TENAGA NASIONAL
Better. Brighter.

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

2016 – 2020

RESEARCH ROADMAP TOWARDS LEADING ENERGY UNIVERSITY

FOREWORD

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

Investing in the future while maintaining our mission and vision, this strategic research roadmap identifies worthy research areas that will keep UNITEN competitive both at national and international stages. This roadmap institutionalized a commitment to excellence with a synergy in research for UNITEN. Our five Research Institutes that focus on Sustainable Energy, Energy Policy and Economics, Power Engineering, Energy Infrastructure and Informatics and Computing in Energy highlight opportunities, research and programs that corresponds to the long term need of our stakeholders.

On behalf of UNITEN, I would like to thank each and everyone of you for your commitment and continuous support. Let's make this research roadmap a journey towards realization of our mission and vision.

Yours Sincerely,

DATO' PROF. IR. DR. KAMAL NASHARUDDIN BIN MUSTAPHA
Vice Chancellor
Universiti Tenaga Nasional

ABOUT THE ROADMAP

A Roadmap shows:

Commitment	Provides and shows a clear DIRECTION. Provides FOCUS on strengths and niche areas.
Planned Efforts	Supports synergies of efforts and teamwork. Facilitates prioritization of budget and grant applications. Projects are independent of individuals. Aligns newcomers.

A Roadmap is made up of:

A big picture of development and application of generic technologies, methodologies and techniques.

- Consolidates and expands current/base strengths.
- Looks for advances and/or quantum jumps.
- Applies in future applications.

BASIS OF FORMULATION
of UNITEN Research Roadmap

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

TNB's Need

TNB's Need
Domestic Dominance Regional Champion (DDRC) Aspiration

TNB's Need
- TNB Technology Roadmap
- TNB Focus Areas
- Reimagining TNB

UNITEN Research Roadmap 2016-2020

Nation's Need
Malaysia Education Blueprint 2013-2025

Nation's Need
National R&D Framework and National Priority Areas

Nation's Need

NATIONAL PRIORITY AREAS

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ROADMAP 1
2008 - 2015:
Enhancing Research Culture & Inculcating Research Quality

