the BEESF

The smart green transportation system provided with rechargeable devices has been represented using a HEOM with smart transportation time. A rechargeable device is an example of a six-cell wet cell battery. The alternating plate for each cell of a lead storage battery is made from a lead alloy grid packed with sponge plates or covered with lead dioxide (anode). Each cell is filled with an electrolyte solution of sulfuric acid. In this part, we have taken an example to show the usage of HEOM in a Smart green transportation system. They describe flow as the number of vehicles that travel across a period. Speed is the rate of acceleration of a vehicle. The number of vehicles defines the number of vehicles immediately occupying a unit length of the route.

Assume a very small Smart green transportation system unit in Fig. 2 with three junctions {A, B, C}. Here in a limited duration between the two nodes, each junction is defined as a travel time X. The period will be

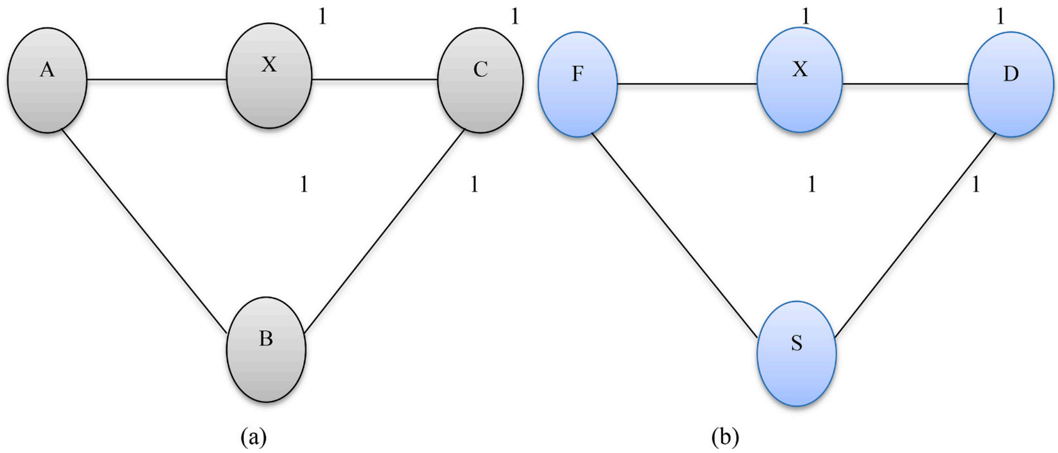


Fig. 2. (a) and (b) Illustration of a smart green transportation system with travel times.

varied with any other period for another two junction nodes. It should be considered as the input to the HEOM model. Fig. 2 showed that the time of travel from junction node A to junction node C is two time intervals and is marked twice as the other junction node period. An additional junction D between the A and C junctions is added to minimize this problem. Therefore the travel time is limited to 1 time period.The decided period is one of the required and preferred parameters of the Time-Space Network. Adding many junctions virtually, the very small period increases the network's complication, and the long period affects the network's accuracy. In practice, the HEOM model would have Both Problems to resolve.

B) Axis in space (junction)

From Fig. 3, the possibilities of time for the same four junctions contain the axis of the plot that shows the junctions in vertical and horizontal time scheduling, respectively. The nodes and curves representing the two important parameters of the HEOM model, which has each node that indicates the junction for the original and virtual cases for the curves that indicate the travel period.

In this work, there were two various curves in the HEOM model. The first type is solid curves in landscape position in the figure. Three indicates the BEESF halt for the exchange of power at any junction connected with the power grid. A curve belongs to this type that is termed as the connecting curve of the grid. The lined curve in Fig. 3 is the transportation curve for the BEESF between any junctions in any scheduled period. This is of another type, and it is termed as transportation curve. It is to be noted that both the curves are suitable to connect the physical and virtual stations for the second type of transporting curve to connect the transportation system. The smart green transportation systems without the rechargeable devices are considered a virtual station, and the BEESF could not be connected to the power station at the junction. In the HEOM model, being the BEESF is difficult to set up a connection-based protocol in Vehicle Routing.

