FINANCING RURAL ELECTRIFICATION
AND RENEWABLE ENERGY

BASIC PRINCIPLES FOR SUBSIDY POLICY

SELECTED ESSAYS

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1 INTRODUCTION: SUBJECTS COVERED

The challenge of expanding access to modern facilities, such as electricity, to the large unserved population in developing countries is to overcome the problem of low ability to pay within a private sector / local community initiative based framework of service supply. This calls for the provision of adequate financing schemes comprising an affordable mixture of investor equity, loans and investment grants. The same holds for the penetration of renewable energy technologies in the competitive power markets.

Given the importance of subsidies and the scarcity of subsidy funds, what are the basic principles to follow in the design of subsidy schemes if maximum benefits are to be obtained. The fourth papers presented here address the issue from different angles:

- The first paper provides an analytical framework for understanding the practical subsidy implications of achieving the objective of maximum access in rural electrification. The analytical model is used to deduct the general subsidy principles to follow if maximum access is to be achieved. The paper explains also how the general maximum access principle for subsidy policy can be adjusted to take the objective of regional equity into account.

- The second paper on the minimization of free rider affects applies the maximum access principle to the analysis of optimal cost-effective subsidy policies for the promotion of solar home systems.

- The third paper deals with the implications of a Regulator’s imposition of lifeline tariffs on regulated distribution companies.

- The fourth paper shows that the subsidy options for grid connected renewable energy can be listed within a simple two-by-two matrix showing on the one axis the two basic subsidy funding mechanisms and on the other axis the two basic subsidy targets.
2 SUBSIDIES FOR MAXIMUM ACCESS

1.1 Access – the fundamental equity issue

The basic equity issue in rural Senegal is the inequity in access to basic services such as quality education, potable water, commercial credit institutions, health clinics and electricity. Seen from this point of view, the over-riding objective of rural energy policy is to increase access to modern forms of energy.

Expressing the equity impact of subsidy policy for rural energy in terms of its ability to expand access has the advantage of avoiding confusion. Equity is served when access is expanded! In the short term, equity is decreased in the area where an electricity project is implemented. Within the village the relatively richer get access, whereas the poorest are unable to afford the cost of connection. The neighbouring villages that are not electrified will feel discriminated. But seen in the national perspective, inequity is reduced, and at the local level, the poorer households and neighbouring villages will be connected over time - the available infrastructure facilitates their access in later years.

If the access interpretation is accepted as the primary guideline for ASER’s subsidy policy, then prudence is needed in the fixing of subsidy levels. Excessive levels of subsidies given to individual rural energy projects are counter-productive to the objective of expanding access:

- They favour the few and make large-scale expansion unaffordable.
- They stifle private initiatives as potential consumers and private entrepreneurs prefer to wait for Government hand-outs.

It is incontestable that the majority of rural households in Senegal are too poor to pay the full economic/financial cost of electricity supply of the baseline consumption of 15 kWh per month. Subsidies are needed if significant penetration rates are to be achieved in rural electrification. But it is a mistake to believe that equity is best served by a “high-subsidy” policy, which tries to achieve a 100% connection rate in an individual single village. A “lower subsidy” policy, which aims to achieve a 33% connection rate in four different villages within the same overall subsidy amount is more efficient from the equity point of view. It gets more households connected for the same amount of financial support. This is illustrated in the Subsidy Rates for Maximum Access chart.

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The chart shows the demand and supply curves for rural electrification (subsidies) as a function of the level of subsidy expressed in terms of FCFA per serviced household:

- The demand curve, $D$, shows that increasingly higher subsidy rates are required if electrification through either grid connection or through the acquisition of a SHS is to become affordable for an increasing number of new consumers. The demand curve expresses household ability / willingness to pay for electricity through the demand for subsidies. The slope of the demand curve is partly determined by the distribution of income. Its position depends on (i) the population’s ability to pay, which increases over time with per capita income; (ii) the cost ex-subsidy of the product (lower costs shift the demand curve for subsidies to the right); (iii) quality of service (poor service decreases demand); (iv) the marketing skills of project developers and other suppliers (turning latent wants into effective demand); (v) the local availability of the product (“keeping up with the Jones’ effect”); and (vi) on the availability of credit. Thus, innovations in financial instruments that make better financing terms available to consumers or the provision of indirect subsidies to household electrification in the form of public promotion campaigns to increase consumer demand or in the form of technical assistance to manufacturers, etc. can shift the demand curve to the right.

- The supply curve, $S$, shows the relationship between the number of consumers per year that can get a subsidy and the size of the subsidy rate. The position of the supply curve is determined by the annual budget for direct subsidies. The curve’s intersection with the y-axis shows the size of the annual subsidy budget; the intersection with the x-axis, the total number of non-electrified rural households.

- The optimal level of subsidy is $S_1$. It allows a maximum number of households to get access to electricity. If the subsidy level is higher, for example, $S_0$, the number of households that can be reached is reduced by the availability of funding to $H_0$. 

The chart shows the demand and supply curves for rural electrification (subsidies) as a function of the level of subsidy expressed in terms of FCFA per serviced household:
The number of households asking to be electrified at this level of subsidy amounts to \( H_2 \), resulting in an unsatisfied demand of \( H_2 - H_0 \). If the level of the subsidy is lower, for example \( S_2 \), the subsidy fund is sufficient to supply subsidies to \( H_2 \) households. But due to insufficient ability to pay of the \( H_2 - H_0 \) households, only \( H_0 \) households will ask to be connected (or purchase a SHS). Some of the funds on the public budget line for the subsidy are not used.

The model shows that the optimal level of the subsidy is defined by the position of the supply and demand curves. The **optimal balance** is achieved when the *incremental cost for expanding access by one additional consumer* is the same across the technology options and supporting interventions.

