Renewable Energy Sector 'Best Bets' Project

Final Sector Best Bet Investment Opportunities

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NEXT™

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1 Acknowledgements

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2 Introduction

This report builds upon the Global Renewable Energy Sector Foresight Report completed in the first phase of this project. In that report, a number of niche opportunity areas were identified that provided potential investment opportunities for Trinidad and Tobago (T&T) in a regional and international context.

Table 1 lists a number of sub-sector niche areas derived from that report. They have been rated on a 1 to 3 diamond basis in terms of the potential opportunities they may offer to T&T based upon a combination of the author's experience in the country and region as well as expert advice from independent parties.

Table 1: Rating of potential renewable energy opportunity areas for T&T

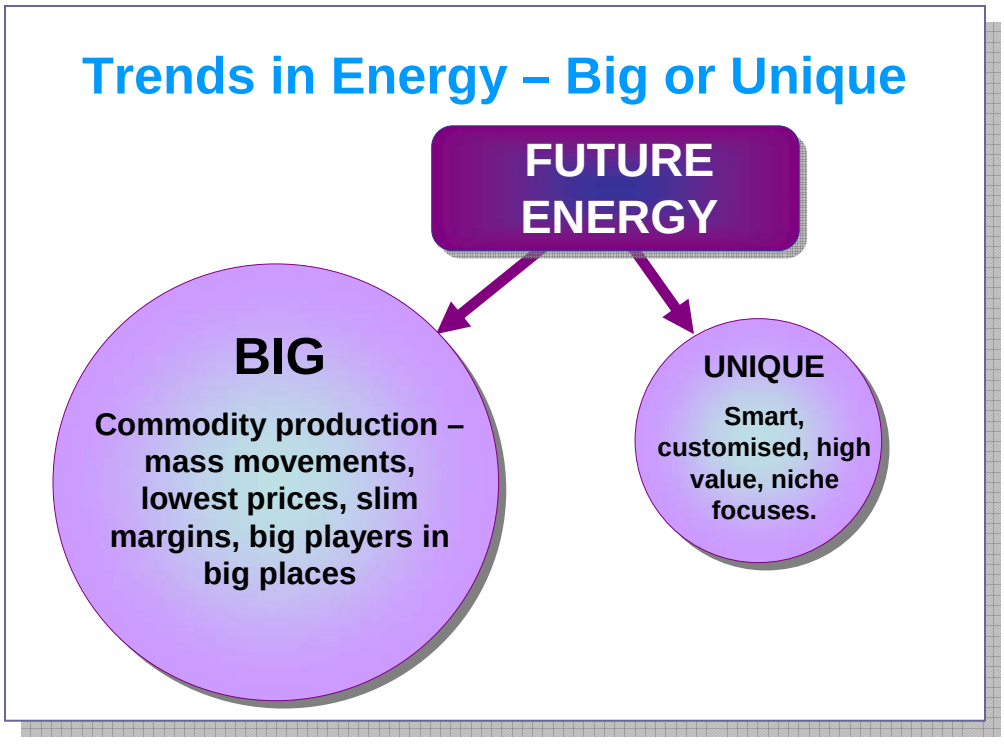
Bio Renewable Energy			
Biomass	♦♦♦	Bio-fuel – non-food crop sourced	♦♦
Bio-fuel – food crop sourced	♦	Bio-generation systems	♦♦♦
Waste to energy systems	♦♦		
'Techno' Renewable Energy			
Wind generation	♦♦♦	Large hydro	♦
Solar PV generation	♦♦	Wave and tidal power	♦♦♦
Solar water heating	♦♦♦	Geothermal	♦♦
Other solar (air-conditioning etc)	♦♦	Hydrogen	♦
Small hydro	♦♦	Other	♦
Energy Efficiency			
Smart sensor-based control systems	♦♦	Energy saving products	♦
Design focuses	♦	Software based energy management packages	♦♦♦
Turnkey Package Solutions			
Decentralised community-based 100% renewable energy systems	♦♦♦	Decentralised household 100% renewable energy systems	♦♦♦
Decentralised commercial 100% renewable energy systems	♦	Smart local grids	♦
Infrastructure For One			
Consumer applications	♦	Portable tech-based micro-generation systems	♦♦
Energy generating clothes/fashion	♦♦	Micro-energy devices for mobile living	♦

- ♦ Unlikely to be appropriate for reasons such as technology costs, economies of scale, capabilities and enablers available and infrastructure issues.
- ♦♦ Appropriate for limited niche application areas.
- ♦♦♦ Appropriate for a greater number of niche application areas.

A major consideration for a small country such as T&T is deciding which opportunity areas are likely to provide the greatest value adding for the country. As the recent rapid cyclical rise and slump in commodity oil and gas, ethanol, steel, and aluminium prices has demonstrated, reliance on areas such as these as a large part of the economic base can have major impacts upon the status and resilience of the country's economy. Boom and bust cycles of this magnitude (which have happened before) lead to many negative consequences economically and socially.

In this context, the big global trend in all sectors is for businesses to become either 'big' or 'unique' – as illustrated in Figure 1.

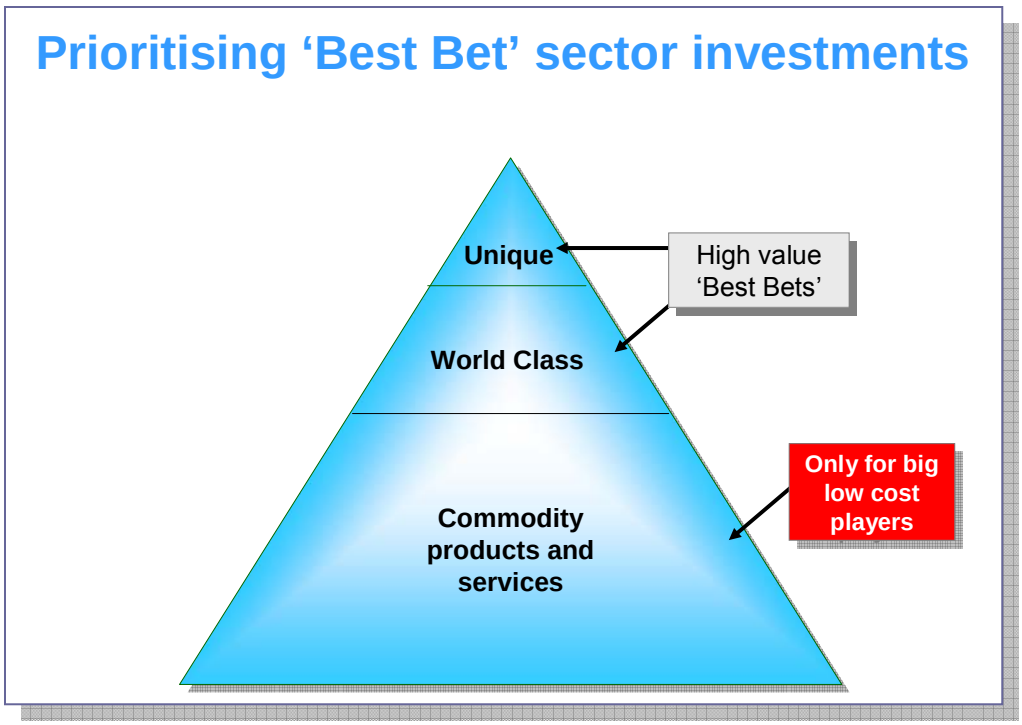
Figure 1: Global trends in the energy sector



When looking for alternatives to those areas which are underpin the boom and bust commodity cycle business model, care needs to be taken in assessing which options may create the greatest value for the country and largely free them from such cycles. For example, it is clearly going to be difficult for a small country such as T&T to be an internationally cost-competitive player in renewable energy sectors such as bio-ethanol and bio-diesel as the land areas required are vast and the throughput volumes required to justify the capital investments needed are potentially large. The pricing of these fuels is also commodity linked and so the value adding component is small.

In order to select those opportunity areas where T&T may be able to potentially create greater value in the emerging renewable and sustainable energy markets, each possibility was subjected to a simple evaluation within the context shown in Figure 2.

Figure 2: The value triangle –assessing the value adding potential of investment propositions.



In order to achieve such value adding, it was decided to choose only potential opportunity areas that fitted in the 'world class' and 'unique' categories. This led to the selection of nine renewable energy sector best bet opportunity areas that had the potential to provide T&T with an opportunity to develop high value internationally competitive offers based upon the following four criteria:

- Market potential – in terms of size and a high local value-adding potential.
- Resource availability and sustainability.
- Capability and enablers available locally.
- Technology that is appropriate for a small country such as T&T.

Following are brief descriptions of the nine potential best bet areas that were chosen:

Potential Best Bet 1: Turnkey Package Community Systems

- The model for this best bet is based upon community systems that have been developed in Europe to provide 100% fossil fuel free energy supplies to communities ranging in size from 750 people (e.g. Jühnde in Germany) up to up to 27,000 (e.g. Güssing in Austria).

- Such turnkey community renewable energy packages can embrace a range of energy sources including biomass, biogas, solar, wind, and waste-to-energy systems.
- A wide range of technologies from both the developing and developed parts of the world can be integrated into such turnkey packages to provide a customised community system to suit almost any situation in almost any part of the world.
- The proposition provides long-term sustainable energy supplies and significant employment for smaller communities and is able to continue to provide a solution long after a country's oil and gas resources are exhausted (in the case of oil and gas dependent economies such as T&T) and for countries without such resources.
- It provides a solution for areas with poor access to national infrastructure systems.
- Such community systems also generate significant new local employment opportunities because they are fuelled and managed at a community level.
- The design, construction, and management of such systems would form the basis of a business that could expand throughout the region and even possibly worldwide.

Potential Best Bet 2: Wave energy

- T&T is surrounded by a restless sea. The country has considerable potential for harnessing wave energy.
- Professor Prakash Persad and his team in the Mechatronics group at the University of Trinidad and Tobago are currently working on a project to harness wave energy to power desalination plants.
- Large wave farms are now being developed off the coast of Portugal. The economics of wave energy use are becoming more competitive as each year passes.
- There are a number of other wave energy harvesting technologies being developed around the world e.g. in Australia ([1]).
- T&T has a great deal of engineering expertise in both the energy and marine sectors and so has a pool of talent that could contribute significantly to this field.
- There is considerable potential to develop innovative wave energy harvesting solutions, not only for T&T but also for countries that offer huge potential in this field such as Australia.

Potential Best Bet 3: Solar Thin Film Photo-Voltaic (TFPV) Systems

- Because of T&T's artificially low energy costs, photo-voltaic (PV) systems are currently not a significant feature in the country's energy scene.
- However, following recent breakthroughs in TFPV systems by companies such as Nanosolar in the USA, a whole new opportunity area has opened up.
- Being able to apply thin film PV systems to construction components and other surfaces offers a whole new range of interesting options.
- There is already at least one company in T&T in the electronic component manufacturing area that has expressed an interest in entering this field.
- T&T also has a booming construction sector that involves both local and offshore companies. There is a strong global trend emerging to build greener buildings that incorporate energy generation capabilities such as TFPV.

[1] http://www.environmentalmanagementnews.net:80/StoryView.asp?StoryID=1002566

- It also has a strong marine industry sector and a number of TFPV applications are being designed to provide solutions in the marine industry.
- The basis of this business may be as simple as securing a regional license from a smart solar technology development company offshore.
- It may be possible to manufacture and distribute innovative construction and marine sector components that incorporate this technology for local, regional and possibly even international markets. Examples of where such technology is already being used include windows, shade screens, wall panels, roofs, and panels to power equipment aboard marine vessels.

Potential Best Bet 4: Solar air-conditioning systems

- Air-conditioning is used extensively in the Caribbean and other tropical and sub-tropical areas around the world.
- There have already been some prototype solar-powered air conditioning systems developed in several parts of the world – including Sweden and Denmark.
- Commercial units are now being sold by companies based in a number of countries including China, Spain, and the USA. These range from so-called solar hybrid air-conditioning systems through to 100% mains independent solar powered units.
- Air conditioning costs are becoming high in the non-oil producing countries, not only in the Caribbean but right around the world's tropical belt.
- There is a real opportunity to develop, sell, and install solar powered air-conditioning systems that operate on a stand alone basis and do not have any requirement for standard electricity inputs.
- Sharp have already manufactured a solar powered TV. There are solar powered refrigerators of the market. It is a real opportunity area that requires the application of technical skills and innovation.
- The business model may not be anything like that for standard air-conditioning companies and could include enhanced venturi flow type concepts that have been traditionally used in Middle Eastern countries such as Dubai and are currently being incorporated into innovative new building designs planned for construction in that same region.
- The big opportunity will be for exports because the high level of energy subsidies currently prevailing in T&T will not provide much in the way of local market opportunities.

Potential Best Bet 5: Biogas systems for household use

- The government of Nepal is funding the development of hundreds of thousands of household-sized biogas generation systems which utilise human and animal waste.
- Not only do such systems provide a reliable and cheap source of gas for cooking and other household purposes but they also provide a means of safely dealing with human waste streams and improving the sanitary environment in small communities.
- It is a highly decentralised solution that does not require major infrastructure investments for either gas reticulation or sewage system installation.
- It is a proven technology that just needs a modern customised modular design-and-build approach to be taken to maximise the potential of such systems.
- Again, the opportunities will largely be for export to markets that have to pay real (unsubsidised) prices for energy.

- This best bet is also unlikely to require large investments for setting up a business.

Potential Best Bet 6: Free-standing turbine systems

- This is a unique evolving field with three technologies currently being developed that show a high level of promise.
- A potential opportunity exists to use such systems off the coast in areas where there are strong tidal flows to generate electricity in a totally sustainable way.
- These technologies are designed to automatically position themselves to maximise generation from changing current flows and directions.
- Once again, the opportunity may simply be the securing a regional license for one or more of these technologies from a high technology manufacturer offshore.
- Local companies may be involved in design, build, and operate projects in regional markets which have the right energy market economic factors.

Potential Best Bet 7: Hot rock geothermal systems

- The Caribbean region is known for its high level of volcanic activity, geothermal zones, and hot rocks.
- Geothermal energy is one of the most under-exploited renewable energy areas in the world and yet it has vast potential and can provide total energy independence to many countries which possess such natural and sustainable resources.
- New technological developments, such as the newly developed Kalina process that is being used in the village of Unterhaching in Germany, offer highly cost-efficient ways of using even lower temperature hot rocks and geothermal zones.
- There is a great deal of expertise in the whole area of geothermal power in The Philippines, New Zealand, and Iceland.
- It is becoming a cost-competitive option that could offer a lot of opportunities for the region.
- The hot rock technology in particular offers opportunities in areas that do not necessarily have volcanic activity – as is the case in Unterhaching.
- It is an engineered solution that uses skills in the field of deep drilling, heat exchange systems, and high-technology systems such as the Kalina process – which is currently an evolving technology
- T&T companies could lead the way in this field in the Caribbean by creating the right offshore alliances with companies developing this technology offshore in Germany and possibly also in Australia.

Potential Best Bet 8: Software-based energy management

- It is clearly going to be a major challenge to produce and supply an additional 50% more energy globally by 2030 over and above today's energy supply if current demand trends continue. There are already significant challenges associated with matching supplies to the demand that exists today, as long-term increases in the cost of oil, gas, and electricity demonstrate.
- Achieving energy use savings of 30 – 50%, compared to current use levels, is becoming an integral part of future energy strategies.
- There is considerable evidence being derived from practical projects e.g. the Berlin Energy Partnership projects, which have proven that 30%+ savings can be readily

achieved (in this case 34 – 35% by retrofitting old buildings with better insulation and more efficient energy-based systems). A recent McKinsey Group study ([2]) says a 50% savings in current energy use levels is achievable, based upon the current technological developments that are commercially available.

- T&T has a well developed energy sector and within that a number of highly regarded energy specialists, such as Mr Anthony Paul, who are involved in the development of 'new energy' and software related solutions for the energy sector.
- This best bet would focus on developing smart ICT based energy use efficiency management systems for which specialist software applications are an integral part.
- The other components would include things like 'smart sensor' systems that determine if certain areas in buildings or processes need to be 'on'. For example, if no-one is in a room then the air-conditioning and lighting would automatically shut off.
- Using such technologies, energy savings as high as 95% have been achieved e.g. in hotels.
- There is a real and rapidly growing opportunity for electrical engineers and software developers to form an alliance to develop smart energy management systems.
- There are a number of ICT companies in T&T that have a history of being innovative and, if strong public private partnerships are built, they could help drive developments in this opportunity area.

Potential Best Bet 9: Micro-electricity generation systems

- This is a real 'wild card best bet' and is based upon the sugar battery development being pursued by Sony in Japan. They have already developed prototype batteries that use sugar and enzymes that can power a Walkman music player.
- This is a totally sustainable battery concept that suits people on the move – and increasing numbers of people are living mobile lifestyles / workstyles.
- Such a development also gets over many of the current problems associated with the use of heavy metals, e.g. nickel and cadmium, in most traditional batteries. These create a toxic waste problem.
- T&T has considerable expertise in both the fields of sugar production and microbiology. There is no reason why T&T could not become a global leader in the development of bio-battery type micro-energy generation units.
- They may even power evolving fibre optic illumination systems which require 1% or less of the power of traditional incandescent bulbs.
- There is also the illuminating capability of the local firefly that could also form the basis of some interesting developmental project work in the renewable energy field. The field of 'biomimicry' is a rapid growth area internationally.
- This best bet also offers a potential partial solution to the world's increasing demand for energy. A projected 50% increase in demand by 2030 clearly cannot be supplied form traditional sources.