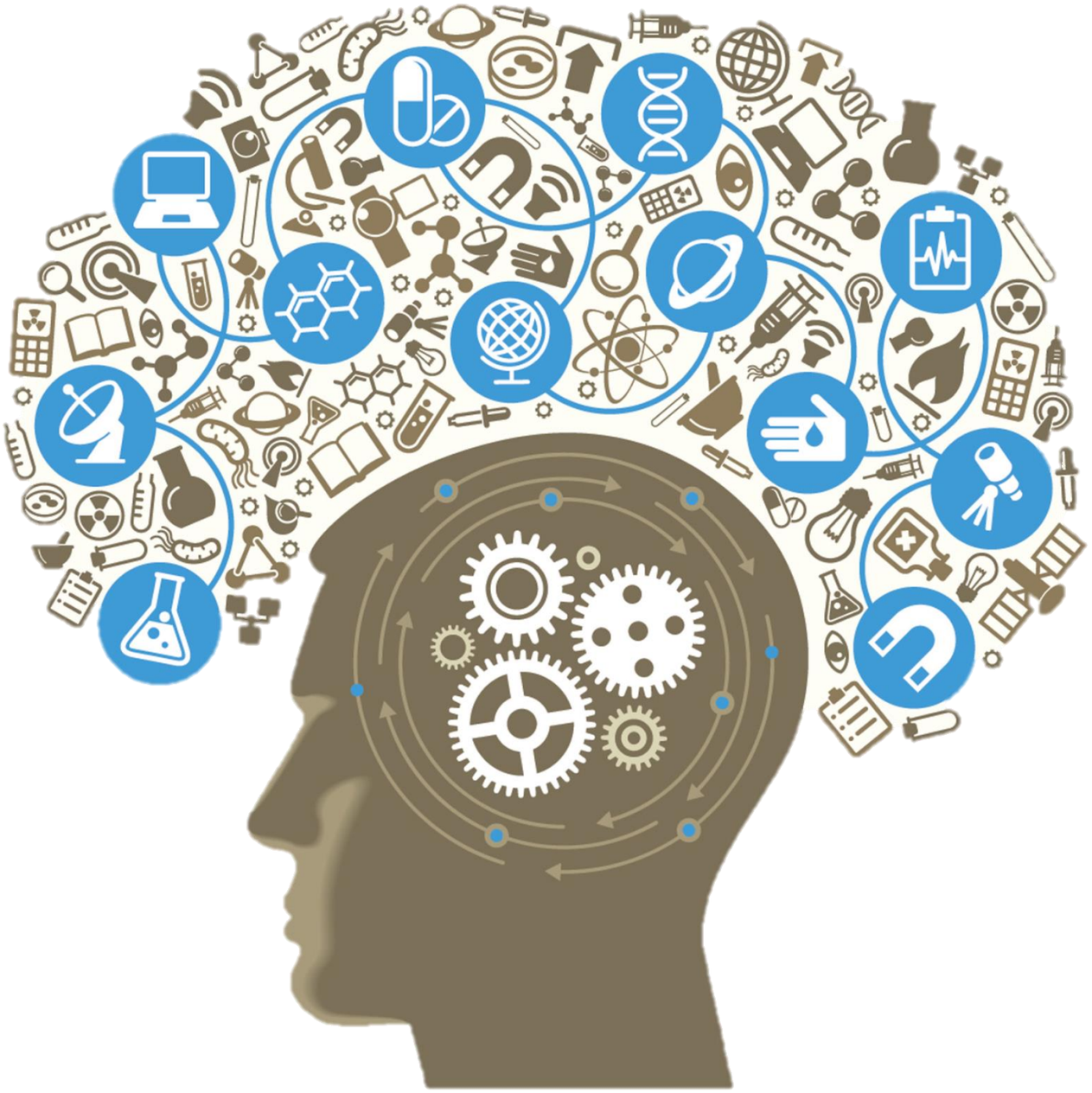
KEY

SHIFTS

ROADMAP 2
2016 - 2020:
Promoting Research Excellence

From Research Discoveries to Commercialization (Complete R&D Ecosystem)

TNB FOCUS AREAS



- Smart Cities
- Renewable Energy
- Big Data Analytics
- Energy Efficiency
- Energy Storage
- Electric Vehicles
- Power Transmission
- Power Generation
- Power Distribution
- Dam Safety
- Alternative Fuel Generation
- Energy Related Disaster Management
- Super Clean Coal Technology
- Cyber Security
- Renewable Energy (RE) Outlook 2050
- Carbon Footprint

UNITEN'S KEY MILESTONES

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

National leader — Sep 2017

Regional leader — 2020

Emerging global champion — 2025

Top teaching university in Malaysia – SETARA Tier 6 Outstanding

Established **research collaborations** with **world-class institutions** (e.g. Oxford Institute of Energy Study

>1,500 students touched by first 7 blended learning courses

Internet speed upgraded to 10GB – highest in Malaysia

Fundraising and industry partnership functions launched,

First intake for **multidisciplinary programme**

Entrepreneurship Programs launched

Multi-career track talent development pathways

Improved ranking – Top 200 in QS Asian Ranking

Improved ranking - Top 151-200 in QS World by Subject – Electrical & Electronic Engineering

6 leading local and international faculty recruited as **strategic hires**

Top university with **adaptive blended learning technology**

Increased international students to 11%

New building featuring **open concept lab for research and teaching** completed

Higher Institution Centre of Excellence (HICOE) status in energy security

Improved ranking - Top 100-150 in QS World by Subject – Electrical & Electronic Engineering

Partnering with top employers 35 of top 50 employers in Malaysia to recognize UNITEN as provider-of-choice

Excellent value creation via innovation, Intellectual Property and commercialisation

International center of specialization in future energy supply, transport and utilisation

~RM104 mil cumulative gains in donations and sponsorships (from 2016)

~RM165 mil cumulative additional research grants and consultancy revenue (from 2016)

