

PD-ABI-673

**THAI/U.S. TECHNOLOGY ASSESSMENT
OF ELECTRIC TUK-TUKS**

Thailand'
October 23 - November 2, 1993

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP



WORLD ENVIRONMENT CENTER

DISCLAIMER

This project was sponsored by the U.S. Agency for International Development through WEC's Cooperative Agreement in support of the US - Asia Environmental Partnership (US-AEP). The opinions expressed herein are the professional opinions of the author and do not represent the official position of the Government of the United States of America or the World Environment Center.

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I. EXECUTIVE SUMMARY

The City of Bangkok adds 10,000 new vehicles to the road each month, causing air pollution to reach danger levels on a daily basis. The primary mode of transportation for most Thais is still the three-wheeled tuk-tuk taxi. Tuk-tuk contributions to the poor air quality are largely due not only to the number of tuk-tuks on the road, but also to the fact that tuk-tuks utilize refurbished two cycle engines for power. At the request of the USAID mission in Thailand, two experts from the Electric Power Research Institute and two experts from Advanced Electric Car Technology traveled to Bangkok to determine whether the tuk-tuks are likely candidates for conversion to non-polluting electric power.

This exchange, was conducted under the auspices of the United States-Asia Environmental Partnership (US-AEP), through a Cooperative Agreement with the World Environment Center (WEC). The assessment was to include: a demonstration of a recently converted electric tuk-tuk, review of tuk-tuk manufacturing facilities and capabilities, review of market potential, and determination of Thai government support and potential subsidies. The conversion was a joint effort between Advanced Electric Car Technology (AECT) and the Electric Power Research Institute (EPRI).

The potential for electric tuk-tuks in Thailand is tremendous. The key to successful implementation of an electric tuk-tuk fleet rests more on government and utility support than it does on technology. The fact is that the technology exists and was successfully demonstrated during this visit. However, without government support in the form of subsidies, air pollution tax credits, etcetera, the vision of an electric fleet can not be met. In Thailand, this support does exist. Equally important, the two electric distribution utilities, PEA and MEA, both support the idea. This support will be key in providing the necessary infrastructure to support an electric vehicle fleet.

The secondary purpose of the visit was to explore the needs of the Thai utility industry, identify opportunities for application of U.S.-developed technologies to meet these needs, and develop a plan for a long term relationship between the Thai utilities and EPRI.

The challenges facing the utility industry in Thailand are numerous as rapid economic growth has produced an annual utility growth rate of 10 percent. Simply meeting the new demand for electricity is a challenge that has proven difficult to achieve through generation additions alone. Besides the capital intensive requirements for new generating plants, there are also associated environmental impacts that outweigh the importance of electricity supply. These environmental impacts range from air quality problems with fossil plants to natural

resource destruction with hydroelectric plants. As high growth rates continue, other problems surface related to environmental concerns, system reliability, and plant life extensions. The pressures associated with operating under this variety of problems require that the Thai utilities have access to a research and development organization (such as EPRI) that can provide products and services for direct application by the utilities and their customers. This type of support and expertise is currently unavailable in Thailand today.



II. INTRODUCTION

The Electric Power Research Institute (EPRI) is a not-for-profit research, development, and deployment firm for the electric utility industry. EPRI currently supports some 1600 projects ranging from advanced power plant technologies to high efficiency cooling equipment. EPRI is funded by voluntary contributions from member companies in the United States, as well as international members from three other continents.

On October 23 through November 2, 1993, EPRI provided two volunteer specialists, David Porter and Edwin Riddell, to visit Thailand and meet with government, industry, and utility officials. In addition, Advanced Electric Car Technology, Inc. (AECT) also provided two volunteer specialists, Chaz Haba and Richard Mayer. The primary purpose of this visit was to assess the potential for electric tuk-tuks. The assessment was to include demonstration of a recently converted vehicle, review of tuk-tuk manufacturing facilities and capabilities, review of market potential, and determination of Thai government support and potential subsidies. This report describes the specialists' findings, conclusions, and recommendations.

