



Department of Industrial and Management Engineering
Indian Institute of Technology Kanpur



Forum of Regulators

5th Capacity Building Programme for
Officers of Electricity Regulatory Commissions
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Rural Electrification in Thailand: Policy and Implementation

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การไฟฟ้าส่วนภูมิภาค
PROVINCIAL ELECTRICITY AUTHORITY



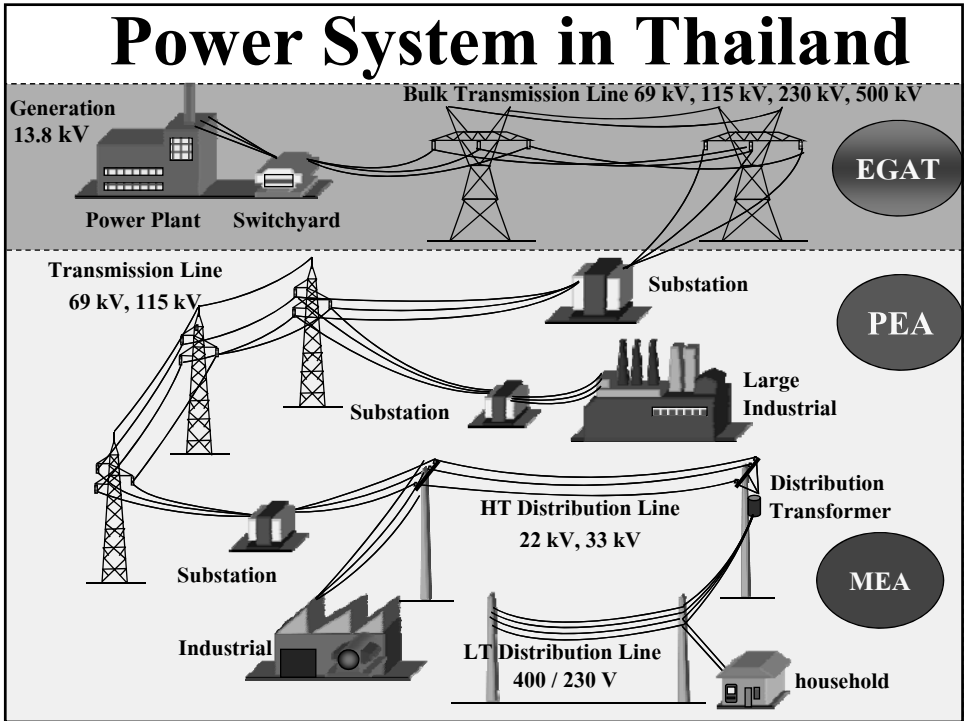
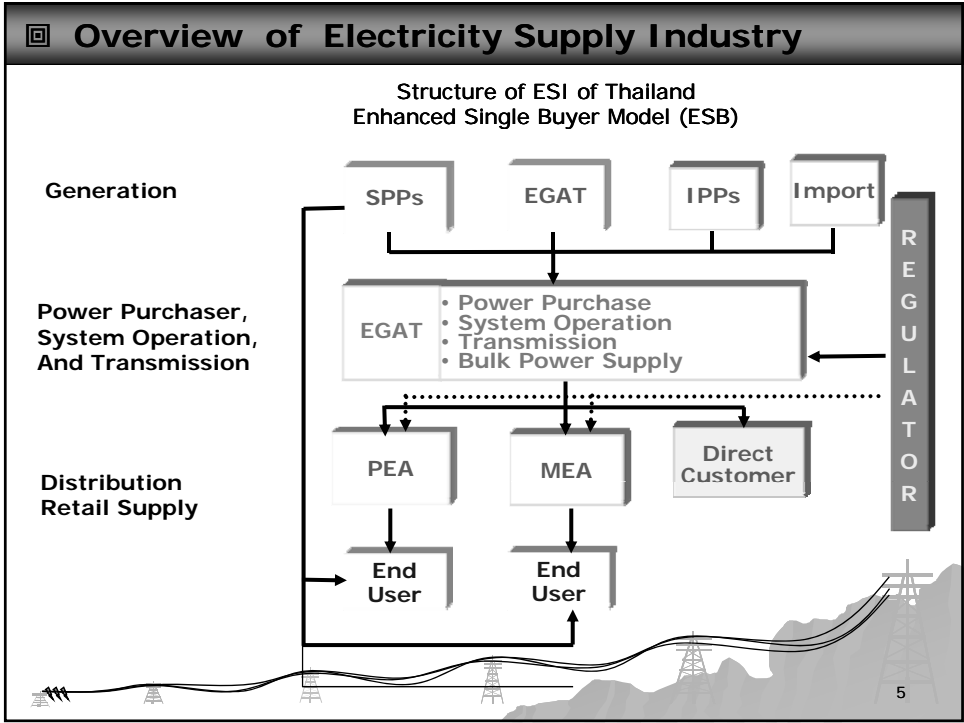
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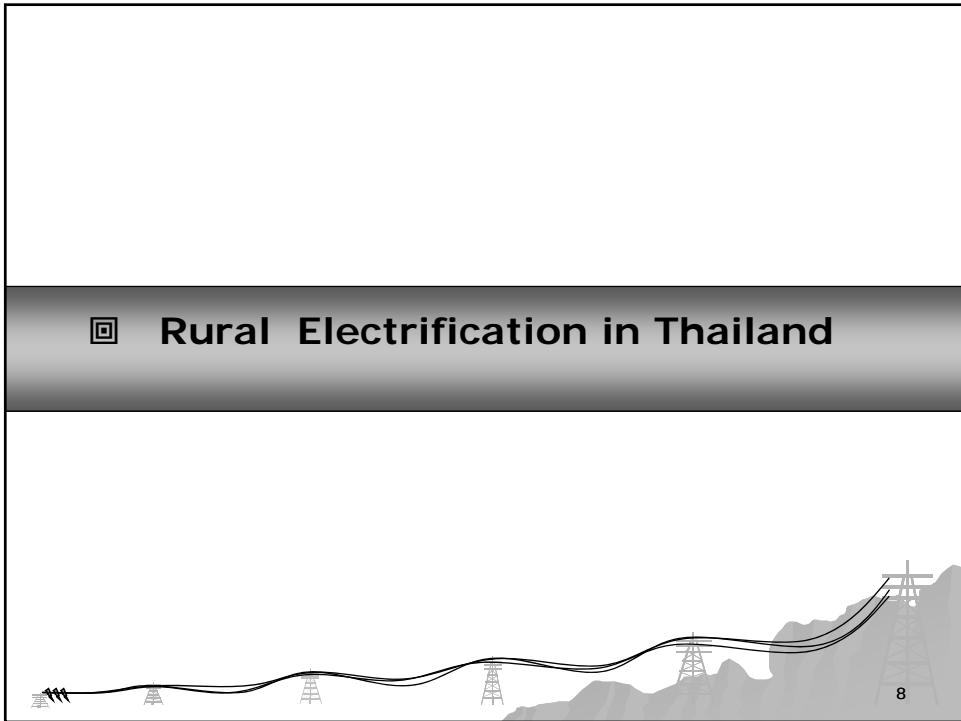
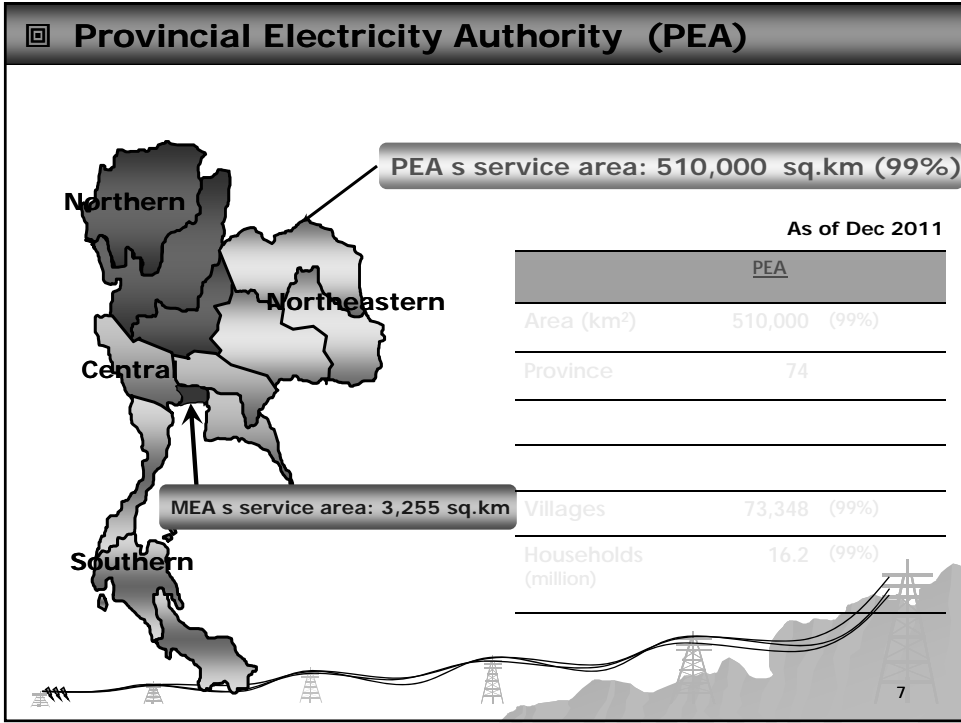
Reungvith Vechasart
Assistant Governor (Retired) 22nd October 2012


