The Business Case for Airport Renewable Energy Projects: Why Airports are Uniquely Suited for Renewable Energy Investments

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PREFACE

The National Academy of Sciences Transportation Research Board is administering research funded by the Federal Aviation Administration (FAA) under the Airport Cooperative Research Program (ACRP). HMMH was selected to prepare guidance to the aviation industry through a project entitled "Developing the Airport Business Case for Renewable Energy." The guidance is expected to be published in the first quarter of 2016.

A panel of industry experts from airports, federal and state government agencies, and private industry identified this research need and has provided oversight throughout its implementation. The panel recognized that while airports have been active participants in the renewable energy industry over the past ten years with as many as 100 individual projects developed on airport property in the U.S., the industry as a whole does not fully understand the complex drivers behind these projects and how airports have consistently made a strong business case for their development. Furthermore, the experience of project operation has validated the business case and provides a robust body of evidence supporting the business advantages of renewable energy that could more broadly benefit the industry in the future.

INTRODUCTION

Organizations prepare a business case analysis to engage in a thorough investigation of the alternatives to a proposed project. More and more, the benefits associated with projects are optimized not only through the immediate and quantifiable financial benefits, but also when considering the self-sustainability, environmental and social benefits. Airports, in their roles as businesses and government, are in a unique positon to make credible arguments that can support both the financial and policy objectives to maintain the long-term self-sustainability of the airport as a critical component of the regional and national transportation infrastructure.

Renewable energy has long held a broad appeal for its environmental and local benefits. Advances in technology, which have benefitted greatly from the revolution in materials science and the digital age, have improved system performance and dramatically decreased energy production costs particularly as markets have emerged. Airports, like much of society, have been active participants in renewable energy deployment, but there preparation for evaluating such opportunities has been haphazard.

In current practice, airports are typically presented with opportunities to pursue renewable energy projects based on the availability of grant funding programs or inquiries from private entities. In such circumstances, it may not be possible for airports to engage in a thorough investigation of the alternatives to the proposed projects and reach an informed decision that optimizes airports' financial, environmental, operational, and social benefits. An effective, objective business case evaluation would assist airports embarking on renewable energy projects to advance future airport planning that targets economic, environmental, and social objectives. With the broad universe of sustainable measures that can be undertaken, implementing renewable energy projects has been limited although it can be a significant opportunity to lower greenhouse gas emissions.

WHAT IS A BUSINESS CASE?

The business case is a systematic process for solving a problem. The product of the business case is a presentation of the solution and why it is superior to the business from other alternatives considered.

The scope for this research provides additional context in relationship to the proposed research.

"A business case explores all feasible approaches to a given problem and enables airports to select the best option."

This definition is consistent with the core purpose of a business case. However, the research scope seeks to quantify benefits beyond the traditional financial analysis using customary metrics like return on investment and total cost of operation.

"The objective business case evaluation would assist airports embarking on renewable energy projects to advance future airport planning that targets economic, environmental, and social objectives."

It is here that the business case evaluation becomes more difficult to document. Economic data can be collected and evaluated to determine the short- and long-term costs of various alternatives. For example, the cost of electricity today versus the cost of electricity in ten years can be readily generated by using various assumptions of expected future pricing. However, the economic "benefit" of some expenditures, such as for investment in infrastructure modernization, may lack sufficient data to document potential economic benefits. Do airports have the data to calculate the economic benefits to the business from decreasing the risk of an electrical system failure and airport shut-down? And how do you measure the business value of being a recognized industry leader in sustainability? While a case could be made on one side or the other, the strength of objectivity lies in the verifiability of the evidence, and, lacking such information, could quickly dissolve into a philosophical debate.

With this ambiguity in mind, the researcher sought to militate against subjectivity by discussing the renewable energy business case with airport industry thought leaders who had implemented renewable energy projects to see how they developed a business case. The responses received suggested a broad misunderstanding of the term "business case" which focused on whether or not a project will produce an immediate or short-term financial benefit. Researchers asked representatives of existing aviation

renewable energy projects if they could describe the business case for the project and not uncommonly heard the response that "the project really wasn't able to support the business case," which is analogous to saying the project didn't produce an immediate or short-term financial benefit or otherwise was not particularly cost-effective. Yet, the project solved some sort of problem that had been perceived and therefore was implemented as a solution. Selecting renewable energy as a solution to a problem required developing a business case, even if through an informal and largely oral process.