The specialists found a large potential for electric tuk-tuks in Thailand. The current tuk-tuks, utilizing two-cycle engines, greatly contribute to the poor air quality. The manufacture of tuk-tuks in Thailand is currently 300 per month. However, the opening of a new factory by Pholasith Tuk-Tuk will increase capacity to 1000 units per month. While all new units do not stay in Thailand, significant numbers do remain and will continue to contribute to air pollution problems unless an alternative, nonpolluting vehicle design is adopted. Achievement of this is a high priority of the Thai government.

The EPRI representatives had a secondary purpose to explore the needs of the Thai utility industry and to foster a long-term relationship between EPRI and the Thai utilities. Given the challenges facing the Thai utility industry, it would greatly benefit from the availability of a research and development organization such as EPRI.

The major issues facing the three electric utilities in Thailand are:

Supply Capabilities: Continued high growth rates have put a premium on new generating capacity while placing a strain on existing plant capabilities.

Reliability of Supply: These growth rates have also placed a strain on existing transmission and distribution facilities, resulting in a diminished quality of supply to the customers as well as significant line losses for the utilities.

III. DISCUSSIONS AND FINDINGS

A. Introduction

The visit to Thailand included a series of meetings culminating in a press conference on October 29, to demonstrate the electric tuk-tuk. The volunteer specialists met with various representatives of the private sector and utilities. All meetings were kindly arranged by R.J. Gurley of the local U.S. Agency for International Development (USAID) mission.

B. Meetings with Pholasith Tuk-Tuk

The week began with introductory meetings between key management of Pholasith and EPRI, AECT, and USAID representatives. Preliminary discussions were held to evaluate the successful conversion of the first tuk-tuk and to explore the potential for future conversions in Thailand. Also included, was a thorough inspection of the current Pholasith factory and a detailed review of the plans for the new factory currently under construction.

Previous to the establishment of Pholasith 10 years ago, all tuk-tuks were imported. Pholasith currently employs 150 people at a factory that fabricates all tuk-tuk parts except the engine (used Daihatsu engines imported from Japan). The current factory can produce 1000 units per month and exports 50 percent of its new units. Chief export customers are South Africa, Cambodia, China, and Vietnam.

The tuk-tuks are excellent candidates for conversion to electric vehicles due to the way in which they are operated. Tuk-tuks are rented daily from a fleet manager for eight hour shifts. The average shift covers a distance of approximately 200 kilometers. These shift lengths, distances traveled, and central pick-up and return points make the viability of electric units extremely high. The central location opens many options for charging, from central charging stations to exchangeable battery packs.

C. Pollution Control Department Meetings

Meetings were conducted with the top two officials in the Pollution Control Department (PCD), a Division of the Ministry of Science, Technology, and Environment (MOSTE), to discuss Royal Thai Government support of an electric vehicle program. The concept was fully supported by PCD with an additional push to electrify tuk-tuks all across Thailand, not just in Bangkok. A key point in

support of the project was that PCD wants to assist in the testing phase to ensure that the demonstrations are working demonstrations (i.e., electric tuk-tuks are actually on the street as taxis, delivery vehicles, etc.) and not just displays.

Major support was provided in the form of verbal commitments by the PCD to provide the following incentives for manufacturers and purchasers of electric tuk-tuks.

- 5 to 7 year income tax exemptions
- low to no interest loans
- tax exempt import status (for electric components)
- purchase incentives

D. Tuk-tuk Demonstration and Press Conference

The first week's activities were culminated with a demonstration and press conference at the Queen's Sirikat Convention Center. Presentations were made by the Minister of MOSTE, the U.S. Ambassador, the President of Pholasith, USAID (Tom Reese), AECT (Chaz Haba), and EPRI (David Porter) prior to the actual demonstration. The support and favorable publicity afforded this effort served to impress all involved with the potential for success of an on-going effort to electrify tuk-tuks.