These potential best bet areas were then reviewed by ten energy sector stakeholders who were asked to rank them in order from 1 to 9 with 1 being the best bet that the reviewer rated as offering the best prospects for T&T and 9 the least.
A summary of this ranking exercise is shown in Table 2.

[2] http://www.mckinsey.com/mgi/reports/pdfs/Curbing_Global_Energy/Curbing_Global_Energy_executive_summary.pdf

Table 2: Outcomes of the ranking exercise carried out in association with key T&T energy sector stakeholders

NIHERST - Renewable Energy Sector Project														
								Date:			November 13, 2008			
		REVIEWER												
Best Bet No	Title	TB	CB	KC	KH	RR	RTY	FLK	CS	AS	FC	Final Score	(Final Score Adj)	Rank
1	Turnkey package community schemes	7	9	6	5	2	5	5	1	8	1	49	37	
2	Wave energy	9	8	3	4	2	3	6	8	1	4	48	30	
3	Solar Thin Film Photovoltaic systmes	4	7	2	2	3	1	1	9	2	2	33	14	2 (1)
4	Solar air-conditioning systems	2	9	1	3	4	7	3	1	6	8	44	30	3 (3=)
5	Biogas systems for household use	5	9	5	8	4	8	4	8	3	6	60	39	
6	Free standing turbine systems	8	9	7	7	6	6	9	9	4	5	70	46	
7	Hot rock geothermal systems	6	9	9	9	3	9	8	9	9	7	78	57	
8	Software-based energy management	1	6	4	1	4	2	2	3	5	3	31	18	1 (2)
9	Micro-electricity generation systems	3	9	8	6	7	4	7	9	7	9	69	44	
E1	Bio-energy - ethanol from sucrose / cellulosic ethanol and biodiesel								1					
E2	Wind generators								1					
E3	Fuel cells								1					
E4	Fabrication of electric boats and motors										1			
E5	Fabrication, installation and maintenance of towers and parts for wind turbines										1			

Note:

- Three reviewers (highlighted in yellow) scored the best bets rather than ranking them. However, the overall ranking of the nine opportunity areas changed little if their results were included or omitted.
- The four areas marked E1 – E4 were additional opportunity areas suggested by the reviewers as offering potential opportunities to T&T. However, the authors had considered these areas during the global foresight research phase and comment as follows:
    - E1 - This is another commodity area just like oil, gas, and sugar. The country is not suited to the large scale, lowest cost production models required. In addition, it does not provide long-term resiliency for the economy.
    - E2 – Whilst wind is a major global growth area, wind turbines and support structures are built in large manufacturing plants in large economies. They are largely imported as finished units which only require a small amount of local assembly input and offer little long-term value adding for local companies.
    - E3 – Because fuel cells are in the 'big' category, there is little likelihood a significant value adding business could be successfully established in T&T.

- o E4 – the same comment applies as for E3, unless it was a high value specialist niche focus area.
- o E5 – See E2.

The three best bet areas rated most highly overall by this group of stakeholders offer potential for developing successful businesses in T&T upon the basis of the four selection criteria shown in Table 3.

Table 3: Best bet selection criteria

Rank	'Best Bet'	Market Potential	Resource Availability	Capability & Enablers	Appropriate
1	Software-based energy management	✓✓✓	✓✓✓	✓✓✓	✓✓✓
2	Solar TFPV	✓✓✓	✓✓	✓✓	✓✓✓
3	Solar air-conditioning	✓✓✓	✓✓	✓✓	✓✓✓

The three final Renewable Energy Sector Best Bet Investment Opportunity Cases detailed in the remainder of this report differ somewhat from the original brief opportunity area descriptions. This is due in part to new material found during additional research combined with recent commercial developments that have occurred since the original Global Foresight Report was completed. The modifications are also due to the comments and feedback gathered from key energy sector stakeholders interviewed here in T&T as part of the best bet development process.

3 Renewable Energy Best Bets

3.1 Best Bet 1 Title: 'EnerSave'

(This best bet is derived from 'Potential Best Bet 8: Software-based energy management'.)

3.1.1 The Investment Opportunity

- The future of the global energy sector is being shaped by two major trends:
  - Climate change.
  - Resource use efficiency.
- Much of the current energy usage in both the commercial and domestic sectors regionally is inefficient and substantial savings can be realised by utilisating the latest in technologies.
- Energy use efficiency is likely to be a major growth area for at least the next two decades due to the increasing global demands for energy and the increasing pressures that are coming on to the traditional models which supply energy.
- This Best Bet Investment Opportunity is built around a business that offers a range of smart technology-based energy saving solutions that are customised to provide the greatest benefit to individual clients.
- The business will use intellectual capital to adapt a number of smart offshore hardware and software technologies to the markets in which it operates and initially collaborate with local ICT companies to undertake any system customisation work required to develop client specific solutions. At a later stage this capability may become 'in-house' and be further developed in conjunction with specialist energy and electrical engineers and scientists at T&T's two main universities.

3.1.2 Rationale

- Based upon current trends, by the year 2030 global energy demand may have increased by 50%. This poses some major challenges.
- On the other hand, various studies indicate that, with the technologies available today, energy use savings of between 25% and 50% (depending upon the sector) are potentially achievable ([3]).
- Projects such as the Berlin Energy Partnership have demonstrated that retrofitting existing buildings with modern energy systems can save at least 30% of the previous energy consumption levels.
- Amortisation exercises that estimate the payback period for energy saving investments show that these can be recovered in as little as one year and usually between two and three years ([4]).
- There is huge potential in this area throughout the Caribbean and internationally.
- There is a great deal of expertise that has been developed in Europe in particular, because of the high energy pricing policies and structures prevailing in European

[3] http://www.mckinsey.com/mgi/reports/pdfs/Curbing_Global_Energy/Curbing_Global_Energy_executive_summary.pdf

[4] Personal Communication, Marco Wagner, CEO, Projects Online, Germany http://www.projects-online.de

countries, that could provide a valuable platform for developing a regionally focused T&T based business in this field through the formation of strategic alliances.

3.1.3 Customer Offer

- A business that provides energy saving solutions to a whole range of clients ranging from large businesses and organisations through to the household level.
- An assessment is made of each client's current energy use levels and the potential savings that could be achieved.
- A package of the necessary procedures, hardware, and software (including customisation if required) is put together and the return on investment detailed in an amortisation table.
- The aim is achieve a combined 30% or more savings in current energy use levels.
- The solutions provided cover a range of application areas such as electricity usage, process heat and refrigeration systems, and potentially also vehicle fuel use efficiency.
- The offer also includes energy saving partnership arrangements where 'EnerSave' arranges the up front capital cost for installing the energy saving solution and receives a share of between 67% and 80% the savings achieved as its reward over the next 10 – 15 years. The terms of each agreement will reflect the associated complexity and risk.

Figure 3: An overview of the 'EnerSave' customer offer ([5])

[5] NEXT Archives

3.1.4 Foresight Context

- The strong global trend towards greater resource use efficiency.
- Growing global concerns about the potential impacts of climate change upon the future of the human race.
- The trend towards more sustainable solutions.
- The development of more energy efficient systems, processes, and technologies.
- The growing range of increasingly smart ICT-based software and hardware applications that facilitate better energy use management.
- More governments introducing policies and regulations that support greater energy use efficiency.

3.1.5 Target Markets

- The primary target market focus would be those Caribbean countries that are not endowed with oil and gas reserves and where energy costs are particularly high because electricity is largely generated using imported fossil fuels. Smaller island nations such as St. Vincent and the Grenadines, Grenada, and Barbados are good examples.
- Within those markets owners of larger premises such as government bodies, educational institutions, manufacturers, hotel and restaurant owners and operators, and large retailers would be a priority because they use large amounts of energy.
- The second market focus would be for individual households in these same countries but the package offered to such customers would need to be easily replicable so that economies of scale could be achieved.
- The third market focus might be on large energy users in Trinidad and Tobago itself. However, that would be subject to determining whether such solutions have a short enough pay back period in light of the relatively high levels of energy subsidies that prevail in the country.
- In the longer term the business would aim to market its unique in-house developed energy efficiency solutions in other parts of the world where opportunities are opening up e.g. in parts of Africa and Central / South America.

3.1.6 What We Have

- Markets which have considerable potential for achieving improvements in energy use efficiency ([6]).
- Some of the highest cost energy supplies in the world are in Caribbean countries e.g. Montserrat, St. Vincent and the Grenadines, St. Lucia, Grenada, Dominica, Jamaica, the Dominican Republic, the Bahamas, and Barbados.
- Recent recognition at government level that improving energy use efficiency should be a national priority in T&T ([7]).
- Neighbouring markets which are highly dependent upon imported fossil fuels and which have high energy cost structures. In 2008 St. Vincent and the Grenadines paid EC$ 70 million for energy imports ([8]). A 30% reduction in use would free up EC$ 21 million that could be invested into pressing needs elsewhere in the economy.

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6 http://worldenergy.org/documents/trinidad.pdf ; http://worldenergy.org/germany.pdf

7 http://opm.gov.tt?news?index.php?pid=2001&nid=sp080630

8 Personal communication, Hon. Minister Jerrol Thompson, SVG Government

- A cadre of well trained engineers in the electrical and energy sectors whose skills and talents are highly regarded internationally.
- At least one T&T based company that manufactures and exports custom-built electronic control systems and another that delivers energy efficient solutions.
- Highly experienced energy sector consultants who are working in a number of markets – including emerging markets in Africa.
- Several well-established software development companies that have expertise relevant to this best bet e.g. the TSL Group.
- Innovative energy saving partnership models from offshore such as those associated with the Berlin Energy Partnership initiative in Germany.
- A whole range of existing and emerging technologies that offer considerable energy savings. Simple examples include:
  - Compact fluorescent tubes.
  - More efficient fluorescent tube starter units.
  - Sensor systems that automatically turn electrical items on when people enter specific areas and off when they leave.
  - Smart voltage regulation systems that cut the energy use of lighting systems.
  - Window double glazing with light responsive tints.
  - Various types of insulation technologies.
  - More energy efficient appliances and equipment.
  - Modern heat exchanger systems that significantly reduce process heating and cooling requirements.
  - Highly efficient gas turbines such as BHKW and Organic Rankine Cycle units which operate at up to 95% energy conversion efficiency ([9]).
- Emerging technologies include:
  - LED technologies that potentially offer a reduction in energy use of up to 99% compared to traditional incandescent units.
  - Smart 'brains' that control a range of energy-related building functions automatically to optimise use efficiency.
  - Hybrid and more fuel efficient vehicle technologies that reduce fuel use by 30% or more.
- Many large public and private sector buildings and complexes that could yield significant financial benefits to the owners if such energy use efficiency programmes were to be pursued.
- Generally short amortisation times to recover the investment made in energy efficiency improvement projects (except in situations where energy subsidies have a significant distorting effect on the market).
- A number of internationally recognised energy sector consultants with high levels of expertise in this field.

3.1.7 What We Need

From the Private Sector

- An entrepreneur who can pull together the various components required and form the necessary alliances to be able to provide the type of custom-designed and built solutions that 'EnerSave' will need to deliver to clients.
- Innovation in the financing and delivery areas to provide customers with the incentive to proceed with implementing energy use efficiency projects.

[9] Personal communication, Kai Wenzel, Jürgen Stau & Co, Hamburg, Germany, 2008.

- Linkages between key local and offshore stakeholders to provide synergies e.g. in the software development and technology areas.
- Leading edge knowledge relating to current and emerging technology and software options.
- A focus on offshore market opportunities where energy costs are much higher than in T&T.
- A shift in thinking away from traditional oil and gas sector approaches to a much broader energy thinking context that includes a strong energy efficiency focus.
- The development of a staged marketing strategy that focuses first on the 'low hanging fruit'.

From the Public Sector

- Greater recognition that energy use efficiency is a huge opportunity area internationally and of the potential that the country has for exploiting opportunities in this area, particularly in neighbouring countries that have been suffering from high energy costs and which will continue to do so in future years.
- To adopt a new strategic focus in the way the T&T energy sector offer is presented to the world through government agencies with a focus on growth opportunity areas identified through sector foresight studies.
- To include developing capabilities in the energy use efficiency area as a focus of the Vision 2020 Energy Sector strategic plan.
- Recognition that improving energy use efficiency will improve the global competitiveness of the T&T economy. The energy sector has made T&T a relatively high cost country and this has held back the development of many non-energy sectors.
- To increase the amount of tertiary education funding that focuses on developing skills in the field of energy efficiency.
- Ideally, to remove the current subsidies for electricity and fuel so that the real costs of energy are reflected in the economy and the incentive to use the resource more efficiently is increased.
- This will provide a stronger platform for new T&T-based businesses in the energy efficiency area to work with large local clients to test and refine their offers.
- To include publically owned buildings such as government offices, hospitals, state owned company premises and older housing units in a tender programme where tenders are awarded to the party that offers the greatest energy use efficiency improvement (with a minimum of a 30% improvement being the target).
- The tender basis will be that the winner funds the investment required to improve the energy use efficiency of the buildings and receives a majority share of the annual savings achieved over a pre-determined period of time (say 10 – 15 years) following completion of the upgrade programme.
- Funding of R&D to develop innovative new technologies and solutions in the field of energy use efficiency for sale into regional and international markets.
- The setting of standards and enforcement of those standards needs to be improved.
- To institute policies and initiatives that encourage tertiary and research institutions to become more aggressive in their approach to commercialising research findings.
- To provide a strong IP protection framework and its enforcement to ensure that patentable innovative solutions developed in T&T can generate additional knowledge based revenues for the country.
- Recognition that this field offers intellectually stimulating jobs for the increased number of graduates coming out of the country's tertiary institutions over the coming

years. One of the biggest concerns many students have is the dearth of such jobs in T&T as the country has been slow to move towards the 'knowledge economy'.

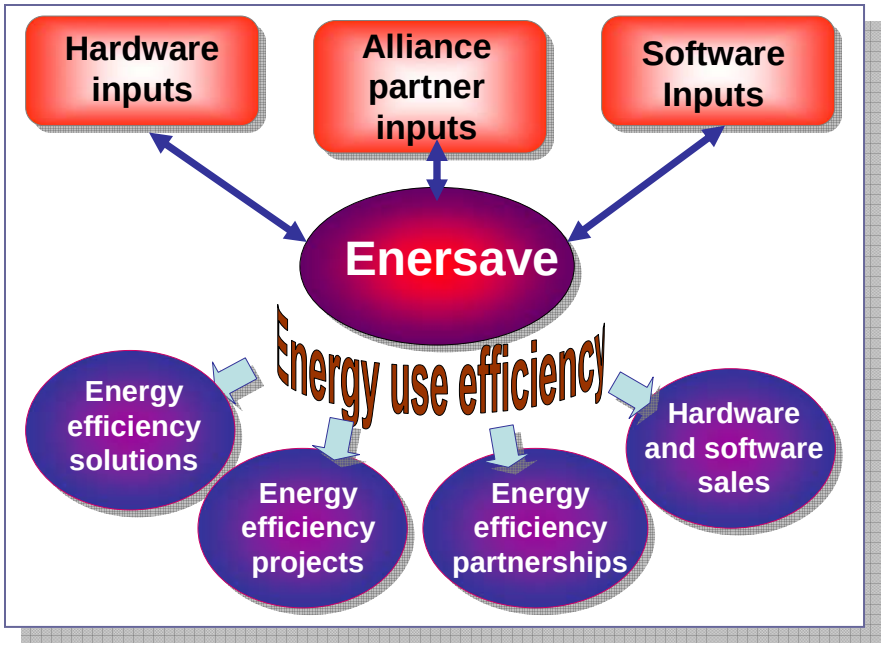
From the R & D Sector

- Access to R&D resource people and facilities to help develop innovative energy use efficiency solutions, particularly in the area of smart software based control systems.
- A reduced focus on the traditional energy sector R&D programmes and a greater focus on research that relates to energy sector areas that offer strong growth prospects over the next few decades.
- A more urgent focus on commercialising research findings developed at the country's universities and research institutions.
- Greater emphasis on international collaboration projects that assist in the development and transfer of 'appropriate technologies' into the region.
- A higher level of public private sector partnerships to develop mutually beneficial outcomes.

3.1.8 A Possible Business Model

In order to develop a business that is capable of delivering regionally (and eventually internationally) attractive and competitive solutions, the model for a business built around this best bet opportunity area may look something like that shown in Figure 4.

