



**Asia-Pacific
Economic Cooperation**

Successful Business Models for New and Renewable Energy Technology Implementation in APEC



APEC Energy Working Group

October 2009



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Report

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SUMMARY

Implementation of new and renewable energy technologies is always difficult due to the initial costs involved, the low availability of finance for frontier projects, the frequent need for successful public/private sector participation and adverse public perception. Worldwide, however, there are many economies that have actively pursued the introduction of new and renewable energy and both governments and the private sector have contributed. Some of these initiatives have been successful and some have not.

An understanding of the factors that lead to the successful introduction of new and renewable energy technologies can help in the establishment of effective implementation programs, minimizing risk, overcoming the impediments involved and avoiding mistakes which have been made in other countries. Specifically, identification of the business models that have been applied successfully in both developed and developing economies will promote early commercialization of new and renewable energy technologies and will be instrumental in driving down the costs of these technologies.

Business models are designed to extract maximum value from a business activity conducted within a particular regulatory framework. It is the regulatory environment, therefore, that is largely instrumental in shaping the various business models that have been developed. In the case of new and renewable energy technology many incentives are offered by most APEC governments to promote the commercialisation of new and renewable energy through a series of fiscal, financial, regulatory and other measures such as those illustrated in Table 1.

The ways in which these incentives operate to drive the introduction of new and renewable energies and shape the business models involved are central to the formulation and application of a successful business model.

The study presents 16 case studies of business models applicable to:

- Heat and power production,
- Renewable fuels (biofuels) production,
- Alternative transport fuels.

The business models that have been employed in each of these areas are generally quite different because different regulatory environments apply and the associated value chains for the businesses are not the same.

The case studies that have been chosen are:

Heat and Power Production

- Solar Power Purchase Agreement Model – Corporate,
- Solar Power Purchase Agreement Model – Residential,
- Lanai Solar Farm – The Flip Model,
- Hepburn Wind Farm, Australia – Local Owner Co-operative Model,
- Geothermal Heat Pumps, Canada – Energy Service Contract Model

Table 1: Policies and Measures to promote New and Renewable Energy.

Fiscal/financial	Regulatory	Other
Feed-In Tariffs and Net metering	Renewable Portfolio Standards RPSs	Government facilities use NRET
Excise tax exemption or rebate	Mandated sales/purchase for fleet vehicles (enforced)	Information dissemination; public awareness campaigns
Road/registration-tax exemption or rebate	Harmonised refueling facility standards and codes	Voluntary agreements with OEMs to develop and market NRET equipment
Sales/Import tax exemption or income/profit tax credit (purchasers and OEMs)	Vehicle conversion standards and industry codes of practice	Direct R,D & D funding for NRET
Investment tax credits for distribution infrastructure and R&D	Health and safety regulations	
Grants/tax credits for equipt conversion/acquisition	Exemptions from energy end use restrictions	
Rapid depreciation for commercial plant and distribution infrastructure		
Parking/Road User charge exemptions		

Biofuels

- Ethanol Production, USA – Corporate Ownership Model
- Ethanol Production, USA – Local Co-operative Model
- Biodiesel Production, New Zealand – Farmer Owned Model
- Ethanol Production, USA – Engineer/Builder Owned Model
- Ethanol Production, USA – Franchise Model

Alternative Transport Fuels

- NGVs, New Zealand – Government Management Model
- NGVs, Malaysia – NOC Management Model
- NGVs, India – Court Order Model
- Synthetic Gasoline, New Zealand – Tolling Model
- Electric Vehicles, China – Free Market Model
- Hybrid Electric Vehicles, USA – Consumer Incentive Model

A large number of business models, and variants thereof, have been employed for the commercialization of new and renewable energy technology. Not all have been successful but those that have include:

Heat and Power Production

- Community Wind Models
 - Multiple Local Owner model
 - The Flip model
 - Consumer Cooperative model
 - Municipal Ownership model
- Multi-party Ownership models for Anaerobic Digesters
 - Dual Ownership Model
 - Community Digester model
- Third Party Ownership model
 - Utility Ownership model
 - Private Sector Ownership model
 - Co-operative Ownership model
- Project Aggregation model
- Renewables-as-Appliance models
 - Retailer Sales model
 - Standardized Configuration model
- New Construction model

-
- Environmental Credit Market models
 - Renewable Energy Credit Market model
 - Carbon Offset Market models
 - Emissions Allowance Market models

Biofuels Production

- The Corporate Business model
- The Farmer-Owned Business model
- The Engineer/Builder-Owned Business model
- The Franchise Business model

Alternative Transport Fuels

- State Management models
- State Ownership models
- Third Party Ownership models
- Public-Private Partnership model
- Free Market model

A number of lessons can be learned and conclusions drawn about the characteristics of the business models considered herein. These are:

General

1. Governments create business environments and business models are constructed to respond by extracting maximum value for the business from the opportunity available,
2. There is no universal business model that can be used to introduce and sustain different new and renewable energy technologies in the market place,
3. Successful business models are those that conform to the existing business conditions such that they:
 - Control key elements of the value chain,
 - Extract maximum value for the business,

-
- Provide a positive value stream to all participants,
 - Have multiple revenue streams,
 - Are hedged against changes in product prices and other revenue determinants,
 - Respond to customer requirements,
 - Are sustainable over time.
4. Business models that are appropriate for introducing a new and renewable energy technology may be quite different from those required for maintaining ongoing participation in the new industry once it has become established.
 5. Any business model is likely to fail if there is a change in the commercial conditions on which it is predicated. If the project drivers change, or are removed, it is likely that the revenue stream will fail.
 6. An unsuccessful business model is one that is unable to adapt to changing commercial conditions,
 7. The success of a business model often depends upon the people involved and the partnerships established.

Energy Type

Appropriate business models are usually quite different for different new and renewable energy forms and different conclusions can be drawn for:

- Heat and Power production,
- Biofuels production and use,
- Alternative Transport Fuels.

Heat and Power

Heat and Power production from new and renewable energy resources has the following characteristics:

- The primary energy (e.g. Solar, Wind, Hydro) employed is usually free,
- The heat and power produced is usually sold directly to the end user or into a utility grid,

- The key elements of the business model configuration relate primarily to the conversion of primary energy into heat and power and the financing thereof,

The following conclusions apply to business models that have been used for heat and power production:

1. Most renewable energy technologies for heat and power production are of small to medium size,
2. The combination of new technology and small scale makes financing difficult,
3. Business models that have been applied to heat and power production place strong emphasis on securing finance and attracting customers,
4. New business models are dominated by North American activities – primarily in the United States,
5. New business models are designed to introduce novel energy forms such as wind, solar, and small hydro into markets that are usually highly regulated,
6. Most of the sophisticated models are designed to take advantage of government incentives and are only effective so long as these are in place,
7. A number of the more innovative business models are only viable in short time windows since they are finely tuned to take full advantage of government incentives which can change significantly over short time periods,
8. Business models applicable to heat and power production reflect the need to secure strong partnership arrangements with equipment suppliers, installers, financiers and product customers.

Biofuels

Fuel production from biomass has the following characteristics:

- Considerable cost is involved in harvesting the biomass feedstock which is also characterised by a low energy density,
- The biofuels produced must be distributed to the consumer and are most commonly used as an alternative transport fuel,
- The key elements of the business model configuration, therefore, involve feedstock supply, its processing into fuel, fuel distribution and project financing.

The following conclusions can be drawn about the business models identified:

1. Business models for biofuels production are now quite well established,
2. Most have grown out of the agricultural industry and are largely promoted by that industry,
3. The businesses involved are usually middle to large scale operations and the emphasis is on production,
4. The industry is characterised by significant government incentives and mandates which determine the configurations of the business models employed,
5. The most successful commercial models control key elements of the value chain and have several revenue streams,
6. Partnership with fuel distributors is one of the keys to business success,
7. Profitability in the biofuels industry is closely linked to international oil prices.

Alternative Transport Fuels

Alternative Transport Fuels production from new and renewable energy resources has the following characteristics:

- The primary energy feed stock cost makes up a significant proportion of the final alternative transport fuel supply cost,
- The transport fuels produced must be distributed to the consumer and may require substantial infrastructure facilities as in the case of compressed natural gas (CNG) and liquefied petroleum gas (LPG),
- Key elements of the business model configuration therefore involve feedstock supply, its processing into a usable fuel, fuel distribution and project financing,

Many of the business models that have been developed are quite different from those used to commercialise other forms of new and renewable energy because:

1. Introduction of ATFs is generally controlled by a government led program,
2. Business models that have developed for the introduction of ATFs have a high level of government involvement,
3. Business models for the introduction and use of ATFs have failed badly in cases where government support and involvement has been greatly reduced over a short time period,

4. Business models employed by the private sector focus on ATF outlets and promotion of consumer uptake,
5. Large scale introduction of ATF's such as synthetic fuels often involve public/private partnerships which have proved to be commercially sustainable and an effective business model.

Project Scale

The following comments relate to the size of a new and renewable energy project:

1. Different business models are applicable to large, medium and small scale projects,
2. Most new and renewable energy projects are small to medium in size,
3. Business models developed for small scale projects (wind, solar and small hydro) concentrate on capturing the full value of government incentives and support packages,
4. Business models used for small scale new and renewable energy projects are mostly orientated to community participation with some essential third party involvement,
5. Business models for large scale projects are often utility based, designed for large commercial operations or have a high level of government involvement.

APEC Economy Applicability

The following conclusions can be drawn about the applicability of the business models identified to different APEC economies:

1. Not all business models for the introduction and use of new and renewable energy technology are applicable in all APEC economies,
2. Many business models are dominated by experience in the USA where the focus is on extracting maximum value from the many government financial incentives available,
3. APEC economies can learn from the sophisticated business models developed in the USA but will need to modify them to fit their own economy conditions,
4. Less prescriptive regulatory regimes have tendered to place reliance on conventional business models for the development of new and renewable energy technology,
5. The business models employed in developing economies are usually strongly driven by government policy and do not always seek to maximise commercial benefits,
6. Emerging new and renewable energy policies in many developing economies offer opportunities for community participation and are small/medium scale businesses for which the models are quite well established.

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1. Introduction

With the notable exception of hydro power, much of the world's electricity has been generated for more than a century using fossil fuels as the source of primary energy. Similarly, Gasoline, Diesel, Avtur and Fuel Oil derived from Crude Oil have fuelled almost all transportation systems worldwide. Indeed, there has been a progressive trend over time from the utilization of renewable energy, such as fuel wood, to fossil fuels which are readily available and have higher energy densities.

Now, however, the world is facing high crude oil prices, a desire for energy security and a political resolve to limit Greenhouse Gas emissions. This situation has greatly increased interest in new and renewable sources of energy both for electricity generation and to provide alternative fuels for transport and industrial energy supply.

1.1 Study Overview

Implementation of new and renewable energy technologies is always difficult due to the initial costs involved, the low availability of finance for frontier projects, the frequent need for successful public/private sector participation and adverse public perception. Worldwide, however, there are many economies that have actively pursued the introduction of new and renewable energy and both governments and the private sector have contributed. Some of these initiatives have been successful and some have not.

An understanding of the factors that lead to the successful introduction of new and renewable energy technologies can help in establishing effective implementation programs, minimizing risk, overcoming the impediments involved and avoiding mistakes which have been made in other countries. Specifically, identification of the business models that have been applied successfully in both developed and developing economies can promote early commercialization of new and renewable energy technologies and can be instrumental in driving down the costs of these technologies.

1.1.1 Objectives

It is the aim of this study to draw on, and analyze, past experiences with a view to identifying those business models that have proved successful in bringing new and renewable energy resources to market and to identify which models, or components thereof, are applicable in different APEC economies.

The overall objectives of the project are to:

- Identify the key elements necessary for successful introduction of new and renewable energy technologies,
- Define those business models that have proved successful in the introduction of new and renewable energy technologies throughout APEC and elsewhere,

-
- Facilitate an APEC response to limiting Greenhouse Gas (GHG) emissions,
 - Promote national self sufficiency and energy security through the increased use of indigenous energy resources,

Specific objectives include:

- Identification of the new and renewable energy technologies that have been, or are likely to be, introduced in each APEC economy,
- Establishing a database of commercial new and renewable energy activities throughout the APEC economies and selected activities worldwide,
- Identification and evaluation of the drivers and impediments associated with new and renewable energy projects throughout the APEC economies, and how they are addressed by each of the business models described,
- Description of the regulatory regimes and incentive packages required for successful commercialization of new and renewable energy technologies,
- Identification of the commercial structures required for the successful introduction of new and renewable energy technologies.

1.1.2 Coverage

This project covers the following topical areas:

- All forms of new and renewable energy that have been, or are likely to be, introduced in one or more APEC economies. These are listed in Table 1.1.
- All elements of the energy value chain including production, transportation, distribution, fuel/energy storage and end use,
- Institutional, commercial and market factors involved in the introduction and operation of new and renewable energy systems,
- The environmental, social, political, economic and technical factors that determine the choice of each business model,
- The drivers for each alternative transport fuels program as they apply in different situations and in different APEC economies.

Consideration is given, primarily, to those new and renewable energy forms that that have reached full commercial operation as indicated in Table 1.1.

1.1.3 Emphases

Emphasis is placed on identifying and evaluating:

- The **drivers** for each business model considered,
- The **barriers** faced in the commercialisation of each new and renewable energy form and how they have been successfully overcome,
- The **risk management** strategies employed – particularly as they relate to project financing,
- The **contract structures** employed for primary energy acquisition and energy product sales,
- The degrees of **vertical integration** involved in each of the business models considered.

Table 1.1: New and Renewable Energy Options considered.

NRET Form	Status
<p>Renewable Energy Options</p> <p>Hydroelectricity generation Electricity generation from Wind Power Electricity generation from Solar Energy Electricity generation from Geothermal Energy Electricity generation from Marine Energy Production of Biogas Production of Biodiesel from Micro-algae Production of Biodiesel from animal fats and vegetable oils Production of Ethanol from agricultural biomass Production of alcohols from forest biomass</p>	<p>Commercial Commercial Commercial Commercial Demonstration Commercial Development Commercial Commercial Development</p>
<p>New or Alternative Energy Sources</p> <p>Compressed Natural Gas (CNG) Liquefied Natural Gas (LNG) Liquefied Petroleum Gas (LPG) Methanol - from natural gas or coal Hydrogen - from natural gas, coal or biomass Co-generation of Heat and Electricity</p>	<p>Commercial Commercial Commercial Commercial Development Commercial</p>
<p>Non-conventional Hydrocarbon Fuels</p> <p>Gas to liquids Coal to liquids Biomass to liquids</p>	<p>Commercial Commercial Development</p>

2. Business Models

2.1 Definitions

A **Business Model** is a framework for creating value. The term is used by commercial enterprises to represent various aspects of their business, including its purpose, offerings, strategies, infrastructure, organizational structures, trading practices, and operational processes and policies.

For the purposes of this project we employ the business model template proposed by Osterwalder (2004) which divides the description of a business into nine inter-related building blocks as illustrated in Figure 2.1.

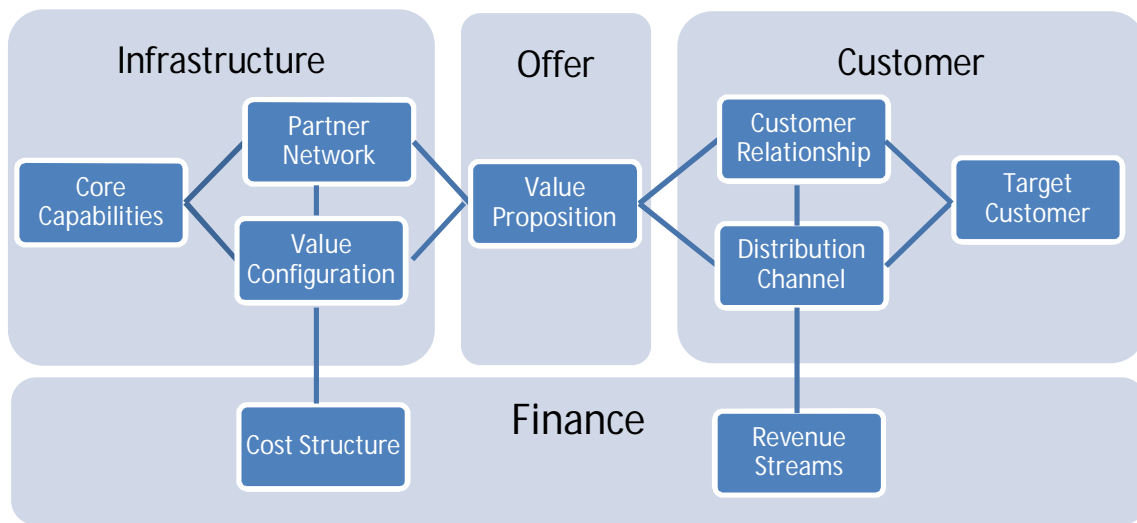


Figure 2.1: Business model template showing building blocks and their relationships.

These building blocks can be grouped, and are defined, under the following headings:

Infrastructure

Core capabilities are the capabilities and competencies necessary to execute a company's business plan,

The **Partner network** means the business alliances that make up the business model,

The **Value configuration** refers to the rationale that makes a business mutually beneficial for a business and its customers.

Offering

The **Value proposition** means the products and services a business offers.

Customers

A **Target customer** refers to the target audience for a business's products and services.

Distribution channel is the means whereby a company delivers products and services to customers. This includes the company's marketing and distribution strategy.

Customer relationship refers to the links a company establishes between itself and its different customer segments and the management thereof.

Finances

Cost structure refers to the way in which the company's products are monetarised to produce revenue.

Revenue is the way a company makes money through a variety of revenue flows, i.e. the company's income.

There are at least 20 different business models that have been recognised based on this classification. Their configurations differ considerably between the electricity and transport sectors so these are considered separately.

In the following sections each of the business models that has been employed, successfully or otherwise, for the commercialization of new and renewable energy technologies is analyzed, compared and presented in terms of the foregoing criteria. In particular, close attention is given to the way(s) in which successful business activities are financed in a field where banks have limited experience of previous financing activity.

2.2 The Electricity and Transport Fuel Sectors

Renewable energy in the electricity sector is dominated by hydro, geothermal, wind and solar power. Commercial production of hydro and geothermal power is, of course, well established but the business models for electricity production from wind and solar energy are less well developed. This is also true for pico, micro, mini and small hydroelectricity production which attract a different commercial focus due to their small size.

In all cases, however, the innovative commercial focus is on electricity production and sales – rather than its distribution and end use for which long established business models already exist.

By contrast, the use of new and renewable fuels in the transport sector tends to focus on the distribution and end use of an alternative fuel. Commercial fuel production is of primary importance for biofuels, of course, but business models are already well established for production of fuels such as Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG).

2.3 Key Issues

There are several key issues that are integral to the successful introduction of new and renewable energy, whether for heat and power production or as an alternative transport fuel. These include:

- Project financing,
- Delivery to the consumer – notably grid integration,
- Effective and affordable conversion of vehicles to use alternative fuels,
- Existence of a robust and stable regulatory framework,
- Achievement of consumer acceptance and market penetration,
- Sustainability.

These issues are explained in the following sections.

2.3.1 Financing

Most new and renewable energy projects are regarded as frontier projects by banks and other financial institutions which often have little or no experience of financing them. Consequently, obtaining finance is a key issue for such projects. It is understandable, therefore, that many of the business models which have been applied involve either establishment of an effective bank guarantee (e.g. a power purchase agreement) or financing outside the normal banking system (e.g. through a co-operative).

The various ways in which financing of new and renewable energy projects has been achieved are identified and reviewed in the following chapters.

2.3.2 Fuel Distribution

Establishment of an effective distribution system is integral to the introduction of new and renewable energy and can represent a major part of the cost of implementation.

Alternative transport fuels, such as unconventional hydrocarbon (UHC) fuels, biodiesel and low alcohol blends with gasoline, have the advantage that they can utilise, with little or no modification, the extensive systems that already exist in most countries for distribution of conventional petroleum fuels.

Natural gas can be distributed using the existing gas pipeline distribution system but requires new equipment for compression to CNG and dispensing. Other gaseous fuels, such as LNG, LPG and hydrogen, require completely new equipment for their transportation, distribution and dispensing and the associated costs can make up 60-70% of the cost of introducing such fuels.

For electric vehicles the existing electricity distribution system provides the basis for the distribution infrastructure but electric (EV), hybrid (HEV), plug-in-hybrid (PHEV) and fuel cell (FCV) vehicles require considerable investment in engine technology and recharging infrastructure in order to achieve general market introduction.

Probably one of the greatest problems involved in the introduction of alternative transport fuels into the market is the so-called “chicken and egg” dilemma. Thus, fuel suppliers are reluctant to invest in extensive fuel distribution and dispensing systems until such time as there are sufficient alternative fuelled vehicles in operation; vehicle owners, on the other hand, are reluctant to convert to alternative fuel use until there are sufficient fuel outlets to provide a continuous supply of the new fuel. In most cases this dilemma is broken by government action but several private sector business models have also been developed.

Electricity distribution, on the other hand, can utilise existing grid infrastructure if it involves continuous supply (such as geothermal power and hydro-electricity) or it can be delivered on site to a captive market where this is co-located.

For those new and renewable energy forms (such as wind and solar power) which are not continuous, integration into an electricity grid can be a significant and costly problem. In some cases this means that new markets and business models need to be identified to address the special needs of distributed power generation and use.

2.3.3 Vehicle Conversion

Most alternative transport fuels require some degree of engine and vehicle modification to enable or optimize their use. For UHC fuels, biodiesel and low alcohol blends, the extent of engine modification is either negligible or small. For high alcohol or gaseous fuels, engine and vehicle modifications are quite extensive.

Historically the practice has been to modify conventional gasoline or diesel engines to operate on the alternative fuel. This often results in sub-optimum performance (e.g. advantage cannot be taken of the high octane number of gaseous and alcohol fuels) but it does offer the advantage of allowing the engine to operate using either the alternative transport fuel or the conventional gasoline or diesel for which it was originally designed. These vehicles are said to be “bi-fuelled”. This capability has proven to be an essential transition measure during the period required to establish an alternative transport fuels market that is supplied by purpose built engines and vehicles provided by the original equipment manufacturers (OEMs).

Involvement of the OEMs is key to the successful establishment of alternative transport fuels as each fledgling market develops. Most, if not all of the OEMs, have already done sufficient research to enable production of market-ready alternative fuelled vehicles (AFV) within as little as 18 months, but they will not commence large scale production until there is a market. Again, there is a “chicken and egg” dilemma that must be addressed and business models designed to encourage the market entry of OEMs have been developed accordingly.

2.3.4 Institutional and Regulatory Framework

Gasoline and diesel have been used as transport fuels for roughly 100 years and a great deal is known about their properties and the safety precautions required for their handling and use.

While many alternative fuels have properties that make them safer than conventional gasoline and diesel, these properties are less well understood and appropriate regulations for safe handling and use need to be established. Similarly, the supporting standards and codes of practice must be adopted and industry service personnel trained and certified in their application.

There are many examples where an alternative transport fuel has been prematurely introduced into the market before the necessary standards, codes of practice and regulations have been established. The results are usually negative and customer acceptance suffers. Both governments and private sector developers must, therefore, ensure that the appropriate institutional and regulatory infrastructure is in place for successful implementation of an alternative transport fuel program.

Similarly, the introduction of new and renewable energy for heat and power production requires an equivalent supporting regulatory framework.

2.3.5 Consumer Acceptance

No alternative energy form can be introduced into the market unless it is accepted by consumers – otherwise there is no market.

There have been many situations where an alternative transport fuel, for example, has not been accepted by consumers – usually because they believe that the fuel is hazardous or that it is being promoted under false pretences. Gaseous fuels are a case in point where the general public often equates “*gas at high pressure*” with “*bomb*”. In many cases such misconceptions are fostered mischievously by commercial competitors, environmental groups or other stakeholders who do not support the introduction of a particular alternative transport fuel.

Consumer acceptance cannot be assumed; it has to be won on the merits of the product that is being introduced to the market. One of the key issues involved in introducing an alternative fuel or energy form is to ensure that its performance is faultless and that the consumer perceives greater benefits, than disadvantages, from its use.

For these reasons, it is essential that an appropriate institutional and regulatory structure is in place (see Section 2.3.4), and that a professional public education campaign is conducted to ensure that consumers are fully and truthfully informed. In this regard proponents of alternative transport fuels need to concentrate in the initial stages on engaging the “early adopters” who in time will influence the larger market.

The various ways in which consumer acceptance of new and renewable energy have been achieved are identified and reviewed in the following sections.

2.3.6 Sustainability

Sustainability is a currently fashionable term used to describe satisfaction of the PESTE criteria that have long been used in feasibility studies to determine whether or not a particular project is commercially viable. The PESTE acronym refers to:

- **P**olitical acceptability,
- **E**nvironmental acceptability,
- **S**ocial acceptability,
- **T**echnical acceptability,
- **E**conomic viability.

Modern practice also undertakes to examine a project for its **C**ultural compatibility. To be sustainable an alternative fuel or energy form must meet contemporary standards for each of the PESTE(C) criteria as the key to its successful introduction into the marketplace,

There is a commonly held misconception that sustainability, once satisfied, lasts forever. This is not so. Thus, an alternative transport fuel, such as biodiesel, may be sustainable so long as the parity price of crude oil is above, say US\$ 80/bbl. However, below the relevant parity price biodiesel will no longer be sustainable. Similarly, the imposition of a value on the price of carbon emissions may well move a renewable energy form in or out of the sustainability range.

Sustainability, therefore, depends upon the weightings and values placed upon the PESTE(C) criteria. This is why there are many historical examples of alternative transport fuels that were sustainable over a particular period of time in a particular economy but were discontinued when conditions (usually the parity price of crude oil) changed.

Identification of the PESTE(C) sustainability criteria for each of the new and renewable energy forms that have been introduced into the market is a key element of this study.

3. Implementation Policies

A business model is simply a means whereby economic value (money) is gained from the sale of a product. The way in which such a model is configured is determined primarily by the commercial and regulatory environment within which the business is conducted. Ultimately, therefore, a successful business model must be configured to take full advantage of government policies and incentives and may ultimately be dependent on them for its success. Indeed, there are many examples of the failure of otherwise successful business models due to changes in government policies and the types and levels of incentives available.

Before examining the different business models that have been used to commercialize new and renewable energy, it is appropriate to understand the regulatory environments that can be, and have been, established to promote commercialization. It is the purpose of this Chapter to present these together with the types of incentives/drivers which determine how a particular business model should be configured.

3.1 The Role of Government

The oil-price shocks of the 1970s provided the initial impetus for the development of renewable energy as countries sought to reduce their dependence on imports of crude oil and refined products. Since the 1990s, however, attention has shifted to the threat of global climate change due to rising concentrations of GHGs in the atmosphere resulting primarily from the burning of fossil fuels. As a result, governments are looking to fuels and energy forms that emit less carbon dioxide (CO₂), methane (CH₄) and nitrogen dioxide (NO₂), which are the main GHGs resulting from energy use.

Energy independence is also becoming important as terrorist attacks and natural disasters, together with political instability, increasingly threaten the functioning of the oil-based economy. Indeed, as renewable energy technologies mature, many utilities and large energy companies are using them as tools to hedge against increasing and fluctuating prices in fossil fuel markets.

Renewable energy systems differ from conventional energy in terms of their cost structure. Thus, fossil fuels generally have moderate or low up-front capital costs but high operating costs, due to their ongoing fuel consumption, whereas primary renewable energy is usually free (sunlight, wind, geothermal heat, ocean energy) but requires a fairly high initial investment.

The financial community has initially been reluctant to invest in emerging renewable energy technologies. Nevertheless, wind and solar power have emerged as the leaders in new electricity generation capacity in recent years in the leading European renewable energy economies, India, Japan, and the United States, with double-digit annual growth. This success is due to clear, directed government policies and support programs.

As an absolute minimum, therefore, governments must establish an appropriate regulatory environment and institutional infrastructure to support the introduction of renewable energy. In

reality, however, they usually need to assist in overcoming the initial cost barriers associated with the introduction of new technology and infrastructure. Small-scale renewables, in particular, require three types of measures to apply at the same time *viz*: legislation, incentives, and education.

Table 3.1: Policies and Measures to promote New and Renewable Energy.

Fiscal/financial	Regulatory	Other
Feed-In Tariffs and Net metering	Renewable Portfolio Standards RPSs	Government facilities use NRET
Excise tax exemption or rebate	Mandated sales/purchase (enforced)	Information dissemination; public awareness campaigns
Road/registration-tax exemption or rebate	Harmonised standards and codes	Voluntary agreements with OEMs to develop and market NRET equipment
Sales/Import tax exemption or income/profit tax credit (purchasers and OEMs)	Exemptions from energy end use restrictions	Direct R,D & D funding for NRET
Investment tax credits for distribution infrastructure and R&D	Health and safety regulations	
Grants/tax credits for equipt conversion/acquisition		
Rapid depreciation for commercial plant and distribution infrastructure		
Parking/Road User charge exemptions		

There are numerous options for policies and actions to promote new and renewable energy, as illustrated in Table 3.1. These are discussed in the following sections.

3.2 Financial Incentives

Incentives can be designed to encourage or discourage certain actions or behaviours. Tax policy provides a good opportunity to ensure that, at least in the early years of market development, new and renewable energy forms can be priced competitively with conventional fuels and energy. Tax relief helps to maintain a comparative price advantage and is probably the most important element for market success.

Financial, or market-based, incentives can target energy/fuel production and supply, the sales or import of equipment and infrastructure or the end use. Taxation measures are the most cross-cutting and can be applied as a subsidy, a tax exemption or a penalty.

The financial incentives listed in Table 3.1 are demand-side fiscal measures aimed directly at reducing the cost to the end user of switching to an alternative fuel. Supply-side fiscal measures that reduce the tax liability of energy providers and/or equipment manufacturers can also lower these costs in an indirect way. For example, profit-tax credits can be used to encourage Original Equipment Manufacturers (OEMs) to develop and market dedicated alternative fuelled vehicles (AFVs) and to encourage fuel providers to invest in distribution infrastructure.

3.2.1 Feed in Tariffs

A Feed-in Tariff (FiT), also known as a Feed-in Law (FiL), solar premium, renewable tariff or renewable energy payment, is an incentive structure that sets a fixed guaranteed price at which power producers can sell renewable power into the electric power network. Some policies provide a fixed tariff while others provide fixed premiums added to market- or cost-related tariffs which usually differ for different forms of power generation. A FiT is normally phased out once the renewable electricity achieves significant market penetration, such as 20%, as it becomes economically un-sustainable.

The feed-in tariff system has been enacted in some states in Australia, Austria, Brazil, Canada, China, Cyprus, the Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Israel, Italy, the Republic of Korea, Lithuania, Luxembourg, the Netherlands, Portugal, Singapore, Spain, Sweden, Switzerland, and in some states of the United States.

These economies all have different versions of the system. Some are introducing only part of the system, in an attempt to realize the success of FiT while keeping the market for fossil energy suppliers the same. In the UK the name FiTino was introduced to mean "Feed-in tariff in name only".

The US National Renewable Energy Laboratory (NREL) has identified a number of key factors that are necessary to achieve a successful FiT policy. These are summarized as follows and are discussed at length at the website: www.nrel.gov/applying.../scepa_webcast_20090212_tariffs.ppt

- **Stability.** Energy projects normally take several years to develop, so FiTs have to be in place at least five years or longer to provide certainty for investors and manufacturers.
- **Long-term contracts** in the range of 15-20 years allow investors time to recover their costs.
- **Adequate energy prices.** FiTs must cover project costs, plus a reasonable return to create stability, attract investors, lower risk and keep financing relatively simple.
- **Annually decreasing payments.** As innovation and growth reduce technology costs, tariffs should be lowered according to a transparent and incremental plan. This encourages rapid deployment and increases competition among manufacturers.
- **Different tariff rates** according to technology type, project size and resource quality.
- **Incorporate FiT into the electricity rate base.** Tying FiT payments to ratepayers distributes costs and provides certainty that investors will get paid.
- **Reduce bureaucracy.** Streamlining approvals reduces initial barriers and cost. It especially helps small projects and encourages broader participation.

3.2.2 Net Metering

Net metering is a way to encourage consumers to invest in renewable energy sources such as solar or wind power. In a net metering system, the electric company allows a customer's meter to run backwards when the electricity generated is more than that consumed. At the end of the billing period, the customer pays only for the net consumption i.e. the amount of electricity consumed, minus the amount generated.

Net metering lets on-site producers of electricity feed excess electricity into the public grid at the retail price. It is used mostly to support smaller, distributed energy systems that are installed on or near buildings. Thirty-nine US states have net metering which is also available in Mexico and is becoming popular in Canada - now being available in British Columbia, Ontario, and Manitoba.

3.2.3 Grants, Rebates and Loans

Grants or Capital subsidies are one-time payments made by the government or a utility to cover part of the capital cost of an investment, such as a solar hot water system or alternative transport fuel infrastructure. Grants to grid-connected renewable energy projects can come in the form of *buy-down grants* or *development grants*. There are multilateral, bilateral, and national sources for these grants. In most developing countries, renewable energy development is carried out by small companies with low capital resources, and grant facilities that can share some of these costs can provide significant stimulus to the market. However, these facilities need to be carefully structured to target the right projects and the committed developers.

Buy-down grants are used to lower the cost of a renewable energy project or system that is not yet commercially viable but has promising potential in the long term. Grants for grid connected

renewable energy have been used mostly to promote technology demonstration projects, and are seldom used to promote commercial scale applications – generally because the size of the projects can lead to very high grant program costs and can cause market distortions.

Buy-down grants can come in the form of *co-investment funds*, which is typical for demonstration projects, or as *rebates*, which are more commonly used for market stimulation.

Development grants are a tool for helping to lower the high cost of development grid connected renewable energy projects, especially in new markets, where the cost and time to develop projects can be significant, amounting in some cases to millions of dollars and several years. Contingent development grants convert to loans if the project is successfully developed.

A **rebate** is an amount paid by way of reduction, return, or refund of money that has already been paid or contributed. It is used primarily by marketers as an incentive or supplement to product sales.

In the case of a **loan**, the borrower is obligated to repay the lender at a later time. Typically, loans are used to finance capital expenditure for the development of infrastructure. They are often provided at a low rate of interest and/or guaranteed by government. Provision of loans is one of the principal functions of financial institutions.

3.2.4 Tax Incentives and Benefits

Tax incentives and benefits are the most common measure used by governments to promote the introduction of new and renewable energy. They can be applied to a wide variety of taxes but are usually only maintained for a period until the market for the energy product is deemed to be established.

Instead of tax exemptions for renewable energy, some governments have implemented energy taxes on fossil fuels. These taxes are similar to, but usually much higher, than the system benefits charges (SBCs) that are levied for the purposes of system maintenance or improvement (e.g. for upgrading system efficiency). Similar taxes include emission-related taxes, such as on CO₂ or SO₂ emissions. These taxes are meant to correct a market failure that to incorporate the external costs of fossil energy sources in the heat and electricity sectors. Such taxes (as implemented, for example, in Austria, Denmark, Finland, Italy, the Netherlands, Germany and Sweden) make it easier for renewable energy to compete in the marketplace. These tax revenues can also be used to support the introduction of renewable energy technologies as, for example, in Austria, Italy, and Denmark in the 1990s.

3.2.4.1 Excise Taxes

Fuel taxes measures are employed by most economies to promote alternative transport fuels. They can involve a lower rate of excise duty (and/or sales tax) or its complete exemption. In some cases, commercial vehicles may enjoy a rebate on fuel taxes. These measures reduce the payback period for converting or acquiring an AFV and are also highly visible so they raise public awareness of the potential cost savings from using alternative fuels.