The identification of optimal subsidy rates, therefore, calls for a **close consultation process between politicians and technical planners**. The total annual budget for direct and indirect subsidies depends on the Government’s (and donors’) sectoral priorities for funding. An increase in annual direct and indirect subsidies shifts the supply and demand curves to the right, but leaves less funding available for other sectors. **Politicians, therefore, should define the subsidy budget with reference to inter-sectoral policy priorities.** By modelling the demand and supply curves, the technical planners can support the political decision taking process providing information on the marginal costs of reaching various annual connection levels. The politicians can then compare this with their perceptions of the benefits of the marginal expansion in the annual connection rate.

Once the overall subsidy budget has been decided, the **optimisation process**, in principle becomes a **technical task for planners involving two steps**:

- Since access can be expanded through a shift of either the demand curve or the supply curve, planners must aim to achieve the *optimal balance between direct and indirect subsidies* within the given budget. The optimal allocation of funding is achieved, when a marginal change in the two budgets results in same horizontal shift in the two curves. Thus, when not enough projects are implemented the first pertinent evaluation is to check whether the project sponsoring capabilities are too weak (increase in indirect subsidies for TA), or the ability to pay is too low (increase in direct subsidy).

- The next step is the **allocation of funds to alternative activities and products within the budgets for direct and indirect subsidies.**
  - Within the budget for indirect subsidies, the division of funds between (i) support for promotion campaigns, (ii) technical assistance to reduce equipment costs and (iii) measures to reduce the transactions costs.
  - Within the budget for direct subsidies, between funds for support for feasibility studies and other project preparatory support versus subsidies for equipment investments. Or between subsidy funds for SHS and for grid electrification investments respectively.

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2 In practice, the process is the reverse, starting bottom-up with proposals for funding of individual activities proposed by project promoters, which are judged on the basis of their individual merits. But since financial resources are limited, balancing of priorities takes place at the central planning level.
1.2 Regional Equity

If the “maximum access model” is the sole guideline for subsidy policy, then only the most economic projects are implemented each year. All other projects are postponed to later years.

The **financial rate of return of electrification projects** is determined by the cost of investment per consumer (beneficiary household) and by the level of the average demand per consumer. Since regional poverty incidence is linked to relative geographic isolation, electrification projects in poor regions are squeezed both by higher than average costs of investments and by lower than average levels of consumer demand for power. In addition, fuel costs are higher due to costs of transport. Thus, under the maximum access model, they would be the last in line.

Politically, the **accelerated electrification of isolated rural areas** may be justified on grounds of regional balance or social equity objectives, even when the economic rate of return is negative and lower than the average of proposed projects. The incidence of poverty is higher in some regions than in others, and since one ethnic group may be largest group in the disadvantaged area, lack of financial support to local electrification could easily be interpreted as ethnic discrimination.

Project promoters adjust for the high costs and low ability to pay of the local population by **providing extra-high subsidies to projects located in low-income / high cost regions**. This shifts the supply curve S in the “Subsidy Rates for Maximum Access” chart to the left and makes it more steep (less elastic). Less overall access is achieved.

From the point of view of **economic allocative efficiency**, the regional equity policy is undesirable. Providing the highest subsidies to the projects with the lowest rates of return results in a drain of resources away from more productive investments. But, firstly, national cohesion would suffer if concessional funding were concentrated on the faster growing regions only. Secondly, since some of the poorest regions benefit, the **social impact of regional equity policy** may be positive provided that two conditions are fulfilled:

- There must be an upper bound on the level of subsidies per beneficiary household; otherwise the social loss from lost project alternatives will be higher than the social benefit from implementing the project.
- The granting of higher subsidy levels must be based on transparent and objective criteria; otherwise, there is an obvious risk of arbitrary intervention in the project selection process.

The adoption of objective quantitative criteria for handling the regional equity issue permits the REF to operate on near-commercial banking procedures in the evaluation of finance requests.

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3 Project promoters can always find a justification for implementing non-economic projects: strategic considerations (nearness to border), regional equity (district has low electrification rate), political (combating threat of ethnic unrest, or promoting the re-election of a local politician).
1.3 Subsidies to promote indirect access to electricity

The philosophy/rational of the poverty orientation strategy of the Nepal Energy Sector Assistance Programme has two main premises:

(i) That the huge inequality in national access to modern energy services is the main equity issue to address; and that any cost-effective measure to expand access improves equity. Only 13% of Nepal’s population has access to electricity, and only 4% of the rural population.

(ii) Since the program will not enable the poor in the target areas to get direct access to electricity, specific measures must be implemented to maximize the benefits to the poor from indirect access to modern energy services.

The subsidy policy adopted by the Government with the help of technical assistance from the Nepal Energy Sector Assistance Program has three key poverty-related aspects:

1. The basic subsidy principle of the program is that investments have to achieve maximum access per unit of ”subsidy support” (the sum of direct and indirect subsidies). Therefore,
   - subsidy rates for different technologies (expansion of the national grid, isolated grids, stand-alone solar home systems) are fixed at the individual levels that across the technologies provide the same marginal expansionary effect on demand.
   - emphasis is put on reducing the number of “free riders”. Subsidies to SHS are ”market pump priming” subsidies, which are limited to a five year period and have declining rates during these years.

2. The basic subsidy principle was adjusted to take the need of regional balance into account. In the micro-hydro component (micro-grids), a “transport” subsidy is provided for investments in micro-hydro plants in inaccessible areas. The investment subsidy per installed kW is an increasing function of the number of days it takes to get from a village to the nearest road. The fact that SHS are promoted, is another aspect of regional equity policy.