C) Mathematical Formulation

In the HEOM model, The BEESF is Termed as below:
Conditional Assumptions:

$$\sum_{ab\in I} A_c, ab, l = 1\forall l, \forall c \tag{1}$$

Conditional Assumption: 1

$$\sum_{ab\in Ii+} A_c, ab, l+1 = \sum_{ab\in Ii-} A_c, ab, l\forall l = 1, \ldots.FS-1\forall a\forall c \tag{2a}$$

Conditional Assumption: 2

$$\sum_{ab\in Ii+} A_c, ab, d = \sum_{ab\in Ii-} A_c, a, 0\forall a\forall c \tag{2b}$$

Conditional Assumption: 3

$$\sum_{ab\in Ii-} A_c, ab, FS = \sum_{ab\in Ii-} A_c, a, FS\forall a\forall c \tag{2c}$$

Eq. (1) indicates the BEESF constraint for optimization. Here Every

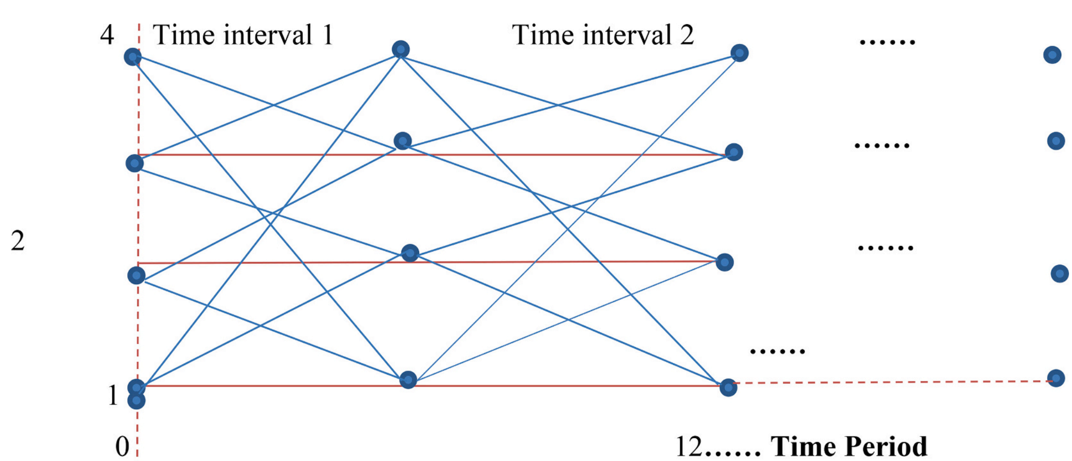


Fig. 3. Illustration of the HEOM model.

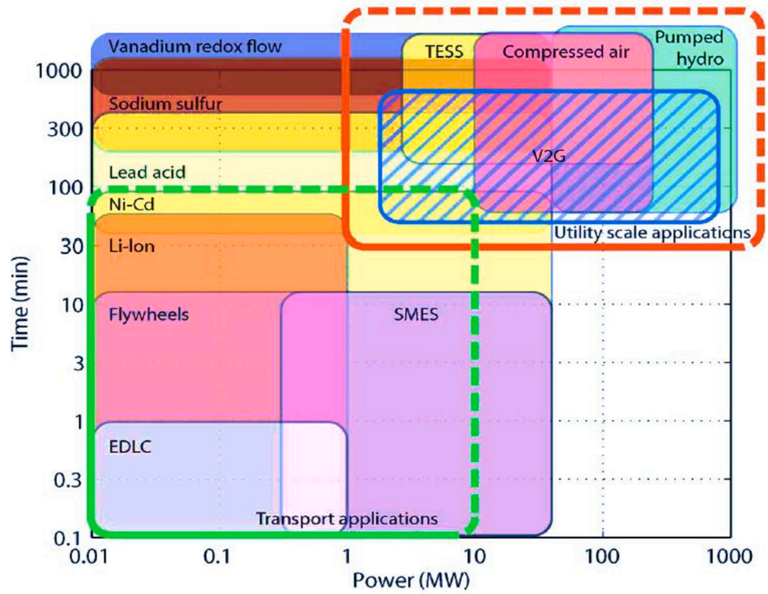


Fig. 4. Storage technology.

BEESF c is only being one curve in the period as listed in Eq. (2(a), (b), (c)), which indicates the BEESF connecting constraints.

Solution:1 for the Conditional Assumption: 1

In (2a), Every BEESF c injunction a will be at the node (a, l) in the HEOM model at the finish of period l. It denotes the next period (l + 1) of the curve, which has its source (a, l). When we looked at input and output as follows, the input and output of each junction node are equal.

