

Benefit Estimates of Rural Electrification in the Philippines

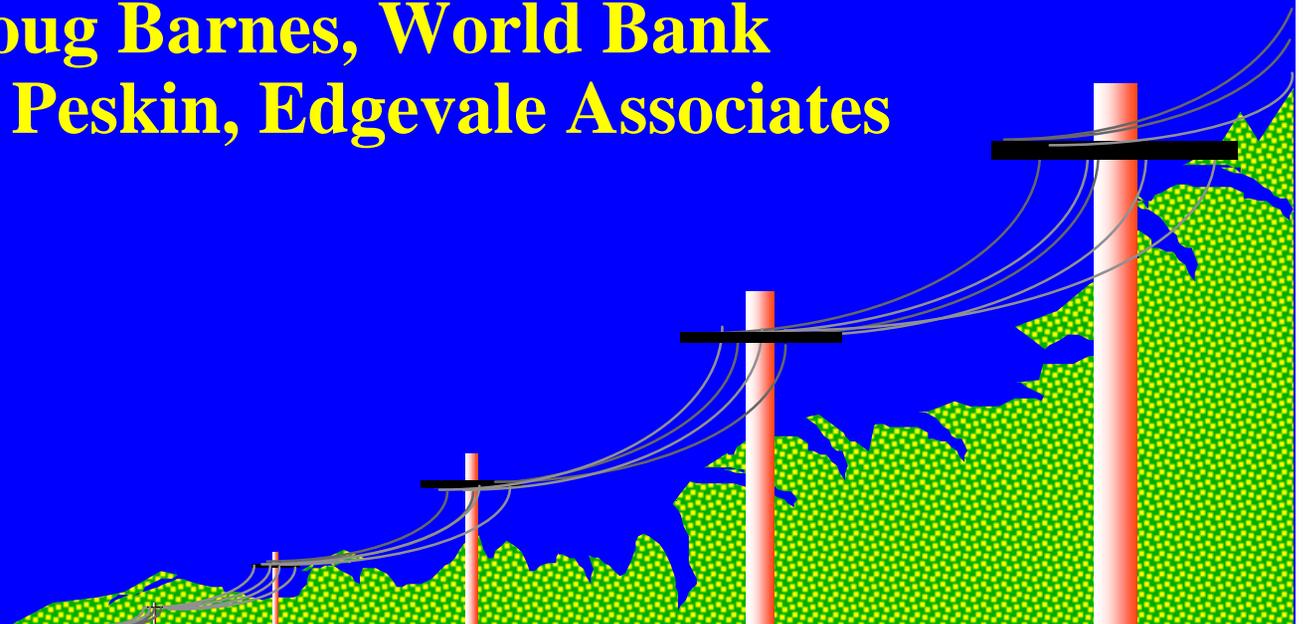
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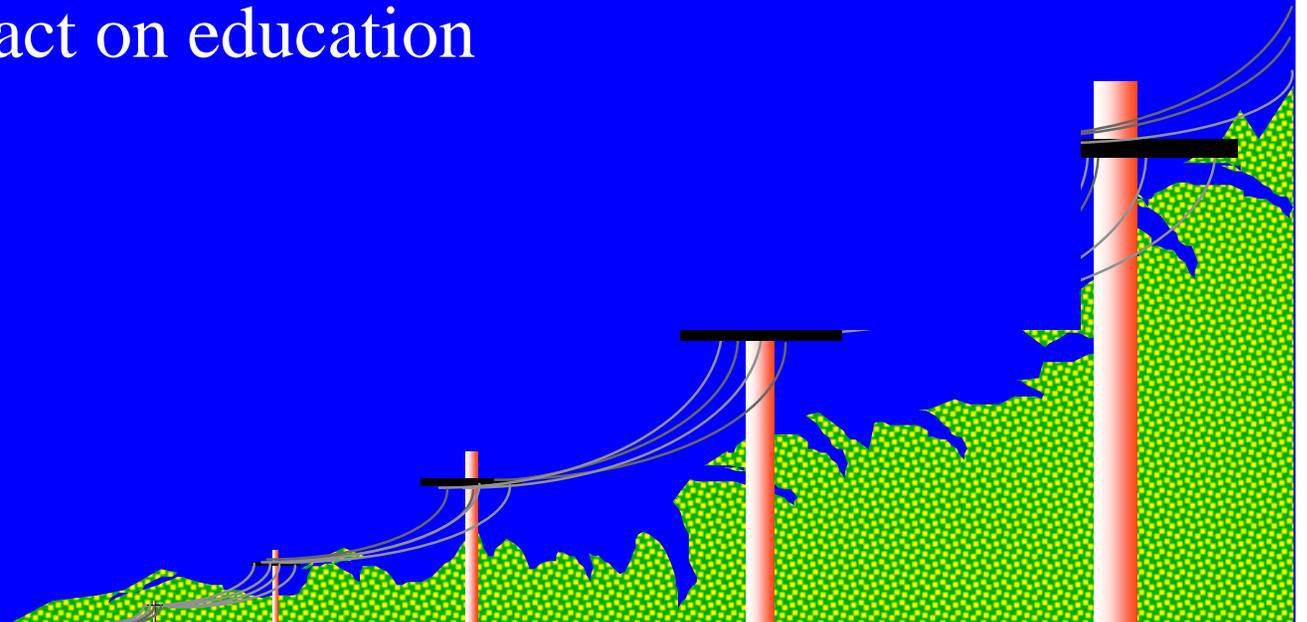
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Purpose of the Study

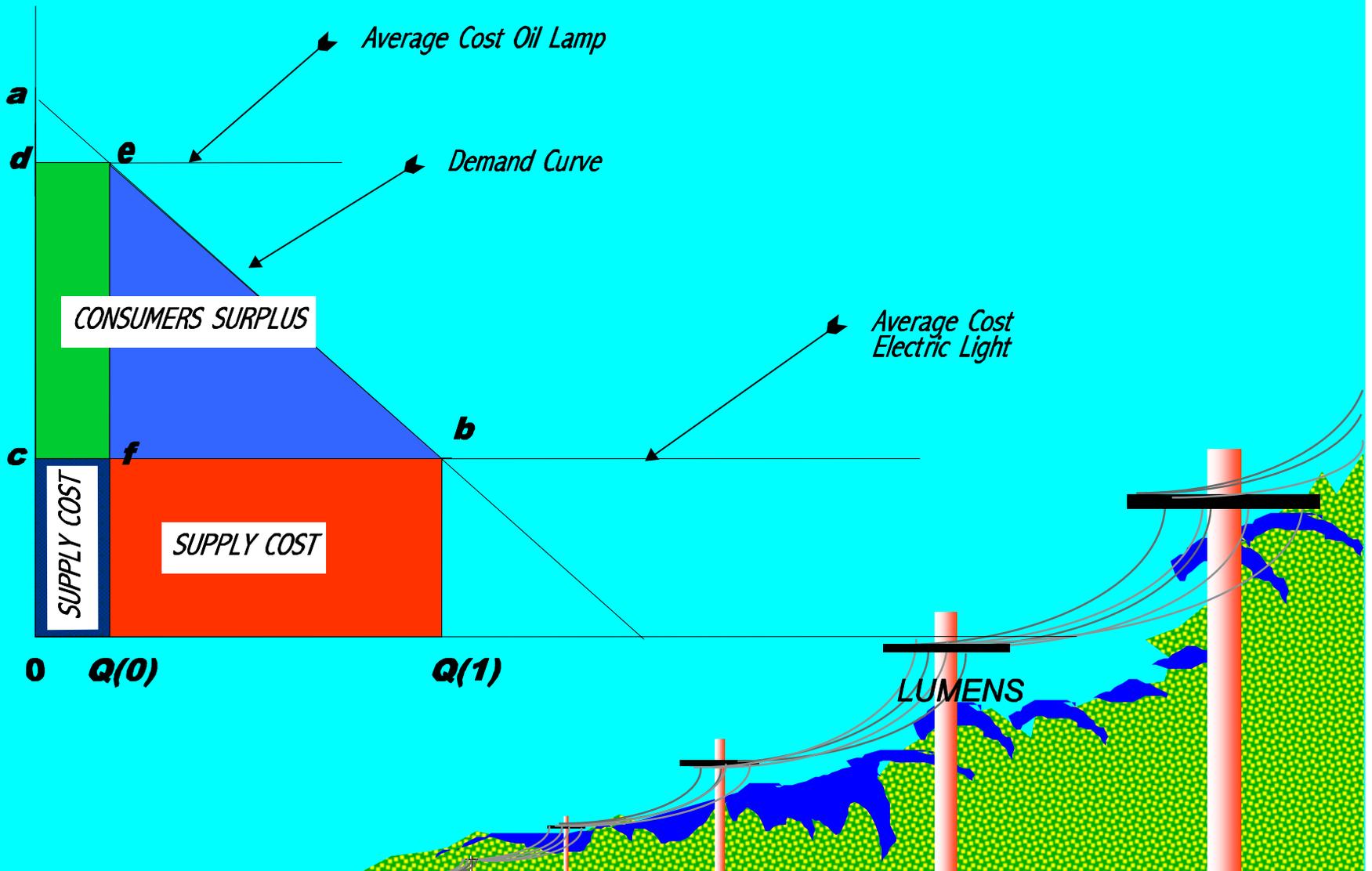
- Further develop Bank's methods to measure benefits of rural electrification
- Quantify some of the “unquantifiable” benefits such as impact on education