Building on this concept, there is question as to if developing a business case is an objective process. The project scope suggests that an objective business case is more effective. Yet, the expression "making the case" is to explain why something should be done. This discussion becomes more nebulous when discussing a topic such as renewable energy which is relatively new and its benefits and challenges not widely understood or accepted. "Making a case" for renewable energy requires educating stakeholders about the benefits of renewable energy and why potential challenges are not founded. This process becomes much more complicated than the core "business case analysis" which focuses on financial metrics such as simple payback or return on investment, and potential skeptics can question the value to the business of financial investments in renewable energy that are more difficult to quantify. As a result, making the business case for renewable energy becomes more of an advocacy process and perhaps less objective than it might for other types of projects.

Yet, with more than ten years of experience in the implementation of airport renewable energy projects, there is now a body of evidence that can be drawn upon to understand why projects have been developed. Whether or not airports in the past developed a business case for their projects in advance, their experience and the drivers behind those projects can help airports develop a business case for future renewable energy projects by aligning their project objectives with the benefits accrued by others. Irrespective of objectivity or lack thereof, the critical message is that an effective business case must present credible information to support proceeding with the renewable energy project, and much of that information consists of difficult to measure benefits to the long-term prosperity of the organization including those with a broader environmental and social context.

INHERENT BENEFITS OF RENEWABLE ENERGY

There are a number of characteristics of renewable energy that provide unique benefits to energy consumers which are central to making the renewable energy business case. The specific characteristics of renewable energy include:

- the Energy source is essentially free for most technologies (though biomass does require a feedstock),
- the Energy produced is emissions free (or at least carbon neutral),
- the Energy source is local, and
- the Energy produces broader societal benefits that have enhanced value.

The key element to making the airport business case for renewable energy is documenting and communicating the inherent benefits of renewable energy. In this research, the business cases for renewable energy that have been developed were reviewed, and each was based on the same principles

which focused on why renewable energy will solve a problem that cannot be solved in another way. Each business case listed the same inherent benefits of renewable energy and then emphasized which ones provided the most benefit to solving specific problems based on the particular objectives of the organization and the interests of their constituents. This discovery led the team to focus much more on researching the fundamentals of renewable energy rather than the application of renewable energy for particular organizations. The inherent benefits of renewable energy are presented in Table 1 below.

Table 1. Core Principles of the Renewable Energy Business Case

Issue	Solution	Benefits
Electricity price volatility and uncertainty	Procure electricity through long-term contracts for renewable energy	Allows for accurate forecasting and budgeting of future electricity costs
Inflated electricity prices during peak usage times	Reduce use from the grid during high demand periods through on-site generation (also referred to as peak shaving)	Allows utility customer to avoid high demand charges applied during peak use
Challenging regulatory environment for new construction	Provide mitigation for future impacts through renewable energy	Facilitates future development
Expanding markets leads to a decrease in installed costs for renewable generated electricity	Assess the cost of renewable electricity compared with other generation sources	Renewable energy is cost-competitive
Aging electric network decreases reliability	Invest in generation and distribution projects to improve system reliability which may include renewable energy for back-up generation and battery storage	Advance reliability consistent with resiliency and climate adaptation
Greenhouse gas and renewable energy policy mandates and goals	Procure clean renewable electricity	Achieve policy goals
Over-reliance on particular types of energy	Procure energy from a diversity of sources including renewable energy	Spread out the operational and financial risk associated with a single energy source
Lack of control over electricity	Generate a portion of electricity on-site which could include renewable energy	Minimize risk associated with external shortages; manage use better for financial and reliability benefits
Tight operating budgets due to increasing costs and challenging market conditions	Host a renewable energy facility and purchase the electricity to reduce costs, or simply act as a landlord and receive regular lease payments	Improvement of the business bottom line
Desire to build a credible green brand	Generate or purchase renewable energy	Will be able to speak of green successes

DEVELOPING THE AIRPORT BUSINESS CASE

Developing the airport business case for renewable energy is a systematic decision-making process. The first step is to prepare the basis for the business case which includes outlining the vision based on a problem and a solution, and identifying the guiding principles underpinning the potential solution. The second step is to integrate preferred project into existing planning and capital programming processes that airports typically follow for all capital projects to formalize decision-making and secure project approval. The third step is the implement the project which for airports includes public bidding and oversight.

