NEXTGREEN GLOBAL BERHAD

R&D ANNUAL REPORT

Summary of Nextgreen's R&D activities in 2021

Green concept and sustainability in the pulp and paper industry: **"Nextgreen's approach"**

First Edition, Year 2021

Green Technology Park, Pekan, Pahang Darul Makmur
+603 7725 2088 I www.nextgreenglobal.com

NEXTGREEN
PULP & PAPER

VISION

To be the most innovative green technology company with sustainable zero waste industry model that ultimately leads us to greener future

MISSION

To accelerate the world's transition to green and sustainable products.

AIM

To develop and deliver innovative products/processes, and improve the existing ones using the latest green technology for enabling future growth.

MESSAGE FROM THE MANAGING DIRECTOR

During 2020 and 2021, the COVID-19 pandemic and related movement restrictions and lockdown had a significant impact on us and the global economy.

Nonetheless, these challenges only strengthened our commitment to review and renew our strategies to shape our business for accelerated growth through value creation for our stakeholders.

Firstly, we acknowledged that a strong stand on climate change is a significant pillar to address global climate challenges. Aligning with the Sustainable Development agenda forms the core of Nextgreen's holistic approach and strategy, with the development of our flagship industrial park, Green Technology Park (GTP) in the town of Pekan.

In May 2021, Nextgreen Global was a participant of the United Nations Global Compact (UNGC). This reflects our adherence to the principles-based approach of becoming a responsible business in practicing sustainability. Creating value through GTP is our core strategy, as we firmly believe that 'Waste-to-Value' adds value to stakeholders, society and the environment.

It took 20 years of extensive R&D to introduce our exclusively owned technology patent for Pre-Conditioning Refiner Chemical Recycled Bleached Mechanised Pulp (PRC-RBMP). This is a patented hybrid of chemical, biological, mechanical and thermal processes that preserve the condition of Empty Fruit Bunches (EFB) fibre for use in paper production.

Dato' Lim Thiam Huat

Managing Director of Nextgreen Global Berhad

Utilising oil palm biomass to produce green products and renewable energy presents other major opportunities for value creation. Our emphasis on innovating products, applications and processes are critical in improving efficiencies in terms of resource, cost, time and energy. Another R&D direction in the Nextgreen roadmap to sustainability lies in our education and research hub. To encourage continuous research on cutting-edge technologies which are essential in the development of new products, the hub will be based at GTP Pekan.

Our mission for the hub is to fully explore the development of innovative bio-products from oil palm biomass and wastes from oil palm plantations and mills. This hub also centralises our efforts to work proactively with higher education institutional partners and other sectors to produce the next generation of skilled and highly trained local workforce for the industry.

2020/21 was productive for Nextgreen. We signed two Memorandum of Understanding (MoU) with two established local universities, namely Universiti Malaysia Pahang (UMP) and Universiti Teknologi Mara (UiTM).

These agreements commenced our upcoming R&D projects and initiatives, including the open exchange of research information and knowledge and training, internship, and industry placement. Nextgreen will continue to foster industry-university collaborations which tap into green technology such as bio-integrated zero waste to improve resource efficiency and for greener supply chain. Collaborations with universities will explore the utilisation and application of oil palm biomass, while industry collaborations will seek ways to assist with employment opportunities for local communities to improve their socio-economic outlook. R&D is an exciting new thrust for us. With environmental consciousness rising, customers are demanding for recyclable and reusable packaging, along with less wasteful packaging.

Nextgreen is developing sustainable food packaging from oil palm empty fruit bunches (EFB) as raw material, with an incorporation of nanocellulose. Working with Universiti Putra Malaysia (UPM), we have secured a research grant funded by the Malaysian Ministry of Energy, Science, Technology and Climate Change (MOSTI) for this project.

In future collaborations, Nextgreen will be focusing on developing new products and services while improving the existing ones to ensure competitiveness and supply chain sustainability. We will continue to create value for our stakeholders with breakthrough projects and new business divisions in the pipeline, driving the company's long-term growth.

In addressing local and global environmental challenges, Nextgreen investments and efforts in research and development will contribute to the realisation of a more sustainable future, thus fulfilling our brand promise to be the:

> **"NEXT GENERATION OF GREEN**

Ms Lim Kah Yen

Executive Director of Nextgreen Pulp & Paper Sdn. Bhd.

MESSAGE FROM THE EXECUTIVE DIRECTOR

The fundamental objective of R&D is to create value for company, industry and for the whole society.

