National University of Singapore

Professor Vernon L. Snoeyink

on behalf of

Professor Shih Choon Fong, President of NUS

May 2007

University Vision

"Towards a Global Knowledge Enterprise"

- NUS will be
  - a globally-oriented university, in distinguished league of leading public universities in the world.
  - a key node in global network of knowledge communities at forefront of ideas.
  - a dynamic community, imbued with a "no walls" culture and a spirit of enterprise, which promotes
    - free flow of ideas &
    - builds synergies among processes of creating, imparting & exploiting knowledge.

NUS

- Founded in 1905
- Corporatized University as of April 2006
- University ranking *(London Times Higher Education Supplement)*
  - World: Top 20
  - Asia: Top 3
- Current capabilities
  - 23,469 Undergraduate students *(12.3 / 1)*
  - 9,075 Graduate students *(4.7 / 1)*
  - 1,913 Tenure-track Faculty & 1347 Research Staff
  - 14 Faculty academic units from medicine to architecture to engineering to music

NUS National University of Singapore

FACULTIES / SCHOOLS

Areas of Excellence in the *SCIENCES*

Yong Loo Lin School of Medicine

- Anatomy
- Biochemistry
- COFM
- Diagnostic Radiology
- Obstetrics & Gynaecology
- Ophthalmology
- Orthopaedic Surgery
- Otolaryngology
- Medicine

Faculty of Dentistry

Faculty of Engineering

- Applied Membrane Science & Engineering
- Transportation Engineering
- Quality Engineering
- Digital Communications
- Polymer-related Research
- Intelligent Control Systems
- Electromagnetics
- Digital Signal Processing
- Heat Transfer
- Mass Transfer
- Fluid Mechanics
- Micro-scale Heat Transfer
- Manufacturing
- Rapid Prototyping
- Environmental Engineering
- Rheology
- Computational Mechanics
- Integrated Circuit Failure Analysis and Reliability

School of Computing

- Pricing Strategies
- Data Mining and Intelligent Data Analysis
- Intelligent Systems
- Cross-cultural Issues
- Computer-mediated Communication
- Electronic Businesses
- Constraint Logic Programming
- Geographic Information System
- Computational Learning Theory

Faculty of Science

- Biology and Biotechnology of Antifreeze Proteins
- Molecular Marine Biotechnology
- Fish Reproductive and larval Physiology/Endocrinology
- Systematics of Crustaceans and Fish
- Proton Beam Machining
- Superconductivity
- Geophysical Fluid Dynamics
- Stereochemistry and Organometallic Chemistry
- Miscibility of Polymer Blends
- Molecular Spectroscopy and Molecular Reaction Dynamics
- Capillary Electrophoresis
- Computational Chemistry
- Polymer Chemistry
- Development of Phosphine-gold Anti-cancer Drugs
- Wide-ranging Applications and Impact of Chen-Stein Method
- Quasi-Monte Carlo Method
- Approximation
- Recursion Theory
- Algebraic Topology and K-theory
- Multivariate Splines
- Analysis, Probability and Their Applications in Economics and Finance
- First-principles Study of Polyatomic Chemical Reactions
- Monte-Carlo Simulation Method
- Theoretical Chemical Physics
- Spectral Analysis of Large Dimensional Random Matrices

SCIENCES: Faculty of Dentistry; Faculty of Engineering; Faculty of Medicine; Faculty of Science, School of Computing.

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FACULTIES / SCHOOLS

Areas of Excellence in the *HUMANITIES*

School of Business

- Interior Point Optimization Methods

Yong Siew Toh Conservatory of Music

- Woodwinds
- Brass
- Percussion
- Strings
- Piano
- Orchestra Instruments
- Composition

School of Design & Environment

- Design Computing
- History Theory and Criticism
- Urban Studies
- Design Technologies
- Total Building Performance
- Construction Management and Economics
- Corporate & Securitised Real Estate
- Institutional and Spatial Analyses of Real Estate
- Housing Research