Solution:2 for the Conditional Assumption: 2

In the Eq note (2b), the output should be the same at each junction as the BEESF input. c.

Solution:3 for the Conditional Assumption: 3

As same in Eq. (2c), at the last period (l + n), should have an equal and same input-output follow up for the end BEESF c.

$$A_c, aa, l\ G_{low}, c \le G_c, a, k \le G_{high}, c, \forall k \in \mathrm{Ks}\forall l, \forall c, \forall a \tag{3}$$

$$E_{low}, c \le E_c, k \le E_{high}, c, \forall k, \forall c \tag{4}$$

$$E_c, k = E_c, k-1 + \sum_k G_c, a, k, \forall k, \forall c \tag{5}$$

$$E_c, k = E_c, FS\ k = FS, \forall k \tag{6}$$

The BEESF rechargeable constraint of the power source is listed in Eq. (3). Where the BEESF c based on two constraints as listed as follows,

Constrain-1: Charges over the grid when Gc, a, k > 0 and.

Constrain-2: Drains to the grid when Gc, a, k < 0.

Note that Glow, c is non – positive in the energy acquiring constraints of BEESF, represented in Eq.(4). The energy optimizing constraints of BEESF are given in Eq.(5). And The energy optimizing limits of BEESF x is given in Eq.(6). As stated earlier, a BEESF state can change power only with the grid as it is in landscape HEOM model curves, which is termed that the BEESF stops at a specific junction when it is joined to the power grid at that junction.

D) SCPOU Preparation with the BEESF

The SCPOU paradigm, along with BEESF, is as follows:

- The objective function of SCPOU:

The objective function is represented by Eq. (7), which indicates the entire cost, constituted into two different parts. The total cost of the generated power includes the cost of fuel generating the electric power and the beginning terminal costs of each unit over the first part. Whereas in the second part, the entire BEESF smart green transportation cost is listed as follows.

$$min \sum_k \sum_{u\in P} [F_T, \mathrm{u}(G_u, k) + SS_u\ , k + C_u, k] + \sum_c \sum_l E_c, ab\ A_c, ab, l \tag{7}$$

Analysis Solution: 1- for Smart green Power System Constraints.

The smart system's balance power constraint is represented in Eq. (8), and (9) represents the system's spin reserve constraint. On a grid-joining curve, BEESF c can only be joined to a grid, that is, A_c, aa, l = 1

$$\sum_{u\in P} G_u, k - \sum_c \sum_{a\in RJ} G_c, a, k = G_L, k\forall k \tag{8}$$

$$\sum_{u\in P} MR_u, k - \sum_c \sum_{a\in RJ} MR_c, a, k \ge MR_k, \forall k \tag{9}$$

Analysis Solution-2 for Thermal Unit Constraints.

It provides the generating unit limiting capacity (10), slope up constraints (11), slope down constraints (12), low OFF time constraints (14), and low ON time constraints (13), etc…

$$G_{low}, uA_u, k \le G_{high}, uA_u, k, \forall u, \forall k \tag{10}$$

$$G_u, k - G_u, k-1 \le SR_u(1 - z_u, k) + G_{low} z_u, k, \forall u, \forall k \tag{11}$$

$$G_u, k-1 - G_u, k \le SD_u(1 - w_u, k) + G_{low} w_u, k, \forall u, \forall k \tag{12}$$

$$\sum_{a=1}^{UK_u} (A - A_u, k) = 0, \forall u, \forall k \tag{13}$$

$$\sum_{a=1}^{DK_u} A_u, k = 0, \forall u, \forall k \tag{14}$$

$$(z_u, k - w_u, k) = A_{uk} – A_{u(k-1)} \tag{15}$$

$$z_{uk} + w_{uk} \le 1 \tag{16}$$

Flow Constraints of the Power Grid Line has The SF approach which is implemented for the indication of the power grid power line e flow limits in (17)

