



# UNIVERSITY OF MALAYA LIVING LAB GUIDELINES VOLUME I

STEP BY STEP GUIDANCE Title: Universiti Malaya Living Lab Guidelines Volume 1

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#### Chief Editor:

Professor Dr. Sumiani Yusoff [Chairperson, UM Eco-Campus & UM Living Labs]

#### **Main Contributors**

Theme o1: Landscape & Biodiversity Management Dr. Sugumaran Manickam [Faculty of Science] - LLoo5-15SUS

#### Theme o2: Waste Management

Professor Dr. Sumiani Yusoff [Institute of Ocean & Earth Sciences (IOES)] - LL004-15SUS Dr. Lee Hong Gee [Faculty of Medicine] - LL030-16SUS

#### Theme o3: Water Management

Associate Professor Dr. Zeeda Fatimah Mohamad [Faculty of Science] - LL002-15SUS

#### Theme o4: Energy Management

Dr. Mohd Yazed Ahmad [Faculty of Engineering] - LL014-16SUS Dr. Adi Ainurzaman Jamaludin [Faculty of Science] - LL015-16SUS

Theme o5: Transportation System Management Ir. Dr. Yuen Choon Wah [Faculty of Engineering] - LL024-16SUS

Theme o6: Green Procurement

Dr. Suhana Mohezar Ali [Faculty of Business & Accountancy] - LLo33-17SUS

Theme o7: Education Management (Environment & Climate Change) Dr. Asmawati Muhamad [Academy of Islamic Studies] - LLo31-16SUS

Theme o8: Change Management (Governance, Participation & Communication) Dr. Sorayya Malek [Faculty of Science] - LL023-16SUS

Reports, Technical, and Graphic Panel:

Mr. Mohd Fadhli Rahmat Fakri [Research Officer, EcoCampus@UM] – Review of the Second Edition Ms. Aireen Zuriani Ahmad [Research Assistant, UM Living Labs] Mrs. Nur Fatehah Raudhah Ariffin [Assistant Registrar, UM Eco-Campus & UM Living Labs]

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# UM LIVING LAB GUIDELINES VOLUME 1

#### **EXECUTIVE SUMMARY**

University of Malaya Living Lab Guidelines Volume 1 consist of collective guidelines which divided into 2 parts (Part A and B). Part A provides a sustainable event management guideline which consist of some tips and tricks for event planner to organize any single event, program, conference, workshop, seminar and so forth in a sustainable and greener way. This guideline is an initiative to encourage community to start implementing sustainability best practices through event organization.

On the other hand, part B is holistically a compilation of UM Living Lab Project Guidelines which provides step-by step guidance and know-how in tackling respective sustainability topics: landscape & biodiversity, waste, water, energy, transportation, green procurement, education and change management as stated in UM Eco-Campus Blueprint (UMECB). This compendium aims to provide a basic reference for users and general public on how to contribute their part in respective topics and eventually promote the importance of sustainability education and awareness to wider community.



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# UM LIVING LAB GUIDELINES VOLUME 1 FOREWORD

Assalamualaikum w.b.t and Salam Lestari,

Globally, we face significant environmental, economic, and social challenges. Today, more than ever, we need to act and to help create a world that supports generations to come.

University of Malaya (UM) via strategic coordination of UM Eco-Campus Secretariat and UM Living Labs works to provide solutions to these pressing issues and to make the world and campus a better place. We challenge ourselves to collectively work in providing solutions toward a common goal: campus sustainability pathways. By setting holistic goals and working to accelerate the achievement of these goals, we strive to cultivate a dynamic, innovative and energized campus community of sustainability and to integrate cutting-edge yet practical sustainability practices into our daily operations.



University of Malaya Living Lab Guideline is a compendium of UM Living Lab's eco-campus and sustainability policies formulated based on eight (8) core areas stipulated in the UM Eco-Campus Blueprint namely: 1) Landscape And Biodiversity Management, 2) Waste Management, 3) Water Governance, 4) Energy Management, 5) Sustainable Transportation System, 6) Green Procurement, 7) Educational Management: Environment & Sustainability, and 8) Change Management: Governance, Participation And Communication. All UM Eco-Campus Core Areas are chosen in-line with the agendas of Sustainable Development Goals (SDGs) relevant to UM as a world renowned higher academic and research institution.

UM Eco-Campus & UM Living Labs aims to continuously transform knowledge and ideas into new practical products, processes, systems and services, to befits the need of both the organization and stakeholders by leaving no-one behind aligned with Sustainable Development Goals (SDGs) aspirations. We believe that sustainability initiative and practices should be translatable, replicable and useful for the application of masses, hence the guidelines serve the purpose as a referral step-by-step guidance in tackling various sustainability areas. We hope that this University of Malaya Living Lab Guidelines will be useful as a basic guidance at all levels: individual, community or organization to start implementing and practicing sustainability initiatives on daily basis.

We would like to express our appreciation and thanks to all respective contributors of UM Living Lab researchers to ensure the success of these guidelines as part of the publication showcase of successful translational and action research. Thank you for taking the time to learn about UM's efforts to achieve a more holistic campus sustainability performance, and I invite you to join us in becoming responsible stewards of the environment.

#### 'Be Different, Be the Change'

#### PROFESSOR DR. SUMIANI YUSOFF

Chairperson, UM Eco Campus & UM Living Labs

- Director, Institute of Ocean & Earth Sciences (IOES)
- Program Leader, UM Living Lab (Zero Waste Campaign)

University of Malaya

Telephone: +603-7967 4635 Email: sumiani@um.edu.my / ecocampus@um.edu.my







# SUSTAINABLE EVENT MANAGEMENT GUIDELINE

# **'BE DIFFERENT, BE THE CHANGE!'**

Sumiani Yusoff<sup>1</sup>

Aireen Zuriani Ahmad<sup>1</sup>

Mohd Fadhli Rahmat Fakri<sup>1</sup>

Nur Fatehah Raudhah Ariffin<sup>1</sup>

<sup>1</sup>UM Eco-Campus & UM Living Labs Secretariat Office, University of Malaya, Kuala Lumpur, Malaysia

#### SUSTAINBLE EVENT MANAGEMENT GUIDELINE

#### INTRODUCTION

Did you know that almost 50% of the plastic we produce is single use? This means it goes into landfill or worse, ends up in the ocean, where thousands of animals and ecosystems are suffering. According to the Ocean Conservancy, plastic has been found in more than 60% of all seabirds and 100% of sea turtle species. Ingesting plastic has life-threatening effects on wildlife and this plastic eventually ends up being digested by humans.

On top of that, World Earth Day celebration which is annually been celebrated by almost 193 countries worldwide on April 22 is an initiative to demonstrate and promote environmental awareness. With the theme of **'Protect Our Species', World Earth Day 2019 celebration** is a call upon protecting our ecosystem and planet.



Without we even realized that we are one of the culprits that seriously damaging the environment **and planet. Hence, it's** time for each individual and society to start acting to together save our planet. If everyone begins to make changes, collectively things will improve!

Following that, the events industry has recently launched a vision to become waste free by 2020. But how do we do that? There are plenty of small things you can actually do to create a more sustainable event. The purpose of this guideline is to provide collection of useful tips and tricks for event organizers in order to implement sustainability in event management.

#### What Is Sustainable Event Management?



According to ISO 20121, sustainable event management is the process of integrating environmental and social responsibility issues into event planning. Sustainable event management requires organizer to consider the needs and values of different stakeholders that are impacted by the event they handled. On the one hand, this is an initiative to encourage everyone to take part in promoting sustainability, focusing on event management.

Making small changes can make a difference to your bottom line. Every party plays important roles in embedding sustainability worldwide. It takes steps to reduce significant negative impacts, or harm, such as solid waste, but with the help of the society, everyone can contribute and be the agent of change!

#### 1) Venue selection

- i) Select an Eco-Friendly Venue
  - Find a venue for your event where you may practice recycling processes and commitment to reduce waste.
  - If it turns out that the venue isn't sustainable, but the space is integral to creating your perfect event, there are many other small changes you can implement to ensure your event is as ecofriendly as possible.



#### ii) Consider the Accessibility of the Venue

- Choose a venue close to public transport to encourage delegates to ditch their cars.
- Encourage participants to take public transports or walking is a plus point to reduce carbon emission, but make sure to provide relevant information (e.g walking distance and routes) to the venue.

#### iii) **Don't** Waste the Energy

- Be thoughtful to always use the energy prudently by turning off all lights, air-conditioning and equipment before leaving the venue.
- Maintain the air-conditioning at the recommended temperature settings ranging from 24 to 26 degrees Celsius as advised by Tenaga Nasional Berhad (TNB).
- Use natural daylight for lighting purposes as far as practicable which not only help to lower your energy consumption but also save you some money off your bills at the end of the month!



#### 2) Event Materials & Management

- i) Go paperless
  - The benefits of digital marketing are endless, but most importantly you are able to reach a bigger audience a lot faster and often a lot cheaper. You could even just use social media and then your marketing could be completely free.
  - Provide QR code and website for promotion, online registration and collection of feedbacks. This is collectively important to reduces the negative impact on the environment specifically in usage of papers whilst makes the whole process much quicker and more efficient.



#### ii) Minimize printed promotional materials

- Re-think if banner production is necessary. If it is still needed, avoid printing the date or reuse it again for the next time.
- If printed matter is unavoidable, reduce the number of pages as much as possible (e.g. adopt double-sided printing wherever practicable).
- Avoid often using excessive materials that are bad for the environment since it is only a one-time event.
- You may always promote your event via email, social media and online channels. It saves cost and the environment as well.
- iii) Gifts
  - Avoid giving free gifts and souvenirs.
  - If gifts and souvenirs have to be given out, explore green products.
  - Avoid distribution of plastic and "environmentally-friendly" bags.
- iv) Event decoration
  - Choose environmentally friendly decorations and reduce the use of disposable items.
  - Start practicing 'No balloons'! They are non-biodegradable, and therefore altogether ill-advised.
  - You can always have fun, celebrate, and remember with Do-It-Yourself (DIY) gifts which is not only adorably eye-catching but environmentally-friendly alternatives.

#### 3) Refreshment and Dining

#### i) Food Estimation

Estimate carefully the amount of food needed. Prepare the most appropriate portions of meals according to expected number of participants to minimize food wastage at source.

#### ii) Healthy and Sustainable Food Menu

Avoid Shark fin, Bluefin tuna and Black moss on the menu by adopting Government's green menus practice and make reference to WWF's Sustainable Seafood Guide, in particular the marine species in the "Avoid" list. Serve organic, locally produced food and beverages as far as practicable.

#### iii) Avoid Food Waste

According to the UN's Food and Agriculture Organization, 1.3 billion tons of food gets wasted every year. This is astonishing, but event planners can make small but nonetheless meaningful changes to help reduce this. Do remind participants to only take portion that they needed.



#### iv) Offer Takeaway Boxes

Introducing takeaway boxes will dramatically reduce your food waste and gives your guests the options to enjoy their delicious food at a later date. In other sustainable way, organizer should encourage participants to bring their own bag or food container!

#### v) Recover the food leftovers

If disposal of food leftovers is unavoidable, dispose them in the collection facilities for food waste recycling. **Don't s**imply mix them with other trash!

#### vi) Set up water refilling stations

Avoid serving bottled water or packed drinks for meetings, seminars, conferences and events but drinking water in a glass or provide drinking water dispenser is a quick and easy step towards sustainability.

#### vii) Ditch the straws

- Avoid the use of single-use food and beverage containers and cutleries.
- Practice using stainless steel straws and if possible do provide bio-degradable cutleries.



#### 4) Reduce, Reuse and Recycle

- i) Recycling Bins
  - Provide recycling bins so that people are encouraged to recycle your waste to make your conference as environmentally friendly as possible.
  - Inform participants about the recycling arrangement in place. Make sure all the bins in your venue are clearly labelled.
  - Prepare appropriate messages or signage to promote recycling and bring the recycling arrangement to the attention of colleagues and participants.



#### CONCLUSION

Organizing a sustainable event does not have to be daunting. Small, manageable changes are a great place to start and once you have these initial sustainable changes nailed you can move on to bigger, and even more effective changes. Although it means making changes to your established processes, the overall benefits to the environment and your attendees are positive.

These are few ways you can make sure you are being more sustainable in the day to days runnings on your venue. Make sure you're doing everything in your power to ensure you're lowering your carbon footprint and helping to save the planet, one plastic straw at a time.

Becoming sustainable has absolutely undeniable positive effects on the environment. Creating a more sustainable conference many benefits; not only for the environment but also for your company. Ensuring your organization events are environmentally friendly can often attract more attendees as people are naturally drawn towards more ethically conscious companies.

Start Making a Difference Incrementally. A baby step will eventually lead to huge changes towards more sustainable and greener environment. Be part of the solution, not part of the pollution, the power is in your hand!



#### REFERENCES

- Guideline for Green Promotion and Campus Activities. (n.d.). Retrieved from https://www.polyu.edu.hk/greencampus/files/Policies/Guideline\_for\_Green\_Promotion\_an d\_Campus\_Activities.pdf
- New Sustainable Event Management (2018 Edition): A Free Guide to Better Green Meetings. (2018, November 08). Retrieved from https://www.eventmanagerblog.com/sustainableevent-management
- Going green? Six tips for more sustainable events & exibitions. (2018, June 13). Retrieved from https://www.rapiergroup.com/going-green-six-tips-sustainable-event/
- Why You Should Ditch Balloons if You Love the Environment. (2017, November 22). Retrievedfromhttps://earth911.com/living-well-being/events-entertainement/balloons-<br/>environment/
- Environmentally-Friendly Alternatives. (n.d.). Retrieved from https://balloonsblow.org/environmentally-friendly-alternatives/
- Top Tips for Designing a Sustainable Conference | Corporate Event News. (n.d.). Retrieved from https://www.corporateeventnews.com/top-tips-designing-sustainable-conference

# 01 LANDSCAPE & BIODIVERSITY MANAGEMENT

imba

Guideline for Landscape Management and Biodiversity Conservation, University of Malaya

- 1. Dr. Sugumaran Manickam
- 2. Benjamin Ong Jia Ming
- 3. Nurul Fitrah Mohd Ariffin Marican
- 4. Associate Professor Dr. Zeeda Fatimah Mohamad
- 5. Associate Professor Dr. Sarinder Kaur Kashmir Singh

### GUIDELINE FOR LANDSCAPE MANAGEMENT AND BIODIVERSITY CONSERVATION, UNIVERSITY OF MALAYA

#### 1) INTRODUCTION

The UM Sustainability Science Research Cluster (SuSci) launched its Eco-Campus Blueprint in April 2016, covering eight Core Areas (Bidang Teras), all of which fall under the purview and **implementational authority of the University of Malaya (UM)'s Department of Development and** Estate Maintenance (JPPHB).

There were concerns that the blueprint was too academic and meant to address a primarily research **audience. Thus, a series of dialogues called the 'Greening Roundtable' were held dur**ing the 2015-2016 academic year. The Roundtable, comprising the Deputy Vice-Chancellor (Development), JPPHB, The Rimba Project, the Rimba Ilmu Botanic Garden and a handful of observers, discussed all parts of the Eco-Campus Blueprint relevant to campus greening and biodiversity conservation.



Figure 1: Greening Roundtable

Drawing from the outcomes of the Roundtable, this document presents operational guidelines for landscape management and biodiversity conservation centered around three Focus Areas (Table 1). In any event, a campus master plan for landscape management and biodiversity conservation is still needed, and it is hoped that the Roundtable will be a vehicle towards making this a reality.

Table 1: Focus areas for landscape management and biodiversity conservation at the University of Malaya

Focus Area	
1. The Greening Roundtable	
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#### 2) FOCUS AREAS

#### i) The Greening Roundtable

#### a) Structure of the Greening Roundtable

The Rimba Project (RIMBA), a campus sustainability Living Lab administered by UM's Sustainability Science Research Cluster (SuSci), mooted the idea for a Greening Roundtable to bring together key stakeholders to discuss and implement best practices in campus greening and conservation. The long-term aim is to produce a greening policy that will be endorsed and enforced by UM's top management.

The Greening Roundtable document should contain not just guidelines but also the structure of the roundtable, and what its role is. Prof Rafiq suggested placing the Roundtable as an advisory unit assisting the Vice-Chancellor and Deputy Vice-Chancellor (Development). The following roles have been suggested for the Roundtable:

- 1. Act as a forum for all decisions regarding forest conservation.
- 2. Set policies and annual planning; take authority away from DVC and place it in the hands of the Roundtable.

It was proposed that the Roundtable can meet quarterly or so for monitoring and planning. The DVC (Development) will be the secretariat and chair, but the Roundtable may be comprised of various interested parties (e.g., researchers working on urban heating). However, it was also cautioned that the Roundtable should not admit too many members as it would end up burdened by too much bureaucracy and red tape. It should not be over-formalised.

For authority, the VC has to appoint the Roundtable, and the DVC (Development) needs to approve the budget and call for a Roundtable meeting to present a plan before implementation.

## Action

## Decisions need to be made on:

- 1. Whether or not the Roundtable can be formalised.
- 2. Whether or not the Roundtable will continue.
- 3. List of stakeholders: JPPHB, Rimba Ilmu, The Rimba Project, etc.
- 4. Active members vs. observers: e.g., SuSci, SDSN, UMCares, Living Labs, academics.
- 5. Frequency of Roundtable meetings.
- 6. Scope of the Roundtable: short-, medium- and long-term objectives

## b) Sustainability of the Greening Roundtable

There is concern from both the DVC (Development) and Rimba Ilmu that if the existing Living Labs (whose staff are funded on a contract basis) are discontinued at any point, all of these conservation efforts will collapse.

**JPPHB's role is more of maintenance** than social engagement due to language and time barriers. While JPPHB can support greening and conservation efforts logistically, there must be an interface. The ideal situation would be to maintain The Rimba Project and other Living Labs for the next 5-10 years. SuSci has been funding the Living Labs from 2015-2018. However, there is no progress yet as to the possibility of UM absorbing Living Lab personnel as a long-term part of the UM Development team. If a long-term Roundtable committee is formed, it is the VC's responsibility to maintain it.



Figure 2: Volunteers are a valuable asset in the implementation of greening and conservation strategies

While it would be good to continue involving volunteers, even volunteers need management. There is also a time constraint factor: student volunteers prefer short-term projects (e.g., completed within one semester) with very clear goals, like tree tagging. In order to ensure long-term sustained action in landscape management and conservation, there must be a team of core staff employed for the medium- to long-term. This will be considerably more difficult without The Rimba Project or an equivalent management team.

Going forward, 'volunteerism' should be rebranded to include campus sustainability. The conventional view is that volunteering focuses more on the "human side of things," like helping out in old folks homes, orphanages and gotong-royong. Undergraduates can be involved in the conservation work of the Living Labs and research on sustainability solutions, but this must somehow be incentivised. These ideas need to be raised with the DVC (Student Affairs and Alumni) and DVC (Academic and International).



- 1. Continue pursuing possibility of appointing Living Lab personnel in relevant roles within the Development team, with a 2- to 3-year commitment/contract, so as to reduce dependence on SuSci.
- 2. Negotiate with SuSci on Living Lab output; JPPHB and SuSci KPIs should be integrated and streamlined.
- 3. Develop strategies and systems for undergraduates to be more involved in conservation and research: find ways to incentivise this and/or incorporate it into part of the formal academic syllabus.

#### ii) Conservation of UM's Biodiversity, Forests and Green Spaces

#### a) Biodiversity surveys and conservation

Since 2014, The Rimba Project has conducted biodiversity surveys in UM's Section 12 and Jalan Elmu bungalow zones, 15 acres each to the west and east of Jalan Universiti, respectively. The Section 12 biodiversity survey was cited as a milestone, setting the scene for a more biodiversity- and conservation- conscious approach to development. This 30-acre land bank is the focus of an ongoing conservation effort between JPPHB, UM Holdings, The Rimba Project and the Residents Association of Section 12. In 2016, RIMBA embarked on a survey of UM's land in Section 16.



Figure 3: The Rimba Project team during a biodiversity survey

In May-June 2016, RIMBA completed tree tagging in eight bungalow lots of Section 12 earmarked for conversion into a commercial parking space. Private concessionaire Asiapark has commenced operations on those lots. The development of the parking and demolition of bungalows was carried out in consultation with RIMBA, to ensure that as many trees as possible were preserved.

The following zones have been earmarked for physical (re-)development in the near future:

- Padang Varsiti
- Ambang Asuhan Jepun
- Residential Colleges 3, 4, 7 and 8
- Examinations Building
- Jalan Elmu
- Section 16

#### Action

- 1. While biodiversity surveys have been included in the DVC's Development Checklist, survey teams need ample time to conduct surveys before developments commence. These studies should be done first before architects draw up plans. Depending on the size and scale of the construction, minimum advance notice between 2 weeks and 6 months is needed to conduct an adequate biodiversity survey.
- 2. It was suggested that if the developer were internal, JPPHB would
- 3. pay for the survey; if external, the contractor would pay for it. If integrated into the development process, this can be a source of steady income for initiatives like the Rimba Project.
- 4. Biodiversity studies must be done periodically, be made compulsory reading for contractors, and included in the info packs of calls for proposals.
- 5. Explore possibilities for collaboration with state government, municipal council, NGOs and private enterprises to manage urban green pockets, including ideas like afforestation in empty lots.

#### b) Forest review and conservation zoning

In 2015, UM ranked 65th on the UI Green Metric tables, an increase from 73rd in 2014. Out of six evaluation categories, however, UM scored poorly on Setting and Infrastructure (SI), receiving only 654 points out of an available 1,500. Two of the six indicators for SI are 'Area of campus covered in forested vegetation' and 'Area of campus covered in planted vegetation'.

Forests contribute many ecosystem services to our urban campus, including water catchment (mitigating erosion and flooding), habitat for biodiversity (UM is home to 90 bird species, of which over 20 are migrant species), and heat regulation (maintaining pleasant ambient temperatures especially around colleges and faculties).

**Out of UM's total land area of 360 ha, an estimated 100 ha is forested (see** Appendix B, p.11). However, as of April 2016, UM's forest cover has decreased by 4.8% since July 2014. This decrease is approximately equivalent to 7 football fields. It was suggested that an immediate priority should be to reconnect fragmented forests to the main Rimba Ilmu/Bukit Arang area.

For future developments, it was recommended that forests be integrated into design: it is often not necessary to clear an entire forest for infrastructural development. Two approaches to landscaping were pointed out: intrusion is about land clearing and replanting after construction, while insertion seeks to build according to the land with minimal disruption. Similarly, there is a contrast between reforestation, which is about replanting lost forest, and afforestation, which is about establishing a forest or stand of trees where there was previously little or no tree cover.



Figure 4: Creative selection of diverse tree species enables effective forest-style landscaping within a small area. The resulting canopy reduces ambient heat while providing a habitat for biodiversity

#### Action

1. Identify forested areas that will be developed, with respective order and timeframe.

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- 2. Investigate costs, deliverables and timeline for biodiversity corridor/forests links project, and identify potential degraded sites for reforestation. Find creative ways to improve habitats, like what was done at the Rimba Ilmu Front Terrace.
- 3. Come up with a reasonable conservation target and boundaries for forest preservation, e.g., should colleges and faculties have a forest quota.

#### c) Management and conservation of Rimba Ilmu

Rimba Ilmu was founded in 1974 as an arm of the then-Department of Botany. Today, it is managed as part of the Faculty of Science's Institute of Biological Sciences (ISB). The Rimba Ilmu Botanic Garden is part of UM's 60-hectare Bukit Arang forest, one of only two green lungs on the KL-PJ border that service the population from PJ Selatan in the west, to Bangsar and Kerinchi in the east.

At present, many structures in the garden are in disrepair. In October 2016, an electrical failure in the Herbarium caused the air conditioning to malfunction. ISB/Bursary claim that no funds were available for the repair thereof. A total of 70,000 accessions—some of which are type specimens (original specimens of new species)—are at risk of damage from the elevated temperature and humidity. Further complicating matters, maintenance and upgrading work in Rimba IImu is difficult as Rimba IImu receives an annual budget (excluding salaries) of only approximately RM20,000 from ISB.



Figure 5: Unauthorised **encroachment into UM's forests** can lead to damage of our trees

Meanwhile, other problems persist. The boundaries of Rimba Ilmu are uncler, and UM's forest in general are at constant risk of encroachment. There have also been reports of animal poaching. Under the DBKL KL City Plan 2020, Bukit Arang, one of 10 sites within DBKL's city limits identified for preservation.

Any exploration or development of Rimba Ilmu should be for the purposes of research, conservation and/or education, and should be with the permission of Rimba Ilmu and appointed management partners. However, the setting of boundaries needs a committee appointed by the VC. The DVC (Development) has to be in the Secretariat. If more authority is needed, it has to be a committee formed under the Board of Directors (LPU), chaired by a board member. This committee needs to be impartial, chaired by someone neutral, e.g., VC or representative.

#### Action

- 1. Set up a committee or task force to investigate gazetting Rimba Ilmu as a national heritage.
  - 2. Conduct a mapping exercise to determine Rimba Ilmu's boundaries.
  - 3. Determine criteria for gazettement, including: boundaries, biodiversity baseline, permissions and penalties for development, unauthorised trail making, poaching and harvesting of resources.
  - 4. If Rimba Ilmu is to grow and/or build capacity in the coming years, a long-term caretaker plan is needed. Perhaps a joint-management scheme between ISB and DVC (Development) should be considered. Both sides should determine their respective stakeholders in park management.
  - 5. Design strategies for better resilience in the face of technical failures, and explore possibilities for long-term external funding.
- 6. Propose timeline for action plan.

#### iii) Estate Maintenance and Management

#### a) Protocol for developers and contractors

A lot of trees and green space become collateral during hastily planned or poorly executed construction and development works. There is a loss not only to biodiversity and aesthetic beauty, but also to initial investments of the University: it is counter-productive, for instance, to clear a stand of trees that may have cost thousands of ringgit some years back, just because a detailed pre- and post-construction inventory was not carried out.



Figure 6: A tree has been earmarked for removal during an upcoming construction

Rimba Ilmu cited the case of damage caused during construction of the UM Arena (stadium) was. About 50- 60 trees of rare species behind the bus stop were cleared during the construction; this land was under the jurisdiction of JPPHB. When approached by Rimba Ilmu, the contractors said they would "transfer" the trees somewhere else. What happened was that the contractors just removed the trees and put them on the ground, where they dried up and died out.

JPPHB suggested that the Tree Preservation Order Act 2000 (which calls for the replanting of trees with a trunk girth of over 50 cm diameter, or the payment of a RM5,000 fine otherwise), if properly enforced, could be an opportunity to tap contractors to channel resources into campus greening and conservation.

However, it was also pointed out that such a standard was unfair: it is not only large or old trees that have value. Some trees, by virtue of their rarity or ecosystem services otherwise, should be valued accordingly. Furthermore, many of those trees that were lost weren't large yet; they needed time to grow and this unfortunate incident curtailed that.



Figure 7: Inspecting trees delivered by contractors/suppliers (left). JPPHB contract staff play an important role in supporting greening efforts and translating them into reality (right)

#### Action

A clear and transparent tree management protocol needs to be formulated. This may include:

- 1. JPPHB to consider changing contract requirements for contractors, to factor in cost and time for biodiversity studies and inventory work.
- 2. A landscaping checklist should be developed to factor in conservation needs before any work commences.
- 3. Assessment of development site by JPPHB, Rimba Ilmu and relevant stakeholders, to be counter- signed by at least both JPPHB and Rimba Ilmu before construction begins.
- 4. A form that lists trees to be preserved, trees to be removed and trees to be planted in replacement. The species and value of trees are to be determined by JPPHB and Rimba Ilmu.
- 5. Adequate timeframe for University action and notice to contractors.
- Inclusion in all future development contracts a clause for replacement or penalty for all trees damaged or destroyed during construction. This must be based on an inventory pre- and postconstruction to be done by both JPPHB and Rimba Ilmu.
- 7. This must also be legally binding so that contractors cannot get away scot-free. Identify legal assistance needed for the above.

