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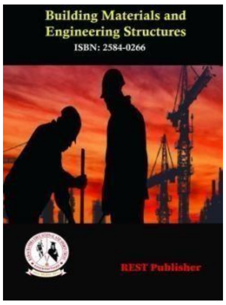

Analyzing Power Systems and Power Electronics Interdependencies: A DEMATEL Method Approach

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Abstract: *Energy research encompasses all aspects of electrical energy, focusing on innovation in energy production and delivery, alternative resources, and efficient devices. It involves studying systems and equipment for converting, providing, and utilizing energy as electricity. Power electronics have become essential to power systems, enhancing quality and efficiency and promoting the development of intelligent, efficient energy solutions. There are various types of power electronics within power systems. The architectural study of converting electrical energy from one form to another falls under power electronics. Globally, electronics recycle or recover more than 80% of the total electricity produced, averaging 3.4 billion kilowatt-hours annually. Power electronics converters, also known as power converters or switching converters, are used to process or convert electrical energy. Electricity exists as AC power and DC power, leading to the classification of distribution systems into AC and DC based on the type of power used. Power system analysis is crucial for designing electrical power systems. It involves calculations and simulations to ensure that the electrical system and its components are appropriately specified to function as intended, endure expected stress, and be protected from failures. Advantages of power electronics include high power density electricity and improved efficiency, reaching up to 99% in energy conversion. Their efficiency and reliability make switching power supplies suitable for medical devices with acoustically sensitive applications. Power system reliability addresses issues like service interruptions and power outages, often guided by specific codes relevant to consumers. Common reliability indices in the US include SAIFI, SAIDI, and CAIDI. The DEMATEL (Decision Making Trial and Evaluation Laboratory) method is applied across various industries such as non-metal mineral products, general equipment manufacturing, coal mining and washing, textiles, and food manufacturing. DEMATEL visualizes and assesses the interactions and dependent relationships between factors through a structural model, identifying critical elements. Evaluation parameters for power electronics include their application in power systems, transportation systems, energy conservation, heating and lighting control, and renewable energy integration. Power electronics in power systems are ranked highest, while energy conservation is ranked lowest.*

Keywords: *MCDM, Power Electronics in Power Systems, Power Electronics in Transportation Systems, Energy Conservation, Heating & Lighting Control and Renewable Energy Integration.*

1. INTRODUCTION

Power electronics-based power systems are driven by the extensive use of electronic power conversions in applications like renewable energy generation and energy storage. Power converters often feature a multi-time level control scheme that adjusts the current to maintain the stability and quality of the electricity system. These converters replace the electromagnetic interfaces of electrical machines and networks with decoupled domain relationships, achieved by the low impedance and high-power factor of DC power sources and loads. Consequently, tightly regulated power converters with decoupled dq-domain computers actively manage power flow and mitigate power factor cycles in the system. The main challenge is ensuring that the numerous incompatible components in power electronics and electric machine-based systems work together to maintain system stability. This coordination is presented through a lateral structure based on the synchronization mechanism of Synchronous Machines (SM), which have supported energy technology development for over a century. Electrostatic converters function as virtual synchronous machines.

Over the past thirty years, power systems have seen extensive research and increased responsibilities. Various methods have been formulated to solve Internet backbone equations, including nodal analysis, modified nodal analysis, and state-variable analysis, leading to the development of multiple simulation programs. The most widely used is EMTP, which employs nodal analysis with fixed-step integration for electrical equipment and power electronics. SPICE uses a modified nodal algorithm with factor integration for power networks. In the Simulink environment, the Power System Blockset (PSB) is a graphical tool that allows for the creation and simulation of power systems, with block sets representing common components and devices found in electrical power networks. Compared to fixed-step algorithms, Simulink's variable-step event-sensitive algorithms offer more accurate zero-crossing detection of currents.

The revolution in power electronics is ongoing, with developments such as HVDC transmission, static VAR compensators, uninterruptible power supplies for protecting sensitive equipment, and variable-speed motor drives. Power semiconductor devices may eventually replace physical switches in distributed power lines, making electricity from windmills and photovoltaic facilities more compatible with utility transmission networks. Wind turbine technology is divided into systems without power electronics, systems with partially rated electronics, and systems with full voltage-controlled interfaces. Induction generators in wind turbines maintain nearly constant speed despite torque variations, with power aerodynamically controlled by pitch control, active stall, or stall mechanisms. Soft-starters are typically used to reduce startup current, and dynamic compensators are needed to minimize reactive peak load from steam turbines.

