RV COLLEGE OF ENGINEERING
Bengaluru-560 059

REPORT ON

EXPERIENTIAL LEARNING / PROJECT BASED LEARNING

ACY 2023-24

THEME

ENERGY

Title of the Project

REGENERATIVE ACCELERATOR

Students Group

SL. No.	USN	Name	Prog.
1	1RV23AI017	ANIKET R T	AIML
2	1RV23AI011	AHIBHRUTH A	AIML
3	1RV23ME125	YASH PRASHANT M	ME
4	1RV23ME085	PREETHAM P	ME

Project Evaluators

SL. No.	Name of the Evaluators (Enter the Names in Capitals)
1.	Dr PRAKASH R
2.	Dr SHIVANANDAPPA K
3.	Dr S ANUPAMA KUMAR
4.	Prof SAVIRTRI KULKARNI

Index

INTRODUCTION

Implementing a windmill generator within a car wheel to produce electricity represents a cutting-edge convergence of automotive engineering and renewable energy technology. As the car travels and its wheels spin, the embedded wind turbines can capture and convert the kinetic energy generated by the wheel's rotation into electrical power. This innovative system can potentially supply energy to various electronic systems in the car, such as lighting, infotainment, and climate control, thereby reducing the load on the vehicle's main battery and improving overall energy efficiency. Additionally, for hybrid and electric vehicles, the electricity generated can supplement the primary power source, extending the range and reducing the frequency of recharges.

This approach not only enhances the vehicle's energy efficiency but also promotes sustainability by reducing reliance on fossil fuels and lowering emissions. By integrating windmill generators into car wheels, the automotive industry can make significant strides towards developing greener, more energy-efficient vehicles. This aligns with the increasing consumer demand for environmentally friendly transportation solutions and contributes to global efforts to combat climate change. As such, the adoption of this technology represents a significant step forward in the pursuit of sustainable and innovative automotive design.

Problem definition

The prototype addresses the challenge of optimizing energy usage and enhancing sustainability in automotive systems. Traditional vehicles rely heavily on fossil fuels, contributing to environmental degradation and resource depletion. Even electric vehicles face challenges such as limited range and reliance on charging infrastructure.

Literature review

Research that explores innovative technologies and designs in automotive engineering, particularly those aimed at improving sustainability and reducing environmental impact, can provide context for the development of windmill generator technologies. {Source**:** "Review of vehicle-to-grid, vehicle-to-home, and vehicle-to-vehicle applications and their impacts on EV batteries and power grids" by A. Rajasekar et al. (Renewable and Sustainable Energy Reviews, 2017) discusses innovative applications of vehicle technologies that intersect with renewable energy integration.}

Research often explores various methods of harvesting energy from vehicles, including regenerative braking, solar panels on car roofs, and kinetic energy recovery systems. These studies focus on improving vehicle efficiency and reducing energy consumption by utilizing otherwise wasted energy.

{Source: "Energy harvesting in road vehicles" by A.J. Bihlmaier et al. (IEEE Transactions on Vehicular Technology, 2016) discusses different approaches to energy harvesting in vehicles, which could provide insights applicable to windmill generators in car wheels.}

Challenges and Considerations:

1) Efficiency and Performance: Optimizing the efficiency of windmill generators to effectively capture energy without significantly affecting vehicle performance is a primary challenge.

2) Durability and Safety: Ensuring that turbines are durable, safe, and resistant to environmental conditions (e.g., weather, debris) is crucial for practical implementation.

3) Market Acceptance: Consumer acceptance and cost-effectiveness will influence the adoption of this technology in mainstream vehicle production.