#### b) Tree planting and maintenance

There are many large and old trees on campus. The wellbeing of these trees is at stake because they have yet to be identified (increased risk of accidental damage), and because they are potential lightning magnets. JPPHB is working on a survey of heritage trees on campus, including a report on the value of UM's trees.

At present, the selection of trees for planting is often arbitrary, dependent on a **contractor's recommendations, a supplying nursery's stock, or a Vice**-Chancellor's whims and fancies. In the Deputy Vice-Chancellor (Development), Professor Faisal **Rafiq's words, "There is no science to it." There needs to be a more systematic** approach to the selection of trees, one that takes into account landscape, functional, conservation and biodiversity values, among others. JPPHB put it this **way: "the right species in the right place." In addition, it was agreed that more** native species should be planted, especially rare and lesser-known species.

Under the new zoning system on campus (e.g., Chancellery zone, Rimba zone), we should have a vision of what kind of trees ought to be planted in each zone. It was suggested that Rimba Ilmu, The Rimba Project, JPPHB and urban planning experts should consider working on a catalogue of common tree species, to be used as a reference point for all future planting activities so that informed choices can be made instead of just going with whatever trees the contractor supplies. The catalogue could cover these criteria:

- 1. Conservation status: rare or common
- 2. Origin: native or not
- 3. Growth rate: fast, medium, slow
- 4. Durability
- 5. Recommended clear distance/radius/buffer between trees and buildings/other trees
- 6. Size: define large, medium, small
- 7. Canopy-forming ability and quality
- 8. Permanence: short-lived or long-lived species

Dipoteriocatepus costatuus Rocks. Lest and a lest and a main and a Dipoteriocatepus and a dipoter	Hangpeets and noisenses Homospheric control is 3.6.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.		
Large tries, up to 6Dm tail, with a spherical crown Pruits - golden hairs and winged		Connection gauge with publicarials decision posteriors	

Figure 8: Example of a tree species catalogue (from Malaysian Threatened and Rare Tree Identification and Landscape Guideline by Sime Darby Property)

#### Action

- 1. Ensure that all tree suppliers are credible nursery providers and not merely middlemen.
- 2. Ensure care for new seedlings and young trees, which are susceptible to damage from grass-cutting blades: PVC collars at the base of the trunk are seldom effective enough.
- 3. Prepare tree species catalogue.
- 4. Research and resolve dispute concerning the practice of mulching: Some assert that it is beneficial to the wellbeing of trees, while others argue that mulching attracts termites that may damage trees.

#### c) Interpretation and information management

A lot of the hard work that JPPHB puts into maintaining greenery on campus goes unnoticed, and therefore under-appreciated and sometimes even misinterpreted. Also, there is very little communication between JPPHB and the campus community. Perhaps it has always **been assumed that JPPHB's role is "in the shadows" and need** not be shared, but if we really want the campus community to rally in support of the conservation of our green spaces, they ought to know what goes on behind the scenes.

#### Pericopsis.org



Figure 9: Pericopsis.org is an example of a user-friendly web repository for documentation and visualisation of our trees (and other flora) on campus. A similar repository can be tailor-made for UM

JPPHB runs a web-based GIS interface that can track tree maintenance status (e.g., whether a tree is to be trimmed or removed), alongside a variety of other information, from data on individual trees and hydrography, to utilities and the built environment. Water Warriors mentioned that it would be interesting to see if there is a connection between vegetation and water bodies on campus. They are already working to develop a GIS platform on Tasek Varsiti and other water bodies on campus, in collaboration with **researchers at ISB's Bioinformatics** division.



Figure 10: Tree tagging is part of the Rimba Project's Trees of UM initiative

**Citing The Rimba Project's Trees of UM documentation initiative, launched at the** UM Library in October 2015, the Deputy Vice-**Chancellor (Development)'s vision** is that the Trees of UM project will eventually cover all of UM, with specific zones, e.g., Chancellery zone. Its aim should be to get people interested in trees, for **example, pokok lontar (the Borassus flabellifer palm) that is part of UM's emblem.** 



Figure 11: Visiting students reading the Trees of the Library brochure (left). Student volunteers designed and developed two new trails in Rimba Ilmu, preparing accompanying interpretive brochures as well (right)

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#### Action

- 1. Develop a user-friendly online resource where the campus community can find out about trees planted and removed, along with other developments. This could build on JPPHB's GIS interface, or take the form of an updates section or sub-page on the JPPHB website. It was suggested that this should eventually be an interactive website.
- 2. Continue mapping and tagging trees, and support awareness building with interpretive material, e.g. print or digital brochures. Besides knowledge and awareness building, such publications can serve as a communication and branding tool for visitors, strategic partners and public dissemination.

#### 3) Appendix A

#### i) The RIMBA-JPPHB Greening Roundtable

The Guidelines for UM Landscape Management and Biodiversity Conservation (July 2018) is adapted from ideas and resolutions put forward during the RIMBA-JPPHB Greening Roundtable series in 2015-2016. Roundtable meetings were held on 15 Dec 2015, 26 Apr 2016 and 29 Aug 2016.



Figure 12: The RIMBA-JPPHB Greening Roundtable

Here is a list of everyone involved in one or more of the above stages:

## Deputy Vice-Chancellor (Development & Estate Maintenance)

- Professor Faisal Rafiq Mahamd Adikan Deputy Vice Chancellor (Development)
- Mr. Maszairizam Masri Assistant Engineer, JPPHB
- Mr. Mustafa Abdul Rani Administrative Assistant and Nursery Supervisor, JPPHB

## Rimba Ilmu Botanic Garden

- > Dr. Sugumaran Manickam *Coordinator*
- Mr. Ghazali Sabda Senior Assistant Science Officer
- Mr. Zulkapli Ibrahim
   Garden Supervisor

## The Rimba Project (RIMBA)

- Benjamin Ong
   Project Officer / Roundtable Convenor
- Vanessa Ting
   Project Officer
- Nurul Fitrah Marican Project Assistant
- Angeline Lim
  - Volunteer Rapporteur
- Elena Shim
   Volunteer Rapporteur
- Tan Kai Ren Observer
- Raja Widad Raja Wahidin Observer
- Asif Khan
   Observer

#### Living Labs

- Dr Zeeda Fatimah Mohamad Principal Investigator, Water Warriors
- Affan Nasaruddin
   Project Officer, Water Warriors
- Mohd Shahrul Amin
   Project Assistant, Water Warriors

### Faculty of the Built Environment

 Dr Goh Hong Ching Senior Lecturer, Faculty of the Built Environment

#### 4) APPENDIX B

i) Background

This assessment of forest cover is based on the UM LCCF Forest Inventory Report prepared by Hamdan Omar of FRIM (2013). The forest sites within UM were identified in that report as follows:



Figure 13: Strata of forests in the study area

The FRIM report indicates that most of the forest sites on campus are fragmented (isolated and perhaps too small to support viable breeding populations, especially of larger animals). The largest forest sites are the least fragmented.

We note, however, that the campus boundary map in the illustration above (found on page 5 of the report) is somewhat inaccurate. MAHSA University (along Jalan Universiti) is included within the UM boundary, while the Palapes and Zero Waste Campaign sites around the Damansara Gate are not. Nonetheless, these errors almost cancel each other out, and the corrected total area of the University stands at about 363 ha, just 4 ha shy of the 367 ha stated in the FRIM report.



#### ii) Review of Forest Site

Figure 14: Google Maps image of 14 forest sites in the University of Malaya. The area of each forest site was estimated using the polygon function on Pericopsis.org, an urban tree-mapping platform run on the Google Maps engine. The total forest area reported by FRIM was 108.1 ha, while Pericopsis.org yielded a close estimate of 108.5 ha (July 2014)

N	o. Location	Latitude	Longitude	July 2014	April 2016	% Change
				Area (m²)	Area (m²)	·····3·
1	Bt Arang/R. Ilmu	3.130068	101.655006	641,352	641,352	-
2	Bt Cinta/Sprint	3.132939	101.654046	106,000	106,000	-
3	KK4/Sec 16	3.123426	101.648555	95,742	81,055	-15.3
4	KK8/Sec 16	3.128526	101.648617	61,691	54,676	-11.4
5	Law/KK1	3.116760	101.660668	37,778	30,850	-18.3
6	Eng/PJ Gate	3.116251	101.652410	27,423	19,527	-28.8
7	APM/Science	3.124519	101.652254	27,140	25,837	-4.8
8	INTAN/Arts	3.119921	101.650808	26,617	16,394	-38.4
9	KK12/Sprint	3.124723	101.661572	16,058	16,058	-
10	KK11/Sprint	3.130240	101.661143	15,481	12,820	-17.2
11	FPP/PJ Gate	3.117232	101.652316	9,784	9,784	-
12	KK7 (west)	3.126378	101.650229	7,923	6,730	-15.1
13	FBL/Arts	3.121455	101.651066	6,825	6,825	-
14	KK7 (east)	3.125548	101.651267	5,334	5,230	-2.0
	TOTAL			1,085,147	1,033,137	-4.8

Table 2: Change in forest cover of 14 sites in the University of Malaya (1 ha = 10,000 m2)

#### 5) DISCUSSION

In 2014, the total forest cover as a percentage of total campus area was approximately 29.9%, while the percentage as of April 2016 is 28.5%. This is a decrease of some 50,000 m2 of forested land within two years, nearly equivalent to 7½ football fields. Forest clearing for construction and development is the main cause of this decrease.

A significant portion of UM's forest cover comes from the Bukit Arang/ Rimba Ilmu forest, which alone accounts for over 60% of total forest cover, and nearly 18% of total campus area.



Figure 15: The secondary forest between the PJ Gate and the Faculty of Business and Accountancy (FPP)

## 6) RECCOMENDATION

Besides serving as a habitat for plants and animals, forests in urban areas also help to moderate ambient temperature (thereby reducing heat), generate fresh air, and reduce flooding—the forest absorbs water far better than most drainage systems. The presence of nature in the urban landscape has also been linked to positive psychological effects in studies on the Attention Restoration Theory. Future greening plans for the University must, therefore, take into account not only the protection of existing forested areas, but also strategies to increase forest cover as well as enhance existing forests and green spaces.

#### i) Minimize Net Forest Lost

Development should not result in a significant net change in forest cover. New developments should be creatively designed to harmonize with existing greenery and vegetation (insertion), instead of replacing or wiping out forested areas wholesale (intrusion).

#### ii) Afforestation and defragmentation

Forested land that may be cleared for development should be balanced by forest rehabilitation efforts in other parts of campus. Where possible, establishment of new forest sites (afforestation) can also be considered. For example, the grass field near the 9th College Gate (coordinates 3.121273, 101.649851) lies in between two fragmented forest sites—INTAN/Arts (site no. 8) and FBL/Arts (site no. 13). If rehabilitated, it could serve as a corridor linking these two forest fragments.

# 02 WASTE MANAGEMENT



# Kod Amalan Pengasingan Sisa Makanan di Punca

- 1. Professor Dr. Sumiani Yusoff
- 2. Keng Zi Xiang
- 3. Nur Syuhada Mohd Zain
KOD AMALAN PENGASINGAN SISA MAKANAN DI PUNCA

# PENGENALAN UM ZWC

UM ZWC adalah satu inisiatif yang bermula daripada projek kelas pengurusan sisa pepejal pelajar tahun akhir jurusan Kejuruteraan Alam Sekitar yang dikendalikan oleh Profesor Madya Dr Sumiani Yusoff pada tahun 2009 dan telah berkembang sehingga kini. Operasi UM ZWC merupakan urusan harian tujuh hari seminggu tanpa henti yang memerlukan pemerhatian dan komitmen yang tinggi dalam memastikan semua sisa di dalam kampus diuruskan secara teratur dan mengikut prosedur yang ditetapkan. Objektif UM ZWC adalah:

- 1) Untuk membangunkan dasar dan sistem inovatif supaya penghantaran jumlah sisa pepejal ke tapak pelupusan sampah dapat dikurangkan untuk pemulihan sumber dan tenaga menjadi baja organik dan biogas.
- 2) Untuk menyelaraskan aktiviti kitar semula dan menggandakan usaha serta menyusun strategi untuk meningkatkan kadar kitar semula di dalam kampus UM.
- 3) Untuk memupuk kesedaran dan membudayakan amalan pengasingan sisa dipunca dalam kalangan komuniti di dalam kampus UM.
- 4) Untuk membentuk perkongsian strategik dengan pelbagai pihak berkepentingan untuk membentuk sistem pengurusan sisa bersepadu.

Di antara usaha yang telah dilakukan oleh pihak UM ZWC untuk mengurangkan beban terhadap alam sekitar dan memastikan sumber-sumber bahan mentah diurus dengan lestari dan cekap termasuklah:

- Pengasingan sisa makanan dipunca Green bag scheme
- Projek pengkomposan hasil daripada sisa makanan di sekitar kampus.
- Projek kitar semula sisa kertas, plastik dan kaca, sisa elektronik, sisa tekstil, dan sisa kayu untuk tujuan pemuliharaan alam sekitar.
- Rawatan sisa makanan secara pencernaan anaerobik untuk penghasilan biogas.

UM ZWC juga dirujuk sebagai suatu inisiatif institusi untuk mencapai satu model pengurusan sisa bersepadu menjurus ke arah pencapaian kampus sisa sifar pada masa akan datang. Selain itu ia juga merupakan satu model berinovasi untuk beralih ke arah pengurusan sisa yang mapan.

# 1. DEFINISI

Jadual 3: Terma dan definisi

Terma/ungkapan	Definisi/maksud	
Jenis Sisa	Merujuk kepada sisa makanan, barang yang boleh dikitar semula dan sisa baki	
Sisa makanan	Pengelasan dan penerangan seperti di dalam senarai semak di Bahagian 7	
Barang kitar semula	Pengelasan seperti di dalam senarai semak di Bahagian 7	
Sisa Baki	Sisa pepejal yang bukan di dalam pengelasan seperti "sisa makanan" dan "barang kitar semula". Juga bukan sisa berbahaya dan sisa elektronik.	
Air larut resap	Cecair yang mengalir daripada plastik sampah/pelapik sampah.	
Kod	Kod Amalan untuk pengusaha kafeteria/dewan makan.	
UM Zero Waste Campaign	Kempen di UM yang berusaha untuk mengurangkan penghantaran sisa ke tapak pelupusan bertujuan untuk mengurangkan beban terhadap alam sekitar.	
Pihak berkepentingan	Merujuk kepada pengusaha kafeteria/dewan makan, JPPHB, UM ZWC, OSH dan kolej kediaman.	
Kebuk sampah	Tempat perantaraan sisa sampah sebelum pengutipan dijalankan oleh pihak JPPHB.	
РТј	Merujuk kepada mana-mana pihak/unit yang bertanggungjawab dalam kampus UM (kolej kediaman, fakulti, pusat pengajian, akademi dan institut ).	
JPPHB UM	Jabatan Pembangunan Dan Penyelenggaraan Harta Benda, Universiti Malaya	
Bekas sisa	Merujuk kepada beg plastik, tong dan lain-lain untuk penakungan sisa pepejal	
Beg plastik berwarna/putih/lutsinar	Beg plastik sampah yang berwarna/putih/lutsinar untuk membuang sisa makanan.	

### 2. TUJUAN PELAKSANAAN KOD AMALAN

- 2.1 Untuk menggalakkan amalan terbaik dalam pengasingan sisa makanan dipunca di Universiti Malaya, dengan adanya Kod Amalan ini, ia dapat mengoptimumkan operasi sedia kala di kafeteria/dewan makan di dalam UM serta boleh mengurangkan penghantaran sisa ke tapak pelupusan.
- 2.2 Menyediakan garis panduan kepada pengusaha kafeteria/dewan makan mengenai proses pengurusan sisa makanan di UM dengan memperkenalkan Kod Amalan pengasingan sisa makanan dipunca yang dipersetujui antara pihak-pihak berkepentingan.
- 2.3 Untuk memperkenalkan pelaksanaan Kod Amalan pengasingan sisa makanan dipunca ke semua kafeteria/dewan makan yang ada di UM.

#### 3. SKOP DAN APLIKASI

Kod pengasingan ini diaplikasikan kepada semua pengusaha kafeteria/dewan makan di dalam UM kampus ini selaras dengan dokumen perjanjian perlantikan menjalankan perkhidmatan premis makanan pada klause 4.3 Kebersihan Makanan, Keselamatan dan Kesihatan Pekerjaan dan Alam Sekitar yang terkandung perkara 4.3.7 seperti berikut:

- 4.3.7 Membuang sampah sarap dan sisa makanan ke dalam bekas-bekas yang disediakan khas oleh Universiti atau Universiti boleh mengarahkan pengusaha menyediakan bekas buangan sampah sendiri. Pengusaha mestilah memastikan bahawa sampah dibungkus dalam plastik dengan sempurna dan semua sampah dibuang di tempat pembuangan sampah yang disediakan berdekatan dengan Premis tersebut.
- Pengasingan sisa makanan dipunca oleh pengusaha kafeteria/dewan makan
- Pengendalian dan penyimpanan sisa makanan di dapur premis makanan.
- Pemindahan sisa makanan dari bekas sisa makanan oleh pengusaha kafe ke kebuk sampah di setiap PTj.

#### 3.1 PERANAN UM ZWC, JPPHB DAN OSH

Peranan UM ZWC dalam usaha untuk menggalakkan inisiatif kitar semula didalam kampus disamping usaha/langkah mengurangkan beban terhadap alam sekitar adalah:

Mengendalikan latihan kepada pengusaha kafeteria di dalam kampus untuk melakukan pengasingan sisa makanan dipunca.

Memastikan penyebaran maklumat dan informasi berkaitan pengasingan sisa makanan dipunca disebarkan secara meluas dan berkesan untuk mewujudkan budaya menjaga kebersihan persekitaran dan memelihara kelestarian alam sekitar.

Mengurangkan jumlah penghantaran sisa makanan ke tapak pelupusan sampah yang boleh mengakibatkan masalah pencemaran dan pelepasan gas rumah hijau.

Menjalankan aktiviti pengurangan sisa pepejal bersepadu didalam kampus dengan merawat dan memproses sisa makanan yang dihasilkan oleh warga UM menjadi sumber yang berharga iaitu baja organik.

Selain daripada itu, peranan JPPHB dan OSH dalam usaha ini adalah:

- Memastikan kesemua sisa makanan dikutip disetiap kebuk sampah untuk dihantar ke tapak UM Zero Waste Campaign.
- Mengendalikan program pengasingan sisa makanan dipunca kepada pengusaha kafeteria/dewan makan dan melakukan penguatkuasaan yang bertujuan untuk mendidik dan membudayakan amalan pengasingan sisa makanan dipunca.
- Menjalankan pemantauan terhadap kepatuhan pengasingan sampah di kafeteria/dewan makan didalam kampus UM.

#### 4. PENGASINGAN SISA MAKANAN DIPUNCA

- 4.1 Pengusaha kafeteria/dewan makan hendaklah mengasingkan kesemua sisa seperti sisa makanan, barang yang boleh dikitar semula dan sisa baki.
- 4.2 Pengusaha kafeteria/dewan makan hendaklah memastikan kesemua bekas sisa dibersihkan dan dibuang di rumah sampah di setiap PTj sebelum habis waktu beroperasi, tanpa mengira berat atau jumlah untuk mengelakkan bau yang tidak diingini dan menjaga kebersihan premis makanan daripada serangga atau makhluk perosak.
- 4.3 Pengusaha kafeteria/dewan makan hendaklah memastikan bahawa sisa makanan diasingkan ke dalam plastik yang berwarna/putih/lutsinar sebelum dihantar ke rumah/kebuk sampah.
- 4.4 Pengusaha kafeteria/dewan makan perlulah memastikan bahawa tiada air larut resap yang berlebihan dari sisa makanan sebelum menghantarnya ke kebuk sampah untuk mengurangkan jumlah berat sisa makanan dan untuk mengelakkan kebocoran air larut resap di atas lantai.
- 4.5 Sisa bukan organik seperti plastik, kertas, kaca, besi, cawan, pinggan dan peralatan makan adalah tidak dibenarkan untuk dibuang atau dicampurkan ke dalam beg plastik berwarna/putih/lutsinar.

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4.6 Sisa bukan organik mesti diasingkan daripada sisa makanan dan dibuang ke dalam plastik sampah berwarna hitam biasa. Pengusaha kafeteria/dewan makan mesti menggunakan tong sampah yang berwarna jingga khusus untuk sisa makanan yang telah diasingkan daripada sisa-sisa yang lain dengan menggunakan beg plastik yang berwarna/putih/lutsinar.

#### 5. PEMINDAHAN SISA SAMPAH KE RUMAH/KEBUK SAMPAH

- 5.1 Pengusaha kafeteria/dewan makan hendaklah memindahkan sisa makanan ke kebuk sampah yang telah disediakan disetiap PTj.
- 5.2 Pengusaha kafeteria/dewan makan perlulah memastikan kebersihan dan keadaan bekas sisa makanan sebelum menjalankan apa-apa pemindahan sampah ke kebuk sampah untuk mengelakkan kejadian yang tidak diingini seperti kebocoran larut resapan.
- 5.3 Sisa makanan yang telah dibuang di rumah sampah akan dikutip oleh pihak JPPHB untuk dihantar ke Pusat UM Zero Waste Campaign untuk dirawat dan diproses menjadi baja organik.

#### 6. PEMANTAUAN DAN PENTADBIRAN

- 6.1 Kod Amalan ini akan ditadbir oleh ahli jawatankuasa daripada Kod Jawatankuasa Pentadbiran JPPHB, OSH dan UM ZWC.
- 6.2 Peranan Jawatankuasa Pentadbiran Kod Amalan adalah untuk membangun, sentiasa mengkaji semula dan menilai Kod Amalan dengan sewajarnya untuk kepentingan semua pihak termasuk pengusaha kafeteria/dewan makan.
- 6.3 Penguatkuasaan dan pemantauan berkala akan dilakukan oleh pihak JPPHB dan juga OSH untuk memastikan supaya kesemua pengusaha kafeteria/dewan makan melakukan pengasingan sisa makanan dipunca.

# 7. SENARAI SEMAK SISA MAKANAN DAN BARANG YANG BOLEH DIKITAR SEMULA

Barangan	50 - S	Sisa makanan (beg berwarna/putih/lutsinar)	Pusat kitar semula	Kebuk sampah (beg hitam)
Sisa sayuran	Benih	Å		
	Kulit	√		
6.933.3379.97 <b>4</b> 9.939.939	Root	. N		
	Bahagian yang rosak	√		
	Bahagian yang tidak boleh dimakan	4		
	Kulit	Ń		
Sisa buah-	Biji	√		
buahan	Bahagian yang rosak	N		
	Bahagian yang tidak boleh dimakan	N		
	Lemak	N		
Sisa daaina	Tulang	Ń		
5150 doging	Bahagian yang tidak boleh dimakan	V		
	Uncang teh	Ń		
Minuman	Serbuk kopi	√		
	Sisa buah-buahan	N		2
	Tepung	4		
Makanan yang sudah tamat tempoh	Kanji/beras	N		
Sisa makanan d	daripada dapur	V		s
Barang yang ba 1.) Tin minuma aluminium, kac 2.) Semua beka plastik atau bel	oleh dikitar semula seperti : In :botol plastik , besi, tin Ia, Tetra Pak, etc Is makanan: tin logam, botol kas, dan lain-lain		Å	

Jadual 4: Senarai semak sisa makanan dan barang yang boleh dikitar semula

3.) Pembungkusan kadbod dan pembungkusan berasaskan kertas 4.) Bekas polisterina	
Sisa baki (semua sisa-sisa yang ada selain yang dinyatakan di atas)	N

Pengasingan sisa makanan dipunca dengan menggunakan tong sisa makanan yang berwarna jingga yang dialas dengan beg plastik berwarna/putih/lutsinar.



Rajah 16: Tong sisa makanan

Selain daripada sisa makanan seperti tisu, penyedut minuman, peralatan makan seperti sudu dan garpu plastik hendaklah diasingkan dan dibuang ke dalam beg plastik berwarna hitam.



Rajah 17: Pemindahan sisa makanan didalam beg plastik berwarna putih/lutsinar ke rumah sampah yang disediakan



Rajah 18: Sisa sampah yang telah dilonggokkan di rumah/kebuk sampah akan dikutip oleh pihak JPPHB untuk dihantar ke UM Zero Waste Campaign untuk tujuan rawatan tapak



Rajah 19: Tapak pengkomposan UM Zero Waste Campaign dan pencernaan anaerobik yang digunakan untuk merawat sisa makanan dan sisa organik daripada UM menjadi baja organik dan menghasilkan biogas



Rajah 20: Pusat sumber dan tapak UM Zero Waste Campaign yang menjadi rujukan dan penyelidikan berkaitan pengurusan sisa bersepadu yang terletak berhampiran susur keluar pintu pagar Damansara

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# 02 WASTE MANAGEMENT



Guideline on Green Waste and Wood Waste Separate Collection and Management for Institutional Area

- 1. Professor Dr. Sumiani Yusoff
- 2. Keng Zi Xiang
- 3. Mairuz Asmarafariza Azlan

#### GUIDELINE ON GREEN WASTE AND WOOD WASTE SEPARATE COLLECTION AND MANAGEMENT FOR INSTITUTIONAL AREA

#### PART 1: Introduction

The Guideline is introduced for the sustainable management of green waste and wood waste in UM campus. Green waste refers to grass clipping, dry leaves, trimmed tree branches and other types of garden / yard waste. Wood waste is referring to unwanted bulky wooden items such as old /damaged furniture as well as chopped tree trunks /branches. Green waste has been separately collected by JPPHB (Jabatan Pembangunan dan Penyelenggaraan Harta Benda) since the establishment of the UM waste transfer station in year. As municipal bio-waste, both green waste and wood waste can be sorted at source for resource recovery i.e. recycling, treatment and energy recovery.

A separate collection of wood waste by JPPHB was recently developed in year 2015 to facilitate the separate storage of wood waste from UM campus in a different open top Ro-Ro bin. The source segregated wood waste is collected by a local company, TSP Waste Management Sdn Bhd to a biomass (wood-fired) power generation plant at Rasa, Selangor. Since inception in Nov. 2014 until Dec. 2017, a total of 166.05 ton of wood waste has been collected separately from UM for energy recovery. With average of 50 ton/year of wood waste being diverted from disposal in landfill, it is a relatively significant waste stream in a university campus in Malaysia. The separation of wood waste at source is not as challenging as food waste segregation at source and is achievable in a brief period as the stakeholders involved in the collection process is much lesser.

Three important aspects are identified as the enabling factors of successful implementation of wood waste and green waste separate collection in a campus:

- 1. Organized separated collection method
- 2. Functional intermediate storage facility (transfer station)
- 3. Collection for treatment and disposal

Despite different collection methods of green waste and wood waste are practiced by different campus (depending on needs and available space, resource and facility), separate collection is able to be achieved with determination from management body. For example, for campus without internal waste collection team or doesn't have sufficient space for intermediate storage, the management can design and issue a tender /RFQ with a separate collection of green waste and wood waste for off-site treatment (i.e. composting) and energy recovery. For campus with internal waste collection team and possesses in-campus transfer station such as UM, an organized separate collection can be implemented to achieve the desired recycling goal.



