Michael Angelo A Pedrasa, PhD
Coordinator, Energy Engineering Graduate Program

6 December 2016
Public Forum on Industrial Policy, Climate Change and Energy: Charting a Sustainable Future
College of Engineering Theater
University of the Philippines, Quezon City
About the Program

- Instituted in 1983 with the objective of training specialists who will
  - Develop indigenous sources of energy
  - Improve the efficiency of energy utilization
  - Introduce appropriate energy technologies

- The curriculum was revised in 2009 to enhance the expertise of researchers, engineers and scientists in
  - Developing and managing applied energy technologies and
  - Developing analytical tools for energy planning
    - To effectively transmit critical technical and policy-oriented knowledge to support institutions
    - To meet the demands of the dynamic and complex character of an evolving energy sector within a competitive and market-based framework.
Vision and Mission

Vision

A regional hub and a proactive leading contributor to the country’s science, technology, and innovation for energy security, independence, and resilience towards sustainable development.

Mission

- To lead energy research and development efforts of regional and national significance;
- To train solutions-oriented leaders for the energy sector;
- To develop innovative solutions to regional and national energy issues; and
- To influence decision-making on energy policy and management.
Energy Engineering Graduate Program Committee

- Michael Angelo A. Pedrasa, PhD (Coordinator, EEEI)
- Ariel C. Blanco, PhD (DGE)
- Rinlee Butch M. Cervera, PhD (DMMM)
- Eric C. Cruz, PhD (ICE)
- Louis Angelo M. Danao, PhD (DME)
- Prospero C. Naval, PhD (DCS)
- Joey D. Ocon, PhD (DChE)
- Mili-Ann M. Tamayao, PhD (DIEOR)
Research Thrusts

1. Resources
   - Resource assessment
   - Renewable energy resources
   - Fossil fuel
   - Alternative fuels

2. Conversion & Storage
   - Internal combustion engine
   - Electrochemical energy conversion
   - Electromechanical energy conversion
   - Photovoltaics
   - Low enthalpy converters
   - Converters for renewable energy

3. Transmission & Distribution
   - Smart grid
   - Conventional power systems
   - Storage and transport of hydrogen and carbon

4. Utilization
   - Demand-side management
   - Energy audit, conversion, and efficiency
   - Green buildings
   - Transportation systems

5. Systems Modeling & Decision-Making
   - Life-cycle analysis
   - Energy and environmental markets
   - Policy and management
   - Decision-support systems
   - Integrated assessment models
Research Facilities

- Department of Mechanical Engineering
  - Vehicle Research Testing Lab

- Department of Chemical Engineering
  - Fuels, Energy and Thermal Systems Lab
  - Laboratory of Electrochemical Engineering

- Department of Industrial Engineering and Operations Research
  - Computing Laboratory

- Department of Geodetic Engineering
  - Applied Geodesy and Space Technology
  - EnviSAGE Research Lab

- Department of Mining, Metallurgical, and Materials Engineering
  - Advanced Ceramics Laboratory, Materials for Energy

- Electrical and Electronics Engineering Institute
  - Solar Laboratory
  - Power Systems Simulation Laboratory
  - Smart Grid Research Center
  - Electric Power Research Laboratory

- Institute of Civil Engineering
  - Transport and Environment Group, National Center for Transportation Studies
Courses Offered

- EgyE 201  Energy Resources, Uses and Systems
- EgyE 211  Energy Conservation
- EgyE 221  Solar Energy I
- EgyE 222  Biomass Energy
- EgyE 223  Wind, Hydro and Ocean Energy Systems
- EgyE 231  Energy Economics and Systems Evaluation
- EgyE 231  Energy Economics and Systems Evaluation
- EgyE 251  Energy Planning
- EgyE 273  Power Plant Technology
- EgyE 297  Sustainable Energy
- EgyE 297  Energy Development in the Philippines
- EgyE 320  Energy Resource Assessment
- EgyE 332  Energy Optimization and System Dynamics
Recent MS Thesis and PhD Dissertation

- Analysis of the Effects of **CME-Diesel Blends** on the Performance and Emission of a Heavy Duty Turbochanged CRDI Engine

- Hydrodynamic Modeling and Resource-Device Suitability Analysis of Northern Luzon for Tidal Stream Energy Assessment

- Comparison of Layer-Forming and Bromine-Doping Methods of Pentacene Layer in Solid State **Dye-Sensitized Solar Cell**

