IMPLEMENTATION PACKAGE FOR LARGE-SCALE DISSEMINATION OF SOLAR WATER HEATERS

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SOLAR WATER HEATERS

- **USE ENERGY FROM THE SUN TO HEAT WATER**
- **HOT WATER STORED AT 60^{O}C TO 200^{O}C, DEPENDING UPON DESIGN**
- **HOT WATER AVAILABLE FOR ABOUT 300 DAYS/YEAR**
- **INDUSTRIAL, COMMERCIAL AND DOMESTIC APPLICATIONS**

SWHs: CONSUMER'S VIEWPOINT

- **SWHs PROVIDE HOT WATER FOR ABOUT 300 DAYS IN A YEAR**
- **THEY REQUIRE LITTLE OR NO ATTENTION DURING OPERATION**
- **THEY SAVE ELECTRICAL ENERGY**
- **THEY SAVE INTERIOR SPACE (SINCE THEY CAN BE LOCATED ON ROOFTOPS)**
- **THEY ELIMINATE ACCIDENTS IN BATHROOMS**

SWHs: POWER PRODUCER'S VIEWPOINT

- SWHs SAVE POWER
- THEY AVOID INVESTMENT IN NEW GENERATION CAPACITY CORRESPONDING TO SAVED POWER

SWHs: ELECTRICITY DISTRIBUTOR'S VIEWPOINT

- SWHs SAVE ENERGY
- SAVED ENERGY CAN BE DIVERTED TO MORE PROFITABLE CONSUMER CATEGORIES

SWHs: SOCIETY'S VIEWPOINT

- SWHs SAVE FOSSIL FUELS FOR ELECTRICITY GENERATION
- THEY SAVE FIREWOOD, COAL, FURNACE OIL, ETC., USED IN BOILERS
- THEY REDUCE DAMAGE TO THE ENVIRONMENT

PASSIVE DIRECT SWHs

- THERMOSIPHON/NATURAL CONVECTION PRINCIPLE (HOT WATER RISES, COLD WATER SINKS)
- COLLECTOR ASSEMBLY CONSISTS OF BLACK ABSORBER CONNECTED TO TUBES
- WATER IN TUBES IS HEATED BY SOLAR ENERGY

PASSIVE DIRECT SWHs

- **HEATED WATER RISES DUE TO CONVECTION TO A STORAGE TANK**
- **DISPLACED COLD WATER DESCENDS INTO THE COLLECTOR**
- **HOT WATER STORED IN A STORAGE TANK**
- **HOT WATER CAN BE DRAWN FOR VARIOUS USES**

OTHER TYPES OF SWHs

- ***ACTIVE SWHs*** -- MOTOR IS USED TO TRANSFER THE WORKING FLUID BETWEEN THE COLLECTOR AND STORAGE TANK

OTHER TYPES OF SWHs

- ***INDIRECT SWHs*** -- WORKING FLUID (WHICH MAY BE WATER) IS USED TO COLLECT HEAT WHICH IS THEN TRANSFERRED TO FLUID THAT HAS TO BE HEATED (E.G., MILK)

OTHER TYPES OF SWHs

- **FLAT-PLATE COLLECTORS VS CONCENTRATORS**
- **EVACUATED TUBE COLLECTORS**

POTENTIAL DEMAND FOR SWHs

- INDUSTRY (THERMAL OPERATIONS BELOW 200^{O}C -- DAIRIES, FOOD-PROCESSING, ETC..)
- COMMERCIAL ESTABLISHMENTS (CANTEENS, HOSPITALS, HOTELS, ETC..)
- INDIVIDUAL HOUSES/APARTMENTS

POTENTIAL DEMAND FOR SWHs

- TOTAL POTENTIAL DEMAND IN INDIA IN 1997: ABOUT 260 SQUARE KM OF COLLECTOR AREA
- TOTAL COLLECTOR AREA IN USE IN 1997: ABOUT 0.3 SQUARE KM
- POTENTIAL ~ 860 TIMES CURRENT USE