Figure 21: Separate collection system for green waste in campus

# PART 2: Separate Collection System

In contrary to general waste, green waste and wood waste are often collected separately in Malaysia because of its nature which is bulk /large in size. Therefore, separation at source is often easily achievable for green waste and wood waste. Nonetheless, green wastes sometime are mixed together with general waste, especially for campus with limited space for waste storage and without internal collection team (direct collection by appointed waste management contractor). Normally a refuse compactor vehicle (RCV) with rear-end loader is used for direct collection of waste from campus (without transfer station) in Malaysia. Unlike split waste collection vehicle, waste collection with conventional RCV is not able to collect waste separately. Thus without a separate collection schedule, all the non-hazardous waste such as general waste and green waste are normally collected together in a single trip.



Figure 22: Refuse Compactor Vehicle



Figure 23: Split Collection Vehicle

Therefore, it is imperative to implement the procurement of waste management service for a campus to enable the separate collection of green waste and wood waste for recycling and treatment, instead of landfill disposal. For campus with internal waste collection team and transfer station, separate collection is easier to achieve. Firstly, all the buildings or areas in the campus. At the transfer station, designated waste storage facility, such as open too Ro-Ro bins are used to store the green waste and wood waste separately in a temporary basis before pick-up by waste collection truck for treatment or disposal. For example, in UM campus, there two open top bins allocated for storage of green waste. The positions of these open top bins are fixed and cannot be mixed up. By having this kind of setting and arrangement, part of the collected green waste can be used for

shredding and composting at the back of the transfer station. To ensure wood waste is not mixed in the other bins, regular training and communication with the waste collection team is important







Figure 25: Photo of UM waste transfer station

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Figure 26: Wood and green waste open top bins in UM transfer station

Collection aspects	Direct Collection (kerbside to disposal site)	In-campus collection team (transfer station)
Type of collection vehicle	Split vehicle / open top bin	Open top bin / Lorry
Contract for separate collection	Required	Optional, depend on collector / on-site treatment
Transfer station	No	Yes
Coloured bag for green waste	Yes	Optional

Table 5: Criteria to enable separate collection of green waste and wood waste



Figure 27: Internal waste collection team carry out separate collection of wood waste for separate intermediate storage at UM waste transfer station

#### PART 3: Waste Conversion (Composting / Energy Recovery)

Separately collected green waste and wood waste is a resource instead of waste. By practicing separate collection of green waste and wood waste for treatment, waste is being diverted from landfill for resource recovery and promote the achievement of circular economy for municipal biowaste. Normally green waste can be shredded as mulch or feedstock for composting. Wood waste can be crushed as feedstock for power plant or boiler for industrial application, or processed wood pellets. In the campus of UM, part of the separately collected green waste is shredded for a composting site located adjacent to the UM waste transfer station. While wood waste is collected separately for intermediate storage in open top bin before collection by a waste management company to a wood-fired biomass power plant located at Rasa, Selangor. The average wood waste collected in a month is about 5.0 ton. Green waste shredded for composting at UM is about 2.0 ton per month.



Figure 28: Resource recovery of green waste and wood waste



Figure 29: Green waste shredding and composting

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Wood waste collected to a transfer station
Crushed wood waste
Wood-fired power plant at Rasa

Figure 30: Wood waste collection for energy recovery

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# 02 WASTE MANAGEMENT



# Guideline on the Proper Disposal of Unused Medications

- 1. Professor Dr. Debra Sim Si Mui
- 2. Dr. Lee Hong Gee
- 3. Dr. Tan Kit Mun
- 4. Associate Professor Dr. Pauline Lai Siew Mei

- 5. Mrs. Che Zuraini Sulaiman
- 6. Mrs. Woon Soo Chin

#### GUIDELINE ON THE PROPER DISPOSAL OF UNUSED MEDICATIONS

#### 1) INTRODUCTION

Expenditure on medication contributes to a substantial proportion of the hospital budget. An approximate sum of RM 62 million had been set aside for medications in the 2016 UMMC budget. Thus, unused or unwanted medications contribute to economic wastage (1, 2). Improper disposal of these unused medicinal products also has adverse consequences on the environment and public health (3, 4).

There are multiple reasons for households to possess unused medications, which include the **medications that had passed the expiry date, the patient's condition had improved, a change in** medical treatment, the patient had died, non-adherence to treatment, hoarding of medications, etc. There are also several routes for these unused medications to gain entry into the environment; such as through disposal as household waste that will be taken to landfills or through flushing medications into toilets or drains that ends up in the sewage system, resulting in possible contamination of surface water (4). Management of these active pharmaceutical ingredients in the environment is both challenging and potentially costly (5). It is thus highly desirable to reduce the risk of releasing these unwanted medicinal products into the environment, which may pose harm not only to the environment but also to public health.

While there are international and national guidelines on the safe management of healthcare wastes, these tend to be at the organizational level (7, 8). Information concerning the proper disposal of unused or unwanted medications in the household is still scarce (9) and the recommendations equivocal (6). Several agencies advocate throwing of unused medications in the household garbage (mixed with kitty litter or coffee grounds to make them unpalatable), flushing them down the toilet, or pouring them down the drain to avoid misuse/abuse or accidental ingestion of unused medications by other household members and pets. In developed countries like the United States of America (USA), the United Kingdom (UK) and Australia, there are community-**based medicine "takeback" programmes, which experts believe to be the safest and most environmentally protective way to dispose of unused or unwanted medications, but this is not the most convenient or readily available option to the majority of patients (10). Thus, it is important for us to create pathways hat are both environmentally friendly as well as user friendly for our community-dwelling patients.** 

#### 1.1 Definitions

The terms used throughout this article are as defined below:

#### 1.1.1 Unused medication

Medication that had passed its expiry date, contaminated and deemed unsafe to be used, or no longer needed by the patients.

#### 1.1.2 Expired medication

Medication which had passed the "used-by" date stated on the medication bottle, packaging or label written by the pharmacy personnel before being given to the patient and medication which was not kept within the required cold chain environment stated on the product packaging.

#### 1.1.3 Returned medication

All medications and medication related items returned to the outpatient pharmacy of University of Malaya Medical Centre.

#### 1.1.4 Discarded medication

Medication which needed disposal through incineration.



Figure 31: Tips on how to reduce unused medications

#### 2) CONSEQUENCES OF UNUSED MEDICATIONS ON THE ENVIRONMENT

#### 2.1 Introduction

The impact of medication waste which contaminates the environment may pose a larger threat to all living organisms living on the planet compared to common household waste.

#### 2.2 Types of medication wastes

When a medication is no longer suitable or safe to be used, it has turned into waste. Medications contain active ingredients (otherwise known as chemicals). When unused medications are discarded into the landfill or sewage, these active ingredients may eventually leak into surface water and contaminate the environment.



Figure 33: Importance of safe disposal of unused medications

#### 3) THE PATIENTS', PRESCRIBERS' AND PHARMACISTS' ROLES IN REDUCING EXCESS MEDICATIONS AT HOME

Patients may possess unused medications for many reasons including resolution of their illness, side effects from medications, poor compliance to treatment regime, death of a family member, expired medications, contaminated medications, change of treatment by their doctor, change in their **medical condition or keeping medications "just in case" or for possible future consumption. Patients** who are older and with multiple chronic conditions may be more likely to experience polypharmacy where they are prescribed five or more types of medications and possess unused medications due to all the reasons listed above. The prescriber and patient are both important parties in reducing the amount of unused medications in the patient's possession.

#### 3.1 Patients' Role

From the patient's point of view, there are several steps that they can take to reduce the amount of unused medications in their house. The instructions to the patient are listed below

- 1. Set a time every month or every two months to check your stock of existing medications for expiry date, condition and amount left.
- 2. Do not keep unused medications in the home as there can be a risk of accidental poisoning of vulnerable parties such as children, persons with dementia, persons with visual impairment and pets.
- 3. Do not share your unused medications with other persons without a doctor's instruction.
- 4. Bring medications which are expired, spoilt, or not required anymore to the nearest pharmacy or healthcare facility that is willing to accept the unused medications for safe disposal.
- 5. Always bring a list of medications, dosages and amount left with you to your doctor's visits. Discuss with your doctor whether all the medications are still required based on your recent medical condition and blood test results.
- 6. Collect only the amount of medication that you require from the pharmacy, while taking into account what you have left in stock at home.

#### 3.2 Prescribers' Role

The following are recommendations for the prescriber to help reduce amount of unused medications the patient may have.

- 1. Check the adherence of patients to their medication regime every visit.
- 2. Check for side effects or adverse events experienced by patients.
- 3. Conduct a medication review every 4 to 6 months, especially for those with multiple medical conditions who experience polypharmacy.
- 4. Prescribe only the amount of medications that the patient requires.
- 5. Counsel patients on reasons for adherence to their medication regimes.
- 6. Counsel patients not to stockpile medications at home for various reasons including wastage, risk of accidental poisoning of vulnerable persons such as children, persons with dementia or visual impairment and pets.

#### 3.3 Pharmacists' Role

Pharmacists are also responsible in helping to reduce the amount of unused medications patients possess. Pharmacists should ask patients whether they need all the medications to be dispensed in the first place or whether they have sufficient supply at home. If there are enough supplies to last for 2 months, then the pharmacist should not dispense more so as to avoid over stocking.

Campaigns and awareness posters can be created to suit different healthcare settings and for waiting areas in the clinic and pharmacy. The following are examples of posters we used in our public awareness campaign in our hospital.

#### Are you experiencing unwanted effects from your medications?



Figure 34: Unwanted effects of medications

#### 4) THE CORRECT STORAGE CONDITIONS FOR MEDICATIONS

#### 4.1 Preventive measures

Properly stored medications will not only ensure medications do not turn bad, their efficacy can be assured too. It is recommended that the patient checks the instructions printed on the **manufacturer's packaging on the correct methods to store the medication prior to opening** as well as after opening.

#### 4.2 Appropriate storage condition

#### 4.2.1 Store in a cool dry place

Medication should be stored in a location away from sunlight, below 25oC. It is also not advisable to keep medication in the bathroom as the humidity in the bathroom is high.

#### 4.2.2 Store between 2 to 8oC for items that require refrigeration

The most appropriate location to store medications that require refrigeration is in **the centre of a fridge. It is not advisable to place the medications at the fridge's door** or in the vegetable compartment, as the temperature in these areas are not ideal.

If a medication requires freezing, it will state specifically on the package that it needs to be stored <0 degree Celsius. This medication can then be stored in a freezer.

# 4.2.3 Protect from light

Certain medications which need to be protected from light are usually packed into an amber bottle (brown bottle) or packaging that can avoid medication from being exposed to light. These medications should be kept in the original packaging and should not be repacked into another container.

#### 4.3 Do not keep medication in the car

Keeping medication in any compartment of a car is not appropriate. The temperature in a car when parked outdoors is often >40 degree Celsius. In these high temperatures, the efficacy of the medication may be affected.

# How do you avoid medication wastage?



Figure 35: Tips to avoid medication wastage

#### 5) HOW DO WE AVOID HAVING EXPIRED MEDICATIONS?

Everyone plays an important role in reducing the amount of expired or unused medications.

#### 5.1 Check the expiry date of medications

Patients should cultivate a good habit of checking the expiry date of medications once purchased or collected from pharmacies. Sometimes, it can be a challenge to read and interpret the expiry dates provided by the manufacturers, as the print is usually small.

#### 5.2 First in first out (FIFO)

Whenever patients collect their new supply of medications, it is advisable to store **medications that have a later expiry date "behind" medications that have a shorter expiry** date. This ensures that stocks with an earlier expiry date will be used up first.

#### 5.3 Do not overstock

It is advisable to keep sufficient medication for everyday use. However, it is unadvisable to stock excessive amounts of medications as Medications prescribed by doctors may change due to a change in your condition.

# 6) EXPIRED/UNUSED MEDICATIONS – WHAT DO WE DO WITH THEM?

6.1 The correct methods on the disposal of unused/expired medications Expired or unused medications need to be disposed of correctly, so as not to harm the environment. The disposal method depends on the dosage form of the medication, as shown in Table 6.1.

Table 6: Method of safe disposal of the different dosage forms (of medications)

No.	Dosage forms	Method of safe disposal
1.	Tablet / capsule	Incineration
2.	Suppository / pessary	Incineration
3.	Liquid / mixture / syrup	Incineration
4.	Cream / ointment / gel / paste	Incineration
5.	Eye / ear / nasal drops	Incineration
6.	Patch Prefilled injection with or without needle / via	Incineration
7.	ampoule	Incineration
8.	Non-metered dose inhaler / nasal spray	Incineration
9.	Metered dose inhaler / nasal spray	Normal waste in the garba
10.	Implant	Incineration

# How do you dispose medications safely?



Return these medications to a pharmacy, and they will send your unused medications for incineration.



Figure 36: Procedure of medications disposal

#### 6.2 Return of expired and unused medications to a pharmacy

Since 1971, Sweden has had a formal programme of returning drugs to a pharmacy for incineration and proper disposal (11). As a consequence of this program, 85% of the general public in Sweden believed that returning unused medications to a pharmacy was better than throwing them in the garbage (2%) or flushing them down the drain (1%); and 43% reported returning unused medications to a pharmacy for disposal (11).

In 2010, the Pharmaceutical Services Division, Ministry of Health Malaysia (MOH) implemented the "Return Your Medicines Program", where patients can return their unused or excess medicines for safe disposal (12).



Figure 37: Flow of how unused medications are returned to the pharmacy and sent for incineration

# 7) CONCLUSION

Safe disposal of unused or expired medication is crucial to reduce the risk of contamination of the environment and surface water and the possibility of the residual chemicals entering the food chain. It is also important to reduce the stockpiling of unused medications in the household which can lead to accidental ingestion by vulnerable persons including children, persons with dementia and visual impairment and also pets. Apart from contamination of the environment, medication wastage is also a great waste of financial resources for a particular individual as well as health care system. The different parties involved all play a vital role in the reduction of wastage of medications; the patient, the prescriber, the pharmacist, the organization that dispenses and accepts back the medications for safe disposal and the government in terms of policies and regulations as outlined above. This set of guidelines were developed in the hope that it can reduce the amount of unused/wasted medications and to reduce the inappropriate disposal of these medications.

# 03 WATER MANAGEMENT



Guideline for Lake Restoration: Lesson Learnt from The Journey of Water Warriors

1. Associate Professor Dr. Zeeda Fatimah Mohamad

- 2. Professor. Dr. Abdul Halim Sulaiman
- 3. Dr. Hazreena Hussein
- 4. Dr. Fathiah Mohamed Zuki
- 5. Siti Norasiah Abd Kadir
- 6. Affan Nasaruddin

#### GUIDELINE FOR LAKE RESTORATION: LESSON LEARNT FROM THE JOURNEY OF WATER WARRIORS

#### I. INTRODUCTION

This guideline is simply a sharing of experience as part of the lesson learnt based on our five years' experience managing Tasek Varsiti (Varsity Lake) in University of Malaya developed by university's Living Lab initiatives called Water Warriors.

#### 1. What are Water Bodies?

Water body or a body of water is the accumulation of water on the Earth. This may refer to huge accumulations such as lakes, rivers, oceans, seas, and also smaller pools of water such as streams, ponds and wetlands.

#### 2. What is a Lake?

A lake is a body of fresh or salt water, surrounded by land. Lakes receive their water from rainfall, streams and groundwater. A lake can be in form of an open system (with an inlet and outlet) flowing like a river or a close system (without an inlet or outlet). In an urban setting, most lakes are manmade, whether for recreation purposes or leftover from mining industry.

#### II. LONG-TERM MANAGEMENT

In contrast to the 'quick fix" approach, a long-term lake management sets a higher priority on finding lasting solutions.

#### 1. Integrated Lake Basin Management (ILBM)

The ILBM is an approach for sustainable management of lakes, which can be used as a reference for long-term lake management. ILBM integrates institutions, participation, policies, technology, information and finance; forming the six pillars:



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#### III. RESTORATION

The restoration of any water body should be treated based on the needs of the place. In the case of Tasek Varsiti, the process was divided into three stages: Research, Fixing and Life. The following will elaborate more on these three stages.

#### 1. Research

According to the National Water Quality Standards for Malaysia, the best water quality for a lake with recreation use with body contact is at least Class IIB. The six parameters needed for this standard are Ammoniacal Nitrogen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, pH and Total Suspended Solid. To get an accurate data, water monitoring tests needs to be done in-situ (onsite) such as for dissolved oxygen and temperature and ex-situ (at the lab).

Several low-cost monitoring kits are available in the market such as La Motte Low Cost Monitoring Kit and Japan Kyoritsu Pack Test, Simplified Chemical Analysis Products for Water Quality. Though the result using these kits may not be so accurate, they provide an important baseline data to presented to the stakeholders.

#### i. Point Source and Nonpoint Source Pollution

The research prior to its restoration can start with finding out the point source pollution and nonpoint source pollution. Point source pollution refers to any single identifiable source of pollution from which pollutants are discharged such as from pipe, drains or sewerage lines and are usually related to any buildings or factories nearby the water body. On the other hand, nonpoint source pollution can be caused by rainfall for example, which carries runoff water possibly polluted with human-made pollutants such as fertilizer and trash.

# ii. Water Quality Monitoring

Checking the water quality is important to know the current state of the lake and to set the target for lake restoration. Water monitoring can be done either accurately in a lab or using low cost monitoring kit to provide a baseline data.

#### 2. Fixing

The "fixing" stage involves all the civil and hardscape work such removal of sedimentation, deepening of the lake, installing rip-rap for lake bank protection, converting part of the lake into a wetland area and many others. Again, the need for these fixing depends on the condition and needs of that particular water body.

#### 3. Life

It is important to encourage the surrounding community to be part of the "life" stage. Carnival-like event could be hosted when the lake is restored, with various fun activities for the community to participate in such as competitions, exhibitions, games and others. Various flora and fauna was introduced and reintroduced to the lake. This includes local fishes (in contrast to invasive fishes) such as kaloi, patin and sebarau to provide a sanctuary habitat for them and ducks and geese which will give the visitors the enjoyment of watching their antics behaviour. New trees could also be planted during a tree planting ceremony. In addition to that, new attractions can also be initiated such as providing paddle boats, building jetty and a cool hangout place in the form of a treehouse.

# IV. FACING THE CHALLENGES

#### 1. Eutrophication

Sometimes lakes may appear to have green or brown (it worse cases, it would appear blueish) layer of substance on it – this is called algae bloom. It happens when the lake is eutrophic due to nutrient loading from fertilizers or human/animal waste. To reduce algae bloom, the nutrient inlet needs to be controlled, aeration needs to be provided using aerator or from recreation activity such as kayaking or you may even introduce zooplankton such as daphnia which feeds on the algae. There are also instances when weeds (Najas spp.) or wetland plants (water cabbage, water hyacinth) grows abundantly on the lake surface. This can be overcome by controlling nutrient loading, through manual harvesting or introducing new species which feeds on the plants such as releasing grass carp which feeds on Najas spp.

#### 2. Invasive Species

Invasive species (such as non-local fish) poses a threat for local species who might not be able to compete with them. A drastic measure to overcome this is by draining the lake and capturing the fishes using nets (especially the fishes that bites). Another method is simply through giving awareness to the community.

#### 3. Rubbish Management

The human habit of littering is difficult to solve sometimes. The following are some examples on how we tried to tackle this problem. The available dustbin at the lake was upgraded to a more convenient kind that has an opening in the front (so that the user **won't need to pick**-up the rubbish lid and dirtying their hands). Community program such as Responsible Lakers was initiated, where the community could use the kayak for free in return for picking the rubbish at the lake and complete a simple rubbish assessment.

#### V. HEARTWARE APPROACH

The heartware approach below as just some examples of the initiatives one can do to reenchant and capturing the community's heart.

#### 1. History, culture & nature

Place attachment (human bond with nature) are usually related to the history, culture and nature of the place.

#### i. History and culture

Any water body would usually have its own history, whether related to the culture of the people living in the place or its geographical changes over time. Information about the history and culture of the water body can be obtained from the library, digitally in the internet or you may interview people who have lived there a long time (surely, they would have a lot to tell).

#### ii. Nature

It's a good idea to record any sightings of rare and interesting biodiversity in the area either through photography or video. You can even create a checklist for the visitors to the area.

# 2. Citizen science

Citizen science is defined as community participation in a scientific research. Using the place-based approach, the citizen in the Tasek Varsiti case are the surrounding community who work or study in the university (they might not necessarily live here). Citizen science could make the community feel like they are included and part of the restoration work, hence giving them a sense of belonging to the area.

# i. Eco-Heart Index

Prior to the Tasek Varsiti restoration, the community was engaged in doing citizen science on water quality monitoring. The results are then plotted in the form of Eco-Heart Index – the plotting of water quality **parameters to create a 'heart' shape.** 



#### ii. Online mapping

The results of the monitoring can be archived and stored in the form of online mapping. This provides a platform for the stakeholder to access the information for any decision-making process and for the community to be aware on the state of the lake. Example of online mapping tools are Google My Maps and ArcGIS. Figure 38 shows an example of online mapping for water quality monitoring using Eco-Heart Index using Google My Maps.



Figure 38: Example of online mapping for water quality monitoring using Eco-Heart Index using Google My Maps

#### 3. Education

#### i. Environmental Education Programmes

Water bodies provides many opportunities to be used as an open classroom for programmes such as citizen science, nature walk, nature hunt and outdoor lectures. Information about the program can be shared through social media or website.

#### ii. Creative Publicity

#### a. Social Media

Facebook, YouTube, Instagram and Twitter are all useful social media to spread the information to wider audience. For example, the story of Tasek Varsiti was made into a video in YouTube titled "Tasek Varsiti, Universiti Malaya: Dahulu & Sekarang." (Tasek Varsiti, University of Malaya: Now & Then).

#### b. Lake Maps and Posters

Through consistent recording and archiving information about the lake, various publication can be produced such as biodiversity map, nature trail map and posters (birds, trees, wildflowers).



Figure 39: Tasek Varsity Map

c. Art

Creating art is a form of communication to the public that has the ability to spark conversation and promote behaviour change concerning environmental issue. There are various kinds of nature art and trash art that you can create such as below:



Figure 40: Nature and trash art

# iii. Interpretive Space

Information about the history, culture and biodiversity for example, could be presented physically in the form of an interpretive signages situated strategically at the lake to form a story about the place. The use of technology to further enhance this interpretive space such as website and virtual tour can also be incorporated.

# iv. Park code

Park code can be developed through discussion with stakeholders on the needs of the place. Below is some example of the park codes for Tasek Varsiti:

- a) Party responsibly. The lake is a beautiful place for you to set up a picnic basket **but leave nothing behind (there's more than 17 dustbins around the lake for you** to choose from!)
- b) Share the beauty of nature with others; let flowers bloom. Plucking them will only make the bees upset.
- c) Catching fish is only allowed if you're a fish, a bird or a lizard (unless they too, learn how to use fishhooks which are harmful when left behind).
- d) We are trying to get our educated ducks to quit smoking, so please don't set a bad example for them.
- e) The quality of our lake water depends on you. Washing vehicles near the lake will make the water soapy and oily, while throwing food inside the lake increases its nutrient content.
- f) Your pets (fish, turtle, etc.) deserves better. Dumping them here can make them home-sick and also disturbs the ecosystem of the lake.
- g) Safety vest can keep you safe (and make you float like a geese); always wear them when doing water recreation activities.
- h) Most importantly, discover your lake: measure the height of a tree, train your eyes and ears to look out for birds, take awesome wildlife photographs, lift up logs and sift through soils to find all sorts of little wrigglers, make a collection of dried grasses, sketch a plant and stalk some insects! The lake is an open museum and there's so much to experience here!



# 04 ENERGY MANAGEMENT



Guideline on Energy Monitoring and Management for Energy Saving in University of Malaya

- 1. Dr. Mohd Yazed Ahmad
- 2. Dr. Fathi Alias
- 3. Professor Dr. Faisal Rafiq Mohamd Adikan
- 4. Dr. Ahmad Khairi
- 5. Dr. Khairunnisa Hasikin

### <u>GUIDELINE ON ENERGY MONITORING AND MANAGEMENT FOR</u> <u>ENERGY SAVING IN UNIVERSITY OF MALAYA</u>

### 1) INTRODUCTION

Cost of Electricity bills represents one of the major components of operating cost across various types of buildings and facilities. Inefficient use and improper management of electricity will not only cause higher operating budget but also waste of natural resources and unnecessary CO2 emissions. The main contributors for energy usage in office buildings are air conditionings and lightings [8, 9]. In university of Malay the number of split air-conditioning units are quite significant, and most of the lightings are using manual switches. Such conventional setups fully rely on human factors hence there are tendencies of non- optimize use of energy. A smart power monitoring and power management system can be one of the solution to address this problem.

Proper management of electrical power has become crucial nowadays due to its significant impact in reducing the consumption of energy, reducing electricity bills and at the same time lowering CO2 emissions. Collected data and findings from literatures indicated that there are still significant percentage of users (approximately more than 30%) of users are not really care to turn off switches. In addition, implementation of smart space or smart office over existing building often incur high starting investment as a result such solution is not been fully adopted.

This Project proposed a quick and simple approach to reduce unnecessary energy usage by using novel modular electrical energy monitoring and power management system featuring easy installation without the need of major renovation and rewiring. This system is developed in-house by UM researchers; therefore, we have full control over the sub components to be used which then allows us at some extend control the overall cost of the system. Results from our first phase study indicated that under well controlled environment it is possible to achieve approximately 34% reduction of electrical energy usage for lightings and approximately 47.8% for air-conditioning. In addition, the proposed system has made it convenient to the space occupants since all the switching and temperature setting and regulations are automatically taken care of. The use of the proposed system at more locations will bring better impact on energy savings and CO2 reductions thus benefits the Institution and promotes sustainability.

### 2) GUIDELINES & GOOD PRACTICE:

- 1. It is a good practice to utilize the available sunlight for lightings. When light intensity in a certain location increases due to the sunlight, the lights can be switched-off or set to be dimmer. A system that uses photocell sensor with regulator can be employed.
- 2. Electrical energy consumption can be reduced by simply change the type of lamp used e.g. from the fluorescent lamps to LED lamps (light emitting diodes). This approach demands quite high initial investment [3] but will benefit in long run.
- 3. A straight forward method that detect space occupancy and switch appliances such as light and Air-conditioning unit (AC) can be a good approach for spaces such as lecturer office, and lecture halls.
- 4. Heating and cooling is the main source of power consumption that contribute to the high electricity bills. Recently Universiti Teknologi Petronas (UTP) have come out with a method of energy saving which is accessed via a simulation of energy for a centralized HVAC (system for heating, ventilating, and air conditioning) in academic building. They utilized adaptive cooling technique for continuous cooling load [4].

Since the academic building is not always occupied, the presence of occupants in a building has an important impact on the required cooling of a building [5,8]. This implies that, cooling load in a building is mostly driven by the number of recipient. In addition, occupancy pattern in an academic building especially laboratory, workshop, and classroom is likely to change every semester or academic year. Therefore, it needs appropriate design and analysis tool to optimize the performance of the system [6].