5th Capacity Building Programme for Officers of Electricity Regulatory
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 การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย <small>PUBLIC ELECTRICITY AUTHORITY</small>	Content
<div style="background-color: #ccc; padding: 5px; margin-bottom: 5px; border-radius: 5px;">1. Evolution of Rural Electrification in Thailand</div> <div style="background-color: #ccc; padding: 5px; margin-bottom: 5px; border-radius: 5px;">2. Policy, Strategies, and Implementation</div> <div style="background-color: #ccc; padding: 5px; margin-bottom: 5px; border-radius: 5px;">3. Lessons from Thailand Experience</div> <div style="background-color: #ccc; padding: 5px; margin-bottom: 5px; border-radius: 5px;">4. Conclusion</div>	

Geography	Land Area 513,255 sq.km.
Capital	Bangkok
Province	77
Population	67 million (10 million in Bangkok)
Currency	Baht (30.2 Baht/US\$-2011 average reference rate)
Language	Thai
Government	Constitutional Monarchy
	Head of Government : PM Yingluck Shinawatra
Electric Generation Capacity	32,395 MW
Peak Demand	26,121 MW










1. Evolution of RE in Thailand


NESDP

To develop the country economically and socially

PEA Target

To extend electricity supply to all rural villages




1. Evolution of RE in Thailand


4 Stages of RE in Thailand

New Rural Household Electrification Stage


Initial Stage




Accelerated Rural Electrification Program Stage



Rural Household Electrification Stage



New Rural Household Electrification Stage



1964 - 1975

Target : 10,000 villages
Electrified villages : 10,000

1972 - 1994


Target : 64,228 villages
Electrified villages : 64,228

1995 - 2009

Target : 73,213 villages
Electrified villages : 73,213


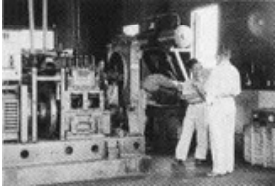
2010 - Present

Target : All Rural Household
Electrified villages : 73,348




1. Evolution of RE in Thailand

Stage 1 : Initial Stage


Period	<ul style="list-style-type: none"> 1964 – 1975 (12 years) 	
Target	<ul style="list-style-type: none"> 10,000 Villages By Small Diesel Power Plants 	
Investment	<ul style="list-style-type: none"> 96.5 MB. (2.67 M.USD) Consist of <ul style="list-style-type: none"> PEA Revenue = 70 % Customer Expense = 30 % 	
Status	<ul style="list-style-type: none"> Electrified Villages 20 % 	

Remark : (*) Exchange Rate: 1 USD = 36.2 Baht




1. Evolution of RE in Thailand

Stage 2 : Accelerated Rural Electrification Program Stage

Period	<ul style="list-style-type: none"> 1972 – 1994 (22 years) 	
Target	<ul style="list-style-type: none"> 64,228 Villages By Grid System 	
Investment	<ul style="list-style-type: none"> 25,988 MB. (717.9 M.USD) 1972 – 1994 <ul style="list-style-type: none"> PEA Revenue = 70 % Customer Expense = 30 % 	
Status	<ul style="list-style-type: none"> Electrified Villages 98 % 	<div style="background-color: #ccc; padding: 5px; border-radius: 5px; text-align: center; font-size: small;"> Source of Fund </div> <ul style="list-style-type: none"> PEA Revenue Domestic Loan External Loan

Remark : (*) Exchange Rate: 1 USD = 36.2 Baht




1. Evolution of RE in Thailand

Stage 3 : Rural Household Electrification Stage

Rural Household Electrification Project phase 1 – 3 (1995 – 2006) Solar Home System Project (2004 – 2006)	Period	<ul style="list-style-type: none"> • 1995 – 2006 (12 years)
	Target	<ul style="list-style-type: none"> • 73,213 Villages (4 Projects) • By Grid System and Solar Cell
	Investment	<ul style="list-style-type: none"> • 16,944 MB. (468 M.USD) • Consist of <ul style="list-style-type: none"> • PEA Revenue = 55 % • Domestic Loan= 25 % • External Loan = 30 %
	Status	<ul style="list-style-type: none"> • Electrified Villages 99.98 %

Remark : (*) Exchange Rate: 1 USD = 36.2 Baht




Future Plan of RE

Stage 4 : New Rural Household Electrification Stage

Accelerated Rural Household Electrification Project (AHEP)	Period	<ul style="list-style-type: none"> • 2010 – 2011 (2 years)
	Target	<ul style="list-style-type: none"> • 91,527 Households
New Rural Household Electrification Project (NHEP)	Investment	<ul style="list-style-type: none"> • 2,045 MB. (65.3 M.USD) • Consist of <ul style="list-style-type: none"> • PEA Revenue = 25 % • Domestic Loan= 75 %
Remote Rural Household Electrification Project (RHEP)	Status	<ul style="list-style-type: none"> • Electrified Villages 61.12 % (55,941 Household)