Traditional World Bank Approach

- DEMAND FOR ELECTRICITY IS A DERIVED DEMAND FOR:
 - LIGHT (LUMENS)
 - OTHER POWER NEEDS (E.G., FOR IRRIGATION)
- ELECTRICITY ALLOWS THESE DEMANDS TO BE SATISFIED AT LOWER COSTS
- ESTIMATE BENEFITS FROM PRIMARY DEMAND CURVES OR FROM COST SAVINGS

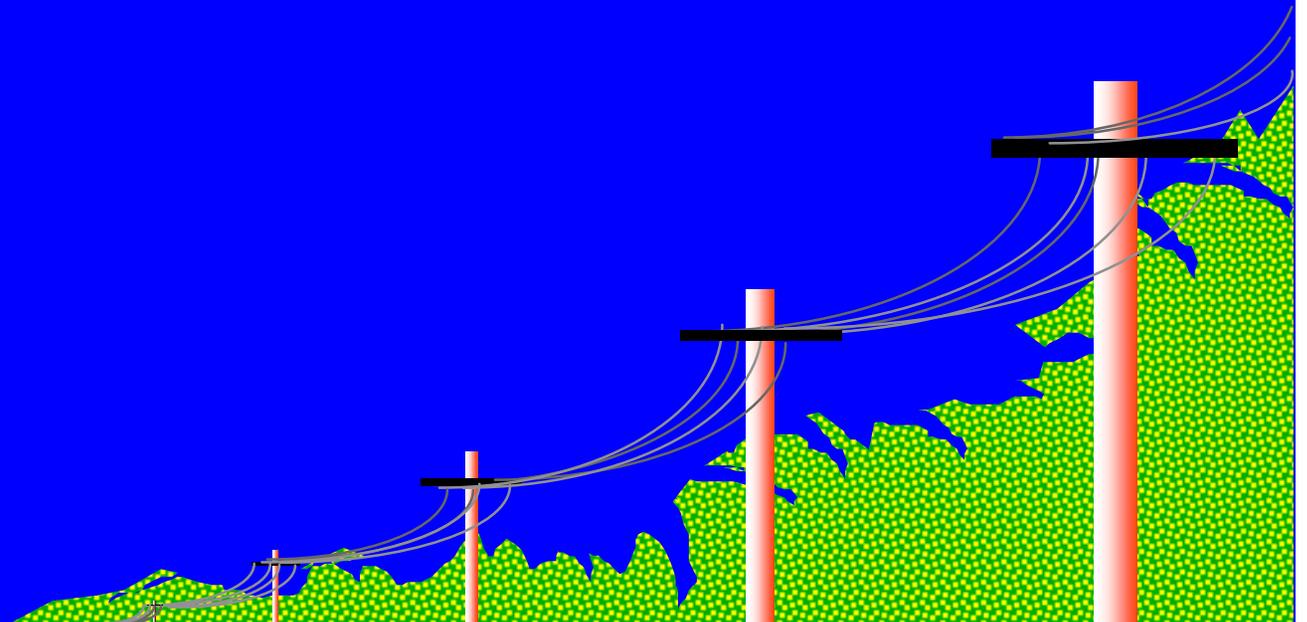
Demand For Lumens



Key Assumptions

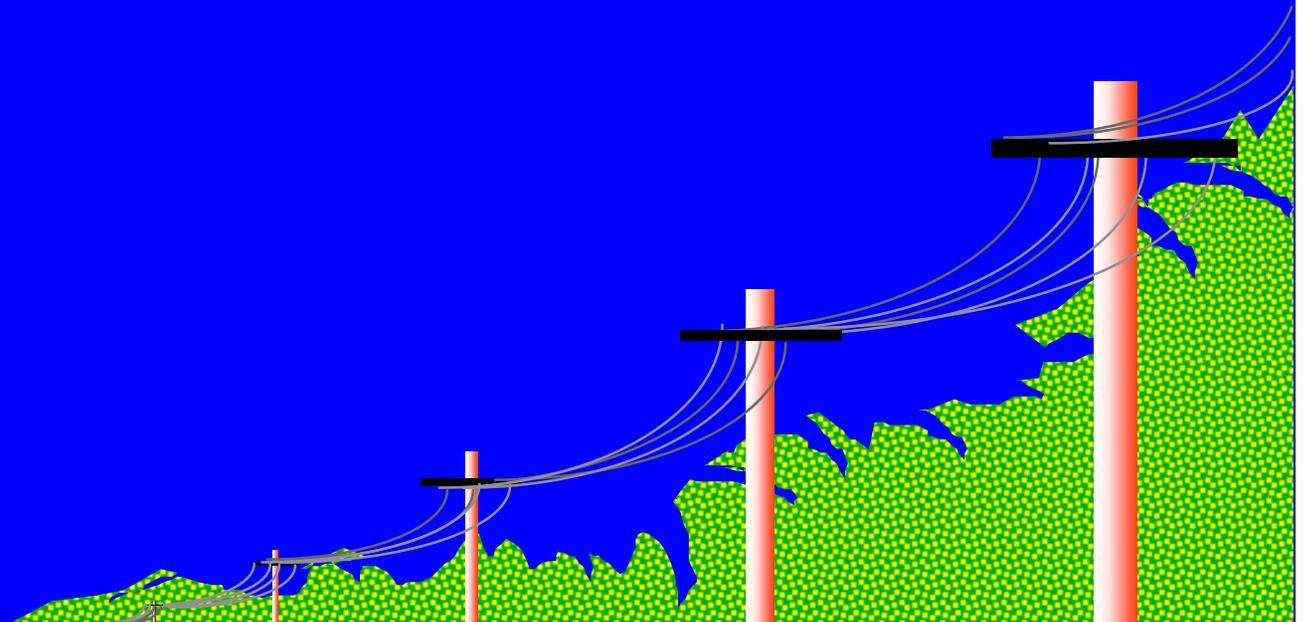
- FUNCTIONAL FORM OF DEMAND IS KNOWN
- DEMAND IS INDEPENDENT OF SOURCE OF LUMENS
- ASSUMES SINGLE DEMAND CURVE FOR RICH AND POOR
 - THUS, BENEFITS COULD BE OVERSTATED
 - » ERROR IS LESS THE MORE THE PROJECT RAISES INCOME

Extension Of The Traditional World Bank Approach: The Philippines Project



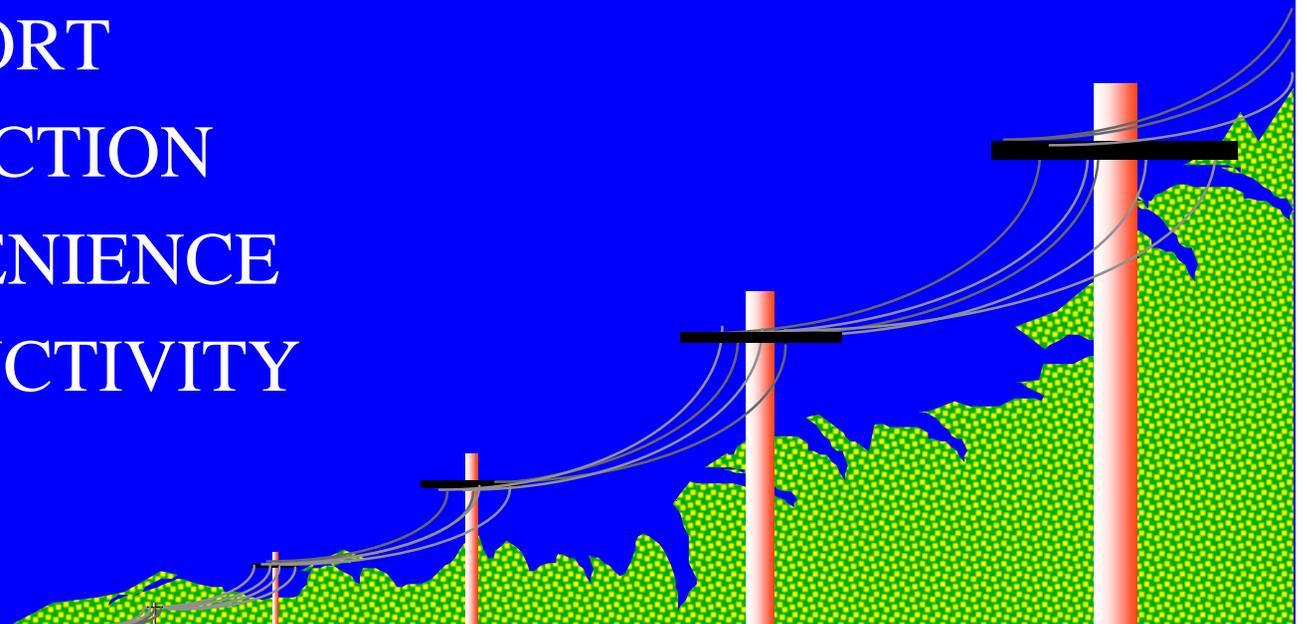
Key Feature:

- EXTENSION OF THE LIST OF PRIMARY DEMANDS BEYOND DEMAND FOR LUMENS OR DEMAND FOR COST SAVINGS

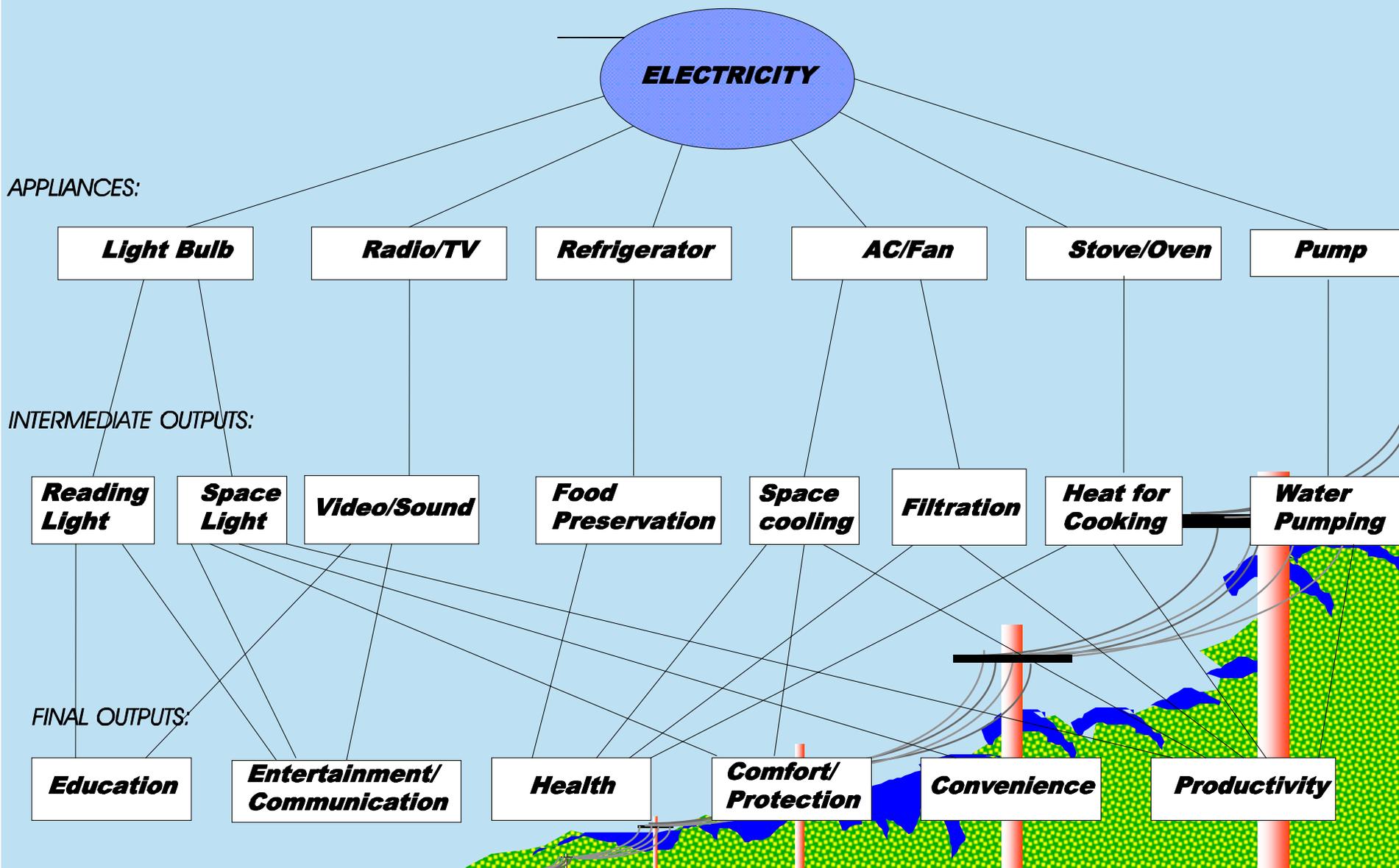


Demand For Electricity Is Derived From Demand For:

- EDUCATION
- ENTERTAINMENT
- HEALTH
- COMFORT
- PROTECTION
- CONVENIENCE
- PRODUCTIVITY

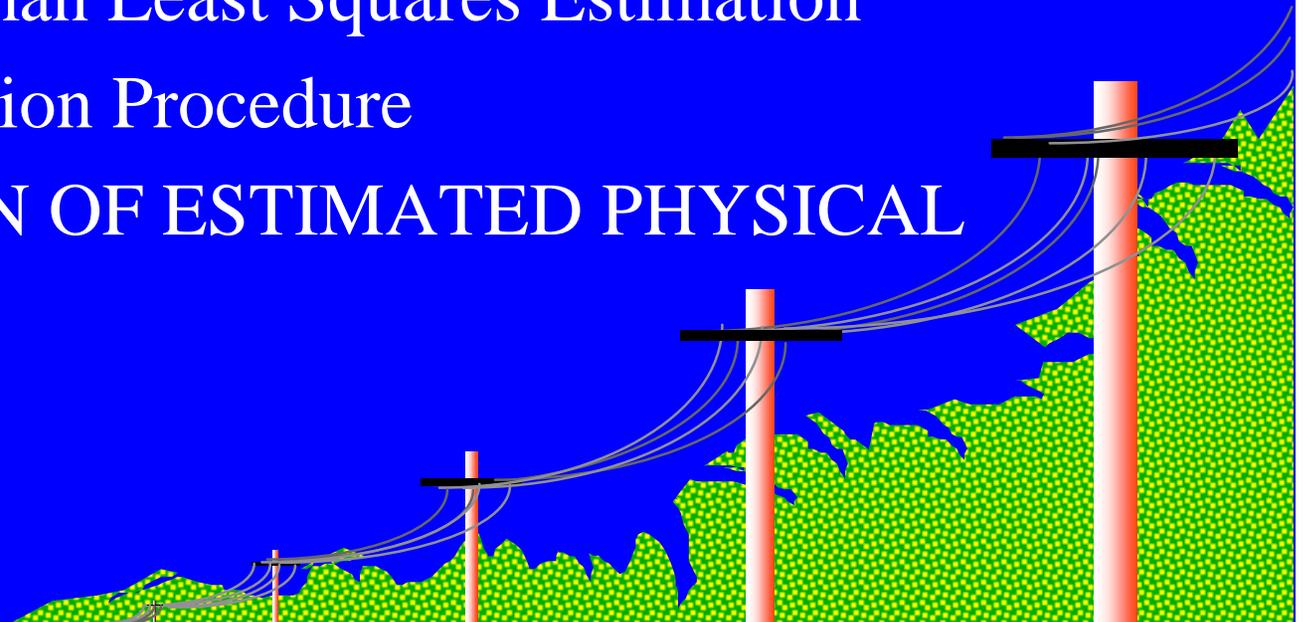


Derived Demand “Model”