- 5. It has been reported in [7] that there are quite a significant percentage (about 30%) representing number of users that do not really care to turn off switches. Therefore, a solution such as autonomous switching is needed to address this 30% category.
- 6. Although there are plenty of efforts in improving efficiency and reducing the unnecessary electrical usage, however most of the existing techniques are not convenient and costly due the need of high initial investment, involve major renovations due to the need of hacking the walls for installation of energy saving system. The modules as indicated in Figure1 developed under UM-LIVING LAB can be employed to address some of these concerns.



Figure 41: Modules of Smart Modular Electrical Energy Monitoring and Management System and The Integration of Modules to Control a Lecturer Room

Results indicate that, under a controlled environment this system can offer greater than 10% energy savings



Figure 42: Project future plan

# 04 ENERGY MANAGEMENT

# Energy Saving Culture Guideline

- 1. Dr. AdiAinuzaman Jamaludin
- 2. Associate Professor Dr. Rohana Jani
- 3. Dr. Zul Ilham Zulkiflee Lubes
- 4. Dr. Mohd Istajib Mokhtar
- 5. Nurul Emy Idayu Zulkifli

ENERGY SAVING CULTURE GUIDELINE

### 1) Objectives

- i. To highlight the potential of energy conservation with low-cost approaches
- ii. To create an efficient energy management system.
- iii. To reduce energy-related operating costs
- iv. To increase awareness of energy saving throughout the campus
- v. To develop research related to energy saving culture
- vi. To improve UM reputation as a green and sustainable campus

### 2) Definition

### Energy Saving Culture

Energy saving culture is where people make intentional choices to save energy not because they are told to but because they want to.

### Energy Conservation

Energy conservation is the act of saving energy by cutting back the usage and involves any behaviour that results in the use of less energy. Energy conservation can be achieved by the efficient use of energy. Energy conservation in a building can be achieved in many ways but in the holistic manner, it should be started from the source itself; **building's design and** structure



Figure 43: Interrelated factors in achieving building energy efficiency Source: Al-Mofleh et al. (2009)

### Building and service design

Holistic approach as it starts from the source. Nevertheless, in the existing building, it requires high cost when comes to retrofitting and renovation. The successful of building and service design are relying on occupant behaviour and needs which always change over the time.

### Occupant behaviour

Occupant behaviour as it is a low-cost approach with long term effect. Occupant behaviour can be in the form of occupancy and vacation patterns, employee awareness and training. Not easy to be controlled and maintained but it is a low cost approach with long term effect especially with developing of an Energy Saving Culture. Integration with operation and technological actions/building & services design leads to optimal results of energy conservation.

### **Energy Efficiency**

Energy efficiency is the application of advances in science and technology to provide services and products that require the use of less energy to perform the same function. By paying less, the usage of electricity is reduced while at the same time enjoying the same amount of amenities for the purpose of protecting the environment.

Energy efficiency is an organisational commitment that is achieved by changing the way everyone views and consumes energy especially 'individual actions on a daily basis'.

### 3) Malaysia's Potential in Energy Conservation

Located in the equatorial region, Malaysia has a high potential in energy conservation because she only has a little seasonal variation with a consistent annual average of temperature and humidity. The climate in Kuala Lumpur is hot and humid all year long and is only affected by the weaker Southeast monsoon from April to September. The average temperature is 23-32°C and the average rainfall reaches up to 190mm. The wind direction is mainly from the north-west to the south-west throughout the year. The Malaysian climate is generally described by Ahmad (2008) as the following;

- The daytime maximum temperature of 30-35°C, warm all year around.
- The range of average monthly temperature is about 1-3°C.
- The average diurnal temperature variation is about 8°C.
- The annual mean temperature is about 27°C.
- The annual precipitation is greater than 1500mm.
- Coastal area high with the wind when inland areas are wingless, leads to thermal stress during the day.
- Solar radiation intensity varies widely with cloudy conditions.
- Only have two seasons, a wet season and a dry season.

Daylight can be fully optimized while natural ventilation can be freely exploited for sustaining thermal comfort in the buildings; rather than using mechanical devices like artificial lamps and air conditioning systems.

Energy saving opportunity is even much greater in the countries where hot and humid climates are common all year around rather than countries with cold climates, Srivajana (2003).

### 4) Benefits of Energy Conservation and Efficiency

Energy conservation and efficiency are both equally important in order to reduce the dependency on fossil fuels and move towards sustainability. Minimize the utilization of non-renewable energy sources, pollution, and energy consumption whilst maintaining comfort, health and safety of the occupants (Kannan, 2006).

5) Energy triangle approach for a new building design



Figure 44: Energy triangle approach for a new building design

The triangle approach focuses more on designing new buildings meanwhile the tools to achieve energy conservation in Malaysia proposed by Al Moflet (2009) are more relevant in achieving sustainable energy in existing buildings.

The proposed tools consist of the use of efficient electrical equipment; the application of passive energy technology in a building such as insulation, evaporative cooling, ventilation and solar heating; and support tools such as public awareness, energy codes, regulations, energy information and databases. The integration between the two ideas can improve the energy conservation efforts for both existing and new buildings.

### 6) Reasons to conserve energy

- i. Reduce energy costs
- ii. Differentiate your organisation
- iii. Decrease carbon footprint
- iv. Be a part of the community sense of belonging
- v. It's the right thing to do
- vi. Research shows that up 30% of energy use can be recovered through behaviour

### 7) Vampire Loads

Some electrical devices, when plugged in even though they are turn off, are still using energy. This Standby Power is known as Phantom or Vampire load. According to a joint study between U.S. Environmental Protection Agency and several environmental agencies, vampire load is approaching 10 percent of average household electric use. For example, when charging the charger, it uses electricity, but charger is still using small amounts of energy even when it is not connected to a device.

Electrical Device	Average* (watts)
Air conditioner	0.9
CD Player	5.04
Coffee Maker	1.14
Computer Monitor (LCD)	1.13
Computer Speakers	1.79
Copier	1.49
Desktop Computer	2.84
DVD Player	1.55
Fax Machine, Laser, Ready	6.42
Laptop Computer	8.9
Microwave oven, (Not Running)	3.08
Multi-function Printer, Inkjet	5.26
Multi-function Printer, Laser	3.12
Music Instruments	2.82
Modem, DSL	1.37
Phone, cordless	0.98
Printer, Inkjet	1.26
Printer, Laser	1.58
Scanner	2.48
Surge Protector	1.05
Television, CRT	3.06
Television, LCD	2.10
Tuner, AM/FM	1.12
USB Hub	1.44
*Lawrence Berkeley National Lab and El denotes products being 'off'	NERGY STAR (2014),

Figure 45: Vampire load of some electrical devices

When considered the impact to the environmental too, Vampire loads are a real problem and will only continue to grow as the digital age advances. However, the dreaded Vampire load can be fought with vigilance and application of the recommendations below:

### 1. Turn appliances off at the wall

Devices that don't need to be left on overnight, such as microwaves, TVs or laptop and get into the habit of turning them off at the wall before going to bed.

### 2. Monitor device usage

Think critically about what appliances that we do or do not use and always be on the lookout to turn appliances off.

### 3. Install LED lights

LED lights are 4-7 times more efficient than typical bulbs. Lights that use less power will naturally use less standby power, be kinder on the environment and monthly bills.

### 4. Wash wisely

Washing machines are one of the biggest culprits of vampire load. Make sure to switch the machine off after use to avoid being charged for unused power throughout the day.

### 5. Electrical boards update

Some modern electricity boards can sense when appliance has entered standby mode and will cut its electricity feed entirely. Not only will ensuring the electrical system is updated save money, but it is an important safety precaution for house and office too.

### 6. Purchase energy efficient models

The more energy efficient an appliance is, the less electricity it will use on standby, the less expenses will be spent on electricity bills.

With these tips and tricks suggested, some efforts and investments are needed but considering the positive impact it will have on electricity bills and the environment, it is worth a try.

### 8) Energy audit

Typically involves in data collection & review, plant survey and system measurement, observation and review of operating practices, and data analysis.

### Challenge

- define the system being considered/system's boundary.
- measure energy flows into & out of the system because it involves;
  - i. collecting energy flow data from various sources.
- ii. estimating energy flows that cannot be directly measured, i.e. heat loss through a wall or in vented air

### Usage

The information of the energy audit can be used to:

- identifies opportunities to improve efficiency
- decrease energy costs
- reduce GHGs emissions that contribute to climate change
- verify the effectiveness of energy management program/opportunities after they have been implemented

### Types

- Level I : Walk-through/Preliminary (Basic)
  - Level II : Standard/General (Intermediate)
- Level III : Computer simulation/Investment-Grade (Advanced)

### Strategies of Energy Audit:

- i. Interview with the Key Facility Personnel
- ii. Document review
- iii. Facility tour
- iv. Facility inspection
- v. Staff interviews
- vi. Utility analysis/inventory energy use
- vii. Identify/Evaluate feasible Energy Conservation Measures (ECM)
- viii. Economic analysis
- ix. Prepare a report
- x. Review recommendations with facility management.

### Utility analysis:

 Building Energy Performance, BEP = Energy Index, EI (known as normalised performance indicator)

 $\frac{\text{Total Building Energy Consumption, TBEC (kWh)}}{\text{Total Floor Area, TFA (m2)}} = kWh/m^2$ 

Energy Utilisation Index, EUI

 $\frac{\text{Annual Building Energy Consumption (kBtu or GJ)}}{\text{Total Floor Area (ft2)}} = \text{kBtu or GJ/ft}^2$ 

### Energy Audit Report

The report explains the existing conditions and recommendations to improve efficiency through improvements in operation and maintenance items as well as installation of energy conservation measures. The report should also effectively reach and understand by various audiences

- CEO, COO, Administrator, Superintendents.
- Facilities/Plant Managers.
- Controller/Plant engineer.
- Operations/Maintenance Staff.

Basic components of well-organized audit report should include;

- i. Executive Summary
- ii. Building/facilities Information
- iii. Utility Summary
- iv. Energy Conservation Measures (ECMs)
- v. Operation & Maintenance Measures (O&Ms)
- vi. Appendices

### 9) What is AEMAS Energy Management Gold Standard (EMGS)?

EMGS is a program of sustainable energy management by ASEAN Energy Management Scheme (AEMAS) supporting by European Union and ASEAN Centre for Energy (ACE). Malaysian Green Technology Corporation (GreenTech Malaysia). Malaysian Green Technology Corporation (GreenTech Malaysia) is the body responsible for managing AEMAS in Malaysia which includes training, assessment and recognition of an organization. The system of certification is based on excellent in energy management as shown in Table 1 below:

Rating	Description
	<ul> <li>Energy Management System in place</li> <li>Certified Energy Manager(CEM).</li> <li>Motivation plan for the personal involved in the Energy Management system.</li> <li>Budget allocated for investment in EE measures.</li> <li>Procurement policies and internal investment criteria "EE-friendly".</li> </ul>
★ ★ ☆	<ul> <li>Same as 1 star + (either one of the following): <ul> <li>Overall EEI improves by 5% (over 2 years).</li> <li>Overall energy consumption decreases by 5%.</li> <li>EEI improves by 1% on year-on-year basis over past 3 years.</li> <li>EE measures representing at least 50% of the total energy saving potential of recommended measures (internal audit) are implemented and achieving at least 1% overall energy savings.</li> <li>EE measures representing at least 50% of the total energy saving potential of recommended measures (external audit) are implemented and achieving at least 1% overall energy savings.</li> <li>EE measures representing at least 50% of the total energy saving potential of recommended measures (external audit by AEMAS certified auditor and approved by senior AEMAS experts) and achieving less 1% overall energy savings are implemented (include cases where NO EE measures are implemented).</li> <li>Fuel-switching project implemented (using NG or RE).</li> <li>Projects involving self-generation of electricity implemented.</li> <li>One RE project implemented.</li> </ul> </li> </ul>
$\star \star$	Open only for 2-star certified companies Same criteria as for 2-star + Energy Manager must be PEM (not CEM) • Renewal of 2-star provides 3-star.

Table 7: The requirement of EMGS

The EMGS 1-Star rating is awarded to companies that have implemented the energy management system, upon an audit by AEMAS auditors. Such companies have an energy

manager, a company-wide energy management committee, and have implemented the entire energy management system.

While, the Two Stars is awarded to companies that have shown improvement in their energy efficiency index resulting from implementation of energy conservation measures and the Three Stars goes to companies that have achieved and maintained their energy efficiency improvement of for at least 5% three years.

### 10) Activities and Products

### Activities

- Program Penerapan Budaya Penjimatan Tenaga bersama Pasukan Eco-Squad SMK Damansara Utama. 3 October 2017 / 11.30 AM – 1.50 PM / DK Rimba Ilmu, UM.
- REEN Application Half Day Workshop. 13 October 2017 / 8.30 AM 1.00 PM / Hospitality Lounge 1, KL Convention Centre (KLCC).
- Program Penerapan Budaya Penjimatan Tenaga bersama Pelajar SMS Seri Puteri. 17 November 2017 / 8.30 AM – 11.30 AM / Surau SMSSP.
- Ceramah Agama & Tenaga. 1 Mac 2018 / 7.00 PM 9.00 PM / Surau Kediaman Kolej Kelima UM.
- Pertandingan Poster Pembudayaan Penjimatan Tenaga. October November 2017 / Damansara.

### Publication & Products

- Button Badge / Fridge Magnet / Postcard.
- Proceeding Paper / ISI Journal / International Referred Journal (Appendix D)

Nurul Emy Idayu Zulkifli, Adi Ainurzaman Jamaludin, Zul Ilham, Rohana Jani, & Mohd Istajib Mokhtar. (2018). The daily practice of UM students on electricity usage towards energy conservation. In Awangku Hassanal Bahar Pangiran Bagul, Jainurin Justine, Andy Lee Chen Hiung, Mohd Rizwan Abd Majid, Andi Tamsang Andi Kele, Datu Razali Datuk Eranza, Huikeng Lau, Mohd Alif Anwar Abu Bakar, Rostika Petrus Boroh, & Tini Maizura Mohtar (Eds.), Climate Change and Campus Sustainability (Vol. II) -Proceedings of the 5th Regional Conference on Campus Sustainability 2018, Universiti Malaysia Sabah (pp.133-146). Sabah, Malaysia: Universiti Malaysia Sabah.

Adi Ainurzaman Jamaludin, Hazreena Hussein & Ati Rosemary Mohd Ariffin. (2018, March). Performance of a residential college building with bioclimatic design strategies towards sustainable campus. Paper presented at the 5th Regional Conference on Campus Sustainability 2018 (5RCCS2018), Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia.  Social Media (Appendix E) Wartawan Kampus UOLS (2018, April 17). UM kongsi ilmu celik tenaga bersama pelajar SM Sains Seri Puteri. Sinar Harian. Retrieved from <u>http://kampusuols.com/article/92636/Uni-Kita/AKTIVITI-KAMPUS/UM-kongsi-ilmucelik-tenaga-bersama-pelajar-SM-Sains-Seri-Puteri</u>

### 11) Challenges & Limitations

Abundant resources and inexpensive energy which is still reliable and affordable to the consumer make the issues of energy savings over a lifetime cost of a building have little **meaning while the developers' philosophy of reducing initial cost and fast profit recovery** often puts a full stop to the effort of energy conservation in building industry (Horvat & Fazio, 2005).

Ryghaug and Sørensen (2009), there are three interrelated problems that failed the energy efficient construction in the building industry which are:

- Deficiencies in public policy to stimulate energy efficiency where this is closely related to tenant-owner dilemma; builders and building owners tend not to be so concerned with future energy cost, energy use and related aspects of the indoor environment because they will not use the building themselves.
- Limited governmental efforts to regulate the building industry *when the authorities primarily focused on energy-economizing that energy should be used in an economically optimal way where deciding to increase energy standards when prices increase* and,
- A conservative building industry where there are only focusing on short-term costs, lack of research and development, contract practices, the communication challenges of interdisciplinary coordination of building projects, and architects' unsupportive attitude towards energy efficiency.

### 12) Solutions

Introduction of new policies, better regulations and reformed practices in the industry itself (Ryghaug & Sørensen, 2009). Proper maintenance has to be carried out to fine tune the performance of the building while the occupants should continually be made aware of energy efficiency practices and do their part endlessly (Kannan, 2006).

Program Penerapan Budaya Penjimatan Tenaga bersama Pasukan Eco-Squad SMK Damansara Utama



Program Penerapan Budaya Penjimatan Tenaga bersama Pelajar SMS Seri Puteri





Ceramah Agama & Tenaga di Kolej Kediaman Kelima

Media appearance





# 05 TRANSPORTATION SYSTEM MANAGEMENT



# University of Malaya Campus Transport Guideline

- 1. Ir. Dr. Yuen Choon Wah
- 2. Associate Professor Dr. Rosilawati Zainol
- 3. Dr. Onn Chiu Chuen
- 4. Dr. Suhana Koting
- 5. Puteri Normiyani

### UNIVERSITY OF MALAYA CAMPUS TRANSPORT GUIDELINE

### 1) INTRODUCTION

The different modes of transport are air, water, and land transport, which includes rail, road and off-road transport. Each mode has its own infrastructure, vehicles, and operations. Generally, vehicles are classified into cars/taxis, motorcycles, light goods vehicles or trucks, buses and bicycles. Higher population means higher mobility and higher transportation usage. Educational institutions such as a university is one of the community with high population since it is a centralized place where all type of activities occur daily. A university consist of facilities for residential, learning, working, event, dining, sports, administration, teaching, research and development and many others to specify. Mobility from one place to another require transportation access. Therefore, universities in Malaysia also faces challenge in managing its transportation management.

Major challenges in transportation management are traffic congestion, unlimited car accessibility within campus, limited parking spaces and lower rates of cycling culture among the campus community. In terms of sustainability context, sustainable transportation does not only focus on a specific type of vehicle, but it requires an integrated transportation system. Sustainability will be achieved by integrating all means of transport modes. Nowadays, higher academic institutions, globally and locally, have been taking initiatives to improve their transportation management to support the sustainable agenda. Educational institutional especially university has a large community that can become a part of the workforce to initiate **and take part in realizing Malaysia's** target to reduce 45 per cent of carbon dioxide (CO2) emission by 2030 to address climate change and global warming.

### 1.1 OBJECTIVE

The University of Malaya Campus Transport Guidelines serves as the outline and a sustainable agenda for University of Malaya campus community. Accordingly, the objectives of this campus transport guidelines are:

- i) To provide information on availability of integrated sustainable transportation system within the campus.
- ii) To inform and promote community to choose shuttle bus and non-motorized transport mode as their main travel mode in campus and reduce transportation carbon footprint.

### 1.2 SCOPE

This guideline covers all information related to transportation services provision available in UM campus and details about the content of Living Lab Project that focused on sustainable transportation system in University of Malaya campus.

### 2) TRANSPORTATION SERVICE PROVISION

The current transportation services provision available in UM campus including bus service (campus bus and external bus), bicycling facility, electric vehicles project, car and pedestrian accessibility.

### A) Bus Service

### 1) Campus Bus (UMRIDE CAMPUS)

- The Student Affairs Division manages 21 buses (including three coasters) and 25 drivers provide shuttle services for students traveling in and outside campus. All these buses are used for students to attend classes.
- UM shuttle bus schedules are always circulated via *siswamail* every semester by Student Affairs & Alumni Division. Any changes and updates of the bus timetable, HEP department will circulate the changes via *siswamail*. Therefore, students are advised to regularly check their *siswamail*.
- Students are advised to wait for the shuttle bus at designated bus stop points which can be found from the UM shuttle bus service route diagram. (As shown in Figure 1)

### 2) Service route

- The routes are limited to shuttle within campus, from Pantai Dalam/Kerinchi, Section 17 (International House) and from 9th Residential College.
- Bus punctuality at every station is subject to number of bus available, number of bus drivers available and the weather conditions such as heavy rain and also subject to the traffic flow on the road.



Figure 46: UM Shuttle Bus Route

### 3) Campus bus schedule

Students are advised to wait at the designated bus stops earlier about 5~10 minutes before the scheduled time.

IP OPERATION TIME NOTES:	
PROM UMS PROM API	
7.30am *7.40am 1. Bus does not operate on th	e following
t 7.45am *7.55am days:	- 14
8.00am *8.10am > Weekend (Saturday & Su	nday).
8.15am *8.25am > Public Holiday.	
8.30am *8.40am	
8.45am *8.55am 2. Bus will operate 1	hour/bu
9.00am *9.10am (8.00am - 8.00pm) on th	e following
9.15am '8.25am week:	
9.30am *9.40am Study Week	
9.45am *9.55am Semaster Break	
1 10.00am *10.10am	
2 10.30am *10.40am 3. Bus does not operate du	ring Friday
3 11.00am *11.20am Prover. Time break starts fro	om 12.30pm
1 11.30am *11.40am until 2.45pm.	0.0000000000000000000000000000000000000
5 12.00pm *12.20pm	
5 12.30pm *12.40pm 4. *Bus schedule depends	on traffir
7 1.00pm "1.10pm situations.	
1.30pm 1.40pm	
2.00pm 12.10pm 5. This schedule will be eff	fective or
0 2.30pm *2.40pm 5 <sup>th</sup> March 2018 (2 <sup>nd</sup> Seme	ster Session
1 3.00pm '3.10pm 2017/2018).	
2 3.30pm '3.40pm	
3 4.00pm '4.10pm	-
A 4.30pm 4.40pm ANY INQUIRIES PLEASE CONTA	CT:
5 4.45pm -4.55pm	
6 5.00pm -5.10pm 26.03-7967 3548/2630	
7 5.15pm 5.25pm	adu mu
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1 6.15nm '6.75nm	
7 6.30pm '6.40pm	
3 6.45pm *6.55pm	
4 7.00pm '7.10pm	
5 7.30pm *7.40pm	6
6 8,15pm *8,25pm	3
7 9.15pm *9.25pm	-
8 10.15pm *10.25pm	r i

Figure 47: Schedule of Route A, B, E (In Campus)

TRANSPORTATION MATTERS, STUDENT AFFAIRS & ALUMNI DIVISION, UNIVERSITI OF MALAVA

### SHUTTLE BUS OPERATION SCHEDULE (ROUTE D / OFF-CAMPUS)

## [MONDAY - FRIDAY]

100000	OPERATION TIME		NOTES
TRIP	FROM UMS	FROM IH	
1	7.30am	*7.40am	1. Bus does not operate on the following
2	8.00am	*8.10am	days:
3	8.30am	*8.40am	> Weekend (Saturday & Sunday).
4	9.00am	*9.10am	Public Holiday.
5	9.30am	*9.40am	
6	10.00am	*10.10am	2. Bus will operate 1 hour/bu
7	10.30am	*10.40am	(8.00am - 8.00pm) on the followin
8	11.30am	*11.40am	week:
9	12.30pm	*12.40pm	<ul> <li>Mid-Jem Break.</li> </ul>
10	1.30pm	*1.40pm	F Study week.
11	2.30pm	*2.40pm	<ul> <li>Semester break.</li> </ul>
12	3.30pm	*3.40pm	3 But door not apprete during Frida
13	4.30pm	*4.40pm	5. Bus does not operate during ridd
14	5.30pm	*5.40pm	until 2.45om
15	6.30pm	*6.40pm	until acceptin
16	7.30pm	*7.40pm	4. *Bus schedule depends on traff
17	8.15pm	*8.25pm	situations.
18	9.15pm	*9.25pm	
19	10.15pm	*10.25pm	5. This schedule will be effective o
IH	International House Break for Friday Prayer		ANY INQUIRIES PLEASE CONTACT:
			<b>2 03-7967 3548/2630</b>
			ি@∕] hep_pengangkutan@um.edu.my
			www.hepa.um.edu.my

Figure 48: Schedule of Route C (Off Campus)

TRANSPORTATION MATTERS, STUDENT AFFAIRS & ALUMNI DIVISION, UNIVERSITI OF MALAVA

### SHUTTLE BUS OPERATION SCHEDULE (ROUTE D / OFF-CAMPUS)

### [MONDAY - FRIDAY]

**OPERATION TIME** 

FROM IH

\*7.40am

\*8.10am

\*8.40am

\*9.10am

\*9.40am

\*10.10am

\*10.40am

\*11.40am

12.40pm

\*1.40pm

\*2.40pm

\*3.40pm

\*4.40pm

\*5.40pm

\*6.40pm

\*7.40pm

\*8.25pm

\*9.25pm

\*10.25pm

FROM UMS

7.30am

8.00am

8.30am

9.00am

9.30am

10.00am

10.30am

11.30am

12.30pm

1.30pm

2.30pm 3.30pm

4.30pm

5.30pm

6.30pm

7.30pm

8.15pm

9.15pm

10.15pm

International House Break for Friday Prayer

**UM** Central

TRIP

1

2

3

4 5

6

7

8

10

11

12

13

14

15 16

17

18 19

UMS

**REFERENCE:** 

MATER	
NOTES	

- Bus does not operate on the following days:
  - > Weekend (Saturday & Sunday).
  - > Public Holiday.
- Bus will operate 1 hour/bus (8.00am – 8.00pm) on the following week:
  - > Mid-Sem Break.
  - > Study Week.
  - > Semester Break.
- Bus does not operate during Friday Prayer. Time break starts from 12.30pm until 2.45pm.
- 4. \*Bus schedule depends on traffic situations.
- 5. This schedule will be effective on 5<sup>th</sup> March 2018 (2<sup>nd</sup> Semester Session 2017/2019).

#### ANY INQUIRIES PLEASE CONTACT:

### 2 03-7967 3548/2630

men hep\_pengangbutan@um.edu.my

twww.hepa.um.edu.my



Figure 49: Schedule of Route D (Off-Campus)

### B) External Bus (RapidKL and MRT bus)

In addition to UM shuttle bus service, there are also external bus route via UM campus, which are RapidKL bus and MRT feeder bus. For more information, please visit their website, <u>https://www.myrapid.com.my</u>.



Figure 50: RapidKL bus

Figure 51: MRT feeder bus

- C) Bicycling Facility
  - 1) Shared Lane Road Markings



In February 2018, installation of shared lane road markings (sharrow) as a guide for cycling route along part of *Lingkungan Budi* route in UM campus has been implemented as initiative to increase and encourage cycling activity among campus community.

Figure 52: Shared lane road markings

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### Shared lane road markings safety rules:

- i) Obey all traffic laws, stopping at all applicable traffic signs and lights.
- ii) Follow the shared lane road markings (sharrows) along the left lane of the road. Where there is no sign of sharrows, ride along the side of the road on the left lane.
- iii) Please be courteous to other vehicles sharing the road with you.
- iv) Use caution on descending hills. Be sure to brake lightly and hold onto your handle bars.

#### Safety advice on road Notice to Cyclists!! Notice to Motorists!! •Don't Speed or Text: Slow your •Respect the Rules: Obey traffic vehicle, follow speed limits & avoid rules for safety and to gain respect text message while your vehicle is in from motorists. Never ride against motion traffic; it is illegal and unsafe. •Every Lane is a Bike Lane: •Be Safe, Be Seen: Be predictable Bicyclists have a right to the road. Be alert and patient. Expect cyclists on and make eye contact with motorists, and use hand signals to indicate your the road at any time, especially on roads displaying the sharrow symbol. intentions. •Pass with Care: Give space when •Be Alert: Check your mirrors. Watch passing vehicles. for pedestrians and cyclists, pay attention while driving around campus. Scan for cyclists before •Wear a Helmet: if possible, use helmet, it reduces the risks of brain turning onto another road. injury and death for cyclists involved in accidents. •Pass with Care: give space when passing cyclists.