GENERAL REQUIREMENTS FOR SWH INSTALLATION

- 1.6 M^2 COLLECTOR AREA WILL HEAT ABOUT 100 LITRES WATER PER DAY (LPD) TO ~ 60^0C
- SHADOW-FREE ROOF OF 3 M^2 AREA SUPPORTING ~ 200 KG OF STATIC LOAD FOR A 100 LPD SYSTEM

GENERAL REQUIREMENTS FOR SWH INSTALLATION

- PIPED WATER WITH 2 M HEAD
- DRAIN PLUG, AIR VENT, SUPPORTS, PIPING
- ELECTRICITY SUPPLY FOR BACK-UP HEATER

ECONOMICS OF SWHs

- **100 LPD DOMESTIC SWH -> RS.11,400 (1999 RS.) + ~ RS.1,500 PIPING, ETC.**
- **LIFE-CYCLE COST OF SAVED ENERGY:**
  - **RS. 1.56/kWh AT POINT OF END-USE**
  - **RS. 1.27/kWh AT GENERATION POINT**
- **LIFE-CYCLE COST OF SAVED POWER: RS. 3,131/kW**

ECONOMICS OF SWH PURCHASED AS ADD-ON TO EXISTING GEYSER

- SIMPLE PAYBACK PERIOD FOR CONSUMER: 5.17 YEARS
- ELECTRICITY DISTRIBUTOR CAN GAIN NET REVENUE OF RS. 2,835/ SWH/ YEAR BY SELLING SAVED DOMESTIC ENERGY TO COMMERCIAL CONSUMERS

ECONOMICS OF SWH PURCHASED INSTEAD OF NEW GEYSER

- **SIMPLE PAYBACK PERIOD FOR CONSUMER: 3.58 YEARS**
- **POWER PRODUCER AVOIDS NEW GENERATION OF 0.8 kW/SWH IF CONSUMER**
  - **REDUCES CONNECTED LOAD BY 2KW**
  - **USES LOW-WATTAGE BACKUP HEATER (300W) IN SWH**
  - **OPERATES AT 0.4 DIVERSITY FACTOR**

ECONOMICS OF SWHs BASED ON FUTURE COSTING

- **MATERIAL OPTIMIZATION + BARREL TECHNOLOGY FOR TANK CAN REDUCE PRICE TO RS. 9,635 FOR 100 LPD SYSTEM**
- **IMPROVED MANUFACTURING PRACTICE + ECONOMY OF SCALE (PRODUCTION OF 20,000 UNITS/YEAR) WILL REDUCE PRICE TO RS. 6,500 FOR 100 LPD SYSTEM**

SCHEME I FOR LARGE-SCALE DISSEMINATION

- **TARGET GROUP: DOMESTIC CONSUMERS WITH EXISTING EWHs**
- **ELECTRICITY DISTRIBUTOR DIVERTS SAVED ENERGY TO HIGHER-PAYING COMMERCIAL CONSUMERS**
- **REPAYMENT OF LOAN FOR SWH COLLECTED THROUGH ELECTRICITY BILL**

SCHEME I FOR LARGE-SCALE DISSEMINATION

- **NET REVENUES TO ELECTRICITY DISTRIBUTOR: RS.2,835/SWH/YEAR**
- **PV OF NET REVENUES OVER 20 YEARS (TARGETING 50% OF 1998 AEH CONSUMERS BY 2018): RS. 4,471 MILLION**

SCHEME II FOR LARGE-SCALE DISSEMINATION

- **TARGET GROUP: DOMESTIC CONSUMERS CHOOSING BETWEEN SWHs AND EWHs**
- **POWER PRODUCER PROVIDES INCENTIVE TO REDUCE CONNECTED LOAD BY 2 kW/CONNECTION WITH SWH PURCHASE**
- **THUS AVOIDS 0.8 kW/SWH NEW GENERATION**
- **821 MW OF NEW CAPACITY AVOIDED OVER 20 YEARS (TARGETING 50% OF NEW AEH APPLICANTS BY 2018)**