At Nextgreen, we are constantly seeking strategic partners that meet the market demand of customers and provide solutions for the manufacturing industry. We aim to continue improving our existing technologies while also innovating new technologies and product development that provide solutions for the changing needs of industry.

OUR MOTIVATION

Biotechnology has been identified by the government as one of the key drivers ushering in a new age of economic development in Malaysia. Based on the biotechnology and circular economy model, GTP in Pekan integrates renewable energy systems and zero waste concepts. This enables Nextgreen to contribute towards pledged climate action targets, while providing opportunities for our commodities to be showcased to the international community.

OUR PLAN

To meet the demand for increasingly competitive skilled workers in the Fourth Industrial Revolution, Nextgreen will house a 40-acre R&D and education hub at GTP Pekan within the next three years. Additionally, we will continue to pour investments into innovative technologies to facilitate the conversion of all wastes from GTP manufacturing facilities and oil palm industries including high quality products from oil palm biomass. By revitalising the printing industry, Nextgreen hopes to optimise environmental benefits while enhancing socio-economic benefits. This will open doors to thousands of job opportunities, fostering the creation of a skilled local workforce, ensuring talent is never depleted while assisting to develop rural communities.

OUR FUTURE GOAL

We will continue advancing R&D to create value and to realise a profitable business while ensuring operational sustainability for sound economic and environmental outcomes. Nextgreen believes taking big strides forward today will set a strong foundation which ensures our business continues to sustain profitable growth targets.

PULP & PAPER MARKET

GLOBAL MARKET

By 2026, the global pulp and paper market is expected to reach USD64,930 million, growing at a CAGR of 4.6%.

Source: www.globenewswire.com

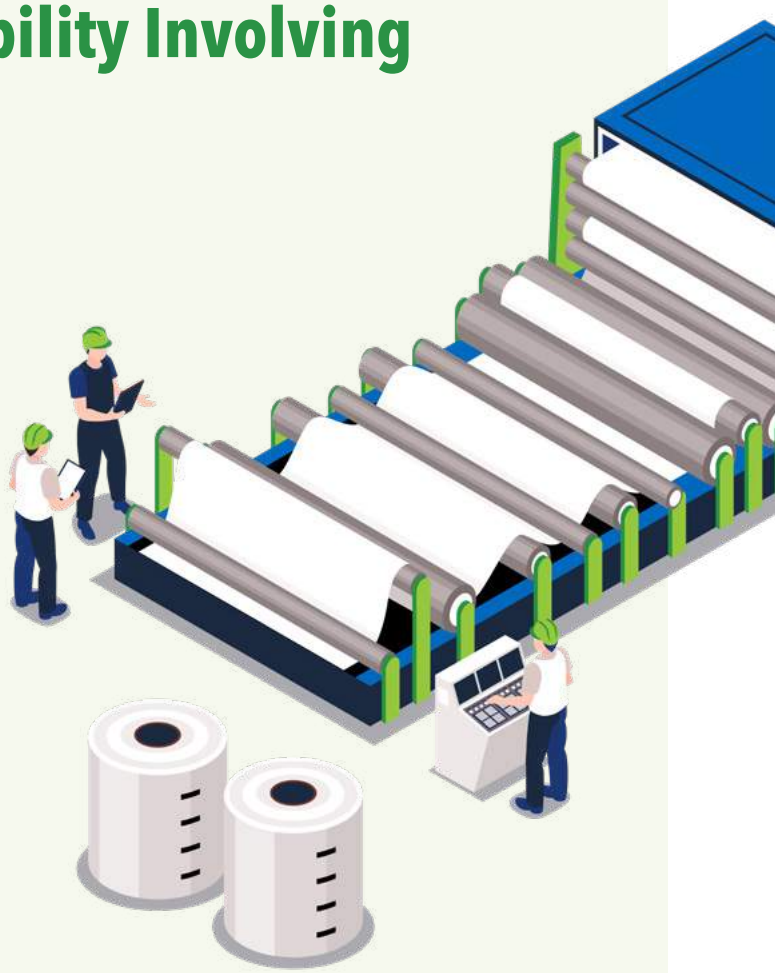
DYNAMICS DRIVER

Similar to other industries, the pulp and paper industry has receiving an increasing demand for environmentally sustainable products.

APPLICATION OUTLOOK

Increased paper packaging usage in the food & beverage, personal care, and cosmetics industries, rising demand across the global retail & e-commerce sector, and rising public awareness about environmental preservation are all contributing to the packaging segment's rise.