Electric, hybrid, plug-in hybrid, and fuel cell-powered trucks use multi-converter power communication equipment, also known as power electronic intensive power sources. These systems feature several DC converters and inverters connected between various buses. In meshed and symmetrical three-phase networks with numerous current and voltage inverters using LCL and LC filters, an impedance-based analytical approach is applied. The nodal admittance matrix is proposed to obtain impedance ratios for different inverters to determine each circuit's contribution to the harmonic stability of the overall power system. The use of electronics in power systems has increased in recent years, with electro-electronic power generation systems becoming essential components of power grids, such as renewable power plants and microgrids.

Power-electronic-based systems are vulnerable to negative impedance instability due to the constant-power nature of most components. However, research shows that altering power electronic controls can prevent such instabilities in some systems. Middlebrook's criteria, based on the DC interface used to construct computer components, state that a system is stable if the Nyquist plot of the product of the source impedance Zs and load admittance Yl lies within the unit circle. Stability criteria, such as the magnitude and phase of admittance, have been proposed and applied in power supply design methodologies.

DC Micro Building Blocks (PEBBs) are power processors that aim to increase power density and provide modular, "plug and play" power modules with varied functionalities. These blocks are not specific to any semiconductor, device, or circuit topology but identify common electrical, mechanical, and thermal components. Digital controls combined with high-frequency, highly resilient circuits enable modular propulsions with reduced size, weight, and cost, while enhancing efficiency. In the realm of education, power electronics labs offer students practical experience in synthesis, wiring configuration, circuit layout, and device selection, which are crucial for converter performance. Similarly, the study of electrical machines benefits from hands-on instruction, helping students intuitively learn energy flow and conversion concepts.

For the past forty years, power electronics have facilitated efficient electrical energy conversion and regulation in various ways. However, the reliability of power electronic systems in emerging applications, especially for grid integration of renewable energy with long operational times in harsh environments, presents significant challenges. Long-term adoption of renewable energy in modern power grids is challenging due to the impact of system life cycle costs on leveling energy costs and service quality. Power circuits, which efficiently convert electrical energy, are essential in wind power systems. Integrating differential wind power units is crucial for achieving high efficiency in power systems. In fixed-speed turbine systems directly connected to the electrical grid, thermosiphons are used as delicate converters. Power converters adapt wind turbine characteristics to phase connection requirements, such as frequency, voltage, active and reactive power control, and harmonics.

2. MATERIALS AND METHOD

Power Electronics in Power Systems: Research on energy and energy systems encompasses all aspects of electricity, innovation in energy production and transportation, alternative energy sources, and efficient devices. Initiatives focus on systems and equipment for converting, supplying, and utilizing energy in the form of electricity. Power electronics have become a crucial component of power systems, improving quality and efficiency and contributing to the development of intelligent, efficient energy solutions. There are various types of power electronics within power systems. Power electronics is a branch of engineering research dedicated to transforming the form of electrical energy. On average, electronic systems reprocess or recycle more than 80% of the electricity produced globally, which amounts to about 3.4 billion kilowatt-hours per year.

Power Electronics in Transportation Systems: Power electronics in electric vehicles serve as the core of the transportation electrification industry. Understanding the fundamental workings of power electronic systems is essential, which includes learning about automobile power electronics such as switch-mode power converters. These systems control both the motor's speed and the torque it generates. Power circuits regulate input and output power, as discussed earlier. Depending on the application, various types of power converters are used. There are two major categories of power sources to consider: alternator (AC) and direct current (DC).

Energy Conservation: Energy conservation involves making choices and adopting practices to use less energy. This can include actions like turning off lights when leaving a room, unplugging appliances when they are not in use, and opting to walk instead of driving. It entails reducing energy demand and finding ways to replenish the energy supply, often by substituting with alternative sources. Conserving energy helps to lower costs and extend the availability of resources over time.

Heating & Lighting Control: Control your home's lighting from a single location with Lifestyle Electronics' central lighting control systems. These systems do more than just adjust your lights—they allow you to manage your lighting whether you're at home or away. Features include:

- Automatic lighting control based on your needs.
- Creation of light scenes for different times such as night, holidays, and other occasions.
- Turning off all interior lights with a single button to activate night mode in your home.

Our lighting control system enables comprehensive management of your lighting, offering high-performance services to make your life simpler and less stressful. Our philosophy is to let you manage everything from anywhere with ease.