The three phases of developing the business case are presented in Figure 1 with the individual aspects of each of the three phases shown in the blue boxes below.

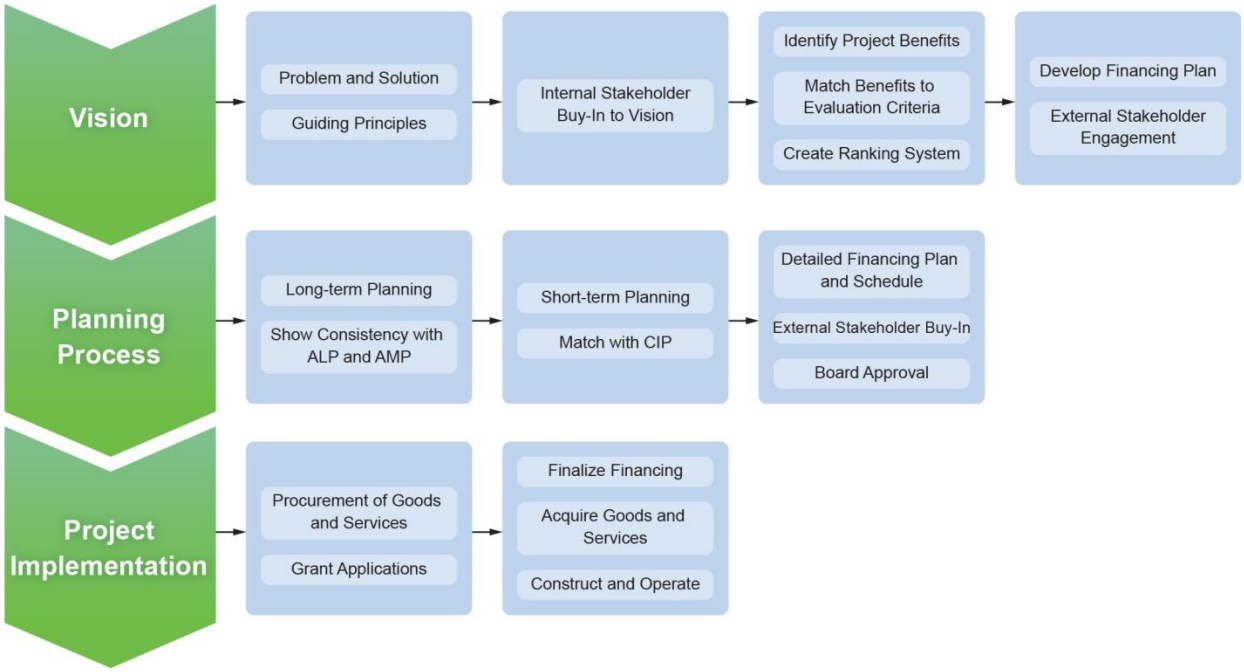

Figure 1. Developing the Airport Renewable Energy Business Case Flow Chart

There are many different drivers for renewable energy projects and the basis for the business case is specific to each airport and their operational needs. Some airports may need to clearly demonstrate the financial benefits of the project to the airport and its stakeholders. Others may want to pursue renewable energy regardless of the potential cost premium. In either case, the airport needs to evaluate the different project attributes and how costs and benefits can be communicated.

It also is essential that airports prepare the basis for the proposed project from which all decisions flow. Building the business case starts from a broad perspective of how the renewable energy project fits into the overall objectives of the airport organization and narrows down to the execution of the renewable energy project.

