

Report on Hydrogen Activities in Malaysia

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PRESENTATION OUTLINES

- Introduction
- Current Energy Status
- New Government Initiatives
- R&D And Demonstration Projects
- Codes and Standards
- Recommendations
- Concluding Remarks

OIL DRIVEN ECONOMY



Malaysia's economy is an oil driven economy – for transportation and power generation

ENERGY ISSUES

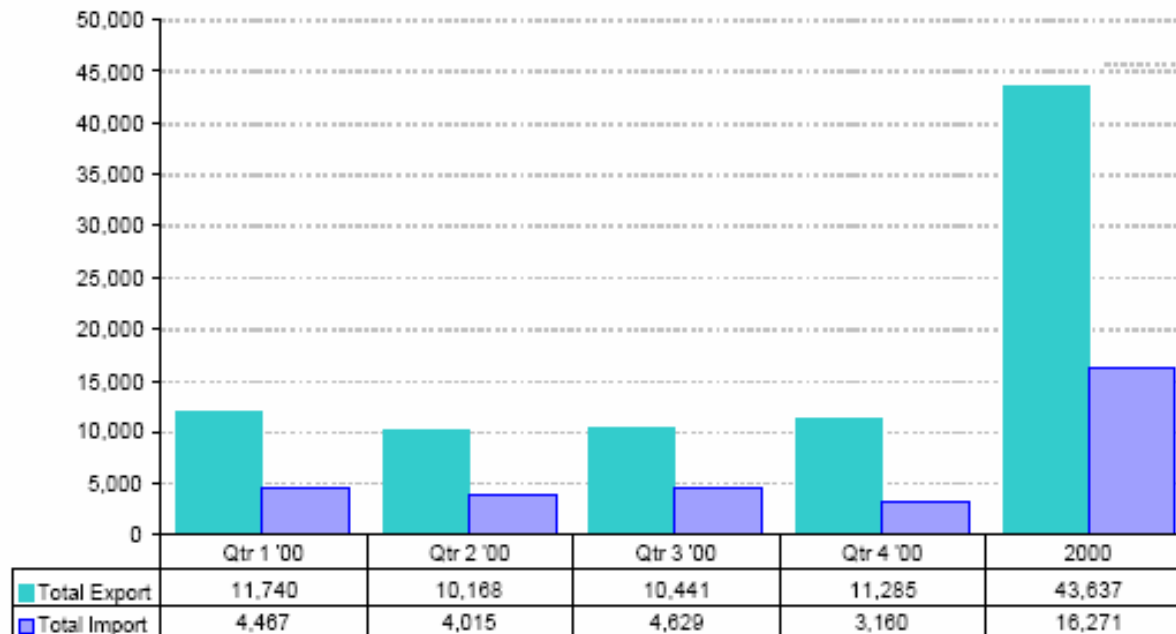
- Current Energy Related Issues
 - Increasing Cost of Energy
 - Availability of Fossil Fuel
 - Efficiency
 - Environmental impact
- Energy policy for sustainable development

OBJECTIVES

- Give overview of current activities in energy, RE, R&D
- Present current status on Codes & standard for hydrogen
- Future directions and recommendations