Mood Lighting Systems:

Lifestyle Electronics provides mood lighting systems featuring energy-efficient LED technology. Digital controls enable you to choose any color of light to suit your mood or situation. Ideal locations for this service include sports stores, museums, gyms, and healthcare facilities. Enhance your art exhibitions with purple lighting, for instance. We understand the impact of lighting on clients and coworkers. Imagine working in a room with dim, red lighting—how does that make you feel? Our mood lighting can help your business increase brand recognition.

Renewable Energy Integration: Grid integration of renewable energy involves redesigning and planning the operation of a reliable, cost-effective, and efficient electricity system using clean energy generators. This process includes decisions about location, optimization, and utilization for a carbon-free future. To integrate significant amounts of green energy sources into electrical power systems, the National Renewable Energy Laboratory (NREL) is developing technologies and techniques. Currently, over 20% of the annual electricity produced in the United States comes from renewable sources, which are increasingly being incorporated into the electric power infrastructure. Energy systems integration (ESI) combines the operation and planning of energy systems across multiple channels and geographic scales to provide reliable, economical energy services with minimal environmental impact.

Method: The DEMATEL method addresses specific issues like pinup binding by working through problems with a hierarchical structure to identify workable solutions. Structural modeling techniques, used to explore interrelationships between organizational components, help in identifying dependencies and context. This can influence the basic concept of relationships and chart direction due to the influence of elements, often utilizing graphs. DEMATEL processes problems, analyzes them, and solves them by structuring and visualizing the issues.

This approach uses a driven diagram, a causal effect model, to present values of influence between interrelated relations and analyze factors. By visually analyzing the conditions between systemic factors, all components are divided into causal and effect groups, providing researchers with a better understanding of the relationships and complexities for troubleshooting computer problems.

The DEMATEL system is integrated into management and emergency response, and it does not require defuzzifying obscure numbers before use. This ensures that the method accurately reflects the character of the issue. To achieve final results from different aspects, DEMATEL is used in each integrated PPA. The Decision Testing and Assessment Laboratory (DEMATEL) is powerful for gathering team knowledge, building structured models, and visualizing causal relationships among subsystems, even though crisp values may not adequately reflect the ambiguity of the real world.

DEMATEL investigates the relationships between equity and various investment factors, integrating ANP to assess their interdependence. It establishes network relationships and uses a systematic data collection process to increase the weight of each ANP factor. The method quickly separates complex factors into sender and receiver groups, translating this information into strategies for selecting management tools. The ZOGP model enables businesses to fully utilize limited funds for planning by combining different configurations with explicit priorities.

The DEMATEL method is also useful for managing electronic waste by identifying and addressing barriers within causally influential subgroups. Decision-makers need to minimize the impact of these barriers to ensure a strong legal framework and effective management. The results from integrated ISM and DEMATEL methods are somewhat consistent, helping to determine the structure and interactions of e-waste management constraints.

Specific applications of DEMATEL involve clarifying factors in terms of causal relationships and analyzing the impact level. However, it does not currently link well to team decision-making, as individual decision-makers may rely on their perspectives, which can lead to discrepancies in group evaluations. Despite this, DEMATEL is widely accepted for analyzing overall relationships and classifying factors into cause-and-effect types. It can determine the significance and level of significance of each piece of evidence, although expanding DEMATEL with source theory could lead to better conclusions.

Instead of relying solely on expert criteria, the method can change corresponding propositions between sources. Integrated Multiple Scale Decision Making (MCDM) and DEMATEL can evaluate and visualize the complexity between criteria. Buyukozkan and Ozturkcan's integration of ANP and DEMATEL helps companies determine important Six Sigma projects and logistics by prioritizing these projects.

3. RESULTS AND DISCUSSION

TABLE 1. Power Systems and Power Electronics

	Power Electronics in Power Systems	**Power Electronics in Transportation Systems**	**Energy Conservation**	**Heating & Lighting Control**	**Renewable Energy Integration**	**Sum**
Power Electronics in Power Systems	0	2	4	2	3	11
Power Electronics in Transportation Systems	4	0	2	1	2	9
Energy Conservation	2	1	0	3	1	7
Heating & Lighting Control	1	3	2	0	2	8
Renewable Energy Integration	2	4	1	3	0	10

Table 1 demonstrates the application of the DEMATEL method (Decision Making Trial and Evaluation Laboratory) in various domains of power systems and power electronics. This includes its relevance to power electronics in power systems, power electronics in transportation systems, energy conservation, heating and lighting control, and renewable energy integration, summing up these values.

