

Solar Technology and Sustainable Development: Building on the Solar Dynamics Experience

BARBADOS

Introduction

Can renewable energy be made profitable? The pioneers of the solar water heating industry in Barbados based their development of this innovative technology on a market survey funded by the Goddards Group in the early 1970's. Today, solar energy has emerged as the main form of renewable energy in use in the country. This is so, primarily because of the extensive adoption of domestic solar water heating technology.

Background

Although Barbadians, Hoad and Sinson had built individual solar water heating units, a commercial unit was produced in Barbados nearly 10 years later after a unit based on a 1964 design was introduced by the Brace Institute. This project was conducted with church members in the Emmerton Lane district of the capital, Bridgetown, spearheaded by an Anglican cleric, then a senior

officer of CADEC (Christian Action for the Development of the Caribbean).

The Initial effort saw the emergence of a small group of entrepreneurs simply following that 1964 design. However, this solar water heating unit, like many other early ones which immediately followed, did not quite meet the requirements and expectations of homeowners, in terms of performance and appearance. Beyond the need to overcome the mistrust of a new and untried product, and to incorporate mechanisms to compensate for the occasional lack of sunshine or overcast conditions, there were the technical issues to be settled such as the placement of the storage tank.

One of three indigenous companies associated with the phenomenal growth of the solar water heating industry in Barbados is Solar Dynamics Ltd. From the outset, Solar Dynamics which started manufacturing solar water heaters from as early as 1973, was challenged to develop a solar water

heating unit to meet the requirements and expectations of homeowners, in terms of performance and appearance. In this regard, a model domestic solar water heating unit would be able to deliver:

1. Water at approximately 135° F.
2. Cope with the salt air, which is a component of the moisture content of prevailing winds over the island.
3. Tolerate the calcium-laden hard water of Barbados.
4. Withstand hurricane conditions.
5. Compensate for the occasional lack of sunshine or overcast conditions and be aesthetically pleasing.

As with most entrepreneurial start-up initiatives, the local banking industry was reluctant to invest in the manufacture of such a new and untried product. This is where the collaborative efforts of local institutions such as the Barbados Institute of Management and Productivity (BIMAP) and the Christian Action for the Development of the Caribbean (CADEC) played a crucial role. The financial support came in the form of Canadian funds through BIMAP and US\$4,200.00 from CADEC.

Product Development, Promotion and Marketing Strategies

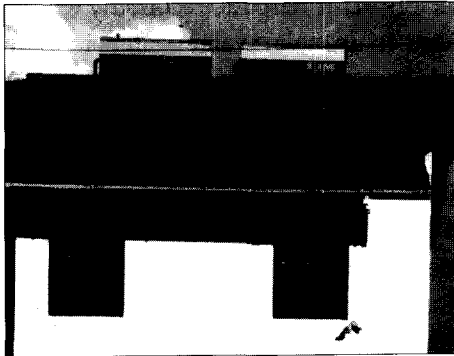
Production Development

Solar Dynamics as the market leader has been one of the companies in the forefront of the promotional activities associated with renewable energy on the island. It involved itself in prudent research and development activity, using advanced methods and new materials in the construction of solar collector panels and storage tanks.

Significant innovations included the following: the use of glass with a greater heat tolerance in the construction of solar panels; improved welding techniques for a more professional finish; improvements in the flow pattern of water through the solar collectors with larger headers to facilitate the calcium build up and prolong collector life; the provision of different tank sizes and collector combinations to match end-user hot water demand preferences; improved modular component designs (reducing the number of parts to be fitted together) so as to expedite installation time; and product standardization to guarantee the desired output temperature on hot water emerging from its systems.

Promotion and Marketing Strategies

The company also supported the government's promotion of renewable energy. It participated in seminars, workshops and exhibitions dealing with the latest advancements in manufacturing and installation techniques, regarding both the domestic and commercial units (particularly for the hotel industry - a major user of energy). Associated with those activities too, were video recordings of "success stories" demonstrating tangible energy and operating cost savings with the application of solar water heating technology to buildings, including many in the hotel sector.



A solar water heating storage tank on roof tops

Government Incentives

Solar Dynamics could not have succeeded without the particular involvement and participation of the Government of Barbados.