Faculty of Law

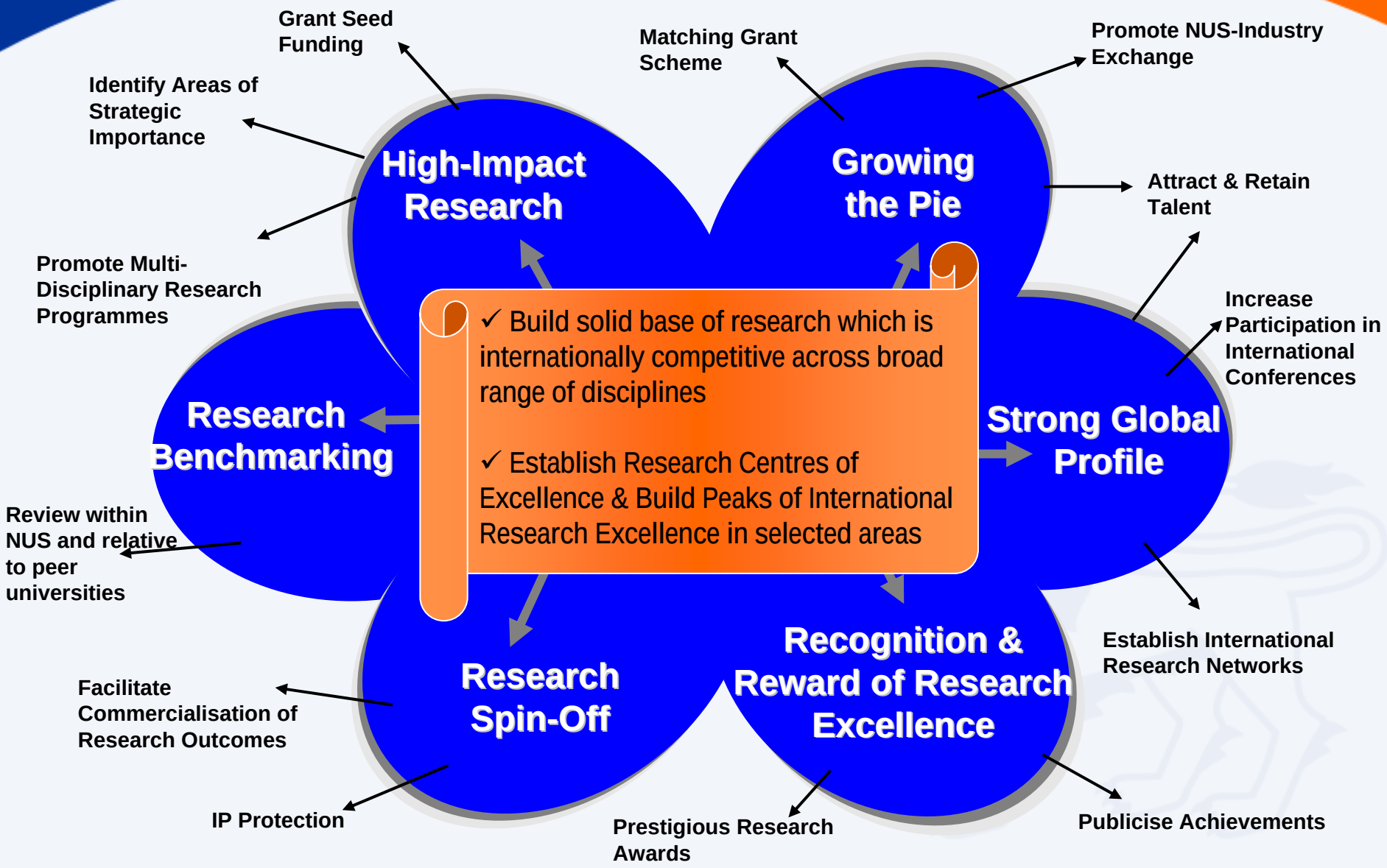
- Banking Law
- Public International Law
- Law of Torts
- Intellectual Property Law

