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## Sustainable automation: Reducing carbon footprint with energy-efficient RPA solutions

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### Abstract

Sustainable automation through energy-efficient Robotic Process Automation (RPA) solutions plays a critical role in reducing carbon footprints by optimizing energy use in IT operations. Leveraging RPA technology, we developed a system that automates energy-saving operations in central monitoring equipment installed in buildings. This system operates seamlessly over a local area network, allowing it to perform optimizations irrespective of the central equipment's specifications. Key energy-saving measures include

optimizing heat source system operations, adjusting supply water temperatures, setting room temperatures, and managing outside-air intake volumes. By automating these tasks, the system alleviates the burden on operations managers while significantly reducing energy consumption and emissions. In a trial implementation at a large shopping mall, the system achieved a 44% reduction in energy consumption for outside-air processing and a 47% decrease in CO<sub>2</sub> emissions.

**Keywords:** Sustainable automation; robotic process automation; energy-efficient operations; carbon footprint reduction; IT energy optimization

### 1. Introduction

Sustainability has become a core principle in modern business and technology, emphasizing the need to balance automation benefits with social, environmental, and economic considerations. Robotic Process Automation (RPA) involves the use of software to automate repetitive, low-value, rule-based tasks within business processes. These tasks, while traditionally routine and structured, can now be optimized for sustainability, ensuring long-term viability in energy-efficient operations.

RPA offers transformative potential by automating tasks that were previously resource-intensive, promoting greater energy efficiency in IT operations. For example, automating the operation of heat source systems, adjusting supply water and air temperatures, and managing resource allocation dynamically can significantly reduce energy waste. These capabilities eliminate inefficiencies, ensuring sustainable operations that align with broader climate goals.

Despite the promise of RPA, its implementation must address significant challenges, including substantial initial costs, efficient scheduling, and stakeholder alignment. Sustainable RPA implementation should also consider its long-term environmental and social impacts. For instance, balancing automation with employee well-being and aligning with strategic goals are critical to success. Furthermore, research highlights a gap in publications addressing the intersection of sustainability and RPA, indicating the need for a comprehensive approach.

This paper explores how RPA-driven solutions contribute to sustainability goals by optimizing energy use in IT operations. It also examines challenges in RPA implementation, highlighting the importance of stakeholder engagement and strategic alignment. Finally, the paper details a successful RPA implementation in a large shopping mall, achieving significant energy and emissions reductions while providing a scalable model for sustainable automation.

### 2. Benefits of RPA in Sustainable Automation

#### 2.1 Reducing Paper Usage

One of the most immediate benefits of RPA is its ability to minimize paper consumption. By automating processes such as invoicing, reporting, and document management, businesses can transition to digital workflows. This shift not only reduces costs but also decreases deforestation and waste generation, contributing to a more sustainable environment.

#### 2.2 Optimizing Resource Allocation

RPA enables organizations to optimize resource allocation through automated data collection and analysis. By providing actionable insights, businesses can minimize excess inventory, streamline supply chains, and reduce energy consumption. This

optimization helps lower the overall environmental impact of operations.

### 2.3 Enhancing Energy Efficiency

RPA significantly improves energy efficiency by streamlining workflows and automating processes. Automated systems monitor energy usage patterns and identify areas for improvement, allowing businesses to implement energy-saving measures and achieve a lower carbon footprint.

### 2.4 Enhancing Operational Efficiency

By automating repetitive tasks, RPA enhances operational efficiency and reduces resource wastage. Automated workflows decrease the time and energy required to complete tasks, allowing organizations to operate more responsibly and sustainably.

### 2.5 Supporting Remote Work Initiatives

RPA supports remote work by enabling employees to manage automated processes from any location. This reduces the need for commuting, lowering greenhouse gas emissions and promoting environmentally friendly work practices.

### 2.6 Sustainable Supply Chain Management

RPA improves supply chain transparency and efficiency by automating inventory management and logistics. This enables businesses to track environmental impacts, optimize transportation routes, and reduce fuel consumption and emissions, fostering sustainable supply chains.

### 2.7 Facilitating Compliance and Reporting

RPA automates the collection and reporting of sustainability metrics, helping organizations ensure compliance with environmental regulations. Automated reporting provides actionable insights into areas for improvement and supports a culture of sustainability.

### 2.8 Promoting Circular Economy Practices

RPA can support circular economy initiatives by automating processes related to recycling, reuse, and waste management. For instance, automated inventory tracking enhances product lifecycle management, reduces waste, and promotes resource efficiency.