- Simulation and Development of a **Biogas Digester** Using Sandwich Type Flat Plate Solar Heat Energy Collector for Small Scale Piggery Application

- Performance Analysis of a Cut-Out Hollow-Pipe **Horizontal Axis Wind Turbine Blade** Using Hybrid CFD and BEM Methods

- A Markup Index in Determining Possible Market Power Abuse in the **Electricity Market**
Research Interests of Affiliated Faculty
Emerson HVACRPG Laboratory
Heating, Ventilation, Air Conditioning, Refrigeration and Power Generation
Dept. of Mechanical Engineering

Research Areas:
Energy Conversion from Low-Grade/Low-Enthalpy Heat Sources

Low-Enthalpy/Grade Heat
Cooling/Heat Pumping
Power Generation
Process Heating
Latent Heating
Combined

Supercritical Brayton Cycle
Organic Rankine Cycle
Thermoelectric Conversion
Combined
Absorption Ref. and Heat Pump
Adsorption and Desiccant Systems
Ejector Ref. and Heat Pump
Sensible Heating
Heating and Dehumidification

Focus Areas

Conventional
OTEC
Ejector-Assisted System (R&D)

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Low-Enthalpy Heat Sources

- Geothermal
- Hot Spring
- Shallow Geothermal
- Hot Dry Rock
- Solar Thermal
- Biomass
- Industrial Waste Heat
  - Furnace Exhaust
  - Engine Exhaust
  - Boiler Flue Gas
  - Others
- Solar Pond
- OTEC
- Combined Sources

Graduate Research (Current and Past)

- A CFD Analysis and an Experimental Evaluation of an Ejector Refrigeration System Heat-Driven by an Internal Combustion Engine, James Honra, PhD EgyE
- Numerical Modelling of Two-Phase Flow and Optimization of Ejector for a Power Plant that Uses a Modified Organic Rankine Cycle and Ammonia, Seyed Hamed Hashemi Sohi, PhD EgyE
- Design and Analysis of Low Grade Waste Heat Recovery System Using Ejector Trilateral Flash Cycle, Celden Co, MSEgyE
- Optimization of Solar Thermal and Biomass Heat Sources with Thermal Energy Storage for A Numerical Design of an Ejector Refrigeration System, Vincent Aylmer Dela Cruz, MSME
- Design of a Vapor Compression-Ejector Refrigeration System, France Orden, MSME
- Design and Performance Evaluation of Hybrid Dryer with Desiccant Dehumidifier and Regeneration System, Efren dela Cruz, PhDEgyE, July 2016
- Ejector Design for Powerplant Application, Edward Bermido, MSME, May 2012
**ADVANCED CERAMICS LABORATORY**
Materials For Energy Research Group
Department of Mining, Metallurgical and Materials Engineering

**Dr. Rinlee Butch M. Cervera**
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**Area Topics and Interests:**
Materials and Devices for Energy Storage and Conversion, Li-ion Batteries, Fuel Cells and Electrolytic Cells, Advanced Ceramics, Nanomaterials

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**Fuel cells**

![Fuel cell diagram](image)

**Electrochemical cells and batteries**

![Electrochemical cell images](image)

TEM and ED images of nanograin size cathode (a) and (b) magnified image.

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**Selected Publications**


On-going Energy Conversion and Structural Studies

- CFD study of Darrieus (cross flow) wind turbine performance in unsteady inflow, skewed inflow
- BEM study of an axial flow wind turbine using pipe cut-out blades
- BEM/CFD study of axial flow tidal turbine performance
- Structural response of a composite (EGlass-Epoxy) tidal turbine blade using FEA
- Thermo-mechanical response of a semiconductor power device during reflow using FEA
The UPMSI Ocean Color and Coastal Oceanography Laboratory (OCCO) orients students and researchers on dealing with the OCEAN as a WORKING ENVIRONMENT

1st as a potential Renewable Energy Resource

2nd as a major consideration in terms of Environmental Impact Assessments

Prof. Laura T. David, Ph.D.
UP Marine Science Institute
In terms of renewable energy resource, we introduce the students to the oceanography and the oceanography of Philippine waters.

Specifically, the nature of its waves, tides and consequential tidal currents, temperature and salinity gradients, and biofuel.

Geographical distribution of tidal types based on Form Number
- Magno et al
In terms of Environmental Impact Assessments we introduce the students to finer scale oceanography and ocean biology.