E. Provincial Electric Authority (PEA)

Two separate meetings were held with PEA. Meetings included senior technical staff as well as senior management. PEA is the rural supplier for Thailand, carrying electricity over 510,000 square meters of territory. PEA has numerous problems requiring technical support and hardware solutions which are the result of years of purchasing from the low-cost suppliers (typically low grade Japanese equipment).

Important issues to PEA are:

- power quality and system reliability
- energy losses (due to line losses)
- the need for underground technology and installation/operation

F. Electricity Generating Authority of Thailand (EGAT)

As the chief supplier of electricity in Thailand, EGAT has some of the same problems as PEA while also holding a unique set of problems of its own. EGAT supplies only 10 major industrial customers directly with all remaining power being sold to PEA and MEA.

EGAT is the key recipient of a major World Bank loan for utility improvements containing two key provisions: Demand Side Management (DSM) requirements, and plant emission improvements. The other critical issue for EGAT is poor equipment performance. This is tied to the fact that most line hardware purchased in the past has been low grade equipment that now sits broken down and unused. EGAT is similar to PEA in that technical support and expertise is needed in addition to improved hardware. EGAT does have an in-house R&D department, but it is a one person operation that is largely ineffective.

Important issues for EGAT are:

- need for tools (software) to design, develop, implement, and evaluate DSM programs
- technologies and expertise to effectively improve plant emissions
- power quality and system reliability.

G. Metropolitan Electric Authority (MEA)

MEA has problems consistent with PEA and EGAT related to system reliability and power quality. MEA's unique problems come in the form of a service territory that consists of the City of Bangkok. Aging infrastructure and low cost equipment purchases (Japanese) are major contributors to operational problems for MEA. The need for state-of-the-art underground networks is also keenly important for MEA in order for Bangkok to continue to attract/maintain key businesses.

Important issues for MEA are:

- power quality and system reliability
- need for a sophisticated underground network
- tools/assistance for implementing/evaluating DSM programs.

IV. CONCLUSIONS AND RECOMMENDATIONS

Thailand is faced with a number of growing problems related to rapid economic growth. However, the country is capable of addressing these problems with the appropriate outside help. Internally, Thailand enjoys great government and monarchy support towards cleaning up the environment. The outside assistance required is available, and could help promote U.S. technology in the region.

Based on the two primary purposes of this visit (electric tuk-tuks and utility evaluation), the following recommendations are made.

Recommendation 1: Promote and Move Forward with the Electric Tuk-tuk Project

The potential for the electric tuk-tuk as a viable mode of transportation is astounding. It is rare when the fit between a technology (electric vehicle components) and an application are matched this well. In addition, this project has excellent Thai government support and two willing and eager entrepreneurs ready to move forward.

Key developments that have occurred to move this effort forward to date include:

- verbal agreement to a joint venture between Pholasith and AECT
- verbal commitment by MOSTE to purchase the first 50 electric tuk-tuks as part of the demonstration effort for the project (cost shared with AID Mission)
- formation of a joint venture between EPRI and AECT to promote vehicle electrification (including the tuk-tuk project)
- USAID (Washington, DC) commitment to fund the first \$200,000 installment for the initiation of the project.

However, these are not the only commitments that need to occur in order to make this project a commercial success. The project proposal in the Appendix is merely Phase I of this effort, primarily the front end design and engineering work. Funding for this scope of work will be approximately US \$1 million, of which only the first \$200,000 has been committed. Phase II of this project will be much larger in scope (approximately US \$3 million) to get the electric tuk-tuks into regular production. All parties involved must be mindful of a continuing need to search for funding.