Top 5 Drivers of Sustainability Involving Pulp and Paper Industry



1 ECONOMIC AND FINANCIAL

Most development models place a greater emphasis on economic expansion than on human rights and welfare, as well as environmental processes and restrictions. This necessitates a paradigm change from seeing the environment as an integral part of the economy to treating the economy as an integral part of the environment. In terms of strategy, this means that the economy should be adjusted to guarantee that environmental services are preserved.

2 POOR MONITORING AND EVALUATION SYSTEM

In order to construct a dynamic improvement process with the goal of increasing their effectiveness, monitoring and evaluation of sustainable development methods must be strengthened. Specific targets, measurements, and data must also be supplied to decision makers to track the progress.

3 SOCIAL

There is a lack of awareness about sustainable development in the society.
Incentives for the business sector to promote and pursue sustainable development are insufficient.

4 POLITICAL

The greatest barrier to the implementation of sustainable development strategies, plans, and projects is inadequate and outdated economic, social, and environmental techniques.

5 INNOVATIONAL

Innovation-oriented research should be implemented in industry. There has to be a stronger link between research institutes and industry, which would also help to solve challenges with knowledge transfer to real-world applications.

Sources:
(1) Singh et al., 2012 (DOI: 10.1007/s10668-012-9390-4),
(2) Manavalan et al., 2019 (DOI: 10.1016/j.promfg.2019.04.059),
(3) El-Sayed et al., 2019 (DOI: 10.1515/npprj-2019-0064),
(4) Tawfik et al., 2022 (DOI: 10.1016/j.chemosphere.2021.133166)

How Nextgreen Gives Back to the Environment

In business, sustainability refers to doing business without negatively impacting the environment, community, or society as a whole (Panchal et al., 2021)

- The effect business has on the environment.
- The effect business has on society

Nextgreen is implementing a closed-looped system as its main industrial system. Through this method, by-products from every production process are fully utilised, producing valuable green products and renewable energy.

Through the bio-integrated zero waste model and the utilisation of palm oil biomass, we are able to contribute towards global effort in mitigating climate change effects by reducing carbon, energy and water footprints, as well as reducing the dependence on trees as resources

Source: Panchal et. al., 2021 (DOI:10.1016/j.jenvman.2021.112811)

HOW NEXTGREEN FOSTERS INNOVATION THROUGH R&D

Nextgreen believes that R&D is a vital component in driving our future sustainability pathway. We consolidate our business practices to adapt to a constantly changing global market. This includes establishing new consumer and societal trends, while emphasising circularity in our operations.

Nextgreen has been working closely with universities and research institutions to ensure that our technologies are cost-effective, energy-efficient, and time-efficient. Equally so, we ensure newly launched goods are marketable and follow market trends. Nextgreen will optimise its active collaborations with various institutions to ensure a wide range of initiatives are covered, including both short- and long term R&D aspects such as:

- **Joint research and development projects.**
- **Exchange of research information, technology, and knowledge.**
- **Training, internship and industry placement.**
- **Industrial visits.**

CURRENT PROJECTS AND PARTNERS

UNIVERSITI PUTRA MALAYSIA (UPM)

Nextgreen is collaborating with UPM on the development of a sustainable food packaging created from empty fruit bunches (EFB) that incorporates nanocellulose, to improve the packaging's mechanical and water barrier qualities. The Malaysian Ministry of Science and Technology (MOSTI) is providing funding for this research in the sum of RM3.3 million.

UNIVERSITI TEKNOLOGI MARA (UiTM)

Together with UiTM, a potential of kenaf bast and kenaf core as fillers for the production of pulp and paper are identified. The goal of this research was to develop EFB/kenaf-based papers.

UNIVERSITI KEBANGSAAN MALAYSIA (UKM)

Besides focusing on products and process development, Nextgreen is also committed in the preservation and conservation of ecosystems. Nextgreen and UKM agreed to team up and create a holistic ecosystem in Green Technology Park and Tasik Chini, Pekan, Pahang.

SHAANXI UNIVERSITY OF SCIENCE & TECHNOLOGY CHINA (SUST)

Nextgreen is working with a group of SUST researchers to develop an environmentally and industry-friendly process to extract lignin from black liquor, which will then be used to produce bio-adhesives.

UNIVERSITI MALAYSIA PAHANG (UMP)

Nextgreen and UMP committed to collaborate in areas such as student industrial training, matching funds, tree replanting projects, and industry talks. As of 2021, Nextgreen has awarded 2 scholarships to qualified UMP students for their study.

INSTITUT KEMAHIRAN BELIA NEGARA (IKBN)

As a technical institution, IKBN has trained numbers of skilled students. In this context, Nextgreen has teamed with IKBN to provide personnel with skills in operations.