OVERVIEW 2010-2015

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

Pre-R&D | Basic R&D | Applied R&D | Prototype R&D / PreCom | Commercialization

Seeding Programs

UNIIG

Government's Fund

International Fund

Other Funds

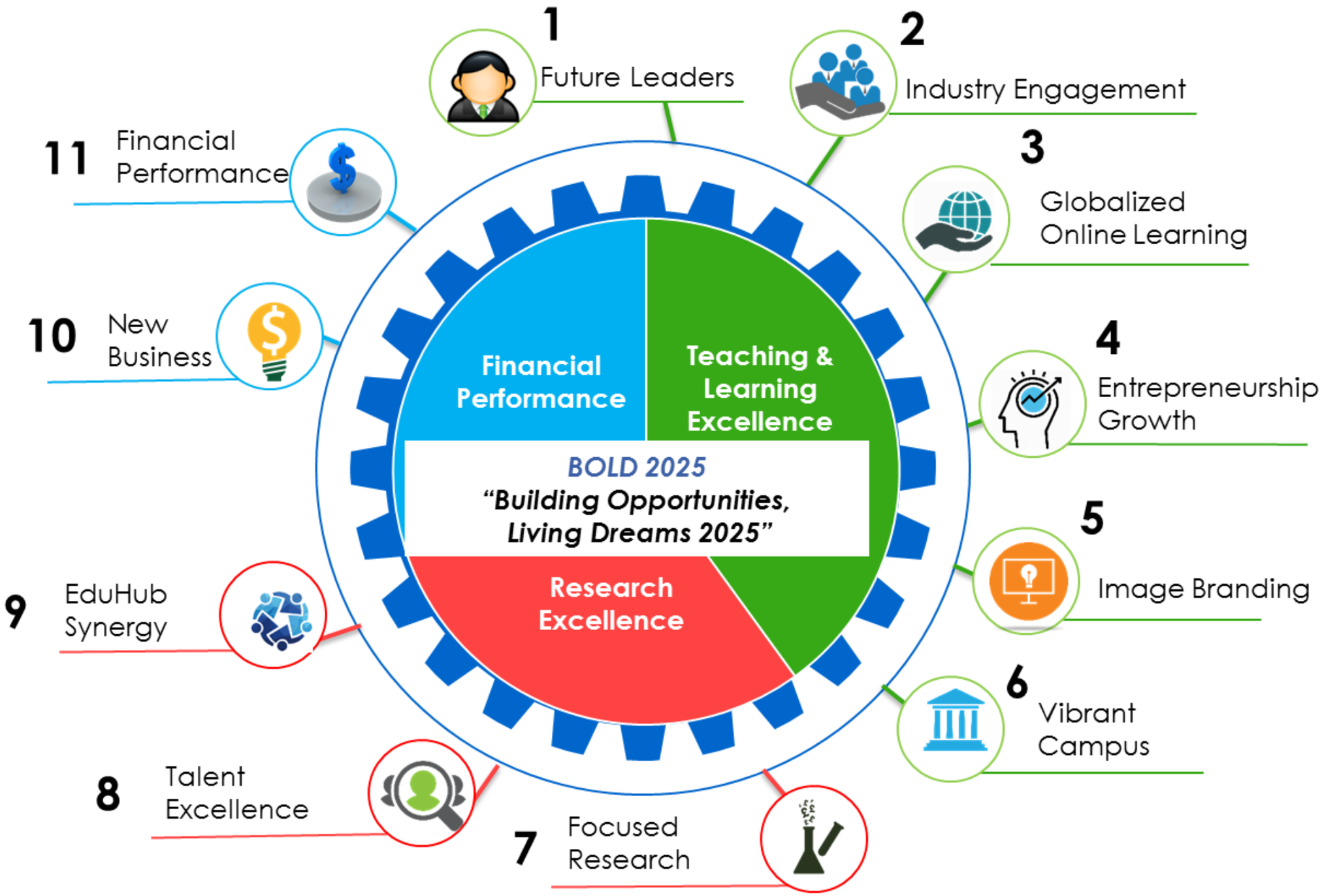
1	Total R&D grant secured:	~RM27.45M
2	Current % of Principal Investigator:	67%
3	Total # of publication:	4818
4	Total # of citation:	6713
8	Amount of consultancy project secured:	~RM60.9M
9	# of consultancy project secured:	413
10	# of commercialized products:	6

