GOWind

Summary Report

US Offshore Wind Advanced

Technology Demonstration Project

DOE – EE0006103

Baryonyx Corporation

August 2014

SUMMARY REPORT

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1.0 PROJECT OVERVIEW

The GOWind Project's main objectives are to (1) install and operate three technically advanced wind turbines upon jacket-type substructures engineered for an environment that may expose the development to tropical storm (hurricane) conditions during its operating life, and (2) demonstrate that a further commercial scale venture can be viable without the benefit of U.S. Department of Energy (DOE) funding or a similar revenue support mechanism.

Although a major source of carbon-free energy, the cost to consumers of offshore wind development has been criticized in the US and Europe. The capital requirements for commercial or utility scale developments are significant, and therefore, in order to attract the necessary capital, an important objective for the offshore industry is to demonstrate rapid cost-reduction strategies. The general approach to financing both on and offshore wind development is utilizing project finance. In order to attract equity and debt to the project, the project must be able to demonstrate a reasonable return on investment.

The above objectives represent exacting demands on the GOWind Project. However, the project benefits by the provision of grant funding from the DOE. The grant provides a sizeable capital offset to compensate for the lack of opportunity for economies of scale and the resultant commercial leverage that ordinarily can be derived by larger, commercial or utility scale projects.

Baryonyx intends to achieve these objectives by deployment of modern Permanent Magnet, Direct-Drive (PMDD) turbines in large multi-megawatt capacity mounted on improved jacket type sub-structures. With the robust wind resource in the Gulf of Mexico this will result in improved Net Capacity Factors (NCF).

With any offshore wind project it is vital to preserve options or future-proof the development to account for changes in technology. GOWind is permitting a physical envelope that height-wise can accommodate up to an 8MW wind turbine generator (WTG), and correspondingly, has received Determinations of No Hazard from the Federal Aviation Administration for up to 650' above mean sea level. The GOWind Project can therefore accommodate WTGs of 4MW, 6MW, 7MW and 8MW nameplate capacity, allowing GOWind to optimize both the energy resource and the capital expenses (CAPEX). This strategy of permitting allows Baryonyx to remain nimble and therefore able to engender competition between turbines suppliers to help maintain a downward pressure on capital cost. The largest line item in the CAPEX budget for a wind project is the WTG cost; therefore, naturally the largest reduction in LCOE can be made through a reduction in a project's WTG cost. Baryonyx's optimal development is the deployment of three, 6MW turbines as a precursor to deployment of a further commercial scale project utilizing either the 6, 7 or 8MW WTG in the 2018/2020 time frame, subject to permits and financing.

Baryonyx received indicative non-binding verbal pricing from Siemens for the 6.0MW-154m WTG, and written non-binding pricing for the 4.0MW-130M WTG (attached hereto as Appendix A). The 4.0-130 turbine offers an alternative to the larger turbines and produces a higher NCF than the larger WTGs. In BP 2, GOWind will examine in detail the economics of a trade-off between the smaller machine that produces a higher NCF against the larger turbine with fewer structures.

In BP1 Baryonyx obtained wind yield analyses for both the Siemens 6.0-1504 and Alstom 150-6MW WTG (Appendix B). Either turbine can be accommodated on the proposed jacket substructure. Indicative pricing was obtained from Siemens at $3,400,000/ MW for small-scale turbine orders and down to $1,700,000/MW for large scale orders. In a published article (Recharge News, January 2014) it was stated that Siemens had contracted with Statoil and Stakraft in respect of the UK Dudgeon Offshore Wind Farm to supply 67, 6.0 MW turbines in two contracts worth £516 M GBP. This equates to a price of $2,050,000/ MW or $12,030,000 per turbine.

It is Baryonyx's plan to formally tender for wind turbine supply after the down-select process. Should GOWind remain in the process post-select we will seek issue a tender invitation to both Siemens and Alstom. In the interim, on the basis of both public information and market intelligence we are using $12.80 M USD as the base price for a 6MW turbine.