Figure 53: Safety rules on UM campus road to both cyclists and motorists



Figure 54: Students are advised to cycle on the left side of the lane



Figure 55: Students are advised to follow the cycling route indicated by sharrow markings



Figure 56: Sharrow information brochure



Figure 57: more sharrow information



### Figure 58: Sharrow safety rules for cyclist



Figure 59: Sharrow infographic as a part of an education campaign in other country

### SHARED LANE MARKING FAQ City of Akron Bicycle Plan



### What is the purpose of this marking?

This new "Shared Lane Marking" (a.k.a. "Sharrow") is intended to inform cyclists and motorists that they both are to share the travel lane. It has been shown to be helpful in creating safer conditions for both cyclists and motorists.

- It reinforces that both cyclists and motorists follow the rules of the road.
- On narrow lanes, it keeps the cyclist from driving too close to the curb (where they are not as visible) and helps the motorist from passing too close.
- 3. Where there is on-street parking, it keeps the cyclist out of the "door zone" of parked cars.
- 4. It reduces wrong way riding by cyclists.

#### If I see this marking in a lane, is the lane only for bikes? No. This marking is used for shared lanes; lanes that are

No. This marking is used for shared lanes; lanes that are used by bicyclists and motorists. Shared lanes are different than exclusive bike lanes which are set aside for bicyclists only and are marked by a solid white line with a bike and arrow symbol.

## As a cyclist, if I dont see this marking, can I still use the travel lane?

Yes. All lanes are bicycle lanes. Cyclists can ride on any street except for those with signs explicitly prohibiting cyclists, such as the expressway routes.

## As a cyclist, what should I do in the presence of sharrows?

The sharrows are placed outside of parked car's "door zone", and on narrow lanes in the center of the lane. We expect cyclists to drive through the center of the sharrow, while still paying attention to potential door openings and surrounding traffic.

## As a motorist, what should I do in the presence of sharrows?

Slow down and drive carefully. When the travel lane is too narrow or busy for safe side-by-side travel by motorists and cyclists the rules of the road require motorists to slow down and wait to pass safely, or until cyclist turns off the roadway. The amount of time saved by gunning past a cyclist is often very minimal and is never worth the possibility of injuring someone!

#### Almost all streets in Akron are shared by cyclists and motorists and dont have sharrows. Why mark only some streets?

Most Akron streets carry low volumes of traffic with relatively slow speeds and special markings aren't needed. We are placing sharrows only on streets where traffic is relatively heavy and speeds are a little higher. We are developing a complete bicycle route network over the next several years which will include shared lanes, exclusive bike lanes, and signage-only routes.

Figure 60: Sharrow information as a part of an education campaign in other country



## **4-Foot Passing Rule**

Bicyclists & Drivers: Please Share the Road! It's not just a good idea... it's the law.



Here's what you need to know about the law:

- When passing a bicyclist, drivers must allow at least four feet between their vehicle and the bicycle.
- Brivers can cross the center double yellow line if necessary to provide the required four feet as long as it is safe to do so.
- When traveling below the posted speed limit, cyclists must keep to the right side of the road unless they are making a left turn or riding on a one-way street.
- If there is only one travel lane, bicyclists may use any portion of the lane to avoid hazards on the roadway.
- No turn by a driver can interfere with a bicyclist who is proceeding straight on a roadway. Drivers attempting to turn left must yield the right of way to bicyclists traveling in the opposite direction.
- Drivers can't force a bicyclist off of the road.



Figure 61: Bicycling safety information as a part of education campaign in other country

### 2) Public Bike Sharing Program (O-BIKE)

In addition, in line with the green SEA games 2017 initiative, the O-BIKE company has placed a lot of the public bike within UM campus to encourage UM citizens to cycle. Adopting the concept of stationless public bike, the public bikes grouping locations can be seen everywhere.



Figure 62: Provision of stationless public bike sharing around the campus



Figure 63: O-Bike instructions

3) Uniride Electric Vehicles Project

### Electric Scooter (E-SCOOTER@UM)

UNIRIDE Pilot Project is one of the initiatives for UM green transport under UM Student Affairs & Alumni Division. To all UM community who are interested to use this facility, you may get more information at their counter located at Foyer Auditorium, Perdanasiswa Complex.



Figure 64: Poster UNIRIDE E-Scooter


Figure 65: Steps to use UNIRIDE E-Scooter



Figure 66: Service counter UNIRIDE E-Scooter





Figure 67: UNIRIDE E-Scooter facilities

Figure 68: Bicycle safety tips

> Electric Bike (UNIRIDE E-BIKE)



Figure 69: Electric bike available at UM campus

UNIRIDE e-Bike is the 1<sup>St</sup> electric bicycle (E-Bike) sharing platform in Malaysia, allowing students and university staff to take a short trip within university campus. The first step to getting on your E-bike is to download the UNIRIDE app that is available in Apple and Google playstore. For more details explanation, please visit <u>https://uniride.com.my/</u>.

- D) Car
  - 1) Car Sharing Program (UNiRIDE)



Figure 70: Car sharing program

UNIRIDE is on-campus car sharing program where user needs to register as a member. A member is eligible to rent a UNIRIDE car by placing a booking online via website and mobile apps. Cars are parked at various UNIRIDE stations inside campus and it can be rented for hourly or daily basis with an option of one-way trip or round-trip booking. For more details explanation, please visit <u>https://uniride.com.my/</u> Then, fill up the online application at <u>www.uniride.com.my</u>. You can also fill up the form via UNIRIDE mobile apps which is available on Google Play or App Store. 2) GrabVarsity



Figure 71: GrabVarsity launch

E-hailing service provider Grab Malaysia has launched a new programme that caters specifically to students from higher education institutions. Grab launched their latest platform known as GrabVarsity in collaboration with a few Malaysian universities at University Malaya. Under this platform, students can also participate in a short-term student-only Grab driver programme, which includes short-term car rentals that allows students to earn a supplementary income. GrabVarsity information can be accessed by the student community via the portal <u>GrabVarsity.com</u>.

#### 3) Pedestrian Accessibility

Walking is the most easier and healthier form of transport. In UM campus, many facilities available for pedestrian and for people with disability. Informative pole is one of the initiatives by Living Lab project to encourage walkability culture in campus, reduce vehicles' carbon footprint and to induce healthy living lifestyle.



Figure 72: Informative sign poles for pedestrian reference



Figure 73: Pedestrian walkways



Figure 74: Walkways for person with disability



Figure 75: Inter-connected walkways around the campus



Figure 76: Traffic light stops for pedestrian



Figure 77: Yellow stripe crossing lines Figure 78: More walkways around campus

#### 3) LIVING LAB LL024-16SUS

#### 3.1 LL024-16SUS Project Brief

The aim of Living Lab Project LL024-16SUS is to develop an innovative and integrated sustainable transport system to solve the traffic problem within the campus. The possibility to implement various policies in UM campus, such as "Sharrow/Shared-Lane", "Park and Ride", "Park and Cycle/Walk", "Car Free Zone/Hour" have been planned. The objectives of this living lab are; 1) To develop an innovative sustainable transportation system to reduce the motorized vehicle number within the campus, 2) To propose a new transportation policy to solve the lack of parking space problem in campus and 3) To create awareness and promote community to choose shuttle bus and non-motorized transport mode as their main travel mode in campus and reduce transportation carbon footprint.

From the first stage of the research, the bus demand trends throughout a typical weekday managed to be identified and suggested to the bus operator and UM management to provide a **"Demand Based Shuttle Bus Service" schedule**. Besides, a **"Bus Tracking Apps"** and **UM Bus Tracking Apps Handbook for UM Bus Drivers** has been developed and promoted to the university management to make sure the use of this apps is beneficial to both students and university.



Figure 79: UM shuttle bus tracking apps



Figure 80: UM Bus Tracking Apps Handbook for UM Bus Drivers

Awareness programs were conducted to educate and promote green transport usage in UM campus by organizing roadshows on **Promoting Green Transport in UM Campus and Introduction to Shared Lane Road Markings**. Simplified survey, brochures and detailed questionnaires on cycling awareness in UM campus has been developed and distributed to promote and inform UM community. The events were conducted between November until December 2017.

A series of **bicycle clinics** also conducted to introduce students on cycling skills and maintenance. 3 slots of bicycle clinics were organized at selected residential colleges between November until December 2017.



Figure 81: Examples of necessities used in the promotional activity and research study such as buntings, poster, brochures, and surveys



Figure 82: Photos of campus community engagement activities and networking



Figure 83: Communication via roadshows conducted around the campus to increase the level of awareness, informing and promote cycling culture

Through the living lab project initiatives, the university is working gradually to improve the infrastructure, programs, and services available for cyclists on campus. To encourage cycling, **shared lane markings**, or sharrows have been painted on the road around February 2018. **Bicycles 'IN LANE' signage pole** also has been installed together to inform and alert vehicle users and cyclists about the shared lane and bicycle routes.



Figure 84: Installation of shared lane road markings (sharrow) in early 2018 along Lingkungan Budi route



Figure 85: Shared lane road markings (sharrow) reminder

In April 2018, **UM Living Lab Training Module: UMBIKE Tour** has been developed in order to encourage more cycling activities around the campus. **Online-survey** has been conducted currently on cycling awareness and perception on shared lane road markings among UM campus community in May 2018.



Figure 86: UMBike tour

#### 3.2 UM Green Transportation System: The Way Forward

Based on the report: A Global High Shift Cycling Scenario by the Institute for Transportation & Development Policy and the University of California, the shift toward cycling initiatives can be adopted by UM campus in attempt to move forward in sustainable green transport initiatives.



Figure 87: Shift toward cycling by ITDP and UC

#### 4) **REFERENCES**

https://www.um.edu.my/

http://www.hepa.um.edu.my/facilities/transportation

https://uniride.com.my/

https://www.worldofbuzz.com/msian-uni-students-with-no-cars-can-now-rent-and- earn-money-withgrabvarsity/

http://www.thesundaily.my/news/2018/03/13/grab-malaysia-launches-grabvarsity

https://www.myrapid.com.my/

Living Lab Project information

http://www.bikeroar.com/tips/how-to-choose-a-safe-cycling-route

https://www.uakron.edu/dotAsset/1370431.pdf

https://www.pinterest.com/pin/305541155947962479/

https://stevegalloway.mycouncillor.org.uk/2014/06/08/road-safety-event-in-york-on-the-9th-june/

https://motoring-malaysia.blogspot.my/2018/03/grab-malaysia-launches- grabvarsity.html

https://www.itdp.org/the-benefits-of-shifting-to-cycling/



# 06 GREEN PROCUREMENT



## **Green Procurement Guideline**

- 1. Dr. Suhana Mohezar Ali
- 2. Professor Dr. Ainin Sulaiman
- 3. Dr. Safiah Omar
- 4. Dr. Farzana Parveen Tajudeen
- 5. Siti Najihah Solehin

#### GREEN PROCUREMENT GUIDELINE

#### 1) Introduction to Green Government Procurement (GGP)

#### 1.1 Definition

The term, Government Green Procurement (GGP), is defined as the process used by public sectors in acquiring the goods, services and works offered which also incorporate environmental criteria that aims to reduce environmental impacts. The GGP is considered an important instrument for sustainable consumption and production.

#### Concepts of the GGP

- It looks at how needs can be satisfied without new purchases.
- It awards contracts to suppliers who can demonstrate good environmental management practices.
- It buys goods that are produced with fewer resources, that do not use or release toxic substances and are energy efficient and easily disassembled for reuse and recycling purposes.
- It considers how goods *purchased are used, maintained and disposed.*



## 1.2 Integration of GGP into Procurement

The integration of the GGP into the procurement process can be implemented with clear green requirements stipulated in the tender documents and contracts. The rules that are associated with the exclusion and selection are aimed at ensuring that suppliers adhere to a minimum compliance with environmental laws.

Technical specifications of the products and production processes, environmental labels, lifecycle costing techniques and environmental award criteria could be utilised to facilitate the contracting authorities in identifying

environmentally preferable bids. The green procurement criteria had been developed for many products and service groups. These criteria can be included directly into the tender without the need for lengthy research into environmental performance characteristics and market analyses.

#### Key Criteria for Environmentally Friendly or Green Products

- Bio-based, biodegradable, compostable, renewable, recyclable, reduced packaging and made of recycled contents.
- Carcinogen-free, chlorofluorocarbon (CFC) free, lead free, mercury free, persistent bio-accumulative and toxic (PBT) free, less hazardous and has low volatile organic compound (VOC) contents.
- Durable, energy efficient, reduced greenhouse gas emissions, resource efficient, upgradeable, water efficient and can be refurbished.

#### 1.3 Benefits of the Government Green Procurement (GGP)

The GPP offers various potential benefits. Since the government is one of the largest purchasers of goods and services, the implementation of the GGP could deliver substantial benefits such as reducing environmental burdens significantly. The GGP is seen as a tool that can be used to achieve environmental goals related to climate change, resource use and sustainable consumption and production. The purchase of goods that are energy efficient, are produced without using or releasing toxic substances and can be easily disassembled for reuse and recycling will result in reduced CO2 emissions and waste.

#### Potentials of GGP

- ✓ Support innovation and domestic economy
- ✓ Increase local companies' competitive advantage
- ✓ Create new demands
- ✓ Increase sustainability efforts
- ✓ Offer a healthy working environment
- ✓ Increase government's reputation

While it is commonly believed that the GPP will result in higher costs, its implementation and practice may also provide financial savings if the authorities take into consideration the full life-cycle costs of a contract, and not just the purchasing price. For instance, although the energy-efficient or water-saving appliances may seem costly, it could help to reduce utility bills significantly in the long run. Therefore, while green products are sometimes considered costly, it should be taken into account that the cheapest upfront price does not necessarily mean the lowest cost in the long term. This is so when other factors such as maintenance and replacement costs are also considered. Some green products such as biodegradable cleaners **may also improve the users or workers' health and safety when used**.

The GPP efforts can also be a major driver for innovation. For instance, besides bringing existing green products to today's market, it can create 'lead' markets in cases where the government's demand is significant, such as in transportation and construction. This effort to

apply the GGP can also create more jobs in companies that use and develop green technology. In other words, the GGP is one of the keys in transforming the world into a green economy.

#### Benefits of the GGP accrued by other countries

- Netherlands Three million tonnes of CO2 and 10 percent reduction in energy consumption.
- Taiwan decreased electricity and tap water consumption as well as CO2 emission.
- Austria City of Vienna achieved an annual savings of EUR 17 million



#### 1.4 International Movement on the GGP

Recognising the importance and potential benefits of green procurement, many countries around the world have been actively integrating green public procurement.

#### Some of the Movement in EU Member States

In 2012, Ireland adopted its GGP action plan entitled Green Tenders which set targets for 50 percent of all procurement in 8 product and service groups to be green. The GGP is established as one of the keys to transform Denmark into a green economy. The Flemish government in Belgium has set a target of 100 percent of its public purchasing to meet sustainable procurement criteria by the year 2020.

#### The European Union

The European Union, for instance, had set a target of 50 percent of public tendering to be green in 2010. The GGP has been highlighted in a number of EU policies and strategies. This **reflects the GGP's potential in reducing climate change**, resource use and sustainable consumption and production. At the national level, majority of the EU Member States have published guidelines which support the GGP. The guidelines emphasise on energy efficient office IT equipment, vehicles and buildings.

#### Canada

In Canada, the Municipal Collaboration for Sustainable Procurement, comprising of 18 cities was established in 2010. The municipal self-assesses its progress in ten GGP best practice areas namely, strategy and action plan, green purchasing policy, supplier code of conduct, sustainability commitments, dedicating staffing and resources, procurement tools and procedures, training and communication, supplier engagement, measurement and reporting, and leadership and collaboration.

Notwithstanding this, Vancouver is bound by the energy efficiency purchasing policy which emphasises on buying Energy Star rating appliances and a procurement policy that is based on sustainable and ethical criteria. Other GGP initiatives include the establishment of Sustainable Procurement guidelines and Social Enterprise Purchasing Toolkits which are developed to promote green economy.

#### USA

In the USA, Green procurement policies, supporting recycled products and environmentally friendly or sustainable purchases have been established to facilitate the GGP implementation. The city of San Francisco is bound by a policy that highlights the use of safer alternatives to toxic chemicals in all its municipal contract awards.

#### New Zealand

In New Zealand, the Auckland Council has established a Low Carbon Action Plan which emphasises on waste minimisation and waste-to energy reduced emissions.

#### Malaysia

In line with the international movement, Malaysia has also incorporated environmental **consciousness as one of the nation's agenda.** Malaysia's aggressive socioeconomic development, over the years, had substantially resulted in polluted rivers and poor quality air (Department of Environment, 2009). While the nation contributes to only 0.7 percent of carbon dioxide emission globally, the intensity levels are reported to be higher when compared to the global average within the energy sector. Due to this environmental degradation issue, the government is committed towards promoting green initiatives in the procurement process within government agencies. The integration of the GGP is expected to facilitate the country in achieving its target of reducing the greenhouse gas emission level by 45 percent, as compared to its GDP, by the year 2030. Under the Eleventh Malaysian Plan, the government

is targeting 20 percent of all goods, services and works acquired to be green by 2020. The commitment of the Malaysian government in promoting the uptake of green procurement is also reflected in the development and launch of the Sustainable Consumption and Production Plan Blueprint.

#### Amongst the Government's initiatives towards the GGP are:

- ✓ The Malaysian Green Technology Policy
- ✓ The Construction Industry Transformation Programme
- ✓ The National Renewable Energy Policy and Action Plan
- ✓ A New Economic Model



The GGP has been recognised and endorsed by the government in several public sectors. This **reflects the GGP's potential as a catalyst in encouraging a** more sustainable use of natural resources, sustainable consumption and production as well as innovation. The Short Term Action Plan which covers the period of 2013-2014 was developed and endorsed in July 2013 by the Jawatankuasa Pemandu which was jointly chaired by the Ministry of Finance and the Ministry of Energy, Green Technology and Water. Under this Action Plan, five Ministries were selected to be pioneers for this initiative.

In 2016, the GGP implementation was further expanded to include twelve additional Ministries and selected government agencies. The implementation which involved 12 types of product groups was based on the Long Term Action Plan (2016-2025).



Figure 88: Pathways of the Sustainable Consumption and Production blueprint

Recognising the importance of the GGP, the government, on 16 January 2017, further extended the initiative to include all the Ministries and government agencies through the issuance of a treasury circular that imposes green procurement. The move highlights the GGP as one of the necessary measures that can be taken to ensure a more effective and efficient use of resources. The issuance of the treasury circular further indicates that a number of rules and principles incorporating environmental elements must be observed in the award of public contracts.

In line with the government's aspiration to achieve 20 percent of green procurement, all the Ministries and government agencies have set their individual targets for the GPP in terms of the overall procurement or for individual products and service groups. In many cases, these agencies have developed their own GGP criteria sets which are similar to the national GGP criteria, with adjustments made, to reflect the particular circumstances or priorities of the authorities developing them. Most of these criteria sets rely on life-cycle assessment data where available, together with eco-labels and the evidence upon which these are based.



In order to assist the contracting authorities in identifying and acquiring greener products, services and works, a list of environmental criteria was developed for five products namely, energy efficient (EE) lighting, cement, paint/coating, ICT, cleaning services and papers. These were inserted directly into the tender documents. In 2015, the listing was expanded to include building facilities-energy management service, green data centre, multipurpose printing device, air conditioning, apparels and furniture.



The Ministry of Energy, Green Technology and Water has also collaborated with SIRIM in developing a green procurement manual, procedures and standard certifications and labelling mechanisms to ease the management of the green purchasing process between the government and the private sector. In 2012, the government launched MyHIJAU, an official

green labelling logo and certification which was aimed at making it easier for consumers to identify green products.

In line with the GGP, the University of Malaya (UM) was selected to undertake the Low Carbon City Framework (LCCF) in 2012. As part of the initiative, the Sustainability Science Research Cluster adopted the approach of introducing green procurement to the staff members at the different faculties and departments across the university.

At the university level, the national policy environment plays a role in shaping decisions about green procurement. Similarly, over the period of 2015, the total national expenditures on tertiary public institutions also increased, pressuring the university to do more with less. The sweeping changes have led the University of Malaya (UM) to take an interest in maximising the resources through green initiatives. Moreover, starting with the 2015/2016 session, the university also begun working towards achieving a higher ranking in the Universitas **Indonesia's** (UI) Green Metric World University (UI Green Metric), the only source of appraisal that recognises and appreciates an international university for its role in sustainable and eco-campus practices. UM's participation in the UI Green Metric requires the university to report contracts awarded based on their social and environmental credentials. UM has joined the UI GreenMetric since 2011 and was ranked 34 in 2017.

In view of this, green procurement could be used as an effective policy instrument and a waste minimisation strategy to encoruage a more sustainable use and disposal of products. Hence, all the faculties and centres in UM should be geared towards implementing the GGP in their effort to advance sustainability leadership and to support the national agenda. It is believed that the implementation of the GGP would result in lower costs that are derived from efficient waste and hazardous material handling, reduced demand for landfill spaces and increased savings acquired through the purchase of only necessary goods which can also be reused. In this regard, it is important that the university, as part of the government entity, introduce the GGP and implement its practices.



To launch the initial setup, various green procurement seminars were conducted regularly under one of the Living Lab Programmes. These workshops targeted the procurement authorities, vendors and researchers, mainly with the aim of disseminating information and providing trainings on green procurement. Additionally, various promotional activities, campaigns and exhibitions were also held to increase the awareness and understanding of the green procurement concepts.

This is important since the implementation of the GGP requires the involvement and cooperation of different departments and staff members across the university. Personals from the Bursary, officers handling procurement matters, as well as certain specialists such as those from the Centre for Information Technology (PTM) are consulted. In line with the **government's aspirations to achiev**e 20 percent GGP in 2018, UM is targeting that at least five percent of its procurement should include the GGP criteria. The university has identified four product and service groups to go green at the initial phase.







Products and Service Groups to go Green in UM



#### 2) Basic Principles of Government Green Procurement (GGP)

#### 2.1 Introduction

Implementing the Government Green Procurement (GGP) will bring forth benefits. However, for the GGP to have a smooth transition, it is necessary for the university to have an overview on how green requirements may affect its procurement process for products, services and works chosen. The outcome can serve as an insight for the university to consider and to select the best way of implementing the GGP that is also in line with legal obligations.

In the public sector, government procurement is about matching supplies and demands. Its responsibility is also to ensure that the products, services and works chosen are duly delivered. In line with implementing the GGP procurement requirement, it is apt to state that the GGP process is not significantly different from the traditional procurement process. In the latter, the main concern is cost effectiveness or value for money while the GGP requirement also considers both the technical quality and price of the products, services and works desired. Its only inclusion in the procurement procedure is the environmental aspects of these products, services and works required so that the usage contributes to environmental benefits. Therefore, the most economically advantageous tender received by the university does not necessarily mean that it would be selected. In contrast, the university has to look for an offer that not only meets the technical and financial requirements but also the environmental criteria in the most cost-effective way. Best value measures not only consider the upfront prices of the products, services or works but also other important factors such as quality, efficiency, effectiveness and fitness for purpose. In the GGP, environmental considerations are included and taken as an equal consideration amongst others, for the awarding of contracts. Nevertheless, the university may not need to purchase new products or services in some cases as it can reuse current existing resources.

All products and facilities affect the environment during their lifecycles, from the extraction process of raw materials to production, utilisation and disposal. Therefore, devising an appropriate contract that also contains environmental needs can help to alleviate the negative environmental effects significantly. Today, various eco-friendly alternatives are available at competitive lifecycle costs (e.g. energy saving ICT equipment, recycled cartridges and others).



Figure 89: illustrates a set of pertinent questions that could be directed to consumers

#### 2.2 Government Green Procurement (GGP) Processes

Reuse Existing Equipment or Share Resources Prior to the procurement process, it is crucial for the staff of the university to assess their actual needs. In some cases, the best solution may be to buy nothing at all. Similar equipment or resources needed by the staff may already be available in the university but not used regularly. In this regard, the same resources or equipment can be simultaneously shared by the staff themselves. For products with seasonal or erratic usage or are intended to be used with peak demands, it may be more cost effective for the university to consider renting them for a short period of time rather than purchasing them. The university may not even need to buy new equipment or built new buildings in cases where existing ones can be reused through repair or refurbishment. By engaging in this practice, the university not only benefits financially, it could also contribute to a reduction in solid waste, energy conservation and natural resources protection. This, in turn, facilitates the alleviation of climate change.

#### 2.2.1 Assessing Actual Needs

#### Scope of Needs

The scope of needs need to be understood thus it is vital to gain the consensus of the parties involved during the needs assessment stage. Doing so can facilitate procurers in making environmentally-conscious decisions at the latter stages of the procurement process. For instance, it will only make sense to implement the requirement of an environmentally sound cleaning device or an environmentally friendly ICT device in contracts when the users of the product or service know what to expect and also understand the reason for the change. Since needs assessment is often carried out prior to the procurement process, it is possible that the staff conducting the assessment may not have all the necessary information that can help him/her to assess the environmental impact of the contract. In this regard, it is worthwhile to conduct a market consultation which can provide some knowledge about the market (e.g.

availability, cost and possible practical implications of greener alternatives). It can also assist the university in identifying potential solutions to minimise the environmental impact of the product or service procured.

A preliminary market consultation with suppliers would allow the university to obtain advice which may be used in the preparation of the procurement procedure. Allowing the market, specifically the preferred university's suppliers know about the environmental criteria that will be included in tenders earlier in advance would give the suppliers ample time to prepare and fulfil these requirements. Hereby, it is recommended that such process to be transparent so that the outcome of this requirement does not confer an unfair advantage on any supplier who participated



#### 2.2.2 Translating the Needs into the Requirement of Contract

The subject matter of a contract is about the type of products, services or works that need to be procured. This process will result in a description of the product, service or work, which would take in a form of functional or performance based definition. In principle, the university is free to define the subject of the contract in ways that meet the needs. Nonetheless, in some cases such as GGP implementation, the choice of a particular product or service may distort the level playing-field in the university's procurement. In practice, this means that technical specifications in GGP should not create unjustified obstacles to competition.

#### Choosing a Green Title

Green titles are increasingly being used in tenders to send a signal and conveys the message that the environmental performance of the product or service will be an important criteria or part of the contract. Using the environmental titles in a contract not only send out a message to the potential suppliers, yet also to the local community and other contracting authorities.

#### Reference to Framework Conditions

In describing the object of the contract, the university has the opportunity to use references to the politico-strategic framework, as a means to illustrate the importance of environmental criteria in the procurement procedure. This is helped by details aims such as the implementation of climate protection objectives at the national level. This would also help in explaining to the potential bidders why the tender description has been extended to contain environmental aspects in comparison with normal procurement procedures.

#### Examples of green titles used in contracts

- Provision of energy-efficient public lighting in Co. Kerry (Kerry County Council, Ireland)
- Internal finishing works, using environmentally friendly construction materials and products (University of Malta)
- Service contract for energy savings in 12 schools (Catalan Ministry of Education, Spain)

#### Developing Environmental Specifications

Once the appropriate titles for contract has been chosen, the specification of the requirements based on the technical specifications can be formulated or developed. As a general rule, the criteria that the university should set are the minimum requirements which should match the market availability of products, services and works; or otherwise the worst case scenario is that no suitable bids will be received. In cases where the market for eco-friendly products and services is not sufficient and has to be subsequently investigated, or if there is only limited availability for certain requirements, it would be appropriate to include this aspect in the award criteria, and not in the tender specifications. In contrast with the selection and exclusion criteria, the technical specifications must refer to the performance characteristics, which is the object of the contract, and not the general competences or qualities of bidders.