Significantly, Solar Dynamics Ltd. was a beneficiary of a government in-

dustrialization incentives policy to local manufacturers, in its thrust for greater economic development of the country. This policy which granted "Approved Enterprise Status" under the Fiscal Incentives Act of 1974, enabled the company to benefit from import preferences and tax holidays. In addition, governments since 1980, have sought actively to promote the competitiveness of solar water heaters, by placing a 50% consumption tax on imported gas and electric units. This was coupled with a further inducement to consumers: except for a break in 1993, solar water heater and installation costs were made fully tax deductible.

Buttressed by easy hire purchase credit arrangements through partnerships with department and consumer appliance stores, the just-mentioned factors together not only gave the solar water heating product prestige and influence, but they also signaled the importance of the industry to the rest of the economy. This allowed Solar Dynamics Ltd. from its early and humble beginnings in the 1970's, to grow and become a model of private sector and indigenous entrepreneurship in the 1990's.

The Challenges Caused by Structural Adjustment in the Domestic Economy

Yet, these fiscal incentives were soon challenged. In 1985, the system of

incentives to the solar water heating industry came under close scrutiny by the Ministry of Finance in Barbados, because of the structural adjustment difficulties then facing the country, brought on by second world oil price shock. Under a World Bank financed Energy Conservation Project, and its outgrowth — the Barbados Energy Awareness Programme — the infant industry economic argument, though challenged, did leave the incentives in place. The consultancy report suggested that the benefits of the retention of the incentives far outweighed the loss of government revenue. Additionally, the report argued that although installation and system costs had a short payback period — approximately three years — the incentives should be kept in place to ensure the success of the fuel-switching and energy saving programme critical to the country's balance of payments position. With the threat of removal of the tax incentives having been withdrawn, Solar Dynamics as part of the wider solar water heating industry, thrived and continued to prosper.

In 1993, however, structural adjustment problems facing the economy, caused the suspension of many homeowner benefits. Withdrawn were the incentives on personal income tax, mortgages and home repairs and allowances for students studying overseas. All of this had a critical effect on the solar water heating industry, leading to a decline in

the number of solar water heaters purchased for that year. Thus, in 1996 when the Barbados government reconsidered the initiative, there was great relief in the industry and understandably so.

Achievements of Solar Dynamics

Setting Quality and Industry Standards

Increasing reliability, aesthetics and continuous improvement associated with each model placed on the market by the company, coupled with the government incentives and its own marketing thrust, ensured that nearly all sectors in the Barbados economy would come to use solar water heaters in their day-to-day operations. Households and hotels now use the units in their bath, kitchen and laundry areas. Units are also to be found in schools, and hospitals. Commercial, industrial and medium temperature usage has seen the units employed, to preheat water for more extreme temperature requirements.

Perhaps the main factors behind Solar Dynamic's achievements have been its relentless drive for product improvement, customer satisfaction and recourse. Solar Dynamics was the first company in the local industry to guarantee a certain output temperature on hot water emerging from its systems. That level of standardization and

reliability rendered its units suitable for preheating purposes in the manufacturing sector. The company significantly enhanced its after-sales service vis-a-vis the competition's, with a discount policy in place after the expiration of the normal three-year warranty period.

In 1974, twelve units were installed nationwide. The number of installations nationwide grew to twenty-one units in 1975. The gradual upward trend continued until 1979 when the number of systems installed jumped to five hundred and forty-five units. Overall, between 1974 and 1979, the solar water heating companies installed some nine hundred and sixty-nine units. In 1980, when tax incentives were introduced, some eight hundred and seventy-nine units were installed. The years 1981 and 1982, respectively saw the installation of eleven hundred and forty-three and twelve hundred and fifty-one solar water heating units. Some twenty-three thousand, three hundred and eighty-eight units were installed between 1974 and 1992. By 1997, more than thirty-one thousand units were installed in homes, hospitals (geriatric institutions), hotels, restaurants, guest houses, schools, commercial and industrial operations throughout Barbados.

As a consequence, the solar water heater industry in Barbados has emerged as the most developed in the region. According to a Barbados Ministry of Finance, Energy Division report, in the

Caribbean, Jamaica's solar water heating industry ranks second. The agency also reports that the installed systems in Barbados, have saved an estimated US\$2.7 million per year since 1992, with cumulative savings of US \$56 million at the end of 1997.