3. Specific subsidies are given to maximise benefits from indirect access to electricity. In the micro-hydro projects and the rural grid expansion projects, the connection rate of households in the grid area will be no more than 30-40%. Only 15-25% of the population living in the off-grid “SHS areas” will be able to afford a SHS once the market infrastructure has been established and subsidies are removed. The promotion of “indirect access” strategy has the following subsidy implications:
   – Since the poorest population is left out of the SHS market, particularly high subsidies were given to ”institutional PV systems”: systems for

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schools, community buildings, health clinics, public lighting. The intention is to ensure that the poor can benefit from improved education for their children and from evening classes, and from improved health services.

- To improve the possibility to attract quality teachers and nurses to remote areas, 75% subsidies are also given to *PV-systems for teachers and nurses* who live in those areas.
- In the *micro-hydro projects* equally strong assistance will be given to promote the productive uses of electricity in the social services - schools, clinics – as well as in commercial applications.
3 MINIMISATION OF FREE-RIDER EFFECTS IN SOLAR ENERGY

The objective is to increase investment in the target area and to avoid subsidising investments, which would be carried out anyway. A subsidy is efficient when the percentage of “free riders” that benefit from the subsidy is low. The principle is illustrated in the chart below.

At the unsubsidised selling price $P_1$ of the technology, consumer demand is limited to the amount $Q_1$. The provision of a subsidy equal to $P_1$ minus $P_2$ increases consumer demand to either $Q_2$ or to $Q_4$, depending on the reaction of consumer demand to changes in the price of the product, the so-called “price elasticity of demand”. If demand is elastic, as shown by the demand curve $D_2$, product sales increase to $Q_4$. If demand is relatively inelastic, as shown by demand curve $D_1$, sales increase only to $Q_2$. In both cases, the number of “free riders” equals $Q_1$, the number of consumers who would invest in the product also without a subsidy. For them, the subsidy is a “free gift”. When demand elasticity is high, the promotional impact, $Q_4-Q_1$, is large compared with the free rider impact, $Q_1$. When the elasticity of demand is low, the promotional impact $Q_2-Q_1$ is relatively small.

A further complication arises, when the subsidy amount set aside in the annual state budget is insufficient to cover total annual demand for the subsidy. In the figure

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6 The policy recommendation from this is that “market pump priming subsidies” should not be used in the case of products or services having a low price elasticity of demand.
above, the public budget, which is available for the subsidy, limits the number of
benefiting customers to \( Q_5 \), which reduces the “market expansion/free rider ratio” to
\( Q_5 - Q_1 / Q_1 \).

The incremental subsidy cost curve is calculated by dividing the number of
additional consumers with the total cost of the subsidy. Because an increase in the
subsidy rate benefits all purchasers of the product, and not just the marginal
consumers, the incremental subsidy cost curve rises steeply. In the chart, a wish to
expand annual sales of SHS from \( Q_1 \) to \( Q_3 \) would require a subsidy per SHS of \( S_3 \) and
lead to annual subsidy payments equal to the area \( P_1 P_3 S_1 S_11 \). If politicians wanted to
expanded annual sales to \( Q_4 \) (doubling the expansionary effect), the subsidy rate must
be raised to \( S_2 \), leading to additional annual subsidy payments of \( P_3 P_4 S_1 S_2 S_22 \). The
incremental expenditure of raising the subsidy rate from \( S_3 \) to \( S_2 \) is much larger than
the increase from zero to \( S_3 \), although the increment in annual access is about the
same. Sooner or later, the marginal economic-financial costs of higher subsidy rates
become larger than the marginal socio-economic benefits of extra subsidies. The
subsidy cost per incremental customer has become so high, that the additional
expenditure no longer reflects national political priorities! To define the balance is a
political decision, the task of planners is to present the cost-effect calculations to the
responsible politicians.

The practical problem with the calculations is that the demand schedules, in
particular, the price elasticity of the demand are not known at the start of the
programme. Planners must make assumptions about the level of annual sales and the
price elasticity of demand with reference to international experience in countries with
similar characteristics. Results during implementation will show whether adjustments
must be made to assumptions and to policy recommendations.

A numerical example illustrates the issue. The elasticity of demand for a product is
defined by the affordability of consumers (“income effect” of price changes) and by
the availability of a close substitute for the product (“cross-price elasticity of demand
effect” of price changes). Consumers capable of paying the high upfront cost of SHS
are located in the upper three income deciles. They can adjust their consumption
pattern, which means that affordability (the income effect) is not an insurmountable
problem. Substitutes exist in the form of small household gensets and car batteries.
But batteries provide lower service and are costly to charge. Gensets provide better
electricity supply, but are more expensive and are, therefore, an option mainly for the
very richest rural households, who would not be interested in a SHS. Thus, the
alternatives are not close substitutes, meaning, that the substitution effect will be
limited. Under these circumstances, it is not likely that the price elasticity of demand
is larger (numerically) than \(-1\). Judging from the experience in Kenya (more than
100,000 SHS installed within less than 10 years) and in Zimbabwe (annual sales of 6-
7,000 SHS), it is reasonable to assume that a well designed promotion campaign could
increase sales in Senegal to 6,000 SHS per year without subsidies, being split
70/20/10 between the 22W, 35W and 55W systems. For ease of calculation, we
assume that only 35 W systems are marketed. The installed market price of a 35W
system is FCFA340,000. Let us further assume that politicians contemplate four

\[ ^1 \text{IEA/OECD estimates of the demand reaction to the 1973 and 1979 oil prices hikes were a short-term}
\text{price elasticity of -0.3 and a long term price elasticity of -0.7.} \]
subsidy options, ranging from 40,000 to 100,000 FCFA per installed system, see table below.