Recommendation 2: Establish a Long Term Relationship Between EPRI and the Thai Utilities

There is no doubt that a long term relationship between EPRI and the Thai utilities would be of great benefit to EGAT, PEA, and MEA. None of these utilities has any internal research and development expertise of any consequence to be able to meet the problems facing the industry in Thailand today. An EPRI membership would provide this expertise critical to the utilities' future.

There are several commitments and concessions being made by EPRI that are not part of the normal international affiliate membership. In addition, verbal commitment has been made by US-AEP to cost share at least one-fourth of the membership each year for the first three years of the agreement.

The membership arrangement would be customized for Thai utility needs. However, the areas of focus would probably include the following items based on early interviews with key Thai utility personnel.

Demand Side Management Program: Access to the DSM program would provide the utilities with all the necessary tools to successfully plan, establish, and evaluate DSM programs and integrated resource planning. EPRI's DSM program features software tools that apply to all aspects of DSM planning and would be available to the Thai utilities if a membership relationship were developed. In addition, there is a vast wealth of reports that document the potential problems and successes of DSM activities in the U.S.

Environmental Division: Access to this group of programs would provide the utilities with key technologies and tools that address the environmental impacts of electric utilities. Technologies and tools include work related to electromagnetic fields (effects and management), global climate management, air quality issues (control technologies, regulations, air toxics management, integrated analysis), ground/surface water issues, and utility waste management (combustion by-products management).

Electrical Systems Division: Access to this group of programs will provide the expertise and technologies necessary to improve the transmission and distribution systems in Thailand. Technologies and tools include work related to Transmission and Distribution (T&D) system productivity (line loss reductions, suburban underground systems), T&D systems equipment reliability, T&D system capacity upgrades, and life extension of T&D systems and equipment.

Two key points related to the benefits of an EPRI membership are:

- Membership provides access to technologies and tools (hardware and software) that would otherwise have to be purchased on the open market through contractors for greater costs. EPRI membership includes not only the access to software, but also training and operating expertise.
- Membership helps promote U.S. technologies. All EPRI R&D work is done on a contract basis, principally with U.S. companies. Therefore, hardware adaptation generally means great export potential for U.S. companies.

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APPENDIX A
SIGN-UP SHEET

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Electric Power
Research Institute

Leadership in Science and Technology

SIGN - UP SHEET

Date:

Utility:

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Contact: DAVID PORTER

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Presentation given by:

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APPENDIX B
BUSINESS CARDS OF PERSONS VISITED



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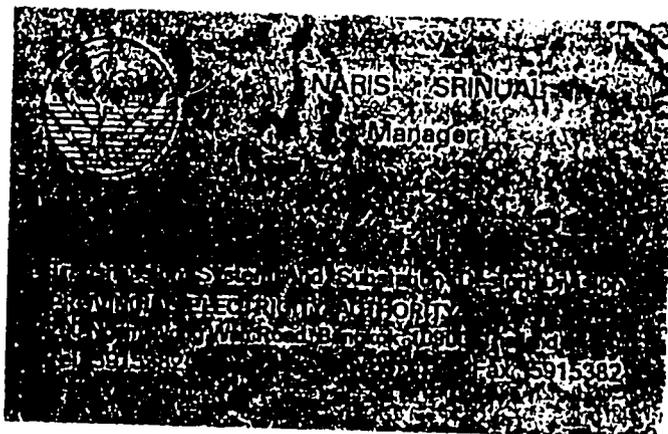
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APPENDIX C
CURRICULUM VITAE

DAVID W. PORTER

David Porter is Manager of International Technology Transfer for the Customer Systems Division at EPRI. He is responsible for marketing the products and services of the Customer Systems Division to member utilities. His specific focus is the exchange of end-use technologies and methods with EPRI's international members.

Porter joined EPRI in 1992 following a 10 year career with Duke Power in Charlotte, North Carolina. As Business Development Director, Porter had responsibility for national accounts as well as new business prospects.