Malaysia is still a net energy exporter

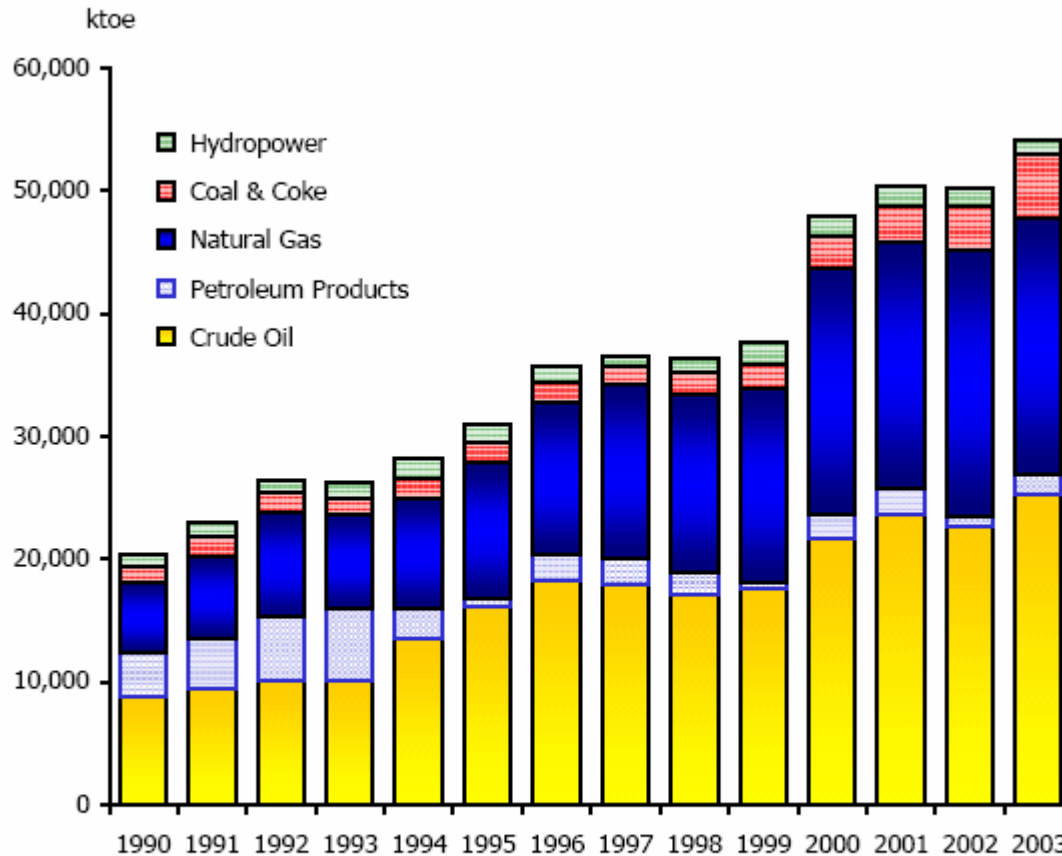
Figure 2
ENERGY IMPORT AND EXPORT (ktoe)



Note : Annual figure is subject to rounding
Source: Department of Statistics, Oil Companies, TNB and others

CURRENT SOURCES OF ENERGY

Commercial Energy Supply



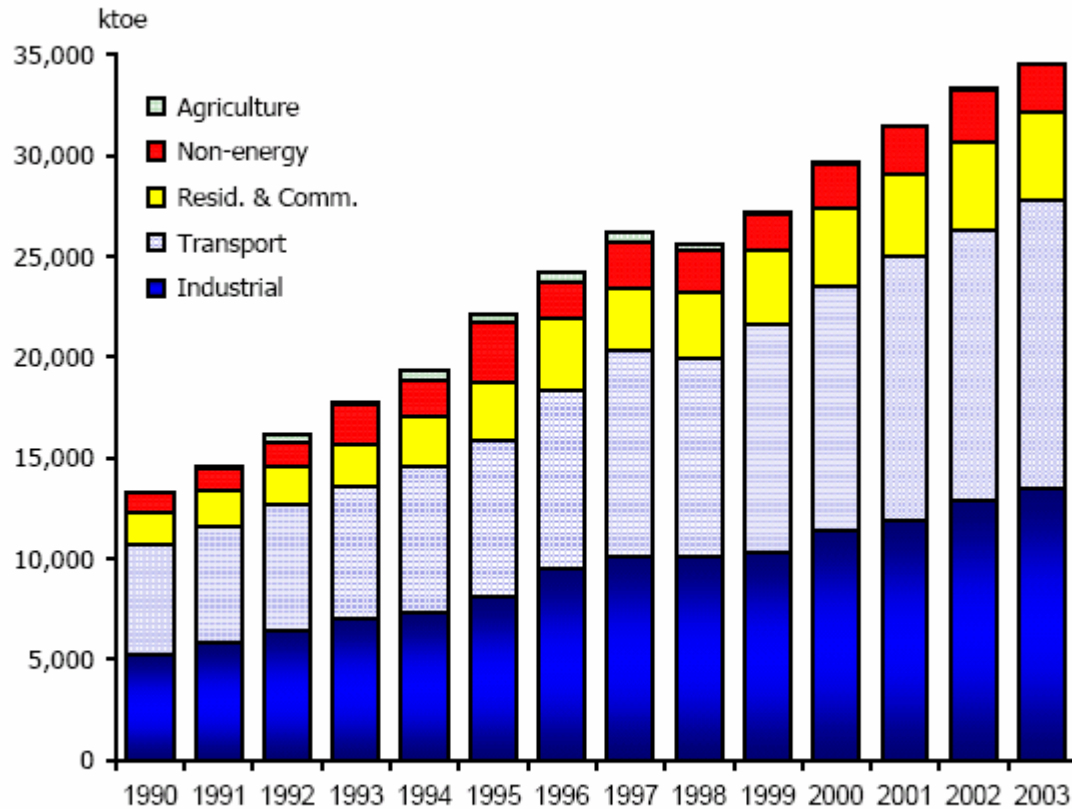
Note : Net natural gas supply after minus exports, flared gas and reinjection and LNG production