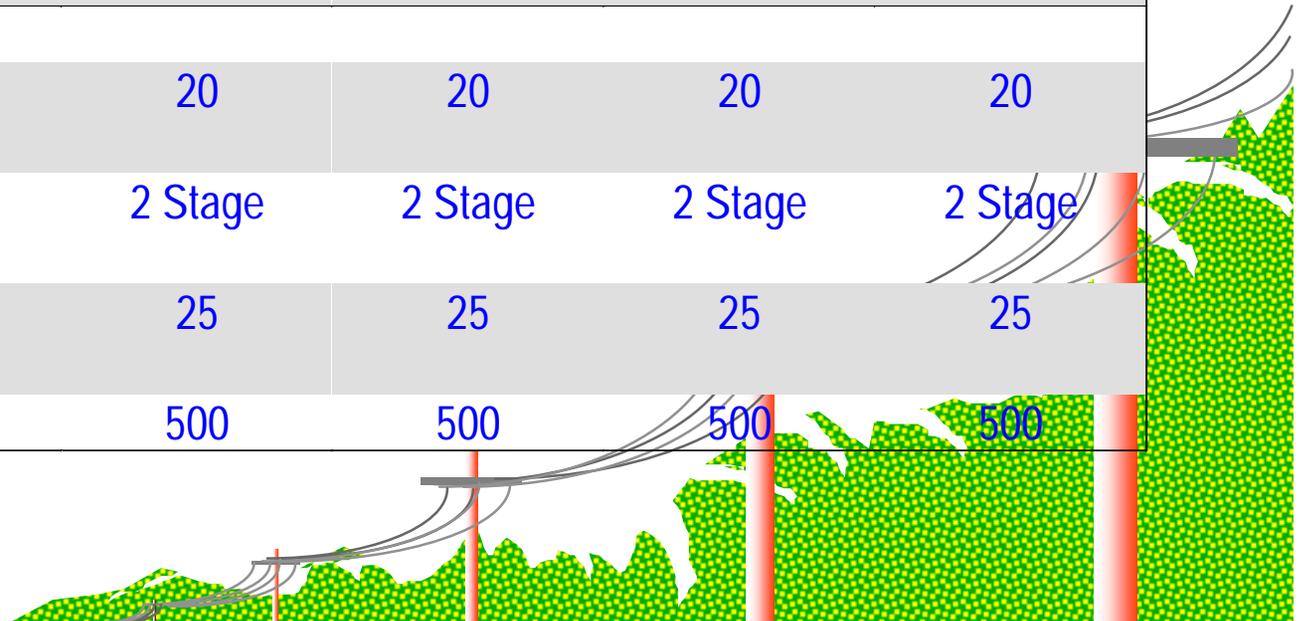
Method Of Approach

- HOUSEHOLD SURVEY
- COMMUNITY (BARANGAY) SURVEY
- EMPIRICAL ESTIMATION OF “PHYSICAL” RESPONSE TO ELECTRIFICATION
 - 2-Step Heckman Least Squares Estimation
 - Tobit Estimation Procedure
- VALUATION OF ESTIMATED PHYSICAL RESPONSE



Sampling Procedure

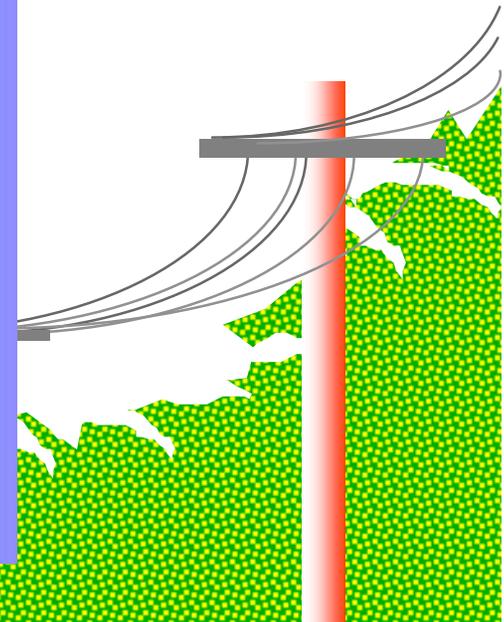
Region	Mountain Province	Nueva Ecija	Batangas	Camarines Sur
Electric Cooperative (Purposive Selection)	MOPRECO	NEECO II	BATELEC I	CASURECO I
Performance rating	B	D	A	C
Official Connections '96	47	68	92	58
Survey Connections '98	62	75	93	50
Survey				
Barangay Questionnaire Sample	20	20	20	20
Stratification Method (Based on proportion with electricity)	2 Stage	2 Stage	2 Stage	2 Stage
HH interviewed in Each Barangay	25	25	25	25
Total Households	500	500	500	500



Background on Electric Cooperatives in Survey

Region	Mountain Province	Nueva Ecija	Batangas	Camarines Sur	Philippines (1995 Nationwide Survey)
Census for Political Area					
Population (Thousands)	130	1,505	1,658	1,432	68,075
% of Population Rural	91	61	73	65	50
Literacy	81	97	96	96	95
Survey of 4 Electric Cooperatives					
% Rural in Cooperatives	100%	100%	100%	100%	
Rural Income Per capita/ Month	1,570	2,496	1,294	1,109	1,077
Exp on Energy/ Month	237	336	416	249	NA

Map of Survey Areas



Questionnaire Design

- Barangay Survey
 - Distance to infrastructure
 - Availability of energy services
- Household Survey (2000 Households, about 67% electrified)
 - Socioeconomic information on HH members
 - HH energy use
 - Farming characteristics
 - Attitudes & Appliance Use