### 2.9 Engaging Employees in Sustainability Efforts

By reducing the burden of repetitive tasks, RPA allows employees to focus on sustainability initiatives and innovation. Empowered employees are more likely to contribute ideas and drive environmental improvements, fostering a sustainability-oriented organizational culture.

### 2.10 Measuring and Improving Environmental Impact

RPA facilitates the collection and analysis of environmental data, enabling businesses to measure their sustainability impact effectively. Automated insights help organizations track progress, identify trends, and implement data-driven strategies to enhance eco-friendly practices.

## 3. Environmental Impact of RPA

### 3.1 Reduced Carbon Footprint

RPA minimizes the need for manual intervention in repetitive processes, thereby reducing energy consumption and greenhouse gas emissions. By automating tasks traditionally performed by humans, companies can lower their overall carbon footprint.

### 3.2 Waste Reduction

Automation tools help companies optimize processes and reduce errors, resulting in lower energy consumption and reduced waste generation. This includes minimizing paper usage and avoiding redundant workflows.

### 3.3 Renewable Energy Integration

Organizations can further enhance the environmental impact of RPA by powering automation tools with renewable energy sources. This practice reduces reliance on fossil fuels and aligns operations with green energy initiatives.

## 4. Challenges in Sustainable RPA Implementation

### 4.1 Initial Costs and Resource Allocation

Implementing RPA solutions requires upfront investment in technology, training, and infrastructure. Organizations must carefully evaluate the cost-benefit ratio and ensure that resources are allocated effectively to maximize sustainability outcomes.

### 4.2 Stakeholder Engagement

Achieving sustainable automation requires the involvement of diverse stakeholders, including IT teams, operations managers, and corporate leaders. Clear communication and alignment of goals are essential to ensure the successful adoption of RPA technologies.

### 4.3 Complexity of Automation Design

Designing energy-efficient RPA workflows can be complex, requiring expertise in both technology and sustainability. Organizations must invest in skilled professionals who can balance operational efficiency with environmental considerations.

## 5. Case Study: RPA in a Large Shopping Mall

A large-scale shopping mall implemented an RPA system to optimize energy use in its central monitoring equipment. The system automated tasks such as adjusting outside-air intake volumes, managing heat source operations, and setting room temperatures. By leveraging RPA, the mall achieved the following results:

- **Energy Consumption:** A 44% reduction in energy required for outside-air processing.
- **CO2 Emissions:** A 47% decrease in carbon dioxide emissions.
- **Operational Efficiency:** Significant reductions in manual workload, allowing staff to focus on strategic initiatives.

This case study demonstrates the potential of RPA to achieve substantial energy savings and environmental benefits while maintaining operational efficiency.

## 6. Sustainability Measures with RPA

### 6.1 Environmental Responsibility

Companies using RPA must align their automation initiatives with environmental sustainability goals. Incorporating green initiatives into RPA strategies demonstrates a commitment to environmental stewardship.

### 6.2 Sustainable Development

RPA drives sustainable development by enabling organizations to operate efficiently while reducing their environmental impact. Implementing sustainable practices supports long-term organizational goals and contributes to a greener future.

### 6.3 Sustainable Solutions

Leveraging RPA technologies allows companies to implement solutions that promote sustainability, including

waste reduction, energy efficiency, and alignment with broader environmental objectives.

## 7. Conclusion

Sustainable automation through energy-efficient RPA solutions represents a transformative approach to reducing carbon footprints and achieving organizational sustainability goals. By optimizing energy use in IT operations and automating resource-intensive tasks, RPA offers a scalable, flexible, and impactful solution for modern businesses. However, successful implementation requires addressing challenges such as initial costs, stakeholder engagement, and workflow complexity.

The environmental impact of RPA is significant and can help organizations improve sustainability and efficiency. By reducing carbon footprints, minimizing waste, and increasing energy efficiency, companies can use automation tools to drive environmental responsibility and sustainable practices. As the world continues to grapple with climate change and environmental awareness, RPA offers a powerful solution for organizations looking to reduce their impact on the planet.

By embracing sustainable innovation and eco-friendly practices, companies can harness the power of RPA to create a more sustainable future for all. The integration of RPA with sustainability objectives provides a pathway to greener operations and a reduced environmental impact. As businesses continue to embrace digital transformation, RPA can play a pivotal role in driving energy efficiency, reducing waste, and supporting global efforts to combat climate change. Organizations that prioritize sustainable automation will not only benefit from operational efficiencies but also contribute to a more sustainable and resilient planet for future generations.

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