FEATURES COMMON TO BOTH SCHEMES

- **FINANCING FROM BANKS/IREDA FOR SWH MANUFACTURERS**
- **ELECTRICITY DISTRIBUTOR'S PENALTIES/ INCENTIVES BY TO ASSURE MARKET TO SWH MANUFACTURERS**

FEATURES COMMON TO BOTH SCHEMES

- **SWH CONTRACTORS AS INTERMEDIARIES TO PROVIDE CONCESSIONARY LOANS AND OTHER SERVICES TO CONSUMERS**
- **INSTITUTIONS, TRAINING, MANAGEMENT, POLICIES TO PROMOTE SWH SALES**

INSTITUTIONS

- **RELEVANT GOVERNMENT DEPARTMENTS (DOE, HUD, BCC, ETC.)**
- **POWER PRODUCER(S), ELECTRICITY DISTRIBUTOR(S)**
- **PROMOTIONAL AGENCY (KREDL)**
- **MANUFACTURER'S ASSOCIATION**
- **FINANCIAL INSTITUTIONS**
- **TECHNICAL SUPPORT ORGANIZATIONS**
- **TRAINING CENTRES**
- **CONSUMER FORUM**

TRAINING

- **MANUFACTURERS**
- **BUILDERS/ARCHITECTS**
- **SERVICE CONTRACTORS**
- **CONSUMERS**

QUALITY CONTROL FROM PRODUCT TO PERFORMANCE

- **OVERNIGHT COOLING MUST NOT BE > $5^{O}C$**
- **AVERAGE OF 300 DAYS IN A YEAR WITHOUT ELECTRICAL BACK-UP**
- **LEAK-PROOF**
- **GUARANTEED SYSTEM LIFE FOR 20 YEARS**

WINNERS

- **CONSUMERS**
- **ELECTRICITY DISTRIBUTOR**
- **MANUFACTURERS OF SWHs, SWH MATERIALS, SELECTIVE COATING EQUIPMENT, INSULATION, ETC..**
- **POWER PRODUCER**
- **ENERGY CONSULTANTS**
- **SOCIETY**

LOSERS

- **POWER PRODUCER IF IT HAS SURPLUS GENERATING CAPACITY**
- **ELECTRICITY DISTRIBUTOR IF ABSOLUTE REDUCTION IN DEMAND + DEEMED OFFTAKE FROM IPPs**
- **GEYSER/BOILER MANUFACTURERS IF NO DIVERSIFICATION TO BACK-UP ELECTRICAL HEATERS/OTHER SWH COMPONENTS**

BARRIERS AND SOLUTIONS

- **WRONG PRICES (= PRICES THAT DON'T REFLECT COSTS)**
- **SOLUTION -- *"GET THE PRICES RIGHT AND ENCOURAGE EFFICIENCY!"***
- **BUT HOW TO GET THE PRICES RIGHT?**
- **AND RIGHT PRICES ARE NOT A SUFFICIENT CONDITION BECAUSE THERE ARE NON-PRICE FACTORS**

BARRIERS AND SOLUTIONS

- **CUSTOMERS CAN AFFORD OPERATING COSTS BUT NOT FIRST-COST**
- **SOLUTION --** ***FINANCING/LEASING (NOT SUBSIDIES!)***

BARRIERS AND SOLUTIONS

- **LACK OF AWARENESS**
- **SOLUTION --** ***INFORMATION AND TRAINING***

BARRIERS AND SOLUTIONS

- **NON-AVAILABILITY OF SYSTEM**
- **CAN YOU PHONE AND GET A SWH AS YOU CAN AN ELECTRIC GEYSER?**
- **SOLUTION -- *COMPLETE HARDWARE + "SOFTWARE" PACKAGE SOLD BY CONTRACTORS/SERVICE COMPANIES***