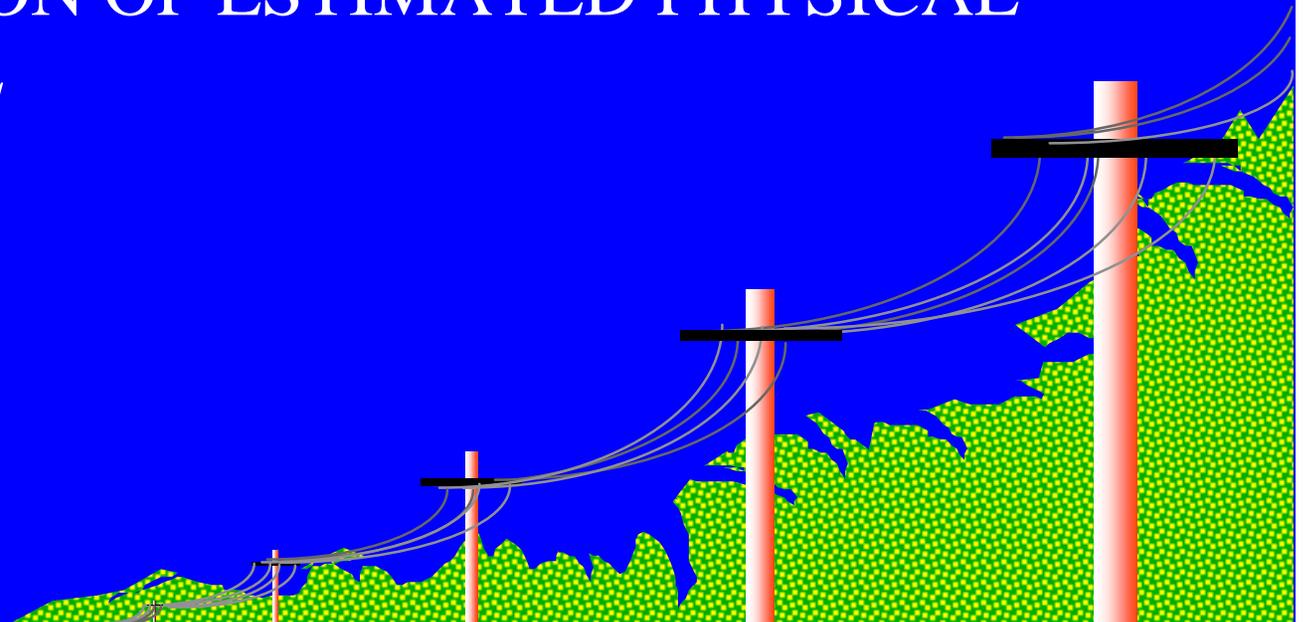
14 ■ Note: 40 Pesos = 1 Dollar



Two Steps in Benefits Estimation

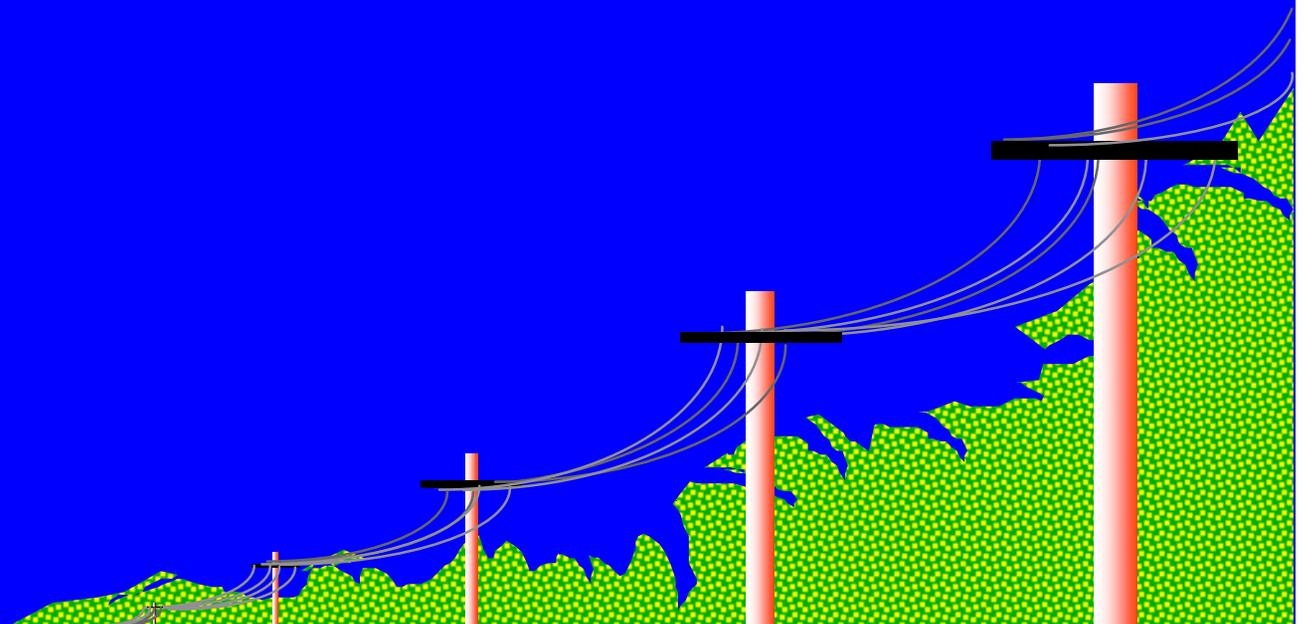
1. ESTIMATION OF “PHYSICAL” RESPONSE
TO ELECTRIFICATION

2. VALUATION OF ESTIMATED PHYSICAL
RESPONSE



Estimation of Physical Gain (Education Example)

- COMPARISON OF EDUCATIONAL ATTAINMENT BETWEEN ELECTRIFIED AND NON-ELECTRIFIED HOUSEHOLDS
 - DIFFERENCE IS ABOUT 1.8 YEARS FOR EACH EMPLOYED ADULT



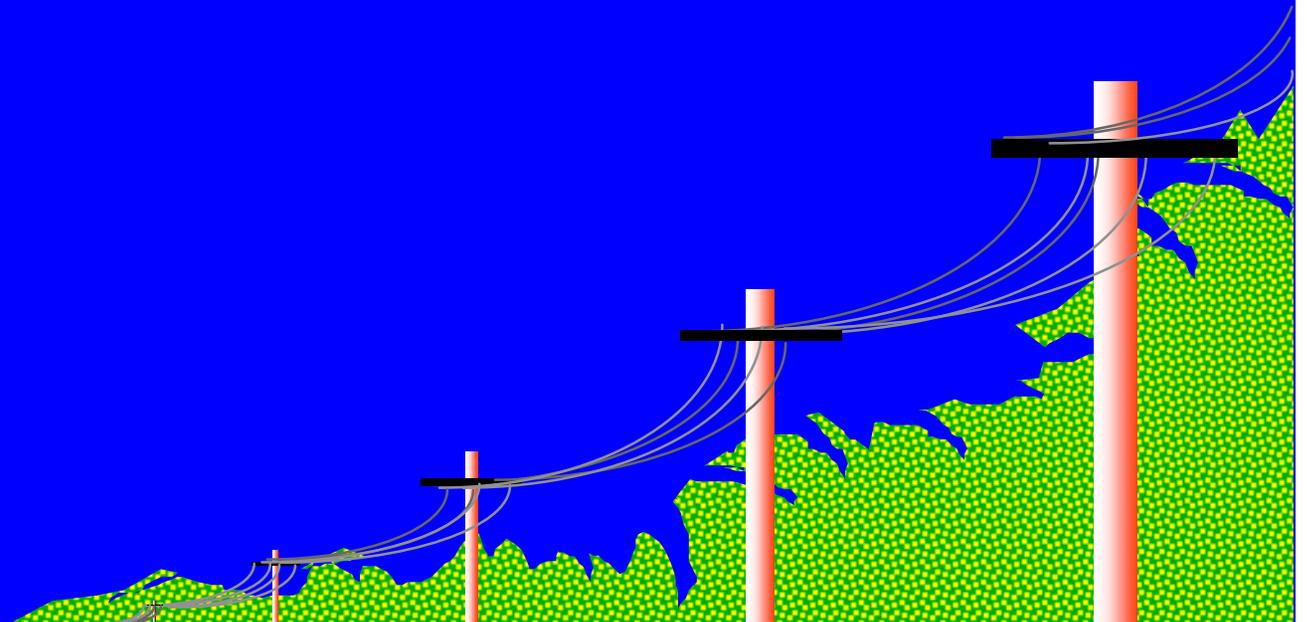
Valuation of Physical Gain (Education Example)

- LEAST SQUARES REGRESSION EXPLAINING 35% of variance for ANNUAL INCOME OF EMPLOYED ADULT

$$\begin{aligned} Y = & A + \\ & + 13,902 \text{ Yrs. Of Education} \\ & + 1103 \text{ Age of Employed Adult} \\ & + \mathbf{2,722 \text{ Interaction of Education and Electrification}} \\ & + 103,050 \text{ Effects of being male} \\ & + 36,898 \text{ Effects of being a professional} \\ & + 1,282 \text{ Effects of being govt official} \\ & - 12,806 \text{ Effects of being forestry worker} \\ & - 10,898 \text{ Effects of being unskilled worker} \\ & - 99,446 \text{ Effects of living in Mountain Province} \\ & - 18,975 \text{ Effects of living in Nueva Ecija} \\ & + \text{error term} \end{aligned}$$