5	Total # of filed patent:	59	6 Total # of granted patent:	7	7 Total # of Copyright and Trademark registered:	131

UNITEN BOLD 2025

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

"To become a **globally competitive, energy-focused university**"



OUR JOURNEY

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

Advancing research on energy industry

2015 | 2016 | 2017 | 2018 | 2019 | 2020

2015
A Research Led University

Improved ranking – Top 200 in QS Asian Ranking

Improved ranking - Top 151-200 in QS World by Subject – Electrical & Electronic Engineering

Higher Institution Centre of Excellence (HICOE) status in energy security

MyRA 5 Star

Transforming UNITEN MyRA Score
2011 2-Star
2014 4-Star
2017 5-Star

QS 4Star Rating

2020
A Leading Asean Energy University

RESEARCH EXCELLENCE STRATEGIC OBJECTIVES

RESEARCH ECOSYSTEM IN UNITEN

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

BOLD 2025
RESEARCH EXCELLENCE
Globally Competitive; Energy Focused University

IEPRe
(Institute of Energy Policy & Research)

- *Direct funding from EC / TNB for Chair in Energy Economy*

IICE
(Institute of Informatics and Computing in Energy)

IEI
(Institute of Energy Infrastructure)

IPE
(Institute of Power Engineering)

ISE
(Institute of Sustainable Energy)

- *Direct funding from AAIBE for Chair in Renewable Energy*

THE ENERGY SPHERE

UNITEN R&D
(UNITEN R&D SDN BHD)

- Research Funding from Industries leveraging on Section 34B, Income Tax Act 1967
- Drive IP & commercialization

iRMC
(INNOVATION & RESEARCH MANAGEMENT CENTRE)

- Research funding from MOHE, MOSTI, Government Agencies, International Agencies
- Develop research roadmap for UNITEN
- Develop research capacity for UNITEN

HIGH PERFORMING WORKFORCE

UNITEN RESEARCH INSTITUTES

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

Institute Of Power Engineering (IPE) (2005)

Power and energy services convergence research cluster emphasizes the multidisciplinary aspects of electrical, information and communication technology, and electronics engineering knowledge towards developing a seamless and intelligent power and energy system.

Institute Energy Policy and Research (IEPRe) (2009)

Delivery of research and consultancy efforts to the electricity supply industry, in the area of Energy Economics, which would enable government and industry players make informed decisions on the industry and create on environment of growth and sustainability

Institute of Sustainable Energy (ISE) (2012)

ISE is a one stop center for Research and Development in Renewable Energy. ISE provides a sustainable platform in national renewable energy development.

Institute of Energy Infrastructure (IEI) (2016)

Vision to be a globally known research center in development and advancement of sustainable infrastructure in energy sector. IEI has set their mission to discover, develop, and deliver innovative solutions in order to provide a better sustainable infrastructure in energy sector.

Institute of Informatics and Computing in Energy (IICE) (2016)

IICE aims at providing frontier research and development in using ICT to address energy challenges. Smart, clean, intelligent and sustainable are the key words of expected results of the R&D. Multi-disciplinary in IICE converge the R&D in ICT to eventually provide recognized solutions for energy sector.