Total R&D Expenditure:

RM5.36 million

RESEARCH PARTNERS:

Summary of R&D Projects in 2021


DEVELOPMENT OF SUSTAINABLE FOOD PACKAGING

Collaborator: Universiti Putra Malaysia

- Utilise empty fruit bunch (EFB) treated by Nextgreen's hybrid technology called Preconditioning Refiner Chemical-Recycle Bleached Mechanised Pulp (PRC-RBMP) as a main raw material for the development of sustainable food packaging.
- Maximise the potential of nanocellulose, which was also made from EFB to enhance the mechanical and water barrier properties of the EFB-based food packaging.



DEVELOPMENT OF EMPTY FRUIT BUNCH-KENAF PAPER

- Enhance the physical properties of EFB-based paper by incorporating kenaf pulp together with EFB.
- The quality of EFB-kenaf paper is expected to fulfill the Standard of ISO 00187.


DEVELOPMENT OF LIGNIN-PHENOL-FORMALDEHYDE ADHESIVE FROM BLACK LIQUOR

- Maximize the use of black liquor as a primary raw material for extracting lignin for environmentally friendly adhesive development.
- Enhance the physicochemical properties of lignin by chemical (phenolation) and physical (microwave-assisted pyrolysis) modifications.



BETTERMENT OF ENVIRONMENT

- Advocating a holistic ecological approach aims to mitigate and conserve the water bodies in Green Technology Park and Tasik Chini Pahang, thereby striking a balance between short-term needs and long-term sustainability.

COLLABORATORS

Universiti Putra Malaysia (UPM)

Universiti Teknologi Mara (UiTM)

Shaanxi University of Science & Technology China (SUST)

Universiti Malaysia Pahang (UMP)

Universiti Kebangsaan Malaysia (UKM)

Institut Kemahiran Belia Negara (IKBN)

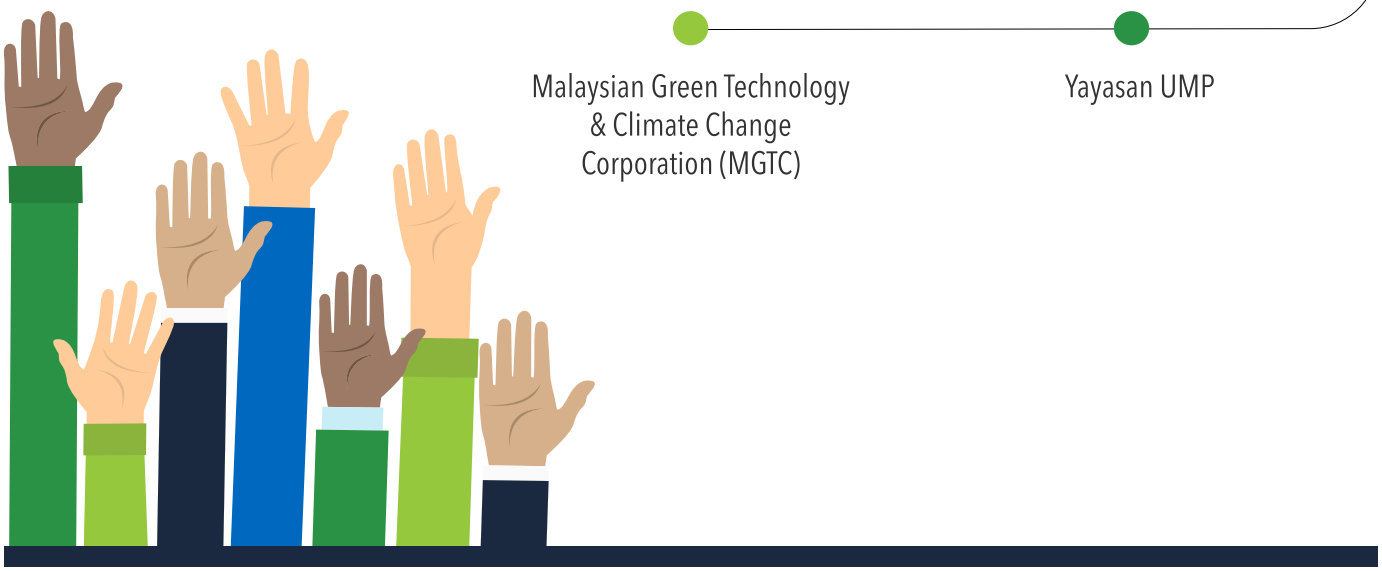
FRIM

Felda

Kami Anak Felda

Malaysian Green Technology & Climate Change Corporation (MGTC)