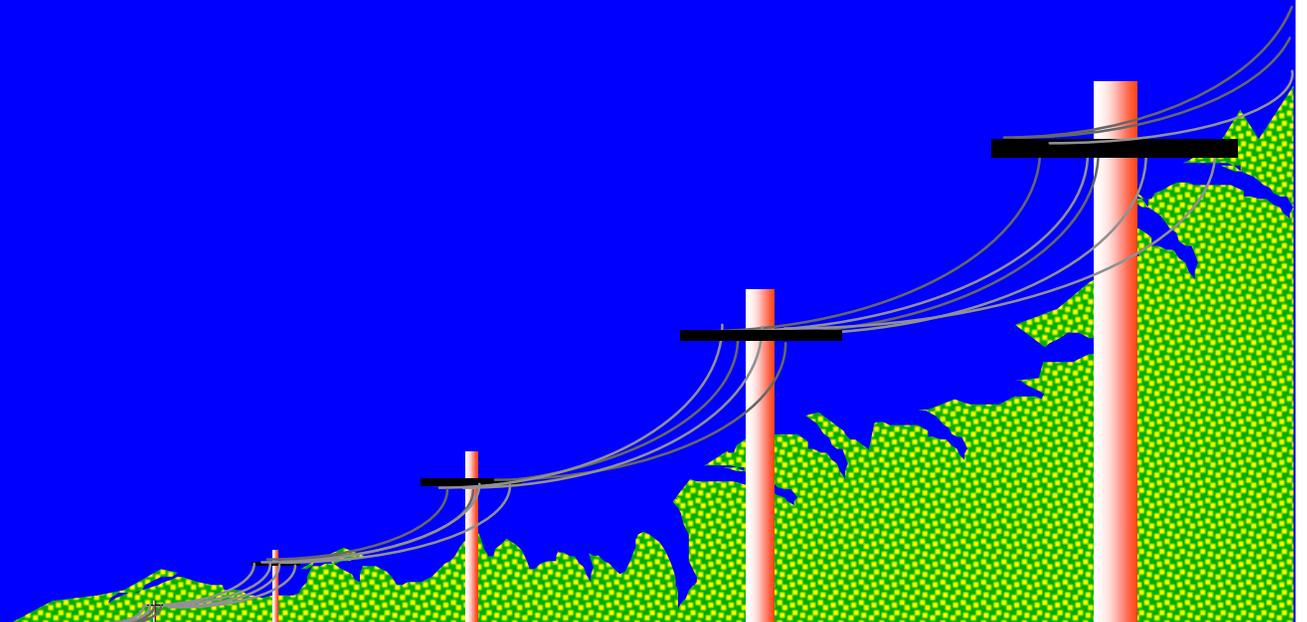
Some Empirical Findings

- BENEFIT ESTIMATES REFER TO THE **GAIN IN BENEFITS** FROM ELECTRIFYING PREVIOUSLY UNELECTRIFIED HOUSEHOLDS



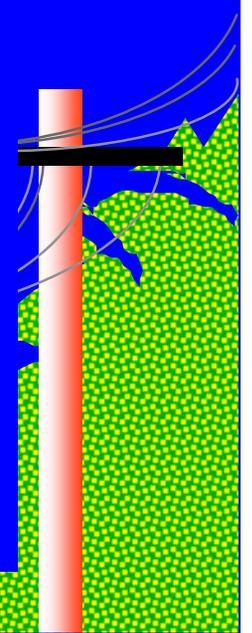
More-Traditional Estimates

- BENEFIT GAINS DUE TO CHEAPER SOURCE OF LUMENS
- BENEFIT GAINS DUE TO CHEAPER RADIO AND TV



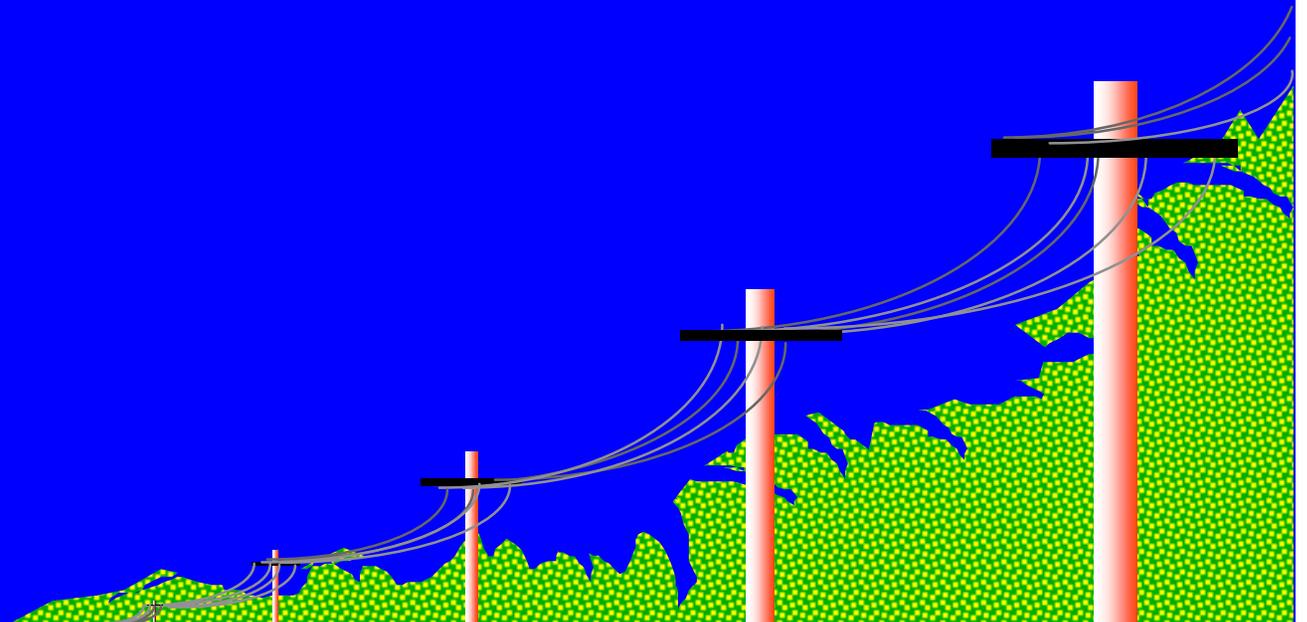
Cheaper Lumens

- TYPICAL LUMEN COST AND CONSUMPTION WHEN KEROSENE IS USED AS LIGHTING SOURCE
 - COST/KILO-LUMEN HOUR: \$0.36
 - CONSUMPTION/MONTH: 4.1 KILO-LUMEN HOURS
- TYPICAL LUMEN COST AND CONSUMPTION WHEN ELECTRICITY IS USED AS LIGHTING SOURCE
 - COST/KILO-LUMEN HOUR: \$0.0075
 - CONSUMPTION/MONTH: 204.4 KILO-LUMEN HOURS



Gain from Cheaper Lumens

- BENEFIT/MONTH/HOUSEHOLD: \$36.75
- TOTAL PHILIPPINE BENEFIT: \$147.5 MILLION/MONTH



Cheaper Radio Listening Hours

- TYPICAL RADIO HOURLY COST AND CONSUMPTION USING DRY CELLS AS POWER SOURCE
 - COST/HOUR: \$0.11
 - HOURS/MONTH: 13.8 HOURS
- TYPICAL RADIO HOURLY COST AND CONSUMPTION USING HOUSEHOLD CURRENT AS POWER SOURCE
 - COST/HOUR: \$0.0028
 - HOURS/MONTH: 104.6 HOURS

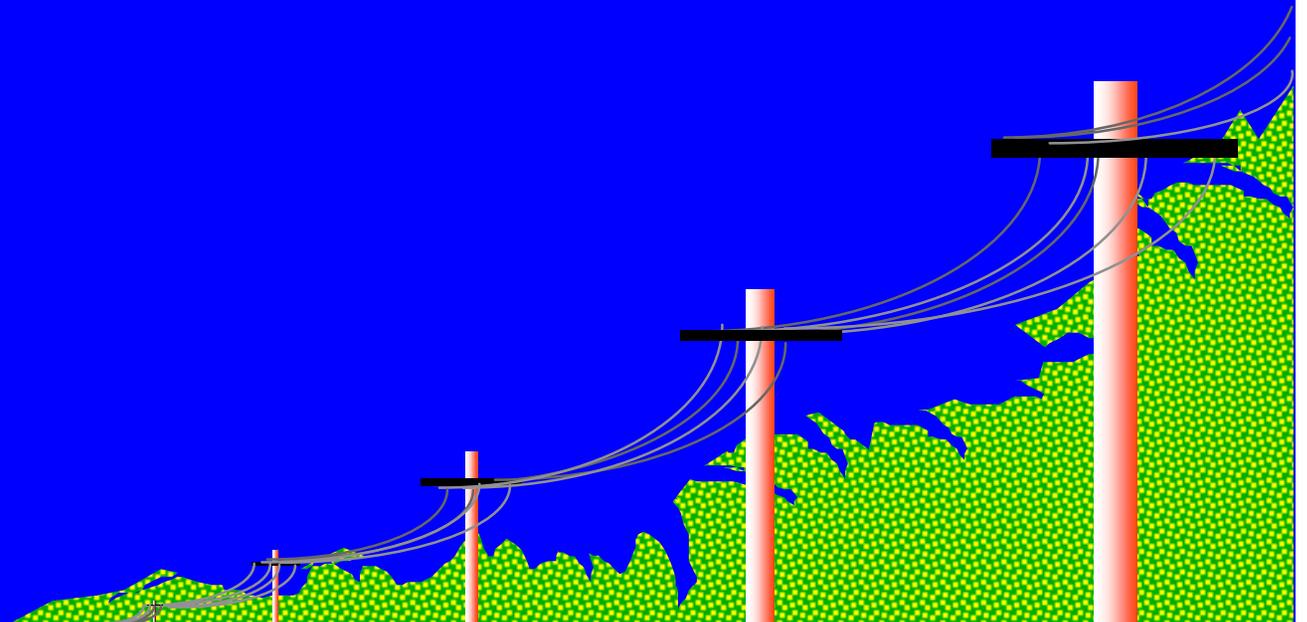
Cheaper TV Viewing Hours

- TYPICAL TV HOURLY COST AND CONSUMPTION USING A CAR BATTERY AS POWER SOURCE
 - COST/HOUR: \$0.22
 - HOURS/MONTH: 1.85 HOURS
- TYPICAL TV HOURLY COST AND CONSUMPTION USING HOUSEHOLD CURRENT AS POWER SOURCE
 - COST/HOUR: \$0.0125
 - HOURS/MONTH: 129.0 HOURS