TABLE 2. Normalization of direct relation matrix

Normalization of direct relation matrix					
	Power Electronics in Power Systems	**Power Electronics in Transportation Systems**	**Energy Conservation**	**Heating & Lighting Control**	**Renewable Energy Integration**
Power Electronics in Power Systems	0	0.181818182	0.36363636	0.181818182	0.272727273
Power Electronics in Transportation Systems	0.363636364	0	0.18181818	0.090909091	0.181818182
Energy Conservation	0.181818182	0.090909091	0	0.272727273	0.090909091
Heating & Lighting Control	0.090909091	0.272727273	0.18181818	0	0.181818182
Renewable Energy Integration	0.181818182	0.363636364	0.09090909	0.272727273	0

Table 2 presents the normalization of the direct relation matrix for various sectors within power systems and power electronics. The matrix includes the following sectors: Power Electronics in Power Systems, Power Electronics in Transportation Systems, Energy Conservation, Heating & Lighting Control, and Renewable Energy Integration. The normalized values indicate the direct influence each sector has on the others. For instance, Power Electronics in Power Systems has a normalized influence of 0.1818 on Power Electronics in Transportation

Systems, 0.3636 on Energy Conservation, 0.1818 on Heating & Lighting Control, and 0.2727 on Renewable Energy Integration. Similarly, Renewable Energy Integration has a normalized influence of 0.1818 on Power Electronics in Power Systems, 0.3636 on Power Electronics in Transportation Systems, 0.0909 on Energy Conservation, and 0.2727 on Heating & Lighting Control. These values illustrate the interconnectedness and the degree of influence between these critical sectors in power systems and power electronics.

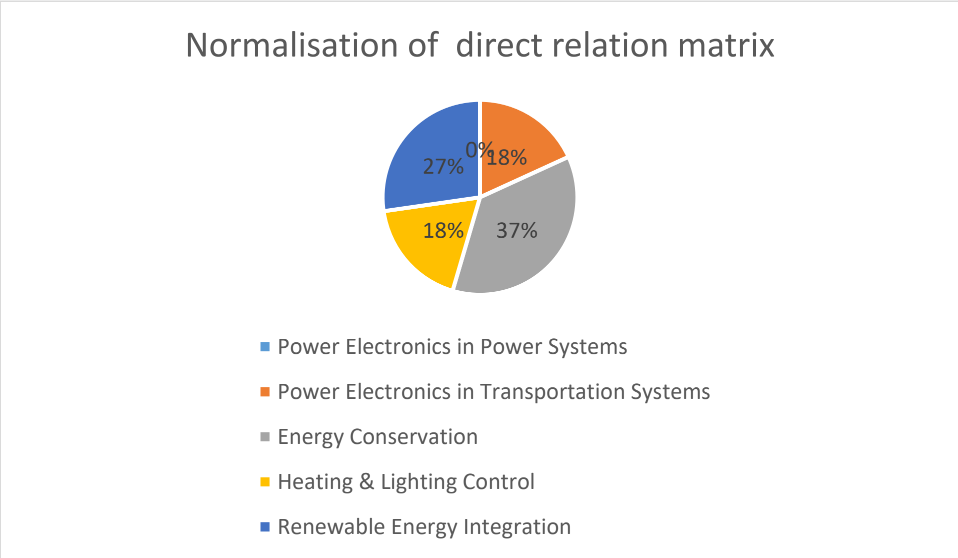

FIGURE 2. Normalization of direct relation matrix

Figure 2 illustrates the normalization process of the direct relation matrix for various criteria such as Power Electronics in Power Systems, Power Electronics in Transportation Systems, Energy Conservation, Heating & Lighting Control, and Renewable Energy Integration, indicating distinct values for each criterion.

TABLE 3. Calculate the Total Relation Matrix

	Power Electronics in Power Systems	**Power Electronics in Transportation Systems**	**Energy Conservation**	**Heating & Lighting Control**	**Renewable Energy Integration**
Power Electronics in Power Systems	0	0.181818182	0.363636364	0.181818182	0.27272727
Power Electronics in Transportation Systems	0.363636364	0	0.181818182	0.090909091	0.18181818
Energy Conservation	0.181818182	0.090909091	0	0.272727273	0.09090909
Heating & Lighting Control	0.090909091	0.272727273	0.181818182	0	0.18181818
Renewable Energy Integration	0.181818182	0.363636364	0.090909091	0.272727273	0

Table 3 displays the calculation of the Total Relation Matrix for different sectors within power systems and power electronics. The matrix encompasses the following sectors: Power Electronics in Power Systems, Power Electronics in Transportation Systems, Energy Conservation, Heating & Lighting Control, and Renewable Energy Integration. The entries in the matrix represent the total influence of each sector on the others.