Figure 4: A possible business model for the ' EnerSave' best bet ([10])



Some important aspects of this proposed model are as follows:

- The formation of strong alliances with suppliers of the hardware and, at least in the initial stages, the software components plus any expertise necessary in highly

[10] NEXT Archives

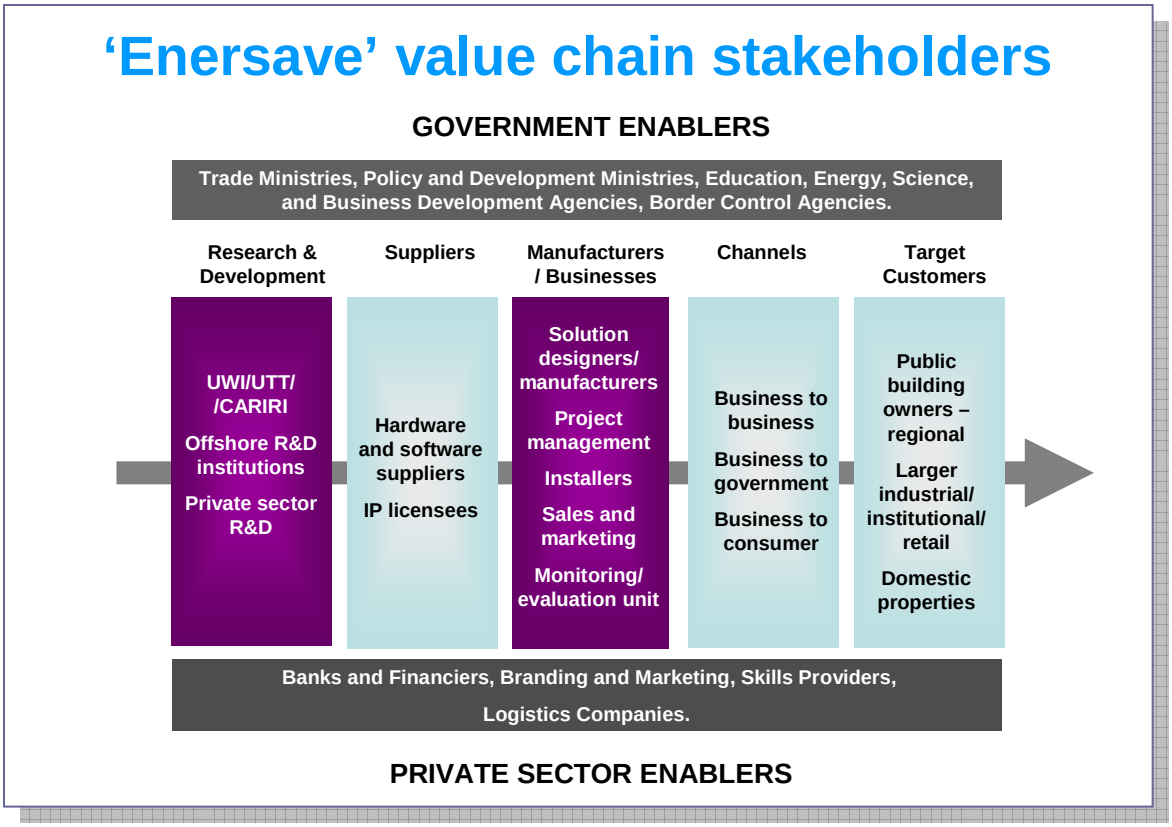
specialised areas to complement that initially available in T&T. This might include an alliance with one or more offshore groups that have been particularly innovative in the field of achieving substantial energy use savings and which have developed solutions that provide very short payback periods.

- The 'Energy Efficiency Solutions' component of the business is a design and specify component that focuses on providing the knowledge input associated with building and infrastructure design to optimise energy use efficiency. This area of the business can also provide the design and specification components for retrofitting projects that might be carried out by third parties.
- The 'Energy Efficiency Projects' component of the business model is a service that offers the installation and commissioning of solutions on a total package contract price basis.
- The 'Energy Efficiency Partnerships' component is a higher value, but more risky, retrofitting component of the business which requires funding up the cost of implementing an energy use efficiency solution and installing it upon the basis of a long-term savings sharing arrangement with the owner of the buildings or process system. It requires high levels of skill and quality control to ensure the benefits are maximised. If a savings target of 30% is set as the goal for the project and 40% is achieved in practice, obviously both parties win to an even greater extent. Thus there is a real incentive to strive for the best possible energy savings result.
- The 'Hardware and Software Sales' component provides the technological inputs required to deliver the energy use efficiency benefits. Initially, the majority of these components would be imported from leading edge international suppliers. However, over time 'in-house' developed technologies (developed in collaboration with T&T's university and research groups) will become an increasing proportion of the overall offer.

3.1.9 Best Bet Value Chain

- The main stakeholder groups in the value chain model necessary to leverage the potential value that could be extracted from the energy use efficiency market through the 'EnerSave' best bet are shown in Figure 5.
- The ''Research & Development' and 'Manufacturers/Business' components of the value chain are the two areas which are critical in order to extract the maximum value from 'Enersave'.
- The R&D component has the potential to add considerable value through the development of innovative solutions that can be marketed regionally and internationally.
- The 'Manufacturers and Businesses' component includes knowledge and project management inputs that are critical for achieving excellent results.

Figure 5: Key stakeholders in the 'EnerSave' value chain model ([11])



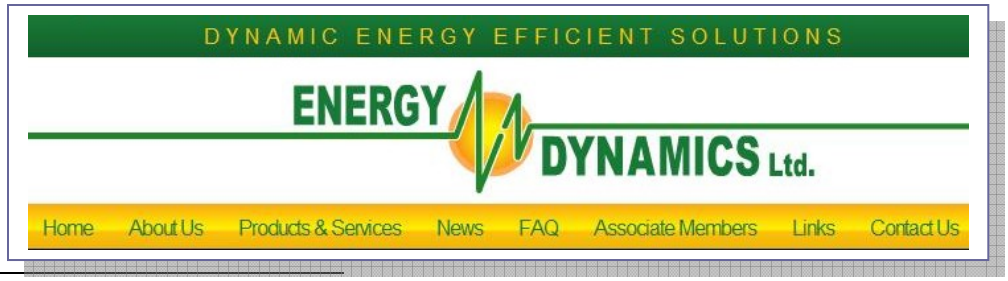
3.1.10 Key Players

The whole area of focussing on developing comprehensive energy use efficiency solutions is a relatively new area of business in many parts of the world. In most countries, with perhaps the exception of some European countries such as Germany and Denmark, the sector is still in a relatively early stage of development. However, there are increasing numbers of businesses focusing on this large opportunity area.

Key Local Players

There are two local players in this field of particular relevance.

Energy Dynamics Ltd. (http://www.energydynamics-lac.com)



[11] NEXT Archives

- An Internet search identified this company as being a very significant player in the local T&T and several regional markets.
- They have been in business since the year 2000 and provide a range of services similar to those described in this best bet.
- Their activities to date include at least one retrofitting project which has achieved a 25% savings in energy use at the La Cabana Beach Resort in Aruba.
- They have developed a close working relationship with a US-based energy investment company, E+Co.
- They also offer a range of other options including water use efficiency and renewable energy.
- This company is definitely a key player in this sector in both T&T and the region.

Electrical Industries Ltd. (http://www.eiltt.com/)

- They have a considerable amount of experience in the electrical engineering field in T&T. According to a representative of the company, they are interested in expanding into both the energy efficiency and green energy areas.
- However, one of the greatest local hindrances is the low cost of energy in T&T and so any developments in these areas would have to be focussed towards regional markets.

It terms of specific persons, the following would be able to make a valuable contribution:

Mr Andre Escalante, Energy Dynamics Ltd., andre@energydynamics-lac.com

- Apart from his role in the business, Mr Escalante has put together some compelling arguments as to why businesses and organisations will benefit from investing in energy efficiency projects.
- In an excellent paper, focusing on energy conservation in the Caribbean, he points out that the cost of energy in most Caribbean countries is amongst the highest in the world ([12]). In such countries, the extra cost of replacing an incandescent lamp with a compact fluorescent unit can be recovered through reduced electricity charges in as little as one month.

[12] http://energydynamics-lac.com/home/files/file/Energy%20Conservation10_12_07.pdf

- He also shows that T&T has an artificially low price of just 5 US cents a kWh compared to 22 – 43 US cents a kWh in 13 other Caribbean countries – a closer reflection of the real cost of energy in global markets.

Mr Paul Kubalsingh and Ms Salishie Tagallie,Electrical Industries Ltd.

- Both have considerable experience in the electrical energy sector and have an interest in seeing the expertise developed within their company being used to pursue new business focuses – preferably on a regional basis.

Mr Johan Sydow, Geochemist with BP and Technical Consultant

- Mr Sydow feels that the 'EnerSave' best bet is an attractive proposition in the Caribbean because of the increasing focus on this area and the growing opportunities for the use of smart technologies that can be incorporated into a range of applications, some of which are very simple and can achieve significant results within very short time frames.

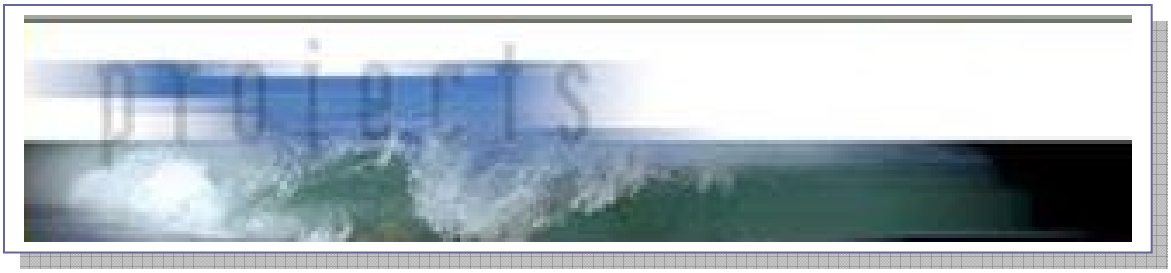
Examples of Offshore Players

The following are a few selected examples of companies and organisations that are taking a highly innovative approach towards deriving greater value in the 'new energy' sector. They have experience and knowledge about the potential that exists in this field, particularly as the world demand for sustainable energy accelerates. Many of these examples come from Germany because it is a country that has been focusing strongly on energy use efficiency for several decades and the government has introduced numerous policies to support improvements in use efficiency.

Rocky Mountain Institute (http://www.rmi.org)

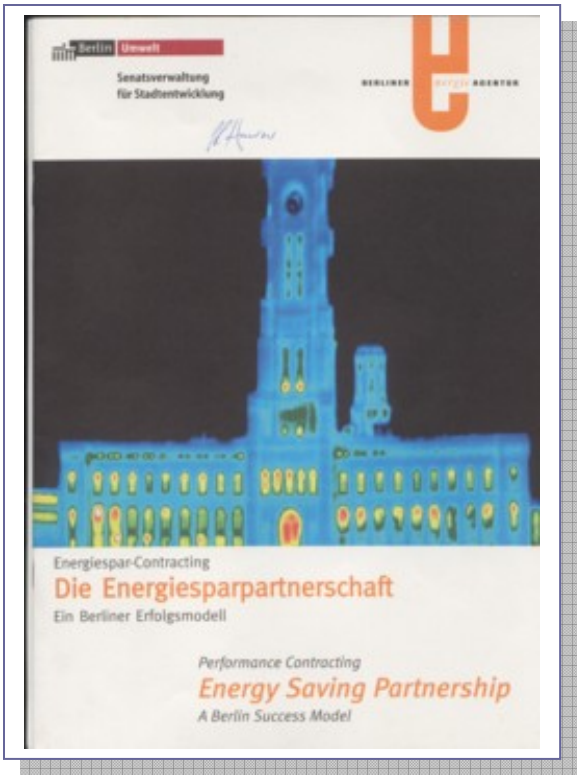
- This is a non-profit organisation which includes Amory Lovin amongst its staff, a man highly regarded internationally for his work in the fields of energy-use efficiency, energy sector transitions, and alternative energy technologies.
- The focus of the Institute is on long-term sustainable solutions and improved resource use efficiency.

Projects-Online (http://www.projects-online.de/)



- This private German company, run by Marco Wagner and based in Nuremburg, has highly developed competencies in the design of leading edge energy efficient solutions for public and private sector clients.
- They develop complete solution packages for a whole range of energy application areas including lighting efficiency, process heat efficiency, smart energy management systems, and high efficiency renewable energy technologies.
- The company has experience throughout Europe, in Thailand, and in association with a related entity in New Zealand, Key Energy Ltd.
- They specialise in analysing the cost benefits of energy efficiency options and developing commercial and domestic solutions which have the most rapid payback periods.

The Berlin Energy Partnership ([13])



13 http://www.berliner-e-agentur.de/index.php?idcat=38

- This programme is hailed as being one of the most innovative internationally in terms of the approach adopted for upgrading the energy efficiency of existing older public buildings such as hospitals, government offices, apartment blocks, libraries and other relatively large buildings that require considerable amounts of energy ([14]).
- Basically, public private partnerships are set up to retrofit a specific number of buildings that are put out to tender as a block offer for each contract.
- The target is to achieve a 30%+ saving in energy needs on a long-term basis.
- The private sector partner provides the capital and delivery component at their cost but are guaranteed a large proportion of the value of the savings achieved (often 80% +) for a pre-determined period of time (10 – 15 years).
- The advantage of this approach is that the cash-strapped public sector does not need to fund the energy efficiency improvements and yet still receives a dividend from the project in terms of the reduced energy cost share that they gain.
- The private sector is incentivised to achieve the maximum economic energy efficiency improvement possible because of the guaranteed payback percentage and timeframe provided for in the contract.
- Large companies, such as Vattenfall, have been involved in such projects e.g. the Berlin Spandau Hospital energy savings project ([15]).

EPV, Germany (http://www.evecto.com/index.html)

- This company manufactures a range of sensors that determine whether areas are occupied or not. If no-one is in a room or area the sensors automatically switch off lighting systems and will switch them on again if someone enters the area. Such systems are now commonplace in many parts of Europe e.g. in hotels.
- This is just one example of modern high-tech components that are evolving to enhance energy use efficiency.

14 http://www.managenergy.net/conference/pdfs/0407ecmem_seefeldt.pdf

15 http://www.vattenfall.com/www/vf_com/vf_com/365787ourxc/366011produ/366139custo/539071berli/index.jsp

Dust Networks In., USA (http://www.dustnetworks.com/)

- This company is included because it is an early entrant in the evolving market space that is leading to the development of 'intelligent electronic neural networks'. These networks have the potential to play a major role in enhancing resource use efficiency – including energy – by using smart 'self-learning' capabilities.

3.1.11 Implementation Roadmap

An indicative roadmap of the targets set to establish the 'EnerSave' business, what will be needed to ensure that they are achieved, and who is involved in order to achieve the desired outcomes for this investment opportunity, is shown in Table 4.

Table 4: Indicative road map for implementing the 'EnerSave' best bet investment opportunity

By when?	What?	Who?
Initial	• Form a consortium to establish the business and identify major opportunity areas.	• Private sector stakeholders.
	• Finalise the business model and strategy to set up and run the business.	• Private sector stakeholders.
	• Identify the 'low hanging fruit' market opportunities.	• Private sector stakeholders.
	• Establish key alliances locally, regionally, and internationally.	• Private sector stakeholders.
	• Access and appoint key personnel.	• Private sector stakeholders.
	• Finalise a commercialisation strategy and roadmap.	• Private sector stakeholders.
	• Develop a branding and marketing strategy.	• Branding/marketing group.
	• Identify funding needs and sourcing.	• Private sector stakeholders.
1st 6 months	• Win 5 energy solution design projects – at least 4 outside T&T.	• Business team + clients.
	• Win 1 energy savings project (probably outside T&T).	• Business team + clients / contractors.
	• Identify a potential energy partnership project in the highest energy cost islands.	• Business team plus marketers.
	• Identify public sector and/or offshore R&D partners to initiate the first product development research project.	• Business team / R&D sector.
2nd 6 months	• Complete delivery of the first 5 energy solution design projects and find 10 opportunities for the next year.	• Business team.

	• Deliver the first energy savings project. • Identify 2 potential energy savings projects for the next year. • Secure a potential energy partnership project in the highest energy cost islands for the next year. • Begin the first PPP product development research project.	• Business team + contractors. • Business team plus marketers. • Business team + public sector partner. • Business team / R&D sector.
Year 2	• Win and deliver 10 energy solution design projects and find 20 opportunities for the next year. • Win and deliver 2 energy savings projects. • Identify 4 potential energy savings projects for the next year. • Deliver the first energy partnership project in a high energy cost island and secure 1 new partnership project for the next year. • Continue with PPP product development research project – first product at the prototype stage.	• Business team. • Business team + contractors. • Business team plus marketers. • Business team + public sector partner. • Business team / R&D sector.
Year 3	• Win and deliver 20 energy solution design projects and find 30 opportunities for the next year. • Win and deliver 4 energy savings projects. • Identify 6 potential energy savings projects for the next year. • Deliver the second energy partnership projects in high energy cost islands and secure 1 new partnership project for the next year. • Continue with PPP product development research project – first product commercial, second at the prototype stage.	• Business team. • Business team + contractors. • Business team + marketers. • Business team + public sector partner. • Business team / R&D sector.
Year 4	• Win and deliver 30 energy solution design projects and find 40 opportunities for the next year. • Win and deliver 6 energy savings projects. • Identify 8 potential energy savings projects for the next year. • Deliver the third energy partnership projects in high energy cost islands and secure 2 new partnership projects for the next year. • Continue with PPP product development research project – second product commercial, 2 more at the prototype stage.	• Business team. • Business team + contractors. • Business team + marketers. • Business team + public sector partner. • Business team / R&D sector.
Year 5	• Win and deliver 40 energy solution design projects and find 50 opportunities for the next year. • Win and deliver 8 energy savings projects. • Identify 10 potential energy savings projects for the next year. • Deliver the fourth and fifth energy partnership projects in high energy cost islands and secure 2 new partnership projects for the next year. • Continue with PPP product development research project – third and fourth product commercials, 3 more at the prototype stage.	• Business team. • Business team + contractors. • Business team + marketers. • Business team + public sector partner. • Business team / R&D sector.