**Table 1: Marginal Subsidy Cost Curve for 35 Wp SHS**

<table>
<thead>
<tr>
<th>Assumed elasticity of demand = minus 1</th>
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</thead>
<tbody>
<tr>
<td>Subsidy per SHS in FCFA</td>
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<tr>
<td>Subsidy in percent of installed cost:</td>
</tr>
<tr>
<td>Sales price of SHS, FCFA</td>
</tr>
<tr>
<td>SHS units sold per year</td>
</tr>
<tr>
<td>Increase in sold SHS compared with zero subsidy</td>
</tr>
<tr>
<td>Stepwise marginal increase in number of sold SHS</td>
</tr>
<tr>
<td>Total annual subsidy expenditures Mill. FCFA</td>
</tr>
<tr>
<td>Annual subsidies divided by added customers, FCFA</td>
</tr>
<tr>
<td>Cost of subsidy per marginal customer, FCFA</td>
</tr>
</tbody>
</table>

Source: Model calculations

Under these assumptions, the introduction of a subsidy of 40,000 FCFA per SHS would expand sales by 706 units and lead to annual subsidy payments of 268 million FCFA. The cost of these subsidy payments divided by the number of additionally sold units – the marginal subsidy cost of expanding the market - is 380,000 FCFA per unit, which is more than the market price without subsidies of 340,000 FCFA. That is, if it were possible to discriminate between customers, it would be cheaper for the state budget to provide the 706 units free of charge to the final users! Expanding the annual market by 1,765 SHS requires 776 million FCFA in subsidy payments or 440,000 FCFA (US$733) per beneficiary household! Compared with a subsidy of 80,000 FCFA per unit, the 100,000 FCFA subsidy increases sales by 353 units at a subsidy cost of 520,000 FCFA per unit!

The expansion impact becomes more favourable if the elasticity of demand is numerically higher. An elasticity of demand of –2, leads to an initial incremental increase in subsidy payments of 210,000 FCFA per added customer for the 40,000 FCFA subsidy and of 350,000 FCFA for the 100,000 FCFA subsidy.

The first step to devise a rational policy for providing subsidies to SHS, therefore, is to define the **politically accepted balance** between the incremental increase in **annual subsidy expenditure** and the incremental increase in **market expansion**. To allow politicians to take the decision on an informed basis, planners must estimate the marginal increase in the annual access to electricity, which is caused by an increase in the subsidy rate.

The next step is for planners to **design subsidy schemes that maximize the “market expansion / free rider ratio”**, that is, to get maximum impact from the subsidy program. The trick to is to discriminate between consumers to a maximum extent.
Provided they are not excessively low, “lifeline tariffs”\(^8\) in grid based electricity distribution (a “collective system”) fulfil the efficiency objective: only the target group of poor households benefit from these. The same degree of discriminatory fine-tuning can not be achieved for subsidies provided to “individual” consumer products and services such as solar home systems (SHS). What can be done, though, is to distinguish between the need for “market pump priming subsidies” and for “social / market deepening subsidies”, respectively, and to devise appropriate designs for each.

The objective of the “market pump priming subsidy”\(^9\) is to get the development of this “natural market” jump started to a level that makes investments by the private sector in a nation-wide SHS marketing and service infrastructure commercially viable. The existence of this marketing structure and the demonstration effect of sold SHSs (“keeping up with the Jones’”) will maintain a high level of annual sales also after the phasing out of the pump priming subsidy. The subsidy should:

- have a lifetime of two to five years and
- be launched with pre-announced time-limits and pre-announced declining subsidy rates during that time. Making consumers aware of that the subsidy rate decreases from a specific date onwards, creates psychological pressure to advance purchase decisions, which increases the price elasticity of demand.

During the market pump priming period, it is inevitable that the richer households pocket the subsidy, as they will be the first to acquire a SHS. The “natural, without subsidies” market for solar home systems amounts to 10-20 percent of households in the off-grid areas. The objective of the “social / market deepening subsidy” is to expand sales to the poorer communities. Optimisation of the use of funds requires use of appropriate phasing to disburse the subsidies. After some years, once annual demand levels off due to the saturation of the “natural 15-20% market” politicians may decide to reintroduce a purchase subsidy to expand access also to lower income groups. As most of the 15-20 percent of richest households have purchased a SHS by then, the free rider problem of this “social / market deepening subsidy” is then relatively limited.

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\(^8\) for low levels of electricity consumption that are financed by extra-high charges on higher residential consumption levels and/or government subsidies to investments.

\(^9\) Temporary, time limited subsidy to create an initial market demand of sufficient size to permit commercial delivery structures to be developed.
4 LIFELINE RATES AS A REGULATORY ISSUE IN THE PHILIPPINES

Lifeline rate\(^1\). Lifeline rates (loss making tariffs on low-consuming customers) are cross-subsidised by above-cost tariffs charged to customers with higher levels of consumption. The minimum possible lifeline rate of a utility (= the maximum level of annual financial losses on lifeline customers that the utility can sustain) depends on the maximum cross-subsidization capacity (= maximum politically acceptable tariff for consumers with high levels of consumption multiplied by kWh sales to them minus the financial cost of their supply). Fixing one of the two rates automatically determines the other by residual calculation.

The ECs in the poorest areas have both the highest cost structures (even after deduction of investment subsidies) and the highest share of very poor consumers. The “commercial” household consumers are relatively fewer and have lower average consumption levels than “commercial” household consumers living in more urbanized franchises. The cross-subsidization capacity will therefore be lowest in the poorer franchise areas. The objective need for subsidies, however, will be higher. This is due to the larger financial loss per lifeline consumer (= cost of supply minus lifeline tariff revenue) and because the ratio of lifeline customers to commercial customers is higher.

Two novelties introduced by the bill reduce the cross-subsidization capacity of an individual utility for lifeline tariffs:

- The EIRC charge appropriates an important share of the total cross-subsidization revenue potential.
- The elimination of cross-subsidies between consumer categories turns the burden of cross-subsidization on the “commercial” household consumers exclusively\(^2\).