Source : Oil companies, power utilities, IPPs and cement, iron and steel manufacturers

Source: National Energy Balance, Ministry of Energy, Water and Communication, 2003

Final Energy Use

Final Energy Use by Sectors

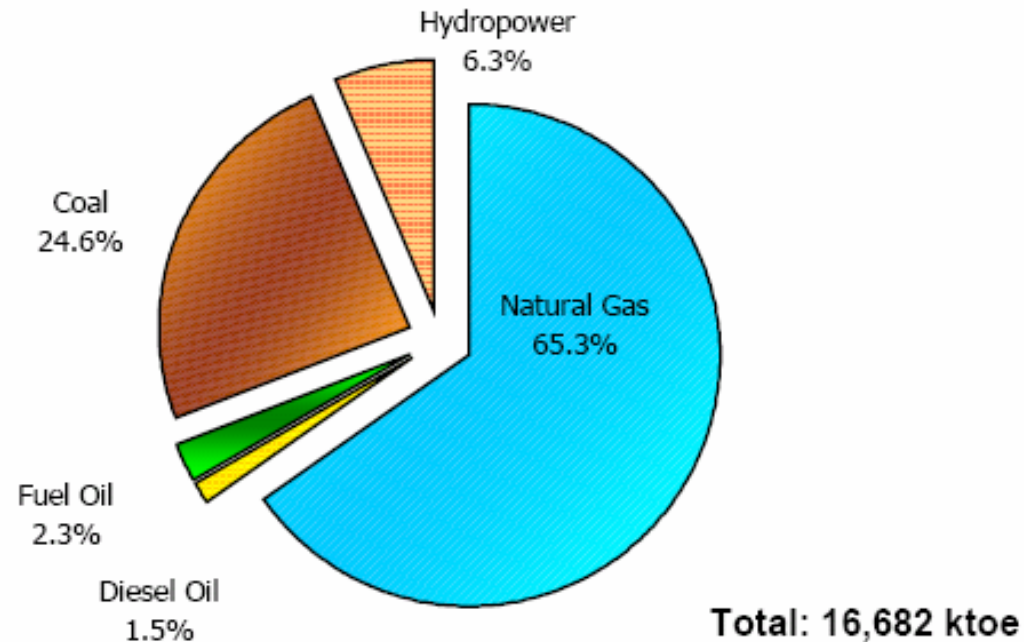


Note : Estimated data for Residential and Commercial from 1980 until 1996

Source : Department of Statistics Malaysia, TNB, oil companies and other.