3.1.12 Financial Scenario

- This financial scenario combines both short-term and long-term elements of investment needs and revenue generation. The short-term component includes the set up cost investment plus a commitment to joint R&D projects with research groups to develop innovative and smart solutions that can add value to the 'EnerSave' offer over time. Short-term revenues will be generated by designing smart solutions, selling smart components, and doing project work.
- The longer term component includes the investment into energy savings partnership projects which have an up-front investment cost but which generate ongoing revenue streams for the next 15 years. The hardware and software component is also expected to include larger sales volumes of higher value components derived from the company's R&D partnerships.
- It is envisaged that the offer in all areas of the 'EnerSave' business will become smarter over the ten year time frame and thus generate higher revenues in every area of the business's operations.
- The summary in Table 5 provides a 'best-guess' estimate of the potential revenues, expenses, and earnings before interest and tax (EBIT) figures that could be achieved over a ten-year period based upon the combination of short- and long-term business focus areas described above.

This financial scenario has not been subjected to detailed scrutiny. It is intended to be an example of what could be achieved in the top 20% of the range of potential scenario outcomes. Before making an investment commitment, it would need further development and to be subjected to due diligence.

Full details can be found in the Appendix at the end of this report.

Table 5: Indicative financial projections for the 'Enersave' investment opportunity

	By year 3	By year 6	By year 10
Gross revenue from all activities	US $ 1,740,000	US$ 6,950,000	US$ 30,000,000
Basis of the revenue figure	• 20 solutions @ US$ 7,000 each. • 4 projects @ US$ 150,000 each. • 1 p/ship project at US$ 200,000 p.a. return. • 3,000 product sales @ US$ 200 per unit.	• 50 solutions @ US$ 9,000 each. • 10 projects @ US$ 300,000 each. • 7 p/ship projects at US$ 200,000 p.a. return. • 6,000 product sales @ US$ 350 per unit.	• 90 solutions @ US$ 10,000 each. • 40 projects @ US$ 500,000 each. • 18 p/ship projects at US$ 200,000 p.a. return. • 10,000 product sales @ US$ 550 per unit.
Capital expenditure*	US$ 1,575,000	US$ 2,950,000	US$ 6,100,000
Operating expenditure	US$ 1,730,700	US$ 4,624,750	US$ 24,465,000
Earnings before interest and tax (EBIT)	US$ 659,300	US$ 3,475,250	US$ 7,185,000

* Does not include government investment and is accumulated for the preceding 2 or 3 years.

3.1.13 NEXT Star Rating

- Because T&T has considerable energy sector related expertise, already has at least one successful company in this field, and the government is making a big investment in tertiary education that is increasing the number of highly qualified graduates, this best bet offers a great deal of potential to contribute a greater non-oil and gas dependent energy sector derived revenue stream for the country.
- The most critical factor associated with pursuing such a best bet is to focus on developing smart solutions that have the potential to generate large savings (in the order of 30% or more) in current energy use costs and have short payback periods (generally less than three years).
- The opportunity is large because the number of companies operating in this part of the energy market in the region is very small and yet the need for solutions is high due to the high prevailing energy costs (T&T excepted).
- With a high likelihood of the global energy demand continuing to increase once the current economic downturn moves into a recovery phase and the cost of energy rising once again because of increased demand, the future for such a business looks to be very positive.
- The prospects could also be enhanced by global moves to penalise fossil fuels through the imposition of carbon taxes and other climate change related policy and regulatory shifts that might come into play when the current Kyoto Protocol is reviewed and replaced.

3.2 Best Bet 2 Title: 'SolarTech'

(This best bet is derived from 'Potential Best Bet 3: Solar TFPV Systems'.)

3.2.1 The Investment Opportunity

- This investment opportunity is built around exploiting the rapid advances occurring in the field of Thin Film Photo-Voltaic (TFPV) technology which offer substantially more competitive options for solar applications.
- Complete turnkey packages built around such technologies are now claimed to be competitive with traditional electricity generation systems such as coal, oil, and natural gas.
- The business will focus on developing decentralised electricity generation and supply systems using TFPV which can be retrofitted to existing buildings or integrated into new construction projects and used in a number of other application areas in the marine, communications, and transport areas.
- It is envisaged that 'SolarTech' will be able to access and supply TFPV technology through licensing or supply agreements and be able to customise the product to provide specialist and turnkey solutions within the Caribbean region.

3.2.2 Rationale

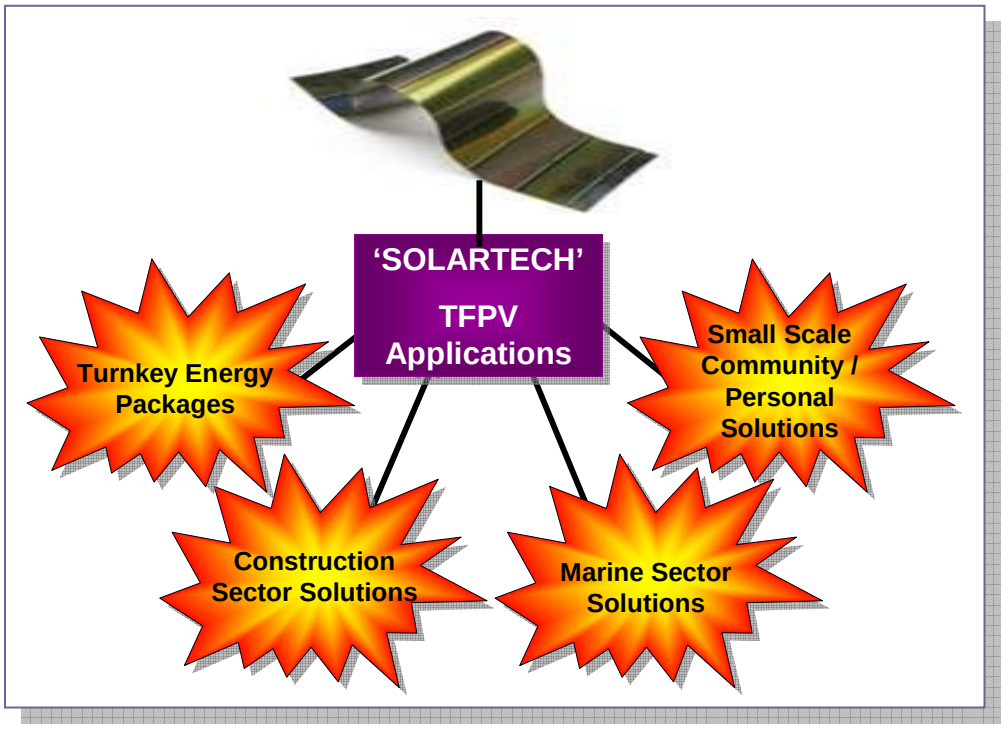
- One of the first companies in the world to develop this technology successfully as a commercial proposition is Nanosolar in California.
- It has been reported that the capital cost of solar power generated from a complete turnkey package that uses Nanosolar's TFPV technology, including generation and storage components, is now 5% cheaper per Watt generated than for coal, oil, or gas fired units - and there are no ongoing fuel costs after that initial capital investment.
- Apart from Nanosolar, there are a number of other companies moving into this new field of solar technology. They include First Solar, Fuji Electric, Sanyo, and G24i.
- The market for this technology is projected to be worth US$ 7.5 billion by 2015.
- The big advantage with this technology is that it is lightweight, has substantially less material requirements for manufacturing and, for example, it can be embedded in walls, roofs and windows in buildings to create 'smart buildings' that have the capability of generating much of their energy requirements.
- There is also potential for even greater cost reductions to occur in this field in the near future. Researchers at the Massachusetts Institute of Technology are in the process of developing a dye-based solar energy collection system that could be the next stage of TFPV technology. Early indications are that it could reduce the cost of generating power substantially because it would increase the amount of energy produced from a PV cell 'by a factor of 40' ([16]).
- This is also a technology that could be retrofitted to existing solar cells and increase their operating efficiency by as much as 50%.
- This promising new technological development may offer a medium to long-term opportunity to progress the 'SolarTech' best bet business into an even more competitive space in future years.

[16] http://web.mit.edu/newsoffice/2008/solarcells-0710.html

3.2.3 Customer Offer

- 'SolarTech' will offer the latest TFPV technology-based product developments (and advances on this technology as they become a commercially viable option) to customers in the Caribbean region.
- They will provide a range of services to clients that include the supply of components through to complete design and installation turnkey packages in a range of sectors.
- This includes the construction sector where TFPV packages can be integrated into building components and, along with the complementary components, help achieve energy self-sufficiency.
- It also includes developing a range of products and applications for the marine sector, which is a significant focus in many Caribbean islands, that are more cost competitive, offer greater reliability, and can be more easily integrated into boat and yacht designs and structures.
- Another part of the customer offer is to design and develop smaller scale specialised packages for community, domestic, and personal use where there is a viable value proposition.
- This may include co-developed product opportunities in the fashion sector – such as solar powered backpacks and jackets that charge cell phones and computers.
- The company will also offer lease packages to customers in particular niches within the categories mentioned above that are highly competitive as an alternative to traditional energy generation and supply models over a period of ten years.

Figure 6: An overview of the 'SolarTech' offer ([17])



[17] NEXT Archives

3.2.4 Foresight Context

- The strong global trend towards greater resource use efficiency.
- Growing global concerns about the potential impacts of the non-sustainable use of resources and climate change on the future survival of the human race ([18]).
- The global trend more sustainable solutions.
- Advances in solar energy technologies that are rapidly improving their efficiency and cost effectiveness.
- Increases in costs associated with 'old energy' technologies that are making them less competitive e.g. coal and nuclear ([19]).
- The global trend away from large-scale grid dependent energy production and distribution systems towards small scale locally based distributed energy systems.
- An increasing number of governments introducing policies and regulations that support a transition towards more sustainable national energy systems.

3.2.5 Target Markets

- The predominant focus markets will be those in Caribbean countries which have high energy costs due to their heavy dependence upon imported fossil fuels.
- It will also be those where infrastructure development is lacking and could include specialised market opportunities e.g. in Latin / South America and parts of Africa.
- Within those markets the focus will be on those areas that initially offer the greatest potential to generate positive results on a return on investment basis.
- Based upon market areas that are currently growing for TFPV use around the world, the best opportunities appear to be with clients in the building and construction area, the marine sector, and those focussing on small community, domestic, and personal use applications.
- It would seem logical to focus on markets which have higher levels of solar radiation on a year round basis i.e. the tropical belt countries.

3.2.6 What We Have

- A rapidly growing TFPV technology sector internationally which is forecast to have strong growth prospects.
- The commercial development of practical applications for TFPV in a range of sectors including construction, the marine sector, energy generation, and small scale applications.
- Evidence from a range of sources that solar radiation levels are considerably higher towards the tropical regions compared to countries nearer the polar regions (e.g.[20],[21]).
- Outside of T&T, high energy costs by international standards in the majority of the Caribbean countries which provide a basis for achieving relatively short payback periods for investments in new renewable energy technologies. Even if using

18 http://www.panda.org/news_facts/publications/living_planet_report/
19 http://www.rmi.org/images/PDFs/Energy/E09-01_NuclPwrClimFixFolly1i09.pdf
20 http://re.jrc.ec.europa.eu/pvgis/countries/europe.htm
21 http://interestingenergyfacts.blogspot.com/2008/04/us-solar-energy-map.html

standard photovoltaic panels, the payback period to recover the capital cost of investment has been estimated at 7 years in Grenada ([22]).

- A strong emphasis on energy skills acquisition in the country's tertiary learning institutions e.g. UTT and the National Energy Skills Learning Centres.
- A pool of well trained and qualified energy and electrical engineering sector personnel who have the potential to play a key role in the development of renewable energy businesses.
- A recent announcement by the T&T Minister of Energy, Mr Conrad Enil, stating that T&T needs to focus more on potential opportunities in the renewable energy field ([23]).
- An increasing emphasis on renewable energy at the country's two main universities.
- Several private sector companies that have expressed an interest in exploring opportunities in the solar energy technology field.
- Several regional businesses that have been involved with the development, installation, and maintenance of solar energy systems e.g. Solar Dynamics in Barbados and Grenada Solar in Grenada.
- Strong construction and marine industry sectors in T&T that provide an avenue for developing mutually beneficial solutions which can be applied throughout the region and potentially also internationally.
- A growing consciousness among well educated young people in T&T about the environment and the need to move towards a more sustainable future. Increasing numbers in this group view renewable energy as an essential part of the future world that they will be living in ([24]).

3.2.7 What We Need

From the Private Sector

- Taking a longer term view of how the international energy sector is likely to evolve and establishing a stronger position in the emerging 'new energy' (renewable and sustainable energy) sector.
- Shifting away from a local inward looking T&T energy business focus to a broader regional focus where greater opportunities potentially exist. This includes a shift in thinking away from centralised energy production and supply models towards decentralised models – an emerging international trend that is gaining momentum.
- To become more entrepreneurial and expand into areas where applications of TFPV offer excellent long-term growth opportunities.
- A joint approach with key stakeholders from associated sectors that offer considerable leveraging potential for the 'SolarTech' best bet. This includes major construction sector and marine sector players.
- A willingness to form strategic alliances with international suppliers of the basic TFPV components required to develop value added applications for the Caribbean markets and other international niche markets.
- The formation of public private partnerships (formal or informal) with key researchers locally and internationally to develop new and innovative applications that will leverage additional value from the 'SolarTech' best bet in the medium to longer term.

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22 Dr Dirk Burkhardt, Managing Director, Grenada Solar Power Inc (Grensol), Appropriate Technologies Conference, UTT, T&T, April 2008

23 http://guardian.co.tt/business/business/2009/02/14/govt-looks-renewable-energy

24 Views expressed by young Gen Y persons to Ian Ivey of NEXT at a range of forums including UTT entrepreneurship course sessions, UWI entrepreneurship course interactive sessions, NIHERST staff training workshops, and during Gen. Y project interviews.

From the Public Sector

- Greater recognition that renewable energy technologies are huge opportunity areas regionally and internationally and of the potential the country has for exploiting such opportunities, particularly in neighbouring countries that have been suffering from high energy costs and are likely to continue to do so in future years.
- Greater recognition of the fact that an increasing number of younger educated persons have an increasing expectation that T&T will move towards a more environmentally conscious and sustainable future.
- To adopt a new strategic approach in the way the T&T energy sector offer is presented to the world through government agencies with a focus on developing centres of excellence and expertise around emerging growth opportunity areas identified through sector foresight studies.
- To include a greater emphasis on developing capabilities and business developments in the renewable energy technologies area, using a target-based approach, as part of the Vision 2020 Energy Sector strategic plan.
- Recognition that T&T could be become the regional leader in renewable energy technologies and applications and benefit economically and socially from that positioning. The country has already developed substantial physical and intellectual capital in the energy sector.
- To increase the amount of tertiary education funding that focuses on developing skills in the field of renewable energy including evolving solar energy technologies such as TFPV.
- Ideally, to remove the current subsidies for electricity and fuel so that the real costs of energy are reflected in the economy and the speed of transition towards future-focussed energy solutions becomes accelerated.
- Removing national energy subsidies will provide a stronger platform for new T&T-based renewable energy sector businesses to work with large local clients in, for example, the construction and marine sectors to develop, test, and refine the products and solutions that they could market regionally and in niche international markets.
- To include a sustainable energy focus as a requirement for all major construction projects overseen by government agencies such as UDECOTT – i.e. to shift towards 'green' buildings that increasingly become self-sufficient from the energy perspective through the incorporation, for example, of TFPV-based windows, wall panels and roofs.
- Funding of R&D to develop innovative new applications for TFPV based products and solutions that can be sold into regional and international niche markets.
- To set a new range of national renewable energy targets and standards and enforce those standards.
- To institute policies and initiatives which encourage tertiary and research institutions to become more aggressive in their approach to commercialising research findings.
- To provide a strong IP protection framework and its enforcement to ensure that patentable innovative solutions developed in T&T can generate additional knowledge based revenues for the country.
- Recognition that this field offers intellectually stimulating jobs for the increased number of graduates coming out of the country's tertiary institutions over future years. One of the biggest concerns many students have is the dearth of such jobs in T&T as the country has been slow to move towards the 'knowledge economy'.

From the R & D Sector

- Improve access to R&D resource people and facilities to help develop innovative TFPV-based applications that can leverage value for 'SolarTech' in regional and international niche markets. .
- A reduced focus on the traditional energy sector R&D programmes and a greater focus on research that relates to renewable energy areas which offer strong growth prospects over the next few decades.
- A more urgent focus on commercialising research findings developed at the country's universities and research institutions.
- The development of practical research priorities in the field of renewable and sustainable energy sectors that will provide the greatest benefits to T&T in the short to medium term.
- Currently some of the focuses being suggested by higher level academics and research persons in T&T as opportunity areas in these sectors may not be viable or practical for a number of reasons including technology costs, economies of scale, local cost structures, private sector capabilities, and logistical issues.
- Greater emphasis on international collaboration projects that assist in the development and transfer of 'appropriate technologies' into the region.
- A higher level of public private sector partnerships to develop mutually beneficial outcomes.