3.2.4.2 Tax Credits and Deductions

A tax credit reduces the recipient's tax obligations. Thus, an **Investment** tax credit allows investments in renewable energy to be fully or partially deducted from tax obligations or income. A **Production** tax credit provides the investor or producer an annual tax credit based on the amount of electricity or fuel produced.

A tax credit is generally more valuable than an equivalent tax deduction because a credit reduces tax dollar-for-dollar, while a deduction only removes a percentage of the tax that is owed. Also, a tax credit can usually be carried forward and can have considerable value to a third party that has a large tax liability.

3.2.4.3 Sales Taxes and Import Duties

The most common way of providing incentives for equipment purchase is to subsidise its cost by reducing the associated sales tax or import duty. Thus, the higher cost of buying an OEM alternative fuel vehicle, the cost of converting an existing conventional fuel vehicle or the cost of renewable energy generating equipment can be offset. Lower rates or exemptions from vehicle registration and/or annual road taxes are another approach.

In most cases, these incentives apply for a specified time to limit the loss of tax revenue and the “free-rider problem” (where the financial benefit from the tax incentive is greater than is necessary to encourage the use of renewable energy or an alternative transport fuel).

3.2.4.4 Energy End Use Taxes

New and renewable energy end use can be made more attractive by reduction of, or exemption from, taxes on the energy end use. This applies most commonly to alternative transport fuels and involves one or more of the following costs:

- Road user charges,
- Road tolls,
- Parking costs and access to ‘no wait’ taxi zones at airports and train stations (Göteborg and other Swedish cities),
- ‘Bad-air’ day traffic bans or limitations (Milan, Paris, etc.),
- Congestion charges and access to carpool lanes (USA),
- Participation in emissions trading schemes (ETS) in Europe,

3.3 Regulatory Actions

Governments can strongly influence the speed with which new and renewable technologies are adopted through appropriate design of their governing regulatory framework. Governments must also be responsible for development of coherent regulations, standards and industry codes of practice covering the health and safety aspects of energy supply, distribution and end-use.

3.3.1 Mandates

The most direct form of regulatory measure is the use of legal mandates for public or private organisations to purchase so-called green power, use an alternative fuel or purchase alternative fuel vehicles.

Though not popular on their own without adequate incentives, a variety of mandates can be legislated and implemented to help promote alternative fuels. These can include:

- Mandates for utilities to include a percentage of electricity generated from renewable energy in their electricity supply portfolios,
- Mandates for municipalities to introduce a percentage of alternative fuel vehicles over a specified period.
- Purchase mandates for private vehicle fleets to buy alternative fuel vehicles over specified periods,
- Mandates for cities with air pollution problems to ban polluting vehicles in congested downtown areas during certain hours of the day,

Mandates have been widely employed for the introduction of alternative transport fuels – especially biofuels. Specifically, the introduction of ethanol as an alternative transport fuel in Brazil, the conversion of diesel buses and three-wheelers to natural gas (CNG) fuelling in New Delhi and other Indian cities and the development of electric and flexible fuel vehicles (FFVs) in the United States have all been mandated by governments.

To help ensure compliance, mandates are best applied in conjunction with incentives and they must both be enforceable and enforced. In general, a transition approach, such as a gradual increase in the mandated quota over time, is most likely to be successful.

While such mandates can lead to fuel switching and result in short-term benefits, they should be used with caution as they can greatly inhibit technological innovation in the medium and long-term by misdirecting investment to non-viable and uneconomic technologies.

3.3.2 Renewable Portfolio Standards

A renewable energy portfolio standard (RPS) is a regulation that mandates the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal. Another common name for the same concept is renewable electricity standard (RES).

The RPS mechanism generally places an obligation on electricity supply companies to produce a specified fraction of their electricity from renewable energy sources. Certified renewable energy generators earn certificates for every unit of electricity they produce and they can sell these, in addition to their electricity, to supply companies. Supply companies then pass the certificates to some form of regulatory body to demonstrate their compliance with their regulatory obligations. Because it is a market mandate, the RPS relies almost entirely on the private market for its implementation. Those supporting the adoption of RPS mechanisms claim that market implementation will result in competition, efficiency and innovation that will deliver renewable energy at the lowest possible cost, allowing renewable energy to compete with cheaper fossil fuel energy sources.

RPS-type mechanisms have been adopted in Britain, Italy and Belgium, as well as in 27 U.S. states and the District of Columbia (Figure 3.1). Regulations vary from state to state, and there is no federal policy. Four of the 29 states have voluntary rather than mandatory goals. Together these 27 states account for more than 42 percent of the electricity sales in the United States. Further details can be found at <http://www.pewclimate.org/sites/default/modules/usmap/pdf.php?file=5907>.

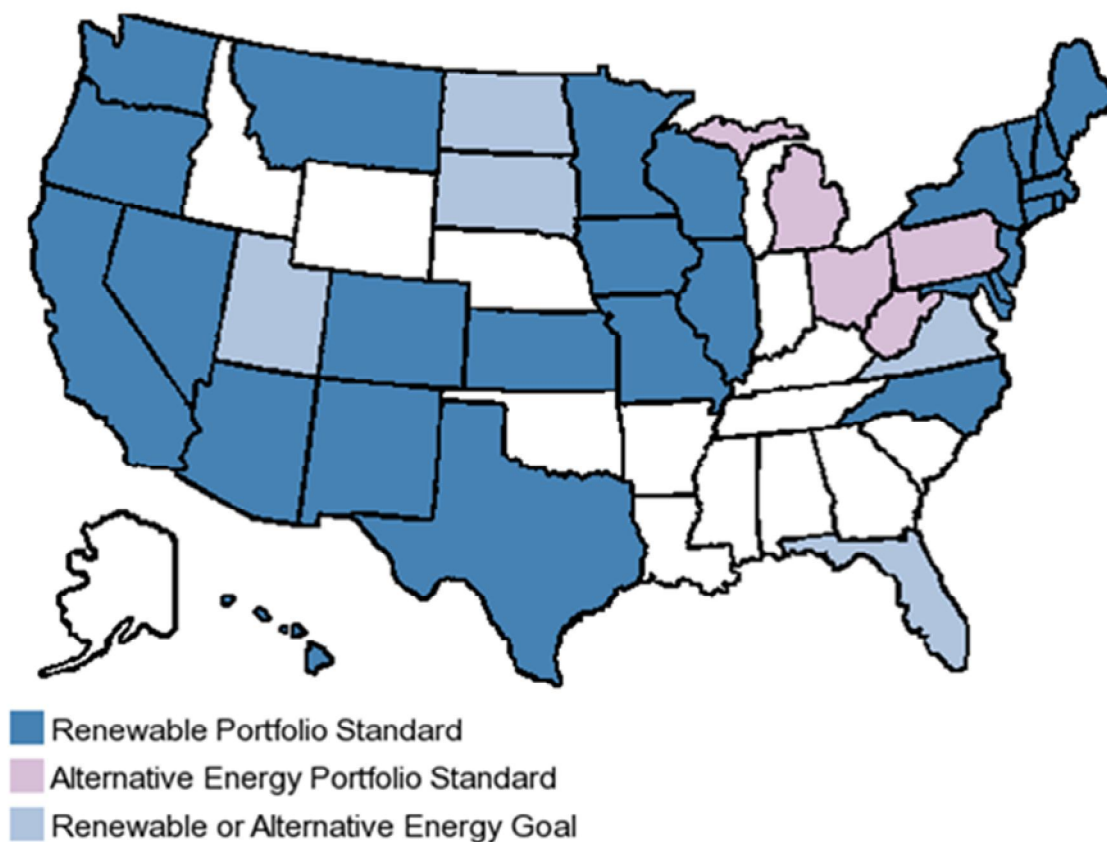


Figure 3.1: Renewable Energy Standards and Alternative Energy Goals in the USA.

It is worth noting that RPS mechanisms have been most successful in stimulating new renewable energy capacity in the United States where they have been used in combination with federal

production tax credits (PTCs). In periods, where PTCs have been withdrawn the RPS alone has usually been insufficient incentive to achieve large capacity increases.

In 2009, the US Congress has been considering federal level RPS requirements. The "American Clean Energy Leadership Act", reported out of committee in July by the Senate Committee on Energy & Natural Resources, includes a Renewable Electricity Standard that calls for 3% of U.S. electrical generation to come from non-hydro renewable energy by 2011-2013.

3.3.3 Tradable Renewable Energy Certificates (RECs)

Green power purchases involve the voluntary purchase of renewable electricity, by residential, commercial, government, or industrial customers, directly from utility companies, from a third-party renewable energy generator, or through the trading of renewable energy certificates (RECs).

Each certificate represents the certified generation of one unit of renewable energy (typically one megawatt-hour). Certificates provide a tool for trading and meeting renewable energy obligations among consumers and/or producers, and also a means for voluntary green power purchases.

3.3.4 Regulations, Standards and Codes of Practice

Standards and codes of practice have already been developed for the production and use of most renewable energy forms and alternative transport fuels in many APEC economies, but they require unification and universal adoption throughout APEC. Regulations are required to ensure the application of these standards for the safe and efficient use of alternative fuel vehicles in particular. Policing and enforcement of regulations is essential for successful introduction and development of renewable energy and alternative fuels markets.

3.4 Other Measures

There are several other measures that can be adopted by governments to promote the introduction of renewable energy. These include:

- Funding research, development and demonstration,
- Increasing public awareness,
- Encouraging OEM participation,
- Leadership in the uptake of alternative transport fuels.

These measures are generally quite affordable to governments but do have significant financial and public relations implications for stakeholders. The ways in which they operate are discussed in the following sections.

3.4.1 Funding Research, Development and Demonstrations

Many suppliers of equipment required for the introduction of new and renewable energy are small under-funded businesses that need assistance - either through direct funding, or from national research organizations - for product development and market introduction.

Governments can support the research, development, demonstration and deployment of new and renewable energy technologies either through voluntary agreements with OEMs and fuel providers or through direct funding of such activities.

3.4.2 Public Education

Information dissemination and education can be a key element of government incentive programmes for both renewable energy and alternative transport fuels. They usually take the form of regular communications, such as TV and radio advertising, web sites or newsletters to inform the public of market and technology developments and to indicate how to apply for subsidies where available.

The aim is to advance public understanding and awareness of the benefits of switching away from conventional energy and fuels and of the various incentives available to them. In some cases, there is a need to reassure both consumers and the general public about the safety of a particular fuel or fuel use. This has happened in several countries in the case of autogas, which has, at times, been the victim of some mischievous publicity.

3.4.3 Leadership by Example

Governments can provide leadership not only by encouraging consumers to consider alternative fuel and energy options but by switching some or all of their own energy use and infrastructure. The introduction of natural gas and autogas as alternative transport fuels has frequently involved the initial conversion of large numbers of government vehicles as a means of leading by example, raising public awareness and kick starting the market.

3.4.4 End Use Control Measures

These involve programs to modify driving behaviour and traffic patterns to facilitate exhaust emission reduction in densely populated urban areas. They are normally implemented by national or municipal authorities and target alternative fuel vehicles. One example is the establishment of “blue corridors.” These are heavy transport routes along which facilities are located for the refuelling of alternative fuel buses and heavy trucks.

3.5 Some Current Incentives

Measures that are in place to promote new and renewable energy generally are listed for a number of APEC economies in Table 3.2 which also includes Germany and Spain for comparison. A full list of economies for which this information is available is presented as Appendix A which is based

on an extensive report prepared by the Renewable Energy Policy Network for the 21st Century. www.ren21.net/pdf/RE2007_Global_Status_Report.pdf .

As indicated in the previous sections, there are a number of incentives that can be offered to encourage the uptake of new and renewable energy. Because different economies favour different approaches, however, there is considerable variation between the policies and measures employed.

Table 3.2: Current Incentives for New and Renewable Energy in different APEC Economies

Country	Feed-in tariff	Renewable port-folio standard	Capital subsidies, grants, or rebates	Investment or other tax credits	Sales tax, energy tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Developed and transition countries										
Australia	*	*	*			*			*	
Canada	(*)	(*)	*	*	*			(*)	*	(*)
Germany	*		*	*	*				*	
Japan	(*)	*	*			*		*	*	
Korea	*		*	*	*				*	
New Zealand			*						*	
Russia			*			*				
Spain	*		*	*					*	
United States	(*)	(*)	*	*	(*)	(*)	*	(*)	(*)	(*)
Chile		*	*							
China	*	*	*	*	*				*	*
Indonesia	*									
Mexico				*	*			*		
Phillipines	*		*	*	*				*	
Thailand	*		*					*	*	

(*) Entries with an asterisk (*) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy.

This considerable variation is illustrated in Table 3.3, which summarises a number of autogas incentives and in Table 3.4, which gives examples of current biofuel mandates.

In many economies the different types and levels of incentives being offered to promote the uptake of new and renewable energy technologies are the subject of frequent changes.

Such changes include:

- Policy Targets for Renewable Energy,
- Power Generation Promotion Policies,

- Solar and Other Renewable Hot Water/Heating Policies,
- Biofuels Policies,
- Green Power Purchasing,
- City and Local Government Policies.

This is well illustrated in the Renewable Energy Global Status Report 2009 update, www.ren21.net/pdf/RE_GSR_2009_Update.pdf that records some of the considerable changes that have occurred over the last approximately 18 months.

Table 3.3: The different Autogas Incentive Policies in APEC

Economy	Fuel tax exemption or large rebate	Vehicle tax exemption or rebate	Grants Tax credits	Fleet vehicle purchase mandates
Australia	Yes	Yes	Yes	Yes
Canada	Yes			Yes
China	Yes			Yes
Japan	Yes		Yes	
Korea			Yes	
Mexico	Yes			Yes
Russia	Yes			
Thailand				
United States			Yes	Yes

While such changes are inevitable, and even desirable, as Governments strive to optimise the incentive packages on offer in a rapidly growing market, they do create some uncertainty from a business perspective and can significantly influence the nature and configuration of the business models that are employed to commercialise new and renewable energy technologies.

Table 3.4: Biofuels Mandates and Targets

Country	Mandate
Australia	E2 in NSW to E10 by 2011; E5 in Queensland by 2010 350 million litres of Biofuels by 2010
Canada	E5 by 2010 and B2 by 2012; E5 in use in Ontario and E7.5 in Saskatchewan and Manitoba;
Chile	Voluntary E5 and B5
China	E10 in 9 provinces 10 mill tonnes Ethanol by 2010, 30 mill tonnes by 2020 0.3 mill tonnes Biodiesel by 2010, 2 mill tonnes by 2020
Chinese Taipei	B1 and B2 by 2010
Korea	B3 by 2012
Malaysia	Mandate for B5 by 2008 suspended
Peru	B2 in 2009; B5 by 2011; E7.8 by 2010 nationally regionally 2006 (ethanol) and 2008 (biodiesel)
Phillipines	B1 by 2007; B2 and E5 by 2009; E10 by 2011
Thailand	E10 and B2 in use; 3 ML/d Biodiesel and Ethanol by 2011
United States	130 billion liters/year by 2022 (36 billion gallons) E10 in Iowa, Hawaii, Missouri, Montana; E20 in Minnesota B5 in New Mexico E2 and B2 in Louisiana and Washington State Pennsylvania 3.4 billion liters/year biofuels by 2017

4. Case Studies

A number of different business models have been used to bring new and renewable energy into the market. In this chapter we present a selection of the different models to illustrate the several different approaches employed, rather than in an attempt to achieve complete coverage of all the variations.

While there are very many similarities between the business models adopted for commercialisation of different types of new and renewable energy there are also significant differences that relate, primarily, to the energy form, availability of infrastructure and proponent experience in similar business activities. The various business models reported are, therefore, grouped under the headings of:

- **Heat and Power** production,
- **Renewable Fuels (Biofuels)** production,
- **Alternative Transport Fuels (ATFs)**.

The characteristics of each business model presented in these case studies are reported in terms of the structure proposed by Osterwalder (2004) as discussed in section 2.1.

4.1 Heat and Power Production

Heat and Power production from new and renewable energy resources has the following characteristics:

- The primary energy (e.g. solar, wind, hydro) employed is usually free,
- The heat and power produced is usually sold directly to the end user or into a utility grid,
- The key elements of the business model configuration relate primarily to the conversion of primary energy into heat and power and the financing thereof.

The following case studies illustrate some of the characteristics of the business models that are currently in use for the production of heat and power from renewable energy.

4.1.1 Solar Power Purchase Agreement Model - Corporate

Walmart Stores Inc, the world's largest retailer, and Sun Edison LLC, North America's largest solar energy services provider have entered into a solar power services agreement whereby SunEdison finances, builds, operates and maintains photovoltaic solar energy systems installed on Walmart stores. Walmart purchases the power under a long term power purchase agreement which delivers long-term, low-risk returns to project financiers. SunEdison develops the project, coordinating system design, construction, and financing with a third party investor (e.g. Goldman Sachs), and

also provides ongoing system maintenance services. The PV manufacturer (e.g. BP Solar, Sharp) installs the system and provides warranties for equipment and performance. The tax-motivated investor provides the capital and owns the system, earning a return on its investment through electricity sales revenues and any applicable federal/state incentives e.g. tax credits.

Business Model Configuration

Core capabilities:

SunEdison offers the following core capabilities:

- Equipment supply,
- System analysis, design and construction,
- System operation and maintenance.

SunEdison offers commercial solar power services that remove the complexity and cost for a large commercial consumer. They are able to do this because their customers purchase solar electricity - not equipment - at prices equal to or lower than current retail energy rates with predictable pricing and no capital outlay.

SunEdison's Solar Power service is delivered in three steps:

- Analysis, Design and Construction,
- Certification and Operation,
- Monitoring and Maintenance.

Partner network:

SunEdison partners with leading energy suppliers and manufacturers to deliver solar energy services to utilities across the U.S. and worldwide. These include:

- Duke Energy, Progress Energy and Xcel Energy as energy suppliers,
- BP Solar, Sharp as PV manufacturers and equipment installers,

Investors in SunEdison's renewable energy company include:

- Goldman Sachs, a global investment banking, securities and investment management firm,
- MissionPoint Capital Partners, a private investment firm focusing on high-growth investment opportunities created by accelerating demand for clean, secure energy and the

large-scale transition to a low-carbon economy,

- Black River Asset Management, an independently managed subsidiary of Cargill, is a global asset management company with more than 20 years of trading and investment experience,
- Greyllock Partners, one of the world's leading venture capital firms.

Value configuration

The reasons why the business is mutually beneficial for itself and its customers are:

Customers;

- Do not have to purchase solar panels themselves,
- Do not have to worry about maintenance and repair of their power supply,
- Can obtain energy from a renewable, clean source,
- Benefit from long term financial return on investment in Energy,
- Gain freedom from high or volatile energy bills,
- Enjoy an increase in employment for the area during installation,
- Creates jobs for ongoing monitoring of the system,
- Reduces Greenhouse Gas emissions,
- Has long term benefits as a result of using zero-emission systems.

Business;

- SunEdison is guaranteed power payments for the life of the contract,
- Long-term, low-risk returns for project financiers.

Value proposition:

The products and services offered include:

- Economic electricity supply,

-
- Custom-Fit Solar Power System,
 - Engineering, Procurement & Construction,
 - System Commissioning,
 - Operations & Maintenance,
 - System Monitoring,
 - Provision of an Online Portal,
 - Program Management,
 - Marketing Support

Target customer:

The target customer for SunEdison is a large commercial energy customer who is able to provide suitable space for the installation of solar panels – in this case Walmart.

Distribution channel:

The distribution channel for the company products and services primarily involves supply of electricity to the customer (Walmart) since there is no grid connection in this case study.

Customer relationship:

SunEdison provides all its customers with ongoing support through the sale of electricity, and maintenance of its solar panels throughout the life of its power purchase contract. It also makes solar energy both technically and financially viable, and enables customers to benefit from:

- Access to solar renewable energy credits to meet RPS requirements, solar energy mandates and other renewable energy objectives,
- No upfront capital investment,
- Full managed systems via their utility-scale command and control centre,
- Quick deployment with no need for expensive transmission and distribution build out,
- Environmental leadership,
- Ratepayer demand for renewable energy,

-
- Support for public affairs and Corporate Social Responsibility initiatives,
 - Solar tax incentives,
 - Fifteen minute interval data and advanced monitoring.

SunEdison has a good understanding of how RPS (renewable portfolio standards) and SRECs (solar renewable energy credits) are managed in each US state and utilizes them in a variety of ways to provide the greatest value and lowest-cost energy to the customer. They also manage the complexity of solar energy economics to offer the most competitive solar energy rates and maximise the use of:

- Federal investment tax credits,
- State tax credits and incentives,
- Local rebate programs such as performance based incentives (PBIs, etc),
- Renewable energy credits.

Cost structure:

The monetary consequences of this business model are that:

- The customer (Walmart) enters into a long term power purchase agreement, the income from which is used to fund the project. Walmart does not pay any up-front costs,
- Finance, which is secured by the PPA, is provided by the investor who owns the project and can offset the costs involved against a substantial tax liability and other financial incentives,
- Equipment purchase and installation costs are paid using the investment capital,
- System management, operation and maintenance is undertaken by the developer (SunEdison) who is paid for this service by the owner (the investor)

Revenue streams:

The main source of revenue for SunEdison is the fee paid to it by the system owner. It can also receive revenues from sale of electricity through the PPA if it has a shareholding in the project ownership company.

Outcomes

SunEdison and Walmart have announced that 22 stores in Hawaii and California will be covered with solar panels in line with this business model. At this time only one, in Hawaii, has been

commissioned so it is too early for an objective assessment of the model to be made. The proponents are clearly confident, however, as they have announced plans for the outfitting of 5 more Walmart stores in Puerto Rico.

Lessons Learned

The following factors contribute to the success of this model:

- SunEdison has developed standardized system design to reduce up-front costs, obtained bulk purchasing discounts from nation's largest PV manufacturers, and has developed a structured financing approach to minimize risk and provide reasonable return to third party investors. By targeting large commercial chains like Walmart, Staples and Whole Foods, they maximize the potential for serving multiple sites,
- The customer obtains renewable energy with no capital investment and minimal hassle at a price less than or equal to its standard utility rate, under a long-term fixed price agreement that provides a hedge against volatile energy prices,
- The third party investor obtains a low-risk return on investment in renewable energy.

4.1.2 Solar Power Purchase Agreement Model - Residential

SunRun is a San Francisco based company dedicated to providing energy using a home solar service and is the first company to offer a **residential** power purchase agreement (PPA) in the United States. It offers residential customers the means of accessing clean solar power through a PPA similar to the type used by commercial buyers, utilities and large-scale solar power plants.

Customers pay an initial deposit of US\$1,000 and thereafter they pay only for energy delivered and not the equipment for delivering it. The equipment is installed, monitored, maintained, and insured by SunRun. There is no lease or purchase of equipment, so the customer is spared the cost and hassle of buying and maintaining the system.

By entering into a monthly service agreement with SunRun, a homeowner's energy costs are set for at least 18 years at about 13 cents per kilowatt hour. The average cost for electricity from a utility is currently around 30 cents per kWh and rising.

Business Model Configuration

Core capabilities:

SunRun offers commercial solar power services that remove the complexity and cost of equipment installation, operation and maintenance for a small residential consumer. All infrastructure is provided at little or no cost to the customer, this includes:

- Project financing,

-
- Equipment procurement and installation,
 - System management, operation and maintenance.

Partner network:

SunRun oversees the design and construction of the solar electricity system by one of its equipment supply and installation partners and has recently entered into a partnership with SPG Solar, Inc, a leader in the design and installation of photovoltaic power systems. SPG Solar has experience in electrical engineering, construction and project development and provides solar technology and professional design-build services.

SunRun is in partnership with US Bank Corp for project funding and to guarantee of Power Purchase Contracts.

Value configuration:

The reasons why the business is mutually beneficial for itself and its customers are:

Customers;

- Benefit by reducing the cost of their electricity by 17 per KWh,
- Do not have to purchase solar panels themselves,
- Do not have to worry about maintenance and repair of their power supply,
- Obtain energy from a renewable, clean source,
- Get credit from the utility company when a home produces more energy than it needs.

Business;

- SunRun is guaranteed payment for the life of the power purchase contract,
- It can obtain federal and state rebates for the installation of solar.

Value proposition:

- SunRun installs and maintains the PV system at the customer's home,
- It sells the electricity generated at a lower price than that offered by a conventional utility,
- The solar panels are custom made for the customer's home,

- SunRun monitors the system using commercial metering systems,
- Sunrun is responsible for system repairs and optimization and also takes care of any damage to the panels that that results from severe weather,
- SunRuns guarantees the system will deliver the agreed amount of energy over the life of the contract.

Target customer:

The target customers for SunRun are residential home owners that are looking to reduce their electricity bills. Companies and businesses may also benefit from PPA's and services are applicable to anyone wishing to invest in a clean renewable form of energy production.

Distribution channel:

SunRun distributes its electricity directly to residential and other customers on whose property it has installed solar panels. Maintenance services are also delivered directly to the customer.

Customer relationship:

SunRun provides all its customers with ongoing support through the sale of electricity, repair and maintenance of its solar panels throughout the life of the contract. In the event that a customer moves from the residence the following options are available:

- ***Transfer the agreement.*** This option lets the customer share the cost of solar power with the new homeowner; they pick up the contract where the original customer left off. There is no charge for transferring the agreement.
- ***Pay out the remainder of the 18-year contract.*** The new homeowner can pay out the rest of the contract and have free electricity and maintenance with no further bills from SunRun. The resale value of the home can be marked up accordingly.
- ***Purchase the system.*** The customer agreement lists the buyout price for specific years. If the new homeowner purchases the system they will not get our free maintenance and repairs, but they will have full ownership of the system.

Cost structure:

Installation of a solar system at a residence can range between US\$20,000 and US\$60,000, depending, primarily, on the size of the system and its output. This cost can be substantially lowered for SunRun with the help of both state and federal rebates. Customers pay a small upfront installation fee (around \$1000) and a monthly rate comprised of a set value for every KWh of electricity used.

Revenue streams:

All of SunRun's income comes from the contracts set up with individual customers. It makes money through selling the power produced by its panels to customers.

Outcomes

SunRun is still small -- fewer than 10,000 customers and only 23 employees -- but the company has raised some serious money from respected investors such as [Foundation Capital](#), [Accel Partners](#) and U.S. Bancorp and its business model certainly makes sense for its customers.

The challenge for SunRun is to take the complicated business of solar and make it simple for the residential consumer to understand. The complexity arises from constantly-changing PV technology, different regulatory regimes that treat solar differently and the vagaries of US federal energy and tax policy that are essential to the business model.

Factors for Success

SunRun has developed a standardized system design to reduce up-front costs, has obtained bulk purchasing discounts from the largest PV manufacturers, and has developed a structured financing approach to minimize risk and provide reasonable return to third party investors.

The customer obtains renewable energy with little or no capital investment and minimal hassle at a price less than, or equal to, their standard utility rate, under a long-term fixed price agreement that provides a hedge against volatile energy prices.

By targeting residential customers SunRun maximizes the potential for serving multiple sites and spreading individual customer risk.

4.1.3 Lanai Solar Farm – the Flip Model

Completed in early 2009, developer Castle & Cooke Inc. has built a grid of 7,400 tilting PV panels on 10 acres of former agricultural land on the island of Lanai in the state of Hawaii, USA. The solar farm has a capacity of 1.2 MW and can supply up to 30% of peak electricity demand on the island. The farm is connected to the local island grid and has large battery storage to maintain output at night and on cloudy days.

Financing for the project was achieved through a private offering of shares to qualified investors who have sufficient tax liability to take full advantage of the applicable state and federal production tax credits (PTCs) and accelerated depreciation. The PTCs available for this project included a federal investment tax credit (30%), a Hawaiian state investment tax credit (35%) and a Hawaiian Qualified High Technology Business (QHTB) tax credit (100%). For every capital dollar spent, therefore, a credit of \$1.65 was received. Financing was brokered by Fallbrook Capital of California with the result that the developer contributed only 1% of the capital and the qualified investors, who own the facility through the limited liability company (LLC) Lanai Sustainability Research (LSR), contribute 99%.

LSR owns and operates the project and sells power to the Lanai utility, Maui Electric. Under a 25-year power purchase agreement approved by the state Public Utilities commission, Maui Electric purchases power from the company for 27 cents per kwh for the first 10 years, 30 cents per kwh for the second 10 years, and 33 cents per kwh hour for the following five years. The current price of electricity is over 50 cents per kwh and the solar panels are guaranteed for 25 years.

Under its majority ownership share, LSR receives the majority of revenues and tax credits, in proportion to its shareholding, for the first six years when its investment will be paid off. At this point the shareholdings will reverse (“flip”) and the developer, Castle and Cooke will become the majority owner in the project. LSR will become the minority owner or drop out of the project entirely.

The Environmental Law & Policy Center (ELPC) cautions that under US federal tax law, LSR must either retain its share in the project or sell the project to the Castle and Cooke at Fair Market Value (FMV) as determined by an independent third party, rather than a pre-arranged price. The IRS position (which is presently under review) is that the equity investor must retain at least a 10 percent share in the project after the flip, or FMV requirements will be triggered.

Business Model Configuration

Core capabilities:

Castle and Cooke’s core capabilities lie in project management and community development.

Partner network:

The partner network is extensive in this model since most of the capabilities required have to be assembled or “franchised” and includes:

- Fallbrook Capital as the Financial broker,
- Lanai Sustainable Research (LSR) and its tax-liable shareholders,
- SunPower Corp as the equipment suppliers and installers,
- Maui Electric as the utility that purchases the power.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

- The developer can finance and build the solar farm for a very small capital outlay,
- The developer gains majority ownership of the solar farm after only 6 years of operation,
- It provides a return on investment for its LSR shareholders,

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- LSR shareholders are effectively able to cash up their tax liabilities,
 - It supplies “green” electricity to help Maui Electric meet its RPS quota,
 - It provides consumers with lower electricity prices.

Value proposition:

The products and services that make up the value proposition include:

- Project financing provided by LSR,
- Project and community management provided by Castle and Cook,
- Electricity generated and sold to Maui Electric.

Target customer:

The target customer is the electricity utility, Maui Electric.

Distribution channel:

The distribution channel is via connection with the Lanai electricity lines system.

Customer relationship:

The main customer relationships include contractual agreements with Maui Electric and the owner of the land on which the solar farm is located.

Cost structure:

The cost structure is determined primarily by the capital and operating costs and the financing costs. Several different incentives, including a feed-in tariff and a renewable energy portfolio standard, are offered by the state of Hawaii to promote renewable energy as listed in Table 3.1 and these help significantly to offset the costs involved.

Revenue streams:

Income from the project is derived from:

- The project cash flow,
- The three applicable state and federal production tax credits (PTCs),
- Accelerated depreciation.

Outcomes

The Lanai Solar Farm has now come on stream and is supplying power to Maui Energy. The business model, which has already been proven for a number of wind power projects, has worked well. It is noted, however, that the considerable success of this project was largely dependent on the availability of the several different tax credits available and that some of these are not currently available.

Factors for Success

The advantages of the flip model include:

- For local investors lacking sufficient tax liability to capture the full value of the federal PTC, the model offers a way to make the project financially viable,
- Sale of electricity to an unrelated third party means the project is eligible for the federal PTC and, possibly, additional state tax incentives,
- Local owners need to raise only a relatively small initial contribution and, under ideal circumstances, will earn revenue from a debt-free (or mostly debt-free) project after the ownership flips and they become the majority owners.

Disadvantages include:

- It may be difficult for the local investors to find a tax-motivated partner to invest in the project,
- In cases where the tax-motivated investor drops out of the project entirely at the time of the flip, the fair market sale of the property to the local investors may require re-financing, so the project may not be entirely debt-free after the flip. This entails some risk that local investors should be aware of prior to initiating a project,
- If the installation is not properly maintained during the first years of the project, the local investors could be left with substantial operating expenses during the later years when incentives are no longer available.
- The somewhat complicated ownership/financing structure necessitates up-front costs for legal and tax advice.

4.1.4 Hepburn Wind Farm, Australia – Local Cooperative Model

In early 2005 the Hepburn Renewable Energy Association (HREA) approached Future Energy Pty Ltd with a proposal to establish a community owned wind farm that would help meet the electricity needs of the Hepburn Shire. Future Energy is a Victorian company established to develop, construct and operate small to medium-sized renewable energy projects throughout Australia. These projects are structured to provide opportunities for direct investment in renewable energy generation by individual investors, community companies and cooperatives, landholders, and corporate entities.

Hepburn Wind (<http://www.hepburnwind.com.au>) has been set up as a co-operative that owns and operates the Hepburn Community Wind Park - Australia's first community owned wind farm. The electricity generated is sold to a utility company, Powercorp, through a long term power purchase agreement. This co-operative is similar to a conventional public corporation except that each shareholder has one vote at meetings. In this way shareholders with A\$5000 invested have as much say as shareholders who have invested A\$100,000. Shareholders of Hepburn Wind elect its board of directors on this co-operative principle and collectively own the Wind Park.

Business Model Configuration

Core capabilities:

Hepburn Wind, through, Future Energy, has the core capabilities required to develop, construct, and operate a small to medium-sized renewable wind energy project. The co-operative lists its strengths as project management in construction and wind energy systems, community development, engineering, strategic financial planning and accounting, media and strategic social change.

Partner network:

Hepburn Wind will manage various power purchase contracts with Powercorp and has entered into a long term maintenance agreement with the turbine provider. With HREA and Future Energy it has been active in building a strong base of support within the local community that, for investment purposes, is taken to include:

- Residents (permanent or part time) of the Hepburn Shire,
- Residents of a property within 30 km of the Wind Park site (Leonards Hill),
- Members of HREA,
- Individuals with a strong personal connection to the community, for example those who visit regularly, have family in the area, are employed in the region or have previously been a resident.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

- It provides a return on investment for its shareholders,
- It supplies “green” electricity that is much needed by utilities to meet their RPS quotas.

Value proposition:

The cooperative will own the turbines and will manage the various contracts with Powercorp, the landholder etc. and administer the co-operative and share dividends.

Target customer:

The target customer is an electricity utility – in this case Powercorp.

Distribution channel:

The distribution channel is via connection to the local electricity grid.

Customer relationship:

The main customer relationships include:

- Contractual agreements with Sustainability Victoria and the landholder,
- Grid connection and electricity supply to Powercorp.

Cost structure:

The cost structure is determined by the capital and operating costs, financing costs and the electricity sales price negotiated with Powercorp. Several different incentives, including a feed-in tariff and a renewable energy portfolio standard, are offered by the Australian and State Governments to promote renewable energy as listed in Table 3.1 and these significantly impact the costs involved.

Revenue streams:

Investment in Hepburn Wind will generate financial returns through the sale of the renewable electricity generated by the Wind Park. The directors anticipate that the majority of earnings will be paid to shareholders as dividends after making allowance for expenses and contingencies. Payments to shareholders from after-tax earnings will carry associated imputed franking credits.

Outcomes

The Hepburn windfarm is now operational and represents a recent example of a small local co-operative wind farm. Similar examples can be found at www.windustry.org/minwind-iii-ix-luverne-mn-community-wind-project and www.team.gc.ca/english/dbprojects/viewproject.asp?id.

Factors for Success

This project is an excellent example of the power of community partnerships that foster leadership and build on community strengths. HREA was initiated by a group of committed people who have a high level of professional skill and whose strengths include:

- project management in construction and wind energy systems,
- community development,
- engineering,
- strategic financial planning,
- accounting,
- media and strategic social change.