Porter received a BS in Mechanical Engineering from North Carolina State University in 1982. He is a registered Professional Engineer in North and South Carolina and is a past president of the Association of Energy Engineers.



September 1992

EDWIN O. RIDDELL

Edwin (Ed) Riddell is Program Manager of the Transportation Program in the Customer Systems Division, at the Electric Power Research Institute (EPRI) in Palo Alto, California. He joined the Institute in January 1992. In this position, Mr. Riddell is responsible for the management of the Electric Transportation Program, which includes work on electric passenger vehicles, batteries for EVs, and storage batteries for electric public transportation.

Before joining EPRI, Ed spent six years with The Transportation Group as Vice President, Engineering, working on electric public transportation systems. From 1979 to 1985, he was Vice President and General Manager of Lift U Inc., the leading manufacturer of handicapped wheelchair lifts for the transit industry. Ed also worked with Ford, Chrysler, and General Motors in the area of auto design (styling), and has worked as a member of senior management for a number of public transit vehicle manufacturers.

Mr. Riddell received a B.S.M.E. degree from Wayne State University, an M.B.A. from the University of Washington, and a degree in Transportation Design from the Art Center.

Ed has been a member of the American Public Transit Association's (APTA) Associate Member Board of Governors for over 15 years. He has also served on APTA's Board of Directors.

July 1992

APPENDIX D
HONG KONG REPORT

**(At no incremental cost to the scheduled Thailand project,
a brief series of meetings were held in Hong Kong.)**

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**ELECTRIC POWER RESEARCH INSTITUTE'S ASSESSMENT
OF TECHNOLOGY TRANSFER TO HONG KONG UTILITIES**

Hong Kóng
October 12-19 and November 18-21, 1993

I. EXECUTIVE SUMMARY

The environmental concerns in Hong Kong range from air pollution (primarily from vehicles and power plants) to the effective disposal of infectious waste and the adequate management of water and wastewater treatment. These concerns constitute a key problem area for the Hong Kong Government; however, the full range of expertise needed to address and solve these problems is not currently available in Hong Kong. The purpose of this exchange, conducted under the auspices of the United States-Asia Environmental Partnership (US-AEP), through a Cooperative Agreement with the World Environment Center (WEC), was to explore the needs of the Hong Kong utilities and Hong Kong Government in order to identify opportunities for the application of U.S. technologies to meet these needs.

The utilities of Hong Kong and the Hong Kong Government have a rather unique formal relationship. The government does hold regulatory jurisdiction over China Light & Power and Hong Kong Electric. However, jurisdiction reigns in the form of a written agreement valid for 15 years. The agreement can be revised during the 15 year term (every five years), but only if both the utility(ies) and the government agree to open negotiations. Consequently, the Hong Kong Government has little true regulatory rule over the utilities.

Two volunteer specialists, David W. Porter and Edwin O. Riddell, were provided by the Electric Power Research Institute (EPRI). They determined that the Hong Kong Government has a great desire to address all key environmental issues, but has not yet been able to identify the proper approach to take. The legislature in Hong Kong realizes that strong legislation is needed; however, they are tentative in enacting such legislation for fear of impeding commercial/industrial development. Further, the Hong Kong Government has not been very successful in assembling cooperative efforts towards problem solutions. This may be partially due to the government having appointed several different branches to work on the same issues. These branches have had little or no inter-departmental communications. Most importantly, the government has virtually isolated Hong Kong's electric utilities from any due process related to addressing utility-associated problems such as power plant emissions or the potential benefits of electric vehicles.

The chance of successfully addressing Hong Kong's environmental concerns is strong due to the government's commitment to an improved environmental stature. However, significant improvements can only be made with assistance from outside Hong Kong. The environmental issues posed in Hong Kong offer scores of opportunities for U.S. businesses. Market-ready technologies need only slight adaptation for the Hong Kong market.