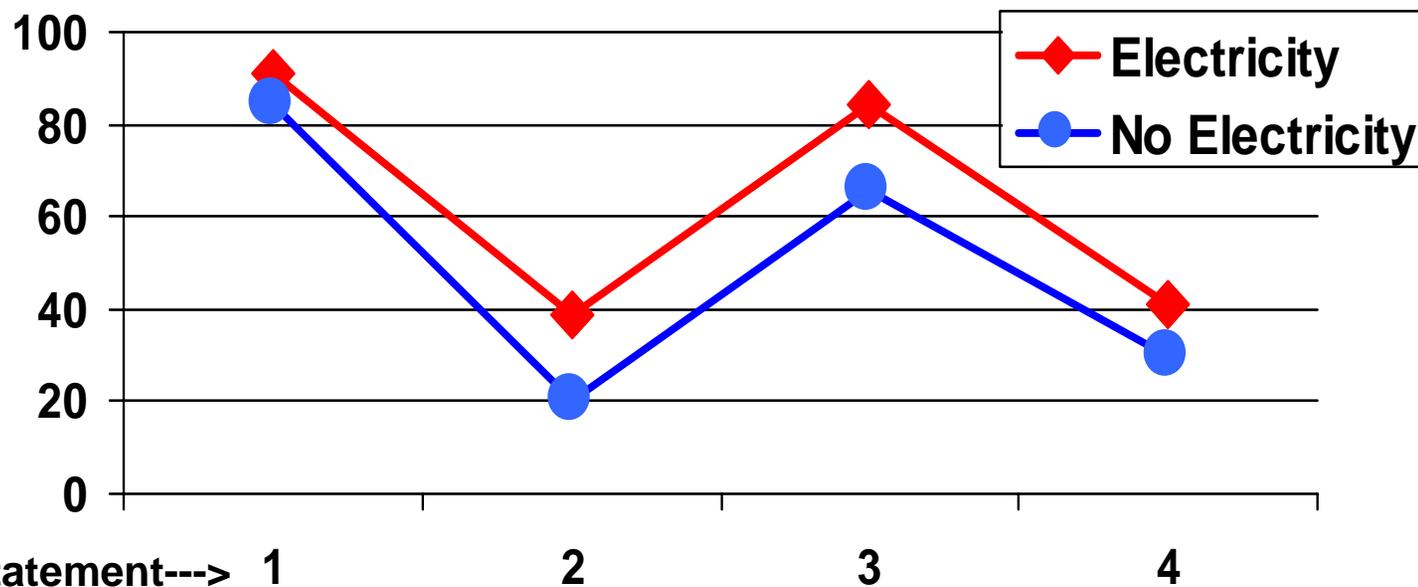
Gain from Cheaper Radio and TV Hours

- BENEFIT/MONTH/HOUSEHOLD: \$19.60
- TOTAL PHILIPPINE BENEFIT: \$77.5 MILLION/MONTH



Communications and Socializing

- 1 Watching TV is a great source of news and entertainment (% agree)
- 2 It is difficult to get news and information (% disagree)
- 3 Watching TV provides great entertainment
- 4 We receive guests in the evening after dark.

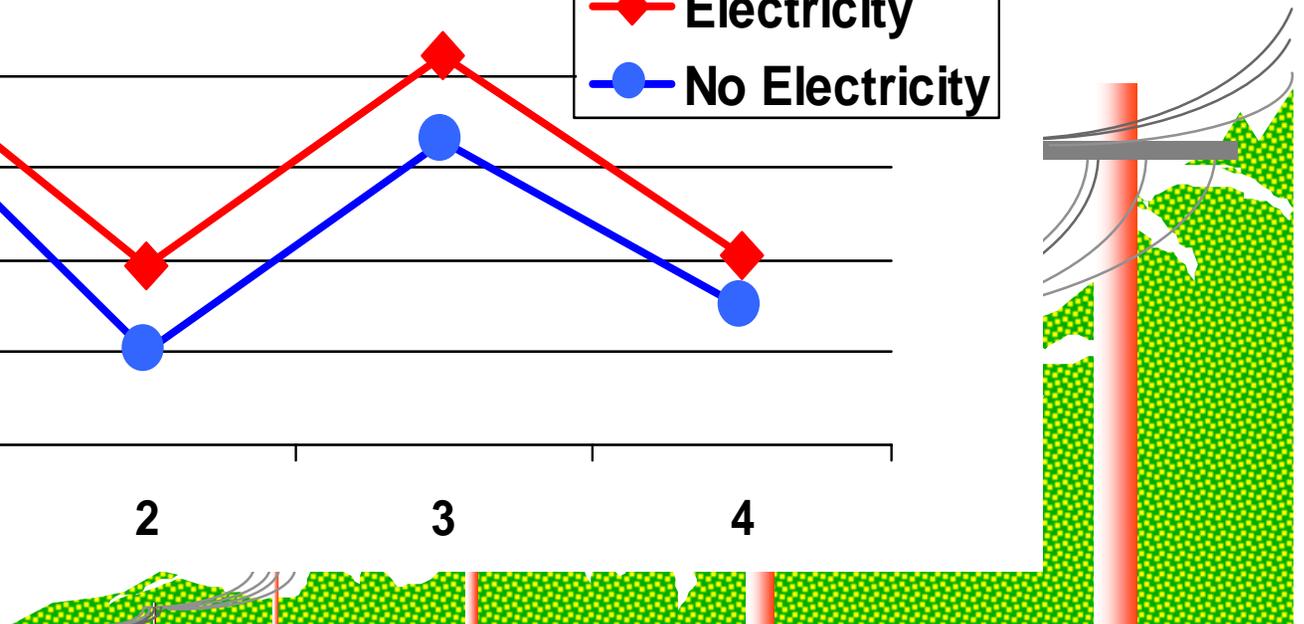


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Less-Traditional Estimates

■ BENEFITS FROM:

- IMPROVED EDUCATION
- SAVINGS IN TIME TO DO HOUSEHOLD CHORES
- IMPROVED PRODUCTIVITY OF HOME BUSINESSES



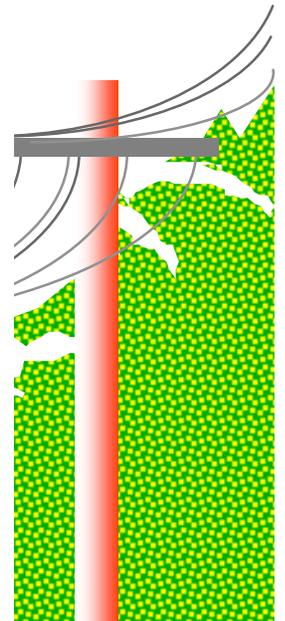
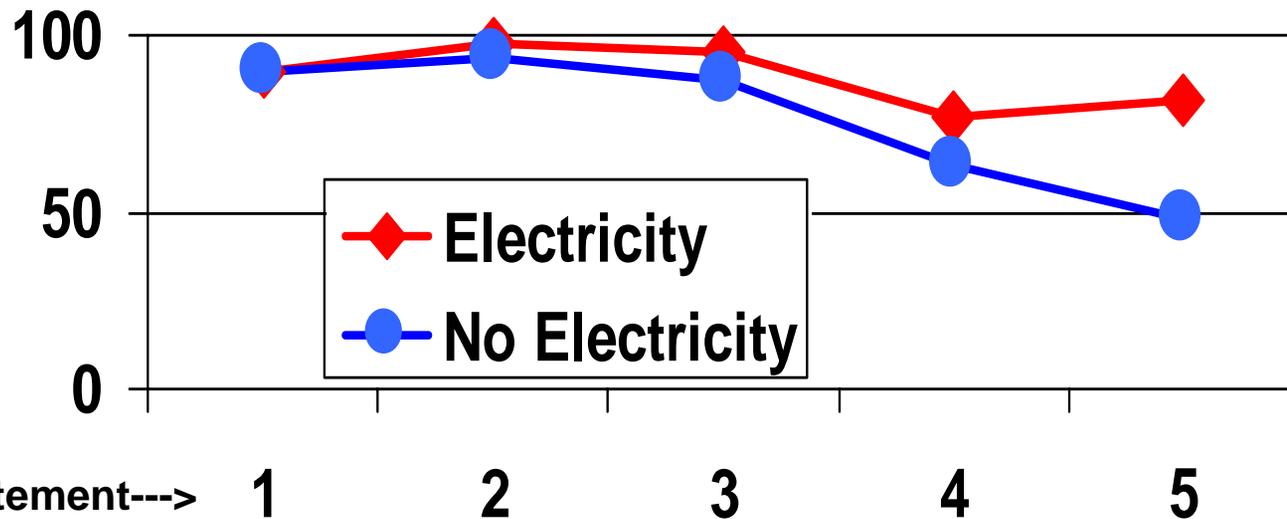
Improved Education

- ADDITIONAL INCOME/YEAR OF ADDITIONAL EDUCATION: **\$68**
- ADDITIONAL YEARS OF EDUCATION IN ELECTRIFIED HOUSEHOLDS: **1.82 YEARS**
- MONTHLY BENEFIT/ EMPLOYED ADULT IN ELECTRIFIED HOUSEHOLDS: **\$10.33**
- ESTIMATED PHILIPPINE EDUCATIONAL BENEFIT GAIN FROM ELECTRIFICATION: **\$80 MILLION/MONTH**