The partnership with Future Energy formed the foundation of this project, offering specialised project development, financial support (and carrying the risk for this), liaison with council, government bodies, local residents and consultants. Without the skills and experience brought to the project by Future Energy, it is unlikely that it would have succeeded.

In addition, the project has captured the imagination of the community and it is ultimately the support of the people within the community that has contributed to its success.

This project has followed a distinct strategy, which evolved as it progressed. The key elements of this strategy include:

- Establishing the viability of project – both technical and community support,
- Establishing partnerships with skilled organisations
- Keeping co-op members, and other stakeholders, informed, inspired and motivated throughout the process through provision of clear, positive information
- Ensuring thorough research and the engagement of professional, unbiased consultants,
- Relationship building with local residents, in the vicinity of the turbines

- Keeping media local and focused on site-specific issues, not engaging in reactionary debate.
- Shared leadership and utilising individual skills

4.1.5 Geothermal Heat Pumps, Canada – Energy Service Contract Model

Earth Energy Utility Corp. (EEU) has applied a utility concept to the provision of GeoExchange technology by providing a turn-key installation and operation of ground source or water heat pump systems, delivering service to building owners through long term utility contracts at fixed rates.

EEU targets owners of large-scale developments (no single residential units). Customers pay a fixed monthly fee that is equal to the utility bill that would have been paid at the time of purchase, had a conventional heating system been installed. The monthly fee is guaranteed for 50 years. Also, the lease down payment is only 75 percent of the installation cost for a conventional system. EEU covers any repairs and replacements over 50 years without extra costs to the lessee. The concept is supported by some European investors (Swiss Re, pension funds, etc.). No government subsidies support this initiative.

Business Model Configuration

Core capabilities:

EEU's core capabilities include project management, provision of a turn-key installation and operation of ground source or water heat pump systems, and system management.

Partner network:

EEU's partner network, primarily, involves its relationship with GeoExchange which offers high efficiency heating and cooling systems using solar energy stored in the ground.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

- It provides a return on investment for its shareholders,
- It provides a heating and cooling system that reduces energy supply costs for consumers,
- It provides consumers with a long term guarantee of energy consumption costs.

Value proposition:

The products and services that EEU offers include:

- Supply of heating and cooling at a fixed price,

- Long term system maintenance,
- A hedge against future increases in energy prices,
- A “green energy” alternative to conventional energy.

Target customer:

The target customers are owners of large-scale developments – not individual residential customers.

Distribution channel:

The distribution channel is directly to the end use customer.

Customer relationship:

EEU engages directly with the customer as a service provider,

Cost structure:

The cost structure is determined by the capital and operating costs, financing costs and the price for the service charged to the customer.

Revenue streams:

EEU receives revenue in the form of a bi-month service fee paid by each customer.

Outcomes

Due to the lack of qualified installers for geothermal systems in Canada, EEU lost much of its potential business. Few incentives are provided for geothermal heat pumps in Canada, whereas countries like the UK and Austria provide generous grants for households and institutions deciding to install such systems. EEU has, therefore, moved its business to Europe, where the investment climate is a lot better.

EEU’s initiative is, however, being pursued by several companies including Lifetime Energy. Lifetime Energy LLC is a joint venture between Next Energy - a distributor of high efficiency water heating equipment for commercial and residential applications - and Waterloo North Hydro which provides the finance. Lifetime Energy offers local customers the ability to buy geothermal systems with a convenient monthly bill. For customers currently using oil and propane, a significant savings in energy use and fuel cost is realized immediately - as much as 70% off their current payments.

Factors for Success

The business model itself is robust in that there is a good product, a receptive market and strong core capabilities in the areas of technology and financial backing. As illustrated by EEU, however,

key factors for success include the availability of qualified installers and financial incentives for both residential and institutional customers.

4.2 Renewable Fuels (Biofuels)

Fuel production from Biomass has the following characteristics:

- Considerable cost is involved in growing and harvesting the biomass feedstock which has a low energy density,
- The biofuels produced must be distributed to the consumer and are most commonly used as an alternative transport fuel which is blended with conventional gasoline or diesel,
- The key elements of the business model configuration involve feedstock supply, its processing into fuel, fuel distribution and project financing.

There are a number of business models that have been used to bring biofuels into the market, (www.farm-energy.ca/IREF/index.php?page=technologies), however the main differences lie in the ownership of the processing plant and the degree of vertical industry integration involved. The following case studies have, therefore, been chosen to illustrate these differences. (http://www.rurdev.usda.gov/rbs/coops/Special%20Studies%20Business%20Models_Informa.pdf).

4.2.1 Ethanol Production, USA - Corporate Ownership Model

Archer Daniels Midland (ADM) is a vertically integrated agribusiness conglomerate. It does not own or manage farmland but its vertical integration means that ADM has capability to undertake grain transportation, storage, processing, ethanol production and seed oil production. Internal staff manages the plant(s) and the functions of grain procurement, renewable fuels marketing and co-product marketing. ADM currently owns and operates ethanol production at seven locations through out the mid-west of the USA and is the largest example of the corporate business model for renewable fuels.

Business Model Configuration

Core capabilities:

ADM has all the core capabilities required for ethanol and biodiesel production. These include grain procurement, transportation, storage, processing, ethanol and seed oil production, ethanol sales and co-product merchandising.

Partner network:

The partner network in this model is limited to relationships with grain suppliers and biofuel distributors since most of the core capabilities required are already available to ADM internally.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers receive a reliable supply of biofuels from a major producer that controls most of the critical functions involved in production.

ADM makes money from several functions in its vertically integrated business structure in addition to the sale of biofuels.

Value proposition:

The products and services that ADM offers include:

- Supply of biofuels,
- A market for agricultural crop feedstock,
- Provision of infrastructure use and consulting services to the biofuels industry.

Target customer:

The primary target customers are the distribution outlets for ethanol and biodiesel and independent refuelling station owners.

Distribution channel:

The distribution channel is by sale of biofuels to distributors and refuelling station owners. Co-products, and management and consulting services are marketed separately through their specific commercial channels.

Customer relationship:

The customer relationships involved in this business model primarily involve engagement with the biofuel and co-product buyers and those to whom management and consulting services are provided.

Cost structure:

The cost structure is determined by the cost of feedstock, plant capital and operating costs, the cost of product distribution and the sales price of ethanol and co-products. The several different incentives offered by the US Federal and State Governments to promote the use of ethanol as an alternative transport fuel ensure that the fuel products can be sold into a competitive fuel market.

Revenue streams:

The revenue streams received by ADM are from:

- The sale of ethanol and biodiesel,
- Provision of industry infrastructure facilities, such as feedstock transportation and storage,
- Provision of Consulting, Management and Service products.

Outcomes

ADM is now the largest ethanol producer in the U.S. and the largest renewable fuel producer in the world. It has been operating its current business model for biofuels production for a number of years and, since 2006, is increasing its focus on bioenergy production using the same model which seems to work well in this activity.

Factors for Success

The corporate business model used by ADM has proven successful over the decade that the company has been in the biofuels business. Key elements for success include the high degree of vertical integration within the business enabling ADM to control a large part of the value chain. In this regard it is noted that the ethanol biofuels business is currently suffering a downturn as enthusiasm for ethanol as a fuel additive is waning – a factor that is not within the control of the ADM business model. The financial robustness of ADM is, however, an important factor in determining the success of this business model.

4.2.2 Ethanol Production, USA – Local Cooperative Model

The Chippewa Valley Agrafuels Cooperative (CVAC) was formed in the early 1990s to establish an ethanol facility in Benson, Minnesota. It initially had over 650 shareholders made up of producers, elevators and local investors. In 1993, CVAC teamed up with the design builder Delta-T Corporation to form Chippewa Valley Ethanol Company, LLC (CVEC). This brought together a local interest with a supply of corn and an engineering firm that had experience and expertise in the ethanol business.

As the size of new ethanol plants has increased, CVEC has expanded and has pursued new initiatives to improve its market position and diversify its revenue stream. In the late 1990s, CVEC was one of the founding members of the Renewable Products Marketing Group (RPMG), which was established by producers to aggregate sales of ethanol in volumes demanded by buyers, and to market the ethanol in a cost-effective manner. Members have also used their buying power to reduce costs for certain raw materials, such as enzymes, by purchasing them collectively through RPMG. Additionally, in 2003, CVEC teamed up with some former technical and marketing executives from Pete's Wicked Ale, and began to produce Shakers Original American Vodka.

Business Model Configuration

Core capabilities:

CVEC has all the core capabilities required for ethanol production. These include grain production, transportation, storage, processing, ethanol production, and ethanol and co-product marketing.

Partner network:

The partner network in this model is largely within the co-op itself. In addition, however, its partnership with Delta-T Corporation and membership of the Renewable Products Marketing Group are key elements of its partner network.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

- The business makes money from several diverse revenue streams,
- Customers have a reliable supply of ethanol from a major producer that controls most of the critical functions involved in production,
- Feedstock suppliers have a guaranteed outlet for their product,
- Access to bulk buying power through RPMG.

Value proposition:

The products and services that CVEC offers include:

- Supply of ethanol and a variety of co-products,
- A market for agricultural crop feedstock,
- Experience and expertise in the ethanol business.

Target customer:

The primary target customers are the distribution outlets for ethanol, refuelling station owners and co-product wholesalers and/or retailers.

Distribution channel:

The distribution channel is by sale of ethanol to distributors and refuelling station owners. Co-products and other services are marketed separately through their specific commercial channels.

Customer relationship:

The customer relationships involved in this business model primarily involve engagement with the ethanol and co-product buyers and those to whom additional industry services are provided.

Cost structure:

The cost structure is determined by the cost of feedstock, plant capital and operating costs, the cost of product distribution and the sales price of ethanol and co-products. The several different incentives offered by the US Federal and State Governments to promote the use of ethanol as an alternative transport fuel ensure that the fuel products can be sold into a competitive fuel market.

Revenue streams:

The revenue streams received by CVEC are from:

- The sale of ethanol and co-products,
- Provision of industry infrastructure facilities, such as feedstock transportation and storage,
- Provision of service products.

Outcomes

CVEC has been conducting a profitable business, or series of businesses, for more than thirteen years and is now well established. It has proven that the farmer-owned business model can be adaptive and progressive, offering business strengths that go beyond an assured supply of grain.

Factors for Success

The success of this business model is clearly related to its ownership structure which provides control of the value chain from the farm gate to the finished fuel. This has the particular advantage of securing feedstock supply at a time when many farmers are diverting their crops back from fuel to food production. The broad ownership base of CVEC is also seen as a factor promoting the robustness of the co-operative business model.

4.2.3 Biodiesel Production, New Zealand – Farmer Owned Model

In 1981 a group of 110 farmers in Southland, New Zealand, formed a co-operative with the intention of making their own fuel by producing rapeseed (Canola) oil from locally grown crops. This initiative was driven by concerns about security of fuel supply during the so-called second energy crisis. A second hand oilseed extraction plant and both feedstock and fuel transportation units were purchased and the co-operative was soon in business producing rapeseed oil which was blended with diesel and used to fuel agricultural machinery. Hired staff was employed to manage and operate the processing plant and associated infrastructure. Later, the raw oil was trans-

esterified to produce methyl esters and glycerol was sold as a valuable by-product that effectively paid for the fuel processing cost.

Business Model Configuration

Core capabilities:

The core capabilities of this farmer co-operative include seed rape production, transportation, storage and processing, seed oil production and end use and glycerol sales.

Partner network:

The partner network in this model is contained almost entirely within the co-operative which is largely self contained.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers (co-operative members) receive a reliable supply of biodiesel from a producer that is effectively under their own control.

The co-operative makes money from savings in the purchase of diesel and sales of glycerol.

Value proposition:

The products and services that the co-operative offers include:

- Supply of biodiesel,
- A market for agricultural crop feedstock,
- Security of diesel supply.

Target customer:

The primary target customers are the cooperative members themselves and the glycerol buyers.

Distribution channel:

The distribution channel is internal to the co-operative which owns the tanker trucks used to deliver the fuel to each co-operative member. Co-product glycerol is distributed separately to commercial buyers.

Customer relationship:

The customer relationships involved in this business model are largely internal as co-operative members are, themselves, the main customers. A competitive buyer-seller relationship is established with glycerol buyers.

Cost structure:

The cost structure is determined by the cost of seed rape feedstock, the price of agricultural diesel, the cost of biodiesel production and distribution and the value of co-product glycerol.

Revenue streams:

The revenue streams received by the co-operative are from the sale of biodiesel and glycerol.

Outcomes

The business model described proved perfectly adequate for several years and maintained a sustainable supply of biodiesel to a small number of local co-operative members. As concerns about security of fuel supply abated, however, it was recognised that Canola oil had a much higher opportunity value if sold into the food market and was, accordingly diverted into this market. Also, the value of glycerol at the time was many times higher than it is today as co-product glycerol is now flooding the market. Consequently, the economics of biodiesel production using this model are now rather less attractive than they were when the project was initiated.

Factors for Success

The initial success of this co-operative business model was certainly due to the fact that the owners controlled all parts of the value chain so could manipulate its configuration to their own requirements. In fact, this is exactly what happened when the focus changed from security of fuel supply to the economic reality of maximising project profitability.

4.2.4 Ethanol Production, USA – Engineer/Builder Owned Model

In 1983 the Broin family built a small plant on its farm in Kenyon, Minnesota and then, in 1987, purchased and refurbished a foreclosed ethanol plant in Scotland, South Dakota. In the early 1990s, Broin & Associates began providing ethanol facility engineering and construction services for other organizations, and by the end of the decade the Broin Companies provided a range of services to ethanol producers that made them the prototype of the engineer-owned business model. These services include project development, design and construction, research and development, plant management, and marketing.

Although the Broin Companies are privately held and do not publicly report their financial status, informal reports indicate that Broin typically retains a roughly 20-25% equity stake in the facilities that it builds.

With its engineering and construction capabilities, ownership and management of partner plants, and its ethanol and distillers grains marketing services, Broin has pioneered the “engineer/builder-owned” business model.

Business Model Configuration

Core capabilities:

Core capabilities include engineering and construction, ownership and management of partner plants and marketing services.

Partner network:

Part ownership of partner plants is a key aspect of this model. Otherwise, the partner network is limited to relationships with grain suppliers and ethanol distributors since most of the core capabilities required are already available to Broin internally.

Value configuration:

Industrial customers have access to proven engineering capabilities for plant construction and operation and ethanol consumers have reliable supply from a major producer that controls most of the critical functions involved in production.

Value proposition:

The products and services that Broin offers include:

- Engineering and Construction services,
- Plant operation and management services,
- Marketing services,
- Ethanol supply,
- A market for agricultural crop feedstock,

Target customer:

The primary target customer is really the wider ethanol industry since Broin offers the services listed above and also sells ethanol to distribution outlets and independent refuelling station owners.

Distribution channel:

The distribution channel is by sale of ethanol to distributors and refuelling station owners. The other services offered are marketed separately through normal commercial channels within the ethanol and agribusiness industries.

Customer relationship:

The customer relationships involved in this business model involve engagement with the ethanol plant proponents and owners, ethanol buyers and those to whom management and consulting services are provided.

Cost structure:

The cost structure is determined by the cost of feedstock, plant capital and operating costs, the cost of product distribution and the sales price of ethanol and co-products. Several different incentives are offered by the US Federal and State Governments to promote the use of ethanol as an alternative transport fuel. With these subsidies the fuel products can be sold into a competitive fuel market.

Revenue streams:

The revenue streams received by Broin are from:

- Engineering and Construction services,
- Plant operation and management services,
- Marketing services,
- Ethanol and co-product sales,
- Plant ownership profits,

Outcomes

The Broin Companies are clearly amongst the technology leaders in biofuels production and have recently announced project LIBERTY that is the world's first commercially viable cellulosic ethanol plant. Construction, which will be completed in 2009, includes conversion of an existing dry mill corn ethanol facility to produce up to 125 million gallons annually of cellulosic ethanol from corn fiber and stover.

In 2007 the Broin companies re-branded themselves and are now grouped within an LLC known as POET.

Factors for Success

The Engineer/Builder business model used by Broin has proven successful over a period of twenty years in the biofuels business. Key elements for success include the high degrees of technical and engineering capability and the vertical integration within the business that enables Broin to control a large part of the value chain. The financial robustness of Broin and its industry leadership are also important factors in determining the success of this business model.

4.2.5 Ethanol Production, USA – Franchise Model

ASAlliances Biofuels, LLC (ASA) was formed in 2004 by Americas Strategic Alliances, LLC, a firm specializing in merchant banking and investments. ASA is building ethanol facilities in several mid-western US states. The basic premise of the company is to combine top-tier service providers with sophisticated financial partners and has assembled a group of world-class companies that collectively possess best-in-class expertise in each of the strategically necessary areas, including production plant design and construction, grain supply, ethanol and distillers dried grain (DDG) marketing, risk management, product plant management, executive management, and corporate development.

Each facility is designed and built by Fagen, Inc. a highly regarded engineering and construction company and is located adjacent to an existing Cargill grain elevator. Cargill, Incorporated provides corn and natural gas procurement services for each facility, as well as ethanol and distillers grains marketing and transportation services. United Bio Energy Management, LLC is responsible for operational and maintenance support services to each facility.

While these partner companies are being relied upon to supply grain to the facilities, manage the facilities, Americas Strategic Alliances continues to provide project development, finance, capital markets, and corporate development expertise. In addition to negotiating contracts with the construction, grain supply, product off take and facilities management firms, Americas Strategic Alliances has assembled a group of equity backers for the project and obtained the debt financing. A group of private equity firms comprised of American Capital Strategies, Ltd., Laminar Direct Capital, LP (a member of the D.E. Shaw group), US Renewables Group, LLC, and Midwest First Financial, Inc., provide a significant portion of the equity and all of the subordinated debt to ASAlliances Biofuels. Challenger Capital Group, Ltd, a Dallas based full-service investment bank, secured \$148 million in equity and subordinate debt - one of the largest financing transactions in the U.S. ethanol industry.

The organization of ASA is not vertically integrated in this “Franchise” Business Model but rather is characterized by its dependence on service providers to link to other levels of the supply chain. Thus, the producer depends on third-party service providers for grain procurement and the marketing of renewable fuels and co-products.

Business Model Configuration

Core capabilities:

Almost by definition all of the core capabilities required for ethanol and biodiesel production are available in the franchise model. ASA provides project development, finance, capital markets, executive management and corporate development expertise; Fagen provides design, engineering and construction expertise; and Cargill provides corn sourcing, energy and corn risk management services, transportation logistics expertise, and the marketing of ethanol and other DDG products.

Partner network:

The partner network in this model is extensive as it relies on service providers to link to other levels of the supply chain.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers receive a reliable supply of biofuels from a major producer that controls most of the critical functions involved in production,

ASA makes money primarily from the sales of biofuels and co-products. It's various franchisees each make money from performance of their specialised functions.

Value proposition:

The products and services that ASA offers include:

- Supply of biofuels, human and animal foodstuffs,
- A market for agricultural crop feedstock,

Target customer:

The primary target customers are the distribution outlets for ethanol, biodiesel, food co-products and retail outlets for these.

Distribution channel:

The distribution channel is by sale of biofuels and food co-products to distributors and retail outlets.

Customer relationship:

The customer relationships involved in this business model primarily involve engagement with the biofuel and co-product buyers and with feedstock suppliers.

Cost structure:

The cost structure is determined by the cost of feedstock, plant capital and operating costs, the cost of product distribution and the sales price of ethanol and co-products. Several different incentives are offered by the US Federal and State Governments to promote the use of ethanol as an alternative transport fuel. With these subsidies the fuel products can be sold into a competitive fuel market.

Revenue streams:

The revenue streams received by ASA are from the sale of:

- ethanol and biodiesel,
- human and animal foodstuffs,

Outcomes

ASA now concentrates on development of facilities with capacity to produce approximately 100 million gallons of denatured ethanol per year and currently owns and operates three fuel ethanol plants of this size. As of August 20, 2007, ASAlliances Biofuels LLC has become a subsidiary of VeraSun Energy Corporation which is indicative of the perceived success of its franchise business model.

Factors for Success

The Franchise business model used by ASA has only been in operation for five years but has been proven successful over many years in other business contexts. Key elements for success include the high quality partnerships established that contribute to the financial robustness of the company.

4.3 Alternative Transport Fuels

Alternative Transport Fuels production from new & renewable energy resources has the following characteristics:

- The primary energy feedstock cost makes up a significant proportion of the final alternative transport fuel supply cost,
- The transport fuels produced must be distributed to the consumer and may require substantial new infrastructure facilities as in the case of Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG),
- Key elements of the business model configuration involve feedstock supply, its processing into a usable fuel, fuel distribution and project financing.

By contrast with the commercialization of heat and power and biofuels discussed in the earlier sections, the introduction of ATFs usually requires consumers to make significant changes to their traditional vehicle and fuel use. The business models that have resulted have, therefore, involved the provision of government incentives for fuel switching and have frequently been managed by governments or government agencies, with equipment and fuel supply being provided by existing industry players.

Because of the high level of government involvement it can be argued that the term business model is hardly applicable. However, governments have become more or less involved in the commercial introduction of ATFs and the way in which such involvement is structured and managed has often determined the success or failure of a particular ATF program. We have, therefore, included several government programs in our consideration of business models applicable to the introduction of new and renewable energy technologies.

The following case studies have been chosen to illustrate several of the business models that have been employed in the introduction of alternative transport fuels (ATFs) in selected APEC and other economies:

- Natural Gas Vehicles (NGVs) in New Zealand, Malaysia and India,
- Synthetic gasoline in New Zealand,
- Electric Vehicles in China,
- Hybrid Electric Vehicles (HEVs) in the USA.

4.3.1 NGVs, New Zealand – Government Management Model

This case study has been chosen to illustrate a business model whereby the introduction of an alternative transport fuel (CNG) has been initiated and managed by government using financial incentives to engage both existing industry operators and consumers (vehicle owners).

In April 1979, the New Zealand Government adopted a target of 150,000 vehicles to be operating on CNG by the end of 1985. It then commenced to establish the infrastructure to support the implementation (e.g. training equipment installers, establishing standards for vehicle conversion and refuelling stations, publicity etc.). The target was subsequently modified to 200,000 vehicles by 1990.

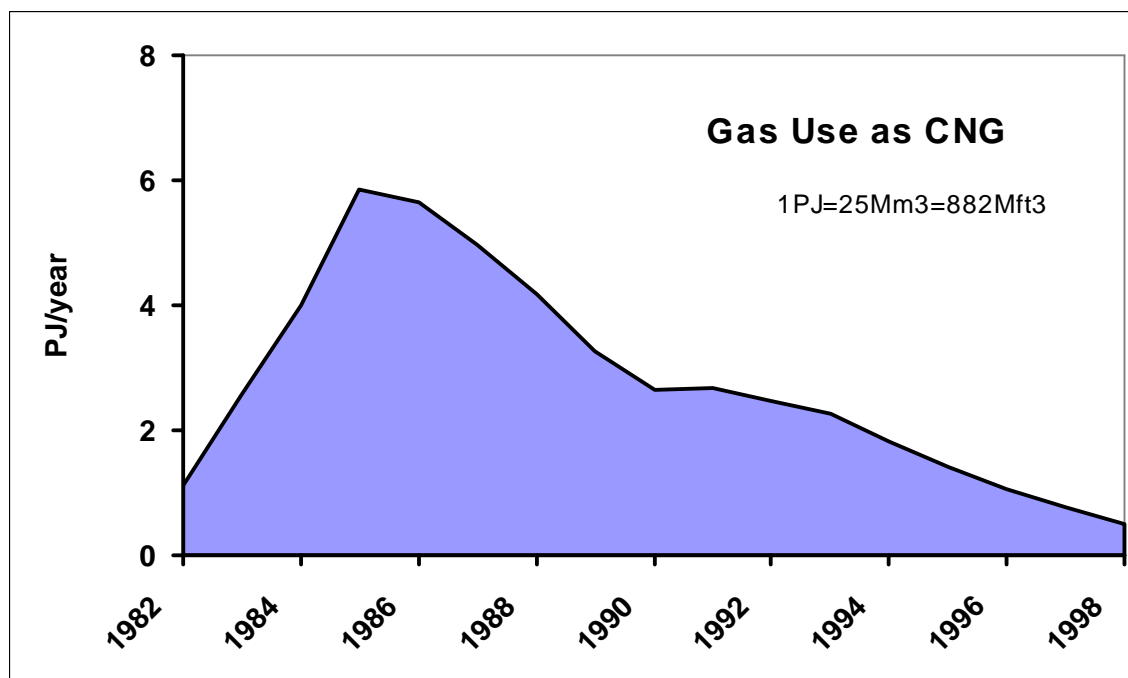


Figure 4.1: Natural Gas Consumption by NGVs in New Zealand

Initially, an incentive package was established to include grants of NZ\$200 towards vehicle conversion and 25% of the capital cost of establishing a CNG refuelling station. In addition, the retail price of CNG was held at 50% of the gasoline price on a litre equivalent basis. These incentives, which were adjusted from time to time and included zero interest loans for vehicle conversion, were sufficient to encourage the rapid uptake of CNG as an alternative transport fuel as illustrated in Figure 4.1

The New Zealand government was ultimately the responsible party for introducing CNG in New Zealand. Initially, it operated through the New Zealand Energy Research and Development Committee (NZERDC), which had representation from both government and private sector interests, and which was funded to commission energy research and studies that addressed national energy needs.

A second body, the Liquid Fuels Trust Board (LFTB), was set up in 1979 under its own Act of Parliament and charged with the task of making New Zealand independent from imported transport fuels. Together, these two agencies initiated the government role in promoting the program. Later the Ministry of Energy and a number of other government ministries and agencies participated actively under the coordination of a CNG Coordinating Committee (CCC), set up to coordinate the needed activities of government agencies and to oversee the program generally. The agencies involved and their functions are listed in Table 4.1. Three ministers of energy presided over the CNG implementation program until 1986 and all proved to be strong champions.

Private sector industry involvement was achieved by creating a market for CNG. This ensured that a number of equipment suppliers were activated and the existing refuelling station owners supplying gasoline and diesel added the equipment necessary to compress, store and dispense

natural gas. The fuel price differential proved to be a sufficient incentive for vehicle owners to switch to CNG – further encouraged by a strong government-led marketing campaign.

Table 4.1: Responsible Agencies and Functions for NGV Introduction in New Zealand

Agency	Function
Ministry of Energy	Became Lead Agency in 1981
Ministry of Transport	Regulation of vehicle equipment and installations
Department of Labour	Regulation of vehicles
Department of Education	Training of vehicle installers
Ministry of Works Post Office	Conversion of large fleets of Government vehicles
Standards Association of New Zealand	Standards for vehicle conversion and refuelling stations
Development Finance Corporation	Loans for refuelling stations and larger fleets
Natural Gas Corporation	Bulk gas to existing gas franchise areas and retailing of gas outside franchise areas
NZERDC and LFTB	Funding and management of research on various topics related to CNG
CNG Coordination Committee	Program coordination and resolution of issues

Business Model Configuration

Core capabilities:

The whole point of this business model is for a manager (the government) to assemble all of the core capabilities necessary to achieve the development of a sustainable CNG industry. In one sense, therefore, the model enjoys all the core capabilities required. More important, perhaps, is the fact that government is in a position to assemble all the capabilities required and to coordinate the functions of several different government agencies as listed in Table 4.1

Partner network:

The partner network includes all those government agencies listed in Table 4.1 together with filling station operators (mostly international oil companies) and equipment suppliers and installers.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers:

- Are assisted financially for vehicle conversion,
- Have financial help to establish refuelling stations,
- Achieve lower fuel costs,
- Have reduced exhaust emissions.

Business:

- The government improves the security of transport fuels supply,
- There is a savings in overseas exchange,
- Retail fuel prices are hedged against fluctuations in the international price of crude oil.

Value proposition:

The Government:

- Encourages vehicle owners to convert their vehicles to CNG fuelling,
- Coordinates the uptake of CNG and establishes the necessary institutional infrastructure,
- Adjusts the levels of incentive offered to manage the sustainable development of the NGV industry.

Target customer:

The primary target customers are the owners of vehicles that have high annual fuel consumption and those that have high exhaust emissions. Gas supply companies, refuelling station owners and equipment suppliers/installers may also be regarded as target customers since their involvement is required for successful development of the new industry

Distribution channel:

In this model the primary product that government is providing is its overall promotion, management and coordination services. These are distributed through:

-
- The CNG Coordinating Committee,
 - Industry Associations (e.g. the Alternative Fuels Association),
 - The regulatory framework put in place by Government.

Customer relationship:

The customer relationships involved in this business model are different from those normally encountered. Thus, the dealings of Government and its various agencies with gas supply companies, refuelling station owners, equipment suppliers/installers and the driving public is effectively an arms-length relationship. It is managed through the regulatory framework that has been established.

Cost structure:

The cost structure is determined by the several different incentives offered by Government to promote the introduction of CNG as a vehicle fuel. Vehicle owners initially receive a NZ\$200 subsidy for conversion of their vehicles and this was later changed to an interest free loan for the full conversion cost. Refuelling station owners received a 25% subsidy for equipment purchase and installation. Otherwise the main cost structure determinant was the retail price of CNG which was held at 50% of the gasoline price on a litre equivalent basis.

Revenue streams:

The revenue streams received by Government are indirect since no additional government revenue is forthcoming from the sale of CNG or associated products and services. Rather the revenue received by Government is in the form of savings on the import of crude oil and refined products that have been offset by the use of CNG. In addition, of course, there are several intangible benefits that accrue to Government. These include:

- Improved balance of payments,
- Increased national self reliance,
- Job creation to service the new NGV industry,
- Reduced automobile exhaust emissions.

Outcomes

By 1985, the NGV industry was well established with approximately 135,000 vehicles and 530 refuelling stations but was still strongly supported by government financial incentives. In 1985, a new government initiated massive economic reforms with widespread deregulation. The removal of incentives for the NGV industry was part of this deregulation and resulted in an immediate loss of public confidence in the still immature NGV industry. Vehicle conversions stopped almost

overnight. Public perception was that if the government no longer supported the NGV industry then it had no future. The problem was compounded by the dramatic fall in crude oil prices in January 1986. Although the pump price of CNG was still only half that of gasoline, the absolute financial advantage was significantly reduced.

Lessons Learned

A number of lessons can be learned from the New Zealand NGV experience. These can be summarized as follows:

- The combination of government leadership and willingness of the private sector to accept risk proved to be a sound business model for the **introduction** of NGVs,
- Financial incentives are necessary for the introduction of NGVs, but these must be managed in response to periodic market studies to address the changing needs of the developing industry. The CNG price differential should be sufficient to maintain an incentive for the initial conversion and continued use of CNG,
- Government and industry must collaborate to establish the necessary institutional infrastructure (standards, regulations, training) for regulation of the NGV industry at an early stage of its development,
- Maintenance of public confidence in a new NGV industry is essential,
- Great care must be exercised in decoupling government involvement in a new industry as it reaches maturity.

Factors for Success

Despite the eventual failure of the NGV industry in New Zealand the business model employed was a good one and extremely effective in achieving the government's goal of maximising the use of CNG as a vehicle fuel. Its key elements for success were its ability to mobilise and incentivise all the players required to establish an NGV industry and its centralised management. Its weakness, in common with that of most business models, lay in its dependence on government incentives. These had two negative effects:

- They distorted the economics of NGV use with the result that at least 30% of the vehicles converted to CNG fuelling did not have sufficiently high fuel consumption to warrant their conversion in the absence of subsidies,
- When the incentives were removed without warning the driving public completely lost confidence in the NGV program and returned to using conventional gasoline. This is well illustrated by the fall-off in CNG consumption depicted in Figure 4.1.

4.3.2 NGVs, Malaysia – NOC Management Model

This case study has been chosen because it represents the well ordered development of a new alternative transport fuels industry under the management of a National Oil Company (PETRONAS).

The NGV program in Malaysia began in 1984 at a time when the high price of crude oil had led many economies to investigate alternative transport fuels. There are now about 40,000 NGVs operating in the country, with a total of 101 NGV stations. About 300 conversions are recorded every month and the numbers are on the rise. All taxis in the Klang Valley (around Kuala Lumpur), Penang and Johor are targeted to be converted by the end of 2009.

Throughout its life, the NGV industry in Malaysia has been the responsibility of the national oil company, Petronas. The program was, however, implemented with the support of a government NGV taskforce chaired by the Economic Planning Unit of the Prime Minister's Department and made up of representatives from relevant government departments.

As commercialization proceeded, Petronas established a wholly owned subsidiary, Petronas NGV Sdn Bhd (PNGV) in 1995. The objective was to give more focus to the development and commercialization of NGV in Malaysia. Key strategies of PNGV are:

- Working towards a critical mass,
- Infrastructure development,
- Optimisation of costs,
- R&D.

From the outset, city taxis were targeted as the prime candidates for NGV conversion and the Commercial Vehicle Licensing Board passed a regulation requiring that 25% of new taxi fleets (with new permits) and all new taxis (replacing old taxis) be NGVs.

A number of incentives have been offered throughout the course of the NGV program. Initially, taxis were offered a personal or corporate loan for vehicle conversion and the price of CNG was set at half that of gasoline on a litre equivalent basis

In 1998, Petronas undertook a major initiative by jointly manufacturing (with Matra of France) 1,000 Enviro 2000 NGV taxis. This was a national initiative to provide local transportation that is environmentally friendly, efficient, and economical. To date, there are Enviro 2000 taxis that have achieved mileages well in excess of 600,000 km and are still in operation without major problems.

Business Model Configuration

Core capabilities:

The National Oil Company, as the responsible party for development of the CNG industry, has most of the core capabilities required for establishment of the fuel distribution network since it is already the primary distributor of transport fuels in Malaysia. Equally importantly, Petronas has the financial capability to sustain development of the CNG industry until such time as it is able to be commercially self sustaining. This means that Petronas can assemble the necessary capabilities for vehicle conversion and, subsequent development of purpose built vehicles such as Enviro 2000 taxis. It is also able to co-ordinate the functions of the several different Government Agencies involved in industry regulation.

Partner network:

The partner network involved was co-ordinated through a Government NGV task force Chaired by the Economic Planning Unit of the Prime Ministers Department and made up of representatives from relevant Government Departments. It was these agencies that worked in partnership with Petronas and its wholly owned subsidiary, Petronas NGV Sdn Bhd (PNGV).

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers:

- Are assisted financially for vehicle conversion,
- NGV refuelling stations are established by Petronas NGV,
- Achieve lower fuel costs,
- Have reduced exhaust emissions.

Business:

- The government improves its security of supply for transport fuels,
- There is a savings in overseas exchange,
- Retail fuel prices are hedged against fluctuations in the international price of crude oil.

Value proposition:

The Government, through Petronas NGV:

- Encourages vehicle owners to convert their vehicles to CNG fuelling,
- Coordinates the uptake of CNG and establishes the necessary institutional infrastructure,
- Adjusts the levels of incentive offered to manage the sustainable development of the NGV industry.

Target customer:

The primary target customers are the owners of vehicles that have high annual fuel consumption and those that have high exhaust emissions. This consists primarily of city taxis. Equipment suppliers/installers should also be regarded as target customers since their involvement is required for successful development of the new industry

Distribution channel:

In this model the primary product that government is providing is its overall promotion, management and coordination services. These are distributed through:

- The Government NGV task force,
- Petronas NGV,
- The regulatory framework put in place by Government.

Customer relationship:

The customer relationships involved in this business model are primarily between Petronas NGV, equipment suppliers/installers and the driving public.

Cost structure:

The cost structure is determined by the several different incentives offered by Government to promote the introduction of NGVs which have changed over the course of the NGV program. Initially, taxis were offered a personal or corporate loan for vehicle conversion and the retail price of CNG was set at half that of gasoline on a litre equivalent basis.