In the technical specifications, the contracting authority defines its requirements within a technical description and/or requirement for functionality and performance. These criteria must be described clearly so that the bidders are able to compile an offer. In the technical specifications, the university also needs to define which other services may be required as part of the procurement procedure. Only offers that match the requirements and tender specifications will be evaluated according to the awarding criteria specified.

When describing the product, service or work for tender, the university has to apply two essentially different concepts. The first is technical performance specifications. This refers to the performance and the technical solution to be offered. They must be specified in details. The second is functional performance specifications. This happens when the university only defines the objectives in the tender. The purpose is to give bidders the flexibility of setting

their own technical specifications in order to achieve the stipulated objectives. A functional performance-based specification describes the desired result or output that is expected. It does not prescribe the input or work method for the tenderers. Thus, they are free to propose the most appropriate solution. This approach offers more scope for innovation; it also challenges the market to develop new and innovative technical solutions. As an example, instead of specifying the detailed specifications of an air conditioning system for a building, the university can clearly state that the building must have a constant indoor temperature of 20-25 degrees. The university can then leave it open to the tenderers to opt for an innovative system. However, in setting the performance based specification, careful considerations must be given to ensure that the assessments are fair and transparent.

In general, when the university sets up the technical specifications in contracts, the university also needs to stipulate the requirements based on the potential environmental impact of each product, service or work it wishes to procure. An illustration is provided below.



These considerations are but general criteria only. They are further explained below. In the case of specific products or services, specific technical specifications may apply. (Please refer to chapter 3.)

#### Specifying Materials and the Production Methods

When definining the technical specifications, the materials and methods of provision need to be taken into account since the origin of products and the production processes involved can form a substantial part of their environmental impacts.

As a contracting authority, the university has the right to insist that the products purchased be made from a certain material or contain a specific percentage of recycled or reused contents. In addition, the university can also set requirements in relation to the restriction of hazardous substances in the product. As a start, the university may refer to legislations which restrict hazardous substances from being used. Labels can be a useful reference point as they are based on scientific information in addition to the lifecycle assessment of the materials and substances found in the products and services.

Of particular importance is how the university can ensure that the requirements regarding the production processes are appropriate for achieving the environmental objectives. A careful analysis of the lifecycle assessment of the product and service will facilitate the university in arriving at an appropriate level of specification for production processes and methods. The lifecycle assessment offers cradle-to-cradle analysis of the environmental impact of the product. It incorporates the costs and the environmental impact of the extraction and refinement of raw materials, manufacturing and other stages of production until the use, disposal and reverse phase.



#### Using Labels in GGP

As outlined in Chapter 1, labels and the GGP criteria set by the government are useful information sources when developing tender requirements at the university level. These can be inserted directly into the tender documents and they can also be utilised during the verification processes. Using labels save time for the contracting authorities as it not only ensures that high GGP environmental standards are being applied but are also being easily verified.



If the contracting authority is satisfied with the above conditions, the labels can be incorporated as part of the technical specifications in the contract. Nonetheless, the university must still accept other labels which have equivalent requirements. In a case where the tenderer is not able to obtain a label within the relevant time limit for reasons which are not attributable to the tenderer, the university needs to consider alternative evidence submitted such as a technical dossier which demonstrates that the label requirements are met. It may be considered a good practice to always refer to the criteria underlying a label as a manner of ensuring that the labels are all relevant. The labels that are being referred to must be suitable for defining the characteristics of the particular supply or service. The criteria for the ecolabel must have been established scientifically and noted in a procedure that is open to interested parties (e.g. government bodies, consumers, manufacturers, dealers and environmental organisations).

As indicated on page 23-25 of this chapter, the ecolabels can be categorised into three different types:

- Type I ecolabels are based on the oriteria established by independent organisations. This ensures a high level of effectiveness and reliability in relation to the attainable possibilities of reducing the environmental impact.
- Type 2 ecolabels are based solely on information provided by the manufacturer. Independent organisations are not involved in awarding the label.
- Type 3 ecolables are based on the manufacturers' details as are type 2. They are also designated based on environmental performance analyses i.e. CO2 emission. They enable ecological comparisons to be made between products with the same function.

#### MyHIJAU Mark

Currently, there are multitudes of eco-related labels existing in the market. This situation has raised confusion among businesses and consumers. Recognising this, the Malaysian Government has endorsed MyHIJAU mark as an offical label to help businesses and consumers identify the green products and services. MyHIJAU was launced with a mission to bring together all the products and services that are already certified by various green label schemes that meet local and international environmental standards under one single mark.



Types of Green Label Certifications Accepted Under MyHIJAU



#### Using Standards in the GGP

Standards represent a solid basis for the tender criteria as they are clear and nondiscriminatory. They help to define the subject matter in a clear way. When reference to a **standard is used, it must be accompanied by the word 'or equivalent'. This means that** evidence of compliance with an equivalent standard must be accepted. The evidence could be a form of test report or certificate from a conformity assessment body.



#### Use of Variants in Contracts

Variants refer to the flexibility incorporated into the technical specifications. Incorporating variants into the contract means that the university allows tenderers to submit an alternative solution that meets certain minimum requirement identified. Both variant and non-variant tenders are then evaluated against the same set of award criteria so as to identify the most economically advantageous tender. This approach is useful if the contracting authorities are unsure of the cost or other impact of an alternative product or service.

To be able to accept variants in the GGP procedure, the contracting authorities need to:



### Verifying Compliance with Technical Specifications

When developing technical specifications, the contracting authorities in the university has to **pay attention to the way it will verify tenderers'** claims. Hence, the contracting authorities of the university should determine in advance, the types of documents that should be submitted together as evidence of the compliance. This is commonly done by providing an indicative list and stating that other equivalent forms of evidence are also acceptable. While the verifying process of the environmental specifications is a complex one, there are other means of verification that do not require the input of technical experts. Labels and standards can be accepted and used as verifications. However, accepted verifications can also include technical dossiers or independent test reports. It should be **noted**, **however**, **that a manufacturer's** declaration is not a suitable verification of compliance since less time and costs are incurred than is the case of bidders who provide verifications through certification documents. Accepting the former can result in the practice of inequality in the treatment of bidders and this should be avoided at all costs so as to promote equal treatment.



#### 2.2.3 Selecting Tenderers and Awarding Contracts



The selection criteria focus on the tenderers' ability to fulfil the contract they are tendering for. In assessing the ability of a tenderer, it is important for the contracting authorities in the university to take into account, specific experience and competence related to environmental aspects which are relevant to the subject matter of the contract. The contracting

authorities may also ask for evidence as proof of the abilities and capacities claimed by the tenderers. It is also advisable for the contracting authorities to exclude companies that have breached environmental laws or have performed badly in terms of environmental performance. The selection criteria help the contracting authorities to assess the suitability of the tenderers in carrying out a contract. It can also be used to shortlist or to reduce the number of candidates who were invited to submit the tender. The most relevant selection criteria should emphasise on the technical and professional ability of the tenderer.



#### Environmental Technical Capacity

Delivering the GGP requirements can be complex. In order to ensure that tenderers have the ability to deliver the required environmental needs and specifications, it is important for the contracting authorities to **evaluate the tenderers' previous exp**eriences as well as their human and technical resources. This includes their technical com petence in minimising waste creation, avoiding spillage/leakage that leads to pollution, Does the company have previous experience with sustainability contracts? Does the company hire or have access to personnel

Does the company hire or have access to personnel with the relevant educational/professional qualification/ experience to deal with the environmental issues?

Does the company own or have access to the required technical equipment or facilities to deal with the environmental issues?

Does the company have the means to ensure the quality of the environmental aspects in the contract?

reducing fuel consumption as well as minimising the disruption of natural habitats.

The need to evaluate these based on the educational and professional qualifications of the **tenderers' staff** is important as it can be a way to ensure that the tenderers are capable of dealing with the environmental issues. **The tenderers' environmental and technical capacity** can be traced through their previous records of orders. Therefore, it is pertinent for the contracting authorities in the university to clearly state the types of information that are considered relevant and the verification documents that need to be submitted by the tenderers. As an additional effort for the tenderers to prove their competence and fortify their capacity, a description of the relevant experts and their technical expertise can also be provided for evaluation by the university.

#### Environmental Management Systems

Environmental Management Systems (EMS) are referred to as organisation-related tools, aimed at enhancing the overall environmental performance of the committed organisation. It facilitates the committed organisation in achieving its environmental goals through consistent review, evaluation and improvement of environmental performance. It enables the organisation to have a clear picture of the environmental impact in relation to its products and process. It also helps the organisation to target those goals that are significant and to manage them well. Relevant areas include the use of natural resources such as water and energy consumption; training of employees and the use of eco-friendly production methods and procurement.

An organisation that is committed to the EMS may request for certification under the Ecomanagement and audit scheme (EMAS) or the European/international standard on environmental management systems (EN/ISO 14001). Globally, there are around 250,000 ISO14001 certified organisations and over 4,000 organisations registered under EMAS. Therefore, the EMS can be used as a verification of the tenderers' technical capability. The use of the EMS however, is not limited to providing proof of technical capacity in performing environmental management measures. If the contracting authorities of the university set other environmental selection criteria such as technical equipment or training, the EMS could serve as a means of proof if it also contains relevant information with regards to the specific requirements.

#### Supply Chain Management Measures

Many environmental impacts arise not only in the delivery of the final product or service. These impacts may also arise further back along the supply chain covering various phases that range from the extraction of raw materials to production, final assembly and delivery stage. For instance, the ICT equipment may have various components (e.g. metals) sourced from across the world. A high risk environmental damage could also occur during the equipment components' extraction and processing stage. Moreover, a construction company may also work with other smaller subcontractors, each of whom will need to implement sustainable practices. For such types of contracts, there is a need for the contracting authorities to look beyond the primary or first-tier supplier. This is to ensure that the environmental requirements can be met. Therefore, the contracting authorities may request for the following information:

- $\checkmark$  An indication of the proportion of the contract which the tenderer intends to subcontract,
- ✓ An indication of the supply chain management and tracking system that the tenderer will be able to apply when performing the contract, and
- ✓ An indication of the transparency of the supply chain management.

#### Supply Chain Management Measures

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A further consideration when evaluating the technical capacity of bidders/operators is that they must be permitted to be dependent on the capacity of other entities. This implies that if two or more organisations wish to jointly apply for a contract, their capabilities must be considered as a combined capacity even though they have not formed a formal consortium or legal link. For example, a facility management company may decide to bring in an environmental advisor to address green requirements so as to be able to manage the building in a more sustainable manner. In this regard, the technical capacity and experience of both organisations should be evaluated at the selection stage. This however, depends on the ability of the bidders/operators to demonstrate their ability by combining their resources for the execution of the contract.

### Product Samples, Checks and Conformity Assessment

Some contracts may encompass the supply of products or materials. In this regard, a sample may be requested during the selection stage accompanied by certificates of conformity or quality. This approach is useful for the purpose of verifying that the respective products meet the environmental requirements specified in the contract (e.g. durability or energy **consumption).** Another alternative is to check on the suppliers' production capacity as well as their research facilities. The verification can either be conducted by the contracting authority or by a **competent body within the suppliers' list of conformity body**.

### 2.2.4 Awarding of Contracts

During the awarding of contract stage, the contracting authority evaluates the quality of the tenders and then compares costs. At this stage, contracts are assessed based on the awarding criteria. The main difference between technical specifications and the awarding criteria is that the former is assessed based on a pass/fail basis while the awarding criteria are weighted through marks; tenders offering a better environmental performance can be given more marks. At the initial stage, it is recommended that the university sets a minimum requirement in the technical specifications and then allocates extra marks for better environmental performance at the awarding stage. This approach is useful when the contracting authorities are not sure of the costs or the market availability of products which meet certain environmental objectives. This practice could also offer some degree of flexibility in implementing the GGP.

### Formulating and Advertising the Award Criteria

The awarding criteria must be formulated in such a way that it could be verified by the contracting authority, the university. If the awarding criteria is associated with factors which cannot be verified by the contracting authority, then it becomes difficult for the tenderers to show that the stipulated criteria have been fulfilled objectively. Therefore, there is a need for the university to consider in advance, the types or means of proof which the tenderers need to provide under each criterion and how this will be evaluated by the university.

As far as possible, the environmental awarding criteria formulated should not artificially close the market. The awarding criteria is supposed to encourage the market to develop and deliver environmentally preferable solutions. A good practice, in this case, may be to discuss the environmental awarding criteria with potential bidders during the market consultation stage.

The awarding criteria and their weightings should be specified in advance in the contract notice or in the procurement documents. Here, the university must indicate that:

The criteria being applied are meant to identify economically advantageous tender, and	the most
$\checkmark$ Relative weightings are applied to the criteria.	

### Weighting Approaches

There is no maximum limit assigned to the weightings listed under the environmental criteria. In this regard, the university needs to take into account:



When setting the awarding criteria, the university may use labels, environmental management systems, test reports or lifecycle costings.

### Using Labels

Besides technical specifications, labels can also be used in the awarding criteria. It is possible to stipulate a combination of labels used in the specifications and the awarding criteria for the same aspect (e.g. energy efficiency) in the evaluation phase. Minimum requirements (e.g. compliance with the requirements of a label) help to ensure that certain environmental aspects that are considered to be important are met satisfactorily. The awarding criteria, in addition, can stipulate that installations or products that exceed the minimum requirement can be given appropriate bonus marks.



### Using the Environmental Management Systems (EMS)

The Environmental Management Systems may also serve as an evidence during the evaluation of the awarding criteria. An offer to carry out certain measures in accordance with the EMS may be relevant.

### Using Test Reports and Certificates

In some cases, the contracting authority may wish to seek test reports or certificates from a third party assessment body which can demonstrate the level of environmental performance offered by the products. For example, in a lighting contract, the university may want to award more marks to a company that can offer lighting solutions that take a longer time to be replaced than another. In this scenario, the university may need to ask the tenderers to provide a test report or a certificate to support this criterion.

#### Example : Evaluation Based on EM

The European Environmental Agency allocated 10 percent of marks to the tenderer who would be carrying out the contract based on the environmental policies, at the awarding stage. Higher marks are awarded to those companies that possess third-party certified environmental management schemes as compared to those without it.

### Using Lifecycle Cost

At the awarding stage of the procurement, the cost of the tender becomes one of the most influential factor for the tender to be considered. Costing will form part of the assessment and may be calculated on the basis of the lifecycle costs.

The lifecycle cost concept comprises not only acquisition costs but all costs incurred during the lifetime of the product or service. It may also include the cost of externalities namely, greenhouse gas emission. By applying lifecycle costing, the university is able to take into account the costs of resource use, maintenance and disposal, all of which are not represented in the purchase price. Often, this would result in a win-win situation where greener products or services become cheaper in the long run.



Some of the potential savings gained from the lifecycle cost approach include:

- Savings on the use of energy, water and fuel The costs associated with energy, water and fuel consumption during use form a substantial proportion of the total costs of owning a product. Reducing this consumption makes clear sense both financially and environmentally.
- Savings on maintenance and replacement In some cases, the greenest alternative will be one which is designed to maximise the period until replacement or which minimises the amount of maintenance work that needs to be done.
- Savings on disposal costs Costs of disposal will eventually have to be paid although sometimes with a longer delay. This ranges from the cost of physical removal to paying for secure disposal. In some cases, there may be positive returns to the owner at the end of the product/servce life when part of the components can be sold or recycled profitably.

### Points and Weighting for Evaluation

Since the tender is evaluated on the basis of different sub-criteria, various weightage can be assigned to the different sub-criteria. The following table provides an example of how the weightage can be assigned for the different criteria.

### Monitoring of Contract Compliance

The provision of environmental contract clauses is only effective if compliance with these clauses is properly monitored. In this regard, different forms of contract compliance monitoring such as those listed below can be applied. The supplier may be requested to supply evidence of compliance. The university may carry out spot checks. A third party may be contracted to monitor the compliance. Appropriate penalties for non-compliance should be included within the contract and the monitoring process should be executed so as to ensure that the action plan is properly implemented and any problems encountered can be rectified as soon as possible. The monitoring process will focus on the five products that are already stipulated in the guideline.

### 3) The four Key Products

### 3.1 Introduction

This section provides an illustration on how the contracting authority may consider addressing the five categories of products through the GGP. These products have been selected based on the environmental impact, budgetary importance and availability of green alternatives. The approaches outlined are mainly based on the Malaysian GGP criteria.

### 3.1.1 Paper

Paper usage is a way of life in the university. It ranges from cardboard boxes, notepads to exam papers. Papers that are used are produced from trees, using huge resources of energy, water, and chemicals such as chlorine which is used for bleaching. As paper consumption is **expected to grow, the university's community needs to take steps not only** in reducing the usage but also by changing the consumption pattern so that the environmental impacts could be reduced.

In a general sense, reducing the environmental impacts of paper require that the purchase of papers be focused on the use of recycled papers or paper made from sustainably harvested virgin fibre. It also demands that the paper production process is characterised by low energy consumption. In addition, certain hazardous chemicals such as chlorine need to be avoided since such materials would be harmful and cause a negative impact on the environment.

Specifically, the technical specifications for paper purchases should have the following:

- A) The fibre source in the paper components can be recycled or harvested and the virgin fibre must meet one or both of the following criteria:
  - i. The raw materials from Virgin Wood Fibre must come from a forest that has been certified under the FSC or PEFC as sustainable forest management (or equivalent certificate) or
  - ii. All Virgin Wood Fibre must have a valid sustainable forest management scheme and/or chain of custody certification that is verified by third party certification schemes such as FSC, PEFC or equivalent.

### B) The recycled fibre meets the qualification of the MS 2080:2008:

- i. Papers certified from the Forest Stewardship Council (FSC) or Programme for the Endorsement Forest Certification (PEFC) or equivalent.
- ii. Papers that are certified by ecolabels or equivalent.

In the awarding criteria, the university shall consider the following:



To ease the process of checking and verifying whether the paper purchased would certify the technical specifications, the university can also refer to the following labels:

~	MyHijau mark and/or an Ecolabel from SIRIM certification or any certified organization.
✓	All products that use the European ecolabel, Blaue Engel (German ecolabel), Nordic Swan, Japan Eco Mark, Chlorine Free Product Association label or Eco Green Seal will be deemed to have complied.
~	Products that use Blaue Engel (German ecolabel), Umweltzeichen (Austri German ecolabel) or FSC recycled label will be deemed to have complied.
~	Products not carrying the MyHijau mark have to provide evidence that they meet the specifications. Documentations can include audit reports, technical data sheets, verified lab test reports and others.

### 3.1.2 Energy-Using Products



Computers, multi-purpose printers and lightings are some of the products with high energy consumption that are procured by the university. These items have a heavy environmental footprint owing to the raw materials consumed and their disposal at end of life. With the increase in volumes and varieties of such products, controlling the costs and the environmental impact of these goods has become a priority. The use of printers that are operated by recycled toners for instance, may be considered as a less expensive alternative and

could potentially reduce wastes. Considering that one toner needs 3.5 litres of oil, in less than a year, the use of recycled cartridges could have saved more oil than the 42 million litres spilled by the Exxon Valdez oil tanker. Therefore, any effort to consider using such products could deliver substantial benefits.

In general, to reduce the environmental impact, the purchase of energy-using equipment should focus on ensuring that the products are designed to be resource efficient and contain less hazardous substances such as mercury. The products should also be designed to facilitate reuse and the recycling process. The following table indicates the technical specifications and the awarding criteria to be used for three types of energy-using products: ICT equipment, multipurpose printers and lightings.

### ICT Equipment

Technical Specifications and Awarding Criteria for ICT Equipment

The technical specifications for ICT equipment purchase should demand that it fulfils at least the International ENERGY STAR, the Electronic Product Environmental Assessment Tool (EPEAT), the Basel Action Network (BAN) or the 80 PLUS criteria.

Categories	Awarding Criteria
Label	Products that have been certified by the MyHijau mark.
Materials	Hazardous Material Separation Incompatible and hazardous materials shall be easily detected and also removable.
	Cadmium/Lead Cadmium or lead may not be intentionally added to plastic parts (over 25 g). Flame Retardants
	polybrominated aprienyl erner (FDUE), polybrominated biphenyls (PBB), chlorinated paraffins shall not be contained in plastics (over 25 g). Halagens
	Any single plastic part of the housing or chassis (over 25 g) must not contain halogen except the maximum 0.5 percent fluoroorganic additives.
	Batteries/ Accumulators The contents of certain heavy metals in batteries and accumulators may not exceed certain limits For mercury, maximum 1 ppm; for cadmium maximum 10 ppm; and for lead maximum 100 ppm.
	Cadmium or mercury must not be contained in displays. Mercury is allowed in the illumination lamps of LCD display only.
Take back and Recycling	The supplier considers a take-back system for used products, it must be connected to an official take- back system or an equivalent. The supplier

For the process of checking and verifying, the university should:

- Ensure that products have the MyHijau mark and/or is certified by the International ENERGY STAR or any certified organisation.
- Ensure that any product which does not have the MyHijau mark shall provide evidence that these requirements are met. Documentation provided can be audit reports, technical data appendix or lab testing reports that had been accredited and others.
- Ensure that the supplier be able to provide evidence that these specifications are met. Documents proving the Energy Star and EPEAT registration or documents proving that equivalent standards are maintained can be accepted.
- Ensure that the supplier shall provide the specified documents for the verification of the award criteria on hazardous substances. The supplier shall provide a statement from the manufacturer certifying that the product does not contain the specified flame-retardants in the plastics. The supplier shall provide a statement from the battery/ accumulator manufacturer that proves the compliance and identifies the type of batteries/accumulators used. If the display manufacturer is not identical with the supplier, the supplier shall present a statement from a display manufacturer.
- Ensure that the supplier shall declare the compliance with the requirements on take back and recycling.

### **Multipurpose Printing Devices**

#### Technical Specifications and Awarding Criteria for Multipurpose Printing Devices

The technical specifications for the multipurpose printing devices purchased should have energy efficiency criteria and are certified with the International ENERGY STAR rating.

Categories	Awarding Criteria
Label	Products that have been certified by the
	MyHijau mark and/or the SIRIM Ecolabel
	certificate. Evidence of ecolabel certifications
	such as the Blaue Engel (German ecolabel), the
	Umweltzeidien (Austria ecolabel), the Eco Mark
	Japan Ecologo the Thai Green label the
	Nordic Swan ecolopel or equivalent such as the
	MyHiigu mark must be provided for supplied
	toners.
Materials	Maximum limitations are met for the Restriction
	of Hazardous Substances (RoHS) for electric and
	electronic products according to the following
	substances:
	Lead (Pb)< 1000 ppm
	Mercury (Hg)< 100 ppm
	Cadmium (Cd)< 100 ppm
	Hexavalent Chromium< 1000 ppm
	Polybromingted Biphenyls (PBB)< 1000 ppm
	Bis(2-Ethylhexyl) phthalate (DEHP)< 1000 ppm
	Benzyl butyl phthalate (BBP)< 1000 ppm
	Dibutyl phthalate (DBP)< 1000 ppm
	Diisobutyl phthalate (DIBP)< 1000 ppm
	The supplier has to prepare a document that
	indicates no contents of Polybrominated
	Binhenyls (PBB), Polybromingted Dinhenyl Ethers
	(PBDE) and chloringted paraffin in the plastics
	proper and enoticated parameter me plastes:
Take back	The supplier has to provide a take-back policy
and	for used or recycled toner cartridges.
Recycling	Recycled packaging. The supplier has to
100	provide some information on recycling on the
	products' packaging

For the process of checking and verifying, the university should:

- 🗹 Ensure that the products carry the MyHijau mark and/or the SIRIM Ecolabel or an ecolabel from any certified organization.
- Ensure that the supplier shall provide specification evidence which states that these specifications are met.
- Ensure that the supplier shall provide documentation, analysis, test reports or other evidence that meet the criteria. All the test reports shall be from verified laboratories.
- Ensure that the supplier shall provide specified documents for the verification of the award criteria on hazardous substances. The supplier shall provide a statement from the manufacturer certifying that it does not contain the specified flame-retardants.
- The supplier shall declare the compliance with the requirements on take-back. and recycling.

### Energy Efficient Indoor Lightings

The technical specifications can be categorised into three different types:

### Luminaires

Fluorescent Lamps

Luminaire efficacy shall be more than 60 Im/W/. Correction for luminaires with high colour temperature and high colour rendering (high Colour Rendering Index: Ra) is as below:

Lamp Parameter	Deduction from luminou
	efficacy at 25°C
Tc > 5000 K	-10%
95 > R > 90	-20%
Ra > 95	-30%

Linear, circular and compact fluorescent lamps must meet power rating

(W) and efficacy (Im/W) according to the category below:

Single- Capped with Non-Integrated Ballasted		sted
Lamp Efficacy	Power Rating (W)	Efficacy (Im/W)
	11 - 50	80
Lamp Survival Factor at 2000 hr	≥ 98	%
Lumen Maintenance Factor at 2000 hr	≥ 92.	5%
Mercury content	≤ 5.0	mg
Number of switching cycles before failure	≥ 10,0	000
Colour Rendering Index	≥ 0	)

Double- Capped Fluorescent Lamp	
Lamp efficacy	≥ 90 lm/W
Lamp Survival Factor at 2000 hr	≥ 9%
Lumen Maintenance Factor at 2000 hr	≥ 92.5%
Mercury content	≤ 5.0 mg
Number of switching cycles before failure	≥ 10,000
Colour Rendering Index	≥0

Single- Capped with Integrate Lamps) or Self	d Ballast (Compact Ballasted Lamp	Fluorescent	~	LED Lamps (
Lamp Efficacy	Power Rating (W)	Efficacy (Im/W)		The efficacy not less than
	< 9	80		Power Rati
	9 - 15	80		< 5
	16 - 24	80		5-10
	> 24	80	20	> 15
Lamp Survival Factor at 2000 hr	≥ 98	%	-0.	
Lumen Maintenance Factor at 2000 hr	≥ 92.	5%	~	HID Lamps (i
Mercury content	≤ 5.0	mg		below:
Number of switching cycles before failure	≥ 10,0	000		Power Rati
Colour Rendering Index	≥0			> 10

1	1FD	lamos	(122)
	LLU	Lumps	1331

and lifetime of the LED lamp as determined by LM80 shall be as indicated below:

Power Rating (W)	Efficacy (Im/W)	Lifetime (hours)
< 5	70	10,000
5-10	80	15,000
10-15	80	25,000
~ 15	80	25.000

ncluding induction lamps)

and lifetime of the HID lamp shall be not less than as indicated

Power Rating (W)	Efficacy (Im/W)	Lifetime (hours)
< 100	> 100	10,000
> 100	80	15 000

For the awarding criteria, extra marks will be given if the products have been certified by the MyHijau mark or a SIRIM Ecolabel.

- ✓ Luminaires
- Luminaires shall have a Luminaires Maintenance Factor (LMF) that meets the requirements for the various light sources
- Mercury, Lead, cadmium, chromium VI, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) shall not be used as constituent parts of the luminaire, in accordance with MS 2237: 2009 or its equivalent on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
- The power factor of the complete luminaire shall be more than 0.90.
- The total power consumption of a LED luminaire shall not exceed the declared maximum power consumption by the manufacturer.
- Packaging of luminaires for the transporting and distribution purposes shall be of corrugated paper materials containing recycled contents.
- The supplier shall provide printed or online information related to maintenance instructions to ensure that the luminaires maintain, as far as possible, its original quality throughout its lifetime and disassembly instructions.