Examples of these include:
- Wave energy dissipation
- Current vector diversion
- Plankton re-distribution & Stratification
- Benthic and Reef Fish Aggregation
- Marine mammalian and reptilian migration routes disruption
• **Vision**

Technologies and products toward sustainable energy & resource utilization

• **Mission**

Train students to scan the technology horizon and look for:
- important questions yet unanswered;
- needs yet unmet, and;
- opportunities still emerging,
and to use the scientific method to seek out an answer, a solution or an enabling technology.

• **Focus**

**Fuels, Energy & Thermal Systems Laboratory**

More efficient, integrated and effective processes for converting biomass and other residue into fuels and high-value products.

Better understanding of energy conversion and thermal systems to inform their continuous development and promotion.
Rizalinda L. de Leon, Ph.D.

- Bioethanol from lignocellulosics via enzymatic pathway
- Hydrothermal liquefaction/carbonization of biomass
- Photocatalytic hydrogen production (catalyst development)
- Nanofluids, Oscillating Heat Pipe
- Microalgae for energy

Angela D. Escoto, Ph.D.

- Phase change materials and insulating materials from plant matter

Kristian July R. Yap, M.S.

- Microfluidic photocatalysis

Fuels, Energy and Thermal Systems Laboratory
Department of Chemical Engineering
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**Research Interests**

- Oxygen electrocatalysis
- Fuel electrooxidation kinetics in novel catalysts
- PEMFC stack development
- Microbial fuel cells (with Dr. Fernando, UPLB BIOTECH)
- Hydrogen production via thermochemical and electrochemical reforming
- Mixed metal oxide catalyst in hybrid water electrolyzers
- Multi-scale modeling of dual-electrolyte hybrid electrolyzers
- Germanium-carbon nanofiber anodes for Li-ion batteries
- Germanium-air batteries
- Technology and cost assessment of electrochemical energy storage for industrial, commercial, and household applications
- Ab-initio calculations for mechanistic studies of electrocatalytic reactions via Density Functional Theory (DFT) Modeling

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Cu/Fe/Ni-based electrodes for pseudocapacitor application (w/ Dr. Balela, DMMME)

Portable emergency pack based on metal-air battery and large-scale cathode production
- Biocompatible transient power systems

Cu-Au nanocatalysts for CO2 recycling to useful chemicals (e.g. C2H4, C2H5OH, CH4)

Corrosion kinetics of aluminum, stainless steel, and carbon steel in E10-gasoline blends

- Supercapacitors
- Metalkine batteries
- Water electrolyzers
- Fuel Cells
- Corrosion
- Lithium batteries
- Germanium batteries
As one of the leading research institutions for renewable energy research in the country, the UP SOLAR LABORATORY is continuously striving to develop, innovate, and promote novel energy technologies in order to uplift the quality of life for Filipino society and to safeguard the environment.

Miguel T. Escoto
Professor, Electrical and Electronics Engineering Institute
With my background in Electrical Engineering, I am involved with energy-related research such as:

a. **Effects of increasing distributed generation in the distribution network**
   - Power quality and losses
   - Models for electric power converters

b. **Effects of increasing penetration of new and renewable energy in the electricity market**
   - Priority dispatch of renewable energy
   - Contribution of large unscheduled generators
   - Role of large-scale storage devices

c. **Electricity consumer behavior**
   - Timely feedback
   - Incentive schemes

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EEEI Rm 426
Michael Angelo A Pedrasa, PhD
Coordinator, Energy Engineering Graduate Program
Assoc. Prof., Electrical and Electronics Engineering Institute
Lab Head, Smart Grid Research Center, EEE Institute

Research Interests:
• Grid integration of renewable and distributed energy resources
• Demand side management
• Microgrid systems
• Resilient electricity grids

Thesis titles of recent/current students:
• Utility-scale distributed generator planning using location-specific hosting capacity analysis
• Detecting exercise of market power in electricity spot markets
• Optimal scheduling algorithm for virtual power plant (VPP) operation in the context of a competitive electricity market
• Optimal allocation of intermittent embedded generator with time-varying generation and demand and types of load considerations
• Optimal placement and sizing of controllable and intermittent distributed generator considering system reliability
• Hierarchical multi-agent-based demand-side management with user comfort as a combination of thermal and other services
• Evaluation of self generating facilities as interruptible loads using hourly load profiles
• An adaptive overcurrent relay coordination scheme for weakly meshed distribution networks with distributed generation

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SEDM Objectives

- Develop integrated assessment models (IAM) for energy systems that can be used to:
  - represent the current technological, market, and policy status of Philippine energy systems;
  - assess sustainability impacts (environment, social, economic) of existing technological and policy mechanisms; and
  - predict impacts of future technological and policy innovations.