Remark : (*) Exchange Rate: 1 USD = 31.3 Baht




Future Plan of RE

Stage 4 : New Rural Household Electrification Stage

Accelerated Rural Household Electrification Project (AHEP)	Period	• 2012 – 2016 (5 years)
	Target	• 131,629 Households
New Rural Household Electrification Project (NHEP)	Investment	• 3,687 MB. (117.8 M.USD)
		<ul style="list-style-type: none"> • Consist of • PEA Revenue = 25 % • Domestic Loan= 75 %
Remote Rural Household Electrification Project (RHEP)	Status	• Under Cabinet Approval

Remark : (*) Exchange Rate: 1 USD = 31.3 Baht




Future Plan of RE

Stage 4 : New Rural Household Electrification Stage

Accelerated Rural Household Electrification Project (AHEP)	Period	• 2012 – 2017 (6 years)
	Target	• 14,100 Households
New Rural Household Electrification Project (NHEP)	Investment	• 1,980 MB. (63.2 M.USD)
		<ul style="list-style-type: none"> • Consist of • PEA Revenue = 25 % • Domestic Loan= 75 %
Remote Rural Household Electrification Project (RHEP)	Status	• Under Cabinet Approval

Remark : (*) Exchange Rate: 1 USD = 31.3 Baht

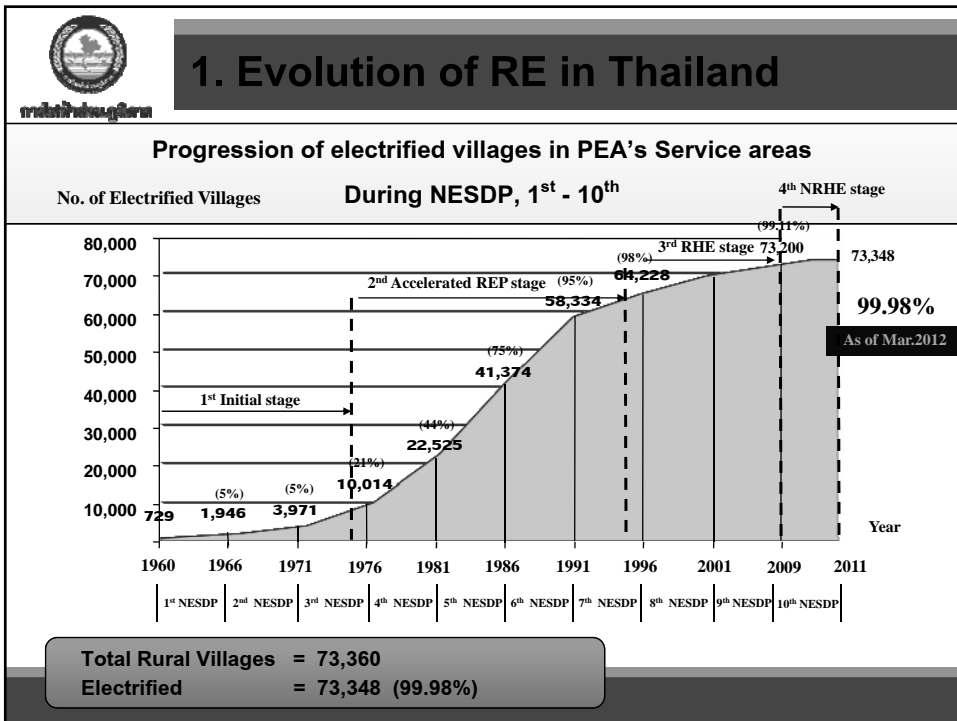


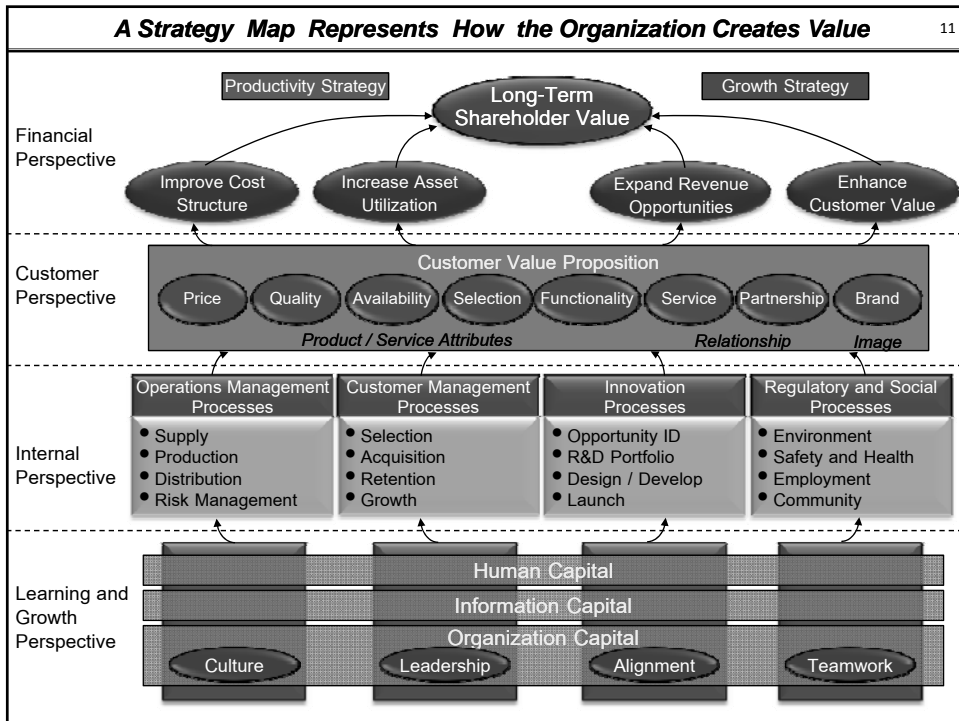
1. Evolution of RE in Thailand

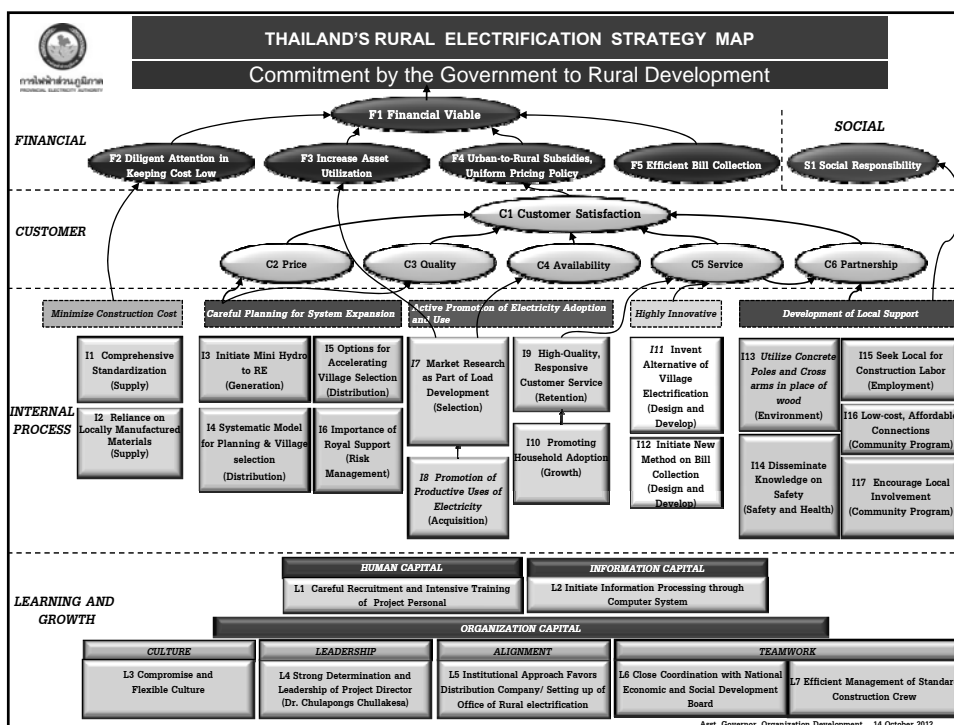
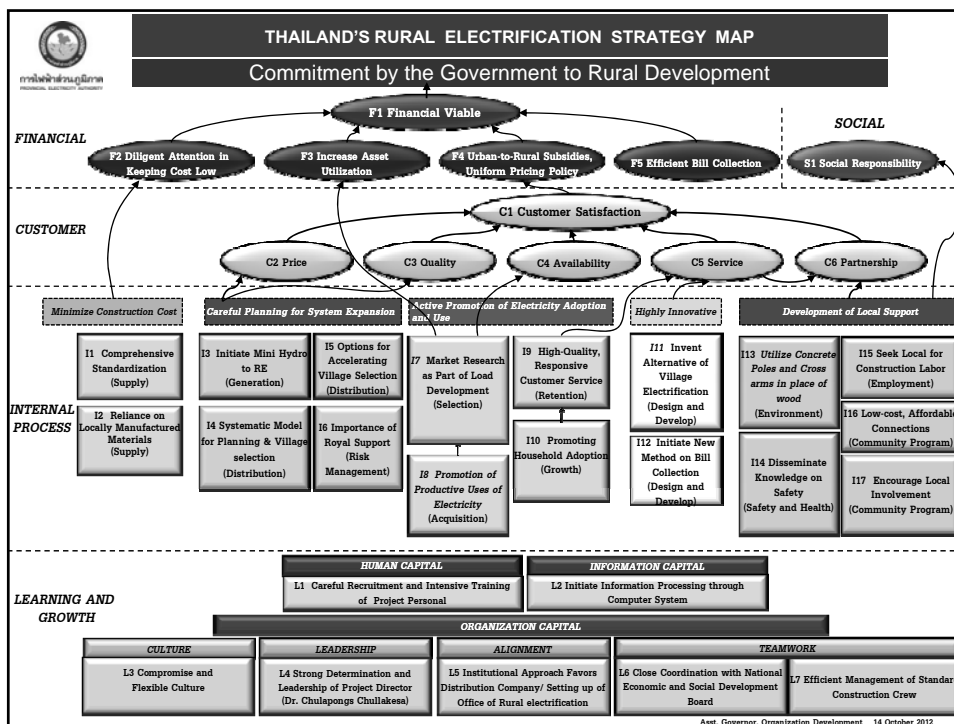
Number of electrified villages and households in PEA's Service areas