Marketing and Overseas Expansion

Improved Marketing Through Partnerships and Alliances

Solar Dynamics embarked on a combination of technology improvements, marketing initiatives and the creation of a distribution network to propel its growth and ensure its sustainability.

After the early successes, and faced with a seemingly tightening market domestically, Solar Dynamics changed its marketing thrust and aligned itself to leading distributors on the island: Modern Living®, Cave Shepherd®, Courts® and Home Centre®. Hire purchase rates of 12-15% by distributors, commercial banks, and credit unions, also helped to fuel the company's growth. (It is noteworthy that the distribution of hot water systems through Plantations Ltd., started in the late 1970's — even before the financial incentives were in place). The immediate impact was to give consumers even better hire purchase terms. In terms of sales, the third

ranking company followed by cornering other leading consumer product distributors on the island: Furniture Ltd.® Brankers, the Kingsley Store, and Courts Home Centre® (Oran Ltd.®). Beyond the recognition and acceptance accorded to Solar Dynamics' products, they were now being placed alongside imported electric and gas units. This served to increase further, the visibility and status of the company's water heating units. Yet, even today, the distribution ratio remains roughly 70:30. Some 70% of sales are conducted in-house for cash; the remaining 30% is shared between distributors.

Overseas Expansion

Today, the company's environmentally friendly and sun energy harvesting systems have also been installed in Antigua & Barbuda, the Bahamas, Belize, Grenada, Guyana, Jamaica, Montserrat, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, and in Trinidad & Tobago. The sustainable energy systems on sale in those countries, are particularly known for their non-polluting characteristics and for saving those countries substantial sums in foreign exchange. The alternative use of the resources has positive implications for the economic sustainability of those economies.

To benefit from the trade arrangements existing within the OECS countries,

Solar Dynamics sought and gained a foothold in the St. Lucian market through Solar Dynamics (St. Lucia) Ltd. in 1993. This represented a joint venture with Minvielle and Chastenet Ltd., a firm which originally sold units for Solar Dynamics in St. Lucia. Trading arrangements between this regional sub-grouping has allowed Solar Dynamics Ltd. to gain easier access into the markets of other OECS member states.

The company believes in consistent product quality wherever it is sold. A scarcity of technical skills in St. Lucia was supplemented by the transfer of personnel from Barbados in key areas of management, sales, and installation. Today the company is staffed by nationals of that country who have been taught successfully, the Solar Dynamics distinctive brand quality - the way the company does business.

The Industry's Impact on Energy Resources and Consumption

Domestic Energy Savings and Economic Impact

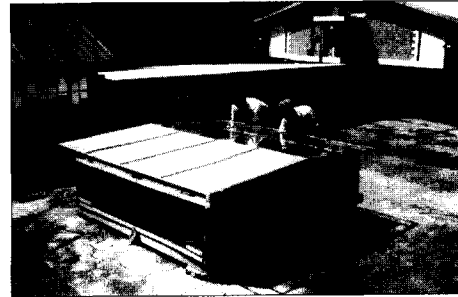
To date, the adoption rate for the installation of units with the construction of new buildings stands at 88%. With almost no operating costs, as compared with natural gas or electricity units, the payback on the capital outlay on most units is less than three years, with an estimated 30% return on investment (ROI) on the individual

units; a better rate of return than many financial investments available on the island.

The success of Solar Dynamics Ltd. has made the solar industry a shining example of the potential for renewable energy consumption and development on the island. A CEIS (Caribbean Energy Information Service) report in 1995 estimated that in 1974 when only twelve units were then installed, the use of solar energy from hot water systems represented less than 0.1% of the total electricity consumption for that year. This figure had increased to 2% by 1980 and to 7% by 1984. The use of solar water heaters by 1992 accounted for the energy equivalent of 15% of total electricity consumption on the island.

In financial terms, and using an energy cost of US\$0.13 per kilowatt hour, the savings emerging from industry performance are substantial. It has been estimated that the amount saved in 1974 was over US\$8.5 million. That figure increased to over US\$9 million by 1992, with an equivalent of over US\$50 million between the period 1974-1992. Stated differently, by 1992 the total installed tankage capacity in Barbados had reached more than 1.05 million gallons from 23,388 solar water heating units with accumulated financial savings of over US\$50 million. Industry watchers estimate that each solar water heater saves in electricity cost, the equivalent of US\$118 to US\$453 per year

(calculating assumptions vary considerably).