### ✓ Fluorescent Lamps

• The supplier shall provide documentation which shows the Lamp lifetime; Lumen depreciation at the end of life, Light colour temperature (K), Light Colour Rending Index (CRI), Luminous flux (lumens) provided by the lamp, Lamp circuit power, Dimensions of the lamp, Mercury contents of the lamp, and Procedure for safe disposal of the lamp at the end of life.

### ✓ LED Lamps (SSL)

- The LED lamps shall be subjected to a Temperature Cycling Shock Test.
- The switching endurance of LED lamps shall be ≥ 50, 000 times, based on cyclic requirements (switch on and off for 30s).
- LED lamps shall be supplied with test certificates from approved independent laboratories which show that standard electrical safety and electromagnetic compatibility (EMC) requirements have been met.
- The colour rendering index shall be > 80.
- If the LED lamp is not in the form of a replaceable lamp, then the replacement and the reassembly of LED modules and the main components shall be easily executed with regular tools (e.g. screwdriver).
- Correction for LED lamps with high colour temperature and high colour rendering is as accorded below:

Lamp Parameter	Deduction from luminous efficacy
	requirement at 25°C
Tc > 5000 K	- 10%
95 > R > 90	-15 %
Ra > 95	-20 %

### ✓ HID Lamps (including induction lamps)

- The supplier shall provide documentation with the lamp that shows the Lamp lifetime, Lumen depreciation at the end of life, Light colour temperature (K), Light Colour Rendering Index (CRI), Luminous flux (lumens) provided by the lamp, Lamp circuit power, Dimensions of the lamp, Mercury contents of the lamp and Procedure for safe disposal of the lamp at the end of life.
- The efficacy and lifetime of the HID lamp shall be not less than as indicated below:

Power Rating (W)	Efficacy (Im/W)	Lifetime (hours)
< 100	70	10,000
> 100	80	15,000

- The colour rendering index shall be > 80.
- Correction for HID lamps with high colour temperature and high colour rendering is accorded as below:

Lamp Parameter	Deduction from luminous efficacy requirement at 25ºC	
Tc > 5000 K	- 10%	
95 > R > 90	-15 %	
Ra > 95	-20 %	

### For the process of checking and verifying, the university should:

- ✓ Ensure that products carrying the MyHIJAU mark will be deemed as compliant.
- ✓Ensure that products not carrying the MyHIJAU mark have to provide evidence that they meet the specifications. Documentations can include safety data sheets such as CSDS, technical data sheets, third party lab test reports, third party verified lab reports or equivalent. Verifications may include on-site monitoring.
- Ensure that the supplier shall provide documentations that show the Lamp lifetime (according to IES LM-80 Approved Method for Measuring Lumen Depreciation of LED Light Sources), Light Colour temperature (K), Light Colour Rending Index (CRI), Luminous flux (lumen) (according to IES LM-79 Approved Method for the Electrical and Photometric Testing of Solid - State Lighting Device), Lamp circuit power, Dimensions of the lamp, Mercury contents of the lamp and Procedure for safe disposal of the lamp at the end of life.



# 07 EDUCATION MANAGEMENT (ENVIRONMENT & CLIMATE CHANGE)



# Garis Panduan Surau Lestari: Imarah Green Project Surau Apium

- 1. Dr. Asmawati Muhamad
- 2. Professor Dato' Dr. Zulkifli Mohd Yusoff
- 3. Professor Dr. Sumiani Yusoff
- 4. Associate Professor Dr. Mohd Roslan Mohd Noor
- 5. Associate Professor Dr. Zeeda Fatimah Mohamad
- 6. Dr. Muhamad Alihanafiah Norasid
- 7. Dr. Nurul Husna Mansor
- 8. Dr. Nur Shahidah Paad
- 9. Nurfarhanim Zainol

### GARIS PANDUAN SURAU LESTARI: IMARAH GREEN PROJECT SURAU APIUM

### 1) PENGENALAN KONSEP "ECO-MOSQUE"

Mutakhir ini, masyarakat Islam di segenap penjuru dunia semakin terpanggil untuk menerapkan konsep mesra alam dan aplikasi teknologi hijau dalam pembangunan masjid, surau, dan pesantren (sekolah agama). Ini selaras dengan anjuran Quran dan Sunnah yang amat menitikberatkan tanggungjawab manusia sebagai khalifah di muka bumi untuk menjaga kelestarian dan keseimbangan alam sekitar, pengurusan dan penggunaan sumber alam secara berhemah, memelihara keindahan alam semulajadi serta mencegah segala perbuatan yang boleh mendatangkan kerosakan (fasad) pada alam sekitar.

Di antara usaha-usaha eko-masjid yang telah dilaksanakan di peringkat antarabangsa adalah pembinaan Masjid Shaykh Zayed di Abu Dhabi yang mengetengahkan konsep penghijauan dengan mewujudkan persekitaran masjid yang dikelilingi taman-taman yang indah, pokok-pokok serta kolam. Kerajaan Qatar juga menetapkan setiap masjid yang akan dibina di negara tersebut haruslah berasaskan model mesra alam, dan mampu menjimatkan air serta tenaga. Di samping itu juga, projek Masjid Cambridge di United Kingdom, turut menitikberatkan konsep bumbung hijau yang membolehkan pencahayaan semulajadi daripada langit secara terus, tenaga yang dijana oleh pam haba daripada sumber tanah dan juga mewujudkan taman komuniti (community garden) ke arah mencapai nilai 'zero footprint'.

Di persisiran bandar Norderstedt di utara Jerman, masjid yang dibina memasang turbin angin di kedua-dua menara setinggi 22 meter untuk menjana tenga elektrik. Menara di masjid ini tidak lagi berfungsi secara praktikal untuk memanggil umat Islam bersolat, sebaliknya simbol kepada budaya Islam ini telah diubah sesuai dengan peredaran zaman moden. Di Afrika, 40,000 masjid di Eutopia melakukan penanaman 5,000 pokok dalam tempoh tiga tahun akan datang. Sebahagian daripada masjid tersebut akan menjadi masjid eco, yang mewujudkan "woodlots" dalam usaha untuk menjadi berdikari dari segi bekalan bahan api mereka. Setiap masjid eco tersebut akan mempunyai kelab menanam pokok tersendiri yang menjalankan bengkel dan Hari Pokok Tahunan sebagai sebahagian daripada satu usaha yang luas untuk memimpin dan mendidik masyarakat tentang alam sekitar. Di Uganda, projek penanaman oleh Muslim Green Top Tree bermatlamat untuk mengagihkan tumbuhtumbuhan dan menumbuhkan 2.5 juta benih-benih buah dan agroforestry. Melihat kepada negara jiran kita, Masjid Al-Mawaddah di Singapura juga mempunyai ciri-ciri kehijauan seperti tiub solar jimat elektrik yang memberi cahaya terus dari langit, atap yang dihiasi dengan taman, lampu sensor gerak, dan paip yang dipasang dengan alat kawalan aliran air. Ia juga mempunyai green wall yang menyuntik rasa ketenangan dan keindahan di dalam dewan solat. Indonesia juga telah meletakkan usaha yang serius dalam menyokong konsep eco-pesantren di beberapa tempat. Antara aspekaspek kualiti hijau yang mereka fokuskan dalam pemeliharaan dan penjagaan adalah air, tenaga, pengangkutan, pengurusan sisa cecair dan pepejal, tanah untuk perkebunan, kesihatan, biodiversiti dan fiqh al-**bi'αh**.

### 2) IMARAH GREEN PROJECT: SURAU APIUM

Imarah Green Project: Surau APIUM merupakan sebuah usaha penyelidikan yang digerakkan secara kolektif oleh kumpulan penyelidik daripada Akademi Pengajian Islam, Fakulti Kejuruteraan, Fakulti Sains dan rakan-rakan strategik dari dalam dan luar Universiti Malaya di bawah geran penyelidikan Transforming the Role of Surau APIUM for Campus Sustainability through Imarah Green Project (LL031-16SUS). Gerak kerja kelestarian surau ini telah bermula pada 1 Mei 2016 di bawah projek Living Lab yang dikendalikan oleh Kluster Penyelidikan Sustainability Science Universiti Malaya.

Surau APIUM telah ditubuhkan pada tahun 1996 bersama tertubuhnya bangunan Akademi Pengajian Islam Universiti Malaya. Dalam tempoh 22 tahun ini, ia telah mengalami proses renovasi fizikal secara berperingkat. Surau berstruktur dua tingkat ini mampu menampung seribu orang jemaah ketika solat Jumaat. Secara umumnya, surau ini bukan sahaja menjadi tempat warga APIUM solat berjemaah ia juga turut dipenuhi dengan pelbagai aktiviti pengisian kerohanian yang lain seperti halaqah, usrah, ceramah, iftar dan sebagainya. Pada hari Sabtu dan Ahad, surau ini turut dikunjungi oleh orang awam yang hadir ke kelas-kelas pengajian awam, seminar dan aktiviti-aktiviti lain yang dianjurkan oleh pelbagai pihak dari dalam dan luar APIUM.

Pada fasa pertama perlaksanaan projek ini (Mei 2016 - Jun 2017), pelajar APIUM dilihat masih belum menunjukkan tahap kesedaran dan kefahaman yang mendalam tentang tingkah laku hijau (green practices) seperti menjaga kebersihan dan keindahan persekitaran surau, mengelakkan pembaziran air dan tenaga elektrik, dan juga amalan kitar semula. Senario ini menggambarkan bahawa mereka mengambil mudah perkara asas yang diajar dalam Islam iaitu menghargai keindahan persekitaran, menjaga kebersihan dan memelihara sumber alam semulajadi. Walaupun masalah ini adalah gambaran biasa pengabaian terhadap alam sekitar dalam masyarakat kita, tetapi ia tetap merupakan isu serius yang perlu ditangani disebabkan oleh para pelajar tersebut merupakan calon graduan atau represantatif yang mewakili institusi Islam di UM, di mana mereka seharusnya menjadi sebahagian daripada komuniti yang mesra alam. Keadaan ini tidak selaras dengan anjuran Islam yang sangat menitikberatkan aspek penjagaan dan perlindungan alam sekitar, menjaga keseimbangan komponen alam sekitar, mengelakkan pembaziran sumber alam dan sebagainya.

Justeru, selaras dengan pelaksanaan projek eko-kampus di bawah Living Lab di UM, para penyelidik berhasrat untuk menjadikan surau APIUM dan komunitinya sebagai fokus bagi penyampaian pendidikan lestari di luar bilik kuliah atau dengan kata lain pendidikan secara praktikal di lapangan. Kami percaya bahawa idea menjalankan Imarah Green Project di Surau APIUM akan dapat membantu Susci menyampaikan pendidikan kelestarian alam sekitar kepada komuniti APIUM khususnya, dan masyarakat luar amnya, melalui penglibatan secara aktif dalam aktiviti mesra alam di Surau APIUM, Pusat Kitar Semula APIUM, Urban Garden APIUM, dan Lestari Shop (Sila rujuk bahagian galeri foto). Di antara perkara-perkara asas dalam pelaksanaan Surau lestari ini ialah menggalakkan perubahan tingkah laku dalam kalangan komuniti APIUM bagi mempraktikkan amalan penjimatan air dan tenaga, pengurusan sisa yang sistematik, peningkatan penghijuaan dan biodiversiti serta mengekalkan keindahan dan keceriaan di persekitaran surau. Pelaksanaan secara berperingkat dalam kempen kesedaran dan juga pembangunan infrastruktur yang mesra alam, serta sokongan padu secara kolektif yang melibatkan kerjasama daripada pelbagai pihak berkepentingan telah membawa perubahan yang positif pada penampilan fizikal dan pembangunan kapasiti warga APIUM dalam konteks mewujudkan surau lestari. Dalam hal ini, pihak penyelidik beriltizam untuk terus menyuburkan lagi amalan surau lestari kepada masyarakat luar, dengan menjemput mengunjungi ke Surau APIUM (eco-tour) serta berhasrat untuk mengembangkan lagi modul pelaksanaan Surau lestari di peringkat masjid/surau di seluruh Malaysia.

### 2.1 Objektif Imarah Green Project: Surau Apium

- 1. **Untuk menonjolkan Surau APIUM sebagai "eco-model" yang akan menjadi contoh** supaya dapat dijadikan rujukan oleh masjid- masjid lain.
- 2. Menterjemahkan budaya mesra alam yang berasaskan ajaran Al-Quran dan Al-Sunnah.
- 3. Memperkasakan Imarah Eco-Friends sebagai kumpulan sukarelawan yang aktif dalam pelbagai aktiviti kelestarian khususnya di Surau APIUM, dan di peringkat luar amnya.

### 3) GARIS PANDUAN ISLAM DALAM AMALAN KELESTARIAN SURAU

Islam mengetengahkan pendekatan yang holistik dalam konteks memupuk amalan kelestarian surau. Perkara penting yang diberikan tumpuan adalah melalui pengukuhan peranan manusia sebagai khalifah Allah. Hal ini kerana, amalan kelestarian surau adalah sebahagian dari tugas khalifah dalam mengurus tadbir alam dengan baik. Menurut perspektif Islam, tanggungjawab khalifah merujuk kepada aktiviti memerintah, mentadbir, mengurus dan seumpamanya sumber alam yang dijadikan oleh Allah untuk kepentingan umat manusia. Status khalifah yang dipikul oleh manusia akan mewujudkan satu jaringan perhubungan di antara manusia sesama manusia, manusia dengan makhluk ciptaan Allah yang lain serta manusia dengan alam fizikal di sekelilingnya. Ini bermaksud seseorang yang menyedari tujuan diciptakan sebagai khalifah bukan sahaja akan berlaku adil pada dirinya sendiri, tetapi akan turut berkongsi kebaikan dan manfaat bersama makhluk ciptaan Allah yang lain.

Pembangunan sumber manusia merupakan matlamat utama bagi proses pembangunan dalam Islam. Manakala manusia sendiri merupakan agen kepada usaha pembangunan yang akan dijalankan di muka bumi ini. Memandangkan sumber manusia menjadi penentu dan kayu ukur kepada keupayaan satu-satu pembangunan yang dirancang, maka pembangunan sumber manusia dari aspek pengetahuan, kemahiran dan kepakaran perlu terus dipertingkatkan. Bagi memastikan pencapaian matlamat pembangunan, manusia perlu sentiasa bersedia untuk mengambil faedah dari setiap sumber yang ada di dunia ini bagi tujuan untuk terus memakmurkannya.

Sebagaimana firman Allah dalam Surah Yasin, ayat 34;

### وجَعَلْنَا فِيهَا جَنَّاتٍ مِنْ نَخِيلٍ وَأَعْنَابٍ وَفَجَّرْنَا فِيهَا مِنَ الْعُيُونِ

# Terjemahan: Dan Kami jadikan di bumi itu kebun-kebun kurma dan anggur, dan Kami pancarkan padanya beberapa mata air.

Ini bermaksud, pembangunan dalam Islam secara tidak langsung juga akan membangunkan kemanusiaan dengan nilai-nilai kejujuran, amanah dan kepatuhan kepada suruhan Allah. Oleh sebab tuntutan kemanusiaan adalah bersifat dinamik, mereka perlu berusaha mencipta dan menyediakan pelbagai kemudahan yang bersifat kontemporari bagi memenuhi keperluan masyarakat hari ini dengan penuh berakhlak dan bertanggungjawab. Hal ini termasuklah pembangunan dari segi kualiti dan kuantiti bagi memastikan kebajikan, keselesaan, kesihatan dan keselamatan masyarakat terjamin. Berdasarkan penjelasan di atas, berhubung keperluan menjaga kelestarian alam, ia bertepatan dengan maksud lain pembangunan dalam Islam iaitu suatu kegiatan penting dan terancang bagi mengubah keadaan buruk kepada baik, dari baik kepada yang lebih baik dan mengekalkan keadaan baik tersebut.

Menurut Islam juga, usaha ini mestilah mengambil kira aspek keseimbangan termasuk kepentingan individu dengan masyarakat, dunia dengan akhirat serta kebendaan dengan kerohanian. Saranan ini selari dengan perintah Allah yang termaktub dalam Surah Al-Qasas ayat 77:

وَٱبْتَغِ فِيمَآ ءَاتَنكَ ٱللَّهُ ٱلدَّارَ ٱلأَخِرَةَۗ وَلَا تَنسَ نَصِيبَكَ مِنَ ٱلدُّنْيَاۗ وَأَحْسِن كَمَآ أَحْسَنَ ٱللَّهُ إِلَيْكَ ۖ وَلَا تَبْغِ ٱلْفَسَادَ فِي ٱلأَرْضِّ إِنَّ ٱللَّهَ لَا يُحِبُّ ٱلْمُفْسِدِينَ ٢

Maksudnya: "Dan tuntutlah dengan harta kekayaan yang telah dikurniakan Allah kepadamu akan pahala dan kebahagiaan hari akhirat dan janganlah engkau melupakan bahagianmu (keperluan dan bekalanmu) dari dunia; dan berbuat baiklah (kepada hamba-hamba Allah) sebagaimana Allah berbuat baik kepadamu (dengan pemberian nikmatNya yang melimpah-limpah); dan janganlah engkau melakukan kerosakan di muka bumi; sesungguhnya Allah tidak suka kepada orang-orang yang berbuat kerosakan".

Berhubung perkara ini, terdapat beberapa perkara asas yang telah digariskan di dalam al-Quran dan sunnah. Pertama, meletakkan Tauhid sebagai paksi dan asasnya. Kedua, digerakkan dengan pendekatan yang bersepadu dan menyeluruh. Ketiga, menekankan proses pembangunan insan sebagai keutamaan bukan semata-mata keuntungan.

### 3.1 Pendekatan Islam dalam Pembudayaan Kelestarian Surau

Kesyumulan Islam berhubung hal pembangunan dapat dilihat dengan jelas melalui al-Quran dan hadis. Sebagai contoh, surah al-Maidah ayat 48 telah menekankan aspek pengurusan sumber alam secara bijak tanpa dipengaruhi oleh unsur hawa nafsu yang membawa kepada kerosakan.

وَأَنْزَلْنَا إِلَيْكَ الْكِتَابَ بِالْحَقِّ مُصَدِّقًا لِمَا بَيْنَ يَدَيْهِ مِنَ الْكِتَابِ وَمُهَيْمِنًا عَلَيْهِ <sup>ل</sup>ْخَاحْمُ بَيْنَهُمْ بِمَا أَنْزَلَ اللَهُ ۖ وَلَا تَتَبِعْ أَهْوَاءَهُمْ عَمًا جَاءَكَ مِنَ الْحَقِّ لِلْكِلِّ جَعَلْنَا مِنْكُمْ شِرْعَةً وَمِنْهَاجًا ۚ وَلَوْ شَاءَ اللَهُ لَجَعَلَكُمْ أُمَّةً وَاحِدَةً وَلَكِنْ لِيَبْلُوَكُمْ فِي مَا آتَاكُمْ <sup>ف</sup>َفَاسْتَبِقُوا الْخَيْرَاتِ <sup>َ</sup> إِلَى اللَّهِ مَرْجِعُكُمْ جَمِيعًا فَيُنَبِّئُكُمْ بِمَا كُنْتُمْ فِيهِ تَخْتَلِفُونَ

Terjemahan: Kami turunkan kepadamu (Wahai Muhammad) Kitab (Al-Quran) dengan membawa kebenaran, untuk mengesahkan benarnya Kitab-kitab suci yang telah diturunkan sebelumnya dan untuk memelihara serta mengawasinya. maka jalankanlah hukum di antara mereka (Ahli Kitab) itu dengan apa yang telah diturunkan oleh Allah (kepadamu), dan janganlah engkau mengikut kehendak hawa nafsu mereka (dengan menyeleweng) dari apa yang telah datang kepadamu dari kebenaran. Bagi tiap-tiap umat yang ada di antara kamu, Kami jadikan (tetapkan) suatu syariat dan jalan agama (yang wajib diikuti oleh masing-masing). Dan kalau Allah menghendaki nescaya ia menjadikan kamu satu umat (yang bersatu dalam agama yang satu), tetapi ia hendak menguji kamu (dalam menjalankan) apa yang telah disampaikan kepada kamu. Oleh itu berlumba-lumba lah kamu membuat kebaikan (beriman dan beramal soleh). kepada Allah jualah tempat kembali kamu semuanya, maka ia akan memberitahu kamu apa yang kamu berselisihan padanya.

Begitu juga terdapat banyak hadis yang menjelaskan tentang kepentingan penjagaan bumi seperti air, udara, tanah dan lain-lain. Hakikatnya kesemua elemen ini adalah sangat signifikan dalam konteks kelestarian surau. Hadis Nabi SAW bermaksud;

Maksudnya; "Sesungguhnya dunia ini cantik dan subur menghijau dan sesungguhnya Allah menjadikan kamu (wahai manusia) selaku pengurusnya dan apa yang terdapat padanya." (Al-Tirmizi, Muhammad bin Isa. 2004. (Rujuk: Jami' al-Tirmizi. Kitab al-Fitan. Hadis No. 2191. Riyadh: Bait al-Afkar al-Dauliyyah). Rajah di bawah menjelaskan secara menyeluruh berhubung pendekatan Islam dalam pembudayaan kelestarian surau.



Rajah 90: Pendekatan Islam dalam Pembudayaan Surau Lestari

Berdasarkan rajah ini, terdapat satu proses penting yang boleh dijadikan panduan agar budaya kelestarian surau dapat direalisasikan dalam kalangan masyarakat. Terdapat empat elemen yang perlu diberi perhatian iaitu ilmu pengetahuan, tazkiyyat al-nafs, dan pembentukan akhlak.

### i) Ilmu Pengetahuan

Pemilihan manusia sebagai khalifah berdasarkan kepada keupayaannya yang telah dikurniakan oleh Allah iaitu akal. Akal rasional yang dianugerahkan oleh Allah kepada manusia telah meletakkan kedudukannya lebih tinggi mengatasi para malaikat dan makhluk-makhluk yang lain. Akal rasional inilah yang kemudiannya akan membantu manusia membangunkan idea dan mereka cipta, mengambil manfaat dari alam serta memanfaatkannya. Selain itu, manusia mampu berfikir, membuat rumusan dan mengkonsepsikan sesuatu dengan akal yang logik. Selain dari kemampuan berfikir, minda manusia yang bersifat kerohanian pula membolehkan manusia melihat kebenaran dengan cara yang tertentu, umpamanya melihat bunga bukan sekadar bunga akan tetapi menterjemahkan bunga dari makna kerohanian. Jelasnya, dimensi kerohanian dalam aspek pemikiran manusia memberikan mereka dorongan dan keyakinan serta kebebasan memilih di antara perkara baik dan sebaliknya.

Di dalam al-Quran, terdapat perkataan al-Nas yang merujuk kepada fungsi dan kelebihan akal manusia. Perkataan al-Nas ini membawa tiga maksud iaitu Absara, **melihat dan berfikir, dengannya manusia dapat mengambil pengajaran. Kedua, 'Alima,** mengetahui/berilmu, dengan ilmu manusia dapat membezakan sesuatu itu benar atau **salah. Ketiga, Ista'zana, meminta iz**in, manusia merupakan makhluk yang beradab, yang kadangkala meminta izin untuk menggunakan sesuatu yang bukan miliknya.

Melalui akal yang dianugerahkan ini manusia berupaya menggarap pelbagai bentuk ilmu pengetahuan seterusnya menjadikan mereka makhluk yang berakhlak. Hal ini kerana, Ibn Qayyim telah menjelaskan bahawa ilmu pengetahuan sahaja yang mampu membina kecenderungan dalam diri manusia untuk berusaha memperbaiki diri termasuk dalam aspek kelestarian surau. Justeru, dalam konteks kelestarian surau, terdapat beberapa ilmu yang mesti dikuasai seperti ilmu pengurusan, sains alam sekitar serta ilmu agama.

### ii) Tazkiyyat Al-Nafs

Tazkiyyat al-nafs merupakan proses kedua yang akan dilalui oleh seseorang individu selepas menguasai ilmu. Hal ini kerana, Sidi Gazalba menjelaskan bahawa pelbagai masalah yang berlaku pada akhlak dan kehidupan adalah berpunca daripada hubungan hati yang jauh dengan Allah S.W.T. Ini bermaksud, aspek kejiwaan akan menentukan bagaimana sikap individu terhadap pembudayaan amalan kelestarian surau.

Tazkiyyat al-nafs bukanlah satu proses yang mudah. Sebaliknya ia memerlukan kesungguhan dan konsistensi dalam aspek pengurusan nafsu, pengukuhan akidah serta penghayatan ibadah. Terdapat beberapa kaedah yang boleh dilakukan bagi melengkapkan proses ini iaitu melalui kawalan diri, refleksi diri dan disiplin diri. Dalam konteks, membentuk budaya surau lestari, ketiga-tiga kaedah ini boleh diimplementasikan melalui beberapa platform. Sebagai contoh; penguatkuasaan peraturan penjagaan surau, mengaktifkan program pengimarahan surau dan memupuk sikap minat membaca melalui pelbagai saluran bagi membina kesedaran. Hubungan amalan tazkiyyat al-nafs ini terhadap pembentukan jiwa dan akhlak telah dinyatakan oleh Allah S.W.T menerusi surah al-Syams ayat 7-10. Allah S.W.T berfirman:

# (10) وَنَفْسٍ وَمَا سَوًّاهَا (7) فَأَلْهَمَهَا فُجُورَهَا وَتَقْوَاهَا (8) قَدْ أَفْلَحَ مَنْ زَكَّاهَا (9) وَقَدْ خَابَ مَنْ دَسًّاهَا

Maksudnya: Demi diri manusia dan yang menyempurnakan kejadiannya (dengan kelengkapan yang sesuai dengan keadaannya). Serta mengilhamkannya (untuk mengenal) jalan yang membawanya kepada kejahatan, dan yang membawanya kepada bertaqwa. Sesungguhnya berjayalah orang yang menjadikan dirinya, yang sedia bersih - bertambah-tambah bersih (dengan iman dan amal kebajikan). Dan sesungguhnya merugilah orang yang menjadikan dirinya yang sedia bersih itu susut dan terbenam kebersihannya (dengan sebab kekotoran maksiat).

Berdasarkan ayat ini, perkataan "fujur" dan "taqwa" merujuk kepada potensi baik dan buruk yang sudah sedia tersemai dalam dasar diri manusia. Namun, manusia mempunyai pilihan untuk mengembangkan mana-mana potensi tersebut. Sehubungan itu, perspektif Islam melihat penyucian jiwa sebagai satu proses pendidikan sepanjang hayat yang amat penting bagi memastikan potensi baik yang ada dalam diri manusia sentiasa mengatasi potensi buruk.

Penghayatan terhadap potensi taqwa itu sendiri boleh dilakukan dengan sentiasa menjaga adab-adab syariat serta menjauhkan diri daripada melakukan perkara-perkara yang boleh menjauhkan diri daripada Allah. Di samping itu, keutamaan penyucian jiwa dijelaskan oleh Baginda Nabi SAW di dalam sebuah hadis:

Maksudnya: Ketahuilah bahawa dalam setiap tubuh terdapat segumpal daging, jika segumpal daging itu baik, maka baik pula seluruh badannya, namun jika segumpal daging itu rusak, maka rusaklah seluruh tubuhnya, ketahuilah gumpalan darah itu adalah hati. (Hadith Riwayat al-Darimi, "Sunan al-Darimi," Kitab al-Buyu"," bab fi al-Halal bayyin wa al-Haram bayyin, no. Hadith 2419, hadis sahih).

