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PROVINCIAL ELECTRICITY AUTHORITY



# Rural Electrification in Thailand: Policy and Implementation

Reungvith Vechasart  
Assistant Governor (Retired)

Suttidej Suttisom  
Deputy Governor (Retired)

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*Capacity Building Programme for Officers of Electricity Regulatory  
Commissions, India Organized by IIT Kanpur, Bangkok, Thailand*





# Content

**1. Evolution of Rural Electrification in Thailand**

**2. Policy, Strategies, and Implementation**

**3. Lessons from Thailand Experience**

**4. Conclusion**

# Geography

Capital

Bangkok

## Thailand at a glance

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

## ENERGY OVERVIEW 2011

Electric Generation Capacity

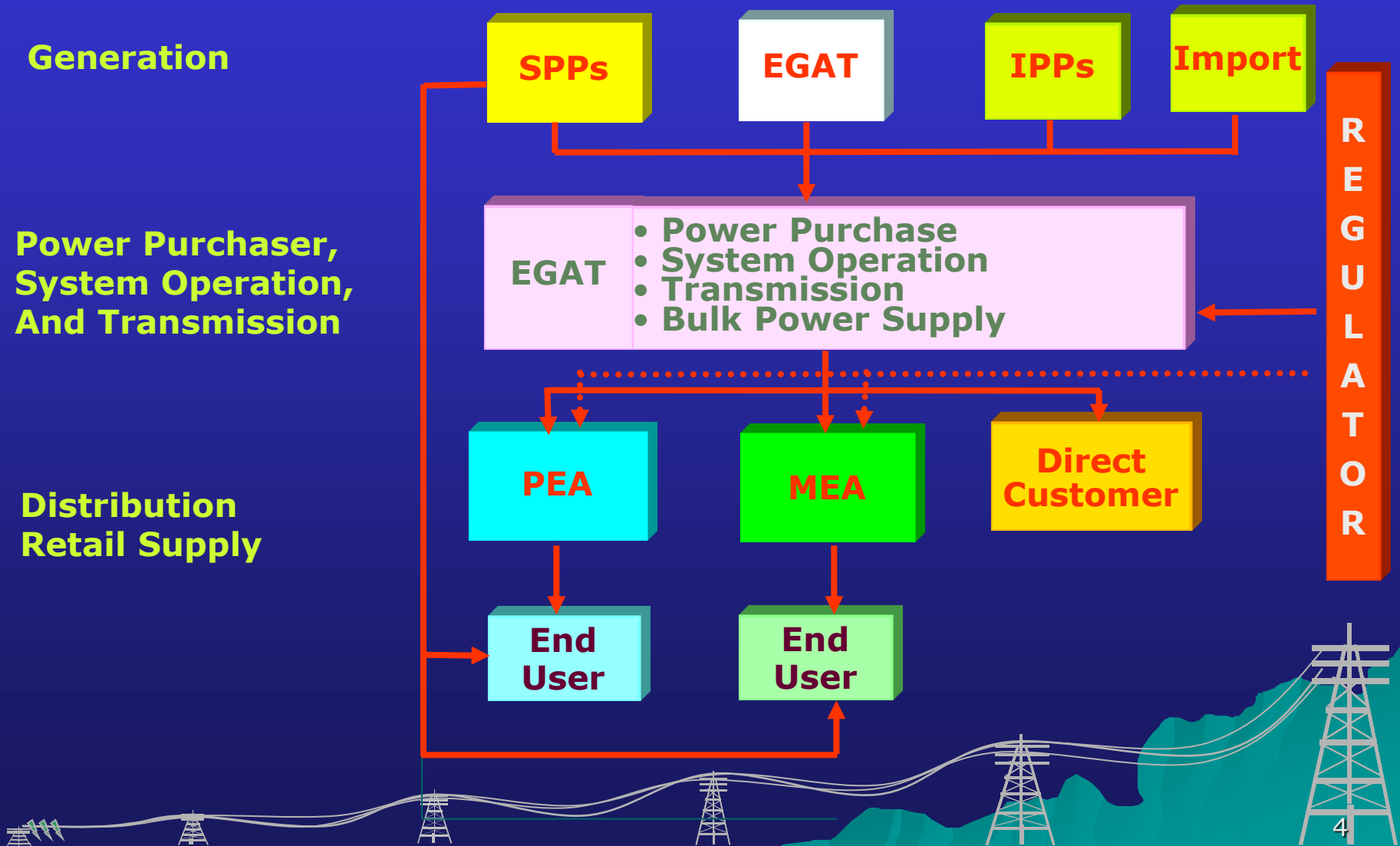
32,395 MW

Peak Demand

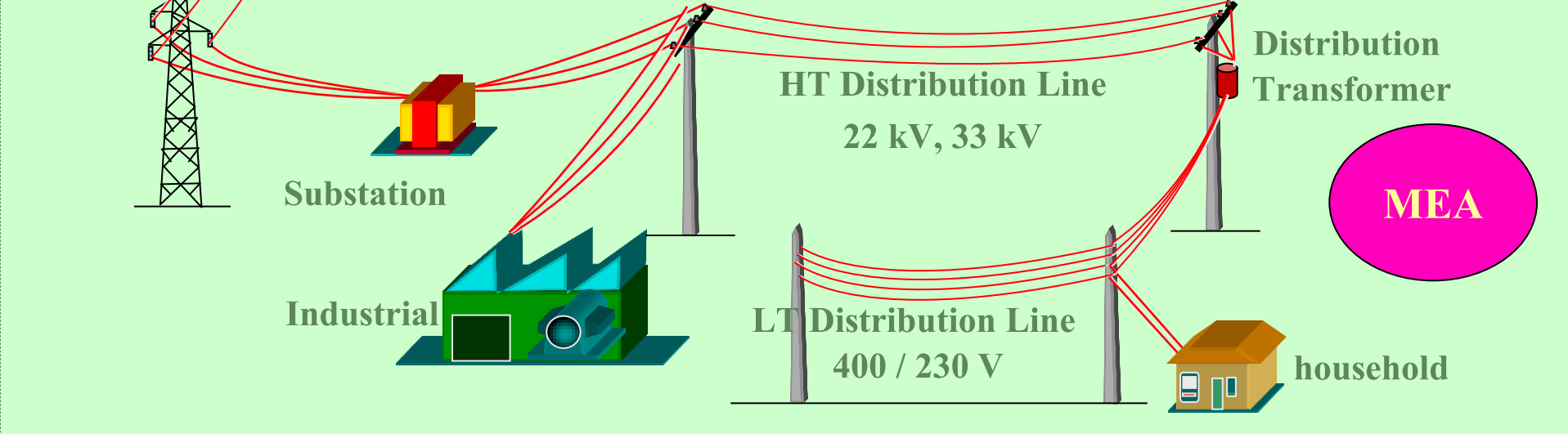
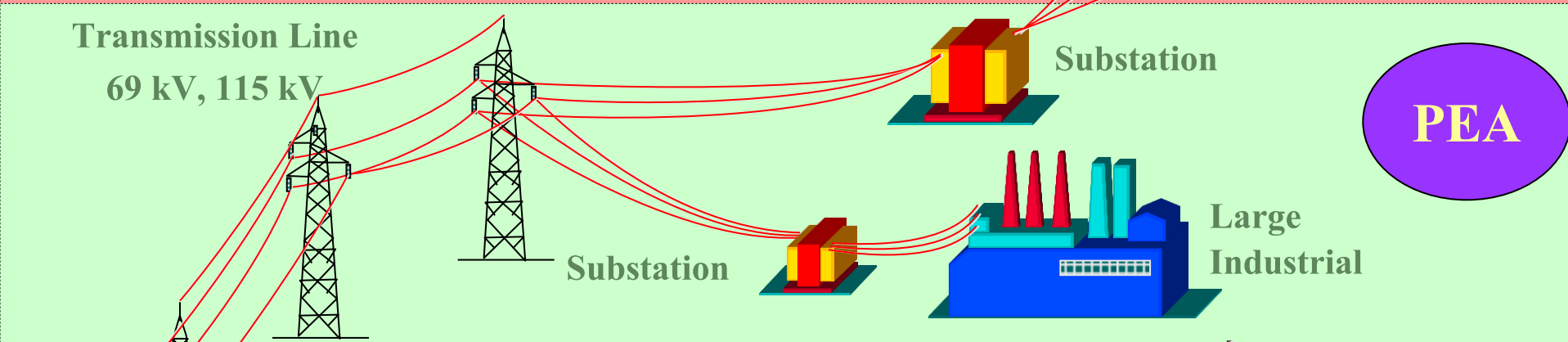
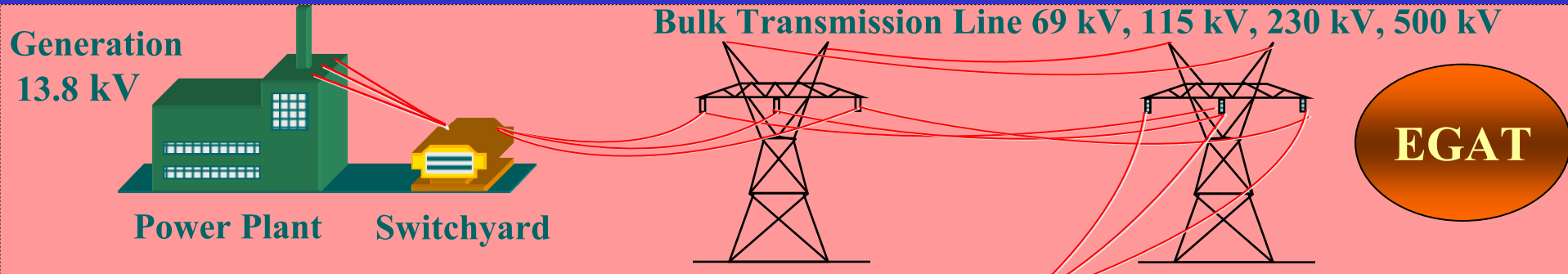
26,121 MW

# Overview of Electricity Supply Industry

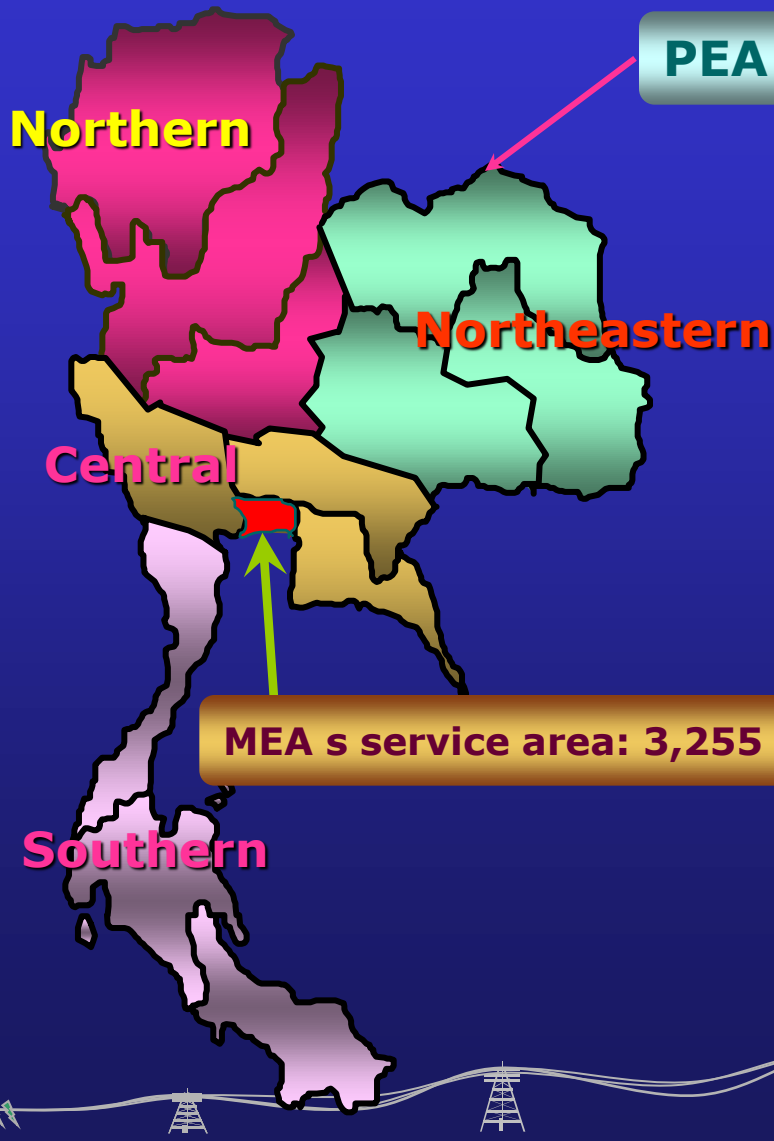
## Structure of ESI of Thailand Enhanced Single Buyer Model (ESB)