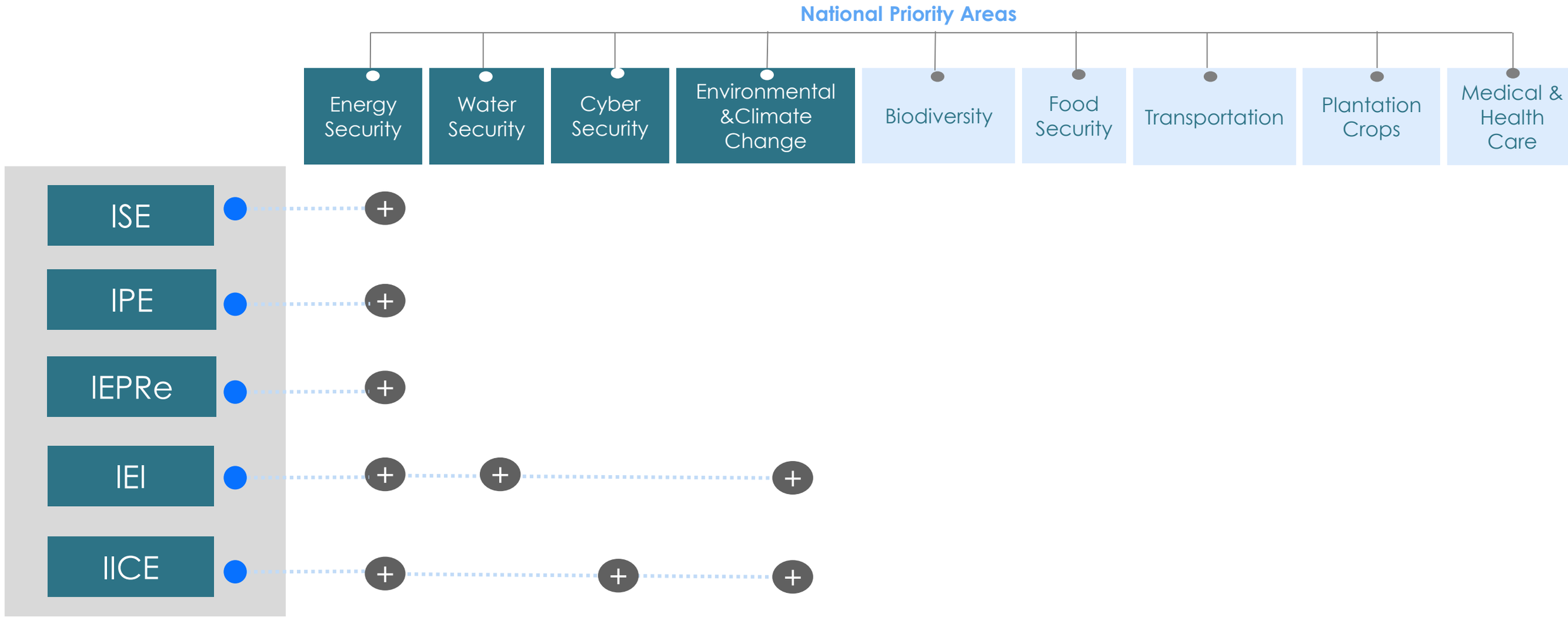
UNITEN NICHE AREAS

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

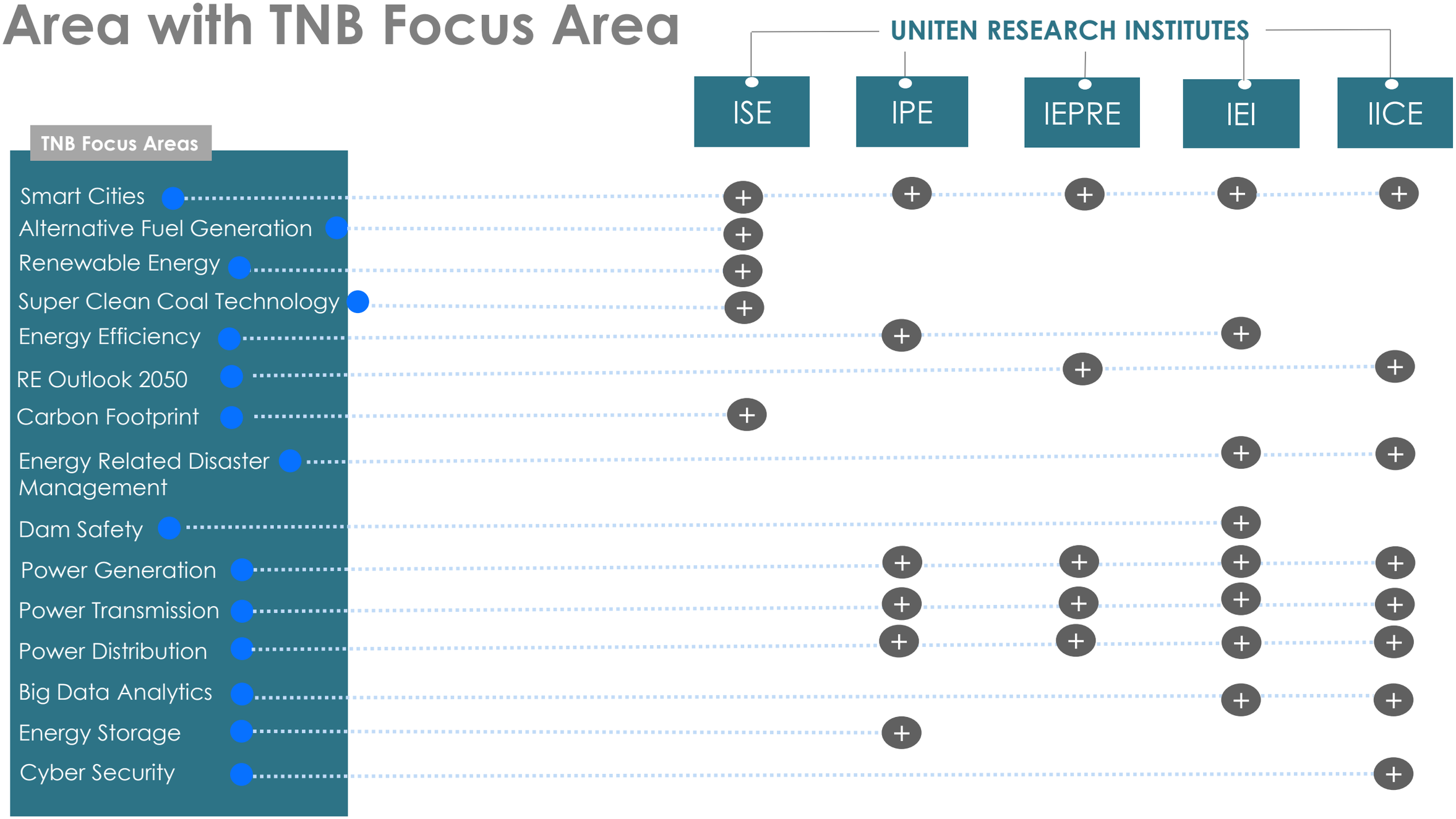
Research Institutes		Niche Areas
Institute of Power Engineering (IPE)	**Power Engineering**	Transmission & Distribution Advanced Technologies; Power Generation & Efficient Energy Utilization; Intelligent & Resilient Future Grid
Institute of Energy Policy and Research (IEPRe)	**Energy Policy**	Energy Economy; Regulatory & Policy; Social Transformation
Institute of Sustainable Energy (ISE)	**Sustainable Energy**	Solar; Wind; Biofuel; Nuclear
Institute of Energy Infrastructure (IEI)	**Energy Infrastructure**	Geospatial Intelligence; Energy Water Security; Sustainable Built Environment; Disaster Risk Reduction
Institute of Informatics and Computing in Energy (IICE)	**Informatics and Computing in Energy**	Energy Info Structure & Ontology; Human Centered Computing; Governance Management and Audit; Data Analytics & Visual Informatics; Intelligent and Secure Energy Systems

Towards Re-imagining TNB

Research Alignment Between UNITEN Research Focus Area with National Priority Areas



Research Alignment Between UNITEN Research Focus Area with TNB Focus Area



ISE ROADMAP