For example, Power Electronics in Power Systems has a total influence value of 0.1818 on Power Electronics in Transportation Systems, 0.3636 on Energy Conservation, 0.1818 on Heating & Lighting Control, and 0.2727 on Renewable Energy Integration. Similarly, Renewable Energy Integration exerts a total influence of 0.1818 on Power Electronics in Power Systems, 0.3636 on Power Electronics in Transportation Systems, 0.0909 on Energy Conservation, and 0.2727 on Heating & Lighting Control. These values demonstrate the overall influence each sector has within the power systems and power electronics framework, highlighting the intricate interdependencies and relationships among these sectors.

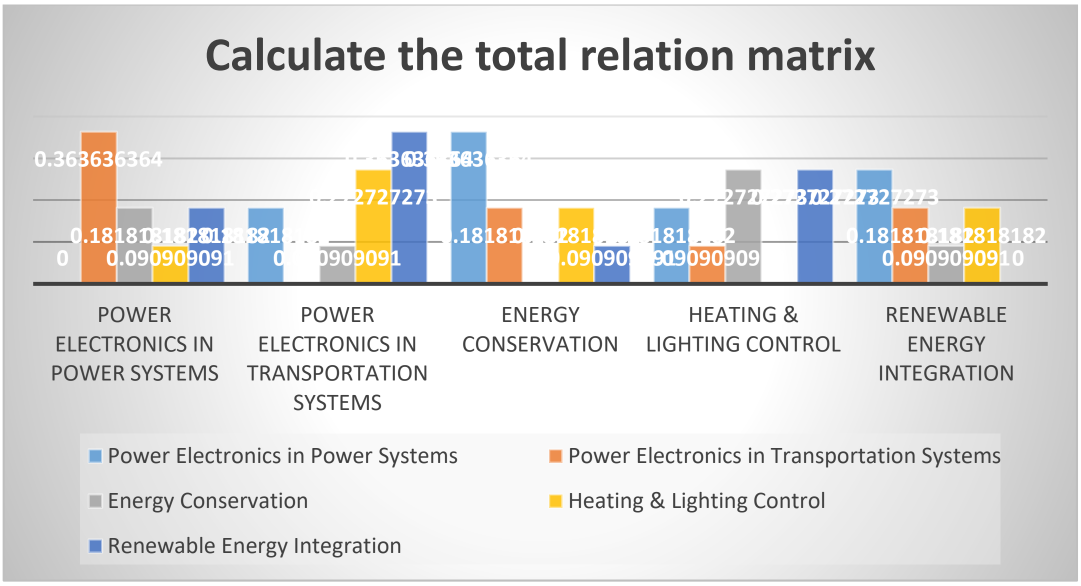

FIGURE 3. Calculate the total relation matrix

Figure 3 illustrates the calculation of the total relation matrix for Power Systems and Power Electronics, focusing on their interactions with Power Electronics in Power Systems, Power Electronics in Transportation Systems, Energy Conservation, Heating & Lighting Control, and Renewable Energy Integration. The figure provides a visual representation of how these elements interrelate and influence each other within the context of power systems and electronics.

TABLE 4. T= Y(I-Y)-1, I= Identity matrix

I				
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

Table 4 presents the calculation represented by \(T = Y(I - Y)^{-1} \), where \(I \) denotes the identity matrix. This computation is applied uniformly across sectors including Power Electronics in Power Systems, Power Electronics in Transportation Systems, Energy Conservation, Heating & Lighting Control, and Renewable Energy Integration. The table illustrates the mathematical operation used to derive \(T \) based on the given matrices, emphasizing its application in analyzing relationships and dependencies among these key areas within the domain of power electronics and systems.

TABLE 5. Y Value

Y				
0	0.181818	0.363636	0.181818	0.272727
0.363636	0	0.181818	0.090909	0.181818
0.181818	0.090909	0	0.272727	0.090909
0.090909	0.272727	0.181818	0	0.181818
0.181818	0.363636	0.090909	0.272727	0

Table 5 presents the matrix of Y values, depicting a set of relationships among different criteria or entities. Each row and column corresponds to a specific criterion or entity, with the numbers indicating the strength or degree of relationship between them. The values range from 0 to 0.363636, reflecting varying degrees of correlation or influence. For instance, higher values signify stronger connections, while lower values indicate weaker associations. This matrix is crucial for analyzing interdependencies or dependencies between criteria, facilitating decision-making processes based on these relationships.