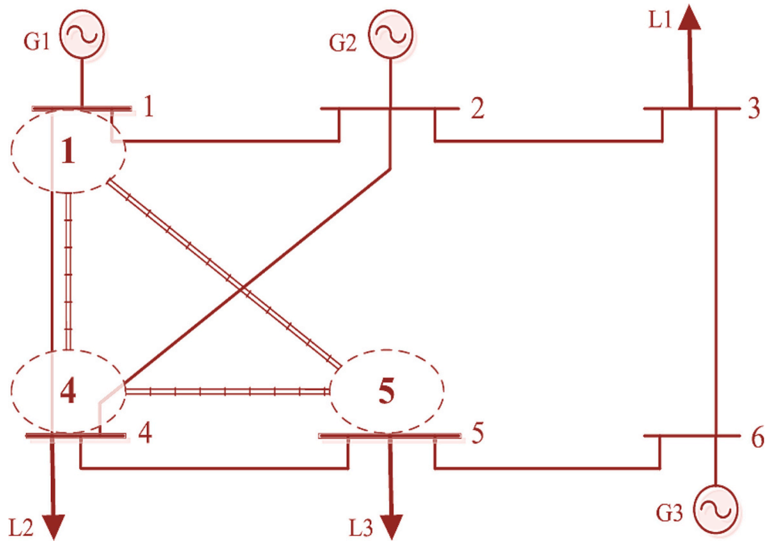


Fig. 5. Six bus three station system in the transportation network.

Table 1
Case 1 BEESF route.

	Overall cost 82526.23								
Time span (0–24)	0–3	3–5 5–6	6–8	8–10	10–12	12–15	15–17	17–20	20–24
Position of HEOM	1–1	1–1 1–1	1–4	4–1	4–1	4–1	4–4	4–4	4–4
Status of H EOM	Charging		Transporting			Discharging		Transporting	

$$-G_{high}, d \leq G_d, k \leq G_{low}, d, \forall k, \forall d \tag{17}$$

2.1. BEESF constraints

Eqs. (1)–(6) are utilized for representing the BEESF-HEOM constraints.

This proposed model can study the BEESF on the schedule generation per hour of thermal power stations' units. In this proposed model, we can analyze the station base and cost of transportation on the mobility of BEESF as discussed using case studies.

3. Discussion and case studies

3.1. BEESF data

We take the (NAS) sodium-sulfur battery technology is endorsed for the HEOM based BEESF model. Nas is battery technology, with new optimistic high temperature has extremely energy effective and low-cost solutions. We could equivalently apply another battery type for the HEOM based BEESF application that involves lead-acid, highly sodium-nickel-chloride. This study considers that NAS batteries provide power and energy densities at 200 W/Kg, and 300 W/kg correspondingly. The power and time relationship has been demonstrated in Fig. 4.

3.2. Power system of six bus case study

The power system of six buses and respective smart transportation networks is shown in Fig. 5. The transmission lines, buses, hourly loads, and generating units over 24 h are provided in Table 1. we consider three transportation stations (1,3,5) with the BEESF system.

As inferred From based on the numerical values tabulated in the Table 1,

3.2.1. Case 1

Impact of the BEESF on the Monthly SCPOU, in this situation, has been considered for the BEESF base station on bus one, and the fuel costs are initially thought to be 0 for each ride among two stations. Therefore, the BEESF power system's average running costs are RS.82526.23, which is less than RS.2968.00 without BEESF. This Expresses the hourly deployment of 1–3 units where BEESF will reconfigure the transmission system's load profile. 4 Hours 11 and 22 were shut down to reduce the cumulative operational costs. The total cost is lowered as the inexpensive component 1 is delivered somewhat over two cycles of 11–20 h and 1–7 h to minimize the more costly units 2 and 3. The BEESF route is shown in Table 1.

- The BEESF starts charging in the first four-time spans 0:00 to 8:00 on bus-one through bus four in the period is five 8:00 to 10:00).