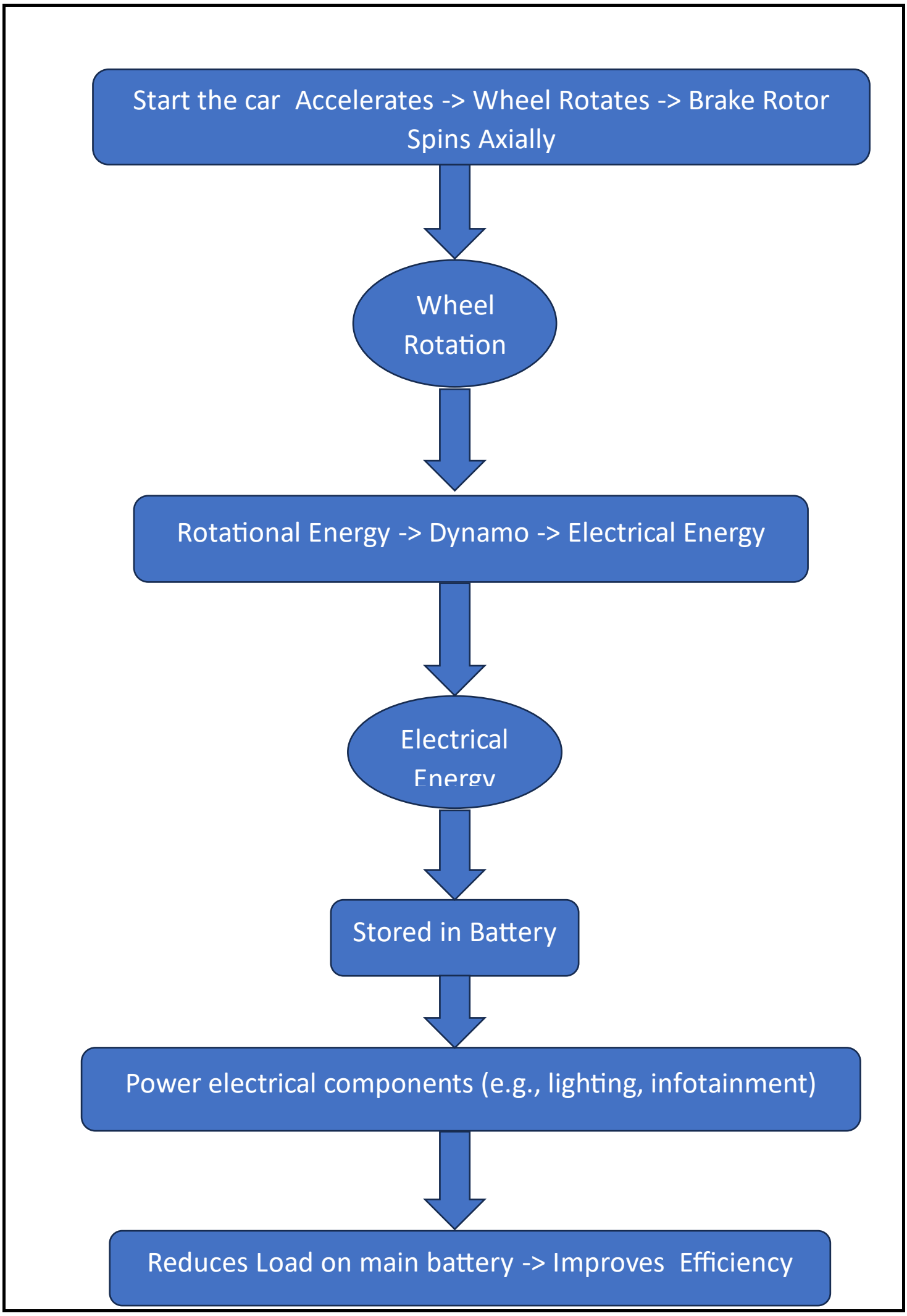
Methodology

→ As per the physics laws, energy can be neither be created not be destroyed, it can only be transformed from one form to another.

→ As the car accelerates, the wheel rotates. The brake rotor is attached to the wheel axially. The rotational energy of the wheel is transferred to the dynamo. The dynamo converts the rotational energy to electrical energy.