Later, in 1995, the government added two more incentives:

- A road tax deduction of 25% for bi-fuel and dual-fuel vehicles and 50% for dedicated NGVs,

- Accelerated capital depreciation for the purchase of dedicated CNG buses and the construction of NGV refuelling stations.

In addition, Petronas has also provided incentives in the form of a rebate for conversion in order to spur the market. The scheme was introduced in 1999 for a period of three years and about 6,000 taxis benefited from it.

Revenue streams:

Revenue streams received by Petronas are from the sale of CNG and associated products and services. The Government benefits from the savings on the import/export substitution of crude oil and refined products. In addition, there are several intangible benefits that accrue to Government. These include:

- Improved balance of payments,
- Increased national self reliance,
- Job creation to service the new NGV industry,
- Reduced automobile exhaust emissions.

Outcomes

The NGV industry in Malaysia is now well established. The appropriate vehicles (taxis) have been converted to NGVs and purpose built vehicles are coming on stream. A wide range of institutional issues has now been satisfactorily addressed. These have included the approval of facilities and equipment and certification of NGV technicians.

PNGV is now focussing its efforts on the heavy-duty market with emphasis on heavy-duty vehicle conversions in the Klang Valley and Johor Bahru. Central to this is a city bus program and interest in the use of CNG in trucking fleets in light of increasing diesel prices.

Lessons Learned

The following lessons can be learned from the Malaysian NGV experience:

- Appointment of the national oil company as champion for, and organizer of, NGV industry development enables coherent and orderly industry growth,
- Ongoing government support and provision of financial incentives is required for the introduction of NGVs and this can be maintained for a long period by the national oil company,
- The development and maintenance of public confidence in an NGV industry is essential.

4.3.3 NGVs, India – Court Order Model

This case study has been chosen because it illustrates how an alternative transport fuel can be mandated to reduce local air pollution and implemented in the absence of a natural gas pipeline network.

Drivers

The NGV market in India has developed almost exclusively in response to a single driver, *viz.* the need to reduce urban air pollution from automobile exhaust emissions.

On July 28, 1998, the Supreme Court of India issued an order to the Government of the National Capital Region (NCR), which includes the city of New Delhi, with a time frame for the following actions:

- Replacement of all pre-1990 auto-rickshaws and taxis with new vehicles using clean fuels by March 31, 2000,
- Provision of financial incentives for replacement of all post-1990 autos and taxis with new vehicles using clean fuels by March 31, 2001,
- No buses more than eight years old to operate except on CNG or other clean fuels, after March 31, 2000,
- The entire Delhi Transport Corporation (DTC) and private bus fleet to be converted to dedicated CNG operation by March 31, 2001,
- New interstate bus terminals (ISBT) to be built in the north and southwest of New Delhi by March 31, 2000 to avoid pollution from interstate buses,
- The Gas Authority of India, Ltd. (GAIL) to expand its CNG dispensing capacity to 80 stations by March 31, 2001,
- Two independent fuel testing labs to be established by June 1, 1999,
- Inspection and maintenance (I&M) facilities for commercial vehicles to be set up immediately,
- Comprehensive I&M programs to be started by the Transport Department and the private sector by March 31, 2001.

Initially, GAIL had responsibility for the NGV program but in December 1998, a new joint venture company, Indraprastha Gas Limited (IGL) was incorporated to implement the orders of the Supreme Court. The IGL joint venture partners are GAIL, Bharat Petroleum Corporation Limited (BPCL), and the Government of the National Capital Territory (NCT) of New Delhi.

Business Model Configuration

Core capabilities:

Indraprastha Gas Limited (IGL) through its joint venture partners (GAIL and BPCL) has all of the capabilities necessary for gas and transport fuel handling and distribution. In addition the Government of the National Capital Territory (NCT) of New Delhi has the jurisdiction to ensure the uptake of CNG.

Partner network:

The partner network involved is co-ordinated through (IGL) in partnership with the Government of the National Capital Territory.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers:

- Are assisted financially with vehicle conversion,
- NGV refuelling stations are established by IGL,
- Achieve lower fuel costs,
- Have reduced exhaust emissions.

Business

- The Government of New Delhi greatly reduces automobile exhaust pollution in the city,

Value proposition:

The Government, through IGL:

- Encourages vehicle owners to convert their vehicles to CNG fuelling,
- Coordinates the uptake of CNG and establishes the necessary institutional infrastructure,
- Adjusts the levels of incentive offered to manage the sustainable development of NGVs in Indian cities.

Target customer:

The primary target customers are the owners of vehicles that have high exhaust emissions. Such vehicles are, primarily, auto-rickshaws, taxis and city buses. Equipment suppliers/installers should also be regarded as target customers since their involvement is required for successful development of the new industry.

Distribution channel:

The primary product that government is providing is its overall requirement that NGVs are introduced in the city of New Dehli. This requirement is effectively distributed through:

- The Government of New Dehli,
- IGL,
- The regulatory framework put in place by Government.

Customer relationship:

The customer relationships involved in this business model are primarily between IGL, the Government of New Dehli, equipment suppliers/installers and the driving public.

Cost structure:

The cost structure is determined by the incentives offered to promote the introduction of NGVs and the cost of CNG. Financial incentives were offered for replacement of all pre-1990 automobiles and taxis with new vehicles using clean fuels and a sustainable price differential between the cost of CNG and gasoline and diesel is now established.

Revenue streams:

Revenue streams received by IGL are from the sale of CNG and associated products and services. The Government benefits from the savings on the import/export substitution of crude oil and refined products. In addition, there are several intangible benefits that accrue to Government; these include:

- Reduced automobile exhaust emissions,
- Job creation to service the new NGV industry,
- Increased national self reliance,
- Improved balance of payments.

Outcomes

The introduction of NGVs in India has been a success despite the almost total absence of infrastructure (gas pipelines) at the outset. Today, there are approximately 850,000 NGVs operating throughout India and approximately 325 refuelling stations. The majority of these vehicles are auto-rickshaws. The business model involved was certainly unusual but it proved effective in initiating the industry and getting it up to a steady state operation.

Lessons Learned

The following lessons have been learned in establishing the NGV industry in India:

- A Supreme Court directive can be successful in engaging Government commitment to the program,
- Centralised program management through GAIL and IGL has proved effective,
- Local government and transport authorities must be fully involved in the NGV implementation program,
- A sustainable fuel price differential for CNG is a necessary incentive for fuel switching,
- OEM support significantly enhances program viability.

4.3.4 Synthetic Gasoline, New Zealand – Tolling Model

This case study has been chosen to illustrate the introduction of an alternative transport fuel that is compatible with conventional petroleum-derived fuels. The concept was that synthetic gasoline would be blended into the gasoline pool with negligible functional impact on the driving public.

The Motonui synthetic fuels plant was completed in 1986 by a partnership between the New Zealand Government and Mobil Oil, who became shareholders in New Zealand Synthetic Fuels Corporation (Synfuels). The synfuels plant was operated by Mobil, which carried the project technical risk. The New Zealand Government carried the financing and market risk for the project since it owned the gas and paid Synfuels a processing (tolling) fee for gas-to-gasoline conversion. This risk was addressed by the government determining that synthetic gasoline would have a priority on the New Zealand market with gasoline from crude oil providing the balance.

The world's first commercial synthetic fuels venture was financed from one of the largest non-recourse loans ever raised on the euro-dollar market on a project loan basis. The facility was for a total of US\$1.7 billion including a standby facility of US\$500 million in case of cost over-runs. The reasons behind the corporation's success in raising such a large loan lay in the determination of its shareholders to formulate a bankable proposition.

Because the New Zealand Government, rather than New Zealand Synthetic Fuels Corporation, owned the natural gas feedstock the government had to give an assurance that the supply of gas

would be continued until at least the project capital cost and debt servicing were recovered. Production risk due to inefficient management and operation of the plant was minimised by contracting plant management to Mobil, which had the experience and resources to do a competent job.

Business Model Configuration

Core capabilities:

The New Zealand Synthetic Fuels Corporation through its joint venture partners (the New Zealand Government and Mobil Oil) had all of the capabilities necessary for the production, handling and distribution of transport fuels. In addition the Government had responsibility for the marketing of Synthetic Gasoline.

Partner network:

The partner network involved is limited to the joint venture between the NZ Government and Mobile Oil in the first instance although the latter clearly has an extensive partner network associated with its production and distribution of conventional transport fuels.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers:

- Are provided with an alternative transport fuel that is indistinguishable from its conventional counterpart.

Business:

- Synfuels received an adequate return on investment for converting natural gas into synthetic gasoline,
- The Government, which owned the natural gas, made money on the sale of synthetic gasoline,
- Mobil oil received an income for licensing the technology and operating the plant.

Value proposition:

The value proposition in this case is indirect because it does not immediately impact upon customers.

Rather the value of the project lies primarily with Government and includes:

- Improved balance of payments,
- Increased national self reliance,

Target customer:

The primary target customer is the New Zealand Refining Company that effectively controlled the national gasoline pool into which synthetic gasoline was sold.

Distribution channel:

The synthetic gasoline product was owned by the New Zealand Government and distributed through the national gasoline distribution system.

Customer relationship:

The customer relationships involved in this business model are primarily between the New Zealand Synthetic Fuels Corporation, Mobil Oil, the New Zealand Government and the New Zealand Refining Company.

Cost structure:

The key elements of the cost structure were:

- The price of natural gas,
- The tolling fee levied by Synfuels for processing natural gas to synthetic gasoline and the sales price of the synthetic gasoline product – the majority of which was exported and sold to overseas refineries which could benefit from its 93 RON clear properties.

Revenue streams:

As indicated above the revenue stream received by Synfuels was in the form of a tolling fee for conversion of natural gas into synthetic gasoline. That received by the New Zealand Government was from the sale of synthetic gasoline and it's by products and Mobil Oil received revenue for licensing the technology and operating the plant.

Outcomes

The New Zealand Synthetic Fuels plant was definitely a technical success and it exceeded its design capacity of around 2,000 tonnes/day of synthetic gasoline by approximately 18% once de-bottlenecking had been undertaken following commissioning. Despite the original plans, the synthetic gasoline product was sold almost exclusively overseas because of its high value as a

refinery blendstock. Indeed, it is possible that no synthetic gasoline ever found its way into the New Zealand gasoline pool.

Following the fall in international crude oil prices in January 1986, synthetic gasoline became uneconomic to produce and the MTG section of the plant was mothballed. The plant still continued to operate, but as a methanol plant producing 4,400 tonnes/day of "wild" methanol (17% water content), which was further distilled to produce chemical methanol. In the late 1980s, the synfuels plant was sold into the private sector and is now owned by Methanex Corporation.

The New Zealand synfuels plant is widely considered to be an economic disaster brought about by the fall in crude oil prices and it became a political football during New Zealand's elections in 1987 following the fall in oil prices. It should be remembered, however, that by selling synthetic gasoline overseas New Zealand was able to achieve a major reduction in its balance of payments and this was a key factor in the nation's economic recovery after 1987.

Lessons Learned

The following lessons can be learned from the New Zealand synthetic gasoline experience:

- A project can be progressed very rapidly and efficiently when championed by senior ministers and government agencies,
- Enabling legislation is likely to be required to expedite a project of this magnitude in an economy that has little previous experience of such projects,
- Government backing and its assumption of the market and financial risks were key factors in engaging Mobil as a project partner capable of assuming the technical risk,
- Despite the original plans for achieving energy security, economics ultimately controlled the way in which the synfuels plant was operated. Thus the synthetic gasoline product achieved a higher value when sold overseas and the plant was effectively reconfigured when the opportunity value of the methanol intermediate outweighed that of synthetic gasoline,
- Introduction of the synthetic gasoline product into the market was seamless and was accomplished as part of the everyday activities of the oil companies without intruding on public awareness.

4.3.5 Electric Vehicles, China – Free Market Model

This case study has been chosen to illustrate the introduction of an alternative transport fuel by a business model that has developed as a direct consequence of natural market forces rather than by financial incentives or regulations established by government.

Background

Over the last few years, China has focused on domestically produced electric scooters, bikes, cars, and buses. As illustrated in Figure 4.2, sales of electric bikes and scooters (E bikes) have increased dramatically since 2000 and reached an estimated 25 million in 2008. This growth has been due in part to the fact that China has a well established bicycle culture, competitive pricing and recently introduced policies that allow E bikes to use regular bicycle lanes. In some cities, there have been bans on the production of new two-stroke gasoline fuelled vehicles since 1996.



Figure 4.2: Growth of Electric Vehicles in China (millions)

E bikes are now preferred by commuters who previously relied on bicycles, mass transit or gasoline fuelled scooters. In Shanghai, Beijing and several other large cities, gasoline powered scooters are being phased out because of the pollution they produce.

E bikes in China cost between US\$200 and \$300 depending on size, quality, and battery type. However, in the highly competitive market for bike manufacturers there is currently no incentive to install lithium-ion batteries that may increase the vehicle cost by as much as 50%.

While the Government of China clearly supports the uptake of E bikes, there does not appear to be any one government agency that has been assigned responsibility for their promotion. Rather, the government has announced its policy of reducing urban air pollution and has apparently limited its involvement to establishing standards, codes of practice and regulations to govern the rapidly emerging industry.

In a number of cities, urban officials effectively administer the local policies and ordinances championed by their city governments. Otherwise, local and national manufacturers produce the E bikes and sell them to willing buyers at competitive prices. Currently the main risk associated with this free market model is that the speed of introduction is outstripping the establishment of institutional infrastructure and this could lead to a lowering of consumer acceptance, which is a key driver for the business model.

Business Model Configuration

Core capabilities:

The core capability that contributes to this business model is the ability of Chinese manufacturers of electric scooters, bikes, cars and buses to produce these vehicles at a price competitive with their conventional counterparts.

Partner network:

Interestingly, there is no obvious partner network involved in this business model as each of the vehicle suppliers is effectively in competition. The requirements of good competition have, however, led to a degree of coordination and standardization although the industry so that communal battery re-charging facilities can be utilised as illustrated in Figure 4.3.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers:

- Are provided with an alternative propulsion system that may be both cheaper and more convenient than conventional counterparts,
- Are provided with incentives to move away from conventional gasoline and diesel.

Business

- Vehicle suppliers have access to a very large and lucrative domestic market,
- This market is extending to exports – primarily to other Asian economies and to the USA.



Figure 4.3: Electric Scooters Being Recharged at a Public Facility

Value proposition:

The value proposition in this case includes:

- Lower operating costs,
- Preferred vehicle operating characteristics (E bikes),
- Avoidance of sanctions imposed on gasoline and diesel vehicles

Target customer:

The primary target customer is the driving public – primarily those that use 2 wheelers for local urban transportation.

Distribution channel:

E bikes are distributed by the OEMs and sold to the public through the same retail outlets as employed by their conventional fuelled counterparts,

Customer relationship:

The customer relationships involved in this business model are between the:

- OEMs, distributors and retail outlets,
- Retail sales outlets and the customer.

Cost structure:

The cost structure elements include:

- The differential cost difference between an EV and its conventional fuelled counterpart,
- The price of electricity,
- The cost of establishing vehicle re-charging facilities,
- The cost of periodic battery replacement.

Revenue streams:

The revenue streams received by EV industry participants are limited primarily to revenue derived from the sales of EVs, electricity, parts, accessories and maintenance services

Outcomes

Despite the comparatively short recent history of electric vehicles, the rapid growth of the E bike market in China means that it is now well established. Most importantly, the EV industry has become established without government fiscal incentives and largely in response to natural market forces. The likelihood of its being sustainable is, therefore, high since there is no need for phasing out government support that usually leads to a significant reduction in consumer confidence and acceptance.

Lessons Learned

The following lessons can be learned from the introduction of EVs in China:

- Strong commercial competition, which has been the main market driver, has enabled vehicle costs to be made very attractive to consumers and has effectively become the free market business model,
- Provided the initial vehicle purchase costs and fuel prices are right, an alternative transport fuel will effectively introduce itself without government assistance or the application of a complicated business model,

- A project can be progressed very rapidly and efficiently when championed by the government and promoted by government agencies, although in China government involvement in the introduction of E bikes has been limited to an announcement of policy and restrictions placed upon gasoline and diesel fuelled vehicles. There has been no apparent need for coordination of activities between different parts of government,

4.3.6 Hybrid Electric Vehicles, USA – Consumer Incentive Model

This case study has been chosen to illustrate the uptake of new and renewable energy through targeted consumer incentives provided by government and administered by several different government agencies.

As indicated in Table 4.2, the growth of Hybrid Electric Vehicles (HEVs) in the USA has been extremely rapid and is forecast to continue. Annual sales of HEVs are expected to reach nearly 800,000 in 2012. Currently the market share of HEVs in the USA is about 2.2%.

Table 4.2: Recent and forecast Growth of HEVs in the USA

Date	Vehicle Sales	Market Share %	Number of Models
2000	9,350		39
2004	84,199	0.5	40
2005	209,711	1.2	37
2006	252,636	1.5	37
2007	352,274	2.1	45
2008	312,386	1.9	50
2012	780,000	4.2	52

The market for HEVs is driven largely by the fiscal and financial incentives put in place by both federal and state governments and by the regulations promulgated to increase the attractiveness of AFVs in general, and HEVs in particular, by comparison with conventional gasoline and diesel vehicles. Since these incentives are directed primarily at consumers rather than the OEMs (Appendices B1 and B2) there is no real need for them to develop specialised business models additional to those already in place for the promotion and marketing of conventional vehicles.

The federal government agencies responsible for the introduction of HEVs are now the US Environmental Protection Agency (USEPA) and the US Department of Energy (USDoE), each of which is acting in response to its requirement to administer the legislative acts for which it is responsible.

Business Model Configuration

Core capabilities:

The core capabilities of this business model are:

- The ability of OEMs to manufacture HEVs in larger numbers,
- The existence of established capabilities for the distribution, marketing and retailing of HEVs.

Partner network:

The partner network for this model is well established and includes the OEMs, vehicle distributors and retail sales outlets which normally also provide parts and accessories, after-sales service and maintenance.

Value configuration:

The reasons why the business is beneficial for itself and its customers are:

Customers:

- HEV's have lower exhaust and GHG emissions than conventional gasoline and diesel fuelled vehicles,
- They have preferred vehicle operating characteristics,
- They contribute to national initiatives to increase energy security since the electricity is generated from domestic primary energy resources and there are economic drivers relating to the cost of securing oil supplies and the potential for export of HEVs.

Business:

- Vehicle suppliers have access to a very large and lucrative domestic market,
- This market is extending to exports outside the USA.

Value proposition:

The value proposition in this case includes:

- Fiscal and financial incentives to move away from conventional gasoline and diesel.
- Avoidance of sanctions imposed on gasoline and diesel vehicles,
- Increasing economic attractiveness of HEVs by comparison with conventional gasoline and diesel vehicles.

Target customer:

The primary target customer is the environmentally conscious section of the driving public.

Distribution channel:

HEVs are distributed by the OEMs and sold to the public through the same retail outlets as employed by their conventional fuelled counterparts,

Customer relationship:

The customer relationships involved in this business model are between the:

- OEMs, distributors and retail outlets,
- Retail sales outlets and the customer.

Cost structure:

The cost structure elements include:

- The differential cost difference between an HEV and its conventional fuelled counterpart,
- The price of electricity (for PHEVs only),
- The cost of establishing vehicle re-charging facilities for PHEVs,
- The cost of periodic battery replacement.

Revenue streams:

The revenue streams received by HEV industry participants are limited primarily to revenue derived from the sales of HEVs, electricity (for PHEVs), parts, accessories, and maintenance services

Outcomes

The HEV market in the USA is now well established but relies heavily on fiscal and financial incentives made available by federal and state governments so is not yet fully sustainable. The number of HEV models available in the market, however, is projected to grow substantially (Table 4.1) and this will boost HEV sales.

Despite its anticipated growth the HEV percentage share of the 2015 car market is expected to remain within single digits, thus limiting their desirable energy and environmental impacts. Nevertheless, by 2015, HEVs may be expected to have a quantifiable positive impact on the local air quality in urban areas.

Lessons Learned

The following lessons can be learned from the USA experience in introducing HEVs:

- As in the case of Flexible Fuelled Vehicles (FFVs), government mandates and fiscal and financial incentives have been very effective in achieving rapid introduction of HEVs,
- Since most of the incentives offered by governments are aimed at consumers (the vehicle owners) rather than the OEMs there is no real need for them to develop specialised business models additional to those already in place for the promotion and marketing of conventional vehicles.
- The strong “hands on” management and guidance of HEV introduction by both federal and state governments has meant that OEMs can respond using their existing marketing models.

5. Business Model Configurations

There are almost as many different business models as there are businesses, however the difference are often quite minor so that, realistically, there are only about twenty distinct business model configurations – each with a considerable number of minor variants. In fact, only a few of these models have been developed specifically for the commercialization of new and renewable energy technologies and examples of most are to be found elsewhere in the business world. Indeed, some of the business models that have been employed successfully are essentially the same as the “business as usual” models already employed in the marketplace. This is often the case for alternative transport fuels where existing business models for transport fuel supply, distribution or end use simply respond to the incentives offered by governments.

Our review of the available literature has shown that several authors have already published studies of the business models applicable to new and renewable energy and have identified those that are likely to be successful in particular regulatory environments. It is appropriate, therefore, to report this work in the present study and to update and build upon it in line with more recent experience.

The main studies to which reference is made throughout the following chapters are:

New Business Models for Customer-Owned Renewable Energy Generation, prepared for We Energies, USA, by Rahul Young and Claire Cowan, ICF International (March 2007). Available at: http://www.weenergies.com/business_new/altenergy/existbusrpt.pdf

A Comparative Analysis of Community Wind Power Development Options in Oregon, prepared by Mark Bolinger, Ryan Wiser, Tom Wind, Dan Juhl, Robert Grace (July 2004). Available at: http://www.cleanenergystates.org/library/Reports/OR_Community_Wind_Report.pdf

Utility Solar Business Models: Emerging Utility Strategies & Innovation, prepared by John Nimmons and Mike Taylor for the Solar Electric Power Association (May 2008). Available at: www.renewableenergyworld.com/.../solar.../utility-business-model-report-released-by-sepa-52670

Business Models for Ethanol and Biodiesel, prepared for the United States Department of Agriculture, USDA, by Informa Economics (January 2007). Available at: www.rurdev.usda.gov/.../Special%20Studies%20Business%20Models_Informa.pdf

In the following sections individual business models are identified in line with the model types cited by these four sources. Each is described briefly and its perceived advantages and disadvantages, or barriers to use, are assessed. For the purpose of identifying successful business models in this chapter we have applied the following criteria – not all of which apply to all business models:

- Ability to attract investment,
- Ability to capture the full value of business incentives available,
- Ability to control large parts of the value chain,

-
- Sensitivity to, and dependence on government incentives,
 - Demonstrated successful use over a long period,
 - Robustness to changes in product prices and business costs.

As in the previous chapter, the various business models reported are described under the headings:

- **Heat and Power,**
- **Renewable Fuels (Biofuels),**
- **Alternative Transport Fuels**

5.1 Heat and Power Production

Production of heat and power from renewable energy sources has resulted in the following model types as designated by ICF International (March 2007):

- Community wind models,
- Multi-party ownership models for Anaerobic Digesters,
- Third party ownership models,
- Project aggregation models,
- Renewable-as-appliance models,
- New construction models,
- Environmental credit market models.

These, together with their several subdivisions and variations, are presented in the following sections.

5.1.1 Community Wind Models

In general, utility-scale wind turbines are the most cost-effective technologies for procuring substantial renewable energy generating capacity. Utility scale has been defined as “one or more 600 kW, or greater, installations interconnected on either the customer or utility side of the meter” (Bolinger et. al. 2004).

In recent years community wind business models have become a mechanism for promoting local ownership. Their advantages and the barriers to their implementation are seen, (Young and Cowan, 2007) to be:

Advantages:

- **Promotion of Rural Economic Development.** Several studies have shown that locally-owned wind projects are more beneficial to rural economies than those that are commercially-owned. Most notably, a 2004 study by the U.S. Government Accountability Office (GAO 2004) showed that community-owned projects produced at least twice the number of jobs, and two to three times the amount of income. The same study concluded that the larger and more diverse a county's economic base, the greater the local benefits in terms of jobs and income because labour and materials can be procured locally rather than imported.
- **Creation of New Revenue Streams for Farmers.** Most wind projects are sited on privately-owned agricultural land and the owner receives a lease payment for use of the land. These lease payments are likely to be higher if the farmer has at least a partial ownership stake in the project. Wind energy revenues are more stable than crop revenues and the American Corn Growers Foundation has been a strong advocate for community wind development since 2001. However, the GAO notes that due to the high costs of utility-scale wind turbines, a commercially-owned project with greater financial resources may be able to install more turbines and thus offer higher overall revenues to the farmer than a farmer-owned project (GAO 2004).
- **Increasing Community Acceptance.** Ensuring a local financial/ownership stake in a wind project may reduce the magnitude of opposition to a proposed project. In addition, piggybacking community-owned turbines on a large commercial project may access the benefits of economies of scale and offer greater incentives for community support of the project.
- **Unique Project Size Niche.** The average project size (10-20 MW) fills a niche between large-scale commercial projects (30-300 MW) and residential-scale wind installations. In some rural areas, community wind projects may be possible in places where limited transmission infrastructure capacity does not make larger-scale projects viable.

Barriers

Community wind projects may face a number of barriers such as:

- Financing difficulties, including the inability of smaller investors to utilize tax credits fully,
- Poor economies of scale,
- Regulatory barriers such as securities regulations and IRS restrictions that present challenges for project financing,
- Unfavourable power buyback rates,

- Burdensome interconnection requirements.

Several ownership and financing structures have been developed to address these barriers. This section summarizes the advantages and disadvantages of each and how the barriers identified have been surmounted.

5.1.1.1. Multiple Local Owner model

This model was employed for one of the first community wind projects, the Minwind project in Minnesota, and may offer the greatest financial returns for investors with sufficient tax liability. It is one of the more commonly-employed community wind ownership structures (Young and Cowan, 2007).

In this model, a group of local investors forms a limited liability corporation (LLC) to own and operate the project, selling power to a utility under the terms of a negotiated power purchase agreement (PPA). Equity financing is raised through the sale of shares in the project. Debt is obtained through a bank or loan fund supporting renewable energy development. Revenues and tax incentives are divided between the project investors in accordance with their proportional ownership share in the project.

The advantages of the Multiple Local Owner model are seen to be:

- Sale of electricity to an unrelated third party makes a project eligible for the federal tax incentives such as accelerated depreciation and the production tax credit (PTC). State tax incentives may also be available,
- This model is the most financially competitive of the seven community wind models reported by ICF International (March 2007) provided the investors can capture at least 65 percent of the value of the federal PTC.

Disadvantages include:

- The sale of shares requires either securities registration or exemption from registration requirements – both of which increase the legal expenses involved with setting up a project,
- The model becomes less financially competitive when investors have insufficient tax liability to take full advantage of the PTC and other tax incentives,
- Administrative costs may be as much as two times higher than for other models (like the flip model) due to the need for coordination and communication between multiple investors.

5.1.1.2 The Flip model

Next to the Multiple Local Owner model the Flip model is one of the most common ownership structures and can be customized to meet project-specific financing requirements.

There are two variations of the model - the Minnesota flip and the Wisconsin flip. In the Minnesota flip model, a single investor or group of investors forms an LLC and partners with a corporation that has sufficient tax liability to take full advantage of the federal PTC and accelerated depreciation. The local investors contribute as little as 1 percent of the equity required to finance the project, with the corporation supplying as much as 99 percent. (The relative magnitude of these ownership shares are one of the variables that can be adjusted within the model.)

The partnership owns and operates the project, selling power to a utility under the terms of a negotiated PPA or a standard tariff. Under its majority ownership share, the corporation recoups the return on its investment by receiving the majority of revenues and tax incentives for 10 years (the PTC expiration period) or until its investment is paid off. At this point, the local investors become the majority owners in the project, and the tax-motivated investor becomes the minority owner or drops out entirely.

In the Wisconsin flip model, the LLC provides a loan to the corporate investor instead of contributing equity to the project. The investor contributes all of the equity for the project, and the remaining financing is provided by a commercial bank loan. The corporation is the sole project owner for the first 10 years, receiving all revenues and tax benefits while paying off the commercial loan and also paying interest to the local owners on the LLC loan (interest payments are the LLC's sole income for the first 10 years of the project.). Upon expiration of the federal PTC at the 10-year mark, the corporation drops out, retaining the LLC loan principal as payment for the project. The LLC becomes the full owner of a debt-free project.

Under US federal tax law, the corporation must either retain its share in the project or sell the project to the local investors at fair market value (FMV), as determined by an independent third party, rather than a pre-arranged price (Kubert 2004). The IRS position is that the equity investor must retain at least a 10 percent share in the project after the flip, or FMV requirements are triggered (Young and Cowan, 2007).

The advantages of the Flip model are seen to be:

- For local investors who have insufficient tax liability to capture the full value of the federal PTC, the model offers a way to make the project financially viable,
- Sale of electricity to an unrelated third party means the project is eligible for the federal PTC, and possibly also state tax incentives,
- Local owners need to raise only a relatively small initial contribution and will, under ideal circumstances, earn revenue from a debt-free (or mostly debt-free) project after the ownership flips and they become the majority owners.

Disadvantages include:

- It may be difficult for the local investors to find a tax-motivated partner to invest in the project as institutional investors are usually only interested in larger-scale investment opportunities than are offered by the typical community wind project,

- Where the tax-motivated investor drops out of the project entirely at the time of the flip, the fair market sale of the property to the local investors may require re-financing, so the project may not be entirely debt-free after the flip. This entails some risk that local investors should be aware of prior to initiating a project,
- If equipment is not well maintained during the first ten years of the project, the local investors could be left with substantial operating expenses during the later years of the project when tax incentives are no longer available,
- The somewhat complicated ownership/financing structure involves up-front costs for legal and tax advice.

One way of overcoming the financing hurdle is to aggregate multiple community wind projects under a single PPA and financing arrangement. The challenge with this approach is the difficulty of aligning multiple projects with different landowners on a similar timeline and is most likely to succeed when it involves multiple landowners on adjacent properties (Young and Cowan, 2007).

5.1.1.3 Consumer Cooperative model

A co-operative is a member-owned, democratically-governed enterprise that provides goods or services for the exclusive benefit of its members. Any profits generated by the cooperative are typically distributed annually to members in the form of a dividend. The amount of the dividend is based on the amount of business each member has conducted with the cooperative, rather than on their level of investment.

Community wind projects are normally structured as consumer co-operatives such that each investor has one vote. Energy produced by the co-operative may either be delivered directly to members for their consumption, or netted against members' power consumption. Under the netting scenario, the cooperative establishes a PPA with the local utility and at the end of each netting period the wind project's output is netted against the electricity consumption of the co-op members.

Co-operative ownership of wind projects is fairly rare, especially in the United States where a number of factors make this model complex and uncompetitive. The TREC WindShare project is one of the few wind projects in North America that employs a cooperative ownership structure and was also the first project to install utility-scale turbines in an urban environment. Sweden is one of the few countries where true cooperatives have generated a substantial amount of wind development.

The advantages of the Consumer Cooperative model are seen to be:

- Utility support for aggregated netting,
- Engagement of community support for wind power development.

Disadvantages include:

- US federal law limitations on allowable rates of return on investments for cooperatives, impedes the model's ability to attract outside investment,
- Difficulties for cooperatively-owned wind projects to capture the value of federal tax incentives such as the PTC and accelerated depreciation either because they have no tax liability as non-profit corporations or because power consumption by co-operative members conflicts with the PTC's requirement that power be sold to an unrelated third party,
- Technical difficulties in achieving aggregated net billing arrangements using existing utility billing systems,
- Obstacles to co-operatives in terms of raising sufficient capital to finance wind projects:
 - a co-op member's power consumption is less than the amount of his investment, the member does not recoup the full value of the investment because the annual dividend payment depends on the amount of power consumed,
 - Businesses are unlikely to invest in cooperatives because inexpensive power increases taxable profits,
 - In the case of aggregated net billing arrangements, the number of potential cooperative members is limited by utility service territories. As turbine technology output increases, cooperatives will need to enlist even more members to ensure that their power consumption is greater than the project's electricity production. Otherwise members are unable to recoup the full value of their investment.

5.1.1.4. Municipal Ownership model

The municipal ownership model involves public ownership of community wind turbines by municipalities or local government entities (school districts, etc.). The power produced is sold to an unrelated third party (a utility) or consumed as behind-the-meter power to offset energy usage at public facilities such as schools. Under some circumstances public entities may be able to reap the benefits of lower-cost financing mechanisms such as municipal bonds.

The advantages of the Municipal Ownership model are seen to be:

- Exemption from lease or property tax payments if sited on town-owned land,
- Access to low-cost financing with municipal bonds. This facility would only be allowable for behind-the-meter projects and would not be accessible for projects that generate revenue from the sale of power to a third party

Disadvantages include:

- Municipalities may not be legally permitted to provide equity investment for some

renewable energy projects,

- Economic benefits for town residents are small as they are not investing directly in the project. There could, however, be indirect benefits such as reduced municipal tax payments or increased municipal services, if the project generated sufficient additional revenue,
- The dynamics of town politics may make the development of a community wind project quite challenging!

5.1.2 Multi-party Ownership models for Anaerobic Digesters

Anaerobic digesters offer the potential for substantial renewable energy generating capacity as well as a number of non-energy benefits to agricultural producers and rural communities. In addition to generating renewable energy, digesters provide cost savings, or new revenue streams, for farmers through the sale of energy and by products for landscaping and livestock bedding, reduce odours from livestock operations and provide an environmentally-preferable manure management strategy that reduces nutrient loading on lakes and streams.

The high capital costs and technical complexity of installing, operating and maintaining anaerobic digesters create substantial barriers to widespread implementation of the technology. These barriers may be addressed through partnership models that effectively utilize the financial resources and technical expertise of multiple stakeholders as well as partnership models that seek to improve economies of scale. Two such models have particular relevance. These are:

- The Dual Ownership model,
- The Community Digester model.

5.1.2.1 Dual ownership model

In this model, referred to in the *Agricultural Biogas Casebook* (Kramer 2004) as the “Dairyland/Microgy model,” the utility finances and owns the electricity generating equipment and a third party installs and maintains the digester. Financing for the digester is provided either from an outside source or by the third party installer in the form of 100 percent non-recourse financing, thereby eliminating the farmer’s personal liability for the capital-intensive equipment. Under the terms of the purchase agreement between the farmer and the utility, all revenues from the sale of biogas are applied to pay down the debt.

The advantages of the Municipal Ownership model are seen to be:

- It offers an innovative approach for joint financing of capital costs and sharing risk,
- It leverages utility expertise in installing generating equipment and supplier/installer expertise for digester operation,
- It provides the utility with a source of renewable energy and distributed generation capacity,

- It requires minimal up-front costs for farmers, minimizes their financial risk and has a low “hassle factor.”

Disadvantages are:

- The financial return for the farmer is low. Thus, in the early years of the project, while the digester debt is being paid off, the farmer’s main benefits are in the form of avoided costs for bedding, fertilizer, and pesticides,
- The utility carries the risks associated with customer-sited systems,
- The utility may not be motivated to address maintenance issues quickly compared to a farmer who has full system ownership (Krom 2006).

5.1.2.2 Community Digester model

The community digester model seeks to take advantage of economies of scale by processing the manure waste streams of multiple farms at a centrally-located shared facility. There are a variety of possible ownership structures that could be employed under the community digester model, including ownership by a single farmer, cooperative ownership by a group of farmers, third party ownership and government ownership.