Yayasan UMP



Events and Affairs

14th Aug 2020

Visit to Biomass Technology Unit, MPOB-UKM

8th Apr & 11th Aug 2021

Visit to UMP & Virtual MoU Signing Ceremony

12th Aug 2021

Visit From UKM to GTP

Events and Affairs

14th Oct 2021

Visit from FRIM to GTP

15th Oct 2021

Visit to UKM-Tasik Chini Research Centre

22nd Nov 2021

Signing ceremony of Sponsorship Agreement between NGPP and UMP

Events and Affairs

25th Nov 2021

Participation in the UPM's CEO@ Faculty Program

30th Nov 2021

Visit from MOSTI to GTP

Events and Affairs

13th Dec 2021

Visit from UPM to HQ (Market and SROI study for NGPP-UPM-MOSTI's Project)

21st Dec 2021

Industry and Community Appreciation Awards Ceremony (ICAN 2021)

UPM

UNIVERSITI PUTRA MALAYSIA

BERILMU BERBAKTI

JUBLI EMAS

UPM 1971-2021

CiRNeT

PUSAT HUBUNGAN & JARINGAN INDUSTRI

Congratulations

CEO@PTJ

UNIVERSITI PUTRA MALAYSIA

YBHG. DATO' LIM THIAM HUAT

Managing Director, Nextgreen Global BHD

UniPutraMalaysia @uputramalaysia uniputramalaysia bppupm

PERTANIAN • INOVASI • KEHIDUPAN

BERILMU BERBAKTI
WITH KNOWLEDGE WE SERVE

R&D PLANNING FOR 2022

1

A study on holistic ecosystem at Green Technology Park, Pekan, Pahang.

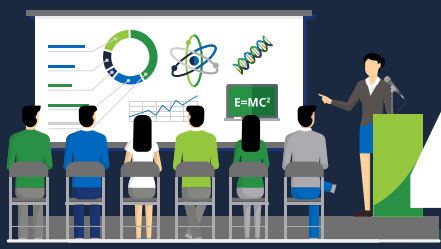
2

Patent application for new technologies.

3

More collaboration with local/foreign universities and research institutes.

4



Initiation of R&D and Education Centre establishment

Nextgreen R&D and Education Centre (RDEC)

a way forward

"Actual model of integrated green technology industry in Malaysia"
"One-stop research centre for integrated green technology"
"Broad industrial and academic partners"

Vision: To be recognized as a R&D and education centre specifically for green technology.

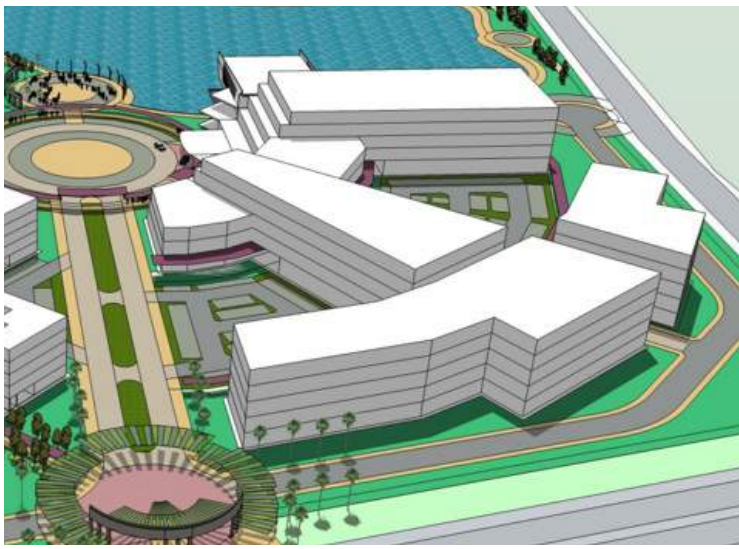
Mission: Value creation through green technological commercialization.

Aim: To develop and deliver innovative products/processes, and improve the existing ones using the latest green technology for enabling future growth.

RESEARCH CENTRE

To provide testing services using various high-end equipment to meet the needs of multidisciplinary field of research;
"particularly in the field of biomaterials, biocomposites, agricultural, environmental science, bioenergy and bioprocess technology."

To offer consultation services including providing proof of concept, contract research, product development and product commercialization.



EDUCATION CENTRE

To offer program module which fulfills the MQA & JPK Standards.

To produce industry-ready graduates.

To become Malaysia's leading provider of green industry-focused education centre.

R&D ANNUAL REPORT