# Power System in Thailand



# ☐ Provincial Electricity Authority (PEA)



PEA s service area: 510,000 sq.km (99%)

As of Dec 2011

	<u>PEA</u>	
Area (km <sup>2</sup> )	510,000	(99%)
Province	74	
Villages	73,348	(99%)
Households (million)	16.2	(99%)

# 📍 Rural Electrification in Thailand



# Historical Background

- Thailand had its first experience with electricity 130 years ago, since 1884
- In 1972 only 10 % of rural villages had access to electricity



# RE Planning Step 1: Reconnaissance Study

- Reconnaissance Study (1970)
  - Overview of the country
  - Assessment on the readiness of Gov., Gen, PEA, and Rural People
  - Recommend whether the Program should be undertaken or not.

# RE Planning Step 1: Reconnaissance Study

- 1971 the Government approve in Principle to cover all of Thailand with grid electricity
- Commitment by the Government to RE Development in Thailand - Important Step

## RE Planning Step 2: Master Plan

- Pre- Feasibility Study , called  
the Accelerated Rural Electrification National  
Plan Study  
(completed in 1972)

# Contents in The Master Plan

- Guidelines for designating priority Areas for electrification
- Financial size for overall programme
- Time-frame for long-term programme
- Processes for implementation

# Contents in The Master Plan

- Organization and management requirements
- Parameters for power system planning
- Technical standards
- Load promotion programme

# Contents in The Master Plan

- Electricity pricing
- Construction, Operation, and Maintenance procedures

## RE Planning Step 2: Master Plan

- 1973 the Government officially approved the Pre-Feasibility Report and adapted it as The National Plan for Thailand Accelerated Rural Electrification

# Area Priority for Electrification

- Within the frame work of the Master Plan, the priority of electrification had already been given to the more economically backward and politically unstable areas.
- In case of Thailand, they are:  
The Northeast – South – North – and the Central Zones



# I4 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

## RE Planning Step 3: Feasibility Study

- Detailed feasibility study of the Accelerated Rural Electrification Project First Phase : ARE 1
- Focus – Northeast Area
- Start Project Construction

# Systematic Model for RE Planning

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

# RE in Thailand: Leadership

## DR. CHULAPONGS CHULLAKESA

- First Director; Office of Rural Electrification
- PEA Governor 1993 – 1996
- Who initiated and handled RE in Thailand from the beginning to finished.

# Most important step in starting RE

## Leadership

- Find the right person to lead and handle all processes

# Lessons Learned: Up to this point

1. Find the right person to lead – Leadership
2. Get Government Commitment
3. Careful Planning – Step-by Step
4. Close coordination with National Planning Agency

# Lessons Learned: Up to this point

5. Set up the

Office of Accelerated Rural Electrification

to take full accountability – single management unit - for implementation of the task.



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# 1. Evolution of RE in Thailand