FUELS FOR POWER PLANT

Energy Input in Power Stations



Note: Figures exclude fuel consumption for self-generation plants
Source: Power utilities and IPPs

‘MALAYSIA ENERGY VISION’

GOVERNMENT INITIATIVES

- Promotes renewable development concept
 - Fuel diversification program for power generation
- Develops 5th Fuel Policy
 - 5% generation from renewable fuel by 2010
- Develops a road map for hydrogen, fuel cell and solar
- Promotes awareness to public and education
- Promotes R&D in Fuel Cell, solar and renewable energy

5th Fuel Policy

- 5th Fuel Policy
 - A target 5% electricity generation to use renewable fuel by 2010
 - Exploits biomass potential as fuel to generate electricity
 - Capacity target less than 10 MW per day per plant
 - Production cost and financing problem

BIOMASS

ENERGY/HYDROGEN POTENTIAL FROM BIOMASS

Sources	(kton/yr)	Potential Annual Generation (GWh)	Potential Capacity (MW)
Rice Mills	424	263	30
Wood Industry	2,177	598	68
Palm Oil Mills	17,980	3,197	365
Biogases	300	218	25
POME	31,500	1,587	177

Source: PTM Annual Report 2000

PALM OIL PLANTATIONS IN MALAYSIA

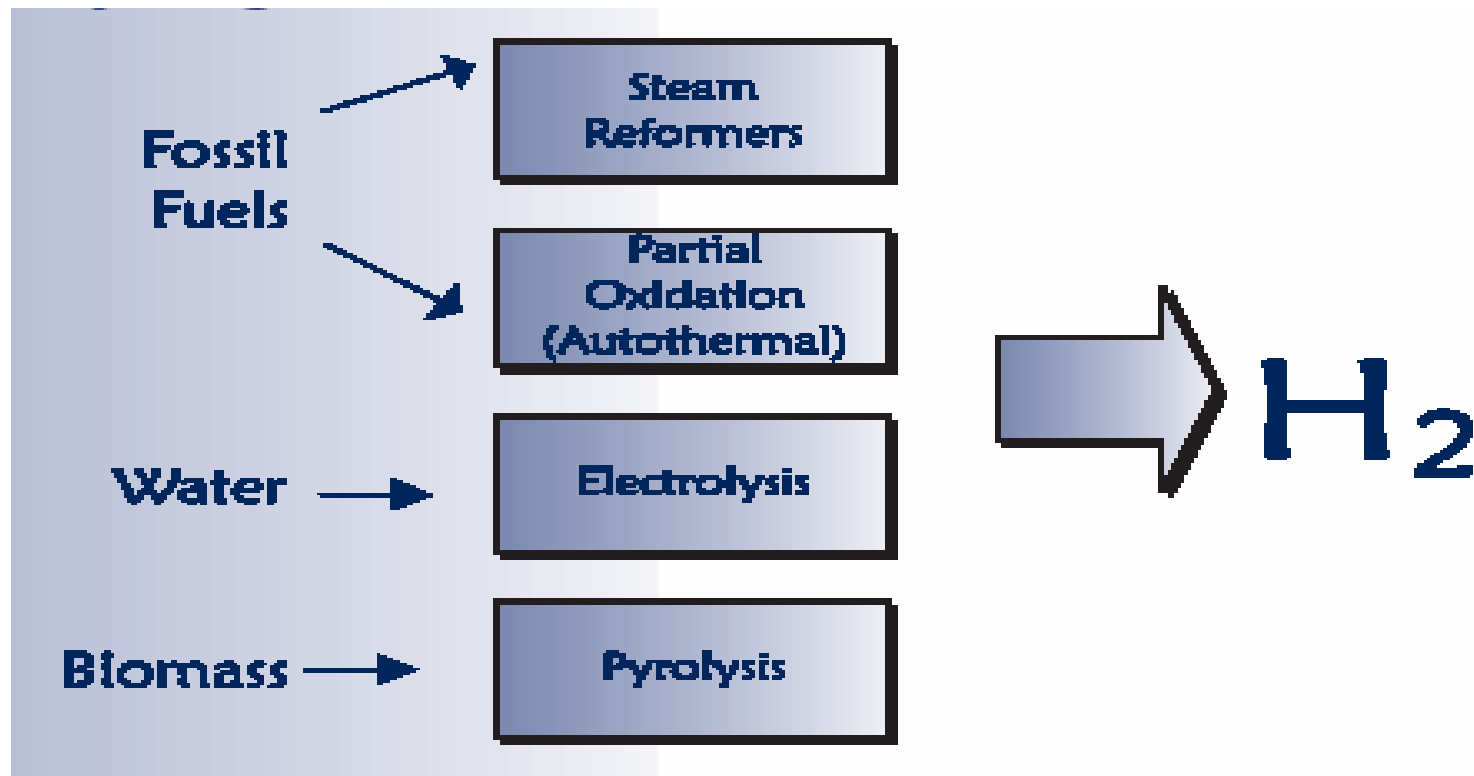


Sources of Biomass from Palm Oil Plantations:

- Empty fruit bunches (EFB)
- Palm Kernel Shell
- Fronds
- Palm Oil Mill Effluent (POME)

OVERVIEW OF H₂ INDUSTRY

HYDROGEN GENERATION



HYDROGEN UTILIZATION

- Current Utilization of hydrogen
 - Food Industry – hydrogenation process in Palm oil industry
 - Feedstock in refinery and petrochemical plant
 - Glass manufacturing industry

OVERVIEW OF R&D ACTIVITIES

- Development of Proton Exchange Membranes Fuel Cell (PEMFC) for stationary and mobile power generation
 - Stacks and components
 - Membranes
 - Hydrogen storage
 - Reforming of natural gas and methanol
 - Air-conditioning for buses
 - Fuel Cell powered motorcycle

OVERVIEW OF R&D ACTIVITIES

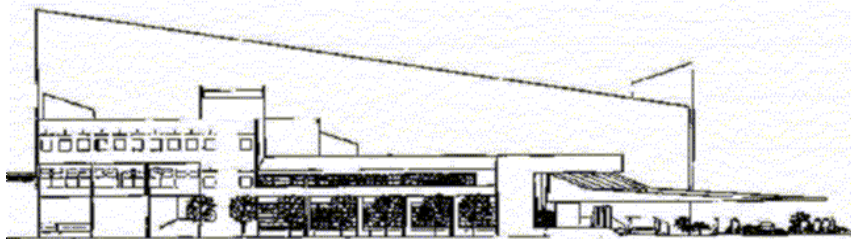
- R&D in solar and wind
 - Solar PV and heating
 - Day-lighting
 - Electricity generation from wind
- Universities and Research Institutions
 - Universiti Kebangsaan Malaysia (UKM) (www.ukm.my)
 - Universiti Teknologi Malaysia (UTM) (www.utm.my)
 - Others

‘DEMONSTRATION PROJECTS’

Zero Energy Office Building

- Zero Energy Office (ZEO) Building

Houses the office of PTM (Malaysian Energy Centre, www.ptm.org.my) with energy efficient design utilizing minimum (zero) electricity utilization from grid supply. Electricity is generated using solar PV to meet the requirement. The building is a demonstration project for building industry to emulate toward energy efficiency and energy self reliance.



PTM's ZEO building office –
Elevation view

Low Energy Office Building



- **LEO (Low Energy Office) Building**

Houses the office of The Ministry of Energy, Water and Communication (MEWC, www.mecm-leo.gov.my) . The building is aimed to demonstrate the use of renewable energy to meet its energy requirement with minimum or zero electricity supply from the grid. A target of BEI (Building Energy Index) 100 kWh/sq. m per year is expected to be achieved, much lower than the existing ceiling of 135 kWh/sq. meter per year.

BIPV Projects



Source: TPM & PJI Holdings

Building Integrated Photovoltaic (BIPV) Demonstration project in Malaysia shows a total of 400 kWp installed at various buildings such as Technology Park Malaysia (picture above) and other installations including BP Gas Stations, research institutions, and universities

Solar-Hydrogen Eco-house



Solar energy is used by PV panel to Generate 5 kW electricity for lighting and for electrolysis process using Proton Exchange Membrane Fuel Cell (PEMFC) to generate 0.54 cu. m per hr hydrogen as clean fuel for cooking and hot water uses. Stored hydrogen is also used by PEMFC at night for electricity generation. Excess electricity is connected to Grid

The Solar-Hydrogen Eco-house, Located at UKM (www.ukm.my) is designed to blend the tropical environment using traditional Malay architecture, which possessed a bio-climatic environment. Among the elements adopted from the Malay kampung house is the raised roof and deep verandah for efficient ventilation and cooling.