If the lifeline rate of an utility is to be kept unchanged after liberalization, the rate charged to higher levels of household consumption must increase unless the cost savings from liberalization are so large that they cancel out the additional subsidy revenue burden.

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\(^2\) A lifeline tariff has two components. (i) The fixed charge (for metering, billing and other services) is set below the de facto cost of supply per household consumer. (ii) A stepwise kWh tariff is used which has a low price for the initial low levels of monthly/bimonthly kWh-consumption, and a higher price for any consumption above that level. A composite of the two is to save the cost of metering for low levels of household consumption. The consumption of the household is limited by the use of load limiters to 50W, 75W, 100W or so. The household pays a low fixed charge depending on the level of load.

This reduces the ratio between the number of “commercial kWh that provide cross-subsidization revenue through overpricing” and the number of “lifeline kWh”.

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The *notion of the lifeline rate* is not defined in the Bill. The lifeline concept can be based on:

- **Absolute poverty criteria** - making a “survival standard” level electricity consumption affordable for the very poorest section of the population. In rural Philippines that would be a 15 to 20 kWh of monthly consumption corresponding to the use of three light bulbs and a small radio.

- Or, it can be a **relative poverty concept**, to allow a “basic comfort” level of electricity consumption to be easily affordable to the poorer parts of the population. In this case, the lifeline rate can be even lower and the eligible monthly consumption rates be higher, say 50 kWh per month, covering the consumption also of a small TV, a fan and a smaller electric cooker.

In the first case, the ability and willingness to pay of the poorer parts of the population would be stretched to the limit. In the latter case, it is judged not be socially acceptable that the share of household income to pay for electricity is higher than X%.

Presently, the lifeline rate is set by the individual utilities; the ERB approves only the average tariff. The draft Bill changes this, as it includes the *fixing of a lifeline rate among the functions of the ERC* (Chapter IV, Regulation Section 30 (i) “ Functions of ERC” Chapter VIII, Transitory Provisions, Section 55):

- “(i) Set a lifeline rate for the marginalized end-users”

The *political motive* for this is to reassure consumers that social considerations will continue to be taken into account also under the liberalized regime. Yet, it may not be the right approach for achieving this objective. The board of a utility can best define what level of lifeline tariff is needed and financially affordable being in closer contact with the customer base than the ERC. Utilities in richer franchise areas can afford to be more generous in their lifeline rates than utilities in poorer areas and may chose to be so. Compared with this decentralized mode of decision taking, the transfer of decision taking responsibility on the lifeline tariff to the ERC has a number of drawbacks:

First, the **ERC should be concerned with technical issues**, such as promotion of utility efficiency and least cost achievement of “total electrification”, and not with political issues.

- The fixing of the lifeline rate is partly a *technical exercise* to estimate the ability to pay of, say, the poorest 20% of the households, or to estimate the social impact of present tariffs by looking at connection and disconnection rates. This, ideally, should be the approach used by management and board of an EC to fix the lifeline rate. It is an instrument for the utility to fulfil its universal service obligation.

- Partly, it is a *political value judgement* to find out how much one can squeeze richer households and what the added social and economic value is of a further decrease in the lifeline rate or an increase in the threshold level. This refers to the practical application of the relative poverty concept. To overcharge higher income consumers is tantamount to a tax on electricity consumption, which is used to subsidize the consumption of lower income households. This use of a
The taxation opportunity has to be compared to the alternative of using the same tax—via a general fee on electricity—for transfer to the general budget for alternative uses in, say, education and health. Politicians are elected to make that kind of evaluations. The prestige and credibility of the ERC will be undermined by doing it.

Second, giving the ERC the responsibility for fixing the lifeline rate politicises the rate fixing process, turning it into a national rather than a local political issue. As argued above, there are no objective technical criteria for fixing the lifeline rate. Thus, whatever the ERC decides can be attacked.

The ERC has the option to fix a national lifeline rate (which seems to be implied by the wording of the text) or to fix individual lifeline rates for each utility.

The argument for a national lifeline rate would be that access to electrification is a national objective and that all poor should be offered access on the same terms. The ERC then has to decide what the appropriate reference case is for fixing the level of the national lifeline rate (composed of the lifeline tariff and the threshold level):

- One option is to fix it on the basis of the lowest rate that can be financially sustained by the poorest utility (highest national lifeline rate). The high rate option would lead to protests by, inter alia, MERALCO’s lifeline consumers that they are asked to shoulder the burden of sector restructuring and liberalization.
- The other is to adopt the lowest lifeline rate presently used by any utility (lowest national rate). The low rate option will make management and boards of utilities in poorer areas protest that they do not have sufficient “commercial” consumption to cross-subsidize the financial losses on lifelines consumers that are imposed by the ERC. They will insist on receiving additional subsidies either from the EIRC or from the state budget to cover their losses on operation. Otherwise, their utility is not financially viable. The EIRS, however, gives only investment subsidies, not subsidies to reduce the annual costs of operation and maintenance. To give annual subsidies is against the “smart subsidy” notion of using scarce subsidy funds to maximise access, not consumption.

There are three major arguments for choosing the individual lifeline rate option.

- The affordability of lifeline tariffs differs between utilities and the ERC, therefore, must take the individual situation of the franchises into account. The ERC can take the existing lifeline rates as the point of reference.
- The poor in the richer franchises (being surrounded by a richer community) are relatively poorer than the poor in the poorer franchises. They should therefore be able to benefit from lower rates, in particular, since the franchise can afford it.
- The impact on the promotion of off-grid electrification must be taken into account. Tariffs and lifeline rates in these will vary because of differences in cost. A national lifeline tariff for the grid connected areas will complicate tariff negotiations between suppliers and consumer representatives. It will be the natural point of reference for local consumer conception of a fair tariff.
(they will tend to be poor in off-grid areas) and for defining their affordability. If the investor availing himself of all available investment subsidies cannot establish a commercially viable operation from the tariff revenue, the national lifeline rate will prevent projects from being implemented.