**NESDP**

To develop the country  
economically and socially

**PEA Target**

To extend electricity supply  
to all rural villages



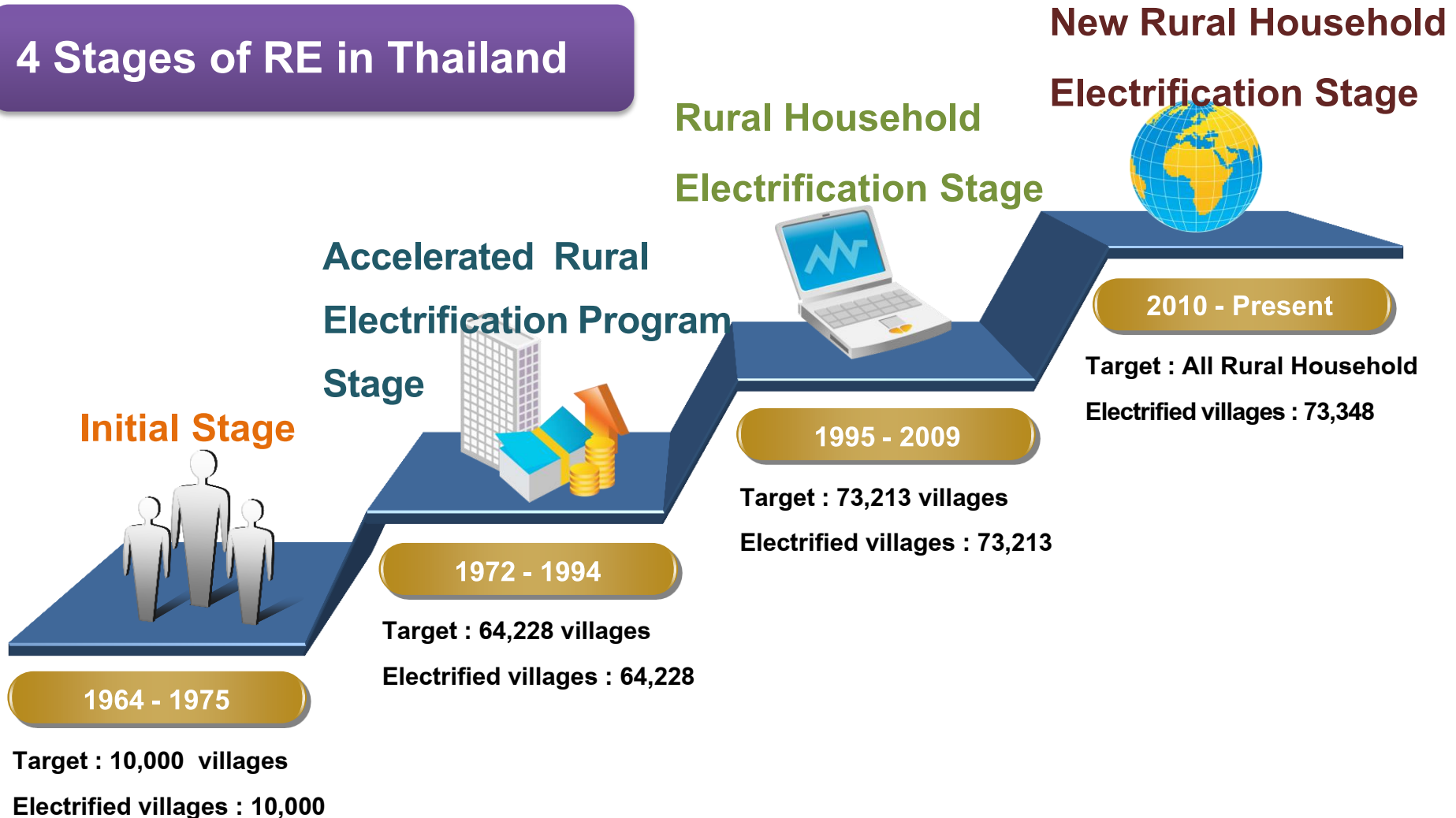




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# 1. Evolution of RE in Thailand

## 4 Stages of RE in Thailand





# 1. Evolution of RE in Thailand

## Stage 1 : Initial Stage

### Period

- 1964 – 1975 (12 years)

### Target

- 10,000 Villages
- By Small Diesel Power Plants

### Investment

- 96.5 MB. (2.67 M.USD)
- Consist of
  - PEA Revenue = 70 %
  - Customer Expense = 30 %

### Status

- Electrified Villages 20 %





# 1. Evolution of RE in Thailand

## Stage 2 : Accelerated Rural Electrification Program Stage

### Period

- 1972 – 1994 (22 years)

### Target

- 64,228 Villages
- By Grid System

### Investment

- 25,988 MB. (717.9 M.USD)
- 1972 – 1994
  - PEA Revenue = 70 %
  - Customer Expense = 30 %



### Source of Fund

- PEA Revenue
- Domestic Loan
- External Loan

### Status

- Electrified Villages 98 %



# 1. Evolution of RE in Thailand

## Stage 3 : Rural Household Electrification Stage

Rural Household  
Electrification Project  
phase 1 – 3  
(1995 – 2006)

Period

- 1995 – 2006 (12 years)

Target

- 73,213 Villages (4 Projects)
- By Grid System and Solar Cell

Investment

- 16,944 MB. (468 M.USD)
- Consist of
  - PEA Revenue = 55 %
  - Domestic Loan = 25 %
  - External Loan = 30 %

Solar Home System  
Project (2004 – 2006)

Status

- Electrified Villages 99.98 %



# Future Plan of RE

## Stage 4 : New Rural Household Electrification Stage

Accelerated Rural Household Electrification Project (AHEP)

Period

- 2010 – 2011 (2 years)

Target

- 91,527 Households

New Rural Household Electrification Project (NHEP)

Investment

- 2,045 MB. (65.3 M.USD)
- Consist of
  - PEA Revenue = 25 %
  - Domestic Loan = 75 %

Remote Rural Household Electrification Project (RHEP)

Status

- Electrified Villages 61.12 % (55,941 Household)



# 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)
- Consist of
  - PEA Revenue = 25 %
  - Domestic Loan= 75 %

Remote Rural Household Electrification Project (RHEP)

**Status**

- Under Cabinet Approval



# 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)
- Consist of
  - PEA Revenue = 25 %
  - Domestic Loan = 75 %

Remote Rural Household Electrification Project (RHEP)