Faculty of Arts & Social Sciences

- Economic Globalisation and Transnational Corporations
- Asian Firms in the Global Economy
- Chinese Business Firms and Their Global Networks
- Gender and Migration
- Historical and Heritage Studies on the Urban Landscape
- Transnational Communities and Globalizing Cities
- Religion, Music, and Constructions of 'Nation' and 'Identity' through Places and Landscapes
- Urban Planning and Public Housing Policy
- Emerging Consumer Society in Asia
- Personnel Selection, Research Methods and Data Analysis
- Adaptations to Changes at Work

HUMANITIES: Faculty of Arts & Social Sciences; Faculty of Law; School of Business; School of Design & Environment; University Scholars Programme

STRATEGIC RESEARCH OBJECTIVES



✓ Build solid base of research which is internationally competitive across broad range of disciplines

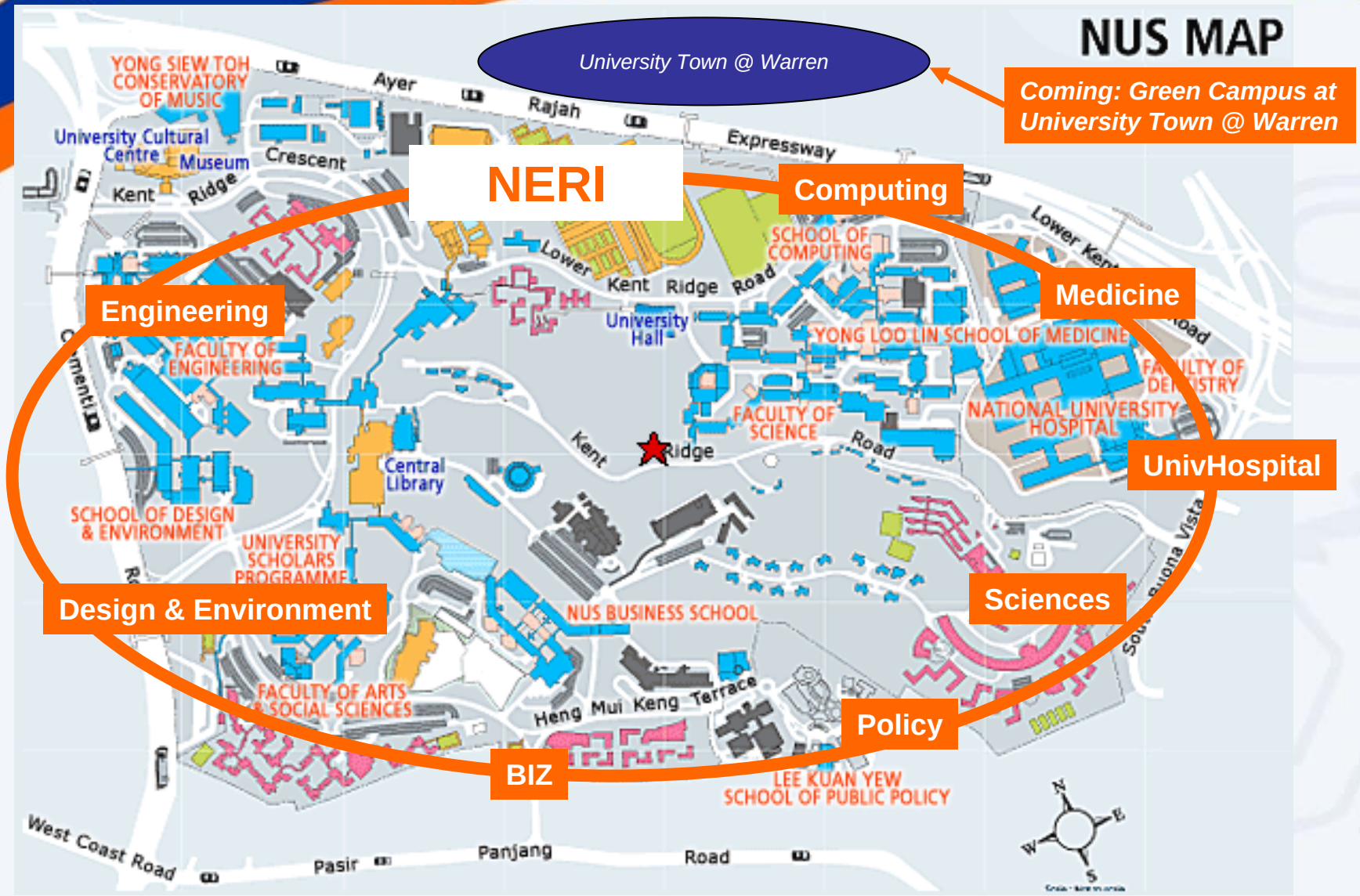
✓ Establish Research Centres of Excellence & Build Peaks of International Research Excellence in selected areas