3.2.8 A Possible Business Model

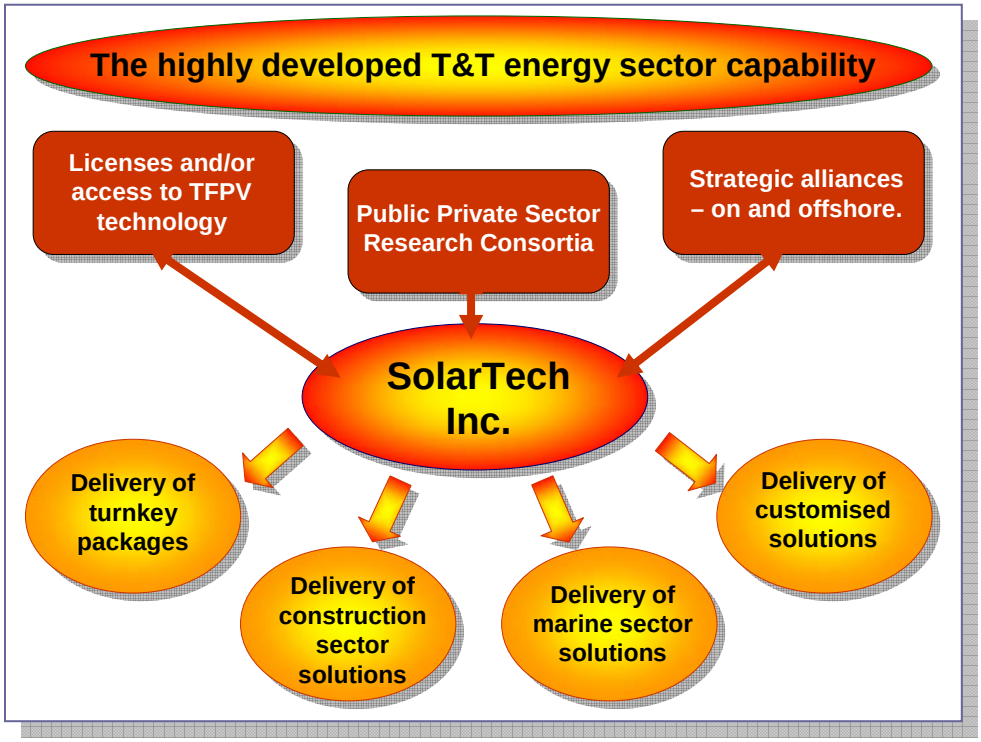
In order to develop a business that is capable of delivering internationally recognised and competitive solutions, the model for a business built around the 'SolarTech' best bet opportunity area may look something like that shown in Figure 7.

The most important aspects of this proposed model are as follows:

- It is built upon the large pool of energy sector expertise that exists in T&T and to which many new graduates are likely to migrate in the coming years.
- On the input side of 'SolarTech', these three areas are of vital importance:
  - Finalisation of an agreement with TFPV manufacturers, such as Nanosolar or Asian manufacturers, to access the technology and base product components, preferably on an exclusive regional license basis if that is at all possible.
  - The formation of links with research groups locally (and internationally if appropriate) that can lead to joint R&D projects which develop unique TFPV related applications that can add value to the 'SolarTech' customer offer over the medium to longer term.
  - The formation of strategic alliances with key stakeholders in focus markets to help identify and secure opportunities for product sales and projects and provide local support services for installation and maintenance.
- On the output side of 'SolarTech' the model focuses on delivering to four market areas, all of which are likely to overlap to varying degrees. These are:
  - The delivery of turnkey packages. These are complete design and install solutions built around the TFPV technology. An example might be a TFPV power generation, storage and delivery system for a major client.
  - The delivery of construction sector solutions. In this area of business the focus in on design and supply (possibly also installation on a sub-contractor basis) of components that contribute to the construction of 'smart green' buildings.

- The delivery of marine solutions. In this area of business the focus is on working with marine sector stakeholder groups to design and deliver TFPV-based energy solutions for clients in this sector.
- The delivery of customised solutions component focuses on unique community, domestic and personal solutions and requires a strong accent on applying innovation to develop new and unique TFPV applications.

Figure 7: A possible business model for the 'SolarTech' best bet ([25])



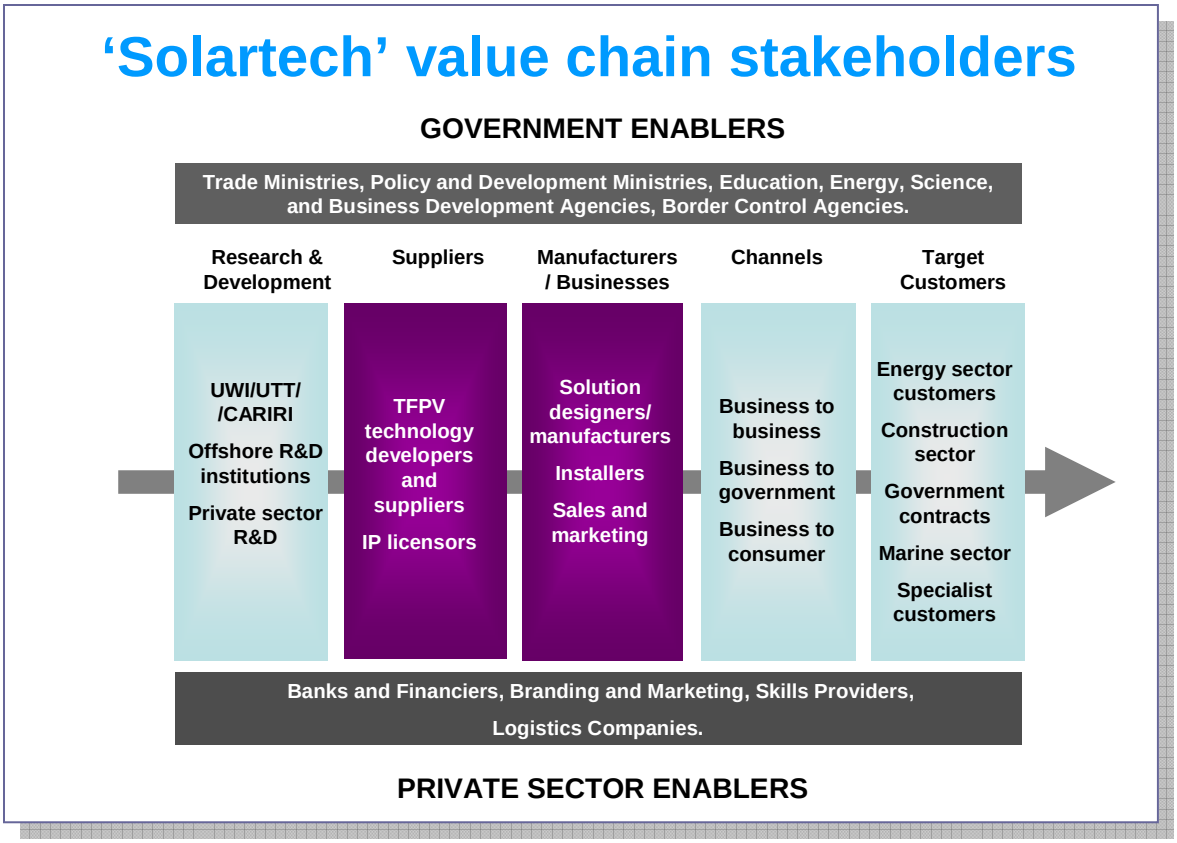
3.2.9 Best Bet Value Chain

The main stakeholder groups in the value chain model that would be needed to leverage the value associated with the 'SolarTech' best bet are shown in Figure 8.

The challenge is to develop the right combination of value chain links to maximise the revenue generation for T&T as a country. The links that are critical for success are being able to access TFPV technology from large offshore developer/manufacturer groups and then developing local cost effective solutions that provide a high degree of customer satisfaction. Thus the highlighted areas in the value chain for this best bet are 'Suppliers' and 'Manufacturers / Businesses'.

[25] NEXT Archives

Figure 8: Key stakeholders in the 'SolarTech' value chain model ([26])



3.2.10 Key Players

Key Local Players

There are several local companies that are involved with the import and installation of solar powered equipment in T&T. A recent article in the T&T Express mentioned two companies in particular ([27]).

Solar Power Concepts Limited

A search for a company website on Google was unsuccessful. However, the company has been reported as being a supplier of solar lights to clients in T&T and so is one of the pioneers in introducing solar technologies into the country. It is a subsidiary of DC Power Systems Ltd.

[26] NEXT Archives

[27] http://www.trinidadexpress.com/index.pl/article_news?id=161420478

Piranha Technology Asset Management Limited
(http://www.tech78.com/company/Piranha-Technology-Asset-Management-Ltd_845914.html)

This company recently imported and installed a solar powered garbage bin which automatically compacts the contents using sun energy. This is an example of an innovative application of solar power in a specialised use situation.

Another company which is doing innovative things in T&T and the region is one of the region's two mobile phone operators.

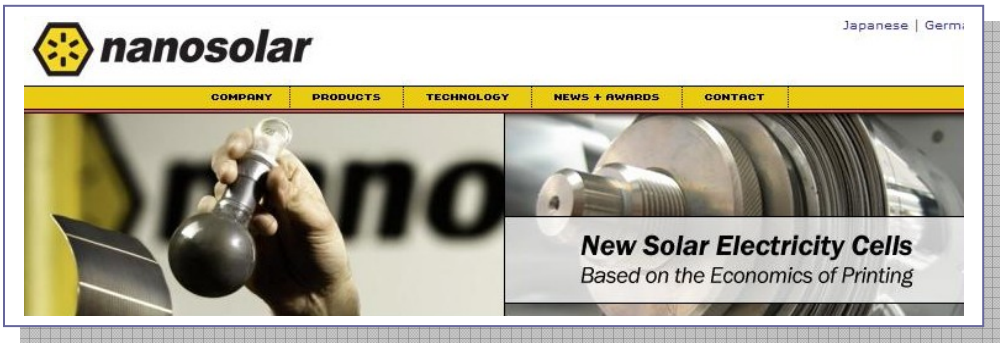
Digicel
(http://www.tmcnet.com/usubmit/2009/02/18/3995103.htm)

On February 18th, 2009, Digicel announced it had launched 'the world's first low cost solar powered phone'. It incorporates novel solar power technology developed by Dutch company, Intivation. The advantage of this development is that the handsets can be used in countries and environments where access to reliable power supplies is not possible.

Examples of Offshore Players

The following are a few selected examples of companies that are leading the way in developing TFPV technology and its applications. They are investing considerable sums to supply rapidly growing demand in this area of the solar energy market.

Nanosolar (http://www.nanosolar.com/)



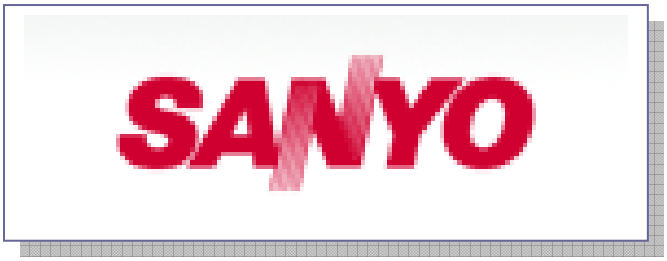
This California-based company has developed a new way of making ultra-thin photovoltaic panels at around 80% less cost than traditional photovoltaic panels. They recently announced that fully operational turnkey solar power generation packages developed using their solar panel technology have a capital cost of US$ 2.00 per Watt all inclusive compared to US$ 2.10 per Watt for coal-fired power stations. The latter also require continued fuel inputs at an ongoing cost to generate energy whereas the Nanosolar generation unit does not.

Nanosolar has built a second production plant in Germany and recently reported that they had 14 months of forward orders in hand.

First Solar (http://www.firstsolar.com/)

This is another US-based company that has many years experience in the solar energy sector and which is investing heavily into the development of TFPV technology. One particularly interesting aspect of this company's business is the lease options they provide as an option to customers to overcome the higher front end costs of purchasing and installing sustainable energy solutions such as those based around solar power.

Sanyo Electric (http://www.sanyo.com/)



Sanyo Electric is a Japanese owned global conglomerate which has invested heavily in a solar energy future. They are one of several large corporations that are betting on TFPV being a rapid growth sector.

Dimensional Innovations (http://www.dimin.com/)

This company works with other innovative companies to develop unique and highly customised solutions for clients. A recent project involved using TFPV solar technology to develop a unique new prototype solar sign solution ([28]). What they have developed is a 'green' solution to signage needs and removed the requirement to install cables and wires to provide illumination in signs.

Oksolar (http://www.oksolar.com/solar_panels/unisolar_flexibles.htm)

This company specializes in supplying a range of flexible solar panel based solutions for a range of applications including the marine sector. It illustrates the potential opportunity areas available in this sector.

Grenada Solar Power Ltd. (http://www.grensol.com/)

This Grenada-based company is included not because it is currently involved with TFPV technology but because it is a pioneer in introducing the design and installation of photovoltaic energy generating systems in Grenada.

They have learned a great deal about the challenges associated with the power that incumbent utilities have within the local energy market in many Caribbean island nations. Often their positions are reinforced by archaic legislation and regulations which are not designed to promote innovation and a transition away from 'old energy' to 'new energy'.

[28] http://www.globenewswire.com/newsroom/news.html?d=159008

3.2.11 Implementation Roadmap

An indicative roadmap of the targets set to establish the 'SolarTech' business, what will be needed to ensure that they are achieved, and who is involved in order to achieve the desired outcomes for this investment opportunity, is shown in Table 6.

Table 6: Indicative road map for implementing the 'SolarTech' best bet investment opportunity

By when?	What?	Who?
Initial	• Form a consortium to establish the business and identify major opportunity areas.	• Private sector stakeholders.
	• Finalise the business model and strategy to set up and run the business.	• Private sector stakeholders.
	• Identify the 'low hanging fruit' market opportunities.	• Private sector stakeholders.
	• Establish key alliances locally, regionally and internationally.	• Private sector stakeholders.
	• Access and appoint key personnel.	• Private sector stakeholders.
	• Finalise a commercialisation strategy and roadmap.	• Private sector stakeholders.
	• Develop a branding and marketing strategy – including a possible Google-linked marketing initiative.	• Branding/marketing group.
	• Identify funding needs and sourcing.	• Private sector stakeholders.
1st 6 months	• Win 5 construction solution projects.	• Business team + clients.
	• Win 5 marine solution projects.	• Business team + clients contractors.
	• Identify a potential turnkey package project in the highest energy cost islands.	• Business team + marketers.
	• Develop sales opportunities for 50 customised solutions.	• Business team / R&D sector.
2nd 6 months	• Complete delivery of the first 5 construction solution projects and find 10 opportunities for the next year.	• Business team + contractors.
	• Complete delivery of the first 5 marine solution projects and find 10 opportunities for the next year.	• Business team + contractors.
	• Secure a turnkey package project for the next year.	• Business team + marketers.
	• Finalise delivery of the 50 customised solutions and pursue 100 new opportunities for the next year.	• Business team + customers.
	• Begin the first PPP application development research project.	• Business team / R&D sector.
Year 2	• Win and deliver 10 construction solution projects and find 15 opportunities for the next year.	• Business team + contractors.
	• Win and deliver the 10 marine solution projects and find 15 opportunities for the next year.	• Business team + contractors.
	• Deliver the first turnkey package and secure 2 potential projects for the next year.	• Business team + marketers.
	• Finalise delivery of the 100 customised solutions and pursue 200 new opportunities for the next year.	• Business team + customers.
	• Continue with PPP application development research project – first application at the prototype testing stage.	• Business team / R&D sector.
Year 3	• Win and deliver 15 construction solution projects and find 20 opportunities for the next year.	• Business team + contractors.

	• Win and deliver the 15 marine solution projects and find 20 opportunities for the next year. • Deliver the next two turnkey packages and secure 2 new potential projects for the next year. • Finalise delivery of the 200 customised solutions and pursue 300 new opportunities for the next year. • Continue with PPP application development research project – first application on the market and a second at the prototype testing stage.	• Business team + contractors. • Business team + marketers. • Business team + customers. • Business team / R&D sector.
Year 4	• Win and deliver 20 construction solution projects and find 25 opportunities for the next year. • Win and deliver the 20 marine solution projects and find 30 opportunities for the next year. • Deliver the next two turnkey packages and secure 2 new potential projects for the next year. • Finalise delivery of the 300 customised solutions and pursue 400 new opportunities for the next year. • Continue with PPP application development research project – second application on the market and 2 further at the prototype testing stage.	• Business team + contractors. • Business team + contractors. • Business team + marketers. • Business team + customers. • Business team / R&D sector.
Year 5	• Win and deliver 25 construction solution projects and find 30 opportunities for the next year. • Win and deliver the 30 marine solution projects and find 40 opportunities for the next year. • Deliver the next two turnkey packages and secure 3 new potential projects for the next year. • Finalise delivery of the 400 customised solutions and pursue 500 new opportunities for the next year. • Continue with PPP application development research project – third and fourth applications on the market and 2 more at the prototype testing stage.	• Business team + contractors. • Business team + contractors. • Business team + marketers. • Business team + customers. • Business team / R&D sector.

3.2.12 Financial Scenario

- The financial scenario that has been developed for the 'SolarTech' best bet investment opportunity assumes that the revenue streams are the component that is largely 'intellectual capital' and does not include the capital cost of the equipment clients require to deliver the system as part of the 'SolarTech' revenue stream.
- Bearing this important assumption in mind, the summary in Table 7 provides a 'best-guess' estimate of the potential revenues, expenses, and EBIT figures that could be achieved over a ten-year period based upon the combination of market focus areas identified in the business model.
- Other assumptions include the business generating additional value for the offers it makes by developing unique applications built around TFPV technologies through public private sector R&D partnerships and projects. In some instances there may be an opportunity to generate revenue streams through IP registration but these have not been included in this financial model.
- The gross profit is relatively high by normal commercial standards but it needs to be viewed within the context described in the first item in this list. It is not unusual

to have this level of gross profit in businesses that have a high degree of 'intellectual capital' as their main asset.

This financial scenario has not been subjected to detailed scrutiny. It is intended to be an example of what could be achieved in the top 20% of the range of potential scenario outcomes. Before making an investment commitment, it would need further development and to be subjected to due diligence.

Full details can be found in the Appendix at the end of this report.