TABLE 6. I-Y Value

I-Y				
1	-0.18182	-0.36364	-0.18182	-0.27273
-0.36364	1	-0.18182	-0.09091	-0.18182
-0.18182	-0.09091	1	-0.27273	-0.09091
-0.09091	-0.27273	-0.18182	1	-0.18182
-0.18182	-0.36364	-0.09091	-0.27273	1

Table 6 displays the I-Y values, representing a matrix where each element signifies the inverse relationships between different criteria or entities. Each row and column corresponds to a specific criterion or entity, and the numbers indicate the strength and direction of the inverse relationship between them. The values range from -0.36364 to 1, reflecting varying degrees of negative correlation or influence. Higher absolute values denote stronger inverse connections, while values closer to zero indicate weaker inverse associations. This matrix is essential for understanding the inverse dependencies between criteria, providing insights into factors that may oppose or counterbalance each other in decision-making contexts.

TABLE 7. (I-Y)-1 Value

(I-Y)-1				
1.890832	1.100689	1.168345	1.038156	1.010775
1.081081	1.837838	0.963964	0.864865	0.873874
0.749868	0.735559	1.612259	0.81558	0.633104
0.788553	0.952305	0.832538	1.666137	0.766826
1.020138	1.195019	0.936584	1.031797	1.768239

Table 7 presents the (I-Y)-1 values, which represent the inverse of the I-Y matrix. Each entry in the matrix indicates the reciprocal of the corresponding entry in the I-Y matrix, reflecting the strength of the inverse relationships between different criteria or entities. The values range from approximately 0.63 to 1.89, with higher values indicating stronger inverse relationships and lower values indicating weaker inverse connections. This matrix is significant for evaluating the intensity of counterbalancing factors or opposing influences among criteria, offering insights into how factors may counteract each other in decision-making scenarios.

TABLE 8. Total Relation matrix (T)

	Total Relation matrix (T)					Ri
	0.890832	1.100689	1.168345	1.038156	1.010775	**5.208797**
	1.081081	0.837838	0.963964	0.864865	0.873874	**4.621622**
	0.749868	0.735559	0.612259	0.81558	0.633104	**3.54637**
	0.788553	0.952305	0.832538	0.666137	0.766826	**4.006359**
	1.020138	1.195019	0.936584	1.031797	0.768239	**4.951775**
Ci	**4.530472**	**4.82141**	**4.51369**	**4.416534**	**4.052818**	

Table 8 presents the Total Relation matrix (T), where each Ri represents the sum of values across each row of the previous matrix (I-Y)-1. The matrix T shows aggregated relationships among criteria or entities, with each column denoting a specific criterion or entity and each row representing the cumulative influence or relation score. The values range from approximately 3.55 to 5.21, reflecting the total combined impact or connectivity strength of each criterion within the analyzed system or context. Additionally, the Ci values at the bottom row indicate the sum of values across each column, providing an overall perspective on the collective influence of all criteria considered in the matrix. This comprehensive analysis helps in understanding the overall interdependence and influence dynamics among the criteria involved.