Status (Mar.2012)	Villages
All Rural Villages	73,360 (100%)
Electrified	73,348 (99.98%)
Remaining	12
In Plan	12

Status (Mar.2012)	Households
All Rural Households in PEA's Service Area	16,385,757 (100%)
Electrified	16,246,885 (99.15%)
In Plan	138,872

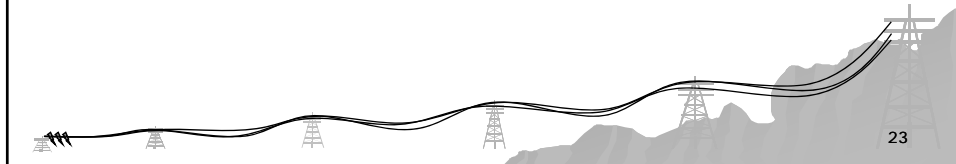






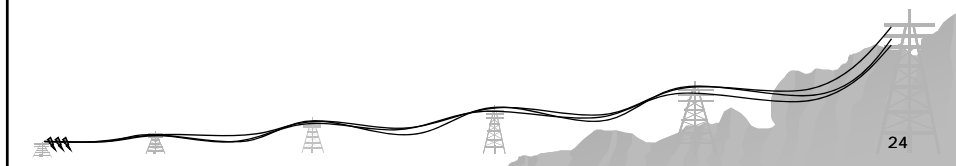
F1 Financial Viable

- ◆ **High cost of investments with low financial rate of returns .**
- ◆ **Intensive RE investment program would have a direct effect on its own financial standing .**



F3 Increase Asset Utilization

- ◆ **Careful system expansion planning .**
- ◆ **Prevent political interference with the village prioritization and selection process**
- ◆ **Emphasize that distribution company must be financially viable .**

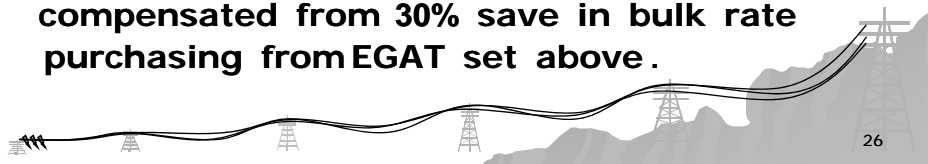


F4 Urban to Rural Subsidy

- Electricity tariff for each customer category must be the same all over the country.
- The tariff structure is based on cross - subsidy between customer categories.
- Oblige the rich customers such as industrial to subsidize the poor one.
- EGAT to sell power at lower price to PEA than to MEA / direct subsidy from the rich capital and industrial area to rural.

F4 SYSTEM OF CROSS - SUBSIDIES :

- ◆ **EGAT charged PEA 30% lower than it charged MEA**
- ◆ **Retail tariff rate structures designed to charge larger users at higher rate than small users**
- ◆ **Both PEA and MEA were required to use the same retail rate structure . PEA is compensated from 30% save in bulk rate purchasing from EGAT set above .**



F5 Efficient Bill Collection

- We was keenly aware that problems in bill collection from customers could lead to financial problems.
- No Money – No Honey
- PEA hired local respected individuals to collect on bills, such as school teacher, village head, or village elder.

I1, I2 Minimize Construction Cost

- ◆ **Standardized the systems , designs , materials , equipment and construction techniques .**
- ◆ **Use locally produced materials when possible .**
- ◆ **Seek local support (e.g. Capital and labor contributions)**
- ◆ **Set up a voluntary system of contributions for the capital costs of extension .**
- ◆ **Find access to concessional loans and grants .**



I1, I2 Cost Cutting Strategies

- ◆ **Reduced procurement and material handling expenses .**
- ◆ **Reduced purchasing cost through bulk purchasing .**
- ◆ **Help strengthening the capability of local industry .**
- ◆ **Get right - of - way permit for free .**
- ◆ **Clearing and cutting economic trees without compensation .**
- ◆ **The saving enabled PEA to provide electricity to an additional 837 villages or 22 % more than targeted for the project .**



I1 Comprehensive Standardization

- Selected 22 kV and 33 kV as the standard for its distribution system through out the country.
- Opted to standardize all of the equipment and components used for construction of distribution systems of all individual electrification projects.