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

| 2016 | 2017 | 2018 | 2019 | 2020 |

BIOFUEL

- Waste to Energy Production Technology
- Advanced Solid & Liquid Biofuels Production
- Advanced Biogas & Biomethone Production Technology
- Fuel Testing Lab Establishment

SOLAR

- Advanced Thin Film Materials & Solar Cell Development
- Power Management & Battery ICs
- Lab/Prototype Equipment Establishment
- Solar Charge Controller

WIND

- Wind Resource Modelling and Assessment
- Design & Development of Low Velocity Wind Turbine

NUCLEAR

- Gen IV – Small Modular Reactor Technology
- Design & Development of Shielding Systems for Nuclear Facility
- Feasibility Study on Thorium Fuel Cycle in Malaysia
- Research on Public Opinion of Nuclear Energy

IPE ROADMAP

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

INTELLIGENT & RESILIENT FUTURE GRID

POWER GENERATION & EFFICIENT ENERGY UTILIZATION

TRANSMISSION & DISTRIBUTION ADVANCED TECHNOLOGIES

2016	2017	2018	2019	2020

- Demand Response
- Asset Management & Development
- Advanced Power System Protection
- Future Diagnostic Techniques
- Energy Management, Efficiency and Security
- Electric Transportation System
- Power Plant Performance
- Smart Power Generation
- Energy Storage
- Power Electronics Applications