→ This electrical energy is stored in the battery. This reduces the load of IC engine which in turns creates less thermal energy aiding mechanical efficiency.

→ Key considerations include optimization of the placement and design of the windmill to maximize the airflow capture without significally impacting the vehicles aerodynamics.


Start the car Accelerates -> Wheel Rotates -> Brake Rotor Spins Axially
Wheel Rotation
Rotational Energy -> Dynamo -> Electrical Energy
Electrical Energy
Stored in Battery
Power electrical components (e.g., lighting, infotainment)
Reduces Load on main battery -> Improves Efficiency

Objectives

→ **Energy Efficiency**: By harnessing wind energy during vehicle motion, the objective is to improve the overall energy efficiency of the vehicle, thereby reducing reliance on fossil fuels and lowering carbon emissions.

→ **Resource Utilization**: Utilizing renewable wind energy to generate electricity while the vehicle is in motion contributes to the sustainable use of natural resources and reduces environmental impact.

→ **Onboard Power Generation**: The generated electricity can power various onboard systems, reducing the load on the vehicle's primary battery and potentially extending its range.

→ **Green Technology Development:** Integrating windmill generators into cars represents a step forward in the development of green technologies for transportation, aligning with global efforts to transition towards sustainable energy solutions.

→ **Innovation and Differentiation**: Car manufacturers may adopt this technology as a means of innovation and product differentiation, appealing to environmentally conscious consumers and enhancing their brand image

Project Execution

Planning and Designing:

Initially it was planned for a system to charge a battery as using a real accelerator of car would be complex and also very expensive. We came up with the idea of using a rotor (rotating manually) connected to an electric motor and through shaft and drive belt, it is connected to electric generator. Using battery would be very expensive, so we decide to connect the system to a power bank just to indicate that there is a production of current. A rectangular wooden base was designed with required amount of dimensions as a base support with two uprights to support the shaft and generator. The uprights were fixed to the wooden base in such a way ensuring less pressure and load on the base.

Implementation:

Implementation of the project was the biggest challenge the entire group faced as there were various components that were not available. Initially it was decided to provide mechanical energy using the electric generator, but it could not rotate the shaft due to heavy load. Alternative was replacing the shaft by PVC pipe for weight reduction but the major challenge was connecting the pipe to the electric motor and generator due to huge difference in their diameter Finaly we came with the idea of rotating the shaft manually by connecting the shaft to a cycle pedal and connecting the generator to the multi-meter instead of battery as they are expensive.

Tools And Technique Used

Tools used are:

1. Dynamo
2. Shaft
3. Battery (power bank)
4. Wheels
5. Wooden Base
6. Stand
7. Multimeter
8. Serpentine Belt

Technique:

- The shaft is connected to the wheel.
- Shaft and dynamo are connected by a serpentine belt.
- As the wheel rotates, the shaft rotates and the dynamo rotates by the help of belt.
- Rotation of the dynamo causes generation of electricity which is stored in battery.

Partial Results

Initial Findings: At Initial stage, an electric motor was used to provide the mechanical energy. The shaft was connected to the generator via thread. But the motor could not rotate the shaft, and due to very -very low or no rpm was generated and hence no current was produced which was not the expected result.

Iterative Improvements:

The improvement made was the replacement of the electric motor with cycle pedal to generate the mechanical energy manually and also replacement of the thread for the connection between a shaft and generator with a rubber band for a greater pulling force between shaft and generator and also for the transfer of energy between them

Current and voltage of this updated model was:

Current: 19.05mA

Voltage= 12V

which was the desired output.

Prototype

Prototype description

The prototype was successfully developed by team viriya on the topic of regenerative accelerator.

A wooden base

2 wooden uprights
A 12 v dynamo

A drive shaft

And A rubber band

The drive shaft is supported by the wooden uprights.

The drive shaft represents the axle of a car.