Yet, if the ERC adopts varying levels of lifeline rates, the outcome of the ERC setting the highest lifeline rates for franchises located in the poorest areas of the country will lead to political outcry of social injustice! This is not an issue now, because the different levels of lifeline rates are the result of decentralized decision taking. But it will become an issue once decisions are taken at central level. The ERC will be asked to justify its principles for fixing the rate. If the answer is that local conditions differ, the logical follow up question is why, in that case, decision on tariff setting has to be taken at central level?

Finally, unless it is impossible to claim that “lifeline consumers” are a “class of consumers”, or unless the lifeline rate is time bound for three years, function (i) in section 30 may contradict the text written to describe function:

“(c) Determine the level of cross subsidies in the existing retail rate until the same is removed pursuant to Section 56 hereof;”

“And Sect. 56 Removal of Cross Subsidy. Cross-subsidies between islands, regions and/or classes of consumers shall be phased out within a period not exceeding three years from the imposition of the EIRC except as otherwise provided herein.”

Recommendation:

It is more constructive and operational in the Bill to state that:

(i) the objective of the lifeline tariff is to make access to a minimum lifeline level of electricity consumption affordable for the poorest households in the franchise

(ii) the ERC as part of its tariff approval procedure verifies that the utility implements a socially balanced household tariff policy, which allows the 100% connection rate target in the franchise area to be reached.
5 FINANCING MECHANISMS FOR RENEWABLE ENERGY

5.1 Introduction

The title of the presentation “Financing Mechanisms for Renewable Energy” can be interpreted in the broad sense of covering the financing of:

1) R&D (research & development) on renewable energy technologies;
2) information and education campaigns to increase awareness of renewable energy technology performance, availability and incentives;
3) investment in renewable energy technologies by energy producers and final consumers.

This presentation covers the third subject. The focus is on the financing of renewable energy technologies by producers selling electricity to the public transmission and distribution grid. The paper presents the most important conclusions from the international experience of schemes to finance renewable energy technologies other than large/medium scale hydropower plants.

Since wind energy is the most important modern renewable energy technology (not including hydro power) with about 6500 MW installed mid-1997 (in 1997 about 1000 MW will be added as against about 100 MW for PV-systems), most examples refer to the financing of wind farms.

A short comment is given at the end about the marketing of stand alone PV systems in rural areas where the villages are not yet connected to the grid.

13 Presentation at China – European Union Renewable Energy Technology Conference Beijing, September 18-19, 1997
5.2 The issues

In the new world of border-free movement of capital, finance for investments is freely available. Under proper national framework conditions, any profitable project will be able to find a source of finance. The job of Governments is to establish such a framework.

Finance for investments in infrastructure projects is given in the form of “balance sheet financing” and in the form of “project financing”. Both forms require that the project proposed for financing is profitable. The difference is the security that is offered to the lender. In balance sheet finance, the lender relies on the overall financial position of the lender (e.g. a national or regional power company) to repay the loan. In project finance, the loan is given to the specific project company that is set up and the lender relies on the cash flow of the project for repayment of the loan.

For various reasons, IPPs (independent power producers) have a dominant position when it comes to using renewable energy. Their projects depend on project financing. Therefore, Governments wishing to promote the use of renewable energy must establish an institutional and regulatory framework that facilitates project financing. The framework must fulfil two basic requirements:

- First of all, the framework must provide IPPs with access to the grid. National energy laws must allow IPPs to set up renewable energy systems and sell their generated power to the national and regional power companies. The key question for grid access is whether IPPs should have unlimited access to sell their output to the grid operator, or whether limits to either annual capacity additions or to total installed capacity should be imposed. The answer depends on the balance between, on the one hand, the Government’s wish to promote renewable energy, and, on the other hand, its wish to keep down the cost of subsidies.

- Secondly, renewable energy systems have higher costs of production per kWh than thermal power plants. The difference in cost has to be subsidised in order to make the investment in the renewable energy system commercially viable for the IPPs. The key issue for subsidies is whether the cost of the subsidy should be born by tax payers or by electricity consumers.

The approaches used by the leading countries in the field of renewable energy are summarised below. In all countries a mix of measures is used. In none of the countries, attempts have been made to “optimise” the mix of instruments. The policy mix is a result of improvisations to developments in the market and to changing shifts in policy priorities. Due to this, the market development of renewable energy technologies in all countries during the 1980s and 1990s has been irregular, with annual peaks and troughs.
5.3 Available financing mechanisms and instruments

5.3.1 Approaches

The two basic financing mechanisms – tax payer or consumer – have each a number of instruments available. One general avenue is to subsidize the cost of investment. The other is to subsidize the price of the output.

5.3.2 Tax payer pays subsidy instruments

Strategies that rely on the tax payer to subsidise renewable energy systems use the following instruments:

- **Capital subsidies.** Renewable energy is capital intensive, whereas operating costs (except in systems using biomass) are low. State subsidies to purchasers of renewable energy equipment are therefore an efficient means to make investments in renewable energy commercially viable for IPPs. The instrument is typically used, when Governments want to jump start a development. In the Netherlands, until 1995, investors in wind farms were given a 30% subsidy; in Denmark until the mid-1980s. In Spain, investment subsidies of up to 40% can be given to the investment in renewable energy. However, wind farms must be no larger than 20 MW each; and the subsidy limit is ESP 400 million (US$ 2.8 million). Some of the German “Länder” give a capital subsidy of up to 8% to wind energy projects.

- **Soft loans.** In Germany, investors in wind farms can obtain 10-year loans at a rate of interest of 4.75%.