IEPRe ROADMAP

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

	2016	2017	2018	2019	2020
ENERGY ECONOMICS	Energy Economics, Energy Policy				
	Energy Environment				
	Electricity Supply Industry				
	Energy Security				
	Governance, Energy Studies				
REGULATORY & POLICY	Capacity Market, Capital Market				
	Agent Management, Hospitality Management				
	Risk Management				
SOCIAL TRANSFORMATION	Corporate & Social Responsibilities, Entrepreneurship, Hospitality Management				
	Aborigines Eco-Community, Behavioral Study				
	Data Analytics and Business Modelling, Change Management				

IEI Roadmap

1997 - 2017
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IGNITING THE FUTURE

2016	2017	2018	2019	2020

GEOSPATIAL INTELLIGENCE

- Geo-hazard, Infrastructure and Asset Risk Management
- Remote Sensing Imagery, Intelligence Image & Geospatial Engineering
- Energy Infrastructure in Virtual Reality

ENERGY WATER SECURITY

- Dam Safety & Sustainability
- Flood Resilience Technology
- Sustainable Water Management & Smart Water Grid

SUSTAINABLE BUILT ENVIRONMENT

- Enabling Technologies for Sustainable Living
- Innovation Construction Engineering & Streetscape
- Green Energy Management & Planning; IHA Sustainable Protocols
- Smart Green Infrastructure & Green Community
- Ecological Restoration & Environmental Pollution Management

IEI Roadmap

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

2016	2017	2018	2019	2020

DISASTER RISK REDUCTION (DRR)

- Emergency Preparedness
- Community Based Disaster Management
- Technologies for Emergency Confinement and Restoration
- Portfolio Risk Assessment (PRA)
- Blackouts, Spillage Fire and Sabotage

IICE ROADMAP

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

2016	2017	2018	2019	2020

HUMAN-CENTERED COMPUTING

GOVERNANCE MANAGEMENT & AUDIT

INTELLIGENT AND SECURE ENERGY SYSTEMS

ENERGY INFO STRUCTURE & ONTOLOGY

DATA ANALYTICS & VISUAL INFORMATICS

SMART CAMPUS

- Crowdsourcing
- Computer Assisted Learning
- Knowledge Management
- Data Governance and Policy
- Agent of Things
- Lightweight Security Technologies
- Cryptographic Engineering, Embedded Security
- Smart Grid Security, Network Intrusion Technologies, Pervasive Advanced Threat Mitigation Study
- Energy Information Management & Representation
- Ontology of Energy Data
- Visualization & Simulation of Energy Data
- Predictive Analytics

BOLD 2025 TALENT EXCELLENCE

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

GOAL

RESEARCH EXCELLENCE

BOLD 2025

INITIATIVES

Each pathway would have its own structure & reward system

Key components for pathways

1. Career path & contract design
2. Support for faculty
3. Appraisal & performance management
4. Rewards & consequences

OUTCOME

UNITEN dual pathways for academic staff

Teaching Pathway
Inspiring Educators

Academic staff who focus on **teaching and applying latest instructional innovations.**

Research Pathway
Accomplished Researchers

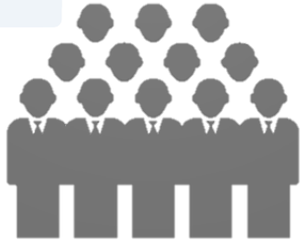
Academic staff who focus on **high impact research** but also have academic responsibilities.