FUEL CELL POWERED TRICYCLE

- A tricycle prototype powered by 300 watt PEMFC using hydrogen was developed and rigorously tested on different road conditions.
- The actual performance follows closely to the design performance. Maximum speed is 40 km/hr, fuel consumption is more than 800 km/gallon of gasoline equivalent and the fuel capacity of 900 km
- The tricycle is used to calibrate a new fuel cell engine simulator currently developed by UTM fuel cell Research Group (www.utm.my). The simulator is used in the design of H2Motive™



FUEL CELL POWERED SCOOTER

- A project developed by UTM fuel cell research group (www.utm.my) is aimed to demonstrate the technical and economic viability of 7 kW fuel cell engine powered by hydrogen fuel. The prototype is called H2Motive™ and it is expected to be tested on the road by end of 2005.
- Design works have been completed
- Fabrication and integration works are in progress
- The power train consists of PEMFC stacks, and traction battery
- Direct drive train uses permanent magnet motor with regenerative braking capability
- The project is fully funded by MOSTI (www.mosti.gov.my)



FUEL CELL POWERED CAR



A demonstration project undertaken by Agni Malaysia (www.agni.com) in which a Malaysian made car 'Kancil' is converted to fuel cell car powered by hydrogen. The prototype is expected to undergo On-the-road testing by the end of 2005

‘CODES AND STANDARDS’

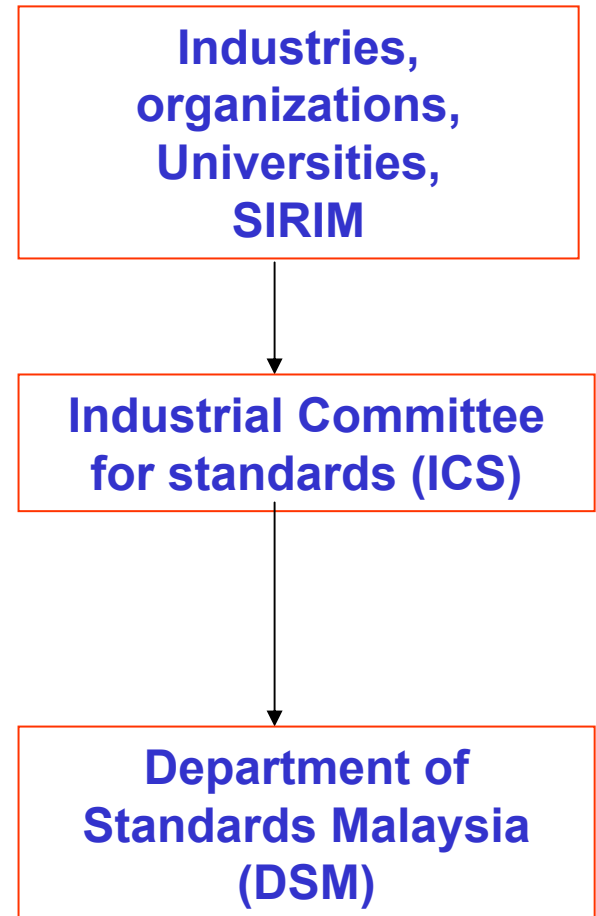
CODES AND STANDARDS ON HYDROGEN

- **Specific codes and standards for hydrogen – generation, storage, distributions and utilization are not yet available**
- **Safety regulation, codes and standard involving hydrogen are implicitly available in different areas depending on its application. e.g. pressure vessels, mechanical etc.**
- **Malaysia normally adapt, adopt and develop codes and standards based on International standards (ISO). Other standards e.g. US, EN, DIN and BS are also used as references where appropriate**