The following renewable energy attributes should be considered when evaluating the business case:

- The ability to reduce costs;
- Diversification of energy supply;
- Locking in long-term energy price stability to hedge against energy market volatility;
- Achieving GHG emissions reduction targets;
- Meeting demand from investors and customers; and
- Demonstrating industry leadership, innovation, and competitive first-mover advantage.

INDUSTRY EXPERIENCE

Renewable energy technologies currently operating at airports in the U.S. include biomass, geothermal (ground source heat pumps), solar photovoltaic, solar thermal, and wind. The location of identified airports hosting renewable energy facilities in the U.S. are shown on Figure 2 by technology type.

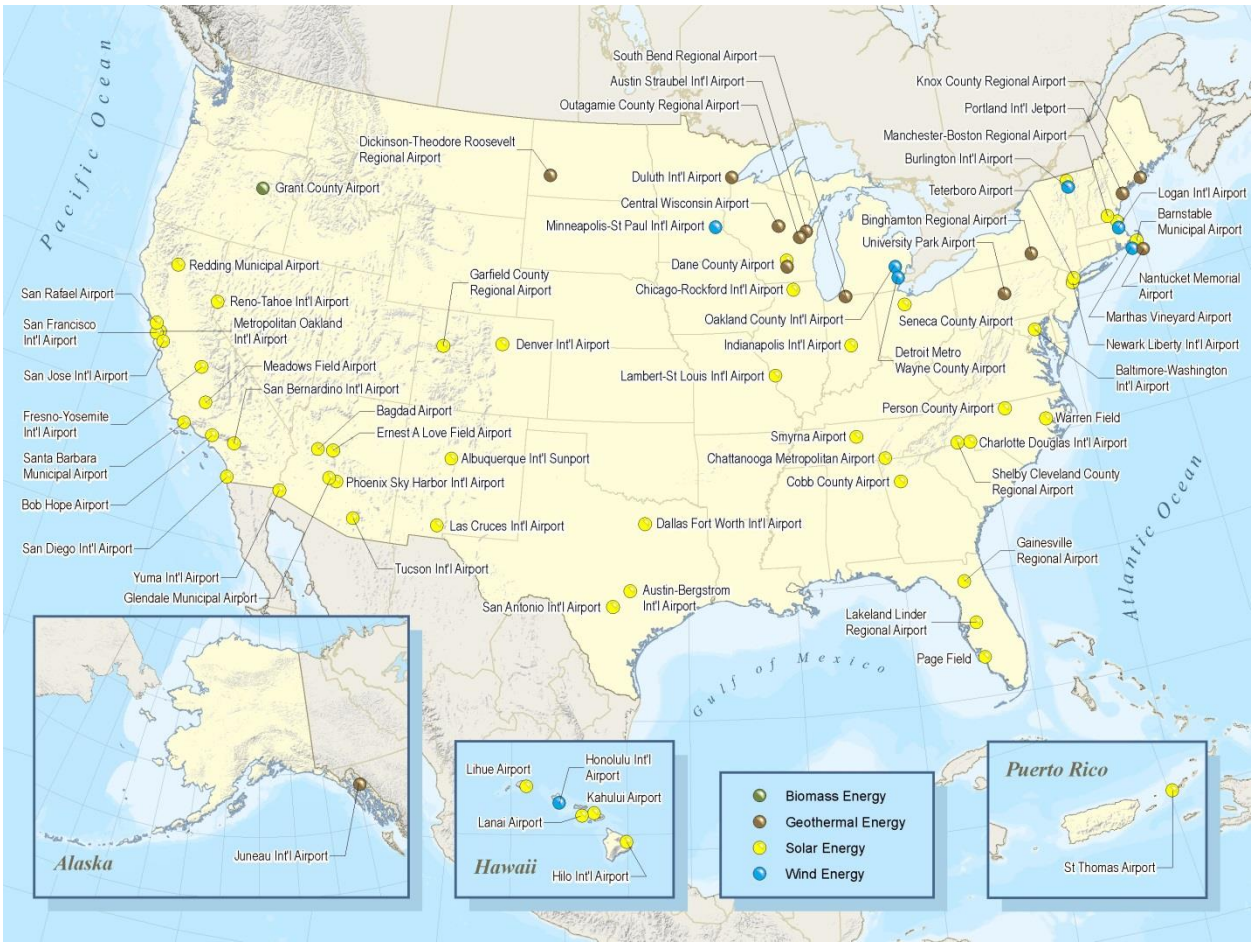

Figure 2. Airport Renewable Energy Projects

The number of installations for each technology known to the author is listed in Table 2. The experience of these projects is useful in developing the business case for airport renewable energy.