Environment & Energy at NUS

NUS Environmental Research Institute - NERI

- A University-level Institute reporting to Office of President
  - NERI Mission: *Establish a sustainable research enterprise in "Environment, Health & Energy" at NUS*
  - NERI Focus Areas
    - Air, land and water systems
    - Human & environmental health
    - Energy systems
  - NERI activities
    - Expand, Enhance, Coordinate, Integrate & Facilitate research & education initiatives across campus in foci areas
    - Recruit eminent scholars, faculty, fellows, graduate students to expand capabilities
    - Pursue Excellence in cutting-edge research in high-impact areas from basic to applied areas, building for long-term excellence across the university

NERI – An Institute on a Comprehensive University Campus



NERI Research Drivers

- Safe Waters for People & Countries
  - Potable water
  - Contaminant control/minimization
  - Pathogen control
  - Persistent organics
  - Hydraulic structures
  - Technology systems
    - membrane systems, sensors systems, bioprocess systems, natural-system wetlands …
  - Catchment protection
  - Runoff management
  - Sediment quality
  - Marina Bay and Singapore H_2O taps

- Energy Systems
  - Water-Land-Energy connectivity
  - Efficient machinery and industrial systems
  - Solar energy capture
  - Fuel cells – chemical, microbial
  - Wind
  - Biofuels
  - Hydrogen storage
  - Green Campus & Dorms

- Climate Change
  - Sea-level rise and mitigation
  - CO_2 & GHG control strategies
  - Alternative energy sources
  - CO_2 controls for mobile, point, areal, & residential sources
  - Acidification of oceans
  - Carbon sinks in ocean systems
  - Industrial production changes – success in a global Carbon-footprint marketplace

- Atmospheric particles - Aerosols
  - Human-health effects
  - Characterization as to source
  - Toxicology of particle surfaces
  - Atmospheric chemistry & physics
  - Particle exchange in lungs
  - Particle chemistry
  - Biogenic particulates (China, Indonesia …)