**Status**

- Under Cabinet Approval



# 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





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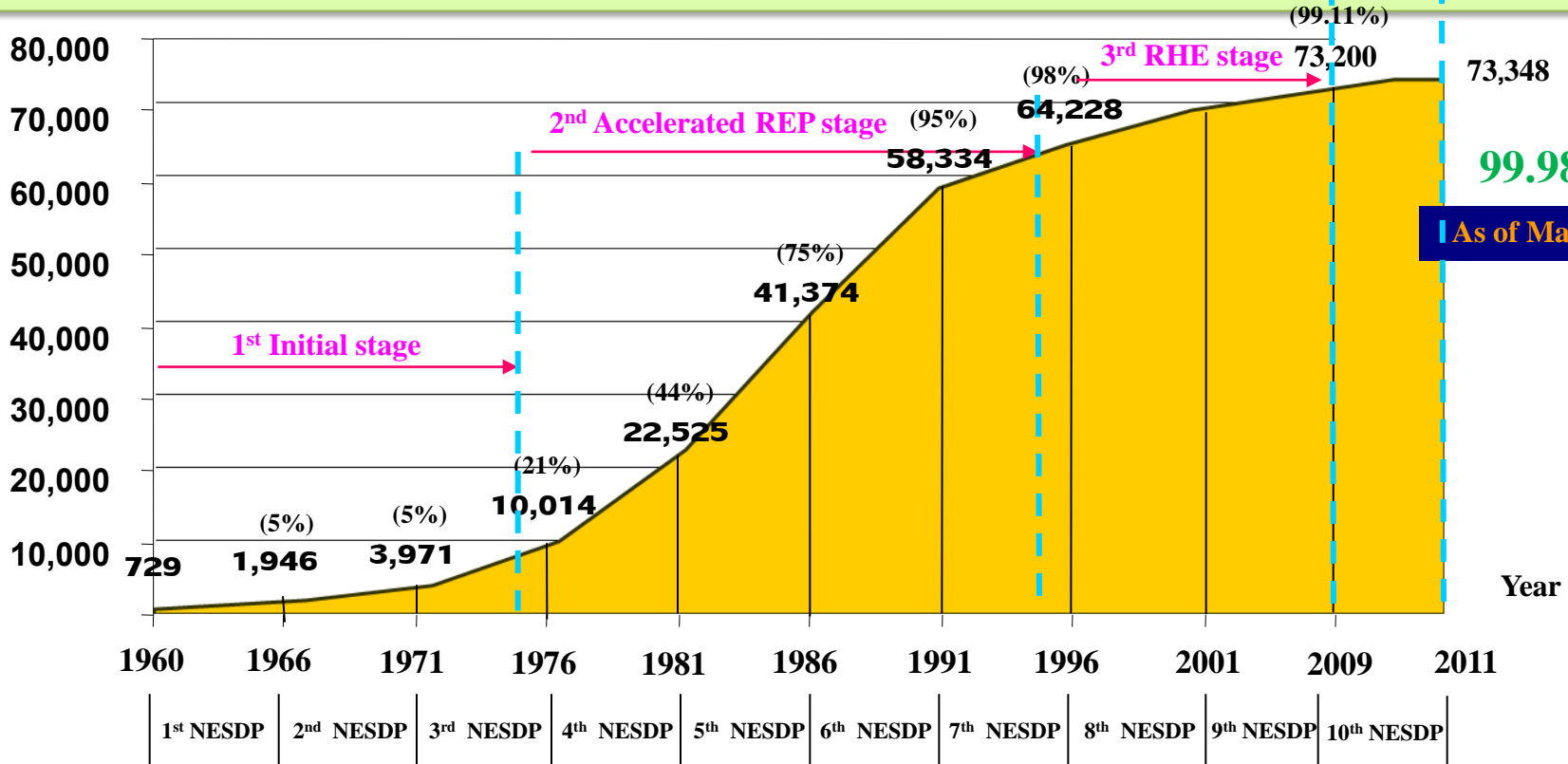
# 1. Evolution of RE in Thailand

## Progression of electrified villages in PEA's Service areas

No. of Electrified Villages

During NESDP, 1<sup>st</sup> - 10<sup>th</sup>

4<sup>th</sup> NRHE stage



Total Rural Villages = 73,360  
 Electrified = 73,348 (99.98%)

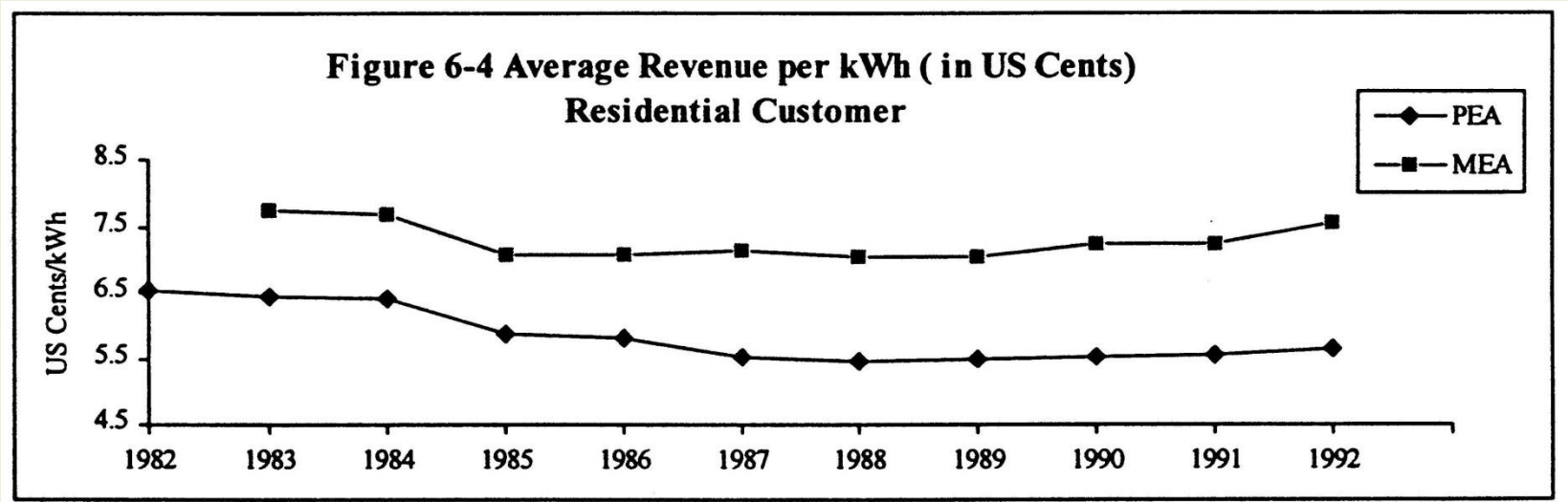


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## 2. Policy, Strategies, and Implementation

As RE needed a large amount of investment but earn very low rate of return:

How did PEA survive the possibility of huge financial lost?



Source : Provincial Electricity Company Yearly Statistics Report (1982 to 1992).  
Metropolitan Electricity Company Annual Report 1992.

# First try to find Concessional Loan

- It is a loan with lowest interest rate and long-term of payment.
- From the World Bank, kfw- Germany, Saudi Arabia Fund, Kuwait Fund, NORAD – Norway etc.