Advantages of the community digester model include:

- Increased economies of scale may improve financial viability of digester operation,
- Low financial risk for individual farmers.

Disadvantages include:

- It does not provide a substantial revenue stream for farmers (though it can serve as a cost-effective manure management strategy),
- Transportation costs can dramatically impact the project’s financial viability,
- Stakeholder coordination may be challenging and time-consuming.

5.1.3 Third party ownership models

There are a variety of models for customer-sited generation under third party ownership which address current barriers to the introduction of renewable energy technologies. Those considered herein involve utility ownership, private sector ownership and cooperative ownership.

5.1.3.1 Utility Ownership model

In some ways, the utility-owned model takes the next step beyond the dual-ownership models discussed in Section 5.1.2.1 above with respect to anaerobic digesters. In this model, the utility owns, installs, and maintains the renewable energy generation equipment, and charges the customer for the renewable energy produced by the system.

Advantages of the utility ownership model include:

- It overcomes customer barriers by reducing the “hassle factor” and providing renewable energy services without requiring substantial up-front investment, technical expertise, or ongoing maintenance on the part of the customer,
- The load served by the renewable systems is retained by the utility and generates revenue instead of providing incentives for systems that will decrease revenue from energy sales,
- It enables bulk purchases of equipment which is likely to lower the per-system cost,
- It capitalizes on the utility’s existing fee-for-service business model,
- It is applicable to a wider range of renewable energy generating resources in jurisdictions (such as some US states) where non-utilities are prohibited from selling electricity.

Disadvantages include:

- The utility retains risks associated with customer-sited systems and is responsible for ongoing distributed equipment maintenance,
- Increasing renewable generation capacity via a number of distributed customer-sited systems will not be as cost-effective as installing centralized, large-scale renewable energy generation capacity.

5.1.3.2 Private Sector Ownership model

In many APEC jurisdictions, including the USA, non-utilities cannot provide electric service, though they can provide thermal energy service (e.g., hot water). This restriction creates a significant barrier to the generation of renewable power using a third party ownership model (Young and Cowan, 2007). The restriction can be avoided if the business arrangement is set up as an equipment lease rather than an energy sales agreement, where the renewable energy generating equipment would be leased at or below the customer’s normal cost of electric service.

Another alternative is the use of third party ownership structures to provide a mechanism for a non-profit entity to access federal tax incentives through the lease of a system owned by a tax-motivated investor. The non-profit entity would either lease the system or pay the private LLC for the energy produced.

Interestingly, this is a situation where the high degree of regulation found in the more developed economies, particularly the USA, mitigates against the introduction of renewable energy for electricity generation in private sector ownership. Developing economies, such as China, are much more amenable to the private sector ownership model.

Advantages of the third party ownership model are seen to be:

- It overcomes customer barriers by reducing the “hassle factor” and providing renewable energy service without requiring substantial up-front investment, technical expertise, or ongoing maintenance on the part of the customer,
- It enables bulk purchases of renewable equipment which is likely to lower the per-system cost.

Disadvantages include:

- It is capital-intensive for the system owner, requiring adequate financial resources and long-term interest in providing the service,
- The financial advantage for **for-profit** end-users in several US states, is uncertain when compared with direct system ownership - particularly when the customer is able to recoup the benefit of federal tax incentives,
- For **non-profit** end-users, an equipment lease structure would preclude the system owner from receiving federal tax incentives, and an energy sales agreement structure would be prohibited in several US states.

5.1.3.3. Cooperative Ownership model

In this model a consumer cooperative is established that provides its members with site assessments and home installation services for residential solar thermal and PV systems. The cooperative also purchases and installs solar hot water systems on community buildings under a third party fee-for-service arrangement. Such installations are funded by cooperative members who want to support renewable energy development by entering into energy production agreements.

Members sign up to fund a certain amount of renewable energy per year at a fixed price and the service provider installs solar hot water systems on community-oriented facilities at no cost to the facility owner. After 20 years, ownership of the facility is turned over to the co-operative at no cost.

After five or six years members of the co-operative will begin to receive dividends on the renewable energy they have funded. The number of installed systems is dependent on the number of cooperative members and their individual commitments to fund the procurement of renewable energy.

Advantages of the cooperative ownership model include:

- It provides a means for environmentally-motivated consumers to support renewable energy development at relatively low cost,
- It overcomes customer barriers by reducing the “hassle factor” and providing renewable energy service without requiring substantial up-front investment, technical expertise, or ongoing maintenance on the part of the customer.

Disadvantages include:

- It is capital-intensive for the cooperative. The relatively small individual contributions made by cooperative members means that membership must be broad based to provide sufficient capital for the installation of new systems,
- Achieving wide membership solely through grassroots marketing efforts is difficult.

5.1.4 Project aggregation model

Aggregation of renewable energy generating projects under a single PPA and financing package is one mechanism for overcoming barriers to obtaining third party financing for small-scale renewable energy projects. Financing institutions may consider such behind-the-meter projects too risky as they depend entirely on the financial health of a single facility. Aggregation of such projects can provide a mechanism for diversifying risk, simplifying the turbine procurement and power sales agreement processes and allowing the projects to achieve sufficient scale to attract institutional investment.

In some ways, this model is similar to the third party ownership model used by SunEdison as described in section 4.1.1, which aggregates projects by working with large chains like Walmart, Staples and Whole Foods under a single agreement involving multiple retail locations. The difference is that the customer retains ownership of the renewable assets under the project aggregation model.

Though renewable energy developers have expressed interest in project aggregation, the model is only just being attempted in the marketplace due to the complexities and challenges of working with multiple companies on different project timelines. Structuring the model as a utility program would be one approach to implementing the model. The program could be set up such that the utility submits an RFP to a targeted set of customers and the most promising bids are accepted into the project portfolio. Once the pre-development work (site assessment, wind resource monitoring, interconnection studies, permitting, etc.) is completed and a standard power purchase agreement executed with program participants, the entire portfolio could be submitted for financing by potential investors.

Advantages of the project aggregation model include:

- Utilities may be uniquely suited to implement the aggregation model due to their access to

information about customer energy usage and established account management relationships with large energy users. It is not, however, necessary that such a model should be implemented by a utility,

- The model is likely be well received by potential customers. In particular, institutional and government customers may be willing to consider longer payback periods than commercial or industrial customers,
- It enables bulk purchases of renewable equipment which can lower the per-system cost,
- It provides a built-in price hedge for the on-site load.

Disadvantages include:

- A long project timeline is required and the model is labour-intensive to administer,
- It impacts utility revenues, unless structured as a third party model where the utility retains ownership of the renewable assets,
- It is currently untried in the marketplace.

5.1.5 Renewables-as-Appliance models

For solar PV to achieve mass market adoption, the following conditions must be met:

- The initial investment must be reduced,
- There must be a reliable and trusted sales channel for small systems that minimizes the hassles associated with system purchases (financing, rebate paperwork, permitting, interconnection, etc.),
- Consumer confusion about the technology must be reduced through the use of standardized rating systems that facilitate comparison shopping (Klein and Erlichman 2006).

Two mechanisms that can be employed by business models seeking to employ a “renewables-as-appliance” approach are:

- Selling PV through high volume retail sales channels,
- Manufacturing renewable energy systems that offer simplified configurations and approximate turnkey applications.

5.1.5.1 Retailer sales model

This business model leverages the reputation of a trusted home improvement retailer thereby streamlining the sales and installation process for purchasers of small systems. The benefits of a “one-stop shopping” approach enables consumers to receive a free in-home consultation to

determine the appropriate system size and configuration and to have access to system financing options.

Installation is conducted by an approved contractor and inspected by a project manager to ensure quality control. To reduce customer concerns about the risk of maintaining unfamiliar technology, short (7 years) and long (25 year) term full and limited warranties are offered. In addition to handling utility approvals and permitting, the assigned project manager also handles the relevant paperwork to apply for state or utility rebates and the rebate amount is deducted from the purchase price.

Advantages of the retailer sales model include:

- It minimizes the burden on the consumer by offering a single solution that encompasses sales, financing, installation, and paperwork,
- It decreases consumer concerns about risk by leveraging a trusted retailer brand,
- It leverages retailer marketing power, reduces consumer search costs and provides an effective sales channel for small systems that face a lower investment hurdle,
- It reduces customer acquisition costs for the installer by leveraging retailer and manufacturer marketing.

Disadvantages include:

- The need to engage retailer support for the model which is dependent on the magnitude of solar incentives and their expectations regarding the long-term stability of incentive offerings,
- The development of partnerships between parties that may not have established business relationships – such as manufacturers, retailers, installers, and financial institutions,
- Reluctance of retailers to take on the risks associated with selling renewable energy technology or investing in the store configuration and sales associate training required to make the model successful.

The success of the model requires the retailer to take a leadership role in developing the business model, most likely in partnership with system manufacturers and installers.

5.1.5.2 Standardized Configuration model

This model seeks to sell a standardized package to the consumer in the same way as a household appliance is sold. Simplified installation is fundamental to the Renewables-as-Appliance business model. Standardized equipment configurations minimize or eliminate tailored design requirements, offering all necessary components in a single package and simplifying the installation process.

Standardized configurations may also facilitate another key component of the approach which is an installed cost within the range customers are willing to pay for a high-end appliance.

As solar thermal technologies typically require more invasive installation processes than PV for connection to domestic hot water systems, the standardized configuration model may be less applicable to solar thermal than to PV.

For wind power, the model seeks to supply a residential-scale wind turbine that is relatively low-cost, low-hassle to install, and operates effectively at the lower wind speeds typically found in a residential setting with battery charging. The turbine is designed to be grid-interconnected so it can take advantage of the full retail rate for power under a net metering arrangement.

Advantages of the standardized configuration model include:

- It simplifies the search process and decreases complexity for the customer,
- It decreases design and installation costs,
- It facilitates mass production.

Disadvantages include:

- Installation of standardized configurations may not be suitable in all locations,
- Ensuring high quality in conjunction with low cost has historically been difficult for manufacturers to achieve.

5.1.6 New Construction model

The new construction model involves bundling renewable energy technologies such as PV and solar thermal into new residential construction. This business model offers several advantages. For the developer, offering potential home buyers a solar option can represent an added selling point, which may be particularly valuable in highly competitive construction markets. From the homeowner's perspective, such options eliminate the time, technical complexity, and informational requirements associated with implementing a solar retrofit (Young and Cowan, 2007).

New construction can also be made "solar-ready," to facilitate the addition of post-construction solar retrofits. For PV, solar-ready residential construction includes ensuring sufficient roof area, proper roof pitch/orientation, and pre-installed wire chase and circuitry. For solar thermal, solar-ready construction includes ensuring an appropriate roof structure to support the collectors, a place for the water storage tank that is compatible with plumbing infrastructure and pre-installed pipes.

In the USA, state and utility incentives have provided critical support for the new construction model. Policies that streamline permitting processes or mandate solar new construction targets play an important role in advancing the new construction model.

Advantages of the model include:

- Reduction of initial costs through standardization of design and installation. Bulk equipment purchases may also lower costs for modules and inverters, particularly at the scale offered by large residential developments,
- Reduction of transaction costs associated with system financing by incorporating PV system financing into the home mortgage and eliminating the need for a separate financing transaction,
- Reduction of search costs and informational barriers, particularly when a solar system is a standard offering rather than a buyer-selected option for the new home purchase,
- Optimised system performance through building design that ensures proper building orientation and minimized shading,
- The ability to overcome aesthetic objections to rack-mounted PV, through building-integrated PV, which is generally better-suited to new construction than to retrofit applications,
- Access to favourable media coverage and greater political support for new developments.

Disadvantages include:

- Difficulties in achieving effective coordination between a diverse set of parties. This involves the need to develop innovative and effective partnerships between builders, PV manufacturers, installers, financiers and lenders, utilities, and local government,
- Possible opposition to, or lack of interest from, homebuilders due to technology risk aversion and concerns about how solar installations will affect building costs, the project schedule, home prices, and profits,
- The need for a higher level of sales expertise and training to sell the system to prospective buyers. The new construction model is markedly less successful in promoting PV when system installation is an option for buyers. Transaction costs may also be higher as installation scheduling and permitting processes are more complex.

5.1.7 Environmental Credit Market models

These models are designed to take advantage the emergence of environmental credit markets which seek to establish a commodity value for the non-energy attributes of renewable power generation. Such non-energy attributes may be environmental (i.e., the value of reduced pollutant or carbon emissions as compared with fossil fuel-generated electricity) or resource-based (i.e., the value of renewably-produced or locally-produced electricity). Several of these markets have the potential (either currently or in future) to provide revenue streams for customer-owned renewable energy projects.

5.1.7.1 Renewable Energy Credit Market model

This model seeks to capitalise on renewable energy credits (RECs), which represent a quantification of the non-energy attributes of power generated using renewable resources, unbundled from the value of the electricity itself. REC markets exist both for regulatory compliance purposes and for voluntary consumption by energy end users (both companies and individuals).

RECs offer producers of renewable energy a fairly simple way to capture an environmental premium to supplement the revenues earned from the electricity they produce. The price of RECs varies by resource type used to generate power, with cleaner resources, such as solar power and wind energy, usually being priced slightly higher than resources that produce some emissions, such as biomass or landfill gas. REC prices also vary by location. If a company has a strong desire to provide local air quality benefits in the region in which it operates, it may be possible to purchase locally-sourced RECs. These local renewable generation sources will have a greater positive impact on local emissions than RECs purchased from renewable generators in distant locations.

Compliance markets, which represent the largest REC trading volumes, are generally wholesale markets in which electric generators participate in order to comply with renewable energy portfolio requirements or other regulatory frameworks (Holt 2005). In voluntary markets, RECs may be sold to end users as stand-alone products (i.e., without associated electricity sales) or bundled with electricity as a green power product.

Though the sale of RECs, carbon offsets, or emissions allowances may comprise a cash-flow element in customer-owned renewable energy projects, such sale does not necessarily warrant the distinction of being a new business model. However, in the interest of collecting a broad range of innovative financing mechanisms for customer-owned renewable projects, and as the future viability of REC, carbon offset, and emissions allowance markets is likely to increase, it is noted that these markets may be accessed to provide additional cash flow for renewable energy projects and to fund the installation of new projects.

Advantages of the REC model include:

- The opportunity to market locally-produced renewable energy nationally,
- Promotion of investment in local renewable energy projects as investors seek to capture two streams of revenue – electricity sales and the sale of RECs,
- Allowing consumers who are not able to purchase green power from their utility to access green power markets.

Disadvantages include:

- If utility-specific buy-back rates for renewable energy exceed the sum available to generators through separate sale of electricity and RECs, this model may not be financially viable,

- Volatility of future REC prices may cause planned renewable projects to not meet revenue goals,
- The local regulatory landscape may not allow unbundling of RECs from electricity sales or utility-specific requirements, such as interconnection and net metering agreements, may restrict customer ownership of RECs,
- A small-scale renewable energy generator may be unable to own or sell RECs under existing regulations or conditions of net metering, PPA, or incentive agreements that assign REC ownership to another party. A number of other factors constrain the viability of REC markets to provide revenue streams for small-scale projects, including unclear or undefined REC ownership conditions and the marketing challenges and high transaction costs associated with selling small volumes of RECs in a market that has low liquidity.

5.1.7.2 Carbon Offset Market models

This model is designed to capture the value of carbon offsets associated with renewable energy production. There is a growing voluntary market for carbon offsets in the USA where organizations can offset some of the carbon emissions produced by their energy consumption through the purchase of carbon credits.

Carbon offsets are created in a variety of ways including sequestration (capturing carbon) or emissions reduction (substituting renewable for fossil generation or reducing fossil generation through energy efficiency). Offset projects include methane destruction, new forestry and forestry practices, renewable energy, Clean Development Mechanism projects (creditable projects in developing countries under the Kyoto Protocol), agricultural practices and energy efficiency.

Because carbon offset markets are not regulated there may be fewer restrictions on market participation by renewable energy projects than is the case with REC markets or emissions allowance markets (Young and Cowan, 2007), but these markets are generally weak and have low liquidity. On the other hand, a renewable energy generator participating in a REC market, or otherwise assigning the environmental attributes of renewable power generation to another party, cannot also participate in a carbon offset market and receive double credit for the same activity. In the case of anaerobic digesters, however, participation in multiple markets is allowed so the non-energy attributes of renewable power generation can be traded in REC markets and the reduced methane emissions that would occur under an alternative manure management strategy can be traded in carbon offset markets.

Carbon offset markets offer an opportunity to all potential customer-sited renewable generation projects because, unlike RECs, carbon credits can be sold only if they meet the criterion of “additionality” i.e. the revenue generated through sale of the credit makes an otherwise unviable project viable. For example, in the case of a community wind project in which the revenue stream from electricity sales is insufficient to develop the project, the revenue derived from carbon credits is deemed to be “additional” and may be sufficient to make an otherwise unlikely project a reality (Young and Cowan, 2007).

The advantages and disadvantages of the carbon offset market model are essentially the same as those listed for the REC model in section 5.1.8.1 above.

5.1.7.3 Emissions Allowance Market models

Emissions allowance markets exist in those US states where cap-and-trade systems have been established to achieve compliance with National Ambient Air Quality Standards (NAAQS). Some programs enable renewable generating units to apply for allowances either from the main allowance pool, or from a defined sub-set of “set aside” allowances that may be allocated only to renewable energy projects. These allowances can be sold separately in allowance markets, or attached to a REC, to make it either a premium renewable energy product or a REC-plus.

Emissions allowance markets are the least-developed in terms of their potential to provide revenue streams for customer-owned renewable energy products and some programs specifically prohibit renewable energy projects from participating in emissions cap-and-trade markets through the allocation of allowance.

Some additional advantages of the emissions market model include:

- It creates a mechanism for new renewable energy generating units to offset their higher costs through the sale of allowances,
- It decreases the cost of allowances by promoting renewable energy development and thereby reducing demand for allowances.

Disadvantages include:

- The additional compliance mechanism required for electric generating units to receive allowances for developing a renewable project.

5.2 Renewable Fuels Production

Production and supply of biofuels starts in the field with biomass feedstocks and includes processing distribution and marketing functions. It is, therefore, a somewhat more involved process than electricity generation from naturally available primary energy sources. Most of the producers and the capacity can, however, be categorized (Informa Economics, 2007) in terms of four main business models:

- The Corporate Business Model,
- The Farmer-Owned Business Model,
- The Engineer/Builder-Owned Business Model,
- The Franchise Business Model.

5.2.1 The Corporate Business Model

The “Corporate” business model refers to a renewable fuels producer that is a corporation. There is generally a fairly high degree of vertical integration in the business. Internal staff manages the plant(s) and the functions of grain procurement, renewable fuels marketing and co-product marketing but the producer does not own or manage farmland. If the corporation produces biodiesel, it might have integrated oilseed crushing operations. Some corporations may provide third-party grain supply and renewable fuel and co-product marketing services to other producers. The structure of this model is illustrated in Figure 5.1.

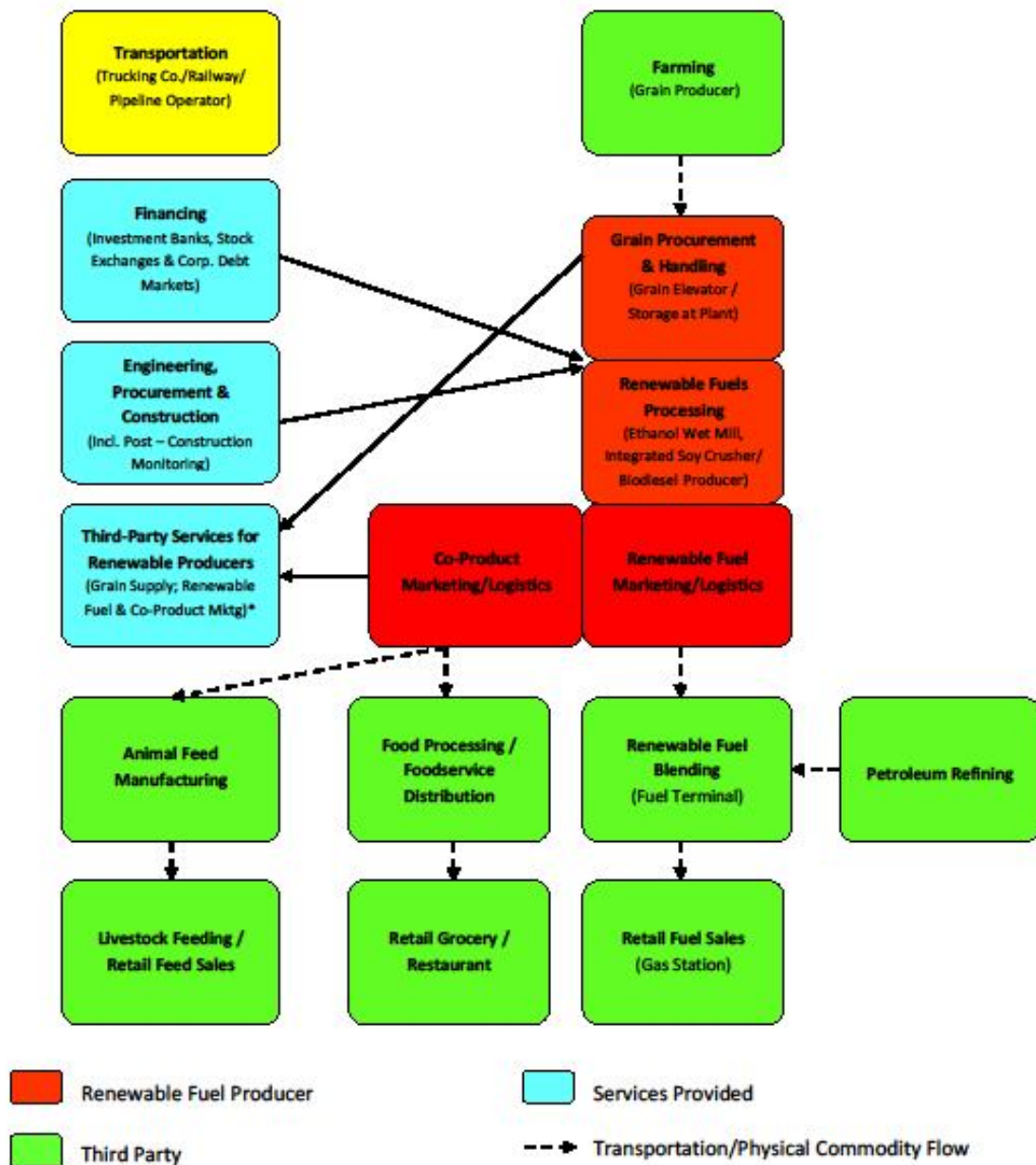


Figure 5.1: The Corporate Business Model

The advantages of the Corporate business model are:

- It is a well known and well established model that is well understood by banks and financial institutions thereby facilitating project financing,
- Vertical integration in the business provides control of a large part of the value chain.

Disadvantages include:

- Sensitivity to changes in government incentives.

5.2.2 The Farmer-Owned Business Model

The legal structure of the “Farmer Owned” business model can be as a co-operative or an LLC or similar organization. In either case, farmers have a majority ownership in the facility. In a co-op or a co-op within an LLC, farmers have grain (and oilseed) delivery obligations to the facility. They have access to storage, including on-farm bins and limited storage at the facility, and they may also have separate grain elevator operations - especially if the ownership is through a cooperative. The structure of this model is illustrated in Figure 5.2.

The advantages of the Farmer Owned business model are:

- It is a well known and well established model that has proven its effectiveness over time so is well understood by banks and financial institutions thereby facilitating project financing,
- There is a high degree of vertical integration in the business through to at least the processing plant gate and this provides control of a large part of the value chain,
- The business model can be adaptive and progressive, offering business strengths that go beyond an assured supply of grain.

Disadvantages include:

- Sensitivity to changes in government incentives,
- US federal law limitations on allowable rates of return on investments for cooperatives may impede the model’s ability to attract outside investment.

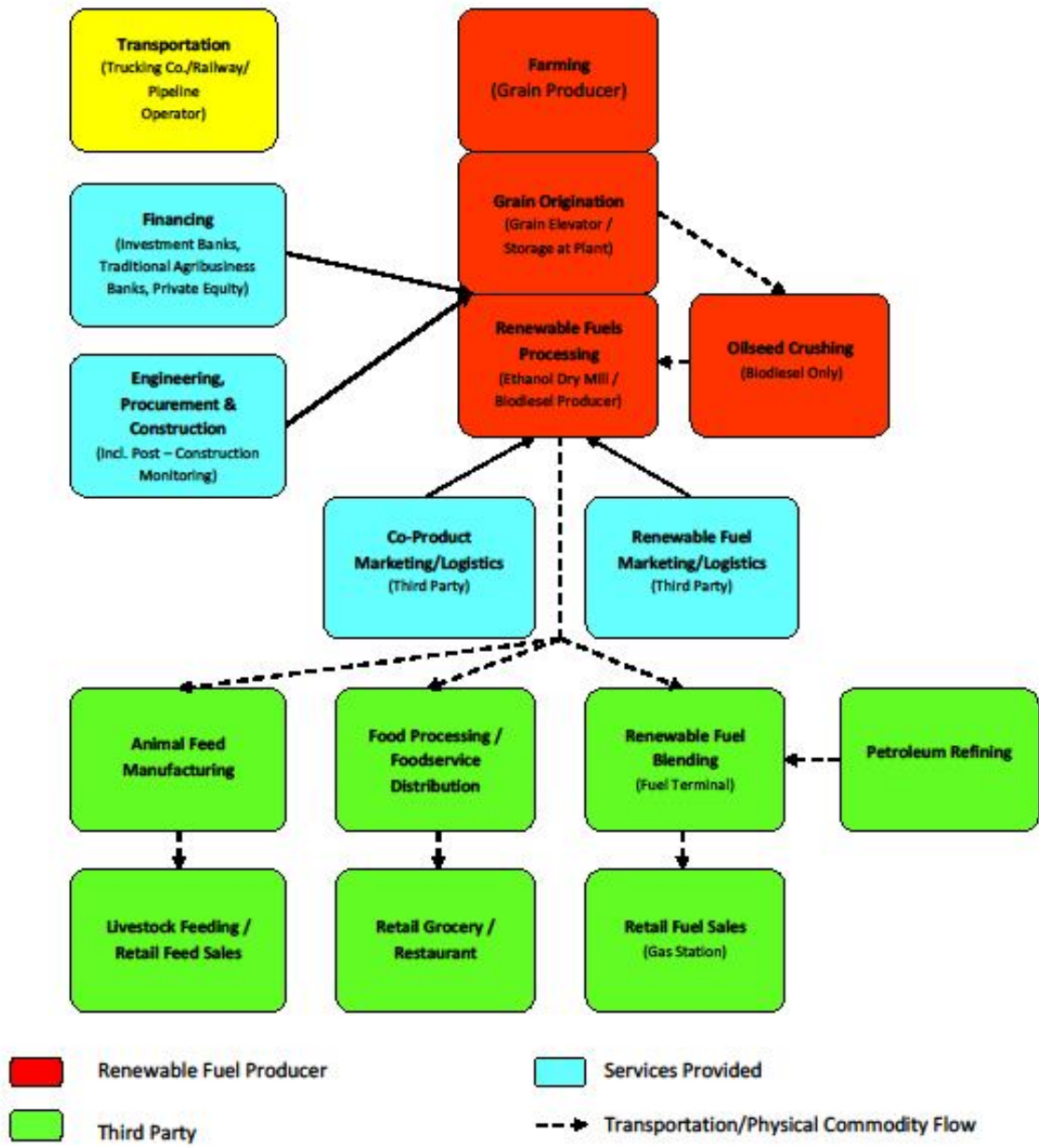


Figure 5.2: The Farmer Owned Business Model

5.2.3 The Engineer/Builder-Owned Business Model

Design/build firms either own facilities outright or maintain a significant ownership interest with investors in individual plants. In either case, the design/build firms maintain a controlling interest in management and normally have ownership in multiple facilities. This provides the scale for internal staff to perform key functions, including grain procurement and renewable fuels and co-product marketing, which they might also provide as services to unaffiliated plants. The structure of this model is illustrated in Figure 5.3.

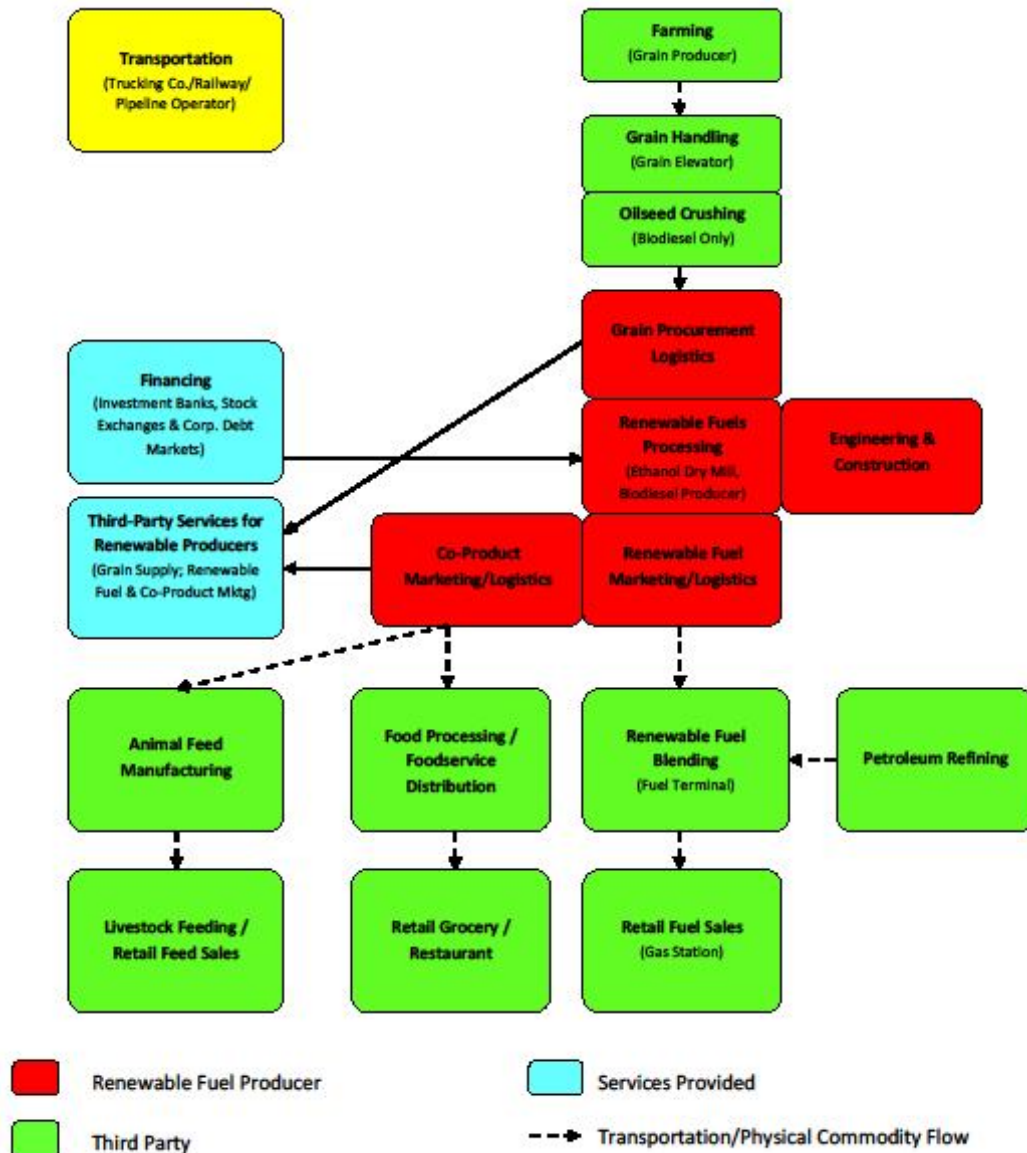


Figure 5.3: The Engineer/Builder Owned Business Model

The advantages of the Engineer/Builder Owned business model are:

- It is a well known and well established model that has proven its effectiveness over time and is well understood by banks and financial institutions thereby facilitating project financing,
- Vertical integration in the business provides control of a large part of the value chain,
- A high level of technology management skill is available.

Disadvantages include:

- Sensitivity to changes in government incentives,

5.2.4 The Franchise Business Model

In the “Franchise” business model the organization is not vertically integrated but depends on service providers, or a partner network, to link to other levels of the supply chain. The plant is designed and built by a major company or consortium and its production process is monitored remotely by the engineering construction company. The producer depends on third-party service providers for grain (or vegetable oil) procurement and the marketing of renewable fuels and co-products.

Given the short operating history of this model, financial institution(s) providing loans/debt may require the producer to enter into long-term agreements with its service providers who may, in turn, invest a moderate amount of capital in the facility. The structure of this model is illustrated in Figure 5.4.

The advantages of the Franchise business model are:

- While the model has only a short history in the new and renewable energy field, it has been proven successful over many years in other business contexts,
- It has the capability to assemble the very best service providers,
- A high level of technology management skill is available.

Disadvantages include:

- It is seen as moderately high risk by banks and financial institutions in this business sector so higher levels of investor equity may be required for project financing,
- There is only limited ability to exert control over the value chain in this business model,
- It is sensitive to changes in government incentives.

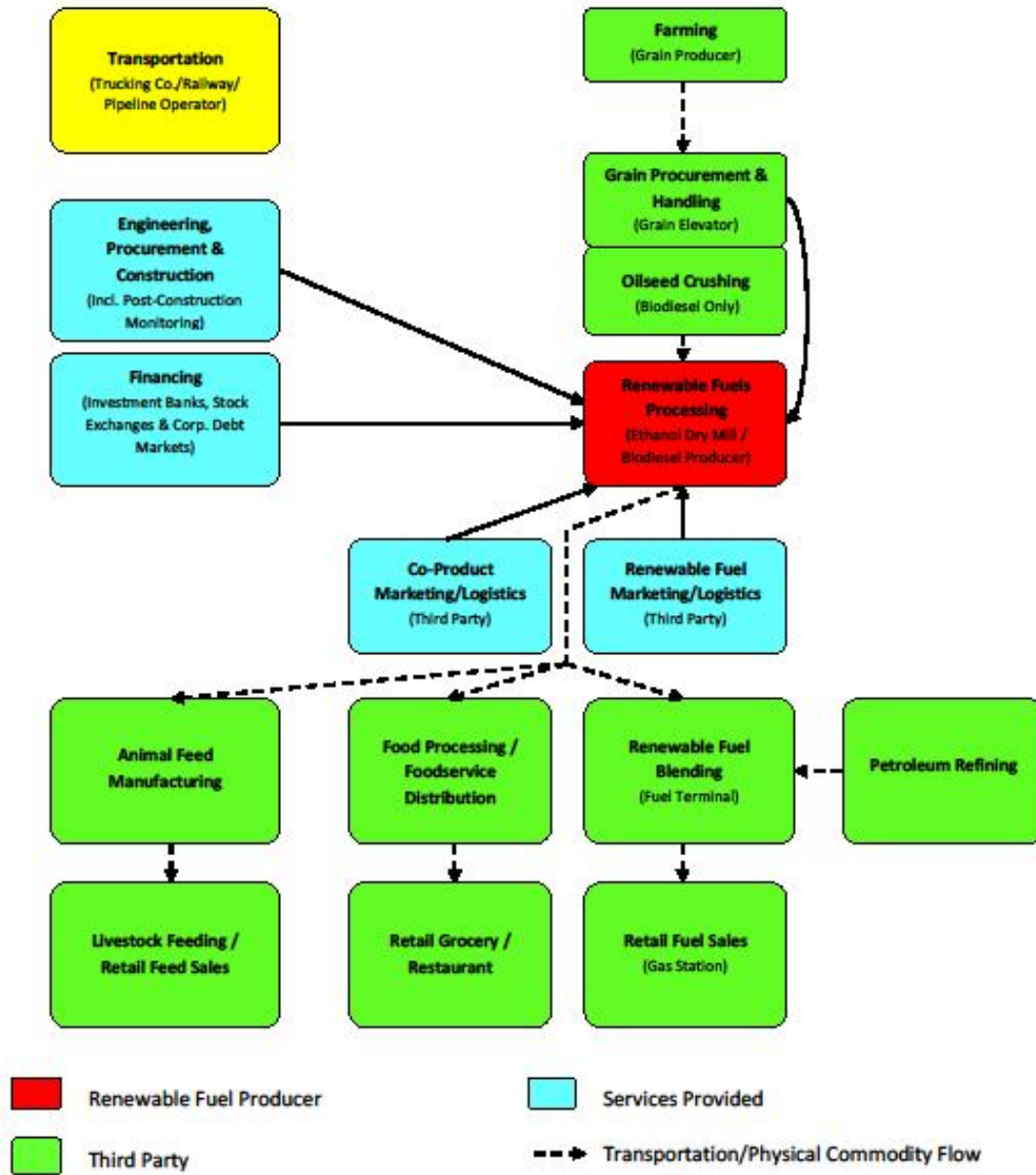


Figure 5.4: The Franchise Business Model

From a rural business perspective the franchise business model has been selected as the model of choice for farmers wishing to invest in the U.S. ethanol industry. This is because there are now several specialized engineering firms that have standardized ethanol plant design and the project development process. These engineering firms guide farmer-investors through every aspect of plant development - from feasibility to plant opening and beyond, including financing, contracting, marketing, procurement and management.