II. INTRODUCTION

The Electric Power Research Institute (EPRI) is a not-for-profit research, development, and deployment firm for the electric utility industry. EPRI currently supports some 1600 projects ranging from advanced power plant technologies to high efficiency cooling equipment. EPRI is funded by voluntary contributions from member companies in the United States, as well as international members from three other continents.

EPRI provided two volunteer specialists, David W. Porter and Edwin O. Riddell, to visit Hong Kong and meet with government, utility and legislative officials. The visits took place October 12-19 and November 18-21, 1993. This exchange was sponsored by the United States-Asia Environmental Partnership (US-AEP), through a Cooperative Agreement with the World Environment Center (WEC). The primary purpose of the exchange's two visits was to explore the needs of the Hong Kong utilities and Hong Kong Government, and to identify opportunities for the application of U.S. developed technologies to meet these needs. This report discusses the specialists' findings, conclusions, and recommendations resulting from the exchange.

The discussions held during these visits found that the Hong Kong Government is committed to addressing all of its environmental problems. The Hong Kong Government has identified its key environmental problems which include: air pollution, the adequate disposal of infectious waste, and proper water and wastewater treatment. The government has also determined that it does not have the expertise within Hong Kong to adequately solve these problems. In addition, the government's efforts, to date, have not been focused in a manner that would facilitate a coordinated effort to obtain solutions. Following these visits, there is little doubt that ample opportunity exists for U.S. businesses as well as a research and development organization like EPRI, to participate in Hong Kong's environmental improvement plans.

The major issues that surfaced during all meetings can be simplified into the following categories.

Power Plant Emissions: Continued economic growth in China has exhausted available supplies of electricity, causing China to look to nearby neighbors for electricity supply. The result of China's needs has been the addition of new generating facilities by the Hong Kong utilities (China Light & Power in particular). Although newer, cleaner generating technologies are being utilized, the net effect on air quality is poor due to new emissions plus the continuing pollution from older, less advanced generating plants.

Demand Side Management (DSM): One major hope of curtailing plant emissions is through demand side management programs. DSM is the practice of utility load shaping in order to more effectively utilize utility assets. DSM can be effectively

utilized to either curtail plant emissions through reduced demands or to defer the construction of new generating plants. Effective DSM is the result of cooperative efforts between utilities and their respective regulatory bodies.

Commercially Viable Electric Vehicles: The government and utilities all realize that major air clean-up is possible with the use of electric vehicles. Both utilities currently have small vehicle fleets which are being tested.

Environmental Solutions Through Technology: The vast range of day to day environmental issues includes water and wastewater treatment, and infectious waste disposal. Identifying and implementing technology solutions in Hong Kong is of prime importance to the government.

III. DISCUSSIONS AND FINDINGS

A. Introduction

Both visits to Hong Kong included similar approaches with a wide variety of Hong Kong participants. The volunteer specialists met with representatives of the utilities, the Hong Kong Government Departments of Electrical & Mechanical Services, Environmental Protection, Government Industry, Architectural Services, and the Planning, Environment and Lands Branch Government Secretariat, as well as with private interests including the Hong Kong University of Science & Technology. All meetings were coordinated with the local US-AEP representative, Gerald Sanders.

B. October 12-19, 1993 Meetings

The October 12-19 meetings included separate meetings with key personnel at each of the two electric utilities, China Light & Power, and Hongkong Electric, Co. In both cases, needs-based interviews were conducted to explore where potential areas of interaction existed.

1. China Light & Power

The most pressing issue facing CL&P is demand side management. While preserving generating capacity is not a driving issue, the environmental impacts of expanding growth in China are key. The Hong Kong Government is working towards DSM mandates (albeit slowly) that will encourage energy efficiency and conservation. CL&P is viewed as the uncooperative Hong Kong utility by the government due to their continued generation expansion to serve the growth in China.