Table 7: Indicative financial projections for the 'SolarTech' investment opportunity

	By year 3	By year 6	By year 10
Gross revenue from all activities	US $ 2,950,000	US$ 8,750,000	US$ 24,700,000
Basis of the revenue figure	• 2 turnkey packages at US$ 250,000 each. • 15 construction sector solutions at US$ 100,000 each. • 20 marine sector solutions at US$ 25,000 each. • 200 customised solutions at US$ 1,000 each.	• 10 turnkey packages at US$ 250,000 each. • 30 construction sector solutions at US$ 100,000 each. • 50 marine sector solutions at US$ 25,000 each. • 500 customised solutions at US$ 4,000 each.	• 40 turnkey packages at US$ 250,000 each. • 50 construction sector solutions at US$ 100,000 each. • 100 marine sector solutions at US$ 25,000 each. • 900 customised solutions at US$ 8,000 each.
Capital expenditure*	US$ 775,000	US$ 600,000	US$ 800,000
Operating expenditure	US$ 1,815,250	US$ 5,296,250	US$ 14,826,500
Earnings before interest and tax (EBIT)	US$ 1,134,750	US$ 3,453,750	US$ 9,873,500

* Does not include government investment and is accumulated for the preceding 2 or 3 years.

3.2.13 NEXT Star Rating

- Because T&T has considerable amount of existing expertise in the energy sector, and is making a big investment in tertiary education that is increasing the number of highly qualified graduates, this best bet has a great deal of potential to form the basis of a whole new business sector in T&T.
- There are already several companies in T&T that have ventured into innovative solar energy application areas, but they are very much at the leading edge.
- The move by Digicel into solar phones is a wonderful example of the sort of innovation that creates new niche opportunities which have major potential regionally and internationally in market spaces that have not been fully exploited.
- There is no doubt that T&T would be operating in a higher risk area by moving into new business developments built around TFPV technologies and associated

applications but the rewards for successful solutions are likely to be substantially greater long-term than for those groups working in the low value 'old energy' commodity field.

- The key to making the 'SolarTech' best bet succeed will be in securing agreements to access the technology, to be aware of emerging solar energy technologies that may improve or supersede TFPV in the coming years and be able to move into the right future positioning as such technological advances occur, and to focus on developing more unique opportunities within the Caribbean and specific developing markets internationally.
- There may be a need to develop innovative funding models for clients to ensure that the upfront costs can be amortised over a realistic payback period or their needs can be supplied on a lease rather than purchase basis.
- This is perhaps a more risky business investment proposition than the other two best bets described in this report because it requires greater thought and invention into developing unique and innovative higher value application areas. Thus it has been rated with four stars.

3.3 Best Bet 3 Title: 'SunCool'

(This best bet is derived from 'Potential Best Bet 4: 'Solar air-conditioning systems'.)

3.3.1 The Investment Opportunity

- The investment opportunity is into a business that provides solar powered air-conditioning equipment and solutions along with passive building design services that minimise the need for air-conditioning.
- The focus of the business will be largely towards market opportunities within the tropical zones of the world.
- It is being established upon the basis of a transitional model which uses intermediate technologies, such as hybrid solar air-conditioning systems initially, that will be enhanced through upcoming technological advances and become increasingly cost competitive.
- Changes in international and national environmental regulations that come into force over the next 5 – 10 years as a result of growing climate change concerns are also likely to favour this business development.

3.3.2 Rationale

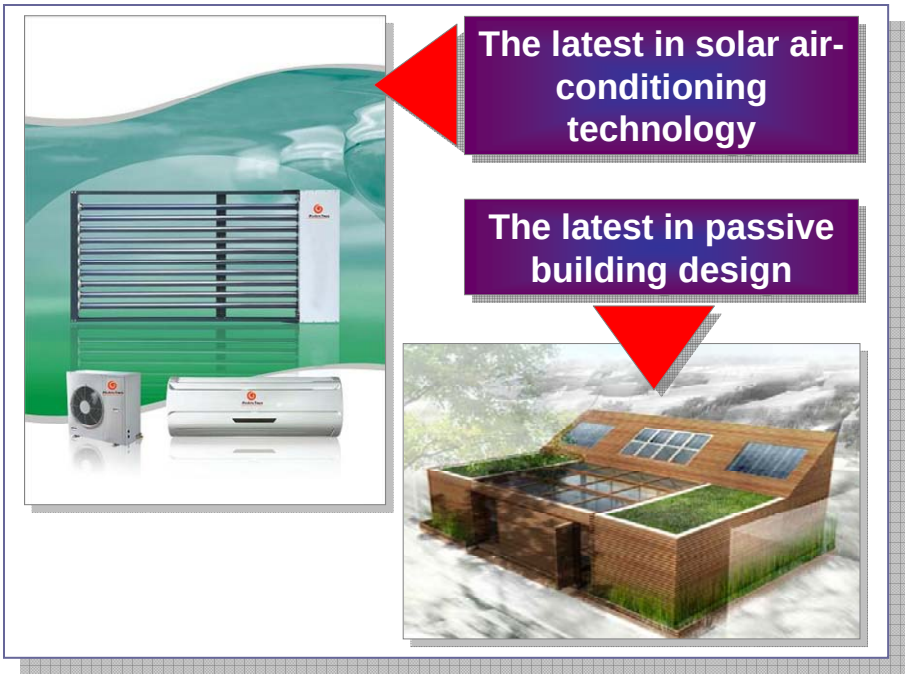
- Standard air-conditioning systems use a lot of electrical energy and the cost of operating such systems in high energy cost countries, including the majority of the Caribbean countries as well as advanced economies such as Singapore, is high.
- Whilst the development of solar-powered air-conditioning systems is still at a relatively early stage, there are several companies operating in various parts of the world that are already offering commercial solar powered air-conditioning systems and have begun making sales.
- Currently there appear to be several evolving options.
  - The first includes solar powered air-conditioning units that can be supplemented by mains power overnight or during times when the solar energy input is insufficient.
  - The second includes solar powered air-conditioning units which operate 100% independently of mains power and that are built around self-sufficient system designs.
  - A third revolves around passive house designs that reduce the needs for heating and cooling ([29]) and the innovative use of known alternative technologies such as evaporative cooling. This is becoming a growth business area.
- Because virtually every public sector building, institutional and commercial sector building, plus many domestic homes, are fitted with air-conditioning units and systems in hot climate areas the potential market opportunity area is huge.
- That potential is not only in the area of new installations but also in the retrofitting market where a cost benefit associated with replacing older inefficient mains powered systems with modern high-tech solar powered systems can be demonstrated.

[29] http://apps1.eere.energy.gov/consumer/your_home/designing_remodeling/index.cfm/mytopic=10250

3.3.3 Customer Offer

- The customer offer is a package built around leading edge solar powered air-conditioning technology – equipment procurement and customisation, design services, installation, and ongoing maintenance services.
- The packages offer a range of choices including solar/electric hybrid units that reduce power consumption by 30-50% ([30]).
- The offer includes a comprehensive design service which focuses on reducing the air-conditioning demands in the built environment through the use of smart building techniques and the innovative use of technologies such as evaporative cooling.
- Initially the customer offer will be designed to satisfy the needs of large public and private sector stakeholders with a focus on those which are involved in big building projects or which own large building complexes which are fitted with older, less efficient mains powered air-conditioning systems and which are paying high monthly electricity charges.
- The offer will also be designed to appeal to customers living in high energy cost countries where there is also a high year round demand for air-conditioning.
- It will also incorporate novel financing packages that assist clients overcome the initially high capital costs of installing solar powered air-conditioning systems. Such packages may include lease rather than purchase options and provide 'SunCool' with long-term additional revenue generation opportunities through tied servicing and maintenance agreements.
- The offer will also be presented in such a way that it appeals to customers who have a long-term view and are keen to lead the way in terms of implementing sustainable and resource efficient solutions.

Figure 9: An overview of the 'Suncool' best bet offer ([31])



30 http://www.excelsiatech.com/product_business_app.html

31 NEXT Archives

Solar air-conditioner photo source: http://img.alibaba.com/photo/11405847/Solar_Air_Conditioner.jpg
Passive house photo source: http://randomknowledge.files.wordpress.com/2007/11/cd3.jpg

3.3.4 Foresight Context

- The strong global trend towards greater resource use efficiency.
- Growing global concerns about the potential impacts of climate change on the future of the human race.
- The trend towards more sustainable solutions.
- Advances in solar energy technologies that are rapidly improving their efficiency and cost effectiveness.
- The global trend towards away from large scale grid dependent energy production and distribution systems towards small scale locally based distributed energy systems.
- More governments introducing policies and regulations that support a transition towards more sustainable energy futures.
- The global trend towards 'green' buildings – as reflected by the LEED accreditation programme ([32]).

3.3.5 Target Markets

- The initial focus will be towards specific customers in high energy cost Caribbean region countries – particularly those which are beginning to focus on more sustainable energy futures.
- These might include Barbados, The Bahamas, Grenada, St. Lucia, and possibly the wealthy French and Dutch dependencies in the region. There is also growing interest in alternative approaches at government level in St. Vincent and the Grenadines, Dominica, and Jamaica.
- Over time, niche opportunities in Latin America, Asia, the Middle East and Africa may also be worth targeting.
- The types of customers that would be initially targeted would be those who either build or own large building complexes that have a large requirement for air-conditioning.
- Such building owners would include those associated with the public sector, hospitals, hotels, office complexes, multi-story apartment complexes, and large retail outlets.

32 http://www.gbci.org/

- One specific focus would be towards older buildings in the above categories which have less efficient air-conditioning systems and where the cost benefits of a carefully structured package, including financing options, provide a cost advantage to the owners.
- Another specific focus is on the passive building design area for new buildings so that the air-conditioning needs could be substantially reduced through the use of innovative design features and applications. Such techniques are now being integrated into major construction projects such as planned Burj Al-Taqa tower in Dubai. This massive tower will incorporate modern versions of traditional ventilation techniques to provide cooling ([33]).

3.3.6 What We Have

- A climate in the country and region that creates a high demand for air conditioning.
- A number of companies that have a great deal of experience in designing, supplying, and installing air conditioning systems.
- Relatively high radiation levels on an all year round basis – although these need further proving, particularly in the rainy season.
- High cost energy throughout the Caribbean region - with the exception of Trinidad and Tobago. Air-conditioning costs can be 50% or more of overall power bills.
- The potential to save between 30 and 50% of domestic and commercial electricity charges with hybrid solar/electric units ([34]) and even more with 100% solar powered systems.
- Considerable technical expertise in the traditional refrigeration and air-conditioning fields in T&T.
- A vibrant construction sector in T&T which can provide a valuable channel for introducing new technologies that provide proven economic benefits.
- A number of suppliers internationally who are already offering commercial hybrid and fully solar powered air-conditioning systems.
- Growing levels of expertise internationally in the area of 'green' buildings and passive building design that can significantly reduce air-conditioning demands.

3.3.7 What We Need

From the Private Sector

- Recognition that this is a potentially large opportunity area regionally and internationally.
- An entrepreneurial group to take a lead role in this business.
- A sound strategy that provides a transition from traditional air-conditioning through hybrid and enhanced performance air-conditioning systems (including passive building design components as part of an overall package for new construction projects) and eventually 100% wholly solar powered systems when the technology reaches a 'market ripe' stage.
- The formation of strategic alliances with offshore partners who can provide the solar technology and passive building design expertise necessary in order to be able to provide leading edge solutions and services regionally and, longer-term, internationally.

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33 http://www.gizmag.com/burj-al-taqa-self-sufficient-skyscraper-design/9431/

34 http://www.excelsiatech.com/product_business_app.html

- The development of innovative financing packages that reduce the impact of the higher up-front costs and offer a potential cost saving advantage in the medium to longer term.
- To work with other key sectors, such as the building design and construction sector, to develop more comprehensive air-conditioning solution packages.

From the Public Sector

- Greater recognition that there are huge opportunity areas regionally and internationally in the air-conditioning / passive building design fields and of the potential the country has for exploiting opportunities in this area, particularly in neighbouring countries that have been suffering from high energy costs and are likely to continue to do so in future.
- A review of the country's 'cheap energy' policy which could well lead to T&T being at a competitive disadvantage internationally long-term because of the relatively high energy use intensity in the country and the inevitable need to raise the domestic cost of energy in future years so that is more comparable to international unsubsidised price levels. The country's oil and gas reserves are finite. The debate today is about at which time point that finiteness may begin to impact. The recent Scott Ryder report indicated that this could happen in T&T as soon as 2020.
- Moving away from the cheap energy policy is likely to provide a boost towards building a cluster of T&T-based renewable energy sector businesses.
- To adopt a new strategic focus in the way the T&T energy sector offer is presented to the world through government agencies with a focus on developing centres of excellence and expertise around emerging growth opportunity areas identified through sector foresight studies.
- To include a greater emphasis on developing capabilities and business developments in niche renewable energy technologies areas, such as solar air-conditioning, as a focus of the Vision 2020 Energy Sector strategic plan.
- Recognition that T&T could become the regional leader in solar powered air-conditioning technologies (and passive building design) and benefit economically and socially from that positioning.
- To increase the amount of tertiary education funding that focuses on developing skills in the field of renewable energy technologies, including solar powered air-conditioning and building design-based air-conditioning use efficiency improvements.
- To include a sustainable energy focus as a requirement for all major construction projects overseen by government agencies such as UDECOTT – i.e. to shift towards 'green' buildings that become increasingly energy self-sufficient through the use of passive building design approaches.
- Funding of R&D to develop innovative new applications and improvements related to the emerging solar air-conditioning products and solutions that can be sold into regional and international niche markets.
- To set a new range of national renewable energy targets and standards and enforce those standards.
- To institute policies and initiatives that encourage tertiary and research institutions to become more aggressive in their approach to commercialising research findings.
- To provide a strong IP protection framework and its enforcement to ensure that patentable innovative solutions developed in T&T can generate additional knowledge based revenues for the country.
- Recognition that this field offers intellectually stimulating jobs for the increased number of graduates coming out of the country's tertiary institutions over the coming

years. One of the biggest concerns many students have is the dearth of such jobs in T&T as the country has been slow to move towards the 'knowledge economy'.

From the R & D Sector

- To take a longer term view of the future of T&T's energy sector in a broader global context and develop a more informed view of how it may need to change.
- To reduce the focus towards traditional energy sector R&D programmes and move towards a greater emphasis on research that relates to renewable energy areas that offer strong growth prospects over the next few decades.
- To undertake an evaluation of what might be truly 'appropriate' and practical emerging renewable energy technologies as the basis for allocating limited research funding resources more effectively and potentially generating a higher return on R&D investments.
- Some of the focuses currently being suggested by academics and research persons in T&T as opportunity areas in the renewable energy sector may not be viable or practical for a number of reasons including technology costs, economies of scale, local cost structures, private sector capabilities, and logistical issues.
- The question of whether T&T companies should be 'big' or 'unique' within a global context needs to be considered in depth.
- Greater emphasis on international collaboration projects that assist in the development and transfer of 'appropriate technologies', such as solar powered air-conditioning, into the region.
- A greater number of public private sector partnerships set up to develop mutually beneficial outcomes and accelerate the development of a cluster of innovative hi-tech renewable energy companies in T&T.
- Improve access to R&D resource people and facilities to help develop innovative solar air-conditioning and passive building design applications that can leverage value for 'SunCool' and T&T in regional and international niche markets.
- A more urgent focus on commercialising research findings developed at the country's universities and research institutions.

3.3.8 A Possible Business Model

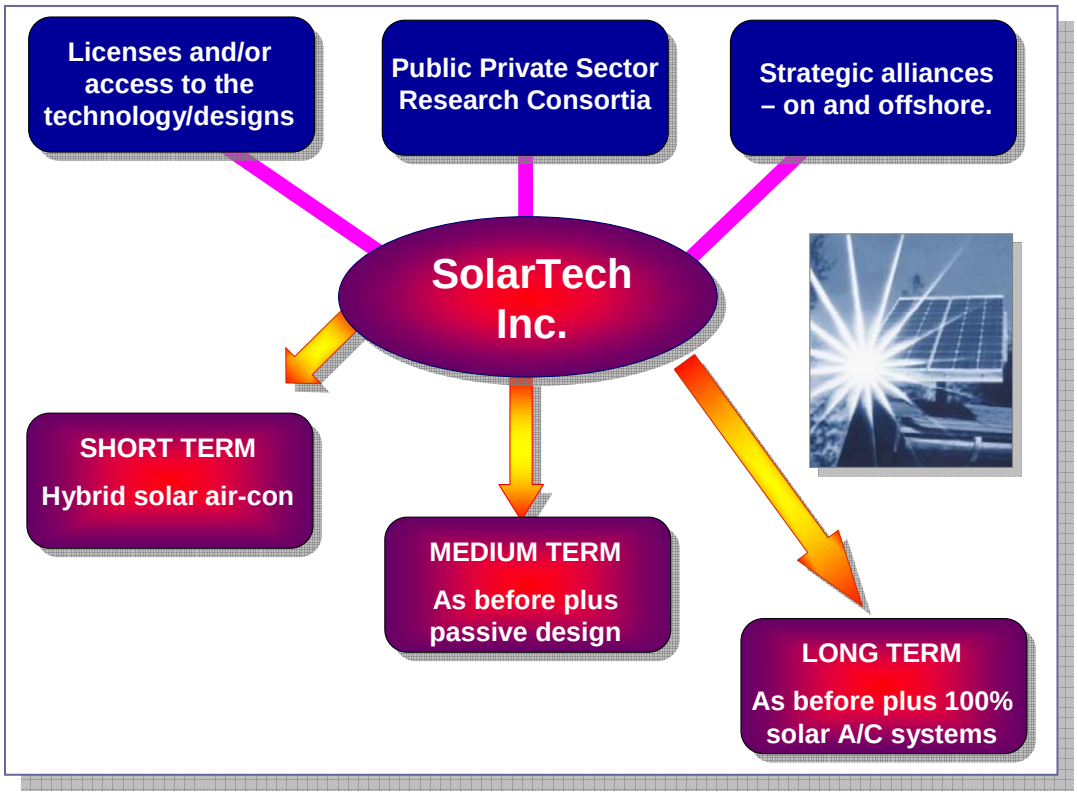
In order to develop a business that is capable of delivering internationally recognised and competitive solutions, the model for a business built around the 'SunCool' best bet opportunity area may look something like that shown in Figure 10.