## F4 Urban to Rural Subsidy

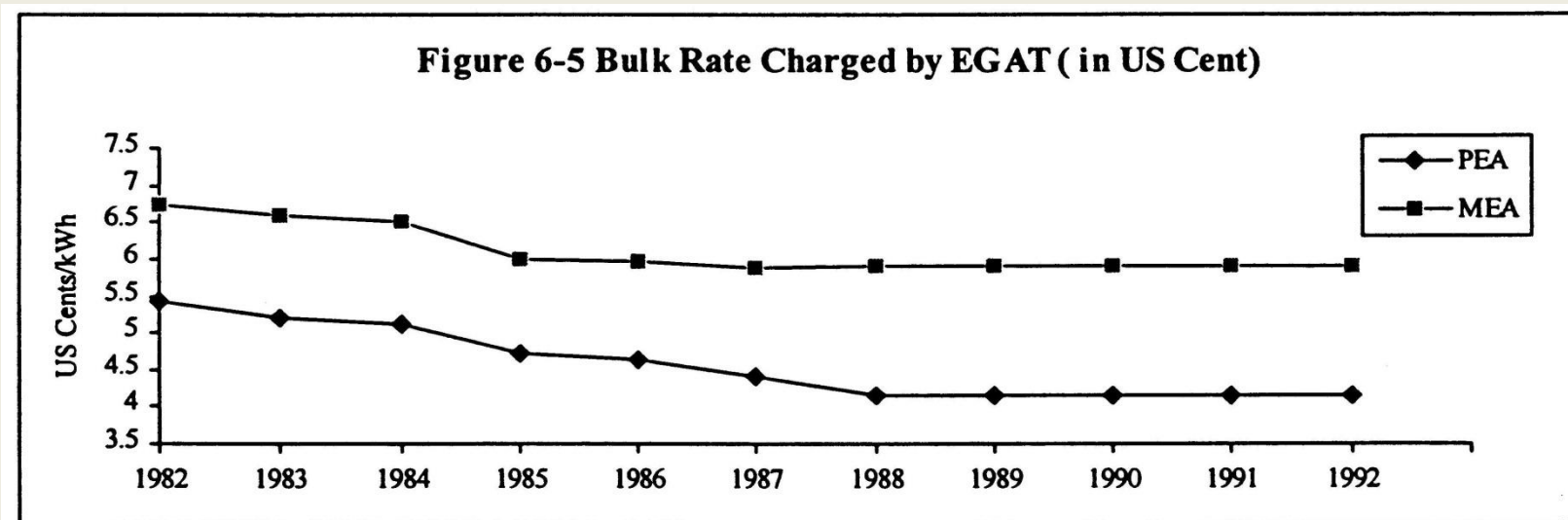
- EGAT to sell power at lower price to PEA than to MEA / direct subsidy from the rich capital and industrial area to rural.
- The tariff structure is based on cross - subsidy between customer categories.
- Oblige the rich customers such as industrial to subsidize the poor one.
- Electricity tariff for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

# 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 .**





Source : Electricity Generating Company of Thailand Annual Report 1992.



# F5 Efficient Bill Collection



- We were 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 teachers, village heads, or village elders.

As rural villages are scattered and need long lines of distribution system to reach:

How did PEA do to Cut Cost or Minimizing the overall Construction Cost?

# I1, I2 Cost Cutting Strategies



- **Reduced procurement and material handling expenses .**
- **Reduced purchasing cost through bulk purchasing .**
- **Help strengthening the capability of local industry .**

# I1, I2 Cost Cutting Strategies



- ◆ **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.

# 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 .**



How to avoid political  
interference or fighting to get  
village construction priority?

# 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)
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# I4 Original Timetable for Thailand's National Rural Electrification Plan

(Source: PEA 1978)

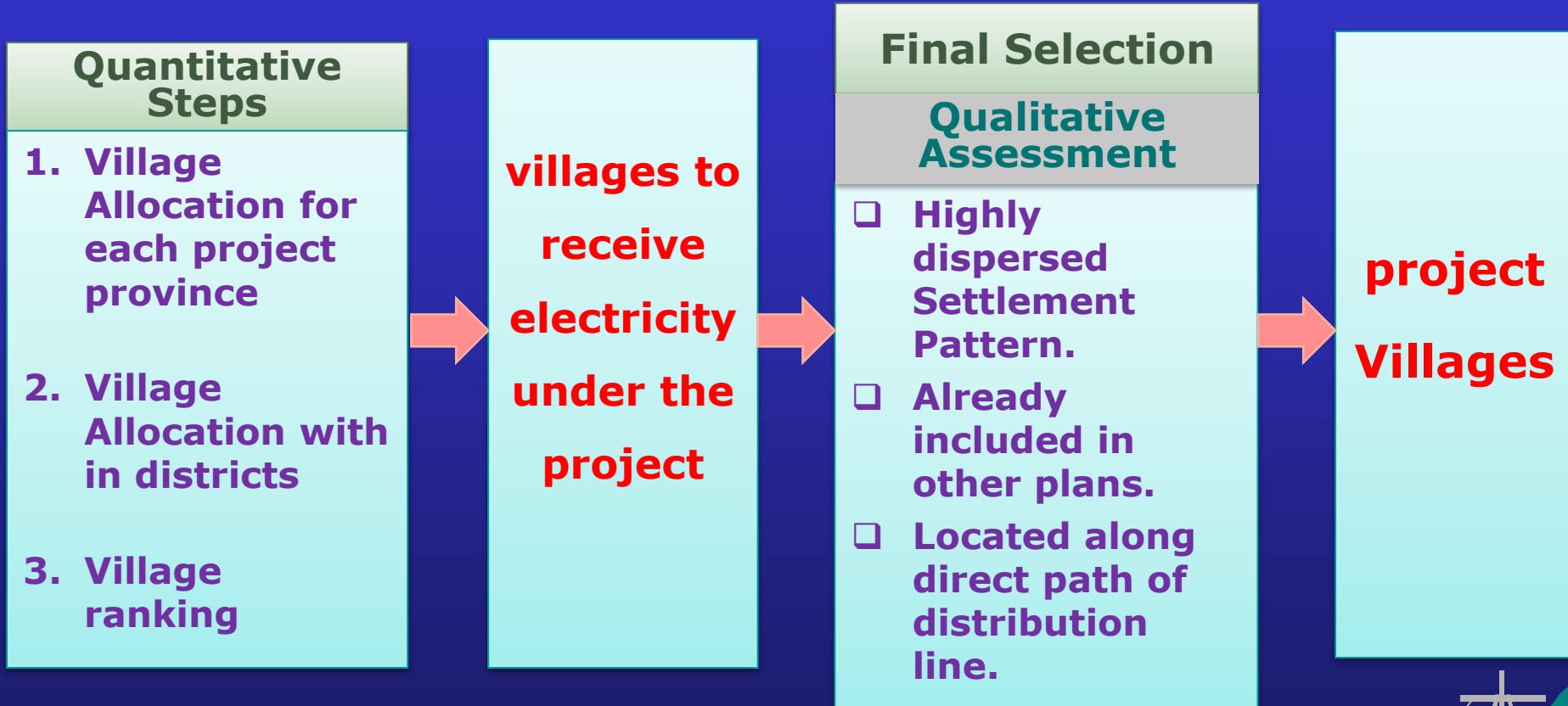
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V	1990 – onward	5,800	47,000	Countrywide