It consists of a welded spur gear through which a serpentine belt can be connected.

This serpentine belt is then connected axially to the dynamo.

As the shaft is set to motion the dynamo rotates converting the mechanical energy into electrical energy.

The drive shift is of the diameter 30mm and of length 150mm, the dynamo is rated at a peak voltage of 16v, and has an rpm range of 1500-10000.

At the rpm of 3000 the dynamo can generate 0.22 watts of power and 18.85 mA of current.

Feedback

The feedback we received was ever helpful.
We were advised to make the model more refined in order to make it more operationally sound.

Development process

The simulation of the entire model was done on solidworks software. Right from the upright designs to the dynamo connections to the spur gear welded to the shaft.

Building of the Model

We faced many challenges developing the model.
The initial idea of a shaft being used was scrapped as it was too heavy and hence enough torque wasn't generated to make useful energy out of the system.

Instead we tried using a PVC pipe due to lightness and hence higher operating rpm.

The PVC pipe however couldn't rotate smoothly enough due to its material and hence we were back to having the shaft
to generate enough torque we connected the shaft with the pedals and sprocket of a cycle wheel which enabled us to generate the required RPM and Torque. **Testing**

In our tests we found the rpms of the model to be about 500 rpm These losses of rpm were down to the use rubber bands since we couldn't find the appropriate serpentine belt for our spur gear
we got a power output of 0.22 watts and a current output of 18.85mA from our model at the peak voltage of 16v.

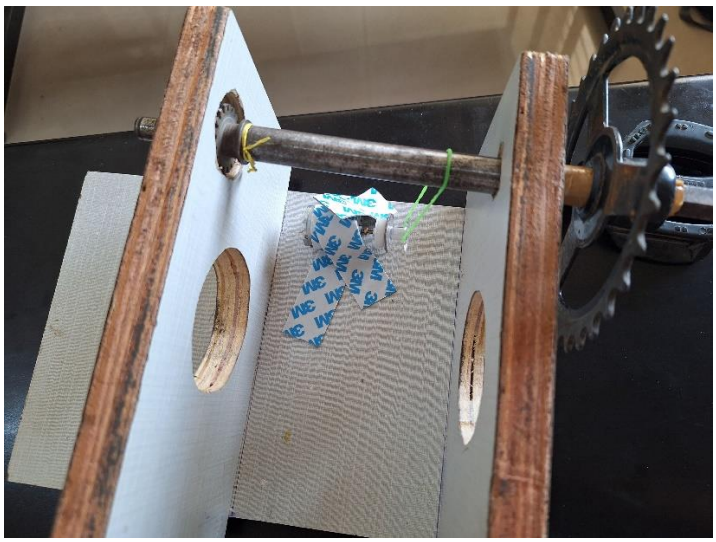
Result

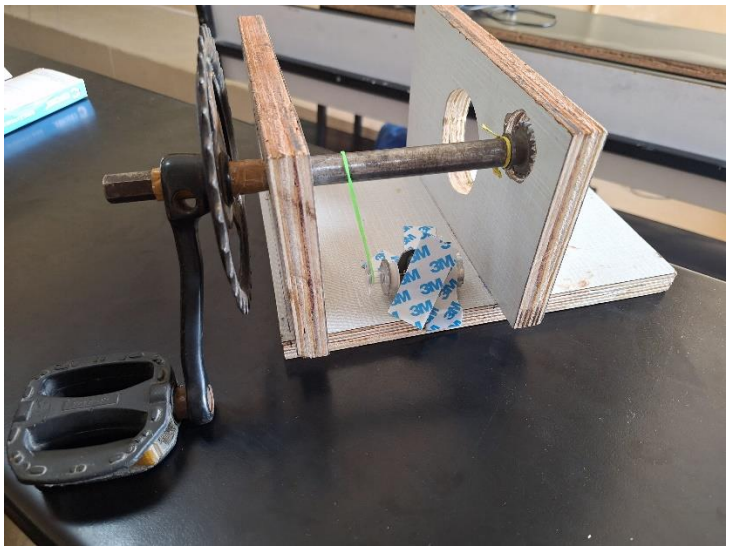
→ In conclusion, adding windmill generators to car wheels to produce electricity is a promising innovation.