- **Tax exemptions / tax rebates.** Tax breaks can be used either to reduce the cost of the investment (the first three below) or to increase the net revenue after taxes from the sales of the output (the last item below). Examples are:
  - exemption from payment of VAT on renewable energy equipment
  - exemption from import duties for renewable energy technologies
  - accelerated tax deductions for investments in renewable energy,
  - tax breaks on returns from investments in environmentally sound initiatives.

In India, the VAT on renewable energy equipment is lower than the normal rate. In China, the imports of renewable energy technologies used to be exempt from payment of import duty; in India this is the case for renewable energy technologies not produced in India. In India, an investor can deduct 100% of the cost of investment in a wind farm from his taxable income in the same year from other activities provided the wind farm is set up before September 1 in a given year. Otherwise he can deduct 50% the first year and 50% the next year. In the Netherlands, such investments can be written off against tax at any time – a scheme, which is particularly attractive to firms with fluctuating incomes. In Navarra, Spain, wind power investors can deduct up to 15% of their earnings from wind power before handing in their tax returns. In Denmark, a wind turbine owner does not have to pay taxes on the level of production, which equals his annual power consumption. Similar tax breaks exist in the Netherlands.
Top-up premium payments per kWh are paid by the state budget to producers making use of renewable energy. In Denmark, IPPs and utility companies are paid a so-called CO₂ premium of 0.1 DKK/kWh (≈1.5 US-cents) for power produced on the basis of renewable energy. IPPs, are paid an additional premium of 0.17 DKK/kWh (≈2.5 US-cents). The power utilities are obliged to pay IPPs a tariff equal to the avoided cost of production (around 4.3 US-cents).

A kWh premium is paid to electricity consumers that purchase “green energy” from their power companies. This procedure does not yet seem to be used in any country. But it could be a powerful tool to stimulate the development of a market for green energy.

Lower VAT on power produced by renewable energy. In the Netherlands, the government is set to reduce the rate of VAT on green energy to 6% compared to the normal rate of 17.5% for conventional energy. This permits renewable energy producers to raise their prices net of VAT, and still be competitive in the eyes of the final private consumers, who cannot deduct VAT payments.

Export subsidies to exporters of renewable energy technology. The Netherlands has a generous programme in place to subsidise exports of renewable energy technologies to non-OECD countries. The belief is that a larger market for national producers will reduce the cost of production due to economies of scale. Between 1993 and 1996, the German programme Eldorado paid 70% of the list price of wind farms in a number of developing countries.

5.3.3 Consumer pays instruments

Financing mechanisms that rely on electricity consumers to pay the subsidy have the following instruments at their disposal:

Premium rates are paid by utilities to IPPs for electricity produced on the basis of renewable energy. These premium rates are guaranteed over a number of years. In Germany, the “Electricity Feed Law” requires regional power distribution companies to pay renewable electricity generators up to 90% of the average price of power to the end-consumer. Presently, this gives a price of DEM 0.175/kWh (≈ US$ 0.097). In the Netherlands, the national tariff for all projects smaller than 2 MW is NLG 0.163/kWh (≈US$ 0.091). In Denmark, utilities are required to pay an “avoided cost tariff”, which is set generously to DKK 0.29 (≈US$ 0.043).

Cost of connection and of grid reinforcement are born mainly by the regional power utility. In Denmark, Government regulations set limits below cost to the charges which power utilities can impose on IPPs for grid connection.

Eco-taxes / green taxes are imposed on non-renewable forms of energy to reduce the gap in the market prices of renewable and non-renewable forms of energy. This approach intends to “internalise” the “external” costs of non-renewable energy (the cost of environmental damages) into its market price. Such taxes are applied in Denmark and in the Netherlands and are contemplated in Germany. The problem with such taxes is that energy intensive industries must be exempted to
avoid their bankruptcy due to competing imports from countries that do not impose green taxation on their manufacturers.

- **“Green pricing” of electricity.** Electricity produced by renewable energy is priced higher (at the level of its cost of production) than electricity produced by thermal power plants. It is marketed and sold to consumers who are willing to pay a premium price for electricity produced by environmentally friendly sources of energy. Examples are found in Sweden, the Netherlands and the USA. From the beginning of 1998, the firm “Automated Power Exchange” in Los Altos will start to operate a “green power exchange market”. One problem with green pricing of electricity is that it only provides a marginal market penetration of renewable energy. Experience shows that only 3-5% of consumers will be willing to sign up to such a scheme. Another problem is risk sharing. Green pricing, which takes advantage of electric customers’ willingness to pay a premium price for a “green” energy supply, has a risky financing side due to fluctuating customer participation rates. A customer may sign up one year and leave the next. The power company, however, is stuck with long-term supply contracts which it has signed with the project developers. The most widely used financing program today is “sustained participation”, where green marketers rely on long term funding commitments from customers. Requiring longer-term customer contracts or beefing up corporate financing reduces the risk in this type of financing. Another possibility is to make use of short term customer programs. An “annual participation” plan could pay for a new renewable energy facility without committing any funds beyond those specifically collected under a green pricing program. Each customer’s yearly contribution pays fully for the lifetime cost premium of the renewable resource. A final design challenge is that the implementation of a green pricing program requires the establishment of a widely recognized and respected auditing and certification system to let consumers know what they are buying.
5.4 Approaches to burden sharing in “electricity consumer pays” strategies

An issue in the “electricity consumer pays” strategy is how to distribute the extra cost associated with renewable energy use among the regional and local utilities on an equitable basis. Three approaches are seen:

- The German Electricity Feed Law obliges the regional distribution companies to purchase any amount of power, which is produced by the wind farms located in its concession area. Since wind resources are unevenly distributed, some regional companies have a “high” rate of wind energy penetration, others a low rate. The law, therefore, contains a so-called “hardship clause”, which allows utilities in supply areas with many wind farms to pass on the costs of their premium payments to wind power to their holding companies. It is proposed that once wind energy has reached a 5% penetration in a regional power utility, the extra cost of the next 5% can be passed on to the neighbouring utility, and so on.