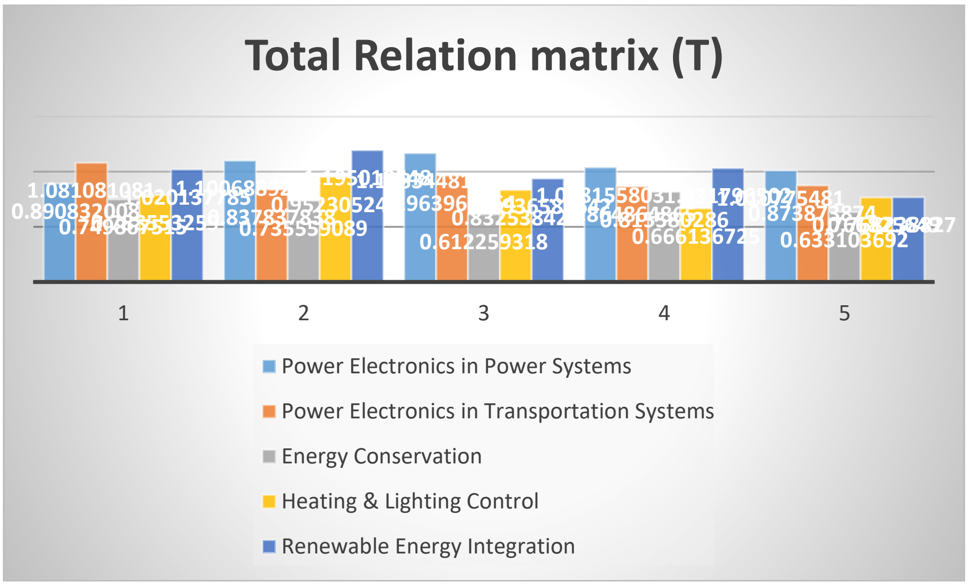

FIGURE 4. Total Relation matrix (T)

Figure 4 illustrates the Total Relation Matrix (T), which results from multiplying the direct relation matrix by the inverse of the direct relation matrix subtracted from the identity matrix.

TABLE 9. Power Systems and Power Electronics Ri & Ci Value

	Ri	Ci
Power Electronics in Power Systems	5.208797	4.530472
Power Electronics in Transportation Systems	4.621622	4.82141
Energy Conservation	3.54637	4.51369
Heating & Lighting Control	4.006359	4.416534
Renewable Energy Integration	4.951775	4.052818

Table 9 provides the Ri and Ci values for different criteria related to Power Systems and Power Electronics. The Ri values represent the total relation strength of each criterion, calculated from the Total Relation Matrix (T). For instance, Power Electronics in Power Systems has a Ri value of 5.208797, indicating its strong overall influence based on the combined relationships within the matrix. The Ci values, listed alongside, denote the cumulative impact of all criteria across each respective column. These values, such as 4.530472 for Power Electronics in Power Systems, offer insights into the collective influence of all criteria considered within the specific context of Power Systems and Power Electronics.

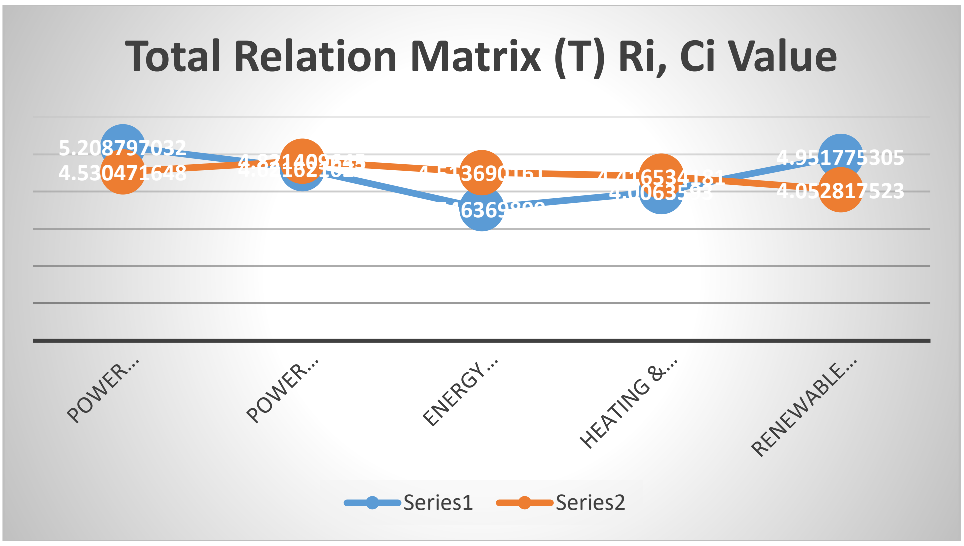

FIGURE 5. Total Relation Matrix (T) Ri, Ci Value

Figure 5 illustrates the Ri and Ci values for Power Systems and Power Electronics criteria. Among these criteria, Power Electronics in Power Systems exhibits the highest Ri value, indicating its strongest overall influence based on the combined relationships within the analysis. Conversely, Energy Conservation shows the lowest Ri value, suggesting comparatively less influence. In terms of Ci values, Power Electronics in Transportation Systems ranks highest, reflecting its cumulative impact across all criteria. On the other hand, Renewable Energy Integration shows the lowest Ci value, indicating its lesser cumulative impact compared to the other criteria examined in the context of Power Systems and Power Electronics.