The most important aspects of this proposed model are as follows:

- The business plan needs to be built around a staged development approach with initial efforts being focused towards 'low hanging fruit' opportunities in areas such as solar hybrid air-conditioning options and ways of increasing the efficiency of use of existing systems.
- The next stage in the business plan would be to expand into the passive design area as an additional focus of the business.
- The third stage would be to market 100% solar powered systems that are independent of mains electricity needs once the technology has matured somewhat further than today and the cost benefits can be demonstrated to be more advantageous to end customers.

- In addition to the staged growth business plan, key alliances will need to be formed from the start, and on an ongoing basis, to secure access to the best technologies and sources of complementary knowledge essential for making this business a success.
- Another important aspect of the business model is that it is designed to deliver to markets which provide the best customer outcomes and greatest returns for 'SunCool'.
- Innovative online marketing in association with Google in key markets will be a leading edge feature as greater volumes of business, even in the hi-tech areas, are being generated this way today.
- MontanStahl in Switzerland (turnover US$ 500 million p.a.) uses this avenue exclusively to service fifteen international markets. It is in the business of manufacturing highly engineered customised metal profiles using a unique in-house developed laser technology ([35]). Turnover in the first two months of February 2009 is likely to exceed that achieved in the first six months of 2008 ([36]).
- Southern Lights Biomaterials has adopted a similar model internationally and is struggling to supply a rapidly increasing demand for its products, even though many world markets are suffering from recessionary trends ([37]).

Figure 10: A possible business model for the 'SunCool' best bet ([38])

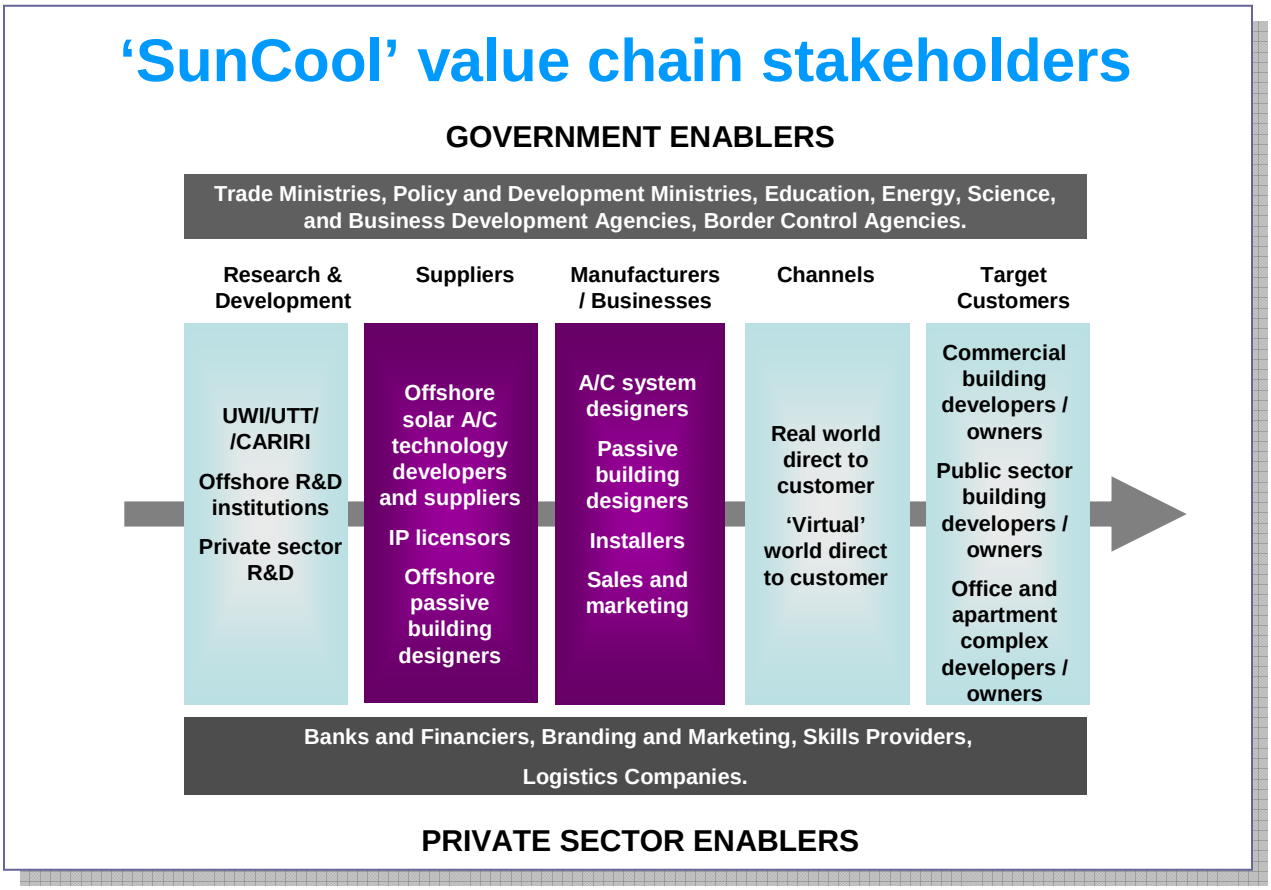


35 http://www.montanstahl.com/
36 Personal communication, Ralf Neimeier, MontanStahl
37 Personal communication, Peter Meyer, M.D. http://www.slv.co.nz/
38 NEXT Archives

3.3.9 Best Bet Value Chain

The main player groups in the value chain model that would be needed to leverage the value associated with the 'SunCool' best bet investment opportunity are shown in Figure 11.

Figure 11: Key stakeholders in the 'SunCool' value chain model ([39])



The challenge is to develop the right combination of value chain links to maximise the revenue generation for T&T as a country. This will require a strong virtual marketing component to maximise the opportunity flow to 'SunCool' and reduce the high costs of traditional travel and face to face visits that many existing businesses in the region still incur.

[39] NEXT Archives

3.3.10 Key Players

Key Local Players

- Because this is an emerging field, there appear to be no businesses or individuals working in the field of solar powered air-conditioning – whether hybrid of 100% systems – or in passive building design.
- Thus it is likely that 'SunCool' will need to be a 'green field' business that is established as a new entity by an entrepreneur or entrepreneurial group.
- However, there are a number of established businesses in the air-conditioning business in T&T which could be potential participants. Following is one example:

Peake Industries Limited (http://www.peakeind.com/hvac/home.htm)

- Peake Industries Limited is one of the largest companies in the air-conditioning equipment segment of the market in T&T. However, their focus appears to be largely within the local T&T market and they note that there are several things that could make it difficult to introduce such technologies into that market. These include:
  - The low cost of energy in T&T (and thus the long payback times).
  - The visibility factor as they may be more intrusive compared to traditional A/C units.
  - The impact of dull weather during the rainy season on performance levels.
- In spite of these limitations their Director and General Manager, Mr Kenneth Boodoo, expressed an interest in looking at opportunities and possible alliances in this area ([40]).

- Several other local companies active in the A/C market include **Servair Ltd**., and **Climate Control Ltd**.

[40] Personal communication, January, 2009

Examples of Offshore Players

In contrast to T&T where the sentiments towards solar powered air-conditioning are relatively negative, there is a lot of commercial activity happening in many countries around the world. Following are a few selected examples of companies and organisations that are leading the way in developing solar air-conditioning technology and passive building systems:

Excelsia Technologies, Malaysia (http://www.excelsiatech.com/contact_us.html)

- This company claims to have designed and built the most efficient solar powered hybrid air-conditioning system in the world.
- They also claim that the system can reduce overall power bills by 30 – 50% and pay back the cost of purchase and installation in as little as 11 months.

SOLCOOL.Net (http://www.solcool.net/solcool.htm)

- This US company offers an air-conditioning system that requires 50% less power, is low voltage and operates on DC current, and which can be powered using solar energy.
- It comes with a battery system that provides up to 12 hours of back-up.

Green Core (http://www.greencoreair.com/)

- This California-based company has designed a solar powered air-conditioning system that can operate 100% independently of mains power. However, the units are fitted with an automatic switch-over capability to mains power so that they can be operated as hybrid units if customers wish to pursue such an option.

Broad, China (http://www.broad.com/english/products/pro_bj.asp)

- This Chinese company offers a range of fully solar-powered air-conditioning units for commercial use.

Rotartica, Spain (http://www.rotartica.com/_bin/home/home.php?idioma=ingl)

- This company also offers solar powered air-conditioning systems designed for domestic use.
- A Danish company developing similar units due to come on the market soon claim that such units use 90% less power than conventional air conditioning units ([41]).

Australian National University (http://www.abc.net.au/news/stories/2009/02/03/2481211.htm)

- Researchers at this university claim to have developed a solar powered air-conditioning system that 'is a cheaper and more effective option that electricity powered cooling systems'.
- It can be powered by just one solar panel on the roof of a building.

[41] http://ecoworldly.com/2008/10/22/denmark-invents-solar-power-air-conditioning-again/

- A prototype unit is currently undergoing commercial testing.

Gerber Architekten, Germany
(http://www.gerberarchitekten.de/index.php?id=11&L=1&cHash=e8894b0909)

- This German architectural group has developed some bold designs for large buildings, such as the proposed Burj Al-Taqa tower in Dubai, that have a high degree of inherent passive building design.
- They are regarded by many as being one of the world's leading groups in this field of activity.

3.3.11 Implementation Roadmap

An indicative roadmap of the tasks and targets set to establish the 'SunCool' business proposition, what will be needed to ensure that they are achieved, and who is involved in order to achieve the desired outcomes for this investment opportunity, is shown in Table 8.

Table 8: Indicative road map for implementing the 'SunCool' best bet investment opportunity

By when?	What?	Who?
Initial	• Form a consortium to establish the business and identify major opportunity areas.	• Private sector stakeholders.
	• Finalise the business model and strategy to set up and run the business.	• Private sector stakeholders.
	• Identify the 'low hanging fruit' market opportunities and develop a business plan that provides for the phase-in of the medium and longer term business opportunity areas.	• Private sector stakeholders.
	• Establish key technology access and partner alliances locally, regionally and internationally.	• Private sector stakeholders.
	• Access and appoint key personnel.	• Private sector stakeholders.
	• Finalise a commercialisation strategy and roadmap.	• Private sector stakeholders.
	• Develop a branding and marketing strategy – including a possible Google-linked marketing initiative.	• Branding / marketing group.

	• Identify funding needs and sourcing.	• Private sector stakeholders.
1st 6 months	• Train key staff in the areas where they need expertise in association offshore technology partners. • Establish the Google online marketing alliance. • Win 3 hybrid A/C packages. • Search out potential opportunities in the three business focus areas and consult key construction sector people.	• Business team / alliance partners. • Business team + Google. • Business team + clients. • Business team + marketers / clients.
2nd 6 months	• Complete sales and installation of the first 3 hybrid A/C sales and installation packages and identify 5 opportunities for the next year. • Identify 2 passive design packages for the next year. • Identify the first 100% solar A/C package opportunity. • Begin the first PPP application development research project.	• Business team + contractors/marketers • Business team + marketers. • Business team + marketers. • Business team / R&D sector.
Year 2	• Win and complete 5 hybrid A/C sales and installation packages and identify 7 opportunities for the next year. • Win and complete 2 passive design projects and find 4 opportunities for the next year. • Win and complete the first 100% solar A/C sales and installation package and identify 2 opportunities for the next year. • Continue with PPP application development research project – first application at the prototype testing stage.	• Business team + contractors / marketers. • Business team + contractors / marketers. • Business team + contractors / marketers. • Business team / R&D sector.
Year 3	• Win and complete 7 hybrid A/C sales and installation packages and identify 9 opportunities for the next year. • Win and complete 4 passive design projects and find 6 opportunities for the next year. • Win and complete 2 100% solar A/C sales and installation packages and find 4 opportunities for the next year. • Continue with PPP application development research project – first application commercial and second at the prototype stage.	• Business team + contractors / marketers. • Business team + contractors / marketers. • Business team + contractors / marketers. • Business team / R&D sector.
Year 4	• Win and complete 9 hybrid A/C sales and installation packages and identify 12 opportunities for the next year. • Win and complete 6 passive design projects and find 8 opportunities for the next year. • Win and complete 4 100% solar A/C sales and installation packages and find 7 opportunities for the next year. • Continue with PPP application development research project – second application commercial and third at the prototype testing stage.	• Business team + contractors / marketers. • Business team + contractors / marketers. • Business team + contractors / marketers. • Business team / R&D sector.
Year 5	• Win and complete 12 hybrid A/C sales and installation packages and identify 15 opportunities for the next year. • Win and complete 8 passive design projects and find 10 opportunities for the next year.	• Business team + contractors / marketers. • Business team + contractors / marketers.

	• Win and complete 7 100% solar A/C sales and installation packages and find 12 opportunities for the next year. • Continue with PPP application development research project – third application commercial and fourth at the prototype testing stage.	• Business team + contractors / marketers. • Business team / R&D sector.

3.3.12 Financial Scenario

- This financial scenario has been developed based on a three stage phase-in of the three business areas described in the model shown in Figure 11 and the potential revenue generation associated with each.
- It is assumed that all the packages will be taken up by the owners and / or constructors of large buildings and building complexes where there is a high need for air-conditioning and where electricity costs are high.
- Because of the rapid development of more cost effective solar powered hybrid and stand alone air conditioning systems, it is the authors' view that these technologies may become more mainstream in the shorter rather than longer term.
- For this reason it is also assumed that the value of each package will increase significantly over the ten year period covered by this scenario because the cost benefits will improve. Innovative financing packages are also assumed to play a part in increasing the overall value of each package.
- The summary in Table 9 provides a 'best-guess' estimate of the potential revenues, expenses, and EBIT figures that could be achieved over a ten-year period.

This financial scenario has not been subjected to detailed scrutiny. It is intended to be an example of what could be achieved in the top 20% of the range of potential scenario outcomes. Before making an investment commitment, it would need further development and to be subjected to due diligence.

Table 9: Indicative financial projections for the 'SunCool' investment opportunity

	By year 3	By year 6	By year 10
Gross revenue from all activities	US $ 1,450.000	US$ 6,200,000	US$ 53,040,000
Basis of the revenue figure	• 7 hybrid packages at US$ 100,000 each. • 4 passive design packages at US$ 140,000 each. • 2 100% solar packages at US$ 25,000 each.	• 12 hybrid packages at US$ 170,000 each. • 8 passive design packages at US$ 180,000 each. • 7 100% solar packages at US$ 60,000 each.	• 60 hybrid packages at US$ 400,000 each. • 18 passive design packages at US$ 280,000 each. • 80 100% solar packages at US$ 300,000 each.
Capital expenditure*	US$ 775,000	US$ 650,000	US$ 800,000
Operating expenditure	US$ 1,448,500	US$ 5,094,000	US$ 41,200,800
Earnings before interest and tax (EBIT)	US$ 253,500	US$ 1,306,000	US$ 12,039,200

* Does not include government investment and is accumulated for the preceding 2 or 3 years.

Full details can be found in the Appendix at the end of this report.

3.3.13 NEXT Star Rating

- Because T&T has considerable expertise in the energy sector and a big investment in tertiary education, which is increasing the number of highly qualified graduates, this best bet has a great deal of potential to form the basis of a whole new business sector in T&T that is unique in this region and which provides exciting job prospects for young graduates with the right skills sets.
- The most critical factor associated with pursuing such a best bet is to focus on taking a phased approach to the establishment of the business that is in tune with technology advances and improved cost benefits.
- Because the Caribbean region has a high demand for air conditioning and the cost of energy outside T&T is high by international standards, the opportunities in the shorter term are not likely to be within T&T itself.
- However, there are many examples of innovative businesses internationally that have evolved on a 100% export basis (services and products). Southern Lights Biomaterials based in New Zealand is an excellent example.
- The rapid developments happening in the solar air-conditioning field internationally, particularly in the past 12 months, suggest that this is not perhaps such a high risk best bet as it may have at first appeared.

4 What Comes Next?

As this project has proceeded it has become clear that T&T is considerably behind many other countries in terms of thinking and understanding about how the 'new energy' sector, built upon renewable and sustainable energy, is developing and the current status of a number of new and evolving technologies. Local T&T views of opportunities in the 'new energy' sector tend to focus on the negative rather than the positive. Such attitudes, coupled with outdated national energy policies, are hindering the transition process needed to provide T&T with a far more robust and resilient economic basis and future.

In countries such as China, Germany, and the USA, renewable energy and energy use efficiency are high profile areas that have attracted considerable investment and which are being driven not only by changing markets and consumer attitudes but also by shifts in government policies and legislation. Market growth rates have been double digit over recent years.