→ This technology uses the movement of the wheels to generate power, which can help run the car's electronic systems and reduce the strain on the main battery.

→ For electric and hybrid cars, it can also extend the driving range.

→ By making cars more efficient and eco-friendlier, this approach supports the move towards greener transportation.





Conclusion

→ In conclusion, the integration of windmill generators into cars presents a promising avenue for enhancing energy efficiency, reducing environmental impact, and advancing sustainable transportation solutions.

→ By harnessing renewable wind energy during vehicle motion, this technology offers the potential to supplement onboard power generation, improve resource utilization.

→ While further research and development are needed to optimize efficiency and feasibility, the pursuit of such initiatives underscores a commitment to greener, more sustainable mobility solutions.

→ Ultimately, embracing these technologies can contribute to a cleaner, healthier planet and pave the way for a more sustainable future for generations to come.

→ In addition to its environmental benefits, the integration of windmill generators in cars can also contribute to economic advantages by reducing reliance on traditional fuel sources.

→ this technology has the potential to spur job creation, economic growth through the development and manufacturing of wind-powered vehicle components, such initiatives can drive progress towards achieving broader sustainability goals and addressing global energy challenges.

Personal reflections

→ Student 1:(Aniket RT)

"Exploring energy harvesting systems in car wheels deepened my understanding of renewable energy integration in vehicles. Building prototypes improved my engineering skills and teamwork. This project solidified my passion for sustainable automotive solutions."

→ Student 2:(Ahibhruth A)

"Investigating kinetic energy capture in car wheels sparked my interest in sustainable transportation solutions. Prototyping challenged me creatively and technically. Collaborating with diverse teammates improved my teamwork skills."

→ Student 3:(Yash Prashant Mistry)

"Researching energy recovery mechanisms in vehicle wheels expanded my knowledge of enhancing vehicle energy efficiency. Hands-on prototyping and testing enhanced my practical skills. This project strengthened my commitment to sustainable engineering."

→ Student 4:(Preetham Paravastu)

"Working on energy harvesting technologies in vehicle wheels broadened my perspective on renewable energy applications in transportation. Prototyping and testing reinforced my technical abilities. Collaboration with peers highlighted the importance of interdisciplinary teamwork."

Future scope

→ We will implement this technology in the IC engine vehicle so that load on the engine is reduced which burns less fuel and produces less pollution.

→ This technology can also be implemented in electric vehicle so that the energy can reused to charge the battery again.

→ In the upcoming future, we will try to find an automated mechanism to detach the supply of current when the battery is fully charged and again charge when battery level come low, to ensure batteries don't get over-charged.

References

- M. Zahir Hussain, R. Anbalagan, D. Jayabalakrishman, D.B. Naga Muruga, M. Prabhahar, K. Bhaskar, et al., *Charging of car battery in electric vehicle*.
- Whitmore, A. Agarwal and L. D. Xu, "The Internet of Things - A Survey of Topics and Trends", *Information Systems Frontiers*, vol. 17, no. 2, pp. 261274, Dec 2014.
- T. Vijayapriya and D. P. Kothari, "Smart Grid: An OverView", *Smart Grid and Renewable Energy*, vol. 2, no. 2, pp. 305-311, 2011.
- Li Y 2016 Infrastructure to Facilitate Usage of Electric Vehicles and its Impact Transp. Res. Proc. 14 2537–43
- Review of vehicle-to-grid, vehicle-to-home, and vehicle-to-vehicle applications and their impacts on EV batteries and power grids" by A. Rajasekar et al. (Renewable and Sustainable Energy Reviews, 2017)