14 Systematic Model for Planning and Village Selection

- Reconnaissance Study to assess readiness of all relevant party, the Government, PEA, EGAT, Rural Population.
- Pre- Feasibility Study (National Plan for Thailand Rural Electrification)
- Detailed Feasibility Study for Individual Project

14 Original Timetable for Thailand's National Rural Electrification Plan

(Source: PEA 1978)

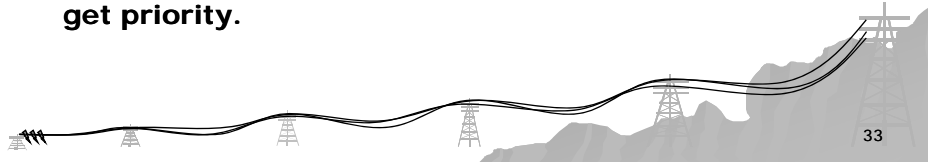
<i>Stage</i>	<i>Fiscal Years</i>	<i>In Program</i>	<i>Accumulated</i>	<i>Region</i>
I	1977-1981	5,200	5,200	Northeast
II	1980 – 1984	8,000	13,200	South
III	1983 – 1987	13,500	26,700	North
IV	1986 – 1990	14,500	41,200	Central
V	1990 – onward	5,800	47,000	Countrywide

14 Village Selection

If not properly plan , it would jeopardize financial viability and success of the program .

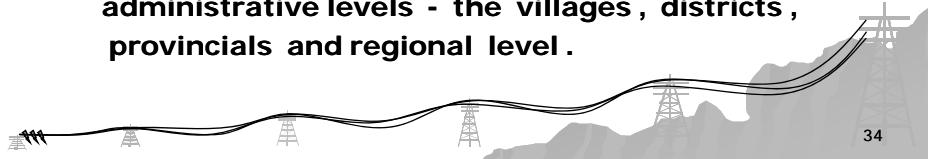
- ◆ **Priority of villages :-**
 - **Potential high demand load ,**
 - **Large productive use of electricity ,**
 - **Maximum achievable economic return ,**
- ◆ **and**
 - **Least cost optimization for grid connection**

If the politicians interfere, the undesired villages may get priority.



14 Village Selection

- ◆ **The quota allocations must maximize economic impacts and potential benefits and at the same time minimizing implementation costs .**
- ◆ **Enable the government to integrate RE with other rural development components .**
- ◆ **Give due regard to social and political requirements (politically unstable areas) at all administrative levels - the villages , districts , provincials and regional level .**



14 VILLAGE SELECTION

- The priority was given to the economically backward and politically unstable region – North East - First
- Ranking Village for final selection:
 - Proximity to the grid
 - Accessible by road
 - Village size
 - Number of expected customers in first five years
 - Potential agricultural and industrial load
 - Number of commercial establishments
 - Extent of public facilities

14 Variables Used to Determine Viability of Electrification for Village Selection

- | | |
|--|--|
| <ul style="list-style-type: none"> • Access of Rural Households (%) • Households Using Cooking Fuels (%) • Dwellings Constructed in Past Five Years (%) • General Health Indexes | <ul style="list-style-type: none"> • Ratio of Students • Agricultural Assessment (%) • Baseline Electricity Data • Overall Village Characteristics |
|--|--|

I4 Access of Rural Households (%)

- | | |
|---|--|
| <ul style="list-style-type: none"> • Public well as source of water supply • Private well as source of water supply • Electric lighting • Radio • Television | <ul style="list-style-type: none"> • Sewing machine • Refrigerator • Electric fan • Water pump for agriculture use |
|---|--|

I4 Variables Used to Determine Viability of Electrification for Village Selection

- | | |
|---|---|
| <p>Households Using Cooking Fuels (%)</p> <ul style="list-style-type: none"> • Charcoal • Wood • Gas • Other Modern fuels | <p>Dwellings Constructed in Past Five Years (%)</p> |
|---|---|

14 Variables Used to Determine Viability of Electrification for Village Selection

General Health Indexes

- Rural population density
- Population birth rate
- Population growth rate
- Ratio of population to local physicians

Ratio of Students

- Upper elementary to lower elementary school
- Lower secondary to upper elementary school
- Upper secondary to lower secondary school

14 Variables Used to Determine Viability of Electrification for Village Selection

Agricultural Assessment (%)

- Gross area in agricultural use
- Arable land under rice cultivation
- Arable land under field crop cultivation
- Total land under fruit trees and tree crops

Baseline Electricity Data

- Consumption in villages already electrified
- Ratio of electrified households to total households
- Households with electricity (%)