# General Framework for Setting Priorities for Villages to be Included in RE Projects

- 1. Maximizing potential benefits while minimizing project cost.**
- 2. Integrating rural electrification into broader national development strategy.**
- 3. Giving consideration to the social and political requirements of less stable areas.**



# Methodology for Village Selection



## 14 Variables Used to Determine Number of Villages to be Selected in Each Province

- Percentage of Rural Households with access to: (see next slide)
- Percentage of households using cooking fuels
- Percentage of dwellings constructed in past five Years
- General health indexes
- Ratio of Students in..(see following slides)
- Agricultural Assessment
- Baseline Electricity Data
- Overall Village Characteristics

## 14 Percentage of rural households with access to:

- Public well as source of water supply
- Private well as source of water supply
- Electric lighting
- Radio
- Television

- Sewing machine
- Refrigerator
- Electric fan
- Water pump for agriculture use

## 14 Variables Used to Determine Number of Villages to be Selected in Each Province

### Percentage of households using cooking fuels:

- Charcoal
- Wood
- Gas
- Other Modern fuels

Percentage of dwellings constructed in the past five years

# 14 Variables Used to Determine Number of Villages to be Selected in Each Province

## General Health Indexes:

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

## Ratio of Students in:

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

# 14 Variables Used to Determine Number of Villages to be Selected in Each Province

## **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



# The Province Allocation Formula

$$(S_i - S_m) \times \left( \frac{0.975 - D_m}{S_x - S_m} \right) + D_m = D_i \dots\dots\dots(1)$$

$$\sum_{i=1}^{27} (D_i \times V_i) = 9,000 \pm 50 \dots\dots\dots(2)$$

# 14 Village Socio-economic Factors for Forecasting District Electricity Demand (Village Allocation for District)

- Households Characteristics
- Agriculture
- Households Income
- Households Expenditures

# 14 Village Socioeconomic Factors for Forecasting District Electricity Demand (Village Allocation for District)

## Households Characteristics

- Household size within village
- Net income per expenditure

*Source: PEA 1978. Vol. I*

## Agriculture

- 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

# 14 Village Allocation for District



## 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*

# The District Allocation Formula

$$K = \frac{\sum S_i V_i - S_m \sum V_i}{S_x - S_m} \dots\dots\dots(1)$$

$$D = \frac{\sum A_i - D_x K}{\sum V_i - K} \dots\dots\dots(2)$$

$$A_i = V_i \left[ \frac{D_x - D_m}{S_x - S_m} \times (S_i - S_m) + D_m \right] \dots\dots\dots(3)$$

# 14 VILLAGE RANKING



Village Ranking 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

# I5 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



How to increase revenue from  
electrified villages?

# 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 from the beginning.**
  - **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 .**



# I16 Low – cost, Affordable Connections



- ◆ **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**



How to manage Power Company

to focus on RE rather than

Generation or Transmission Business

which is more profitable ?