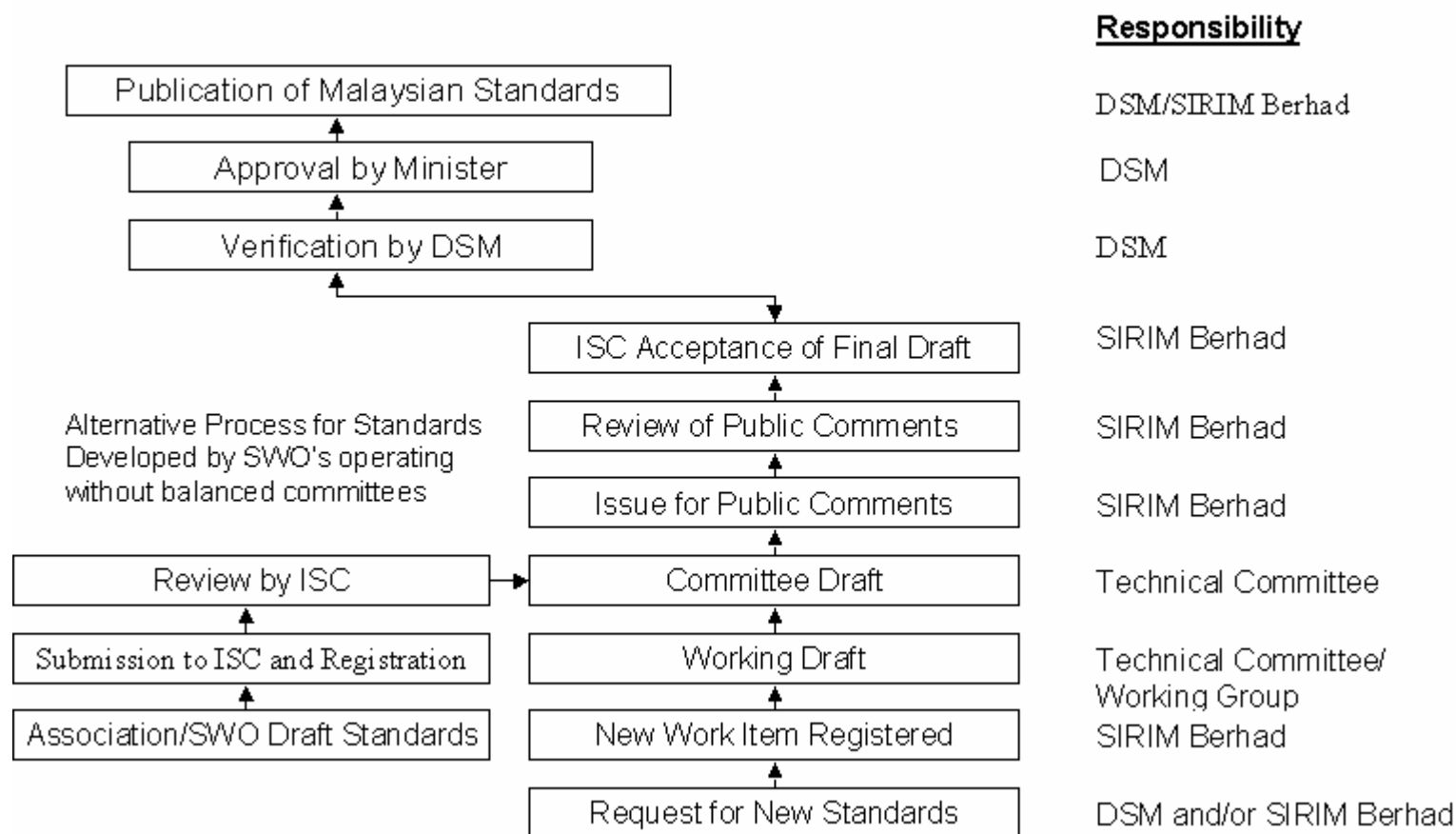
CODES AND STANDARDS

REGULATORY ACCEPTANCE PROCESS

1. New Codes and standards are originated by organizations, universities, Companies and SIRIM (www.sirim.my)
2. Draft codes and standards are vetted and reviewed by Industrial committee for standards whose members comprises of experts in the same area. ICS recommends final approval by Government
3. Department of Standards Malaysia (www.dsm.gov.my) gives final approval. It is then gazette for practice