- Another possibility is to let the system operator (either the operator of the power pool or of the transmission system) charge a levy on all traded / transported electricity. The revenue from this levy is then used to subsidise new investments in renewable energy via a tender system (the British NFFO approach), or to compensate the different distribution companies for the extra-cost of their renewable energy purchase obligations (the Danish “public service obligation”, PSO, approach). Under the Danish “PSO approach”, the energy law provides economic protection to renewable energy and CHP plants. The operation of these plants is declared a PSO, and the production of the plants gets priority in load scheduling and at favourable tariffs. To provide a market outlet for this privileged electricity, all direct consumers and power companies are obliged to buy a certain percentage of their purchases from renewable energy.

- A third possibility is to impose a “purchase or pay” obligation on all electricity companies. Each distribution company must purchase renewable energy amounting to a defined percentage of total electricity purchases. It can do so directly from renewable energy producers; or purchase a “tradable renewable electricity quota” from distribution companies that have purchased renewable energy above the minimum percentage requirement.

5.5 Evaluation of the sustainability of the financing mechanisms

5.5.1 Timing

For different stages of the technology introduction cycle, a different package of subsidy instruments is needed. A “tax payer pays” based strategy is useful in the short term to get a development process started. The “electricity consumer pays” strategy is the solution in the long run, tax based financing would become too expensive.
5.5.2 Incentive impact

When it comes to investment subsidies, experience shows that a direct capital subsidy has a stronger incentive effect on purchases than tax rebates having the same subsidy value. The monetary value of direct capital subsidies is more transparent. (Also this rule has its exceptions, as we shall see in the case of India). The lack of transparency, however, makes it attractive to politicians, as the impact of tax rebates on the state budget is more hidden. Another advantage is the avoidance of a need to set up a separate bureaucracy for the administration of the subsidy payments.

5.5.3 Maintaining the momentum

All active countries have experienced ups and downs in their promotion efforts of renewable energy. But two cases stand out as the extremes: California and India.

California experienced a wind energy boom during the early 1980s when very favourable power-purchase obligations for production from IPPs using renewable energy were imposed on the power utilities. The tariffs during a 10 year period were based on the “avoided cost” principle of pricing. The 10-year tariffs were indexed, and as expectations were that the prices of fossil fuels would continue to increase the agreed tariffs followed an upward trend. After the ten years, the tariffs were to fall down to the avoided marginal cost of production of thermal power. The sharp drop in tariffs at the end of the 10 years period gives a low market value to the wind turbines for the rest of their estimated 20 years lifetime. Many turbines were taken down and shipped abroad to wind farms in India and other countries, where obligatory power purchase tariffs were higher. During 1997, the installed wind farm capacity in the USA fell.

Due to the tight regulation of the national credit market in India, credits are scarce. Liquidity, therefore, has a high value. Under these conditions, the 100% tax write off on wind farm investments against other income, coupled with the availability of specialised credits for wind farms proved to be very attractive to Indian industrial companies. The belief was that the liquidity from the tax savings could be used in the other core activities. Based on the feasibility studies, it was believed, that the wind farm itself would be self-sustainable financially during the first 7-10 years of its operation. At the end of that period, the loans had been repaid, and the wind farm would generate surplus cash during the rest of its lifetime. As a general rule, however, the wind resources and the local grid connections were not sufficiently well investigated; and, invariably, the annual generation of electricity was below the expected level. Instead of being financially self-sustainable, many wind farms turned out to be a drain on financial resources of the company until the loans had been repaid. The outbreak of a financial crisis in India in late 1996, led to a general drop in investments; and the wind farm market collapsed. Even after credit conditions improved, the market for wind turbines did not improve. Investors had lost faith in wind energy.
5.6 Matching length of finance to lifetime of investment

The breakdown of Germany’s Federal Economy Ministry of the costs of wind generation for wind parks and individual turbines over depreciation periods of 10, 15 and 20 years resulted in generation costs per kWh during the write off period of 15.9 Pf ($0.093), 13.4 and 11.8 Pf. Respectively. All of these costs were lower than the current EFL premium of 17.2 Pf/kWh.

5.7 Green banks

A financing mechanism, which relies on neither the government nor on the electricity consumers to pay the bill, is the creation of “green banks”:  
- Triodos Bank a Dutch/British joint venture (the ethical bank that runs the Wind Fund) is the UK’s only social and environmental bank. It has launched a “green savings account” in the UK with the Friends of the Earth (FOE). The new Earth Saver Account for investments in small renewable energy projects allows investors to combat climate change by directing savings to renewables and conservation. It offers investors interest rates up to 5.5% yearly.
- In the Netherlands, the prospect of income tax exemption for returns on capital placed in environmentally friendly investments funds set up by Dutch banks has proved so attractive to Dutch savers that the amount of capital available now exceeds the number of qualifying projects.
# Subsidy Instruments for Market Penetration

<table>
<thead>
<tr>
<th>Subsidy Targets \ Financing Mechanisms</th>
<th>Cost of investment</th>
<th>Price of output</th>
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| Tax payer pays                        | • direct capital subsidies  
• soft loans  
• VAT exemption  
• Import duty exemption  
• Accelerated depreciation  
• Subsidies to exporters of equipment  
• Subsidies to R&D&D | • top-up premiums to producers  
• top-up premiums to consumers  
• VAT/excise duty exemptions | |
| Consumer pays                         | • Major share of connection costs of wind farm to grid paid by utility  
• Local grid reinforcement paid by utilities  
• Feeder line from wind farm to nearest transformer station paid by utility | • Premium rates paid by utilities  
• Green tariffs  
• Eco-taxes on alternative fuels  
• Obligatory quotas for share of electricity produced by renewables | |