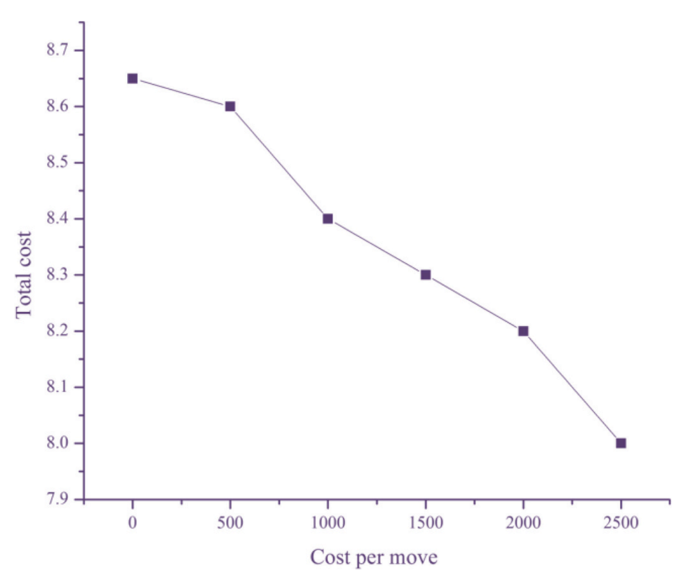


Fig. 6. influence of cost, transportation of the overall cost.

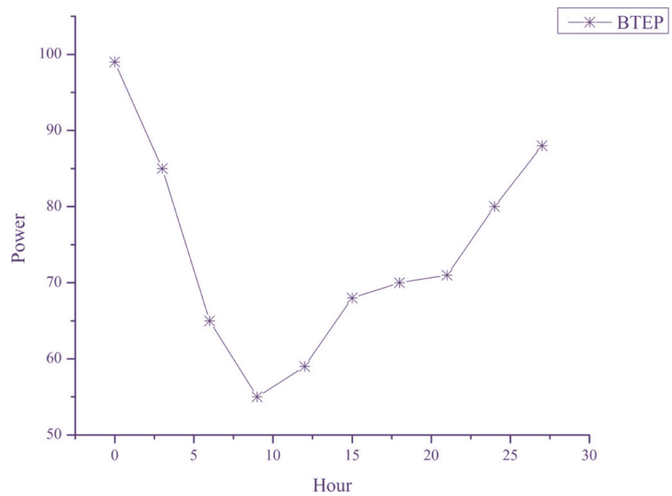


Fig. 7. Twenty four-hourly Active power of wind farm.

- The BEESF starts discharging at bus four in the next six-time spans 10:00 to 22:00 and comes back to its transmitter through the railway 4 to 1 at the last period of the day 22:00 to 24:00

Displays the association between all the total cost, referred to as seven, and the cost of transportation between two BEESF stations per ride. After the travel is pricey the overall price will remain unchanged Rs.1471.21, which means BEESF will live. Fig. 6 shows the overall cost and impacts of the transportation cost of the proposed system BEESF is explained.

3.2.2. Case 2

Addition of renewable energy; In the case of 100 MW of the wind farm is associated by the network power at bus one with 24 h of the profile of the battery based transportation estimated power (BTEP) storage as shown in e Fig. 7. The cost of transportation for every trip difference between the two stations is Rs 200. Backdrops of (1.) test them BEESF of the station, based at bus 1, (2.) Situation 2, BEESF of the base station at the bus 4, (3.) Situation 3, BEESF is fixed at bus 4.

In Table 2, the overall cost for every period has been discussed.

3.2.3. 118 bus system

The railway network modified 118 bus system has been shown in Fig. 8. The total power and energy of 100 MW and 200 MWh are included in the BEESF model. Transportation expenses are originally

Table 2
Case 2 BEESF route.

Scenario	Timespan (0–24)										Overall cost
1	0–3	3–5	5–6	6–8	8–10	10–12	12–15	15–17	17–20	20–24	82526.23
2	1–1	1–1	1–1	1–4	4–1	4–1	4–1	4–4	4–4	4–4	82312.50
3	4–4	1–41–41–1		1–4	4–1	4–1	4–1	4–4	4–4		82862.89