Abdul Halim El-Muhammady turut mengakui pengisian hati dan pembinaan kecenderungan yang baik iaitu tazkiyyat al-nafs menjadi permulaan kepada proses pembentukan akhlak. Proses ini bukan sahaja akan memperbaiki hubungan manusia dengan Allah tetapi juga hubungan sesama manusia dan alam. Sebagai contoh; dalam konteks pembudayaan surau lestari, ilmu dan tazkiyyat al-nafs akan membentuk kesedaran tentang rasa tanggungjawab dalam diri manusia untuk berperanan sebagai khalifah. Keadaan ini secara tidak langsung akan membantu individu untuk berusaha melakukan sesuatu khususnya dalam mengotimumkan fungsi surau supaya dapat dimanfaatkan oleh masyarakat. Dengan ini, ia bukan sahaja akan mendorong seseorang untuk berusaha menyempurnakan diri sendiri bahkan turut sama membantu manusia lain dan alam fizikal ke arah kebaikan.

Perkara ini menepati maksud perintah Allah di dalam Surah Al-Taubah ayat 18:

### إِنَّمَا يَعْمُرُ مَسَاجِدَ اللَّهِ مَنْ آمَنَ بِاللَّهِ وَالْيَوْمِ الْأَخِرِ وَأَقَامَ الصَّلَاةَ وَآتَى الزَّكَاةَ وَلَمْ يَخْشَ إِلَّا اللَّهُ ۖفَعَسَىٰ أُولَٰئِكَ أَنْ يَكُونُوا مِنَ الْمُهْتَدِينَ

Maksudnya: Sesungguhnya orang yang memakmurkan (menghidupkan) masjid-masjid Allah itu ialah orang-orang yang beriman kepada Allah dan hari akhirat serta mendirikan sembahyang dan menunaikan zakat dan tidak takut melainkan kepada Allah, (dengan adanya sifat-sifat yang tersebut) maka adalah diharapkan mereka menjadi dari golongan yang mendapat petunjuk.

### iii) Akhlak

Kesedaran yang terbentuk hasil daripada penghayatan ilmu dan tazkiyyat al-nafs akan menghasilkan akhlak yang baik pada seorang individu. Al-Ghazāli<sup>-</sup>, Miskawayh, Al-Balkhī dan Abul Quasem dalam menjelaskan tentang akhlak mengatakan bahawa ia

adalah tabiat yang dibentuk melalui tingkahlaku yang dilakukan secara berulang. Ini bermaksud, kesedaran sahaja tidak mencukupi, tetapi aktiviti kelestarian surau juga perlu menjadi amalan harian agar budaya tersebut benar-benar dapat direalisasikan. Penekanan berhubung dengan aspek akhlak ini telah dinyatakan di dalam al-Quran menerusi surah al-**Naba' ayat 18 yang bermaksud:** 

# Maksudnya: laitu hari (pada waktu itu ditiup sangkakala) lalu kamu datang berkelompok-kelompok (mengikut amalan dan akhlak)

Bagi mencapai tujuan tersebut, ruang dan peluang perlu diwujudkan menerusi pelbagai bentuk strategi dan pendekatan. Sehubungan itu, Imarah Green Project Surau APIUM, merupakan salah satu platform yang telah menyediakan peluang dengan penganjuran program dan aktiviti berbentuk keilmuan. Pelbagai mekanisme juga disediakan. Contohnya, perlaksanaan bengkel pengurusan alam sekitar, projek pengumpulan bahan-bahan terbuang secara berkala, pengumpulan dan penjualan barangan terpakai, aktiviti penanaman pokok dan lain-lain. Di samping itu, terdapat juga beberapa kemudahan dan insfrastruktur yang telah disediakan di surau dan kawasan di sekitarnya. Antaranya, Rain Water Harvesting System, Mr Thimble, Urban Garden dan Living Green wall. Kesemua ini boleh dimanfaatkan untuk tujuan meningkatkan penjimatan air, penghijauan dan biodiversiti. Oleh yang demikian, semua pihak yang menggunakan surau APIUM boleh menerima manfaat sekaligus meningkatkan kesedaran serta menggalakkan amalan kelestarian surau APIUM Universiti Malaya. Perkara ini jelas menepati saranan Islam yang mementingkan soal maslahah umat dalam apa jua perkara yang dilakukan. Dari Anas bin Malik, sabda Nabi SAW:

ما من مسلمٍ يَغرِسُ غرسًا، أو يَزرَعُ زَرعًا، فيأكُلُ منه طيرٌ أو إنسانٌ أو بهيمةٌ، إلا كان له به صدَقة

Maksudnya: "Tidaklah seorang Muslim yang menanam tanaman atau bertani, lalu ia memakan hasilnya atau orang lain dan binatang ternak yang memakan hasilnya, kecuali semua itu dianggap sedekah baginya" (Sahih Muslim, no: 1553)

Secara keseluruhan, kesemua proses yang telah dibincangkan di atas membawa maksud pembudayaan surau lestari perlu bermula daripada penghayatan ilmu seterusnya proses tazkiyyat al-nafs sehinggalah kepada pembentukan akhlak yang menerbitkan tingkah laku mesra alam selaras dengan ajaran Quran dan Sunnah.

### 4) AMALAN SURAU LESTARI

Beberapa aspek telah ditingkatkan di Surau APIUM bagi menjadikan ianya surau lestari, iaitu:

### 4.1 Menjimatkan Penggunaan Air Paip

### • *"Rain water harvesting system"* atau sistem pengumpulan air hujan

- Telah dipasang di Surau APIUM dengan kerjasama Water Warriors UM pada 12 Oktober 2017
- ✓ Mempunyai:
  - UV Filter
  - Pressure Gauge
  - Water pressure pump
  - Sand filter
- Kapasiti RWHS ini mampu menyimpan air sebanyak 3000 L iaitu terdapat 4 tangki dimana setiap tangki mampu meyimpan 750 L air hujan
- Air hujan ini telah disambungkan di paip mengambil wudhu dan ia juga selamat digunakan untuk kegunaan lain
- Mr Thimble
  - ✓ Dipasang di seluruh paip wudhu' Surau APIUM
  - ✓ Memperlahankan aliran air keluar
  - Penyekat air 4 lubang yang kelihatan seperti "butang", dipasang pada paip air untuk mengurangkan kadar pengeluaran air. Jumlah air yang mengalir (liter/saat):
  - ✓ Tanpa Mr Thimble: 0.194
  - ✓ Mr Thimble: 0.103

# • Kempen kesedaran

'Signage' ditampal pada bahagian tempat wudhu'

# 4.2 Menjimatkan Penggunaan Tenaga Elektrik

- Led bulb
  - Pemasangan lampu LED yang telah di taja oleh pihak MAIWP bagi menggalakkan penjimatan tenaga elektrik
  - ✓ Pemasangan lampu LED siap dipasang pada 15 Februari 2017
  - ✓ Jenis lampu LED yang dipasang adalah FSL
  - ✓ Sebanyak 285 lampu di dalam surau APIUM telah dipasang dengan lampu LED
- Kempen kesedaran (signage) mengingatkan pengguna untuk menutup suis selepas menggunakan.

### Amalan membuka aircond hanya pada hari jumaat

 Pemasangan aircond hanya dibuka bermula pukul 10.30 pagi pada hari Jumaat bagi kegunaan Solat Jumaat dan ditutup semula setelah selesai Solat Jumaat

### 4.3 Menguruskan Sampah Secara Sistematik

- Recycling Center
  - ✓ Terletak berhadapan Blok A, APIUM
  - ✓ Catatan jumlah berat barang kitar semula dibuat setiap bulan oleh pelajar
  - ✓ Barang-barang yang boleh di kitar semula akan dijual kepada vendor

### Lestari Shop

- Lestari shop adalah kedai yang menjual barang yang masih baik untuk digunakan dengan harga yang murah
- Barang yang disumbangkan adalah daripada warga universiti dan orang luar
- Terletak di Aras 2, Blok B, Akademi Pengajian Islam dan telah dirasmikan oleh Dato'Seri Ir. Dr. Zaini Ujang pada 15 Mei 2018

### • Jadual bertugas membersihkan surau oleh pelajar

- ✓ Jadual bertugas membersihkan surau adalah dalam kalangan pelajar dan dibahagikan mengikut hari dan lajnah-lajnah jabatan di APIUM
- ✓ Ianya dipantau oleh Imarah Eco-Friends dan PMAPIUM

### 4.4 Menghijaukan Persekitaran dan Meningkatan Biodiversiti

### • Urban Garden

- ✓ Pokok Gantung
- ✓ Vertical Farming
- ✓ Pokok diatas rak bunga
- ✓ Planter Box
- Terdapat 3 planter box di kawasan sekitar surau yang ditanam dengan pokok bunga.

### Green Vegetation

 Batas dibuat dalam 4 baris dimana terdapat sayuran yang boleh dimakan ditanam iaitu: ulam raja, kangkung, pandan, pokok kari, pokok kunyit, limau purut dan limau kasturi.

### • Living green wall

✓ Dipasang di anjung Surau APIUM

### 5) PEMANTAUAN DAN PENTADBIRAN

Pada tahun 2016, projek ini telah dipantai dan ditadbirurus oleh Kluster Penyelidikan **'Sustainability** Science' melalui UM Living Labs dengan kerjasama Akademi Pengajian Islam. Namun, pada tahun 2018, semua projek UM Living Labs termasuk *Imarah Green Project* telah bernaung secara terus di Pejabat Timbalan Naib Canselor (Penyelidikan & Inovasi) yang diuruskan oleh Pejabat Sekretariat Eko-Kampus Universiti Malaya.

### 6) SENARAI SEMAK PELAKSANAAN AMALAN LESTARI

Senarai semak boleh dirujuk kepada Ketua Projek Imarah Green Project (Dr. Asmawati Muhamad) untuk butiran lanjut.

### Rakan Strategik

### CAPACITY BUILDING

- SWCorp
- GoGreen
- NGO GRASS
- JAWI
- IKIM

### GREEN INFRASTRUCTURE

- LIVING GREEN WALL
- MAIWP
- JPPPHB
- WATER WARRIORS
- ZWC

### COMMUNITY ENGAGEMENT

- Go Green Malaysia
- IAIS
- Musolla Al-Furqan SK Bukit Damansara

### KEMPEN KESEDARAN ALAM SEKITAR

- NGO GRASS Malaysia (Group Alam Sekitar Sejahtera)
- PMAPIUM
- ZWC

7) GALERI FOTO



Rajah 91: Surau Akademi Pengajian Islam, UM



Rajah 92: Majlis pelancaran Imarah Green Project



Rajah 93: Majlis pelancaran Lestari Shop



Rajah 94: Lawatan Dato' Seri Ir. Dr. Zaini Ujang ke kawasan sekitar Surau APIUM



Rajah 95: Menerima kunjungan daripada pelbagai institusi dan organisasi



Rajah 96: Menyertai pelbagai program dan pameran

7.1 Antara Aktiviti Imarah Eco-Friends



Rajah 97: Usrah Alam Sekitar (IEF)

Rajah 98: Gotong Royong Perdana



Rajah 99: Program Pengisian Rohani

Rajah 100: Pusat Kitar Semula APIUM



Rajah 101: Kitar Semula Pakaian Terpakai

Rajah 102: Menjual Barangan Kitar Semula

Kesemua contoh aktiviti yang disenaraikan bertujuan bagi meningkatkan kesedaran alam sekitar.

### 7.2 Aspek Kelestarian Yang Telah Ditingkatkan Di Surau Apium

### i) Penghijauan dan biodiversity



Rajah 103: Pokok Gantung dan Vertical Farming di Urban Garden Apium



Rajah 104: Tanaman sayur-sayuran menggunakan teknik self-watering pots



Rajah 105: Pokok yang ditanam dalam tayar terpakai



Rajah 106: Taman mini di kawasan belakang Surau APIUM



Rajah 107: Rain Water Harvesting System



Rajah 108: Encik Affan Nasaruddin (Pegawai Projek Water Warriors) menerangkan tentang Mr Thimble yang **dipasang pada paip wudhu' Surau APIUM** 



Rajah 109: Papan tanda Mr Thimble yang telah dipasang dipaip air dan peringatan supaya menjimatkan air ketika mengambil wudhu

ii) Pengurusan sisa yang sistematik



Rajah 110: Lestari Shop yang menjual pakaian-pakaian terpakai



Rajah 111: Tong Kitar Semula



Rajah 112: Menjual barangan kitar semula yang dikumpul kepada vendor

# 

# 08 CHANGE MANAGEMENT (GOVERNANCE, PARTICIPATION & COMMUNICATION)

# UM Living Lab System User Manual

- 1. Dr. Sorayya Malek
- 2. Dr. Pozi Anak Millow
- 3. Cham Hui

# UM LIVING LAB SYSTEM USER MANUAL

### 1) INTRODUCTION

The biodiversity web module is incorporated into the University of Malaya Living Lab System. The outcome of the whole web module is shown and discussed in this chapter. The user interface is also included and describe in detail.

Website: <u>http://umlivinglabsystem.com/</u>

### 2) DESCRIPTION OF THE PROJECT

The University of Malaya Living Lab System biodiversity web module is a module especially for biologist and ecologist to calculate the biodiversity indexes and to learn and visualize the diversity patterns on Google Maps.

As a result, users will obtain the plant species information, which are the coordinates of the plant species, its common name, genus species name, diameter of breast height (dbh) and the record date whereby the plant species location is identify. At the same time, the most common diversity indexes are also calculated, which are the Species Richness, Shannon-Wiener Index, and the Simpson's Index.

### 2.1 Homepage of University of Malaya Living Lab System (UM Living Lab System)

Below shows the homepage when the users enter the website on the web browser. A brief description regarding the UM Living Lab System is displayed in the homepage.



Figure 113: Homepage for UM Living Lab System

### 2.2 Polygon Builder

The polygon builder page allows users to draw a polygon on the area of interest on the Google Maps and download as Keyhole Markup Language (kml) file.

This page is added in the web module is that not every user downloaded software that are able to generate kml file, such as ArcGIS and Google Earth.

Just search for the place on the search bar and click on the polygon button, and begin to create polygons. Next, under the KML tab just click on download the kml file.



This page is an iFrame of another website: <u>https://www.doogal.co.uk/polylines.php</u>

Figure 114: Polygon Builder page

### 2.3 Import Polygon File

This page is the Import Polygon File page that allows users to upload the polygon file in kml format. The kml file is download from the polygon builder page or perhaps the users created own kml file using Google Earth.

Selecting the desired polygon file and enter specific name for the polygon, the polygon file will automatically be into the database uploaded by clicking the **Upload** button and able to view in Polygon Map page. An example of polygon file is shown on the right-hand side of the page.



Figure115: Import Polygon File page

### 2.4 Polygon List

This page shows the list of polygons where the users uploaded. Any further modification **and changes are allowed where the user can click on the 'Edit" text, and it will link to** another page, which is the Edit Polygon Information page.

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Figure 116: Polygon List page

### 2.5 Edit Polygon Information

In this page, users allow to make changes on the polygon names and update the polygon name by clicking on the Update button. Else, users may also delete the file they uploaded by clicking on the Delete button.



Figure117: Edit Polygon Information page

### 2.6 Import Biodiversity Data

If the users have a set of data in a spreadsheet, it is advisable for the users to upload the data in excel format (.xlsx), users do not need to enter the plant species data one by one on the 'Add Plant Species' page.

This page whereby users can select the excel file and upload into the system, however the users need to follow the format of the spreadsheet, only then the data is readable by the system. A reference template is given, and users can download it as a reference, to prevent any mistakes. Once the users click on the **Upload** button, the selected excel file will be uploaded into the database.


Figure 118: Import Biodiversity Data page

# 2.7 Add Plant Species Information

This page allows researchers or users to add plant species information where they encountered and contribute to the system.

The researchers and users must enter the plant details, such as:

- ➢ Genus Name
- > Species Name
- ➢ Common Name
- ➤ Latitude
- ➢ Longitude
- Diameter of Breast Height (dbh)
- ➢ Record Date

Next, click on the 'Save' button to save the record.

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Figure 119: Add Plant Species Information page

#### 2.8 Plant Species List

The added plant species is then can view on this page. This page users can view the available plant species records on the database. The users can search the plant species records by record date on the search bar. Users can enter the specific date and can click on the date on the display calendar.

The list shows the Record date, latitude, longitude, diameter of breast height, common name, genus and species of the plant species. By clicking on the 'Edit', it will directly link to Edit Plant Species Page, where user can manage and edit the plant data.



Figure 120: Record date search bar

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Figure 121: Plant species list page

## 2.9 Edit Plant Species Information

From the Plant Species List, when the users click on the 'Edit' text, it will directly link to this page. Whenever there are mistakes or any addition on the plant species data, users are free to perform any modification and update the plant species information by

clicking on the Update button. Else, the Delete button is also available, which allows the users to delete the records.

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Figure 122: Edit Plant Species Information page

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177 | Page
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## 2.10 Polygon Map

The Polygon Map display the uploaded polygon file on the Google Maps. First, the users

can select the area of interest on the drop-down list. The Generate button, will automatically generate the polygon and eventually will display the selected polygon.



Figure 123: Polygon Map page shows the polygon of Faculty of Science

## 2.11 Polygon Species Map

In this page, when the users select the polygon on the drop-down list, and click on the **Generate Tree** button. The map will display the selected polygon together with the plant species which represent in the marker **Ŷ**.

When click on the marker  $\mathbf{Y}$ , it will show the species information, which are the plant genus and species name, the coordinates and together with image of the species.



Figure124: Polygon and Species Map in DTC



Figure 125: Float window shows the information of the plant species *Mimusops Elengi* 

## 2.12 Species Topology

This page allows users to select the plant species either based on the plant species, plant genus or the common name of the plant. After selected a specific plant species, this page will show all the trees available in the campus together in the specify polygon.

Eventually, it allows user to compare the species available and which site has more species selected. The polygon is represented in color with a specific biodiversity range that enhance the representation of data.

Besides, by clicking the **Export** button, the users can download the csv file which contains the value of the diversity index together with the plant species.

The species is then show on the map together with the polygons, the species also represented in a marker  $\mathbf{\hat{v}}$ , when user click on the marker, it can show the plant information on a float window.

The float window consists plant species information and the diversity index, such as the Genus Species name, common name, coordinates, image of the trees and the diversity indexes, which are the Species Richness, Shannon-Wiener index and the Simpson's index is calculated as well.



Figure 126: Colour Indicator of Polygon of Biodiversity Range



Figure 127: Species Topology page



Figure 128: Multiple polygon is shown on the map with colour indication



Figure 129: Float window that shows species information and diversity indexes



Figure 130: Polygon is shown on the map with colour indication and species information

**182 |** Page

## 2.13 Biodiversity Index Report

In this page, the users can generate a report based on the index type and plant species. First, users must select an index type, which are Species Richness, Shannon-Wiener Index or the Simpson's Index. Follow by select a plant species from the drop-down list. After that, click on state the button. The script will return and generate a biodiversity index report. The state button is where the user can download the biodiversity index report in .csv file.



Figure 131: Diversity Index Report page

## 2.14 Overview of the Biodiversity Web Module

The University of Malaya Living Lab System biodiversity web module is a module especially for biologist and ecologist to calculate the biodiversity indexes and to learn and visualize the diversity patterns on Google Maps.

As a result, users will obtain the plant species information, which are the coordinates of the plant species, its common name, genus species name, diameter of breast height (dbh) and the record date whereby the plant species location is identify. At the same time, the most common diversity indexes are also calculated, which are the Species Richness, Shannon-Wiener Index, and the Simpson's Index.

Thus, this site provides several features such as:

- Polygon (kml) creator.
- Upload polygon (kml) file.
- The list of uploaded polygons and the users can update/delete previous records.
- Upload biodiversity data in excel with a reference template.
- Add plant species information.
- The list of added plant species information and the users can update/delete previous records.
- Visualize the uploaded single polygon on Google Map.
- Shows all the plant species within the selected area on Google Map.
- Select interest plant species based on either common name, genus or species name and shows the location of the plant species and calculate the diversity index at the same time.
- Colour indication of the number of species based on area.
- Diversity index report based on the index type and the plant species.

This manual explains how to use the website to have a clearer picture on the uses of this biodiversity module. Users need to be logged into the website to add or make any modifications. Website: <u>http://umlivinglabsystem.com</u>

## 3) OUTCOME OF THE SYSTEM USABILITY TEST

The evaluation form is created based on the System Usability Scale (SUS) which comprises ten questions to assess the usability and functionality of the website. A system usability evaluation form is given to several users that are related to the project.

- > Lecturer from Institute of Biological Science, Faculty of Science, University of Malaya.
- > Lecturers for the Faculty of Built Environment, University of Malaya.
- Researchers from the Rimba Ilmu, University of Malaya.

The users will rank each of the questions as the following table 8 shown.

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

The scores are then convert into numbers and calculate the usability score using SUS. The outcome of the calculated score is average at the SUS score of \_\_\_\_\_ with a \_\_\_\_ grade, which can consider as



Figure 132: Grade rankings of SUS scores from "Determining what individual SUS scores mean: Adding an adjective rating scale." By Bangor, A., Kortum, P., & Miller, J. in 2009

Several comments and opinions regarding the website given by the users are as follows:

- The website can be improved.
- Include a picture glossary for ease of the users in case some of the users do not know the name of the plant species together with the plant information.
- \_\_\_\_\_
- \_\_\_\_\_
- •

The overall impression towards the website is average at the score of 4, indicates "Somewhat satisfied", for the features of the website. However, future enhancement can be done.

# 4) ENCOUNTERED PROBLEMS

The following are some of the problems encountered during the research project analysis and development.

# i) Confusion in using which biodiversity indexes

There are many biodiversity indexes available to measure the biodiversity. Confusion on which biodiversity index should be incorporated into the system. By reading pass research study and interview some experts from this field, Shannon-Wiener index and **Simpson's index is the most commonly used index. This is why only these two indexes** are incorporated into the system.

# ii) Limited Plant Species Images

At first, there are only 10 images provided. However, the image can be included from time to time.

# iii) New Programming Language

This web-based module is written in C# and ASP.net, together with HTML, CSS and Javascript. Some knowledge in database management is also required. These languages are not taught during lectures and require a lot of time to master it.

# 5) BIODIVERSITY WEB MODULE STRENGTHS

The following features illustrate the strength of the biodiversity web module.

## i) Simple and user-friendly interface

The website is designed to simplify the instruction and operability of the website. A side menu is included so that the users can navigate to different page at ease. Simplistic is the basic concept of designing the interface, description is added to for those that are not proficient in using the website.

## ii) Manageable polygon and plant species database

The information of polygons and plant species can be added, edited and deleted by the **users including the name of polygons, and the plant species details. It encourages users'** participation in managing the data from time to time and expanding the database, and

more and more relevant information can be retrieve from the website making the website more comprehensive and complete.

#### iii) Ease of use

The biodiversity web module is easy to use and get started with. The website is design in a sequential fashion, start with managing the polygon and plant species data, follow by visualization of the plant data on the map. This website is designed and planned according to the users, especially biologist and ecologist to meet their requirements. Besides, this website can be access on various web browsers such as Google Chrome, Microsoft EDGE, Internet Explorer, Mozilla Firefox and others.

#### iv) Graphic representation

The uploaded polygon and plant species data will retrieve from the database including the images of plant species. The images of the plant species are obtained from the researcher in Rimba IImu. The retrieved information will then display on the map.

## v) High functionality

The Biodiversity Web Module contains many features and users do not need to download extra software, especially the polygon builder. The users can draw a polygon and download as kml file automatically. Besides, the data can easily manage online and visualize it at the same time. The biodiversity index is also calculated and a biodiversity index report can be generated. All the functions and features are all included in a single web based module. Compare with other website, it only provides stand-alone functions, where it can calculate the biodiversity index or it can just visualize the species on the map.

#### vi) Web module transparency

It refers that users do not need to know where exactly the database resides, how are the system architecture, the database management system and anything regarding the system built. For instance, the users can easily identify the species topology and the diversity index is automatically calculated. This is to determine the users will not be disturbed and confuse by the complexity structure of the web module.

# 6) BIODIVERSITY WEB MODULE LIMITATIONS

The following points are the limitations of the system.

## i) Rigid Google Map

Unlike the Google Map in Pericopsis.org, the users can draw a polygon on the map and show trees automatically. This biodiversity web module only can select based on polygon or plant species, since the polygon is already drawn. However, users do not need to draw the polygon each time use the website.

## ii) Unable to locate tree species accurately

The users unable to check in the species quickly and directly. The users need to pin point in another map that gives the latitude and longitude, then only key into the system.

## iii) Require update from the users

The polygon and plant species data need to keep updated always. Since biodiversity is dynamic and it varies from time to time, thus, researcher needs to update the data, whether there is any new species or the specific plant species is already gone to ensure the accuracy.

## iv) Limited number of plant species image.

The image given by the researcher from Rimba Ilmu is limited, some of the image cannot be shown due to unavailable of the data.

## 7) FUTURE ENHANCEMENTS

There are several enhancements can be considered in the future to increase the usability of the website. Since the web module is built using the dynamic system development method (DSDM), increment on the web module is allowed.

The recommended enhancements are described in the following:

# i) Picture Glossary

A picture glossary is strongly recommended to be added into the web module, since not everyone able to recognize the species name, especially the scientific names. A page with all the plant species information together with plant image, will help users in identifying the plants.

## ii) Increase the biodiversity indexes

There are much more biodiversity indexes that has not been included in the module, if there is any request for it, it still can be embed on the web module as well.

## iii) Increase the flexibility of the map

The map can be enhanced, where the users can draw the polygon on the area of interest and show the trees on the map. Besides, screen capture function can be added, where users can save the image of the map.

## iv) Species Check-in module

This module allows users to add the plant species data by automatically identify the location of the plants. The users are required to identify which is the species and where it is.

# v) Carbon Emission Calculator

The web module can further expand by adding a carbon emission calculator, since the data regarding the number of plants is available in the database.

### 8) Overall Conclusion

In overall, the University of Malaya Living Lab System Biodiversity Web Module has achieved and fulfilled the objectives and requirements of the users, which are the biologist, ecologist and urban planners. However, this web module is not limited within the University of Malaya, other users also can contribute to the website too. In this research project, our study site is the University of Malaya.

There are few empirical study regarding the visualization of biodiversity index. Most of the study just focus on the calculation of the diversity index. With this module, the users can calculate the index and at the same time visualize the species distribution on the map. Besides, providing related information to the users about the location and details of the plants.

There was a lot of knowledge gained throughout the development of the web module. These include learning new programming languages, database management, software development methodology, development platforms tools as well as the biodiversity indexes and conservation biology. Meanwhile, software development includes planning, design, engineering implementation and testing are crucial in completing the project within the given timeline. The actual practice and application about the theories learned before.

There are still ways for improvement of the web module as discussed before. The improved version of the biodiversity web module may be implemented in future based on the functional requirements of the users. Currently, the web module fulfills the needs and objectives of the users.

Finally, the project was completed successfully as part of my final year research project in bioinformatics program. Nevertheless, the project has embedded on the University of Malaya Living Lab System, the website is http://umlivinglabsystem.com

#### 9) Reference

Bangor, A., Kortum, P., & Miller, J. (2009). Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of usability studies*, *4*(3), 114-123.







# UNIVERSITY OF MALAYA LIVING LAB GUIDELINES VOLUME I

University of Malaya Living Lab Guidelines Volume I consist of collective guidelines which provides step-by-step guidance and know-how in tackling respective sustainability topics: biodiversity, waste, energy, transportation, and water among others. This compendium aims to provide a basic reference for users and general public on how to contribute their part in respective topics and eventually promote the importance of sustainability education and awareness to wider community.