TABLE 10. Calculation of Ri+Ci and Ri-Ci To Get The Cause And Effect

	Ri+Ci	**Ri-Ci**	**Rank**	**Identity**
Power Electronics in Power Systems	9.739269	0.678325	1	cause
Power Electronics in Transportation Systems	9.443031	-0.19979	2	effect
Energy Conservation	8.06006	-0.96732	5	effect
Heating & Lighting Control	8.422893	-0.41017	4	effect
Renewable Energy Integration	9.004593	0.898958	3	cause

Table 10 presents the calculations of Ri+Ci and Ri-Ci, aimed at identifying cause and effect relationships among various criteria. The Ri+Ci values represent the sum of the Ri and Ci values for each criterion, indicating the combined influence and impact. For example, Power Electronics in Power Systems has a Ri+Ci value of 9.739269, ranking it first as a cause due to its significant combined influence. Conversely, Ri-Ci values show the difference between Ri and Ci, helping to distinguish between causes and effects. Power Electronics in Transportation Systems, with a Ri-Ci value of -0.19979, ranks second as an effect, indicating its influence is more reactive than causal. Energy Conservation, Heating & Lighting Control, and Renewable Energy Integration are also categorized as effects based on their Ri-Ci values, highlighting their roles in response to or influenced by other criteria within the analysis framework.

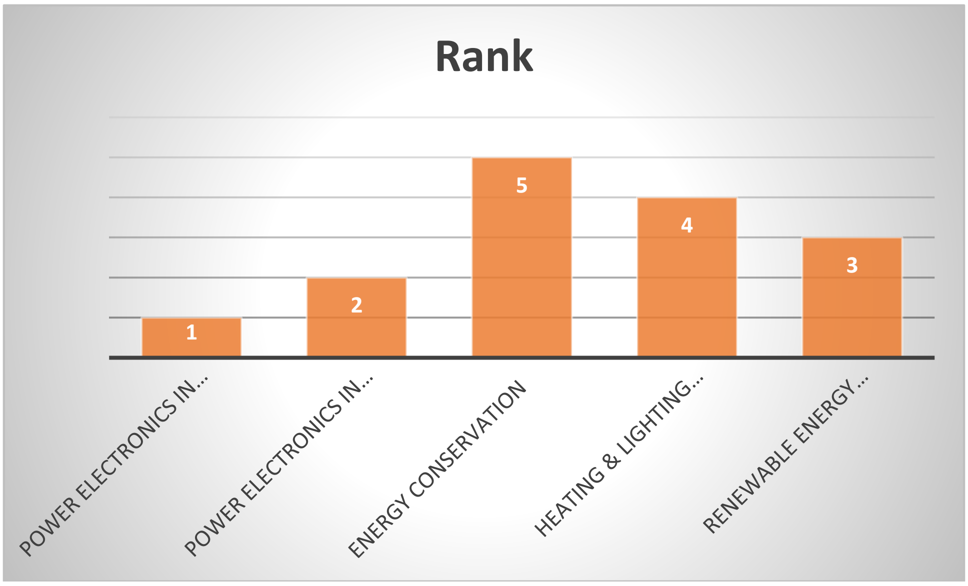

FIGURE 6. Shown the Rank

Figure 6 depicts the rankings derived from the DEMATEL analysis for Power Systems and Power Electronics. In this analysis, Power Electronics in Power Systems has achieved the top rank, signifying its primary influence or causal role within the system. Conversely, Energy Conservation has been assigned the lowest rank, indicating its comparatively lesser influence or more reactive role within the analyzed framework of Power Systems and Power Electronics.

4. CONCLUSION

Energy research and systems focus on all aspects of electrical energy, including advancements in energy production, delivery, alternative resources, and efficient devices. Power electronics play a crucial role in modern power systems, facilitating electronic power conversion for applications such as renewable energy generation and storage. These systems often include multi-level control schemes to ensure stability and electricity quality. They also involve the electromagnetic interfaces of electrical machines and networks. Power electronics have become integral to enhancing the quality and efficiency of power systems, paving the way for intelligent and efficient energy management. Various types of power electronics are utilized across these systems to control and optimize electricity usage, particularly in integrating renewable energy into the grid. This process involves redesigning and planning electricity systems to accommodate clean energy sources effectively, aiming for a sustainable, carbon-free future. DEMATEL (Decision Making Trial and Evaluation Laboratory) is a method used to analyze and assess the interdependencies between factors within different industries, including non-metal mineral products, general equipment manufacturing, coal mining, textiles, and food manufacturing. It visualizes these interactions and identifies critical relationships through a structural model. In the context of power systems, Power Electronics in Power Systems ranks highest in influence, while Energy Conservation ranks lowest, reflecting their respective roles and impacts within the system.

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