NUS National University of Singapore

NERI Director

Research Council

NERI Faculty

NUS Faculty, Research Institutes, & Global-Partner Univeristies

[Research Clusters]$_i$ & [Thrust Areas]$_{ij}$

NERI
Research-area, Faculty-driven Institute

Providing Global focus to Singapore Research and Education

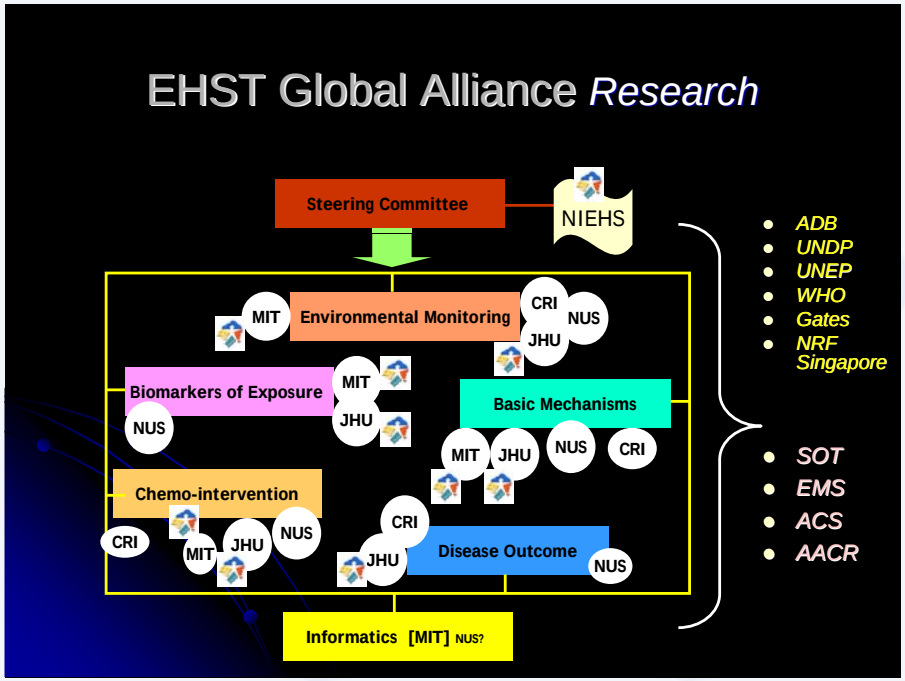
Administration & Support

[Research Clusters]$_i$ Approach

- Cross-disciplinary Research Areas
  - Research areas driven by pursuit of excellence and directed to
    - NUS *niche* areas & capabilities
    - Singapore needs and sponsored R&D opportunities
  - Faculty-developed and faculty-managed units with focus on
    - enhancing research,
    - identification of "gaps" and infrastructure needs,
    - enhancing development of long-term base for continued research success in Singapore, regional and international marketplace
  - [Thrust Areas]$_{ij}$
    - Subsets of a Cluster - allows for enhanced collaboration in a targeted area within an integrated cluster

Research Cluster
Human & Environmental Health

- Thrust Areas
  - Monitoring systems
  - Biomarkers
  - Toxicity of environmental agents
  - Chemo-intervention
  - Disease assessments
- Faculty > 25 in:
  - School of Medicine
  - Faculty of Engineering
  - Faculty of Science
  - Life Sciences
  - National University Hospital

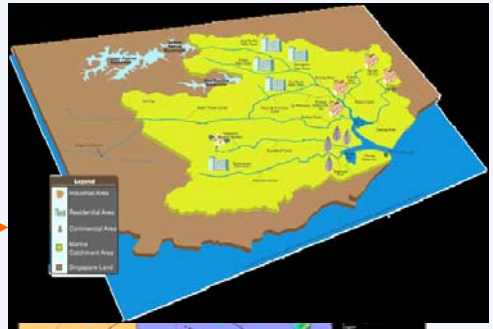


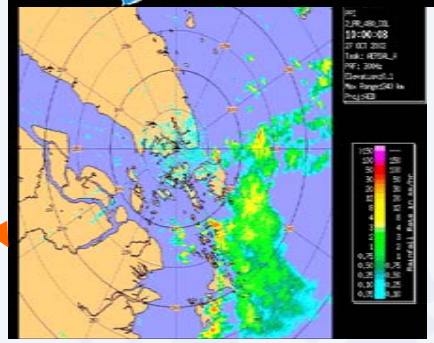
Singapore-Delft Water Alliance

- **SDWA – Started in April 2007 with $65 million over 5yr**
  - **Partners in Research, Education & Support**
    - **EWI - National Research Foundation (NRF)**
    - **Delft Hydraulics - DH**
    - **Public Utility Board – PUB**
    - **TU Delft**
    - **NUS**
  - **Scope**
    - **Analysis of aquatic systems**
      - ***In depth scientific questions***
    - **Smart sensing**
      - ***Sensing, monitoring, data-model integration***
    - **Holistic/systemic approach**
      - ***Integration and interdisciplinary (hydrology, hydraulics, environmental and social sciences, human health***
    - **Information cycle in respect of water cycle**
      - ***Acquisition, analysis, modelling, decision support***