5.3 Alternative Transport Fuels

As explained in Chapter 4 (section 4.3) Alternative Transport Fuels (ATFs) production and use has a number of characteristics that are quite different from production of heat and power or renewable fuels. Thus:

- The primary energy feedstock cost makes up a significant proportion of the final alternative transport fuel supply cost,
- The transport fuels produced must be distributed to the consumer and may require substantial infrastructure facilities as in the case of Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG). This may be the largest cost element in the fuel supply chain.
- The introduction of ATFs often requires consumers to make significant changes to their conventional vehicles and fuel use and they must be encouraged to do so.

The key elements of the business model configuration, therefore, involve fuel supply, fuel distribution, vehicle modification and consumer motivation.

The business models that have resulted are orientated towards infrastructure establishment, program coordination and provision of consumer incentives for fuel switching. They have frequently been managed by governments or government agencies. Private sector equipment and fuel suppliers have, for the most part, responded to the emerging market rather than leading it.

The following business model configurations have been identified for the introduction of alternative transport fuels:

- State Management models,
- State Ownership models,
- Third Party Ownership models,
- Public-private Partnership models,
- Free Market models,

These, models and their variations, are presented in the following sections.

5.3.1 State Management models

This business model has been developed to achieve the introduction of an alternative transport fuel. It is both initiated and managed by government using financial incentives to engage both existing industry operators and consumers (vehicle owners).

The government establishes a co-ordinating committee or task force whose job is to:

- Oversee and coordinate alternative fuel industry development,
- Create and modify, as necessary, appropriate incentive packages,
- Establish and enforce mandates such as requirements for the conversion of fleet vehicles,
- Promote and support the creation of appropriate standards, codes and regulations for both alternative fuelled vehicles (AFVs) and their refuelling stations,
- Ensure that appropriate training courses, covering both AFVs and their refuelling, are established,
- Fund R&D,
- Provide leadership by example (e.g. early conversion of government vehicles to the alternative fuel),
- Encourage and support public relations and communications strategies and programs.

Otherwise, private sector operators are encouraged to pursue their normal business practices such as supply of fuel, equipment installation and maintenance, refuelling station operation and vehicle conversion and maintenance and, in some cases, incentives are offered for them to do so. Funding for the ATF program comes, primarily, from the government in the form of both financial incentives and funding that is targeted to specific program needs. As the ATF program grows the need for its centralised management decreases and government slowly withdraws from the program as it becomes self sustaining.

Advantages of the state management business model are:

- Ability to mobilise and incentivise all the players required to establish an ATF industry,
- Provision of centralised program management,
- Establishment of the necessary institutional infrastructure (standards, regulations, training) for regulation of the ATF industry at an early stage of its development,
- Management of the financial incentives necessary for the introduction of AFVs in response to periodic market studies to address the changing needs of the developing industry,
- Ability to manage the ATF price differential at a level sufficient to maintain an incentive for the initial conversion and continued use of the ATF,
- Maintenance of public confidence through ongoing government support for the industry,

- Ability to encouraged OEMs to produce purpose built ATVs.

Disadvantages include:

- Lack of government experience in commercial business activities,
- Danger of the program becoming too reliant on government support and failing to become commercially sustainable in its own right,
- Distortion of the economics of ATF use leading to conversion of vehicles that do not have sufficiently high fuel consumption to warrant conversion in the absence of subsidies,
- Sensitivity of consumer confidence to eventual government withdrawal.

5.3.2 State Ownership models

The state ownership business model has been developed to achieve both the introduction and ongoing management of an alternative transport fuel. It is both initiated and managed by government through a state owned national energy company able to provide funding and financial incentives to engage both existing industry operators and consumers (vehicle owners).

The model is essentially similar to the state management model presented in section 5.3.1. The key difference is that the ATF program is managed and implemented by a state owned company that operates commercially and owns refuelling station outlets. Also, state involvement is designed to continue much longer than in the state management model thereby providing for greater long term stability and sustainability.

Advantages of the state management business model are:

- Its ability to mobilise and incentivise all the players required to establish an ATF industry and to develop the industry in a well ordered manner,
- It provides a single program management focal point,
- A state owned operator is well positioned to establish the necessary institutional infrastructure (standards, regulations, training) for regulation of the ATF industry at an early stage of its development,
- The state owner/operator is widely experienced in the commercial management and operation of transport fuel supply, distribution and marketing and can maintain its industry leadership role indefinitely,
- Government is able to maintain the ATF price differential at a level sufficient to maintain an incentive for the initial conversion and continued use of the ATF,

- State ownership helps to maintain public confidence in an ATF industry,
- There is opportunity to extend commercial experience and involvement to other economies,
- A national energy company is in a position to establish a business association with OEMs to produce purpose built AFVs.

Disadvantages include:

- Danger of the program becoming too government orientated and failing to become fully commercially sustainable by extending to the private sector,
- Distortion of the economics of ATF use leading to conversion of vehicles that do not have sufficiently high fuel consumption to warrant conversion in the absence of subsidies.

5.3.3 Third Party Ownership models,

The third party ownership business model has several variants. In all cases, however, a private sector company controls some part of the value chain. Examples include:

- The **fuel supplier company** owns and operates transport fuel distribution and retail sales facilities. The facilities can be owned by a national or international oil company, an independent fuel supplier or as a franchise. This is the same as the current model used by oil companies and other fuel suppliers to supply conventional transport fuels,
- A **gas utility** owns and services CNG compressors and dispensing units located either on forecourt space rented from a service station owner or in the depot of a vehicle fleet. The refuelling operation is usually performed by service station or vehicle fleet staff and the owner of the refuelling equipment is paid a tolling fee for compressing natural gas into CNG. It is not uncommon for a gas utility also to provide a co-located CNG vehicle conversion service and to provide low cost conversion loans with payment being made over time by a small addition to the cost of CNG purchased.
- A **refuelling station equipment supplier** installs equipment either on forecourt space rented from a service station owner or in the depot of a vehicle fleet as in the previous example. Revenue comes either from a tolling fee or by leasing the refuelling equipment to the station owner/operator.

Advantages of third party ownership business models are:

- They mobilise additional investment,
- Industry participants who have key capabilities are engaged as investors in part of the value chain,
- Industry participants achieve an additional revenue stream,

Disadvantages include:

- Oil companies and other fuel suppliers are effectively competing against themselves by selling alternative transport fuels such as CNG and are not always eager to do so,
- Gas utilities, which provide financing for vehicle conversion services, often have difficulties in maintaining customer allegiance to ensure repayment of their loans.

5.3.4 Public-Private Partnership model

The public-private partnership model is quite a common way of progressing a large, usually infrastructure, project in which government wishes to retain an interest but a private sector partner is required to provide technology, operational experience or finance. This type of model, of which there are many variants, has been used to bring new and renewable energy technologies into the market.

In most cases the model is applied to a project of national significance such as development of coal-to-liquid and gas-to-liquid production plants in China, India and New Zealand or the construction and operation of a large hydro scheme. The government, most commonly through a government energy company, enters into partnership with a technology provider to form a joint venture company. Project functions and risks are assigned to each partner according to their ability to carry out those functions and manage the associated risks.

In the case study of this model presented in section 4.3.4 the New Zealand government carried the financing and market risk for construction and operation of the New Zealand gas-to-gasoline plant and its joint venture partner, Mobil Oil, carried the technical risk and was the plant operator. The New Zealand Government, rather than the joint venture company, owned the natural gas feedstock so the government guaranteed that the supply of gas would be continued until at least the project capital and debt servicing costs were recovered. The revenue stream in this business model case came from a “tolling fee” charged by the joint venture company for converting government owned natural gas into synthetic gasoline.

Advantages of public-private partnership models are:

- They enable the interests of both public and private partners to be accommodated,
- They engage the core capabilities required for commercial success,
- They provide access to “fast tracking” of approvals and enabling legislation if required,
- They provide both partners with a revenue stream,
- They promote public support for the project through government engagement.

Disadvantages include:

- The market risk in event that product prices fall,
- The technology risk if the plant does not operate to its specifications.

5.3.5 Free Market model

This free market model is hardly a business model in the true sense, yet it is possibly one of the more robust, and potentially sustainable, ways of introducing new and renewable energy into the market. It relies on natural market forces already in place rather than on financial incentives and is assisted by a regulatory framework established by government.

One of the best current examples of the free market model is illustrated in the case study for introduction of E bikes in China as described in section 4.3.5. In this case the primary market driver was the demand for E bikes by consumers who preferred them to conventional gasoline fuelled motorbikes and scooters for reasons of both convenience and running cost. Manufacturers and suppliers of E bikes responded, in a fiercely competitive market environment, by providing the equipment required and facilities for battery recharging as illustrated in Figure 4.3. The result was very rapid market growth (Figure 4.2) that has achieved a naturally sustainable level.

Advantages of the free market model are:

- It requires minimal government intervention or incentives,
- The core capabilities required for commercial success are available to, and provided by, the private sector industry participants,
- It provides strong market signals directly to industry participants and to which they can respond rapidly,
- It provides all industry participants with appropriate revenue streams,
- It keeps prices down through natural market competition,
- It relies on the operation of free market forces.

Disadvantages include:

- Vulnerability to government intervention through inappropriate regulation that may distort the market economics,
- Changes in consumer preferences and demand.

6. Conclusions and Lessons Learned

A number of conclusions can be drawn and lessons learned from the foregoing review of business models that have been used to bring new and renewable energy technologies into the market in APEC economies. These fall quite naturally into the following categories:

- General comments on business models and their effectiveness,
- The type of new and renewable energy involved,
- The scale of the project,
- Applicability to different APEC economies.

6.1 General

1. Governments create business environments and business models are configured to respond by extracting maximum value for the business from the opportunity available,
2. There is no universal business model that can be used to introduce and sustain all different forms of new and renewable energy technology in the market place,
3. Successful business models are those that conform to the existing business conditions such that they:
 - Extract maximum value for the business,
 - Control key elements of the value chain,
 - Provide a positive value stream to all participants,
 - Have multiple revenue streams,
 - Are hedged against changes in product prices and other revenue determinants,
 - Respond to customer requirements,
 - Are sustainable over time.
4. Business models which are appropriate for introducing a new and renewable energy technology may be quite different from those required for ongoing participation in the new industry once it has become established,

5. All business models are subject to failure if there is a change in the commercial conditions on which they are predicated. If the project drivers change, or are removed, it is probable that the revenue stream will fail,
6. An unsuccessful business model is one that is unable to adapt to changing commercial conditions,
7. The success of a business model often depends upon the people involved and the partnerships established.

6.2 Energy Type

Different conclusions can be drawn for different new and renewable energy forms.

6.2.1 Heat and Power

1. Most renewable energy technologies for heat and power production are of small to medium size,
2. The combination of new technology and small scale makes financing difficult,
3. Business models that have been applied to heat and power production place strong emphasis on securing finance and attracting customers,
4. New business models are dominated by North American activities – primarily in the USA,
5. New business models are designed to introduce novel energy forms such as wind, solar, and small hydro into markets that are usually highly regulated,
6. Most of the sophisticated business models are designed to take full advantage of government incentives and are only effective so long as these are in place,
7. A number of the more innovative business models are only viable in short time windows since they are finely tuned to take full advantage of government incentives that can change significantly over short time periods,
8. Business models applicable to heat and power production reflect the need to secure strong partnership arrangements with equipment suppliers, installers, financiers and customers.

6.2.2 Biofuels

1. Business models for biofuels production are now quite well established,
2. Most have grown out of the agriculture industry and are largely promoted by that industry,

3. The businesses involved are usually middle to large scale operations and the emphasis is on biofuel production,
4. The biofuels industry currently enjoys significant government incentives and mandates which determine the configurations of the business models used,
5. The most successful commercial models control key elements of the value chain and have several revenue streams,
6. Partnerships with fuel distributors are one of the keys to business success,
7. Profitability in the biofuels industry is closely linked to international oil prices.

6.2.3 Alternative Transport Fuels

1. Introduction of ATFs is generally controlled by a government led program,
2. Business models that have been developed for the introduction of ATFs have a high level of government involvement,
3. Business models for the introduction and use of ATFs have failed badly in cases where government support and involvement has been greatly reduced over a short time period,
4. Business models employed by the private sector focus on ATF outlets and promotion of consumer uptake,
5. Large scale introduction of ATF's, such as synthetic fuels, often involve public/private partnerships which have proved to be commercially sustainable and an effective business model.

6.3 Project Scale

1. Different business models are applicable to large, medium and small scale projects,
2. Most new and renewable energy projects are small to medium in size,
3. Business models developed for small scale projects (wind, solar and small hydro) concentrate on capturing the full value of government incentives and support packages,
4. Business models used for small scale new and renewable energy projects are mostly orientated to community participation with some essential third party involvement,
5. Business models for large scale projects are often utility based, designed for large commercial operations or have a high level of government involvement.

6.4 APEC Economy Applicability

1. Not all business models for the introduction and use of new and renewable energy technology are applicable in all APEC economies,
2. Many business models are dominated by experience in the USA where the focus is on extracting maximum value from the many government financial incentives available,
3. APEC economies can learn from the sophisticated business models developed in the USA but will need to modify them to fit their own economy conditions,
4. Less prescriptive regulatory regimes have tended to place reliance on conventional business models for the development of new and renewable energy technology,
5. The business models employed in developing economies are usually strongly driven by government policy and do not always seek to maximise commercial benefits,
6. Emerging new and renewable energy policies in many developing economies offer opportunities for community participation and small/medium scale business opportunities for which the models are quite well established.

Bibliography

Galen Barbose, Ryan Wisser, Mark Bolinger (February 2006). *Supporting Photovoltaics in Market-Rate Residential New Construction: A Summary of Programmatic Experience to Date and Lessons Learned*. Available at: <http://eetd.lbl.gov/ea/emp/reports/59299.pdf>

Mark Bolinger (May 2001). *Community Wind Power Ownership Schemes in Europe and their Relevance to the United States*. [LBNL-48357]. Available at: <http://eetd.lbl.gov/ea/emp/reports/48357.pdf>

Mark Bolinger, Ryan Wisser, Tom Wind, Dan Juhl, Robert Grace (July 2004). *A Comparative Analysis of Community Wind Power Development Options in Oregon*. Available at: http://www.cleanenergystates.org/library/Reports/OR_Community_Wind_Report.pdf

California Energy Commission (July 2004). *Accelerated Renewable Energy Development*. Available at: http://www.energy.ca.gov/2004_policy_update/documents/2004-08-27_workshop/2004-07-30_100-04-003D.PDF

Jill Cliburn, (November/December 2006). *American Public Power Magazine*, “Lakeland’s Solar Roofs.” Available at: <http://www.appanet.org/newsletters/ppmagazinedetail.cfm?ItemNumber=17871&sn.ItemNumber=2108>

Dane County Department of Administration (October 23, 2006). *Request for Proposals: Dane County Community Manure Management Feasibility Study*. Available at: <http://www.danewaters.com/management/pdf/MMRFP.pdf>

Database of State Incentives for Renewables and Efficiency (DSIRE). Available at: <http://www.dsireusa.org>

Mark Daugherty (May 2006). *Solar Electric System Marketing, Finance, Sales, and Installation*. Analysis funded by We Energies and Focus on Energy.

Noel Fenlon and Scott Debenham (August 2004). Proceedings from the conference, *Energy 2004, The Solutions Network*. “Federal Bureau of Prison’s ESPC – FCI Victorville.” Available at: <http://www.energy2004.ee.doe.gov/pdf/af-5-fenlon-debenham-handout.pdf>

Teresa Galluzzo and David Osterberg, The Iowa Policy Project (March 2006). *Wind Power and Iowa Schools*. Available at: <http://www.iowapolicyproject.org/2006docs/060307-WindySchools.pdf>

Ed Holt, Ryan Wisser, Mark Bolinger (April 2006). *Who owns Renewable Energy Certificates? An Exploration of Policy Options and Practice*. Available at: <http://www.resourcesaver.org/file/toolmanager/CustomO16C45F69073.pdf>

Mary Myers and Chris Deisinger (November 2005, revised June 2006). *Developing a Community Manure Digester Model for Wisconsin*. Available at: http://www.focusonenergy.net/data/common/dmsFiles/W_RW_RPTE_DevelCommManureDigesforWI.pdf

Public Service Commission of Wisconsin (September 12, 2006). *Application of Wisconsin Power and Light Company for Approval to Change Retail Electric Rates and Natural Gas Rates* (Docket No. 6680-UR-115). “Testimony of Michael J. Vickerman on Behalf of RENEW Wisconsin.”

Kristen Goland, Massachusetts Technology Center (December 5, 2006). Email communication with Tom Michelman, Boreal Renewable Energy Development.

Julia Judd, Solar Electric Power Association. (September/October 2006). *California Builder Magazine*, “The Solar Factor.” Available at: <http://www.cabuilder.com/internal.asp?pid=290>

Charles Kubert, Environmental Law & Policy Center (2004). *Community Wind Financing Handbook*. Available at: <http://www.elpc.org/documents/WindHandbook2004.pdf>

F. T. McCarthy (December 10, 2005). *The Economist*, “Sunrise for Renewable Energy?” Available at: <http://www.nthpower.com/press/EconSunrise.pdf>

Alexander Osterwalder (2004). [*The Business Model Ontology - A Proposition In A Design Science Approach*](#)

Heather Rhodes-Weaver and Jennifer Grove, Northwest Sustainable Energy for Economic Development (March 30, 2004). *Our Wind Co-op: Exploring Joint Green Tag Financing and Marketing Models for Energy Independence*. Available at: http://www.ourwind.org/windcoop/pdfs/AWEA_Paper.pdf

Scotian WindFields (Copyright 2006). Web site. Available at: <http://www.scotianwindfields.org/index.php/article/frontpage/1>

Gary Stern (July/August 2005). *EnergyBiz Magazine*. “ESCOs Adapt to New Realities.” Available at: http://energycentral.fileburst.com/EnergyBizOnline/2005-4-jul-aug/ESCOS_070805-16.pdf

U.S. Government Accountability Office (September 2004). *Renewable Energy: Wind Power’s Contribution to Electric Power Generation and Impact on Farms and Rural Communities*. [GAO-04-756]. Available at: <http://www.gao.gov/new.items/d04756.pdf>

R. Wiser, M. Bolinger, P. Cappers, and R. Margolis (January 2006). *Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California*. [LBNL-59282].

John Young (October 2006). *Alternative Energy: Third Party Financing and Development*. Analysis funded by Focus on Energy. Available at: http://www.focusonenergy.com/data/common/dmsFiles/W_RW_RPTE_AltEnr3rdPrtyFinDevJYoun%20.pdf

New Business Models for Customer-Owned Renewable Energy Generation, prepared for We Energies, USA, by Rahul Young and Claire Cowan, ICF International (March 2007). Available at: http://www.weenergies.com/business_new/altenergy/existbusrpt.pdf

A Comparative Analysis of Community Wind Power Development Options in Oregon, prepared by Mark Bolinger, Ryan Wiser, Tom Wind, Dan Juhl, Robert Grace (July 2004). Available at: http://www.cleanenergystates.org/library/Reports/OR_Community_Wind_Report.pdf

Utility Solar Business Models: Emerging Utility Strategies & Innovation, prepared by John Nimmons and Mike Taylor for the Solar Electric Power Association (May 2008). Available at: www.renewableenergyworld.com/.../solar.../utility-business-model-report-released-by-sepa-52670

Business Models for Ethanol and Biodiesel, prepared for the United States Department of Agriculture, USDA, by Informa Economics (January 2007). Available at: [www.rurdev.usda.gov/.../Special%20Studies%20Business%20Models Informa.pdf](http://www.rurdev.usda.gov/.../Special%20Studies%20Business%20Models%20Informa.pdf)

Glossary of Terms and Abbreviations

The following is a list of terms, abbreviations, and acronyms used in this report and their definitions:

A\$	Australian dollars
ADM	Archer Daniels Midland
AFV	Alternative fuel vehicle
APEC	Asia Pacific Economic Cooperation
ASA	ASAlliances
ASEAN	Association of South East Asian Nations
ATF	Alternative Transport Fuel
Bbl	Barrel
Biodiesel	A non-petroleum-based diesel fuel consisting of long chain esters made by trans-esterification of vegetable oil or animal fat that can be used (either alone, or blended with conventional petro-diesel) in unmodified diesel-engine vehicles.
Biogas	A gas produced by the biological breakdown of organic matter in the absence of oxygen
Bi fuel	A vehicle that can operate on either of two on-board fuels, e.g. natural gas or gasoline
BPCL	Bharat Petroleum Corporate Limited
CCC	CNG Coordination Committee
CH ₄	Methane
CNG	Compressed natural gas
CO ₂	Carbon dioxide
CVAC	Chippewa Valley Agrafuels Cooperative
CVEC	Chippewa Valley Ethanol Cooperative
DDG	Distillers Dried Grain
DTC	Delhi Transport Corporation
EEU	Earth Energy Utility
ELPC	Environmental Law & Policy Center
ETS	Emissions trading schemes
EV	Electric Vehicle
FCV	Fuel cell Vehicle
FFV	Flexible Fuel Vehicle
Fil	Feed-in Law
Fit	Feed-in Tariff
Fitino	Feed-in Tariff in name only
FMV	Fair Market Value
GAIL	Gas Authority of India Limited
GHG	Greenhouse gas
GTG	Gas to Gasoline
HEV	Hybrid Electric Vehicle
HFI	Hydrogen Fuel Initiative
HREA	Hepburn Renewable Energy Association

I & M	Inspection & Maintenance
IGL	Indraprastha Gas Ltd
ISBT	Interstate Bus Terminals
ISO	International Standards Organisation
kWh	Kilowatt hour
LFTB	Liquid Fuels Trust Board
LLC	Limited Liability Corporation
LNG	Liquefied Natural Gas
LP	Limited Partnership
LPG	Liquefied Petroleum Gas
LSR	Lanai Sustainability Research
MTG	Methanol to Gasoline
MW	Megawatt
NCT	National Capital Territory
NO ₂	Nitrogen dioxide
NRET	New and Renewable Energy Technology
NZ	New Zealand
NZERDC	New Zealand Energy Research & Development Committee
\$NZ	New Zealand dollar
OPEC	Organisation of Petroleum Exporting Countries
PBI	Performance Based Incentives
PGU	Peninsula Gas Utilisation
PHEV	Plug-in Hybrid Electric Vehicle
PNGV	Petronas NGV
PPA	Power Purchase Agreement
PTC	Production Tax Credit
PV	Photovoltaic
QHTB	Qualified High Technology Buses
R&D	Research and Development
REC	Renewable Energy Costs
RES	Renewable Energy Standards
RON	Research Octane Number
RPMG	Renewable Products Marketing Group
RPS	Renewable Portfolio Standard
SREC	Solar Renewable Energy Credits
UHC	Unconventional hydrocarbon
UK	United Kingdom
USA	United States
US\$	United States dollar
USD _{oE}	US Department of Energy
USEPA	US Environmental Protection Agency

Appendix A

Incentives for Renewable Energy use, Worldwide

Appendix A: Incentives for Renewable Energy use, Worldwide

Country	Feed-in tariff	Renewable port-folio standard	Capital subsidies, grants, or rebates	Investment or other tax credits	Sales tax, energy tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Developed and transition countries										
Australia	*	*	*			*			*	
Austria	*		*	*		*			*	
Belgium		*	*		*	*		*		
Canada	(*)	(*)	*	*	*			(*)	*	(*)
Croatia	*			*					*	
Cyprus	*		*							
Czech Republic	*		*	*	*	*		*		
Denmark	*				*	*		*	*	*
Egypt	*									
Estonia	*				*					
Finland					*	*	*			
France	*		*	*	*	*			*	*
Germany	*		*	*	*				*	
Greece	*		*	*						
Hungary	*				*	*			*	
Ireland	*		*	*		*				*
Italy	*	*	*	*		*		*		
Israel	*									
Japan	(*)	*	*			*		*	*	
Korea	*		*	*	*				*	
Latvia	*								*	*
Lithuania	*		*	*					*	
Luxembourg	*		*	*						
Malta	*				*					
Netherlands	*		*	*		*	*			
New Zealand			*						*	
Nigeria	*									
Norway			*	*		*				*
Poland	*	*	*		*				*	*
Portugal	*		*	*	*					
Romania					*					
Russia			*			*				
Slovak Republic	*			*					*	
Slovenia	*								*	
Spain	*		*	*					*	
Sweden		*	*	*	*	*	*			
Switzerland	*									
Ukraine	*									
United Kingdom	*	*	*		*	*				
United States	(*)	(*)	*	*	(*)	(*)	*	(*)	(*)	(*)

(*) Entries with an asterisk (*) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy.

Appendix A: Incentives for Renewable Energy use, Worldwide (continued)

Country	Feed-in tariff	Renewable port-folio standard	Capital subsidies, grants, or rebates	Investment or other tax credits	Sales tax, energy tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Developing countries										
Algeria	*			*	*	*				
Argentina	*		*	(*)	*		*			
Brazil	*								*	*
Cambodia			*							
Chile		*	*							
China	*	*	*	*	*				*	*
Costa Rica	*									
Ecuador	*			*						
Guatemala				*	*					
Honduras				*	*					
India	(*)	(*)	*	*	*		*		*	*
Indonesia	*									
Kenya	*									
Mexico				*	*			*		
Morocco				*						
Nicaragua	*			*	*					
Panama							*			
Pakistan			*	*	*					
Philippines	*		*	*	*				*	
South Africa	*		*	*	*		*			
Sri Lanka	*									
Thailand	*		*					*	*	
Tunisia			*	*						
Turkey	*		*							
Uganda	*								*	

(*) Entries with an asterisk (*) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy.

Appendix B

Incentives for Renewable Energy use, USA

Appendix B1: Types of Alternative Transport Fuel Incentives available, USA

State	Grants	Tax Incentives	Loans and Leases	Rebates	HOV Lane Access	Exemptions from Requirements/Restrictions	Fuel Discounts	Technical Assistance	Totals *
Federal US	20	16	6	0	0	1	0	3	46
Alabama	1	0	0	0	0	0	0	1	2
Alaska	0	0	0	0	0	0	0	0	0
Arizona	1	2	0	0	1	1	0	0	5
Arkansas	1	0	1	0	0	1	0	0	3
California	13	0	2	7	1	8	5	1	37
Colorado	1	3	0	1	1	1	1	1	9
Connecticut	3	0	0	0	0	1	0	2	6
Delaware	0	1	0	0	0	0	2	1	4
Dist. of Columbia	0	0	0	0	1	2	0	1	4
Florida	2	1	0	0	1	3	0	0	7
Georgia	0	4	0	0	2	0	0	2	8
Hawaii	0	3	0	0	0	1	0	1	5
Idaho	0	3	0	0	0	0	0	1	4
Illinois	5	0	0	1	0	3	0	3	12
Indiana	3	7	0	2	0	1	1	0	14
Iowa	3	4	2	0	0	0	0	1	10
Kansas	0	5	0	1	0	0	0	0	6
Kentucky	1	4	0	0	0	1	0	2	8
Louisiana	1	2	0	0	0	0	0	1	4
Maine	1	2	2	0	0	0	0	0	5
Maryland	0	3	0	0	0	1	0	0	4
Massachusetts	0	1	0	0	0	1	0	1	3
Michigan	3	4	0	1	0	2	0	0	10
Minnesota	1	1	1	0	0	0	0	1	4
Mississippi	2	0	0	1	0	0	1	0	4
Missouri	3	1	0	1	0	2	0	2	9
Montana	0	8	0	0	0	0	0	0	8
Nebraska	0	3	0	0	0	2	0	0	5
Nevada	1	0	0	0	0	1	0	0	2
New Hampshire	1	0	0	0	0	0	0	0	1
New Jersey	1	2	0	3	1	1	0	1	9
New Mexico	1	4	2	0	0	1	1	2	11
New York	6	3	0	1	1	0	0	3	14
North Carolina	5	5	1	0	0	2	0	0	13
North Dakota	1	6	1	0	0	0	0	0	8
Ohio	6	1	2	0	0	0	0	0	9
Oklahoma	0	5	2	0	0	1	0	0	8
Oregon	0	4	2	0	0	2	0	0	8
Pennsylvania	4	2	2	1	0	0	0	1	10
Puerto Rico	0	0	0	0	0	0	0	0	0
Rhode Island	0	3	1	0	0	0	0	0	4
South Carolina	0	6	0	1	0	2	0	0	9
South Dakota	0	3	0	0	0	0	0	0	3
Tennessee	3	0	1	1	1	1	0	1	8
Texas	5	1	0	3	0	0	1	5	15
Utah	1	1	1	0	1	3	0	1	8
Vermont	0	1	0	0	0	0	0	1	2
Virgin Islands	0	0	0	0	0	0	0	0	0
Virginia	1	3	1	0	1	0	1	2	9
Washington	3	5	1	0	0	3	0	1	13
West Virginia	0	0	0	1	0	0	0	0	1
Wisconsin	2	2	0	1	0	1	0	1	7
Wyoming	0	1	0	0	0	0	0	1	2
TOTALS	106	136	31	27	12	50	13	45	

Appendix B2: Laws and Regulations applicable to Alternative Transport Fuels, USA

State	Individual Vehicle Purchaser/Driver	Fleet Purchaser/ Manager	Fueling/ Recharging Station Builder or Operator	Alternative Fuel Producer	Alternative Fuel Dealer	Alternative Fuel Purchaser	Alternative Fuel or AFV Researcher	Electrified Truck Stop Builder/ Operator	AFV Manufacturer/ Retrofitter	Totals *
Federal US	10	31	9	16	8	4	3	3	6	90
Alabama	1	1	0	2	0	2	1	0	0	7
Alaska	1	2	1	0	1	1	0	0	0	6
Arizona	9	11	4	1	1	0	0	0	2	28
Arkansas	3	4	1	2	3	3	0	0	2	18
California	30	39	7	5	1	5	7	3	7	104
Colorado	8	10	4	1	2	2	2	0	2	31
Connecticut	3	11	4	2	1	0	1	0	2	24
Delaware	2	4	1	0	1	2	0	0	0	10
Dist. of Columbia	2	3	0	0	0	0	0	0	1	6
Florida	6	10	4	7	5	3	6	0	5	46
Georgia	6	7	4	3	3	4	0	0	1	28
Hawaii	3	4	2	5	4	5	3	0	2	28
Idaho	1	3	2	2	4	4	0	0	0	16
Illinois	5	14	9	5	3	3	2	0	1	42
Indiana	2	9	5	8	7	4	2	0	4	41
Iowa	4	8	7	5	7	1	2	0	0	34
Kansas	4	7	2	3	3	2	0	0	1	22
Kentucky	1	4	2	5	4	4	2	0	1	23
Louisiana	5	8	5	6	2	1	0	0	1	28
Maine	4	7	1	3	1	2	0	0	1	19
Maryland	4	6	0	2	0	1	1	0	1	15
Massachusetts	2	7	1	2	3	2	2	0	1	20
Michigan	1	4	3	4	4	1	4	0	2	23
Minnesota	5	8	3	4	3	5	1	0	0	29
Mississippi	3	4	0	1	3	3	0	0	1	15
Missouri	6	10	4	4	2	5	0	0	0	31
Montana	4	5	2	5	3	2	1	0	2	24
Nebraska	3	5	1	2	3	2	0	0	0	16
Nevada	4	6	0	0	1	1	0	0	0	12
New Hampshire	3	6	1	1	1	1	0	0	0	13
New Jersey	6	10	1	0	0	1	0	0	2	20
New Mexico	5	12	6	4	2	4	3	0	2	38
New York	8	18	10	2	3	2	2	0	3	48
North Carolina	2	9	8	7	7	4	0	1	2	40
North Dakota	0	0	4	6	5	3	2	0	0	20
Ohio	1	5	3	3	2	4	1	1	3	23
Oklahoma	5	6	6	4	1	1	2	0	1	26
Oregon	7	10	2	4	3	2	1	0	1	30
Pennsylvania	5	8	4	3	2	5	1	0	3	31
Puerto Rico	0	0	0	0	0	0	0	0	0	0
Rhode Island	5	9	0	1	1	0	0	0	0	16
South Carolina	4	8	1	4	3	1	2	0	0	23
South Dakota	0	2	1	7	5	8	0	0	0	23
Tennessee	4	11	8	7	6	5	2	0	0	43
Texas	9	15	4	3	3	3	1	0	1	39
Utah	9	12	2	0	0	1	0	0	0	24
Vermont	2	7	0	1	0	0	2	0	2	14
Virgin Islands	0	0	0	0	0	0	0	0	0	0
Virginia	5	7	2	5	1	3	0	0	1	24
Washington	9	16	6	9	8	5	3	1	1	58
West Virginia	1	2	0	2	1	1	1	0	0	8
Wisconsin	3	9	3	1	6	4	1	0	1	28
Wyoming	0	1	0	1	1	0	0	0	0	3
TOTALS	235	435	160	180	144	132	64	9	69	0



NRET Implementation Resources

APEC Energy Working Group

September 2009

New and Renewable Energy Technology Services

General

Choosing a wind turbine

http://www.joliet-europe.com/choose_wind_turbine.htm

Energy Saving Trust

<http://www.energysavingtrust.org.uk/business/Business/Building-Professionals>

Exploring New Models of Solar Energy Development

[http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VSS-4S97JCG-2&_user=10&_coverDate=04%2F30%2F2008&_rdoc=13&_fmt=high&_orig=browse&_srch=doc-info\(%23toc%236270%232008%23999789996%23688123%23FLA%23display%23Volume\)&_cdi=6270&_sort=d&_docanchor=&_view=c&_ct=17&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=68028728d8dceacaecfbfb5079a76f8](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VSS-4S97JCG-2&_user=10&_coverDate=04%2F30%2F2008&_rdoc=13&_fmt=high&_orig=browse&_srch=doc-info(%23toc%236270%232008%23999789996%23688123%23FLA%23display%23Volume)&_cdi=6270&_sort=d&_docanchor=&_view=c&_ct=17&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=68028728d8dceacaecfbfb5079a76f8)