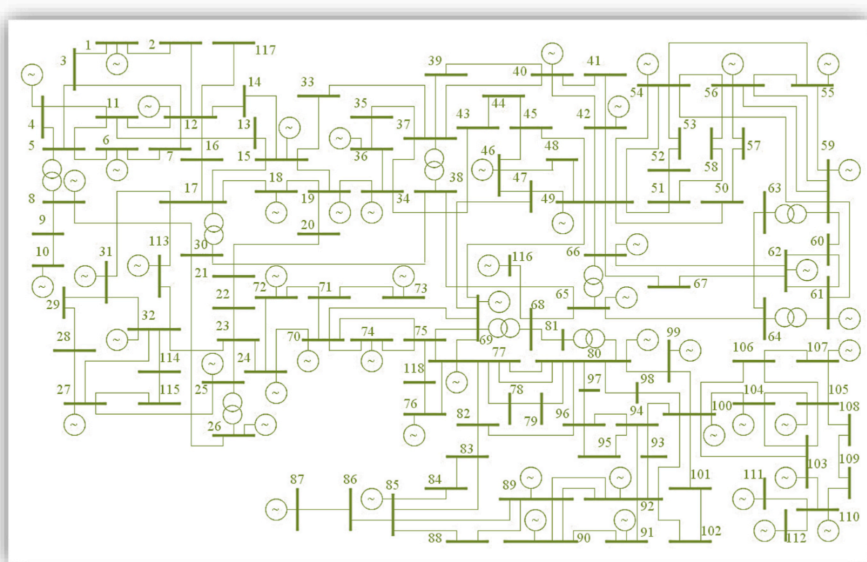


Fig. 8. The modified Transportation network of the IEEE-118 bus system.

Table 3
Case 3 BEESF route.

	Overall cost 82916.98								
Time span (0–24)	0–3	3–5	5–6	6–8	8–10	10–12	12–15	15–17	21–24
Position of BEESF	116–26	26–84 84–8484–84 84–76				76–76	76–33	76–33	37–117
Status of BEESF	T		T	C	C	T	D	T	TT

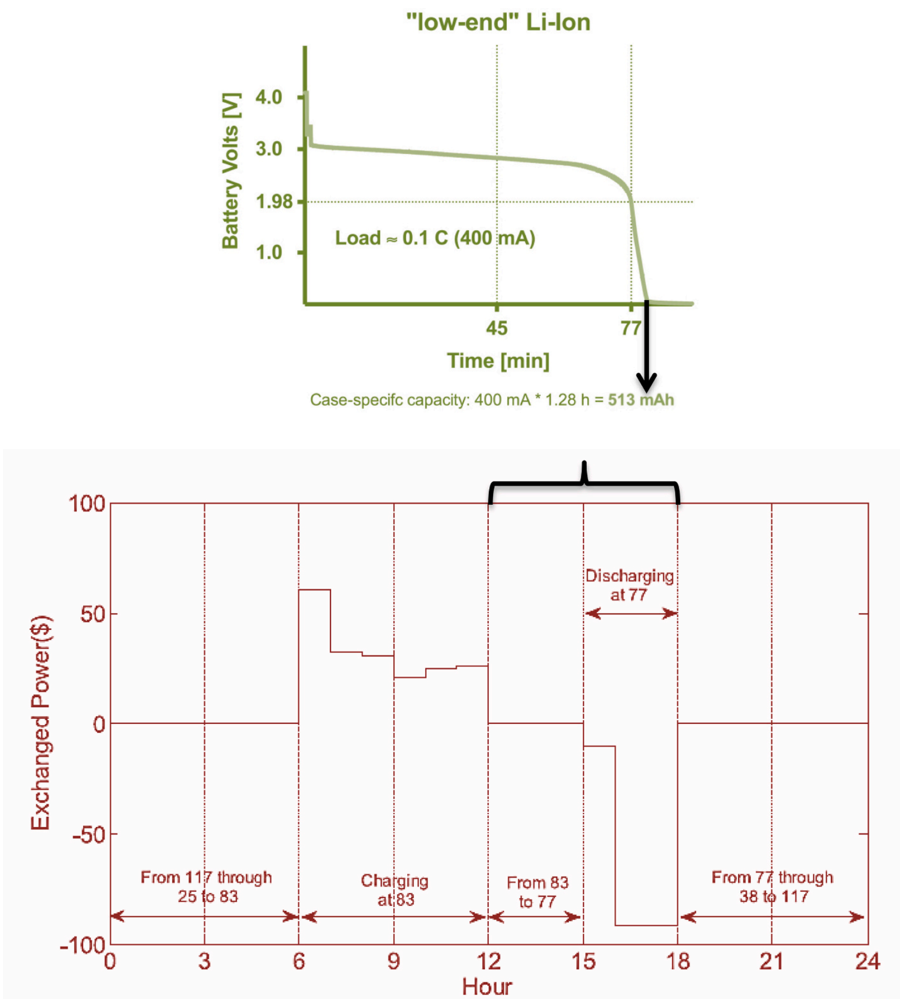
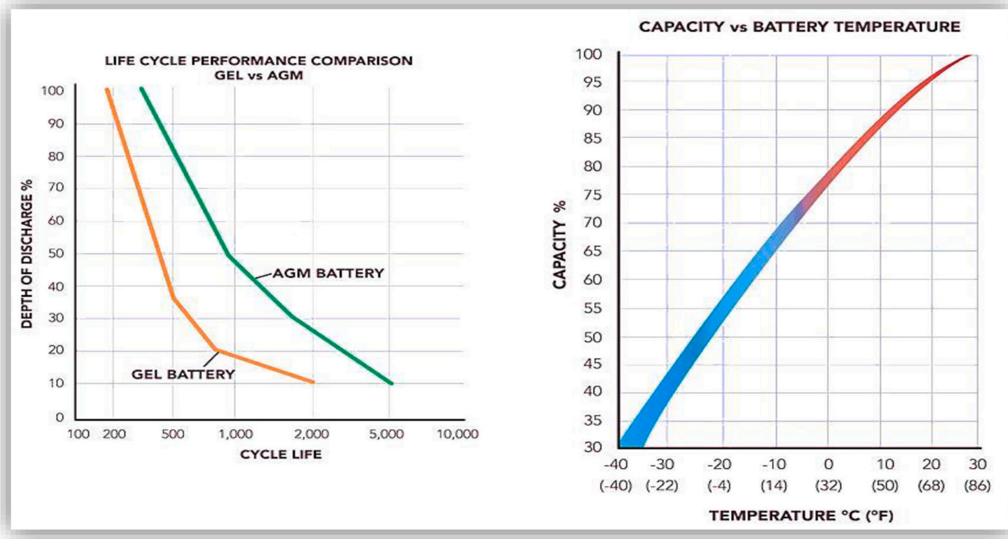
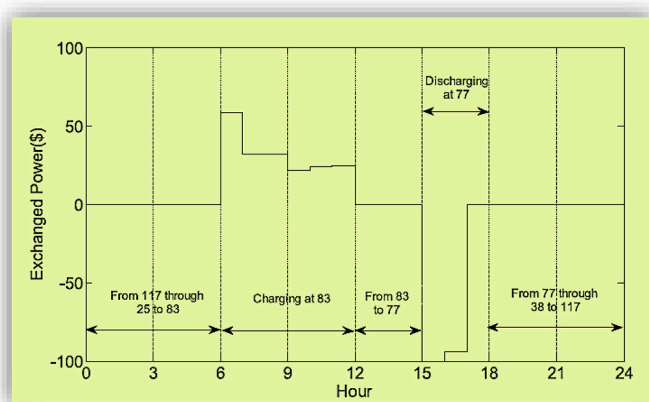