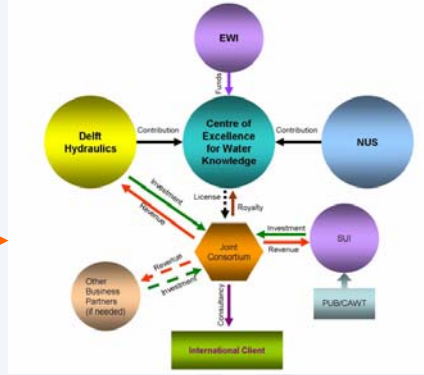
Singapore-Delft Water Alliance

- **Singapore Water Catchments**
  (An example project)
  - **Marina Bay, Marina Channel, Catchments & Contributing Rivers & Canals**
  - **Integration of Model Components**
    - **Rainfall Forecasting**
    - **Catchment Runoff**
    - **Optimal Reservoir Operation**
  - **Advanced Forecasting Model**
    - **Rainfall-runoff models**
    - **River models**
    - **Reservoir model (gate operation)**
    - **Oceanographic models**
  - **Water Quality Assessments**





- **Global Commercialization Opportunities**



Additional Research Clusters

- Sensor systems
- Atmospheric aerosols
- Membrane systems
  - Surface fouling
  - BioMimicry membranes
  - Nano and metal-based membranes
  - Membrane-sensor systems
- Persistent organics & human health
- Energy Systems
  - Solar
  - Fuel cell
  - BioFuels
  - Hydrogen storage systems
- Green Campus and Low-energy Dormitory

Education Cluster
Environment, Health & Energy

Opportunities available in a variety of cross-campus academic degree programs at BS, BA, MA, MSc, MEng & PhD levels

- Environmental Engineering
- Environmental Management
- Health & Environmental Technology
- Bioengineering
- Civil Engineering
- Chemical Engineering
- Computational Engineering
- Logistics & Supply Chain Management
- Industrial & Systems Engineering
- Material Science & Engineering
- Mechanical Engineering
- Law
- Public Policy
- Chemistry
- Industrial Chemistry
- Infectious Diseases
- Microbiology
- Biochemistry
- Computational Biology
- Public Health Medicine
- Architecture
- Urban Design
- Building Science
- Industrial Design
- Geography

Education Cluster
Environment, Health & Energy

- **University commitment to global education for its Undergraduates enhances the focus on *Global Environment, Health & Energy* with Overseas Colleges**

- **NUS Overseas Colleges**
  - **NUS College in Silicon Valley (NCSV), CA w/ Stanford University**
  - **NUS College in Bio Valley, Philadelphia PA w/ Penn University**
  - **NUS College in Stockholm w/ Royal Institute of Technology (Kungliga Tekniska Högskolan, KTH)**
  - **NUS College in Bangalore, India w/ Indian Institute of Science (IISc)**
  - **NUS College in Shanghai, one of China's leading entrepreneurial and academic hubs, w/ Fudan University**

Campus for Research Excellence And Technology Enterprise

- **CREATE**
  - **Location**
    - **NUS "University Campus @ Warren"**
  - **Integrated research-campus community with global partners of Singapore**
    - **Singapore MIT Alliance**
      - ***Initial University team recruited to Singapore for CREATE***
        - » Areas to potentially include Infectious Diseases, Sensor systems, Environmental monitoring …
    - **Additional Universities in process in Asia, Europe, UK, USA …**

NUS & NERI Global Initiatives

- ***International Association of Research Universities (IARU)***
  - **(ANU, Cambridge, Copenhagen, ETHZ, NUS, Oxford, PKU, Tokyo U, UCal-Berkeley,& Yale)**
  - **Energy, Resources & Environment Initiative**
    - **Zurich '06, Tokyo '07 & Canberra '07 Meetings set agenda for action**
    - **"Transformation Towards Sustainability" research program**
      - ***Land use and ecosystem functions***
        - » Urban and rural development interaction, synergies and conflicts
        - » Land use changes in a spatially explicit framework
      - ***Food systems and water resources***
        - » Appropriate water usage
        - » Sustainable consumption and production
        - » Nutrient conservation and soil conservation
      - ***Energy and environment***
        - » Energy and material flows
        - » Anthropogenic effects on natural cycles
        - » Food and bioenergy