U.P. Energy Engineering Program
Sustainable Energy Decision Making (SEDM)

Mili-Ann M. Tamayao, Ph.D.
Industrial Engineering and Operations Research
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SEDM Projects

- Life Cycle Benefit-Cost Analysis of Energy Technologies in the Philippines (Dr. Tamayao, Dr. Danao, and Dr. Soriano¹)
- Sustainability Assessment of Vehicle Electrification in the Philippines
- Multicriteria Decision Analysis (MCDA) as Applied to Specific Energy Technologies and in Energy Planning (w/ Gen Rodriguez and Justin Seranilla)
- Long-term Resource Planning for the Philippine Power Sector (w/ Prof. Angelo Ani)
- Economic and Environmental Impacts of RE policies (e.g., FIT) (w/ Wilhelmina Pleto)
- Evaluation of the Retail Competition and Open Access (w/ Gina Camacho)
- Sustainable energy systems in small island communities (w/ Jayson Corpuz)

¹Funded by the U.P. Center for Integrative and Development Studies (UP CIDS)
²Funded by the UP CIDS
VISION
To provide the essential training and resources for state-of-the-art research and development of materials using gaseous discharges and related technologies.

MISSION
The Plasma-Material Interactions Laboratory aims to provide a learning environment that encourages the advancement of the field, delivers quality technical services, and trains responsible researchers. Embodied in this expertise is the ability to adapt to the changes required by technological advancement and changing needs of the society.

Research Opportunities:
- Plasma devices
  - Glow discharges (DC and RF)
  - Ion sources (low-energy)
- Plasma-material interactions
  - Synthesis (e.g. thin films)
  - Modification (e.g. functionalization)
- Modeling
  - Molecular dynamics
  - Monte Carlo simulations

Research Interests:
- Surface modification (metals, polymers)
- Thin film synthesis (metals, oxides, nitrides)
- Carbon materials (graphene, DLC, PLC)
- Material systems for energy applications
  - Semiconductor materials
  - Photovoltaics
  - Betavoltaics
  - Supercapacitors

Ground Floor, DMMME Bldg., Velasquez St. cor. C.P. Garcia Ave., UP Diliman, Quezon City  http://www.pmil.org
Current Research Projects:

• Plasma modification of spray-deposited graphene films (OVCRD)
• Development of a plasma device and an ion source system for the modification of surfaces (OVPAA)
• Development of low-energy ion source system for the synthesis of diamond-like carbon films (DOST-PCIEERD)
• Plasma cleaning: Development of efficient methods for processing microelectronic device surfaces (USAID-PURE)

Members:
13 Undergraduates (BS MatE)
12 MS students (11 MS MSE/1 MS EgyE)

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Experimental Devices:

Vacuum evaporator
DC Plasma
RF Plasma
Electrospinning Setup
Spray Pyrolysis Setup
Low-energy Ion Source

Collaborators:
TRANSPORT AND ENERGY

Institute of Civil Engineering
Transportation Engineering Group &
Transport & Environment Group,
National Center for Transportation Studies

Research Areas:

1. On-Road Tests of Alternative Fuels for Public Transport (Auto-LPG and Electric)
2. On-Road Tests of Biofuels for Public Transport (Biodiesel and Bioethanol)
3. Transportation Energy Demand and CO$_2$ Emissions Inventory
Past and On-Going Research

2) Benchmarking LPG as an Alternative Fuel to Jeepney
3) Fuel Economy of Public Utility Jeepneys Using 2% and 5% Coco-Methyl Ester (CME)-Diesel Blends (in cooperation with the Philippine Coconut Authority)
4) Development of Drive Cycles and Fuel Economies of Light Duty Vehicles in Metro Manila
5) Instantaneous Fuel Consumption Models and a Case Study on the Fuel Consumption at Different Traffic Conditions Using Shepard’s Interpolation Method
6) Alternative Fuels Vehicle Tests and Research Program – On-Road Tests Component (in cooperation with the Department of Energy through the National Engineering Center)

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and
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Thank you!

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