Because of the well-developed energy sector T&T already has and the increasing number of well-qualified graduates emanating from the country's universities and tertiary institutions, there is a real opportunity for T&T to become a hub for the 'new energy' sector ,not only in the region but also in other international niche markets.

The fact that T&T based Energy Dynamics has been able to establish a successful regional business focusing on energy efficiency and new energy concepts illustrates that such opportunities can be exploited from this country.

A challenge is to overcome the constraints imposed by living in a country that is so highly focused on the 'old energy' sector and which provides energy to local consumers at artificially low prices when compared to most other countries internationally. This is creating a distorted market which, long-term, could prove to be quite disadvantageous to T&T.

The real opportunity is for T&T companies to develop a position in this high growth opportunity regionally right from the start and bypass the local market entirely, at least initially, because the opportunities in the local market are likely to be few and far between and of low profitability until changes in local energy market policies and pricing take place. There is also a need to become more aware of international advances in 'new energy' technologies at all levels within T&T and the rapidly changing cost-competitiveness balance between 'old energy' and 'new energy'.

The real challenge now is not only to see how many of these three Renewable Energy Sector Best Bet Investment Opportunity Cases can become a commercial reality but also for T&T to develop a National Growth and Innovation Framework and Strategy to prioritise the allocation of limited resources into areas which have the potential to generate the best future returns for the country in the energy sector.

The development of such a framework will be essential if the foresighting approach is to take a hold and help stimulate the development of new entrepreneurial businesses that have strong medium to long-term growth prospects and can deliver the type of outcomes

the country desires – higher quality jobs, greater value adding, and a more diverse, resilient, and sustainable economy.

Such a framework and strategy would align all the country's key agencies, stakeholders, and resources in one go-forward direction. Once this is achieved, then the country will make real progress towards achieving its goal of becoming a fully developed nation by the year 2020.

These best bets are ambitious - but being ambitious is critical for the future success of a small nation with big aspirations - such as T&T.

5 Appendix – Best Bet Financial Scenarios

BEST BET SECTOR: Renewable Energy				BEST BET 1: 'Enersave'							
			File date:		17/02/09						
			Last review:		17/02/09						
10 Year Financial Projection Model (US$)											
GOVT INVESTMENT	Description	YEAR									
		1	2	3	4	5	6	7	8	9	10
S&T research	Product development	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000
Education	Skills training	300000	300000	300000	300000	300000	300000	300000	300000	300000	300000
Trade development	Market development	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000
Total Govt investment		**700000**	**700000**	**700000**	**700000**	**700000**	**700000**	**700000**	**700000**	**700000**	**700000**
REVENUE	Description	YEAR									
		1	2	3	4	5	6	7	8	9	10
Product/Service Line 1	Energy Efficiency Solns										
Volume	No of solutions	5	10	20	30	40	50	60	70	80	90
Value/unit	$ Value/soln	5000	6000	7000	8000	8500	9000	9500	10000	10000	10000
Gross line revenue		**25000**	**60000**	**140000**	**240000**	**340000**	**450000**	**570000**	**700000**	**800000**	**900000**
Product/Service Line 2	Energy Efficiency Projs										
Volume	No. of projects	1	2	4	6	8	10	15	20	30	40
Value/unit	$ Value per project	100000	120000	150000	200000	250000	300000	350000	400000	450000	500000
Gross line revenue		**100000**	**240000**	**600000**	**1200000**	**2000000**	**3000000**	**5250000**	**8000000**	**13500000**	**20000000**
Product/Service Line 3	Energy Efficiency Pship										
Volume	No. of Pships	0	1	2	3	5	7	9	12	15	18
Value/unit	$Value per Pship	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000
Gross line revenue		**0**	**200000**	**400000**	**600000**	**1000000**	**1400000**	**1800000**	**2400000**	**3000000**	**3600000**
Product/Service Line 4	Hardware/software										
Volume	No of units	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
Value/unit	$/sale	100	150	200	250	300	350	400	450	500	550
Gross line revenue		**100000**	**300000**	**600000**	**1000000**	**1500000**	**2100000**	**2800000**	**3600000**	**4500000**	**5500000**
Total Revenue		**225000**	**800000**	**1740000**	**3040000**	**4840000**	**6950000**	**10420000**	**14700000**	**21800000**	**30000000**
EXPENSES											
Capex	Description										
Item 1	P/ship investment (1)		500000	500000	500000	1000000	1000000	1000000	1500000	1500000	1500000
Item 2	Equipment (2)	250000	50000	50000	50000	50000	50000	50000	50000	50000	50000
Item 3	R&D (3)	50,000	75000	100000	100000	100000	100000	100000	100000	100000	100000
Total Capex		**300000**	**625000**	**650000**	**650000**	**1150000**	**1150000**	**1150000**	**1650000**	**1650000**	**1650000**
Opex	Description										
Cost of sales	30% of gross (4)	30000	90000	180000	300000	450000	630000	840000	1080000	1350000	1650000
Project inputs	20% of proj revs (5)	1250	3000	7000	12000	17000	22500	28500	35000	40000	45000
Salary and wages	(6)	250000	300000	350000	400000	486000	650000	828000	1040000	1250000	1470000
Freight	1.5% of gross rev. (7)	3375	12000	26100	45600	72600	104250	156300	220500	327000	450000
Marketing	3% of gross rev.	10000	24000	52200	91200	145200	208500	312600	441000	654000	900000
Travel	10% of gross rev. (8)	22500	80000	174000	304000	484000	695000	1042000	1470000	2180000	3000000
Communications	2% of gross rev.	4500	16000	34800	60800	96800	139000	208400	294000	436000	600000
E-commerce	2% of gross rev. (9)	4500	16000	34800	60800	96800	139000	208400	294000	436000	600000
Rental	Estimate	40000	80000	100000	200000	300000	400000	600000	800000	1000000	12000000
Consumables	2% of gross rev.	4500	16000	34800	60800	96800	139000	208400	294000	436000	600000
Administration	5% of gross rev.	11250	40000	87000	152000	242000	347500	521000	735000	1090000	1500000
Total Opex		**381875**	**677000**	**1080700**	**1687200**	**2487200**	**3474750**	**4953600**	**6703500**	**9199000**	**22815000**
Total Expenses		**681875**	**1302000**	**1730700**	**2337200**	**3637200**	**4624750**	**6103600**	**8353500**	**10849000**	**24465000**
EBIT		**-156875**	**123000**	**659300**	**1352800**	**2352800**	**3475250**	**5466400**	**7996500**	**12601000**	**7185000**
EBIT - Capital		**-456875**	**-502000**	**9300**	**702800**	**1202800**	**2325250**	**4316400**	**6346500**	**10951000**	**5535000**
EBIT - (Capex + Govt)		**-1156875**	**-1202000**	**-690700**	**2800**	**502800**	**1625250**	**3616400**	**5646500**	**10251000**	**4835000**
NOTES:	OPEX = Operating Expenditure and CAPEX = Capital Expenditure										
1	The funding required for labour, equipment, and installation costs to generate 15 years of annual paybacks of US$ 200,000 p.a.										
2	Specialist equipment required in-hosue that is not leased or outsourced.										
3	In house investment in public private sector research partnerships to develop unique smart solutions										
4	Hardware and software only										
5	Project consumables and hire charges										
6	Estmates for the first four years and then 40% of projects and solustions costs and 10% of the other two categories.										
7	Shiiping equipment to offshore jobs as required.										
8	Travel for marketing and project delivery work.										
9	Assumes an e-marketing component is set up										

BEST BET SECTOR: Renewable Energy				BEST BET 2: 'SolarTech'							
			File date:	18/02/09							
			Last review:	18/02/09							
10 Year Financial Projection Model (US$)											
GOVT INVESTMENT	Description	YEAR									
		1	2	3	4	5	6	7	8	9	10
S&T research	Product development	150000	150000	150000	150000	150000	150000	150000	150000	150000	150000
Education	Skills training	300000	300000	300000	300000	300000	300000	300000	300000	300000	300000
Trade development	Market development	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000
Total Govt investment		**650000**	**650000**	**650000**	**650000**	**650000**	**650000**	**650000**	**650000**	**650000**	**650000**
REVENUE	Description (1)	YEAR									
		1	2	3	4	5	6	7	8	9	10
Product/Service Line 1	Turnkey packages										
Volume	No of solutions	0	1	3	5	7	10	15	20	30	40
Value/unit	Value per solution $		250000	250000	250000	250000	250000	250000	250000	250000	250000
Gross line revenue		**0**	**250000**	**750000**	**1250000**	**1750000**	**2500000**	**3750000**	**5000000**	**7500000**	**10000000**
Product/Service Line 2	Construction solutions										
Volume	No of solutions	5	10	15	20	25	30	35	40	45	50
Value/unit	Value per solution $	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
Gross line revenue		**500000**	**1000000**	**1500000**	**2000000**	**2500000**	**3000000**	**3500000**	**4000000**	**4500000**	**5000000**
Product/Service Line 3	Marine solutions										
Volume	No of solutions	5	10	20	30	40	50	60	70	80	100
Value/unit	Value per solution $	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
Gross line revenue		**125000**	**250000**	**500000**	**750000**	**1000000**	**1250000**	**1500000**	**1750000**	**2000000**	**2500000**
Product/Service Line 4	Customised solutions										
Volume	No of solutions	50	100	200	300	400	500	600	700	800	900
Value/unit	Value per solution $	500	750	1000	2000	3000	4000	5000	6000	7000	8000
Gross line revenue		**25000**	**75000**	**200000**	**600000**	**1200000**	**2000000**	**3000000**	**4200000**	**5600000**	**7200000**
Total Revenue		**650000**	**1575000**	**2950000**	**4600000**	**6450000**	**8750000**	**11750000**	**14950000**	**19600000**	**24700000**
EXPENSES											
Capex	Description										
Item 1	Equipment (2)	350000	100000	100000	100000	100000	100000	100000	100000	100000	100000
Item 2	R&D (3)	50,000	75000	100000	100000	100000	100000	100000	100000	100000	100000
Item 3											
Total Capex		**400000**	**175000**	**200000**	**200000**	**200000**	**200000**	**200000**	**200000**	**200000**	**200000**
Opex	Description										
Material inputs	10% of gross (4)	65000	157500	295000	460000	645000	875000	1175000	1495000	1960000	2470000
Salary and wages	30% of gros rev.(5)	195000	472500	885000	1380000	1935000	2625000	3525000	4485000	5880000	7410000
Freight	1.5% of gross rev. (6)	9750	23625	44250	69000	96750	131250	176250	224250	294000	370500
Marketing	3% of gross rev.	10000	47250	88500	138000	193500	262500	352500	448500	588000	741000
Travel	5% of gross rev. (7)	32500	78750	147500	230000	322500	437500	587500	747500	980000	1235000
Communications	2% of gross rev.	13000	31500	59000	92000	129000	175000	235000	299000	392000	494000
E-commerce	1% of gross rev. (8)	6500	15750	29500	46000	64500	87500	117500	149500	196000	247000
Rental	Estimate	40000	50000	60000	70000	80000	90000	100000	110000	120000	130000
Consumables	2% of gross rev.	13000	31500	59000	92000	129000	175000	235000	299000	392000	494000
Administration	5% of gross rev.	32500	78750	147500	230000	322500	437500	587500	747500	980000	1235000
Total Opex		**417250**	**987125**	**1815250**	**2807000**	**3917750**	**5296250**	**7091250**	**9005250**	**11782000**	**14826500**
Total Expenses		**817250**	**1162125**	**2015250**	**3007000**	**4117750**	**5496250**	**7291250**	**9205250**	**11982000**	**15026500**
EBIT		**232750**	**587875**	**1134750**	**1793000**	**2532250**	**3453750**	**4658750**	**5944750**	**7818000**	**9873500**
EBIT - Capital		**-167250**	**412875**	**934750**	**1593000**	**2332250**	**3253750**	**4458750**	**5744750**	**7618000**	**9673500**
EBIT - (Capex + Govt)		**-817250**	**-237125**	**284750**	**943000**	**1682250**	**2603750**	**3808750**	**5094750**	**6968000**	**9023500**

NOTES: OPEX = Operating Expenditure and CAPEX = Capital Expenditure

1. All revenue streams are estimates of the value that SolarTech receives excluding the TFPV and ancilliary equipment capital costs for each solution area.
2. Specialist equipment required in-hosue that is not leased or outsourced.
3. In house investment in public private sector research partnerships to develop unique smart solutions.
4. Material inputs required to develop the SolarTech customer solutions over and above those excluded as described in 1 above.
5. 30% of the gross revenue is allocated to cover the cost of intellectaul capital and support staff. Some of this may be outsourced on a sub-contract basis.
6. A general cost allocation for freight.
7. Travel for marketing and client liaison purposes.
8. Assumes an e-marketing component, such as a specialist Google link, is set up to help direct business to SolarTech.

BEST BET SECTOR: Renewable Energy				BEST BET 3: 'SunCool'							
			File date:	19/02/09							
			Last review:	19/02/09							
10 Year Financial Projection Model (US$)											
GOVT INVESTMENT	Description	YEAR									
		1	2	3	4	5	6	7	8	9	10
S&T research	Product development	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000
Education	Skills training	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000
Trade development	Market development	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000
Total Govt investment		**800000**	**800000**	**800000**	**800000**	**800000**	**800000**	**800000**	**800000**	**800000**	**800000**
REVENUE	Description (1)	YEAR									
		1	2	3	4	5	6	7	8	9	10
Product/Service Line 1	Hybrid packages										
Volume	No of packages	3	5	7	9	12	15	20	30	40	60
Value/unit	Value per package $	100000	100000	120000	140000	170000	200000	250000	300000	350000	400000
Gross line revenue		**300000**	**500000**	**840000**	**1260000**	**2040000**	**3000000**	**5000000**	**9000000**	**14000000**	**24000000**
Product/Service Line 2	Passive des. packages										
Volume	No of packages	0	2	4	6	8	10	12	14	16	18
Value/unit	Value per package $	100000	120000	140000	160000	180000	200000	220000	240000	260000	280000
Gross line revenue		**0**	**240000**	**560000**	**960000**	**1440000**	**2000000**	**2640000**	**3360000**	**4160000**	**5040000**
Product/Service Line 3	100% Solar A/c										
Volume	No of packages	0	1	2	4	7	12	20	30	50	80
Value/unit	Value per package $		25000	25000	40000	60000	100000	150000	180000	250000	300000
Gross line revenue		**0**	**25000**	**50000**	**160000**	**420000**	**1200000**	**3000000**	**5400000**	**12500000**	**24000000**
Total Revenue		**300000**	**765000**	**1450000**	**2380000**	**3900000**	**6200000**	**10640000**	**17760000**	**30660000**	**53040000**
EXPENSES											
Capex	Description										
Item 1	Equipment (2)	200000	200000	150000	150000	100000	100000	100000	100000	100000	100000
Item 2	R&D (3)	50000	75000	100000	100000	100000	100000	100000	100000	100000	100000
Item 3											
Total Capex		**250000**	**275000**	**250000**	**250000**	**200000**	**200000**	**200000**	**200000**	**200000**	**200000**
Opex	Description										
Material inputs	35% of gross (4)	90000	229500	435000	714000	1170000	1860000	3192000	5328000	9198000	15912000
Salary and wages	27.5% of gros rev.(5)	200000	275000	398750	654500	1072500	1705000	2926000	4884000	8431500	14586000
Freight	1.5% of gross rev. (6)	4500	11475	21750	35700	58500	93000	159600	266400	459900	795600
Marketing	3% of gross rev.	10000	22950	43500	71400	117000	186000	319200	532800	919800	1591200
Travel	5% of gross rev. (7)	15000	38250	72500	119000	195000	310000	532000	888000	1533000	2652000
Communications	2% of gross rev.	6000	15300	29000	47600	78000	124000	212800	355200	613200	1060800
E-commerce	1% of gross rev. (8)	3000	7650	14500	23800	39000	62000	106400	177600	306600	530400
Rental	Estimate	40000	60000	80000	100000	110000	120000	130000	140000	150000	160000
Consumables	2% of gross rev.	6000	15300	29000	47600	78000	124000	212800	355200	613200	1060800
Administration	5% of gross rev.	15000	38250	72500	119000	195000	310000	532000	888000	1533000	2652000
Total Opex		**389500**	**713675**	**1196500**	**1932600**	**3113000**	**4894000**	**8322800**	**13815200**	**23758200**	**41000800**
Total Expenses		**639500**	**988675**	**1446500**	**2182600**	**3313000**	**5094000**	**8522800**	**14015200**	**23958200**	**41200800**
EBIT		**-89500**	**51325**	**253500**	**447400**	**787000**	**1106000**	**2117200**	**3744800**	**6701800**	**11839200**
EBIT - Capital		**-339500**	**-223675**	**3500**	**197400**	**587000**	**1106000**	**2117200**	**3744800**	**6701800**	**11839200**
EBIT - (Capex + Govt)		**-1139500**	**-1023675**	**-796500**	**-602600**	**-213000**	**306000**	**1317200**	**2944800**	**5901800**	**11039200**

NOTES:	OPEX = Operating Expenditure and CAPEX = Capital Expenditure
1	All revenue streams are gross package values including equipment and installation costs for multi-unit installation projects in commercial, retail, and public buildings.
2	Specialist equipment required in-hosue that is not leased or outsourced.
3	In house investment in public private sector research partnerships to develop unique smart solutions.
4	The material inputs for each package
5	Staff and sub-contractor costs
6	A general cost allocation for freight.
7	Travel for marketing and client liaison purposes.
8	Assumes an e-marketing component, such as a specialist Google link, is set up to help direct business to SunCool.