# 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

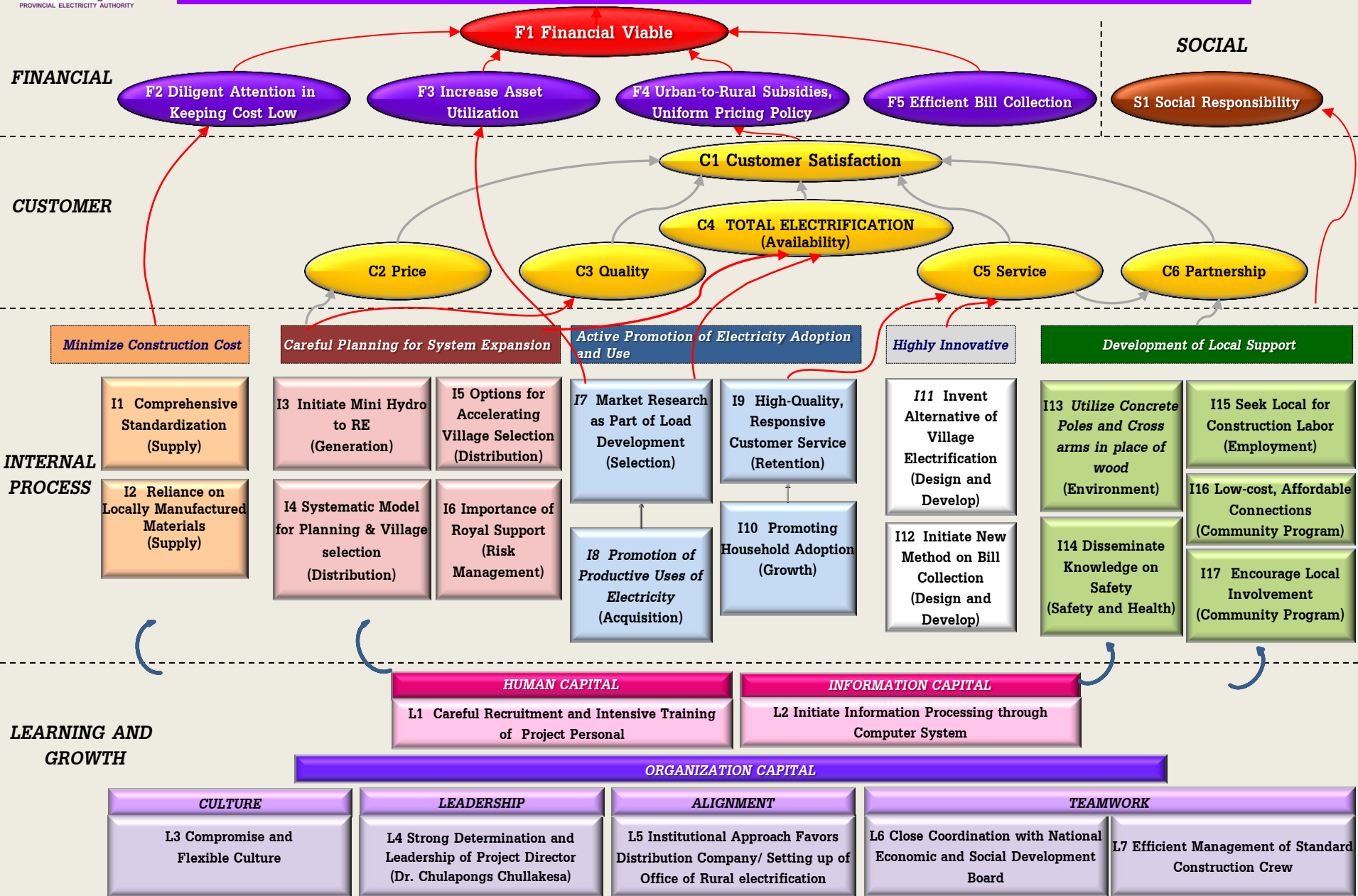


- Separate the generation and distribution via different companies
- PEA mandate is to provide electric power distribution to provincial cities and rural areas throughout the country
- Is free to concentrate solely on distribution
- Do not have to concern itself with power generation and transmission.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



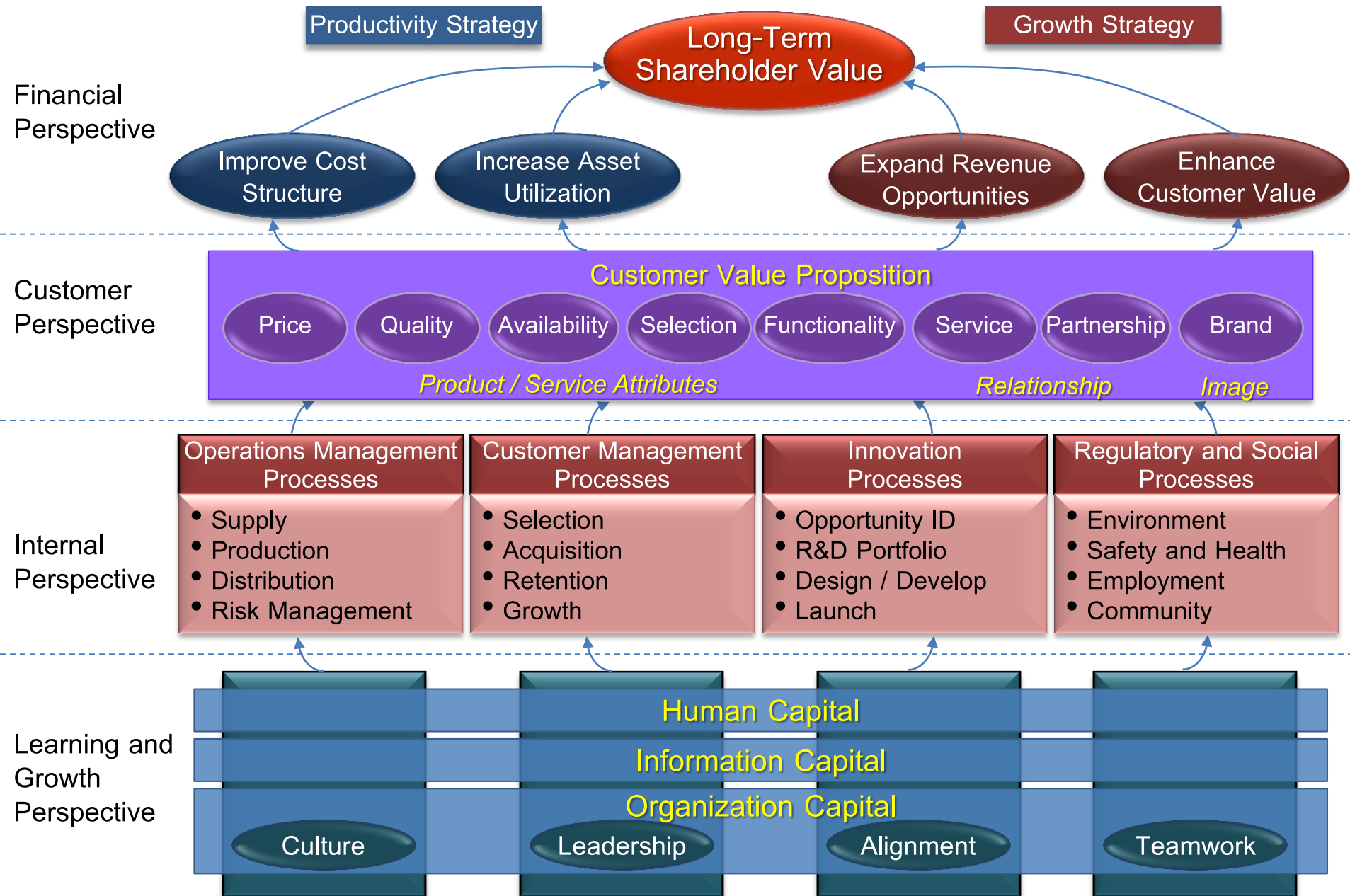
# THAILAND'S RURAL ELECTRIFICATION STRATEGY MAP

## Commitment by the Government to Rural Electrification Development





# A Strategy Map Represents How the Organization Creates Value



# 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

- ◆ **Strong Determination and Dedication of Team Leader,**
- ◆ **Office of Rural Electrification,**
- ◆ **Targeting highest load villages,**
- ◆ **Cross – Subsidies,**
- ◆ **low – cost connections,**



# Conclusion : Key Words

- ◆ **Load Promotion Program,**
- ◆ **Standardization,**
- ◆ **Unique Bill Collection Method,**
- ◆ **Alternative for rich villages**









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