Other important issues to CL&P are:

- establishment of an electric vehicle program for Hong Kong
- collection of load research data to begin DSM planning
- need for tools (software) to design, implement, and evaluate DSM programs.

2. The Hongkong Electric Co., Ltd.

The key issue for this utility is also DSM, but with a different twist in that Hongkong Electric has committed to the government to subscribe to a program of energy efficiency and conservation for the next 15 years. Serving only the Island of Hong Kong provides a different set of problems for Hongkong Electric, primarily related to the large and growing commercial sector.

Other important issues to Hongkong Electric:

- establishment of an electric vehicle program for Hong Kong
- collection of load research data to begin DSM planning
- need for tools (software) to design, implement, and evaluate DSM programs
- need for conservation technologies such as lighting, thermal storage, glazing, etc., along with building energy design expertise.

3. Utility Companies

In terms of generating capacity, China Light & Power is the larger of the two Hong Kong utilities. However, service requirements and needs of the two utilities are vastly different. China Light & Power serves Kowloon and the New Territories. In addition, their largest customer is the Chinese mainland. The only real growth opportunity for China Light & Power is in China since the majority of industry in their service territory has migrated to China.

The Hong Kong Electric Company serves only Hong Kong Island. While the island is a finite service territory, it still functions as the commercial hub for the country of Hong Kong. Commercial development on the island continues at a phrenetic pace, requiring additional demands for electricity from Hong Kong Electric.

Following these initial meetings with the utilities, meetings were held with a collection of government representatives. These meetings included brief presentations on EPRI activities, but primarily focused on governmental needs.

Key issues included:

- identifying key DSM issues
- how to implement DSM with effective government/utility relationships
- identifying good energy efficiency technologies and relating these to environmental improvements
- how to implement an effective electric vehicle program
- how to establish an effective energy code for buildings (none currently exists)
- energy efficiency in the public sector
- energy labeling practices.

Following these brief introductory meetings on October 12-19, it was decided that David Porter would return to Hong Kong on November 18-21 to more formally explore these opportunities/concerns through seminars on DSM and electric vehicles.

C. November 18-21, 1993 Meetings

The last set of meetings consisted of two separate seminars as well as individual meetings with two key Hong Kong legislators.

1. DSM Seminar

The DSM seminar was attended by 11 people representing both electric utilities, all appropriate government branches (Departments of Electrical & Mechanical Services, Environmental Protection, Government Industry, Architectural Services, and the Planning, Environment and Lands Branch Government Secretariat), as well as the Hong Kong University of Science and Technology. The key issues that surfaced throughout the meetings included:

- how to establish an effective energy policy focused on DSM and waste management
- how to promote such a policy once established
- how to mandate environmental efforts related to energy production and utilization
- how to establish integrated resource planning (IRP) and obtain utility commitment and cooperation.

There is no question that tremendous outside support is required in order to establish DSM practices and an energy policy.

2. Electric Vehicle Seminar

The Electric Vehicle Seminar was attended by 15 people representing the utilities, government, and the university. There was little doubt that the government recognizes the potential impact of electric vehicles on the air in Hong Kong. However, to date, the government has been unable to make any substantive progress in promoting the concept of electric vehicles.

Some legislation has been passed, but it too has been largely ineffective. Only low-sulfur diesel fuel regulations will have even a small impact on Hong Kong's air quality. The one key hope related to electric vehicle potential in Hong Kong is that all parties (government and utilities) agree that the potential impact is tremendous. The huge base of public transportation makes the prospects even better. All that is lacking is some cohesive force to pull the groups together in an initial, successful effort.

3. Legislator Meetings

Meetings were held with two of Hong Kong's most influential representatives, Christine Loh and Peter Wong. Both echoed the concerns noted from earlier meetings and the two seminars. Chief concerns were:

- DSM, IRP processes and implementation
- establishing an electric vehicle program and possibly a government fleet for improved air quality
- enacting legislation favorable to electric vehicle registrations in Hong Kong
- addressing the water/wastewater problems in Hong Kong.