Home Solar Power Installation Grants and Incentives

<http://www.yoursolarpowerhome.com/index-grant.html>

How To Get Tax Credits For Energy Efficiency

<http://www.ecohuddle.com/wiki/how-to-get-tax-credits-for-energy-efficiency>

Hybrid power systems based on renewable energies: a suitable and cost-competitive solution for rural electrification

http://www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/Position_papers/ARE-WG_Technological_Solutions_-_Brochure_Hybrid_Systems.pdf

Hydro Energy Businesses Worldwide

<http://www.google.co.nz/search?hl=en&q=hydro+electricity+in+Korea+business+model&btnG=Search&meta=&aq=f&oq=>

Green Building Grants & Incentives

http://www.sustainablebuildingcentre.com/resourcecentre/grants_incentives

New and Renewable Energy Technology Services

General (cont)

Guide to sustainable biofuels procurement for transport

http://www.biofuel-cities.eu/fileadmin/template/projects/biofuels/files/Publications/Procurement_Guide.pdf

REEEP Renewable Energy & Energy Efficiency Partnership

<http://www.reeep.org/31/home.htm>

REN21 Renewable Energy Policy Network for the 21st Century

<http://www.ren21.net/default.asp>

Renewable Energy Businesses Worldwide

<http://energy.sourceguides.com/businesses/index.shtml>

Renewable energy rebates

<http://www.greenlivingtips.com/articles/152/1/Renewable-energy-rebates.html>

Renewable Energy Toolkit (REToolkit)

<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTENERGYNEW/EXTRENENERGYTK/0,,contentMDK:21814304~menuPK:5146597~pagePK:210058~piPK:210062~theSitePK:5138247,00.html>

REToolkit: A Resource for Renewable Energy Development

http://siteresources.worldbank.org/INTRENENERGYTK/Resources/REToolkit_issues_note.pdf

Taxes and Incentives for renewable energy

http://www.kpmg.com.au/Portals/0/Taxes%20and%20Incentives%20for%20Renewable%20Energy_final%20web.pdf

World Energy Council

<http://www.worldenergy.org/>

New and Renewable Energy Technology Services

Australia (cont)

Australian Government - Rebates, grants & Loans

<http://www.livinggreener.gov.au/rebates-grants-loans/>

Energy Matters - Government rebates, incentives & grants for renewable energy

<http://www.energymatters.com.au/government-rebates/>

Ferret - Incentives for installing solar panels for renewable energy

<http://www.ferret.com.au/c/Energy-Matters/Incentives-for-installing-solar-panels-for-renewable-energy-n671632/tags>

Renewable energy in Australia

http://en.wikipedia.org/wiki/Renewable_energy_in_Australia

Solar Energy Australia

<http://www.solaraustralia.com.au/about%20us.html>

Brunei

Renewable energy agency finds new homes

http://www.bt.com.bn/en/focus/2009/07/02/renewable_energy_agency_finds_new_homes

Canada

ecoENERGY

<http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/heat-chauffage/index-eng.cfm>

Federal Government Incentives

<http://www.cansia.ca/Default.aspx?pagelD=139888>

New and Renewable Energy Technology Services

Canada (cont)

Natural Resources Canada - Grants and Incentives

<http://oee.nrcan.gc.ca/corporate/incentives.cfm?attr=0>

Natural Resources Canada (RET Screen)

<http://www.retscreen.net/ang/home.php>

The Heating, Refrigeration and Airconditioning Institute of Canada

<http://www.hrai.ca/renewablesdatabank.html>

Geothermal Heat Pumps

<http://oee.nrcan.gc.ca/residential/business/energystar/procurement/geothermal.cfm>

Chile

Renewable Energy Businesses in Chile

<http://energy.sourceguides.com/businesses/byGeo/byC/Chile/Chile.shtml>

China

China: Program on New and Renewable Energy Development in China (1996-2010)

<http://projects.wri.org/sd-pams-database/china/program-new-and-renewable-energy-development-china>

Hong Kong

Biomass Energy Businesses in Hong Kong

<http://energy.sourceguides.com/businesses/byGeo/byC/HongKong/byP/biomass/biomass.shtml>

New and Renewable Energy Technology Services

Indonesia

Renewable Energy Facts

http://www.solarpowerindonesia.com/solar_energy_information.htm

Japan

Geothermal Energy Resource Toolkit

<http://www.amazon.com/Century-Geothermal-Energy-Resource-Toolkit/dp/1422006476>

Republic of Korea

Hydroelectricity Businesses Worldwide - Korea

<http://energy.sourceguides.com/businesses/byP/hydro/hRP.shtml>

Malaysia

Policies in Malaysia

<http://projects.wri.org/book/export/html/16>

Mexico

Energy profile of Mexico

http://www.eoearth.org/article/Energy_profile_of_Mexico

New Zealand

EECA - Funding

<http://www.eeca.govt.nz/eeca-programmes-and-funding/funding>

New and Renewable Energy Technology Services

New Zealand (cont)

EECA - Solar water heating

<http://www.energywise.govt.nz/how-to-be-energy-efficient/your-house/hot-water/solar-water-heating>

EECA - Technology grants

<http://www.eecabusiness.govt.nz/services-and-funding/technology-grants>

Powershop - Your online energy store

<http://www.powershop.co.nz/>

Papua New Guinea

Policy DB Details: Independent State of Papua New Guinea

<http://www.reeep.org/index.php?id=9353&text=policy-db&special=viewitem&cid=71>

Peru

Wind Energy Businesses in Peru

<http://energy.sourceguides.com/businesses/byP/wRP/byGeo/byC/Peru/Peru.shtml>

Philippines

ReEx Capital Asia

<http://www.reexasia.com/>

New and Renewable Energy Technology Services

Singapore

Leading Enterprises Consolidate Efforts to Champion Sustainable Manufacturing in Singapore

<http://www.greenbusinesstimes.com/2009/05/05/leading-enterprises-consolidate-efforts-to-champion-sustainable-manufacturing-in-singapore/>

Chinese Taipei

Taipei, Taiwan: Taiwan Government Initiatives to Stimulate Green Energy Industry

<http://www.solarbuzz.com/News/NewsASGO82.htm>

Thailand

Transfer of EU Knowledge and Technology for Development of Wind Energy Technology in Thailand

<http://www.serd.ait.ac.th/wind/>

The Energy Policy and Planning Office (EPPO)

<http://www.eppo.go.th/index-E.html>

USA

Dakota Electric Business Services - Rebates, grants and loans

https://www.dakotaelectric.com/business/programs/rebates_grants_and_loans

Department of Environmental Protection, Pennsylvania - Grants, Loans & Rebates

<http://www.depweb.state.pa.us/energy/cwp/view.asp?a=3&q=484977&energyNav=>

Distributed Energy Program

http://www.eere.energy.gov/de/case_studies.html

New and Renewable Energy Technology Services

USA (cont)

DSIRE Solar, Database of State Incentives for Renewables & Efficiency

<http://www.dsireusa.org/>

Geothermal Energy Resource Toolkit

<http://www.amazon.com/Century-Geothermal-Energy-Resource-Toolkit/dp/1422006476>

How to go Solar

http://www.nmsea.org/Downloads/Go_Solar_Guide.pdf

How to Start a Solar Energy Business (cost Effectively)

http://www.ehow.com/how_2263426_solar-energy-business-cost-effectively.html

New business model for solar energy

<http://www.micro-generator.com/2006/09/22/new-business-model-for-solar-energy/>

Renewable & Alternative Energy Portfolio Standards

<http://www.pewclimate.org/node/4120>

SEPA - Utility Procurement Study - Solar Energy in the Utility Market

http://www.trpvplatform.org/IEA-PVPS%20Data/PV_Uilities_SEPA.pdf

Renewable Energy Incentives

http://www.seco.cpa.state.tx.us/re_incentives.htm

The Solar Guide - Solar Financing, Subsidies and Incentives

<http://www.thesolarguide.com/solar-energy-systems/financing-incentives.aspx>

New and Renewable Energy Technology Services

Vietnam

Green Energy is natural choice

<http://www.vge.vn/faqs.htm>



Study Database

APEC Energy Working Group

September 2009

Successful Business Models for New & Renewable Energy (NRE) - General

NRET General

TC9901028 : Renewable Energy Service Delivery

<http://www.iadb.org/projects/project.cfm?id=TC9901028&lang=en>

BOT (Build, Operate and Transfer) an alternative to traditional data conversion and management

<http://www.gisdevelopment.net/proceedings/gita/1999/business/ba003pf.htm>

Build, Own, Operate, Transfer (BOOT)

<http://www.maf.govt.nz/mafnet/rural-nz/sustainable-resource-use/irrigation/equity-investment-options/equity11.htm>

Build, Own, Operate, Transfer (BOOT)

<http://www.businessdictionary.com/definition/build-own-operate-transfer-BOOT.html>

Build-Operate-Transfer Contract

<http://www.investopedia.com/terms/b/botcontract.asp>

Business model

http://en.wikipedia.org/wiki/Business_model

Business Model

<http://www.mainstreamrp.com/pages/Business-Model.html>

Business Model Design and Innovation

www.slideshare.net/.../business-model-design-and-innovation-for-competitive-advantage

Business model innovation will drive Renewable Energy adoption in Off-Grid, Micro-Grid and Mini-Grid Markets

<http://fellows.rdvp.org/gerard-rego/business-model-innovation-will-drive-renewable-energy-adoption-in-off-grid-micro-grid-an>

Successful Business Models for New & Renewable Energy (NRE) - General

NRET General (cont)

Commercialisation of Renewable Energy Technology - A Unique Institution to Finance New and Renewable Energy in India

www.apfed.net/ki/database/doc/BPP027.pdf?PHPSESSID...

Global Renewable Energy, Policies and Measures

renewables.iea.org/

New Business Models for Customer-Owned Renewable Energy Generation

http://www.we-energies.com/business_new/altenergy/existbusrpt.pdf

New Thinking New Energy

http://www.bmu.de/files/pdfs/allgemein/application/pdf/roadmap_energiepolitik_en.pdf

Renewables 2007, Global Status Report

www.ren21.net/pdf/RE2007_Global_Status_Report.pdf

Renewables 2009, Global Status Report Update

www.ren21.net/pdf/RE_GSR_2009_Update.pdf

Renewable Energy Commercialisation Strategies

www.vestforsk.no/www/show.do?page=10&articleid...

Renewable Energy Financing Case Studies: Lessons to be Learned from Successful Initiatives

www.cec.org/files/pdf/.../RE%20Financing%20Case%20Studies_en.pdf

Renewable Energy Rebates

<http://www.greenlivingtips.com/articles/152/1/Renewable-energy-rebates.html>

Rethink Your Business Model Around Green - Harvard Business Online's Leading Green

<http://blogs.harvardbusiness.org/leadinggreen/index.php?page=7>

Successful Business Models for New & Renewable Energy (NRE) - General

NRET General (cont)

REToolkit: A Resource for Renewable Energy Development
http://siteresources.worldbank.org/INTRENENERGYTK/Resources/REToolkit_issues_note.pdf

Taxes and Incentives for renewable energy
http://www.kpmg.com.au/Portals/0/Taxes%20and%20Incentives%20for%20Renewable%20Energy_final%20web.pdf

The Business Model and types of Plants
http://www.desipower.com/how/business_model.htm

Feed-in Tariffs for Renewable Energy
<http://www.newrules.org/energy/rules/feedin-tariffs-renewable-energy>

European Technology Platform Smart Grids
<http://www.smartgrids.eu/documents/vision.pdf>

Wind

A Comparative Analysis of Community Wind Power Development Options in Oregon
www.cleanenergystates.org/.../OR_Community_Wind_Report.pdf

Asia Pacific Wind Power Markets and Strategies, 2006-2015
http://www.emerging-energy.com/user/AsiaPacificWindPowerMarketsandStrategies200620111722848735_pub/AsiaPacificWindPromo.pdf

Case Study: European Offshore Wind Farms - A Survey for the Analysis of the Experiences and Lessons Learnt by Developers of Offshore Wind Farms
http://www.offshore-wind.de/page/fileadmin/offshore/documents/Case_Study_European_Offshore_Wind_Farms.pdf

Successful Business Models for New & Renewable Energy (NRE) - General

NRET Wind (cont)

Choosing a wind turbine
http://www.joliet-europe.com/choose_wind_turbine.htm

Community Wind Energy
http://en.wikipedia.org/wiki/Community_wind_energy

Global Wind Energy Council
www.gwec.net/

Hong Kong Offshore Wind Farm, Hong Kong
<http://www.power-technology.com/projects/hk-windfarm/>

Revolution: Oklahoma Wind Energy Conference
<http://www.windustry.org/events/revolution-oklahoma-wind-energy-conference>

Solar

Community Renewable Energy Is Just Around the Corner
<http://www.renewableenergyworld.com/rea/news/article/2006/09/community-renewable-energy-is-just-around-the-corner-45928>

Hydro

Hydroelectricity Market Research
<http://www.bharatbook.com/Market-Research/Hydroelectricity.html>

Micro-hydro
<http://www.lged-rein.org/knowhow.php?pageid=55>

Biomass

Integration of Renewable Energy on Farms
www.farm-energy.ca/IReF/index.php?page=technologies

Geothermal

Eden Project in deal for pioneering geothermal energy plant
http://www.newenergyfocus.com/do/ecco.py/view_item?listid=1&listcatid=32&listitemid=2690

Renewable energy system maintenance business model
<http://www.freshpatents.com/-dt20090917ptan20090234685.php>

Successful Business Models for New & Renewable Energy (NRE) - Australia

NRET General

Australian Government - Rebates and Funding

<http://www.environment.gov.au/rebates/index.html>

Australian Solar Energy Grants And Incentives - An Overview

<http://www.alternate-energy-sources.com/solar-energy-grants-1.html>

Australia's Renewable Energy Target

www.climatechange.gov.au/renewabletarget/.../fs-ret.html

City of Mitcham - Environmental Grants and Rebates

<http://www.mitchamcouncil.sa.gov.au/site/page.cfm?u=1124>

Global Renewable Energy - Policies and Measures

<http://www.iea.org/textbase/pm/grindex.aspx>

Northern Territory Government - Rebates and Grants

http://www.dcm.nt.gov.au/strong_territory/climate_change/rebates_and_grants

Private Infrastructure Options, BOOTs, BOTs and BOOs

www.uq.edu.au/economics/johnquiggin/.../BOOT.html

Renewable Energy - A contribution to Australia's Environmental and Economic Sustainability

<http://www.mmassociates.com.au/>

Renewable Energy Commercialisation Programme (RECP)

<http://www.environment.gov.au/index.html>

Renewable Energy Commercialisation in Australia

www.futureenergy.com.au/.../AGO%20Commercialisation%20Projects.pdf

Successful Business Models for New & Renewable Energy (NRE) - Australia

NRET General (cont)

Renewable Energy Commercialisation in Australia, Strategies
www.futureenergy.com.au/.../AGO%20Commercialisation%20Projects.pdf

Renewable Energy in Australia
http://en.wikipedia.org/wiki/Renewable_energy_in_Australia

Submission to the Renewable Energy Target Exposure Draft Legislation
[http://www.pacifichydro.com.au/Portals/0/RET%20Exposure%20Legislation%20Submission%20PHL\[1\].pdf](http://www.pacifichydro.com.au/Portals/0/RET%20Exposure%20Legislation%20Submission%20PHL[1].pdf)

Wind

Community Wind Energy
http://en.wikipedia.org/wiki/Wind_turbine

Solar

Hot Frog - Your Solar Energy Directory
<http://www.hotfrog.com.au/Products/Solar-Energy>

Solar power incentives and rebates for Australian business
<http://www.energymatters.com.au/government-rebates/solar-incentives-business.php>

Home Solar Power Installation Grants and Incentives
<http://www.yoursolarpowerhome.com/index-grant.html>

Hydro

Effective stakeholder management: Lessons from hydro-electricity projects
<http://www.skmconsulting.com/Knowledge-and-Insights/Achieve-Articles/2008/People-Define-Projects.aspx>

Biomass

The economic effects of an ethanol mandate
www.aph.gov.au/library/pubs/RP/2007-08/08RP18.pdf

Geothermal

Installed Capacity and Generation from Geothermal Sources by 2020
<http://www.mmassociates.com.au/>

Successful Business Models for New & Renewable Energy (NRE) - Brunei

NRET General

Brunei, Sarawak to study power linkages

http://www.energy.gov.bn:81/index.php?option=com_content&view=article&id=139:brunei-sarawak-to-study-power-linkages&catid=37:news&Itemid=70

Policy DB Details: Brunei Darussalam

<http://www.reeep.org/index.php?id=9353&text=policy-db&special=viewitem&cid=69>

Powering Brunei by wind, water and sun Minister sees the need to diversify

http://www.energy.gov.bn:81/index.php?option=com_content&view=article&id=123:powering-brunei-by-wind-water-and-sun-minister-sees-the-need-to-diversify&catid=37:news&Itemid=70

Wind

Renewable energy agency finds new homes

http://www.bt.com.bn/en/focus/2009/07/02/renewable_energy_agency_finds_new_homes

Solar

Mitsubishi signs solar project deal in Brunei

http://www.eetasia.com/ART_8800540499_765245_NT_811c0820.HTM

Successful Business Models for New & Renewable Energy (NRE) - Canada

NRET General

Canadian Renewable Energy Alliance

<http://new.canrea.ca/site/>

Creating and Building an Ocean Renewable Energy Cluster for Canada

http://www.oreg.ca/docs/march_presentations/NigelPresentation.pdf

Government of Canada - Grants and Rebates for Organizations

<http://www.ecoaction.gc.ca/grantsrebates-subventionsremises/organizations-organisations-eng.cfm>

Government of Canada - eco Energy

<http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/index-eng.cfm>

Green Living Tips - Renewable energy rebates

<http://www.greenlivingtips.com/articles/152/1/Renewable-energy-rebates.html>

Integration of Renewable Energy on Farms

<http://www.farm-energy.ca/IReF/index.php?page=business-models>

National Resources Canada - Grants and Incentives

<http://www.oeo.nrcan.gc.ca/corporate/incentives.cfm?attr=0>

National Resources Canada - Grant Table for ecoENERGY Retrofit – Homes

<http://www.oeo.nrcan.gc.ca/residential/personal/retrofit-homes/retrofit-qualify-grant.cfm?attr=4>

National Resources Canada - Incentive Programmes

http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/about_us/ottawa/funding/incentive_program.html

Navigant Consulting Study Shows Dramatic Improvements in Renewable Energy Technologies

<http://www.energyvortex.com/pages/headlinedetails.cfm?id=823&archive=1>

Successful Business Models for New & Renewable Energy (NRE) - Canada

NRET General (cont)

Power Smart Innovation Challenge

www.bchydro.com/.../innovation_challenge_brief_for_smart_metering.Par.0001.File.innovation_challenge_brief_for_smart_metering.pdf

Promoting Green Power in Canada

www.pollutionprobe.org/.../greenpower/gppromotedwnldpg.html

Renewable Energy

<http://re.pembina.org/canada/policies>

Renewable Energy - Support for Renewable Energy in Canada

<http://re.pembina.org/canada>

Renewable Energy Financing Case Studies: Lessons to be Learned from Successful Initiatives

http://www.cec.org/files/pdf/ECONOMY/RE%20Financing%20Case%20Studies_en.pdf

The Canadian Renewable Energy Network (CanREN)

<http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/renewables/canren.html>

Wind

Bullfrog Power Generation Sources

<http://www.bullfrogpower.com/clean/producers.cfm>

Canada Wind Power Markets and Strategies, 2007-2015

<http://www.researchandmarkets.com/reports/596467/>

Solar

Canadian Solar's Model is Vertical Integration

<http://www.renewableenergyworld.com/rea/video/canadian-solars-model-is-vertical-integration>

Ontario Ministry of Revenue - Solar Energy Systems Rebate Program

<http://www.rev.gov.on.ca/en/refund/sesr/index.html>

Successful Business Models for New & Renewable Energy (NRE) - Canada

Solar (cont)

Solar Power for your Home - Home Solar Power Installation Grants and Incentives
<http://www.yoursolarpowerhome.com/index-grant.html>

Hydro

Brascan Power and Canadian Hydro to Issue \$70 Million of Senior Secured Bonds
http://www.brookfieldpower.com/content/2005/brascan_power_and_canadian_hydro_to_issue_70_mill-763.html

Ford extends with Hydro-Quebec electric company The escape plug-in hybrid PHEV research program
http://www.motiontrends.com/2009/06/Ford/Escape_PHEV_Hydro-Quebec.shtml

Biomass

Barriers to Increased Bioenergy Use in Canada and Some Solutions
<http://www.canbio.ca/documents/CANBIO%20fact%20sheet%20barriers%20final%2031Mar04.pdf>

Advantages of Big Business on Economy
<http://www.docstoc.com/docs/1082513/Advantages-of-Big-Business-on-Economy>

Promising Business Models
www.biop.ca/En/ConferenceEn.html

Geothermal

Geothermal Heat Pumps
<http://oee.nrcan.gc.ca/residential/business/energystar/procurement/geothermal.cfm>

Successful Business Models for New & Renewable Energy (NRE) - Chile

NRET General

Renewable Energy in Chile

<http://www.gtz.de/en/themen/umwelt-infrastruktur/energie/8956.htm>

Renewable Energy and CDM in Chile—Chilean Economic Development Agency -CORFOSantiago

<http://www.berr.gov.uk/files/file51673.pdf>

Wind

Chile Announces New Wind Power Projects, Solar Farm, and Thermal Plant

<http://www.treehugger.com/files/2009/06/chile-announces-new-wind-power-projects-solar-farm-thermal-plant.php>

Wind Energy Catches on in Chile

<http://www.renewableenergyworld.com/rea/news/article/2007/08/wind-energy-catches-on-in-chile-49716>

Solar

Germany to support Chilean renewable energy efforts

<http://www.scidev.net/en/news/germany-to-support-chilean-renewable-energy-effort.html>

Hydro

Iberdrola Sells Chilean Hydro Stakes

<http://www.renewableenergyworld.com/rea/news/article/2009/07/iberdrola-sells-chilean-hydro-stakes>

Pacific Hydro Closes US\$360 Million Finance Deal for New Chilean Hydro Project

[http://www.pacifichydro.com.au/Portals/0/MR%20US%20\\$450mil%20Chacayes%20finance%2026%20may%2009.pdf](http://www.pacifichydro.com.au/Portals/0/MR%20US%20$450mil%20Chacayes%20finance%2026%20may%2009.pdf)

Biomass

Renewable Energy Businesses in Chile

<http://energy.sourceguides.com/businesses/byGeo/byC/Chile/Chile.shtml>

Energy Quest in biomass venture in Chile

<http://cleantech.com/news/2546/energy-quest-in-biomass-venture-in-chile>

Geothermal

Chile launches geothermal exploration tender

http://www.rechargenews.com/business_area/finance/article179901.ece

Successful Business Models for New & Renewable Energy (NRE) - China

NRET General

Case Study: UNDP/GEF Project for Commercialization of Renewable Energy in China

http://www.gefweb.org/China_RE_GEF.pdf

Capacity Building for the Rapid Commercialization of Renewable Energy

<http://www.ccre.com.cn/>

China Passes Renewable Energy Law

<http://www.renewableenergyworld.com/rea/news/article/2005/03/china-passes-renewable-energy-law-23531>

China: Program on New and Renewable Energy Development in China (1996-2010)

<http://projects.wri.org/sd-pams-database/china/program-new-and-renewable-energy-development-china>

China Sets 15% Renewable Energy Target, Ups Ante on U.S.

<http://www.ethiopianreview.com/articles/17160>

Rapid commercialization of renewable energy in China

http://www.un.org/esa/sustdev/publications/energy_casestudies/section2.pdf

Renewable Energy in China

<http://www.nrel.gov/docs/fy04osti/35786.pdf>

Renewable Energy in China

<http://www.martinot.info/china.htm>

Wind

China Clean Energy Report: China Sets Feed in Tariff for Wind Power

www.docstoc.com/.../China-Clean-Energy-Report-China-Sets-Feed-in-Tariff-for-Wind-Power

Wild east: Wind power's new frontier?

<http://www.renewableenergyworld.com/rea/news/article/2007/07/wild-east-wind-powers-new-frontier-51496>

Successful Business Models for New & Renewable Energy (NRE) - China

Solar

Review of Overseas Initiatives that have been taken to increase the uptake of solar water heating
http://www.ebhe.gr/library/Global_Incentives.pdf

Update 1-Suntech, China Huadian partner on solar projects
<http://www.reuters.com/article/rbssIndustryMaterialsUtilitiesNews/idUSN2231567920090722>

Hydro

China continues controversial push towards hydropower
http://www.rechargenews.com/energy/wave_tidal_hydro/article174095.ece

Biomass

Biomass co-firing potential in China
<http://www.reep.org/9863.2669/biomass-co-firing-potential-in-china.htm>

Geothermal

China Plans To Increase Geothermal Development
http://www.earth-stream.com/Earth/Clean-Energy/Geothermal/China-Plans-To-Increase-Geothermal-Development_18_151_642_177908.html

Successful Business Models for New & Renewable Energy (NRE) - Hong Kong

NRET General

Biomass co-firing potential in China

<http://www.reeep.org/9863.2669/biomass-co-firing-potential-in-china.htm>

Database on Particular Policy Issues

http://www.legco.gov.hk/database/english/data_ea/ea-renewable-energy.htm

New and Renewable Energy

<http://www.emsd.gov.hk/emsd/eng/pee/nre.shtml>

Renewable Energy

<http://www.gov.hk/en/residents/environment/energy/renewableenergy.htm>

The Use of Renewable Energy in Hong Kong (2003/09/15)

http://www.greencouncil.org/eng/publication/headline_detail.asp?id=250

Wind

EIA for Hong Kong's First Offshore Wind Farm

<http://www.renewableenergyworld.com/rea/news/article/2009/06/eia-for-hong-kongs-first-offshore-wind-farm>

Hong Kong Offshore Wind Farm, Hong Kong

<http://www.power-technology.com/projects/hk-windfarm/>

Investigation on wind power potential on Hong Kong islands—an analysis of wind power and wind turbine characteristics

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V4S-45H8KN1-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&_view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=5943ce64f2fb72a3821a93ae1fc86ccf

Solar

Hong Kong's place in the sun with Mainland renewable energy

<http://www.hktdc.com/info/mi/a/imn/en/1X002ZY5/1/International-Market-News/Hong-Kong-S-Place-In-The-Sun-With-Mainland-Renewable-Energy.htm>

Successful Business Models for New & Renewable Energy (NRE) - Hong Kong

Solar (cont)

Renewable Energy

<http://www.gov.hk/en/residents/environment/energy/renewableenergy.htm>

Biomass

Biomass Energy Businesses in Hong Kong

<http://energy.sourceguides.com/businesses/byGeo/byC/HongKong/byP/biomass/biomass.shtml>

Biomass CHP

http://re.emsd.gov.hk/english/other/biomass/biom_tech.html

Successful Business Models for New & Renewable Energy (NRE) - Indonesia

NRET General

Energy Policy and Development

http://www.senternovem.nl/mmfiles/5.%20Energy%20Policy%20Indonesia_tcm24-275542.pdf

Indonesia's Renewable Energy Potential

<http://www.esdm.go.id/news-archives/general/49-general/1963-indonesias-renewable-energy-potential.html>

Renewable Energy and Energy Efficiency in Indonesia

<http://www.adb.org/documents/events/2009/Climate-Change-Energy-Workshop/Renewable-Energy-Girianna.pdf>

Statement by the Delegation of the Republic of Indonesia

<http://www.miit.gov.cn/n11293472/n11293877/n12284060/n12284092/n12305428.files/n12305427.doc>

Wind

Utilization of Wind Energy in Indonesia

http://www.migas-indonesia.com/files/article/Utilization_of_Wind_Energy_in_Indonesia.pdf

Solar

Renewable Energy Facts

http://www.solarpowerindonesia.com/solar_energy_information.htm

Hydro

Indonesia's Renewable Energy Potential

<http://www.esdm.go.id/news-archives/general/49-general/1963-indonesias-renewable-energy-potential.html>

Biomass

Biomass Energy Potentials And Utilization In Indonesia

<http://www.bioenergylists.org/stovesdoc/Fuels/msoB2D82.pdf>

Geothermal

Arrow To Build Geothermal Plant in Indonesia

<http://www.renewableenergyworld.com/rea/news/article/2009/07/arrow-to-build-geothermal-power-plant-in-indonesia>

Successful Business Models for New & Renewable Energy (NRE) - Indonesia

Geothermal Continued

Geothermal energy in Indonesia

[http://www.dena.de/fileadmin/user_upload/Download/Veranstaltungen/2007/07/4.4._
Geothermie_in_Indonesien.pdf](http://www.dena.de/fileadmin/user_upload/Download/Veranstaltungen/2007/07/4.4._Geothermie_in_Indonesien.pdf)

Successful Business Models for New & Renewable Energy (NRE) - Japan

NRET General

Agency for Natural Resources and Energy

<http://www.enecho.meti.go.jp/english/index.htm>

Citizen-funded Renewable Energy Projects Gain Momentum in Japan

<http://www.japanfs.org/en/mailmagazine/newsletter/pages/028569.html>

Creating New Energy for Tomorrow

<http://www.mitsubishicorp.com/jp/en/csr/library/pdf/08sr-07.pdf>

Global Renewable Energy - Japan

<http://www.iea.org/Textbase/pm/?mode=re&action=view&country=Japan>

Japan green incentives lift electronics sales

<http://gadgetophilia.com/japan-incentives-on-energy-efficient-gadgets-lifting-sales-at-electronics-retailers/>

Measures on Energy Conservation and Environmental Protection

<http://www.energy.gov.mm/environmentalconsideration.htm>

Public Transport

<http://www.alternative-energy-news.info/technology/transportation/public-transit/>

Renewable energy market opportunities harnessed by Japan and New Zealand

<http://www.asianz.org.nz/our-work/action-asia-business/networking/japan-breakfast-report>

Study on the business model of multi-energy system from consumers' points of view

<http://sciencelinks.jp/j-east/article/200522/000020052205A0910116.php>

Wind

32,000 Solar Schools In Japan By 2020

http://www.energymatters.com.au/index.php?main_page=news_article&article_id=513

Successful Business Models for New & Renewable Energy (NRE) - Japan

Wind (cont)

Alstom Wind Turbines for Japanese Project

<http://www.renewableenergyworld.com/rea/news/article/2009/06/alstom-wind-turbines-for-japanese-project>

Global Wind Energy Council

<http://www.gwec.net/index.php?id=123>

Japan's wind industry stalls as new turbine laws bite

<http://www.businessgreen.com/business-green/news/2245617/japan-wind-power-growth-remains>

PNOC to study wind energy projects in Japan

http://steelguru.com/news/index/2009/06/22/OTkzNzk%3D/PNOC_to_study_wind_energy_projects_in_Japan.html

Solar

Introduction of the New Purchase System for Solar Power-Generated Electricity

- Electricity generated from solar power to be purchased under the system from November

http://www.meti.go.jp/english/press/data/20090831_02.html

Japan Announces Solar Feed In Tariffs

http://www.energymatters.com.au/index.php?main_page=news_article&article_id=335

Japan Wants to Resurrect Solar Incentives

<http://www.greentechmedia.com/articles/read/japan-wants-to-resurrect-solar-incentives-1037/>

Solar Cells Sales Going Retail in Japan

<http://www.greenpacks.org/2009/05/13/solar-cells-sales-going-retail-in-japan/>

Solar Financing, Subsidies and Incentives

<http://www.thesolarguide.com/solar-energy-systems/financing-incentives.aspx>

Successful Business Models for New & Renewable Energy (NRE) - Japan

Hydro (cont)

Chubu Electric in Talks to Buy Hydro Plants in Japan

<http://www.bloomberg.com/apps/news?pid=20601101&sid=a3t6ogLR6fWc&refer=japan>

The Role of Matsunaga Yasuzaemon in the Development of Japan's Electric Power Industry

<http://ssjj.oxfordjournals.org/cgi/content/abstract/9/2/203>

Biomass

Biomass Policy in Japan

<http://www.nedo.go.jp/kokusai/kouhou/190201/1-1t.pdf>

Integrated approach to promote biomass energy in Japan

<http://www.svebio.se/attachments/33/298.pdf>

Diffusion of Biomass Pellets in Japan

<http://www.wattwatt.com/pulses/233/diffusion-of-biomass-pellet-in-japan/>

Geothermal

EIMY (Energy In My Yard)—a concept for practical usage of renewable energy from local sources

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VCN-49FXFRW-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&_view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=457f17037d95e7225622360f960d76a0

Japanese Geothermal HVAC System Maker Seeks U.S. Partners

http://www.achrnews.com/Articles/Breaking_News/BNP_GUID_9-5-2006_A_1000000000000578481

Successful Business Models for New & Renewable Energy (NRE) - Republic of Korea

NRET General

Energy

<http://www.un.org/esa/agenda21/natlinfo/countr/repkorea/energy.pdf>

Financing Energy Development In North Korea

<http://lxmi.mi.infn.it/~landnet/corea/prop/financing.pdf>

Green Growth: Korea's New Strategy. The road to Commercialising renewable Energy

www.koreaherald.co.kr/NEWKHSITE/.../200903270075.asp

Korea gives renewable-energy tax incentives

<http://www.ethicalcorp.com/content.asp?ContentID=2527>

Korea Shoots For The Moon Using Green Energy

<http://businessfightspoverty.ning.com/profiles/blogs/korea-shoots-for-the-moon>

Major green investments on the cards for South Korea

http://www.pv-tech.org/news/ a/major_green_investments_on_the_cards_for_south_korea/

New and Renewable Energy Policy in Korea

http://www.kemco.or.kr/web/kcms/bord/bord_FD.asp?f=4111

Policies in South Korea

<http://projects.wri.org/sd-pams-database/tags/28>

Project 1827 : Korea Land Corporation Pyeongtaek Sosabul-district new and renewable energy model city (Photovoltaic system + solar water heating system)

<http://cdm.unfccc.int/Projects/DB/KEMCO1209009690.84/view>

Renewable Energy Development

<http://renewableenergydev.com/red/tag/south-korea/>

Successful Business Models for New & Renewable Energy (NRE) - Republic of Korea

NRET General (cont)

Renewable Database

<http://www.iea.org/textbase/pm/?mode=re&action=view&country=Korea,%20Republic%20of>

South Korea's Renewable Technology Push

<http://www.energyboom.com/policy/south-koreas-green-push>

South Korea unveils 80 per cent subsidy for domestic fuel cells

<http://www.businessgreen.com/business-green/news/2248391/south-korea-unveils-80-per-cent>

South Korean Energy Firms To Invest KRW3 Trillion On Renewable Energy

http://hydro.energy-business-review.com/news/south_korean_energy_firms_to_invest_krw3_trillion_on_renewable_energy_090708

The Energy Conservation Programme of the Republic of Korea

<http://www.unescap.org/esd/energy/publications/compend/ceccpart2chapter3.htm>

Wind

South Korea slashes import tariffs on renewable energy equipment

<http://www.businessgreen.com/business-green/news/2249866/south-korea-slashing-import>

Wind Power Profile of South Korea (2009)

<http://www.google.co.nz/search?hl=en&source=hp&q=wind+power+in+korea>

Wind Power on the Rise in South Korea

<http://www.renewableenergyworld.com/rea/news/article/2007/01/wind-power-on-the-rise-in-south-korea>

Solar

Dow Corning Selects Korea for Solar Solutions Application Center

<http://www.renewableenergyworld.com/rea/news/article/2009/04/dow-corning-selects-korea-for-solar-solutions-application-center>