Fig. 9. Discharging/Charging of Proposed BEESF Model for Li-Ion Batter in case 3.



(a) GEL Vs. AGMB (b) Capacity Vs. Battery Characteristic



(c) Charging/Discharging analysis concerning GEL vs. AMBT

Fig. 10. Discharging/charging the proposed BEESF model for Absorbed Glass mat batteries (AGMB) Vs. Gel battery in case 4.

assumed to be Zero hours, and the time of travel from any two train stations is three hours h. The period is three h as per IEEE 118 bus standard shown in the Fig. 8.

3.2.4. *Case 3*

The above Table 3 and Fig. 9 shows the smart green transportation system with a base junction setup 117. The entire price of this case with the BEESF smart grid transportation is $813,533.10. It is $598.90 less at cost than the system without the BEESF. It shows the BEESF rechargeable profile and also the BEESF transportation routing for smart grid transportation. In the period of the first two spans (0.00–6.00) of the period. The BEESF system travels from junction 117 to junction 83 via junction 25. It can be charged in-between periods (06.00–12.00), which is done before reaching junction 77 at 5(12.00–15.00). It gets the charged down at span 6 (15.00–18.00). It reaches in return at the final two time period of (18.00–24.00). The forwarding path and the returning path may get varied I the BEESF. And it is shortest as compared to forwarding to junction 77.