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IV. CONCLUSIONS AND RECOMMENDATIONS

The needs and concerns of Hong Kong's utilities and government are nearly identical to those faced by counterparts in the United States over the past several years. The major difference is that Hong Kong does not have the necessary resources or expertise to be able to solve these problems in a timely and cost effective manner. However, the expertise to assist Hong Kong is readily available in a number of different forms that would not only help solve local problems, but would also help promote U.S. technology abroad.

Based on the three major issues identified during the visits regarding:

- power plant emissions
- demand side management
- commercially viable electric vehicles
- environmental solutions through technology,

the following recommendations are made.

Recommendation 1: Establish a long-term relationship between EPRI and Hong Kong Utilities.

Establishing a long-term relationship between the Hong Kong utilities and EPRI could be key to the successful future of the utilities. Neither Hongkong Electric nor China Light & Power have any internal or local research and development expertise. The lack of such expertise severely hinders the utilities' ability to meet impending government regulations.

An EPRI membership for the Hong Kong utilities could be structured so that only key areas of EPRI R&D are chosen to meet local needs in Hong Kong. The three key areas that would seem to have the most applicability for the utilities are:

Demand Side Management Program (DSM): Access to the DSM program would provide the utilities with all the necessary tools to successfully plan, establish, and evaluate DSM programs and integrated resource planning. EPRI's DSM program features software tools that apply to all aspects of DSM planning and would be available to the Hong Kong utilities if a membership relationship were developed. In addition, there is a vast wealth of reports that document all the potential and successes of the DSM activities in the U.S.

Environmental Division: Access to this group of programs would provide the utilities with key technologies and tools that address the environmental impacts of electric utilities. Technologies and tools include work related to Effects and Management (EMF), global climate management, air quality issues (e.g., control technologies,

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regulations, air toxics management, and integrated analysis), ground/surface water issues, and utility waste management (combustion by-products management).

Industrial Technologies: Community environmental needs continue to grow as a problem in Hong Kong. EPRI's industrial program has a component dedicated strictly to essential community services that includes technology development for municipal water and wastewater systems, as well as for medical waste disposal. A worldwide research and development project is being conducted on municipal water and wastewater systems which would be an excellent fit for Hong Kong.

Two key points to note related to the benefits of an EPRI membership for the Hong Kong utilities are:

1. Membership provides access to technologies and tools (hardware and software) that would otherwise have to be purchased on the open market through contractors for greater costs. EPRI membership includes not only the access to software, but also to training and operating expertise.
2. Membership helps promote U.S. technologies. All EPRI R&D work is done on a contract basis, principally with U.S. companies. Therefore, hardware adaptation generally means great potential for U.S. companies.

Recommendation 2: Establish an effective electric vehicle demonstration project.

The government and the utilities realize the potential impact of electric vehicles on cleaning the air in Hong Kong. Unfortunately, none of the parties is sure of what steps need to be taken to ensure success and acceptance in Hong Kong. The best approach to move the effort forward would be to sponsor a successful demonstration effort.

As such, EPRI will be making a formal proposal to key agencies and the utilities of Hong Kong for an electric vehicle project. The proposal will consist of several phases, including:

- feasibility study of electric vehicles in Hong Kong, including the infrastructure issue
- conversion of several internal combustion vehicles to electric, including, at minimum, a taxi, a public light bus, and a delivery van
- testing and documentation of the vehicle operation.

The technologies are available in the U.S. to make this project work. This project could be the building block to export additional U.S. technologies and build an electric vehicle fleet in Hong Kong. The proposal will be completed in the near future, and will hopefully involve a consortium consisting of China Light & Power, Hongkong Electric Co., the Hong Kong Government, EPRI, US-AEP, and the WEC.

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ATTACHMENT 1
BUSINESS CARDS OF PERSONS VISITED

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