Successful Business Models for New & Renewable Energy (NRE) - Republic of Korea

NRET General (cont)

Renewable Database

<http://www.iea.org/textbase/pm/?mode=re&action=view&country=Korea,%20Republic%20of>

South Korea's Renewable Technology Push

<http://www.energyboom.com/policy/south-koreas-green-push>

South Korea unveils 80 per cent subsidy for domestic fuel cells

<http://www.businessgreen.com/business-green/news/2248391/south-korea-unveils-80-per-cent>

South Korean Energy Firms To Invest KRW3 Trillion On Renewable Energy

http://hydro.energy-business-review.com/news/south_korean_energy_firms_to_invest_krw3_trillion_on_renewable_energy_090708

The Energy Conservation Programme of the Republic of Korea

<http://www.unescap.org/esd/energy/publications/compend/ceccpart2chapter3.htm>

Wind

South Korea slashes import tariffs on renewable energy equipment

<http://www.businessgreen.com/business-green/news/2249866/south-korea-slashing-import>

Wind Power Profile of South Korea (2009)

<http://www.google.co.nz/search?hl=en&source=hp&q=wind+power+in+korea>

Wind Power on the Rise in South Korea

<http://www.renewableenergyworld.com/rea/news/article/2007/01/wind-power-on-the-rise-in-south-korea>

Solar

Dow Corning Selects Korea for Solar Solutions Application Center

<http://www.renewableenergyworld.com/rea/news/article/2009/04/dow-corning-selects-korea-for-solar-solutions-application-center>

Successful Business Models for New & Renewable Energy (NRE) - Malaysia

NRET General

Malaysia moves towards renewable energy

http://www.mida.gov.my/en_v2/index.php?mact=News.cntnt01_detail.0&cntnt01articleid=319&cntnt01returnid=131

Malaysia: Towards Green Energy

<http://www.innovasjonorge.no/Internasjonale-markeder/Kontorer-i-utlandet/Malaysia/News/News-in-2007/Malaysia-Towards-Green-Energy/>

Policies in Malaysia

<http://projects.wri.org/book/export/html/16>

Renewable Energy and Kyoto Protocol: Adoption in Malaysia

<http://publicweb.unimap.edu.my/~ppkas/home/index.php/news/articles/29-renewable-energy-and-kyoto-protocol-adoption-in-malaysia>

Renewable Energy in Asia: The Malaysia Report

<http://www.bcse.org.au/docs/International/BCSE%20Malaysia%20Final%20V2.pdf>

“Small Renewable Energy Power (SREP) Programme for the Promotion of Renewable Energy Power Generation”

www.ec-asean-greenippnetwork.net/documents/.../hassan_ibrahim.ppt

Wind

Wind Speed Analysis in the East Coast of Malaysia

http://www.eurojournals.com/ejsr_32_2_09.pdf

Solar

Northern firms embrace solar

<http://biz.thestar.com.my/news/story.asp?file=/2009/7/4/business/4218713&sec=business>

Hydro

Malaysia Tenaga plans \$803 mln hydro-power plants-paper

<http://www.reuters.com/article/rbssUtilitiesElectric/idUSKLR14234620090523>

Successful Business Models for New & Renewable Energy (NRE) - Malaysia

Biomass

Palm Complex Model and Sustainable Biomass Business in Malaysia

http://www.biomass-asia-workshop.jp/biomassws/05workshop/program/11_Ali_Hassan.pdf

Successful Business Models for New & Renewable Energy (NRE) - Mexico

NRET General

Invest in New Mexico's Energy Future

<http://www.emnrd.state.nm.us/ecmd/>

Mexico Offers Diverse Opportunities For Investment in Renewable Energy

http://www.milbank.com/NR/rdonlyres/762DA504-CD95-4A33-83A9-C5790DBF9435/0/0208_Mexico_Offers_Diverse_Opportunities_World_Energy.pdf

Mexican Renewable Energy Development: Creating New Markets

<http://www.re.sandia.gov/en/pb/pd/newmarkets.pdf>

Mexican Renewable Energy Program Documents

<http://www.re.sandia.gov/en/pb/pd/pd-rt.htm>

Renewing New Mexico

http://www.ucsusa.org/assets/documents/clean_energy/acfils08u.pdf

Wind

Gamesa Reaches 10-MW Mexican Wind Supply Deal

<http://www.renewableenergyworld.com/rea/news/article/2009/07/gamesa-in-10-mw-mexican-wind-supply-deal>

Mexico Wind Resource Assessment Project

<http://www.osti.gov/bridge/servlets/purl/53666-De8ycY/webviewable/53666.pdf>

Solar

City's solar energy deal faces obstacles

<http://www.santafenewmexican.com/Local%20News/City-s-solar-energy-deal-faces-obstacles>

How To Go Solar Using New Mexico's New Solar Energy Incentives

http://solar.nmsu.edu/Go_Solar_Guide.pdf

Governor Bill Richardson Announces Support for Small New Mexico Solar Energy Developers in PRC Filing

http://www.governor.state.nm.us/press/2009/august/080509_02.pdf

Successful Business Models for New & Renewable Energy (NRE) - Mexico

Solar (cont)

Sandia Program Promotes Renewable Energy Technologies in Mexico
<http://www.re.sandia.gov/en/pb/ar/MREParticleSandiaTech.pdf>

Hydro

Energy profile of Mexico
http://www.eoearth.org/article/Energy_profile_of_Mexico

Biomass

New Mexico Biomass Information Clearinghouse
<http://nmbiomass.org/>

Geothermal

Geothermal Resource Development Needs in New Mexico
<http://www.geo-energy.org/publications/reports/NewMexicoGeothermalReportSept06.pdf>

Successful Business Models for New & Renewable Energy (NRE) - New Zealand

NRET General

Bioenergy Knowledge Centre - Publications

<http://www.bkc.co.nz/BioenergyResources/Reportsandpublications/tabid/87/Default.aspx>

BioEnergy - Publications

<http://www.bkc.co.nz/Reports/Publications/tabid/147/newsType/CategoryView/CategoryID/5/Default.aspx>

Government rebates, incentives & grants for renewable energy

energymatters.com.au/government-rebates/

Making Renewable Energy Work for New Zealand document

<http://www.morst.govt.nz/current-work/transformational-rst/energy/doc/>

Programs and Funding, Energy Efficiency and Conservation Authority

www.eeca.govt.nz/programmes-and-funding

Renewable Energy Development

<http://renewableenergydev.com/red/tag/new-zealand/>

Wind

Effects of Development - Wind farms

<http://www.meridianenergy.co.nz/default.htm>

Solar

30 year electricity price prediction

<http://www.solarpeak.com/2009/05/30-year-electricity-price-prediction/>

Solar Peak

http://www.solarpeak.com/news_features/news_features.htm

Hydro

Facts about Hydro Energy

<http://www.meridianenergy.co.nz/OurProjects/ResourcesAndPublications/>

Successful Business Models for New & Renewable Energy (NRE) - New Zealand

Biomass

Boiler conversion results in 8 month return on investment and 60% lower emissions

<http://www.eeca.govt.nz/sites/all/files/converting-boiler-to-burn-tallow-means-savings-for-verkerks.pdf>

Geothermal

Geothermal energy

<http://www.eeca.govt.nz/efficient-and-renewable-energy/renewable-energy/geothermal-energy>

Geothermal power production

<http://www.teara.govt.nz/EarthSeaAndSky/HotSpringsAndGeothermalEnergy/GeothermalEnergy/3/en>

New Zealand fast tracks geothermal, wind project

<http://cleantech.com/news/2231/new-zealand-fast-tracks-geothermal-wind-project>

Successful Business Models for New & Renewable Energy (NRE) - Papua New Guinea

NRET General

Policy DB Details: Independent State of Papua New Guinea
<http://www.reeep.org/index.php?id=9353&text=policy-db&special=viewitem&cid=71>

Solar

Solar Power in Papua New Guinea
http://www.homepower.com/article/?file=HP76_pg74_Hay

Hydro

Exploring hydropower at the Coon Rapids Dam
http://abcnewspapers.com/index.php?option=com_content&task=view&id=9243&Itemid=28

Power to
the people!
<http://masalai.wordpress.com/2006/12/21/png-power-making-sure-facilities-in-top-condition/>

Promoting Access to Renewable Energy in the
Pacific
<http://www.adb.org/Documents/TARs/REG/42465-REG-TAR.pdf>

Biomass

Information on priority national projects in all GEF focal areas identified by PNG
for the Pacific Alliance for Sustainability
www.gefcountrysupport.org/docs/223.doc

Papua New Guinea declares first national conservation area
<http://www.physorg.com/news155278758.html>

Geothermal

Geothermal Development in Papua New Guinea A Country Update Report: 2000-
2005
<http://iga.igg.cnr.it/geoworld/pdf/WGC/2005/0136.pdf>

Successful Business Models for New & Renewable Energy (NRE) - Peru

NRET General

PBL New Sustainable Energy Matrix Project in Peru

<http://www.devex.com/projects/pbl-new-sustainable-energy-matrix-project-in-peru>

Peru plans renewable energy investment

<http://www.scidev.net/en/news/peru-plans-renewable-energy-investment.html>

Peru prepares for new biofuel import blending rules

<http://www.rechargenews.com/energy/biofuels/article169529.ece>

Renewable Energy Systems in the Peruvian Amazon Region (RESPAR)

<http://www.pi.energy.gov/documents/EWSLperu.pdf>

Wind

Large Wind Power Park Will Be Peru's First Major Alternative Energy Project

<http://ecoworldly.com/2008/08/31/large-wind-power-park-will-be-perus-first-major-alternative-energy-project/>

Peru Wind Energy News

<http://windenergy.einnews.com/peru/>

Wind Energy Businesses in Peru

<http://energy.sourceguides.com/businesses/byP/wRP/byGeo/byC/Peru/Peru.shtml>

Solar

Solar Power on Peru's Eros Islands

<http://www.tylerwhitaker.com/2008/05/23/solar-power-on-perus-eros-islands/>

Peruvian Solar Energy Organizations

<http://www.solarbuzz.com/CompanyListings/Peru.htm>

Hydro

Micro-hydro power

http://www.practicalaction.org/?id=micro_hydro_expertise

Successful Business Models for New & Renewable Energy (NRE) - Peru

Biomass

Renewable Energy Program Stimulates Growth & Sustainable Business Activity in Peru
<http://stanford.wellsphere.com/green-living-article/renewable-energy-program-stimulates-growth-sustainable-business-activity-in-peru/626390>

Geothermal

Eco friendly geothermal for electricity mining
<http://www.commodityonline.com/news/Eco-friendly-geothermal-for-electricity-mining-22057-3-1.html>

Successful Business Models for New & Renewable Energy (NRE) - Philippines

NRET General

Barriers of Implementing Renewable Energy in the Philippines - Ilagan, Millena, Santos, Valerio
<http://www.scribd.com/doc/13826173/Barriers-of-Implementing-Renewable-Energy-in-the-Philippines-Ilagan-Millena-Santos-Valerio>

Philippines Plans To Double Its Renewable Energy Capacity In 10 Years
http://www.energy-business-review.com/news/philippines_plans_to_double_its_renewable_energy_capacity_in_10_years_090525

Philippine Renewable Energy Law Grants Tax Holiday For Developers
http://www.propertyshowrooms.com/philippines/property/news/philippine-renewable-energy-law-grants-tax-holiday-for-developers_114876.html

Philippines signing off new renewable energy legislation
<http://thinkgeoenergy.com/archives/1648>

Renewable Energy
<http://www.doe.gov.ph/ER/Renenergy.htm>

Renewable Energy in Asia: The Philippines Report
<http://www.bcse.org.au/docs/International/BCSE%20Philippines%20Final%20V2.pdf>

The Philippines Creates \$2 Billion Renewable Energy Trust Fund
<http://www.energyboom.com/policy/philippines-creates-2-billion-renewable-energy-trust-fund>

Wind

The Philippines: Wind Power Through Carbon Finance
<http://www.worldbank.org.ph/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/PHILIPPINESEXTN/0,,contentMDK:20294993~menuPK:333001~pagePK:141137~piPK:141127~theSitePK:332982,00.html>

Successful Business Models for New & Renewable Energy (NRE) - Philippines

Solar

IRG Philippines

<http://www.irg-p.com.ph/aboutus/poolofexperts.html>

Solar energy in the Philippines

http://gc21.inwent.org/ibt/alumni/ibt/docs/DIALOG_2_06_As.pdf

Hydro

Offgrid Business Models

http://www.esmap.org/filez/pubs/921200951916_session2sept21.pdf

Biomass Gasifier–Based Community Productive Uses

<http://siteresources.worldbank.org/EXTRENERGYTK/Resources/5138246-1238175210723/The0Philippine1ity0Productive0Uses0.pdf>

Biomass

Renewable Energy (Biomass) Power Plant Project

<http://www.slideshare.net/tbliconference/renewable-energy-biomass-power-plant-project>

Geothermal

City approves Philippines geothermal expansion

http://www.rechargenews.com/business_area/finance/article182716.ece

Successful Business Models for New & Renewable Energy (NRE) - Russia

NRET General

Alternative Energy in Russia

<http://itecsinsider.com/?p=8279>

Energy Efficiency and renewable energy in russia

http://www.martinot.info/Martinot_EP26.pdf

Energy Efficiency For Sustainable Development in Russia: Renewables, New Technologies, and Policy Issues1

<http://www.ulb.ac.be/ceese/STAFF/safonov/TERM.pdf>

European Practices Offer a Good Model for Russia

<http://www.reep.org/9863.11219/european-practices-offer-a-good-model-for-russia.htm>

Opportunities for Renewable Energy in Russia

http://www.iea.org/textbase/speech/2006/emb_renew.pdf

Renewable Database

<http://www.iea.org/textbase/pm/?mode=re&action=view&country=Russia>

Renewable Development Initiative

<http://ebrdrenewables.com/sites/renew/countries/Russia/default.aspx>

Renewables in Russia: Huge Potential, Uncertain Prospects

<http://www.developmentandtransition.net/index.cfm?module=ActiveWeb&page=WebPage&DocumentID=680>

Russia Renewable Energy Markets and Policies: Key Trends

http://www.iea.org/speech/2007/Merle_Beral.pdf

Russia sets renewable-energy mandates

<http://cleantech.com/news/4079/russia-sets-renewable-energy-mandates>

Successful Business Models for New & Renewable Energy (NRE) - Russia

NRET General Continued

Russia steps forward on renewable energy development
<http://www.energy-enviro.fi/index.php?PAGE=2406>

Russia's Renewable Development Initiatives
<http://ebrdrenewables.com/sites/renew/countries/Russia/default.aspx>

Wind

Russian Association of Wind Industry
<http://www.rawi.ru/eng/index.php>

Solar

Russia Barrels into Solar Silicone Market
<http://www.solarfeeds.com/cleanbeta/6050-russia-barrels-into-solar-silicone-market.html>

Solar Energy Center INTERSOLARCENTER is Russian Regional Center for Renewable Energy Application
<http://www.intersolar.ru/en/moscow/russia/home.html>

Hydro

Adventure in the Hydrolab. Hydro-Space Tour. Star City
http://www.incredible-adventures.net/hydro_space_tour

Russia's Prime Minister to visit the Ormen Lange plant at Aukra
<http://www.hydro.com/en/Press-room/News/Archive/2006/March/16941/>

Biomass

Biomass interests gather in Hamburg
<http://www.energycurrent.com/index.php?id=3&storyid=19111>

In-Depth Analysis of Russia's Ethanol and Biodiesel Market
<http://energybusinessreports.com/shop/item.asp?itemid=2748&affillink=cc>

Geothermal

Mutnovsky Independent Power Project
<http://www.maunsell.com/MarketsAndServices/40/39/index.html>

Successful Business Models for New & Renewable Energy (NRE) - Singapore

NRET General

Leading Enterprises Consolidate Efforts to Champion Sustainable Manufacturing in Singapore
<http://www.greenbusinesstimes.com/2009/05/05/leading-enterprises-consolidate-efforts-to-champion-sustainable-manufacturing-in-singapore/>

Singapore's clean energy industry: a new, sustainable way of doing business
http://www.edb.gov.sg/edb/sg/en_uk/index/news/articles/Singapore_s_Clean_Energy_Industry_A_New_Sustainable_Way_Of_Doing_Business.html

Sustainable Energy Association of Singapore
<http://www.seas.org.sg/about-seas>

Wind

ReEx Capital Asia
<http://www.reexasia.com/>

Solar

REC Invests \$2.6B In Singapore Solar Facility
<http://www.sustainablebusiness.com/index.cfm/go/news.display/id/16241>

REC Solar Modules To Be Installed At Singapore Changi Airport
http://solar.energy-business-review.com/news/rec_solar_modules_to_be_installed_at_singapore_changi_airport_090709

Renewable Energy Development Gathers Momentum
http://docs.google.com/gview?a=v&q=cache:YiYKx3F-ezQJ:www.greensingapore.com/IndProf/SENV/SENV_2009_IP05.pdf+singapore+new+%26+renewable+energy&hl=en&gl=nz

Hydro

Hydro_Turbine_Generators_And_Hydro_Power.html
http://lyyutt.trustpass.alibaba.com/product/12187616-11328177/Hydro_Turbine_Generators_And_Hydro_Power.html

Successful Business Models for New & Renewable Energy (NRE) - Singapore

Biomass

New US\$130m biodiesel plant in Singapore to serve Asian, US markets

http://grasp.rucc.net.au/files/australian_firm_builds_biodiesel_plant_in_singapore_9.11.06.pdf

Geothermal

Accelerating Asia's Geothermal Development

http://www.terrathermal.com/files/Geothermal_2009_SPKR.pdf

A Powerful Team

<http://www.oskienergy.com/index.php?page=team>

Successful Business Models for New & Renewable Energy (NRE) - Chinese Taipei

NRET General

Ministry of Economic Affairs (MOEA)
<http://w2kdmz1.moea.gov.tw/english/index.asp>

New law set to stimulate green energy industry
<http://www.taipeitimes.com/News/biz/archives/2009/06/15/2003446253>

Research and Development of Renewable Energy Technologies
http://www.taipower.com.tw/TaipowerWeb/upload/files/4/Renewable_energy.pdf

Taipei, Taiwan: Taiwan Government Initiatives to Stimulate Green Energy Industry
<http://www.solarbuzz.com/News/NewsASGO82.htm>

Wind

Taiwan's Taipower plans US\$244m wind project
http://www.etaiwannews.com/etn/news_content.php?id=991954&lang=eng_news

Use of wind power growing in Taiwan
<http://investintaiwan.nat.gov.tw/en/news/200705/2007053001.html>

Solar

Future of solar power bright in Taiwan: European Chamber of Commerce Taipei
http://www.etaiwannews.com/etn/news_content.php?id=998175&lang=eng_news&pg=4

Taiwan's first HCPV solar power system inaugurated
http://www.taiwannews.com.tw/etn/news_content.php?id=982050&pg=6

Hydro

Hydrogen Program for Chinese Taipei
<http://www.hpath.org/resources/additional%20material/APEC-Chinese-Taipei-5-05.pdf>

Biomass

Team increases hydrogen production from biomass
<http://www.taipeitimes.com/News/taiwan/archives/2008/11/15/2003428659>

Successful Business Models for New & Renewable Energy (NRE) - Chinese Taipei

Biomass (cont)

The Status Quo of Biomass Energy Industry in Taiwan

<http://www.survision.com.tw/SourcingTaiwan/english/pdf/Biomass%20Energy%20Industry.pdf>

Biomass Energy Industry: Analysis and Investment Opportunities

twbusiness.nat.gov.tw/doc/06-Biomass-Energy-en.doc

Geothermal

Chinese Geothermal Energy Deal Signed With Sinopec

<http://www.chinacsr.com/en/2007/10/22/1779-chinese-geothermal-energy-deal-signed-with-sinopec/>

Successful Business Models for New & Renewable Energy (NRE) - Thailand

NRET General

Asian Alternative Energy - Short Fun Primer

<http://www.slideshare.net/austin.pei/asianalternative-energy-short-fun-primer>

Investigation of Pricing Incentives in a Renewable Energy Strategy

www.eppo.go.th/encon/encon-D04-ExternalityReview.doc

Management of Thai firms in the new millennium for sustainability

http://www.utcc.ac.th/public_content/files/001/P34_1.pdf

Recycling & Renewable Energy in Thailand

<http://thailand.angloinfo.com/countries/thailand/recycle.asp>

Renewable Energy in Asia: The Thailand Report

www.bcse.org.au/docs/.../BCSE%20Thailand%20Final%20V2.pdf

Renewable Energy Policy in Thailand, Facilitation Workshop

www.setatwork.eu/events/0802thailand.htm

Thailand: Alternative Energy & Sustainable Developments

http://www.business-in-asia.com/energy/alternate_energy_ra.html

The Energy Policy and Planning Office (EPPO)

<http://www.eppo.go.th/index-E.html>

Wind

Dawn of an Energy [R]evolution in Thailand

<http://www.greenpeace.org/seasia/en/campaigns/climate-change/features/dawn-of-energy-revolution>

Thailand's first wind farm project of 35 MW gets THB1.8 billion investment

http://www.ecoseed.org/index.php?option=com_content&view=article&id=1569&Itemid=546

Successful Business Models for New & Renewable Energy (NRE) - Thailand

Wind (cont)

Transfer of EU Knowledge and Technology for Development of Wind Energy Technology in Thailand
<http://www.serd.ait.ac.th/wind/>

Solar

Community-Scale Solar Water Pumping, Thailand
http://sgp.undp.org/download/SGP_Thailand2.pdf

Hydro

Micro Hydro-Electricity Cooperatives in Northern Thailand
<http://ideas.repec.org/p/eep/report/rr1998121.html>

Biomass

Thailand Preparing For Energy Production From Biomass
<http://www.hedon.info/1445/news.htm>

Thailand Set to Produce Energy from Biomass
<http://www.thebioenergysite.com/news/3816/thailand-set-to-produce-energy-from-biomass>

Geothermal

Thailand Geothermal Energy Sources
<http://www.dede.go.th/dede/index.php?id=683>

Successful Business Models for New & Renewable Energy (NRE) - USA

NRET General

Business Model for Ethanol and Biodiesel

http://www.rurdev.usda.gov/rbs/coops/Special%20Studies%20Business%20Models_Informa.pdf

Database of State Incentives for Renewables and Efficiency

<http://www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=MT>

Electric Vehicles to power new Business Models

<http://www.triplepundit.com/pages/>

Energy Agreement Among the State of Hawaii, Division of Consumer Advocacy of the Department of Commerce & Consumer Affairs, and Hawaiian Electric Companies

<http://hawaii.gov/dcca/areas/dca/HCEI/HCEI%20Summary.pdf>

Financial Incentives

<http://www.dsireusa.org/incentives/index.cfm?state=us&re=1&EE=1>

Getting To Know Business Models

<http://www.investopedia.com/articles/fundamental/04/033104.asp>

Integration of Renewable Energy on Farms

www.farm-energy.ca/IReF/index.php?page=technologies

Maui County Community Profile - Utilities

www.maui.com/mauibusiness/utilities.cfm

New Business Models for Energy Efficiency

eec1.ucdavis.edu/...0/NewBusinessModelsforEE-WhitePaper

Successful Business Models for New & Renewable Energy (NRE) - USA

NRET General (cont)

New Green Business Models Revealed

<http://www.renewableenergyworld.com/rea/partner/the-wall-street-green-trading-summit-5743/news/article/2007/01/new-green-business-models-revealed-47269>

NREL Highlights Leading Utility Green Power Programs

http://apps3.eere.energy.gov/greenpower/resources/tables/pdfs/0408_topten_pr.pdf

Our Wind Coop Model

www.ourwind.org/

Renewable Energy

http://www1.eere.energy.gov/tribalenergy/guide/renewable_energy_basics.html

Renewable Energy Development

renewableenergydev.com/red/

Renewable Energy Portfolio Standards

www.pewclimate.org/what_s_being_done/in.../rps.cfm

Renewable Energy Toolkit (RE Toolkit)

<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTENERGYNEW/EXTRENERGYTK/0,,menuPK:5138378~pagePK:149018~piPK:149093~theSitePK:5138247,00.html>

REToolkit: A Resource for Renewable Energy Development

http://siteresources.worldbank.org/INTRENERGYTK/Resources/REToolkit_issues_note.pdf

State Clean Energy Policies Analysis (SCEPA) Project:

An Analysis of Renewable Energy Feed-in Tariffs in the United States

<http://www.renewableenergyworld.com/rea/home;jsessionid=46B7E96C87BB3D907303CCA953BE4FAD>

Successful Business Models for New & Renewable Energy (NRE) - USA

NRET General (cont)

State Incentives for Achieving Clean and Renewable Energy Development on Contaminated Lands

www.mljwireless.com/mlj/index.php?qr...

<http://www.eia.doe.gov/oiaf/analysispaper/rps/index.html>

Summary of Renewable Energy and Distributed Generation Task Force Action Plan

<http://www.app.gov/taskforces/renewable/index.htm>

The New Business Model For Cleantech Investment

<http://cleantechbrief.com/node/59>

The New Green Business Model for Investment

<http://www.global-change.com/files/pdf/New-%20Green-Business-Model.pdf>

The Smart Grid - An introduction

[http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages\(1\).pdf](http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf)

We Energies Customer-Owned Renewable Generation New Business Model (NBM) Workshops

http://www.weenergies.com/business_new/altenergy/finalwrkshp_present.pdf

Wind

A Comparative Analysis of Community Wind Power

Development Options in Oregon

[www.cleanenergystates.org/.../OR Community Wind Report.pdf](http://www.cleanenergystates.org/.../OR_Community_Wind_Report.pdf)

American Wind Energy Association

<http://www.awea.org/>

Business Models

<http://www.windustry.org/events/revolution-oklahoma-wind-energy-conference>

Successful Business Models for New & Renewable Energy (NRE) - USA

Wind (cont)

Case Studies of State Support For Renewable Energy
http://eetd.lbl.gov/ea/emp/cases/RE_Loan_Programs.pdf

Community Wind Energy
http://en.wikipedia.org/wiki/Wind_turbine

Community Vs. Corporate Wind: Does it matter who develops the wind in Big Stone Country, MN?
<http://cda.mrs.umn.edu/~kildegac/CV/Papers/IREE.pdf>

Community owned is Business Model for Two Wind Farms in Iowa
<http://apolloalliance.org/>

Cracking the Code - The Key to Energy Efficiency in Buildings
<http://www.slideshare.net/AllianceToSaveEnergy/cracking-the-code-the-key-to-energy-efficiency-in-buildings>

Electric co-ops buy power from Missouri's first utility-scale wind farms
http://www.aeci.org/BFT_Wind_WindFarm.aspx#

Global Renewable Energy Markets and Policies
http://www.martinot.info/Martinot_NAR.pdf

How to Build a Small Wind Energy Business: Lessons from California
www.nrel.gov/docs/fy07osti/41504.pdf

Our Wind Coop Model
www.ourwind.org/

Successful Business Models for New & Renewable Energy (NRE) - USA

Wind (cont)

Policies to Promote Small Wind Turbines

[http://www.awea.org/smallwind/pdf/Policies to Promote Small Wind Turbines.pdf](http://www.awea.org/smallwind/pdf/Policies_to_Promote_Small_Wind_Turbines.pdf)

Renewables 2005 Global Status Report

[http://www.ren21.net/globalstatusreport/RE2005 Global Status Report.pdf](http://www.ren21.net/globalstatusreport/RE2005_Global_Status_Report.pdf)

Roadmap

<http://www.awea.org/smallwind/documents/31958.pdf>

Urban Wind Farm Helps Revitalize the U.S. Rust Belt

<http://mendocoastcurrent.wordpress.com/2007/11/08/urban-wind-farm-helps-revitalize-the-us-rust-belt/>

Using Existing Infrastructure for Wind Turbines

<http://www.alternative-energy-news.info/using-existing-infrastructure-for-wind-turbines/>

Utilities and Wind Power

<http://www.awea.org/>

What is Renewable?

http://www.cec.org/files/PDF/ECONOMY/What-is-Renewable_EN.pdf

Wild east: Wind power's new frontier?

<http://www.renewableenergyworld.com/rea/news/article/2007/07/wild-east-wind-powers-new-frontier-51496>

Wind Industry

<http://www.windustry.org/>

Wind Power - Little Rock - Wind LLC

<http://renewableenergydev.com/red/wind-power-little-rock-wind-llc/>

Successful Business Models for New & Renewable Energy (NRE) - USA

Wind (cont)

Windpower Outlook, 2008

www.awea.org/pubs/documents/Outlook_2008.pdf

Wind Power Project Models

http://www.nationalwind.com/wind_project_models

Wind Turbines

http://www1.eere.energy.gov/tribalenergy/guide/wind_turbines.html

Solar

A New Solar Energy Business Model

<http://wheatfromchaff.net/index.php?s=a+new+solar+energy+business+model>

A Solar Business Model that Makes Sense

<http://tomkonrad.wordpress.com/2006/12/27/a-solar-business-model-that-makes-sense/>

Business Models Driving Solar

http://energycentral.fileburst.com/EnergyBizOnline/2007-3-may-jun/Energy_Bus_Solar.pdf

How to go Solar

http://www.nmsea.org/Downloads/Go_Solar_Guide.pdf

How to Start a Solar Energy Business (cost Effectively)

http://www.ehow.com/how_2263426_solar-energy-business-cost-effectively.html

Lanais Going Green

<http://www.castlecooke.net/property/details.aspx?rid=96&cat=Future+Development>

New Business Model for Solar Energy

<http://www.micro-generator.com/>

Successful Business Models for New & Renewable Energy (NRE) - USA

Solar (cont)

New Jersey's Clean Energy Program - Renewable Energy Incentives Program

<http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program>

One Megawatt Solar Power System Unveiled at Gap Inc.'s West Coast Distribution Center

<http://www.triplepundit.com/pages/one-megawatt-so.php>

Policies to Promote Non-hydro Renewable Energy in the United States and Selected Countries

http://www.eia.doe.gov/cneaf/solar.renewables/page/non_hydro/nonhydrorenewablespaper_final.pdf#page=1

Protect your solar rights.

<http://www.emnrd.state.nm.us/ecmd/Multimedia/documents/SolarRights.pdf>

Solar Energy, New Mexico Tax Credits and You!

http://www.emnrd.state.nm.us/ecmd/CleanEnergyTaxIncentives/documents/STCFactSheet_001.pdf

State Incentives for Achieving Clean and Renewable Energy Development on Contaminated Lands

<http://www.epa.gov/region09/cleanup-clean-air/pdf/CA-Incentives.pdf>

SunRun Offers Innovative Business Model to Bring Affordable Solar Energy to Homeowners

<http://www.globalwarmingisreal.com/blog/2009/01/13/>

[sunrun-offers-innovative-business-model-to-bring-affordable-solar-energy-to-homeowners/](http://www.globalwarmingisreal.com/blog/2009/01/13/sunrun-offers-innovative-business-model-to-bring-affordable-solar-energy-to-homeowners/)

Utility Business Model Report Provides Roadmap of Emerging Solar Strategies

[http://www.renewableenergyworld.com/rea/news/article/2008/06/utility-business-](http://www.renewableenergyworld.com/rea/news/article/2008/06/utility-business-model-report-provides-roadmap-of-emerging-solar-strategies-52682)

[model-report-provides-roadmap-of-emerging-solar-strategies-52682](http://www.renewableenergyworld.com/rea/news/article/2008/06/utility-business-model-report-provides-roadmap-of-emerging-solar-strategies-52682)

Utility Procurement Study - Solar Electricity in the Utility Market

<http://www.solarelectricpower.org/docs/Procurement%20Report%20FINAL%20-%202012-16-08.pdf>

Successful Business Models for New & Renewable Energy (NRE) - USA

Solar (cont)

Utility Procurement Study - Solar Electricity in the Utility Market

<http://www.solarelectricpower.org/docs/Procurement%20Report%20FINAL%20-%202012-16-08.pdf>

Utility Solar Business Models: Emerging Utility Strategies & Innovation

http://solarelectricpower.org/docs/Utility%20Business%20Model%20FINAL%206_03_8.pdf

Utility Solar Business Models: Emerging Utility Strategies & Innovation

<http://www.renewableenergyworld.com/rea/news/article/2008/06/utility-business-model-report-provides-roadmap-of-emerging-solar-strategies-52682>

Hydro

PC Hydro - Powersmart Innovation Challenge Forum

http://www.bchydro.com/etc/medialib/internet/documents/info/pdf/innovation_challenge_brief_for_net_zero_house.Par.0001.File_innovation_challenge_brief_for_net_zero_house.pdf

Vortex Hydro Energy

http://www.nrel.gov/technologytransfer/pdfs/igt20_vortex_hydro.pdf

Biomass

Business Models for Ethanol and Biodiesel

http://www.rurdev.usda.gov/rbs/coops/Special%20Studies%20Business%20Models_Informa.pdf

Geothermal

McLennan Magasanik Associates

<http://www.mmassociates.com.au/>

Geothermal Energy Resource Toolkit

<http://www.amazon.com/Century-Geothermal-Energy-Resource-Toolkit/dp/1422006476>

Successful Business Models for New & Renewable Energy (NRE) - Vietnam

NRET General

Capacity Building of Renewable Energy Development

<http://pid.adb.org/pid/TaView.htm?projNo=42182&seqNo=01&typeCd=2#financingplan>

Country Analysis Brief - Vietnam

<http://www.eia.doe.gov/emeu/cabs/Vietnam/Background.html>

Energy - Potential Uncaptured

<http://www.presscenter.org.vn/en/content/view/216/44/>

Economic potential of renewable energy in Vietnam's power sector

<linkinghub.elsevier.com/retrieve/pii/S0301421508007635>

Renewable Energy in Asia: The Vietnam Report

<http://www.bcse.org.au/docs/International/BCSE%20Vietnam%20%20Final%20V2.pdf>

Renewable Energy for Rural Areas - Vietnam

<http://tcdc.undp.org/sie/experiences/vol8/Vietnam.v8-9.pdf>

Vietnam Energy Profile

http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=VM

Vietnam Renewable Energy Action Plan

www.esmap.org/filez/pubs/vietnamesmap25216.pdf

Vietnam Renewable Energy Development Project

<http://web.worldbank.org/external/projects/main?Projectid=P103238&theSitePK=40941&pagePK=64283627&menuPK=228424&piPK=73230>

Vietnam Renewable Energy Development Project

web.worldbank.org/.../projects/main?...Projectid...

Successful Business Models for New & Renewable Energy (NRE) - Vietnam

NRET General (cont)

World Bank helps Vietnam promote renewable energy

<http://www.mofa.gov.vn/en/nr040807104143/nr040807105001/ns090618135922>

Wind

Germany to propel Vietnam's wind power sector with \$1.4m grant

<http://www.businessgreen.com/business-green/news/2246623/germany-propel-vietnam-wind>

Solar

Model for effective use of solar water heaters by different groups of households

sgp.undp.org/print.cfm?module=Projects&page...

Solar Electric Light Fund

<http://www.self.org/vietnam.asp>

Hydro

Vietnam Hydro Project Gains Final Acceptance

http://findarticles.com/p/articles/mi_qa5392/is_200301/ai_n21328248/

Biomass

Biomass Energy Usage in Vietnam

<http://www.arecop.org/zip/Biomass-vn-pres.pdf>

Present Status on Biomass Energy Research and Development in Vietnam

<http://www.biomass-asia-workshop.jp/biomassws/02workshop/reports/20051213PP10-09p.pdf>

Geothermal

Economic potential of renewable energy in Vietnam's power sector

linkinghub.elsevier.com/retrieve/pii/S0301421508007635