Education

(% agreeing with statement)

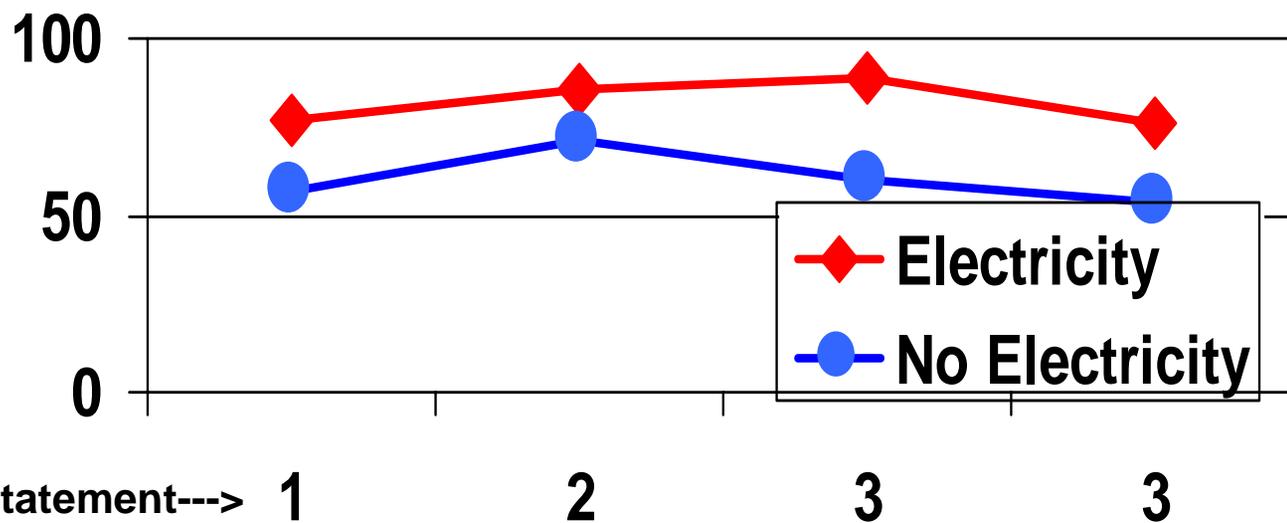
1. Reading is easier with electricity compared to kerosene
2. Having electricity is important for a child's education
3. Because of good light, children study more at night
4. My children study in the evening after dark
5. In my house it is easy to read in the evening.



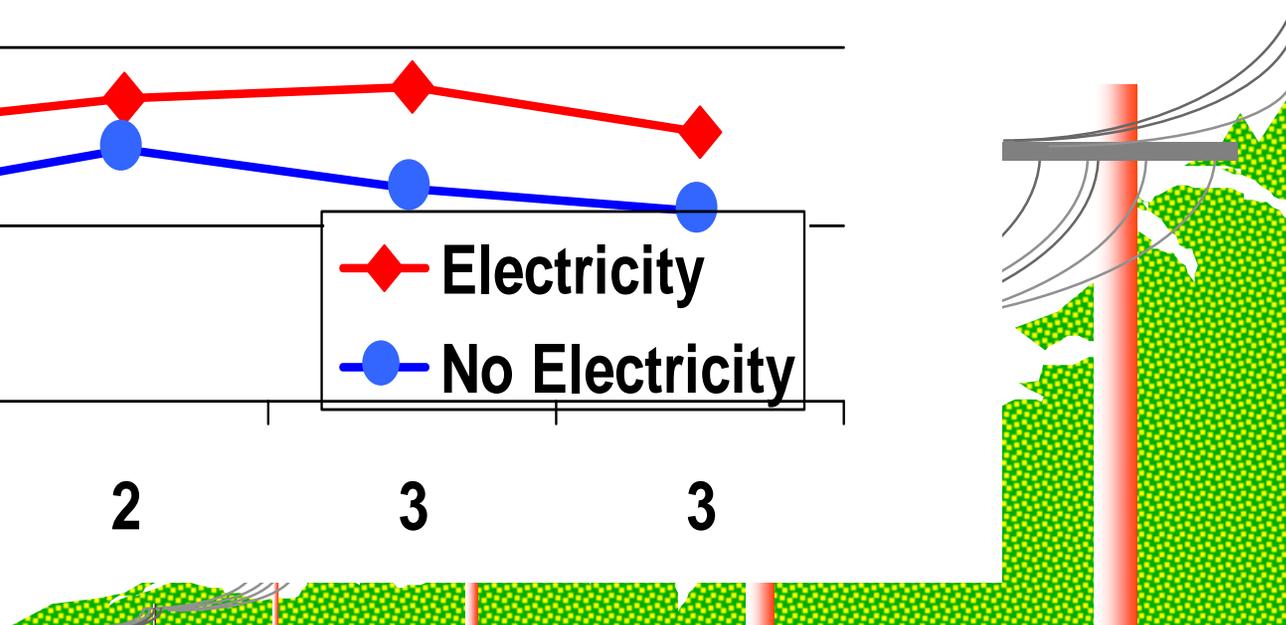
Light and Studying

(% agreeing with statement)

1. My family is happy with light from current fuel
2. Television takes study time away from children
3. I complete work in my house during the evening after dark.
4. Lighting with kerosene can cause health problems..



35 Statement--->



Less-Traditional Estimates

■ BENEFITS FROM:

- IMPROVED EDUCATION
- SAVINGS IN TIME TO DO HOUSEHOLD CHORES
- IMPROVED PRODUCTIVITY OF HOME BUSINESSES



Education Benefits Reflect

- POSITIVE ATTITUDE TOWARDS ELECTRICITY AND EDUCATION
 - **OVER 98%** BELIEVE THAT ELECTRICITY IS IMPORTANT FOR CHILDREN'S EDUCATION
 - **OVER 95%** BELIEVE THAT CHILDREN STUDY MORE WITH GOOD LIGHT
- ACTUAL INCREASE IN STUDY TIME
 - **ABOUT 14 HOURS/MONTH** MORE IN ELECTRIFIED HOUSEHOLDS



Savings in Time

- GAIN IN LEISURE TIME FROM ELECTRIFICATION: 33 HOURS/MONTH
- VALUE OF ADDITIONAL LEISURE TIME/HOUSEHOLD: \$24.50/MONTH
- TOTAL VALUE OF ADDITIONAL LEISURE TIME IN PHILIPPINES: \$97.5 MILLION/MONTH



Improved Home Business Productivity

- ADDITIONAL BUSINESS HOURS/MONTH DUE TO ELECTRIFICATION: 48 HOURS
- GAIN IN HOUSEHOLD INCOME FROM ADDITIONAL BUSINESS HOURS: \$36/MONTH
- ESTIMATED TOTAL GAIN IN PHILIPPINES: \$30 MILLION/MONTH



Summary of Benefits Per Month Potential Benefit for 4 million HH with No Electricity

Benefit/Gain	US\$ Benefit/ Unit Month	US\$ Benefit/ Household /Month	Total Potential Philippine Benefit (Million US\$ /month)
Cheaper Lumens (per HH)	37	37	147
Cheaper Radio/TV (per HH)	19	19	77
Education (per Employed Adult)	6	20	80
Time Savings (per HH)	24	24	97
Business Productivity (per Business only)	36	8	30
Total (excl. Lumens)			284

Conclusions

- BENEFIT GAIN IS SUBSTANTIAL
 - REFLECTS RELATIVELY HIGH PHILIPPINE INCOMES (BETWEEN \$125 AND \$250/MONTH IN SURVEY)
- ROUGH ESTIMATES SUGGEST THAT EVEN HIGH COST SUPPLY (\$20-\$25/MONTH) IS:
 - “WORTH IT” SOCIALLY
 - AFFORDABLE (WITH APPROPRIATE INCOME DISTRIBUTION POLICY)

Conclusions

- OUTCOMES MAY BE DIFFERENT FOR DIFFERENT COUNTRIES. FOR EXAMPLE, THERE WERE NOT IRRIGATION BENEFITS FOR THE PHILIPPINES.
- SUCH TECHNIQUES ARE LONG OVERDUE IN EVALUATING SOCIAL INFRASTRUCTURE PROJECTS
- THEY OFFER BETTER UNDERSTANDING OF THE RELATIONSHIP BETWEEN SOCIAL INFRASTRUCTURE AND DEVELOPMENT OUTCOMES.