Questions & Discussion

NUS Environmental Research Institute

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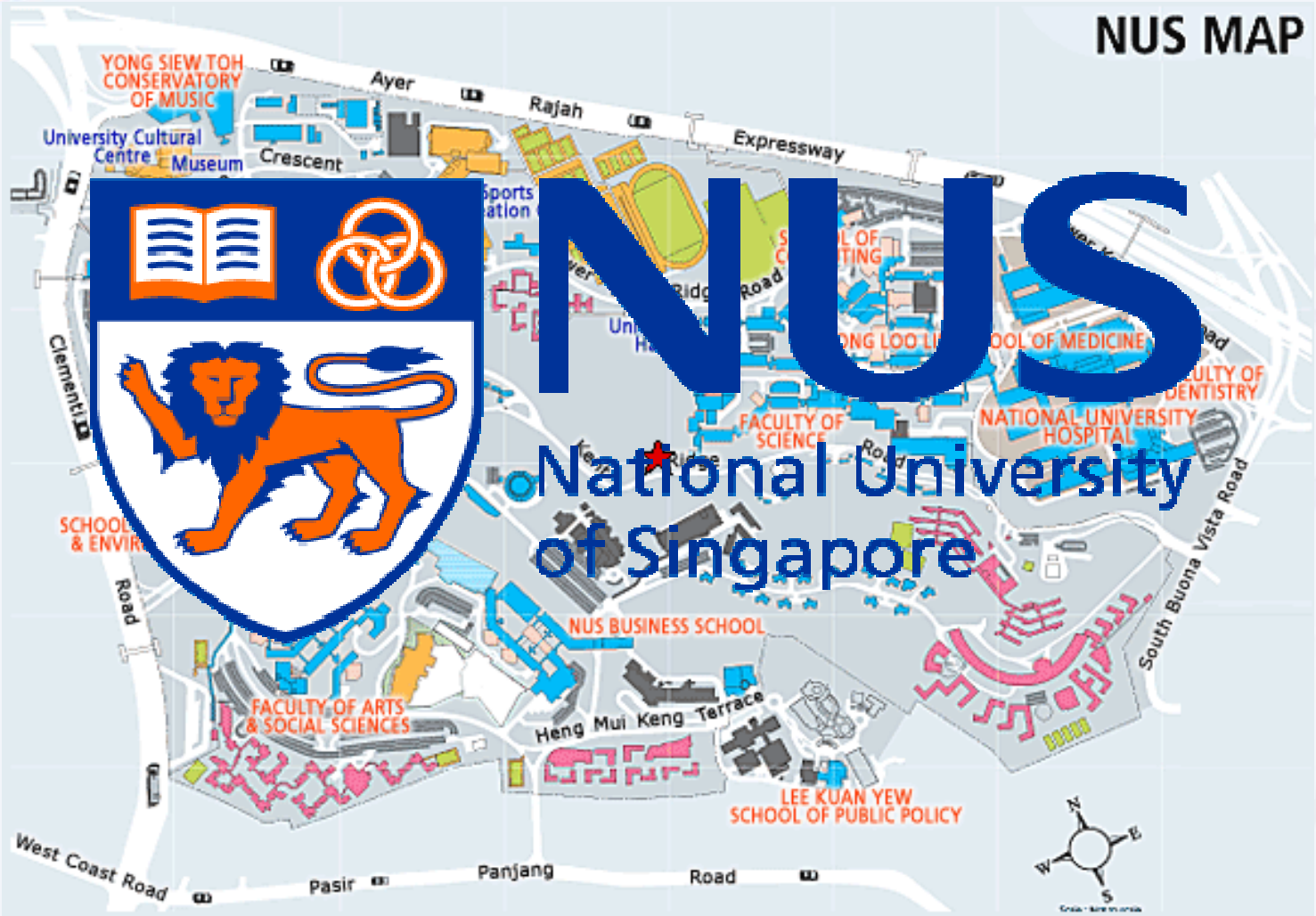
NUS MAP



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