MALAYSIAN STANDARDS (MS) DEVELOPMENT PROCESS



CURRENT STATUS OF MS STANDARDS

MALAYSIAN STANDARD

(updated until 30 April 2005)

No.	Field	Active MS Developed
1.	Food & Agriculture	478
2.	Chemicals	505
3.	Consumer Product & Safety	53
4.	Civil Engineering & Construction	217
5.	Electro Technical	570
6.	Mechanical Engineering	194
7.	Information Technology	522
8.	Petroleum & Gas	136
9.	Halal Standards	3
10.	Plastics	279
11.	Packaging	71
12.	Road Vehicles	86
13.	Fire Safety & Fire Protection	65
14.	Rubber	138
15.	Iron & Steel	73
16.	Textiles	197
17.	Medical Devices	0
18.	Occupational Health & Safety	77
19.	Quality Management & Quality Assurance	98
20.	Environment Management	19
	Total	3,781

** This figure will be updated monthly*

STANDARDS ON HYDROGEN SYSTEM

- No specific codes and standard in MS system
- Codes and standards for Hydrogen systems are 'implicit' in other codes
- Hydrogen generators use their own standards
- Standards development process is clearly defined
- Road Map has set target date on the hydrogen standards development

REFERENCES: CODES AND STANDARD FOR HYDROGEN SYSTEM

APPLICATION	CODES
PRODUCTION	ASME Boiler –Pressure Vessels Sec. VIII NFPA 70/NEC/CEC CGA G-5 H2 Commercial Production CGA G-5.3 Commercial Specification
TRANSPORTATION	DOT 49 CFR ASME B31.8 Gas Transmission ASME Boiler-Pressure Vessel Sec. VIII NFPA 58 Transport of LPG
STORAGE	NFPA 50 A: Gaseous Hydrogen NFPA 50 B: Liquid Hydrogen ASME Boiler-Pressure Vessel Sec. VIII
HYDROGEN VEHICLES	HV-3 : Hydrogen Vehicle Fuel NFPA 52 : CNG Vehicle Fuel NGV2: CNG Storage Tanks SAE 2578 System Safety SAE 2579 Hazardous Fluid Systems
STATIONARY/PORTA BLE FUEL CELLS	CSA FC1 FC Power Plants CSA US Req 1.01 FC Supplemental CSA FC 3 Portable FC Systems ASME PTC 50 Performance Test

FUTURE SCENARIO

HYDROGEN ROAD MAP

Milestone Name	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030	2050	
Hydrogen generation using off-peak electricity			▲																	
Establishment of Centralized H2 production facilities						▲														
Production of low cost cylinder for H2 storage				▲																
Hybrid H2 and CNG bus and Refueling Station			▲																	
Demonstration for Hydrogen powered Boiler				▲																
Introduction of H2 powered ICE taxi and private cars						▲														
Deployment of H2 production facilities for residential and industrial premises									▲											
Deployment of hydrogen powered Fuel Cell for transportation												▲								
Deployment of hydrogen Fuel Cell power generation for residential and industrial premises												▲								
Hydrogen fuel and fuel cells are the technology of choice in the market																				▲

FUTURE SCENARIOS

- Intensification of R&D in:
 - Biofuels and hydrogen generation
 - Hydrogen storage
 - New materials for fuel cells
 - Direct hydrogen from solar
- Development of standards

RECOMMENDED PROJECTS

R&DD Year 2006-2010:

- Hydrogen powered Generations (1-10 MW) using:
 - Biomass (Pyrolysis process, bioprocess)
 - MSW (pyrolysis process, bioprocess)
 - Solar direct
 - Coal (pyrolysis process)
 - Electrolysis using off-peak electricity
- Hydrogen storage
- New materials for fuel cells
- Development of standards

RECOMMENDED PROJECTS

R&DD Year 2006-2010:

- Fuel Cells
 - New and cost competitive membranes
 - Cost competitive catalyst
 - 1 MW PEMFC power generation for residential
- Development of standards

IN CONCLUSION

Malaysia has made a bold step to join the international communities in renewable energy economy

**THANK YOU FOR YOUR
ATTENTION**