BARRIERS AND SOLUTIONS

- **LACK OF LEGAL & POLICY ENVIRONMENT**
- **SOLUTION -- *ENABLING CODES, LAWS AND POLICIES***

BARRIERS AND SOLUTIONS

- **SUPPLY BIAS OF UTILITIES AND GOVERNMENT**
- **SOLUTION -- *DECISION-MAKERS MUST BE SENSITIZED TO EFFICIENCY IMPROVEMENTS & ALTERNATIVE SOURCES AS VALID WAYS OF PROVIDING ENERGY SERVICES***

RECOMMENDATIONS

GRID CODE/ELECTRICITY SUPPLY REGULATIONS

- **UP TO 1 kW AT NORMAL TARIFF IN NEW DOMESTIC CONNECTIONS**
- **ADDITIONAL LOAD AT HIGHER TARIFF**
- **DUAL CAPACITY METERING REQUIRED**

GRID CODE/ELECTRICITY SUPPLY REGULATIONS

- **INCENTIVES (E.G., TARIFF REDUCTION) FOR SWH USERS WHO FORGO HIGHER CONNECTED LOAD (AEH)**

GRID CODE/ELECTRICITY SUPPLY REGULATIONS

- **MAKE SWH INSTALLATION COMPULSORY FOR NEW CONNECTIONS TO NEW HOUSES/ BUILDINGS**
- **IN EXCEPTIONAL CASES WHERE SWHs NOT POSSIBLE, MAKE LOW WATTAGE (300 TO 500 W) COMPULSORY**

GRID CODE/ELECTRICITY SUPPLY REGULATIONS

- **GOVERNMENT BUILDINGS**
- **NEW HOTEL AND TOURIST PERMITS**
- **INDUSTRIES USING COAL**

GRID CODE/ELECTRICITY SUPPLY REGULATIONS

- **ENABLE SWH LOAN REPAYMENT THROUGH ELECTRICITY BILL**
- **TRANSFER THIS PAYMENT (LESS SERVICE CHARGE) TO SWH CONTRACTOR OR BANK**

PUBLICITY

- **MASS CAMPAIGN FOR SWH USE VIA PRINT & ELECTRONIC MEDIA**
- **EMPOWER EXISTING AGENCIES (OR SET UP NEW AGENCIES) TO ENSURE SWH QUALITY CONTROL, PERFORMANCE STANDARDS, TRAINING, ENFORCEMENT, INFORMATION AND PUBLICITY**

MANUFACTURING

- **PROMOTE INVESTMENT IN MASS MANUFACTURING OF SWH**
- **TO REDUCE CAPACITY TARGET**
- **AS SUPPLEMENT TO EXPANSION OF NEW CAPACITY TO BRIDGE SUPPLY-DEMAND GAP**

FISCAL MEASURES: TAX BENEFITS

- **FOR CONSUMERS, MANUFACTURERS, DISTRIBUTORS AND SERVICE AGENCIES**
- **ACCELERATED DEPRECIATION / TAX REBATES**

GOVERNMENT-SPONSORED TASK FORCE/ COORDINATION COMMITTEE

- **TO PROMOTE LARGE-SCALE DISSEMINATION OF SWHs IN KARNATAKA**
- **REPRESENTATION FROM DOE, KPTCL, KPCL, KREDL, ETC.**

BUILDINGS-RELATED MEASURES

- **ENACT BUILDING BYLAWS/CODES TO MAKE SWH INSTALLATION COMPULSORY BY DEFINITE DATE EXCEPT WHERE IMPOSSIBLE**
- **MAKE SWHs MANDATORY IN NEW DWELLINGS AND IN COMMERCIAL ESTABLISHMENTS WHERE HOT WATER USE IS ENVISAGED**

ISRAEL LAW

- **“NO NEW BUILDING IN WHICH THERE IS A SYSTEM OF INSTALLATIONS FOR SUPPLYING HOT WATER SHALL BE BUILT UNLESS THE SYSTEM IS A SOLAR INSTALLATION”**