Table 2. Airport Renewable Energy Projects in the U.S. by technology

Technology	Number of Projects
Biomass	1
Geothermal	13
Solar PV	71
Solar Thermal	3
Wind	7

Solar PV has been the most successful technology deployed at airports. This has been primarily due to its cost-effectiveness and ease of siting on airport property. Solar PV installations at airports have

tracked statewide solar policies and therefore are located in states that have created incentives to stimulate solar markets. Solar can also be readily developed as an adjunct to existing airport development without significant integration costs. It can also be located on buildings or on airfield land that cannot accommodate other uses thereby taking advantage of underutilized property. The low profile of the facilities increase siting opportunities, and the development of glare screening software to eliminate impact is now customarily used facilitating compatible project development.

Geothermal systems of the variety referred to as Ground Source Heat Pumps (GSHP) have also been implemented as part of new airport building construction with success. These systems have received specific FAA environmental protection grants which have helped limit the airport's exposure to higher capital costs relative to traditional fossil fuel fired building heating systems. While GSHP can also be integrated into the airport development plan without conflicting with preferred aeronautical uses by, for example, locating wellfields under parking lots, it is most cost-effective to implement the systems as part of new construction or a major renovation.

Wind power is generally unsuitable for placement on airports because wind turbines are most efficient when located on top of tall structures hundreds of feet above ground level. Such tall structures pose an obstruction hazard to aircraft and FAA rules prohibit these development types near airports. A few modestly tall wind turbines have been located on airport property in compliance with FAA limits but at less than 150 feet tall, they have limited efficiency in capturing wind resources to generate electricity. Many other wind projects consist of building-integrated wind turbines that are relatively small and considerably more inefficient.

There are a few solar thermal projects at airports in the U.S. which are generally considered to be demonstration technologies. A single biomass boiler is located at a LEED certified terminal in a region of the U.S. where wood waste is common and cheap.

AIRPORT SURVEY OF RENEWABLE ENERGY PROJECT DRIVERS

A discussed above, initial research with airports about the business case for renewable energy suggested that airports did not formally consider the business case when developing their projects. However, airports developed renewable energy projects for different reasons and understanding those reasons would be useful in mining information to support the general airport business case for airport renewable energy.

To collect data on the airport's decision-making process and the drivers for undertaking renewable energy, the researchers prepared a simple web-based survey using Constant Contact. To improve response success rates, the survey was limited to 10 questions to make it easy for recipients to respond. This approach was consistent with the type of information sought which was general in nature. In addition, the survey was only sent to one contact from each airport to avoid receiving multiple responses for a single installation. As the researchers had worked with the airport respondents on other related industry initiatives, it was anticipated that response levels would be reasonably high in comparison to a random survey.

The survey was sent to 91 airport contacts and the 22 responses were obtained for a 24% response rate. Here are some of the key findings.

Technology:

- solar = 72.7%
- geothermal = 22.7%
- solar thermal = 9.0%
- wind = 4.5%
- biomass = 4.5%

Source of Initiative:

- internal staff = 50%
- organizational strategic planning = 27.7%
- outside private party = 18.1%

Initiative Leader:

- Director = 31.8%
- Facilities = 22.7%
- Other = 45.4%

Primary Driver

- Economic = 42.8%
- Environmental = 42.8%
- Political = 9.5%

Secondary driver

- Environmental = 42.8%
- Economic = 33.3%
- Social = 14.2%

Most Important Factor (average score on 1 to 5 scale)

- Reducing cost or generating revenue = 4.9
- Demonstrating industry leadership = 4.6
- Locking-in long-term price stability = 4.0
- Diversifying energy supply = 3.4
- Meeting local/state renewable energy policies = 3.1
- Achieving Greenhouse Gas emission reduction targets = 2.6
- Meeting demands from investors and customers = 2.1
- Mitigating permitting obstacles to future expansion = 1.5