3.2.5. *Case 4*

Two BEESF smart grid transportation system with junction 117and 69 is considered here. In this case, it is taken as a smart grid transportation network as NBEESF 1 and BEESF 2. The base junctions are at 117 and 69, respectively. For this case, the entire price is $813,145.50, which is $986.50 lesser than without the BEESF system and $387.60 less than that in case 3. The above figure indicates the BEESF recharging profile for the gel and AGMB model, which shows the BEESF smart grid transportation routing as shown in the Fig. 10, (a), (b), (c) of the proposed BEESF model.

3.2.6. *Transportation comfort ability ratio*

Fig. 11 shows the Transportation Comfortability Ratio. Comfortable travel options should be provided for people with limited mobility. On the premise of accessibility for all, technology must be built, preserved, and updated. A cleaner and safer built atmosphere will lead to improved usage of public transit, cycling, and walking, not only eases congestion and decreases traffic and has beneficial effects on the health and well-being of users. Emerging technology can provide travelers with new and more accessible facilities, improve accessibility and protection, and

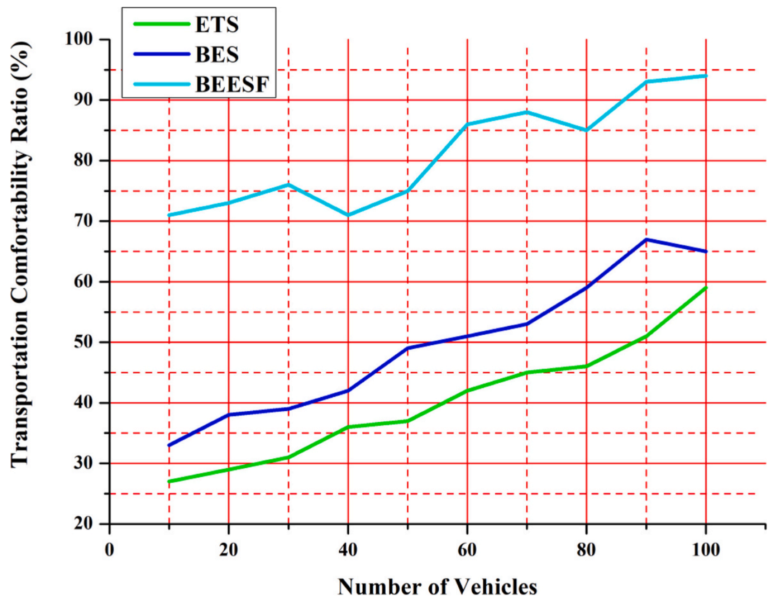


Fig. 11. Transportation Comfortability Ratio.

decrease environmental effects. Innovative vehicle technology will minimize emissions, reduce oil dependence and improve comfort; Smart green optimize transportation using HEOM and BEESF enhance safety;

The BEESF 1 route and case 3 routing are the same, excluding the power to be exchanged during the transportation. BEESF 2 travels to 83 via 77 in the period of 0.00–6.00.and power exchange takes place in the following: Charging at 06.00–09.00 and 12.00–15.00 respectively, whereas discharged at 09.00–12.00.and again, it discharges at 18.00–21.00 while traveling with the load profile towards 77and, in the end, it reached back to the base junction at 21.00–24.00.

4. Conclusion

This paper presents a hybrid energy optimization model (HEOM) that implements BEESF transportation using the railway to apply the V2G-type. The operation and influences of BES on the power grid have been assessed. With superior usage of the workplace, less noisy, unaccident free and increasingly mindful of conditions with web-based analyses for the use of data from consumers as an adaptation in transport administrations, this smart vehicle model framework has added the structure and planning of a smart community. The secured constrained power optimization unit (SCPOU) provides the hourly and locational discharging/charging schedule of the BEESF for the system of power on reducing the operational cost. The numerical case studies show that the six-bus power system linked to the three-station railway system and the railway system linked with the eight-station 118-bus systems establish the proposed HEOM model's efficiency. The simulation results of the HEOM model depth of discharge (10.4%), Capacity (95.3%),Battery Volts (1.0 V), Power (90.3 W/h), Total cost decrease the operation cost of the grid and power grid overload.

Author statement

The authors have no involvement with any financial interest or non-financial interest in the subject matter discussed in the manuscript and this research work is original and not under consideration of any other journal.

Declaration of Competing Interest

NO.

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