Overall Village Characteristic

- Average household size
- Average village population

14 Village Socio-economic Factors for Forecasting District Electricity Demand

- Households Characteristic
- Agriculture
- Households Income
- Households Expenditures

14 Village Socio-economic Factors for Forecasting District Electricity Demand

<p>Households Characteristics</p> <ul style="list-style-type: none"> • Household size within village • Net income per expenditure <p style="font-size: small; margin-top: 20px;"><i>Source: PEA 1978. Vol. I</i></p>	<p>Agriculture</p> <ul style="list-style-type: none"> • No. of households that own lowlands for rice cultivation • No. of households that own upperland for other crops • No. of households with cattle and water buffalo • No. of households owning small livestock
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14 Village Socio-economic Factors for Forecasting District Electricity Demand

Household Income

- Average village income from agricultural sources
- Average village income from livestock sales
- Average village income from wages and salaries
- Average village income from other sources
- Total annual income

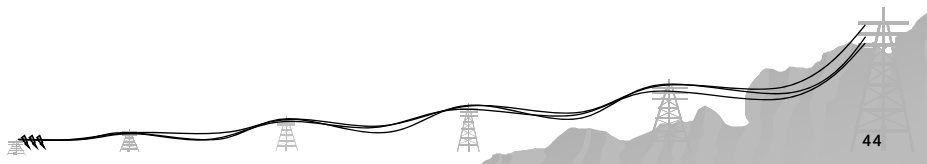
Household Expenditures

- Fixed expenditure
- Variable expenditure
- Subsistence expenditure
- Social expenditure
- Total annual expenditure

Source: PEA 1978. Vol. I

15 Options for Accelerating Village Selection

- ◆ **Devised sound methods for village selection and prioritization criteria .**
- ◆ **Made the program flexible by providing alternatives for villagers and individual including politicians to receive priority treatment , but they have to pay .**



15 Options for Accelerating Village Selection

- Normal Accelerated Project – PEA paid all construction cost
- Partial Contribution for Construction Cost – around 30 %
- Full Contribution – immediately connected to the grid

18 Promotion of Productive Uses of Electricity

- **Implement Aggressive Load Promotion Program .**
 - **Promote rice mill owners to convert diesel engine drive rice mills to electric motors .**
 - **Promote new rice mills to use electric motors instead.**
 - **Promote house hold initial connection rate .**

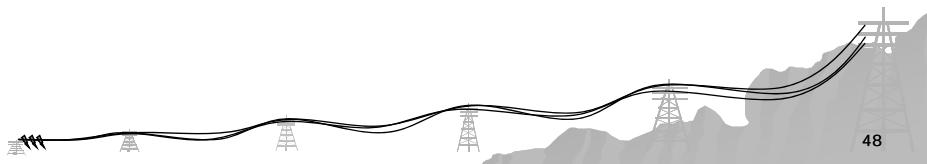
I16 Low – cost, Affordable Connections

- ◆ **Set a relatively low cost and affordable connection fees ,only US\$ 18 .**
- ◆ **Provided loans for house -wiring and initial connection costs - US\$ 98 .**
- ◆ **Appointed village head -men /leaders to take application forms and collected deposit /connection fees for PEA .**
- ◆ **Allowed rice mill owners to pay the connection fees by 12 month – stallments with no interest .**
- ◆ **Coordinated with the Agricultural Bank - loans for rice mills**



L5 Institutional Approach Favors Distribution Company

- ◆ **Designed proper Institutional Arrangement (Focus on Electricity Distribution) to make clear of the responsibility.**
- ◆ **Aimed at Institutional Arrangement that emphasize the significance of RE .**



L5 Institutional Approach Favors Distribution Company

- Separate the generation and distribution via different companies
- PEA mandate is to provide electric power distribution to provincial cities and rural areas throughout the country
- Is free to concentrate solely on distribution
- Do not have to concern itself with power generation and transmission.
- Do not have the burden to provide services to the high-demand, high-growth Bangkok.

3. Lessons from Thailand's Experience

- ◆ **Commitment to Financial Soundness**
- ◆ **Financing Expansion Through Cross – Subsidies and Concessional Loans**
- ◆ **Bulk Tariff Subsidies as Compensation for Universal Electricity Pricing Structure**
- ◆ **Avoid Political Interference**
- ◆ **Gaining Local Support**
- ◆ **Dedicated Distribution Company**



Conclusion : Key Words

- ◆ **We found solutions**
- ◆ **Strong Determination and Dedication of Team Leader,**
- ◆ **Office of Rural Electrification,**
- ◆ **Targeting highest load villages,**
- ◆ **Cross – Subsidies,**
- ◆ **low – cost connections,**
- ◆ **Load Promotion Program,**
- ◆ **Standardization,**
- ◆ **Unique Bill Collection Method,**
- ◆ **Alternative for rich villages**

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