MULTI Tracks

TALENT EXCELLENCE PROGRAM

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

COMPONENT 1: CAREER PATH & CONTRACT DESIGN



SUPPORT STAFF

Increase outputs by supporting High Performing Staff

QS RANKING

Achieve **Top 200** QS Asian Ranking and Top 150-200 Subject ranking

STRUCTURED TALENT PROGRAM

Increase Research Outputs, Improve **MyRA rating to 5 star** >75% and Improve QS Asian Ranking to Top 200

SERIES OF WORKSHOPS

Document for **Multitrack Career** pathway for UNITEN

TALENT EXCELLENCE PROGRAM

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

COMPONENT 2: FACULTY SUPPORT PROGRAM

START UP GRANT
Increase the number of Principal Investigator (PI) to support Section B MyRA

POSTDOC SCHEME
Increase the number of **postdoctoral researcher** to support Section B MyRA

PHD SCHOLARSHIPS (TOP-UP)
Increase MyRA Section D Postgraduates

POSTGRAD SCHOLARSHIPS
Increase MyRA Section D Postgraduates

ACCELERATOR PROGRAM - PUBLICATION
Increase **High Impact Publications** & **Citations** to support Section B MyRA & QS Ranking

ONLINE RESEARCH MANAGEMENT SYSTEM
IT-based research support system for developing high performing staff

UPGRADING UNITEN JOURNALS
Improve MyRA rating and QS ranking

PROMOTION & MARKETING
Increase visibility and branding of UNITEN R&D to improve QS ranking

TALENT EXCELLENCE PROGRAM

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

COMPONENT 3: APPRAISAL & PERFORMANCE MANAGEMENT SYSTEM

BENCHMARK AGAINST:

Multitrack Career Path Scheme

NANYANG TECHNOLOGICAL UNIVERSITY

University of Strathclyde Glasgow

The University Of Sheffield.

UNIVERSITI TEKNOLOGI MARA

UTM UNIVERSITI TEKNOLOGI MALAYSIA

NUS National University of Singapore

DEAKIN UNIVERSITY

UNSW AUSTRALIA

UNIVERSITI TEKNOLOGI PETRONAS

UPM

Imperial College London

Carnegie Mellon University

PURDUE UNIVERSITY

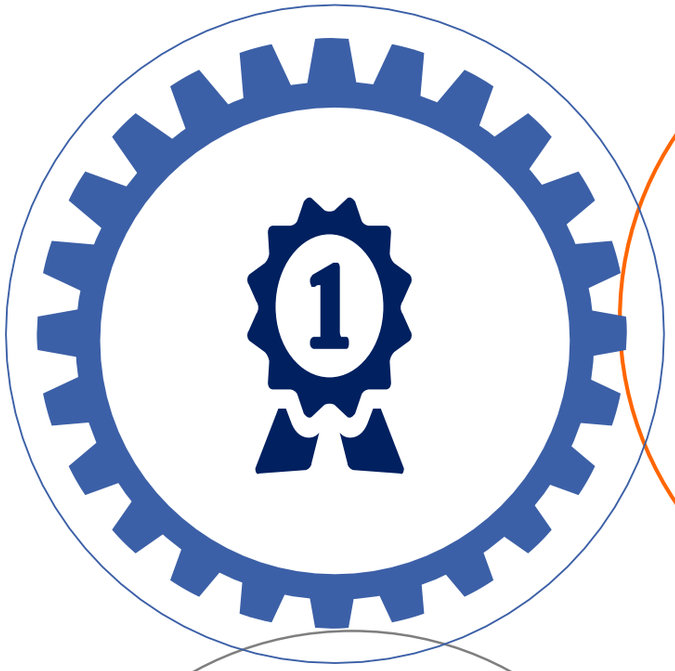
UniMAP

UNIVERSITY OF MALAYA

TALENT EXCELLENCE PROGRAM

1997 - 2017
CELEBRATING THE PAST
IGNITING THE FUTURE

COMPONENT 4: REWARDS AND INCENTIVES



HIGH IMPACT PUBLICATION
Increase High Impact Publication
- **MYRA**

TOP STAFF & RESEARCH CENTRE
Increase the number of PI
– **MYRA/HiCOE**

PATENT GRANTED
Increase the number of patent granted
- **MYRA**

SUCCESSFUL COMMERCIALIZATION
Increase Commercialization
- **MYRA**

GRADUATE ON TIME – PHD STUDENT
Increase Postgraduate
- MYRA

TEACHING & LEARNING MEDIA INNOVATION
Improve **MYRA** & **QS ranking**

TEACHING PUBLICATION
Improve **MYRA** & **QS** ranking