Degree to which project has had a broad positive effect on the airport's bottom line:

- Low = 47.9%
- High = 19.0%
- Undetermined = 19.0%
- Medium = 14.2%

Degree to which project has had a broad positive effect on the airport and its business:

- Medium = 42.8%
- High = 23.8%
- Low = 19.0%
- Undetermined = 14.2%

The information in the responses is conflicting. It indicates that economic factors are the most important drivers for the projects but the economic benefit realized was not as strong. Environmental drivers are also strong. A key response is the importance of being an industry leader which is an indicator of the importance of airports as a gateway for economic development and environmental leadership.

CASE STUDY: SAN DIEGO INTERNATIONAL AIRPORT

San Diego International Airport (SAN), owned and operated by the San Diego County Regional Airport Authority (SDCRAA) since 2003, was the 30th busiest airport in the U.S. in 2014 in terms of flight operations. It served just fewer than 18.8 million passengers in 2014 which is the largest number in its history. It is the largest single runway airport in the country.

Renewable Energy Actions: The SDCRAA executed a lease and power purchase agreement (PPA) with Borrego Solar to install a 3.3 MW solar facility at San Diego International Airport (SAN). Under the agreement, Borrego will construct and operate the facility and SDCRAA will buy all of the electricity output, estimated to be 5.3 million kilowatt hours (kWh), for a 20 year period. Depending on future electricity prices, the SDCRAA expects to save $3-8 million by locking in stable electricity prices from the solar project. The solar facility will interconnect to Terminal 2 with solar modules located on roof of the Terminal Building and on carport structures over the short-term parking area providing a supplemental benefit of shaded parking. An additional 1.8 MW project will also be developed by Borrego over a surface parking lot being constructed on the north side of the airport.

The SDCRAA has also recently completed a 12 KV microgrid on the campus to feed the terminals and reduce energy bills. With the grid in place, most projects, including solar, can feed back into the airport's system to support the entire campus rather than just the facility with which the renewable energy system is associated. The goals are to island the airport for a portion of the year and to stabilize energy use by 2035 when the airport is projected to maximize its capacity. The microgrid will be able to support a variety of power distribution and generation projects around the airport.

Primary Driver: Initially renewable energy was driven by the financial and facilities maintenance division, who were working to control energy costs, and the need for continuation of operations in the case of outages like one experienced in September 2011.

Supplemental Drivers: Sustainability, financial sustainability, and resiliency are the three core values of the Authority's sustainability program – to maximize the airport's ability to stay in place as long as possible. As presented to the Board in a December 2014 meeting, the five overarching objectives of the solar project are: 1) energy efficiency and conservation; 2) energy independence; 3) carbon neutrality; 4) cost containment; and 5) energy leadership.

The airlines serving SAN were supportive of the renewable energy projects for two primary reasons: energy cost avoidance and the opportunity to maintain operational continuity during power outages. The September 2011 outage was severely disruptive to airline and airport operations.

SUMMARY AND CONCLUSION

Airports have been actively developing renewable energy facilities on their property over the past ten years. The data collected as part of a study funded by the National Academy of Sciences Transportation Research Board under its Airport Cooperative Research Program (ACRP) shows that economic factors are important drivers for these projects but the economic benefits of project operations has been less obvious. Environmental considerations are also strong drivers. Perhaps the most revealing factor is the importance of these projects to demonstrating that the airport is an industry leader. One finding that this information affirms is that airports as businesses oftentimes advocate for the development of renewable energy projects on the potential economic benefits, but, as government entities, are realizing the leadership benefits as an important reflection on the economic development and environmental leadership role of the airport. Moving forward, airports can better communicate these benefits as they develop new projects. Furthermore, the potential need to control power sources and its distribution on airport is an important planning consideration on the horizon, as evidenced by the power outage at San Diego and impacts on airport functionality from severe weather events like Superstorm Sandy. The forthcoming guidance associated with this research will help airports articulate the comprehensive business case for renewable energy.

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