Solar drying treatment plant

While solar water heating is the most widely explored solar energy technology in Barbados, the success in this area has increased the attractiveness and spurred on experimentation in other renewable technologies such as the solar dryer. Today in Barbados, much of the R&D regarding alternative energy including the solar dryer is conducted by the University of the West Indies (UWI), Cave Hill campus with assistance from the private sector. The UWI commenced a two-year project in 1993, to design air-conditioning systems based on the desiccant-absorption cycle method. The focus of the work is the development of a low maintenance system particularly for areas where conventional energy for air-conditioning is not readily available.

Lessons Learned

The development of Solar Dynamics and the impact of the company on the economy has much to teach other countries wishing to embark on a similar exercise. For Barbados in particular, the developments revolving around the Solar Dynamics experience show that solar and other renewable energy forms have a potentially high contribution to make to the sustainable development of the region. An analysis of the Barbados experience would reveal the following:

- The solar water heating industry has saved the country a substantial amount in foreign exchange while contributing to the improvements in the health and hygiene standards of the country. The industry has also helped to cushion some of the adverse economic effects of the oil crisis, thus helping the country with its structural adjustment and balance of payments problems.
 - Environmentally, the industry uses a non-polluting and renewable form of sustainable and therefore very environmentally-friendly energy.
 - As to the wealth creation effects, for individuals it has provided to date, one of the highest rates of economic return on investment available on the island. Building on this, at the national level, the incremental individual savings have had a positive impact on the national economy.
- The operations of Solar Dynamics suggest that a uniform Caribbean-oriented company culture is possible. Beyond creating an acceptance for and generating confidence in alternative forms of energy, the entrepreneurial skills honed in making Solar Dynamics a major player in the solar industry are being used not only in Barbados, but to the benefit of other English-speaking Caribbean countries.
 - The Barbados experience regarding the solar industry in essence is this: a great deal is achievable with the right policies are in place to help exploit a local natural resource and create an entirely new industry from the bottom up, and in the process, improve the living standards of inhabitants and the income levels of stakeholders.

Conclusion

Although large-scale commercial use of some renewable technologies remains remote, granted the current world price of crude, successful adaptation of solar energy as in Barbados' case, has shown that some options are available granted the right policy instruments are put in place. The renewable energy endow-

ments of Small Island Developing States vary considerably. Nonetheless, they all have solar energy irrespective of the amount of diffusion. What the Barbados initiative clearly demonstrates is that there are huge benefits, social and economic, to be exploited with the widespread use of solar water heating technology.

Recommendations

It is recommended that Solar Dynamics Limited explore the need to market solar technology more fully throughout the Caribbean, so that other countries would share in energy savings.

Likewise, it could present a great investment opportunity for the company to extend into the Latin American countries with the prospect of penetrating their economies.

The Application of Bio-gas Technology in the Integrated Management of Agro-Industrial Waste Water

JAMAICA

Introduction

In this case-study from the Research and Development Division of the Scientific Research Council (SRC) of Jamaica, the adaptation of Bio-gas Technology is described through various stages of research and development practices aimed at addressing fundamental and complex problems associated with the search for alternative energy and the productive management of animal waste in the context of both small-farm and plantation agriculture.

Among the interesting features of the study are the interactions between technical co-operation agencies, the management of an S&T institution in a developing country, the scope for applications of technological innovations in relation to market size and social costs of farm production, along with the strengthening of indigenous technical expertise and the commercialisation of waste management technology.

In this regard, the experiences of the SRC, originating in 1978, provide useful information on creative strategies deployed by a national institution to address several of the Priority Areas identified in the Programme of Action (POA) of the Global Conference on Small Island Developing States, held in Barbados in 1994.

The issues addressed also demonstrate cross-sectoral linkages between farm production, animal waste, household needs of rural communities, the demands of alternative energy usage on account of economic factors and also the growing requirement to reduce pollution from agro-industrial waste.

Background

Both the external, global environment, as it relates to the so-called "energy-crisis" of the 1970's and the concerns of the Government of Jamaica, to enhance the role of science and technology in development, must be taken into