Since neither the Samsung 7MW nor the Vestas V164-8.0 WTGs have been proven in the field, it is unlikely that either will be financeable in the time required for the demonstration project. Both the Samsung and Vestas WTGs remain candidates for the build-out of the commercial scale project adjacent to GOWind.

The FEED work to date has been based on the Siemens 6.0-154 turbine. At the 50% FEED level any fine-tuning to accommodate one turbine over another incurs no substantial cost change and therefore GOWind is able to maintain commercial flexibility at this stage.

At the time of submission of this report, the GOWind Project is carrying forward two sub-structure or 'jacket' designs prepared to the 50% FEED level: the plated transition piece four-legged design prepared by ODE and the 'twisted' jacket designed by Keystone Engineering.

In reserve GOWind engaged in discussions with the Offshore Wind Power Systems of Texas LLC for deployment of the Titan 200, a self-installing jack-up substructure. The Titan, if certified, would potentially enable a turbine to be erected in port, floated out to the field and jacked up for service. This sub-structure obviates the need for a heavy lift crane barge and so, on a fully installed basis, this unit is cost competitive with the jacket structures.

Through investigation into the WTG market place Baryonyx arrived at a WTG price of $2,125,000/MW for alternative 6MW WTGs, this revised assumption lowers the CAPEX by $18,750,000 over initial 6MW pricing received. Securing a substantial reduction in CAPEX due to consideration of an alternate supplier is a huge benefit to the project as we approach the ERCOT market to secure power off-take. By proposing to sell electricity into the ERCOT market, GOWind has to be able to meet economic imperatives dictated by one of the most competitive electricity markets in the world. In ERCOT natural gas provides the majority of the power demand (54% in 2013, see the ERCOT Market Analysis, attached as Exhibit D to the Grid Interconnection Report), greater than any other single resource, and therefore natural gas sets the price of electricity the majority of the time.

Provided GOWind is successful in developing an offshore wind energy project that is price competitive in ERCOT the implications for other offshore wind energy projects in the US and beyond would be enormous. If other offshore wind energy developments are able to replicate the cost savings achieved by GOWind the offshore wind industry becomes a legitimate competitor to traditional fossil fuels.

Given the stated goal of creating a commercially viable offshore wind energy industry it is incumbent on GOWind to supply power at as competitive a power price as feasible. Texas, ERCOT in particular, is the perfect proving grounds for creating a commercially viable industry – ERCOT is an energy only competitive market with some of the lowest power prices in the country. Although it is an energy-only market it has found itself capacity constrained. Because the GOWind Project generates coincident with system load, unlike West Texas wind, it is a desirable addition to a market flooded by off-peak wind. The table below created by AWS Truepower shows the on-peak nature of the coastal profile:

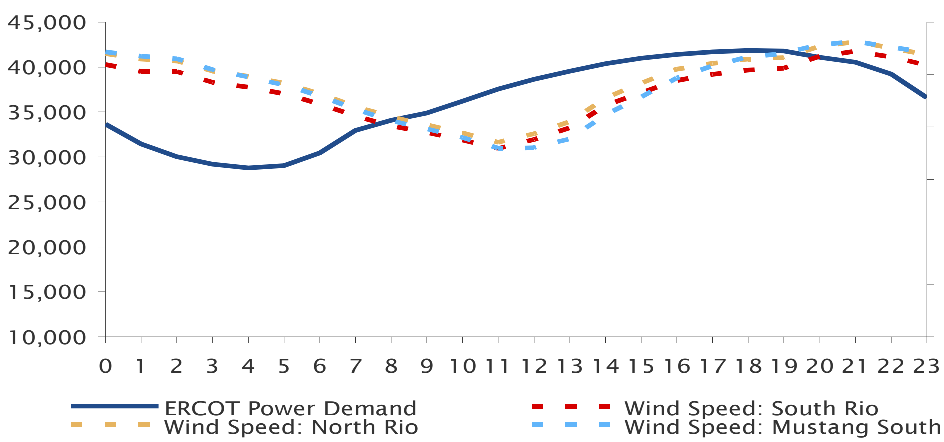

Figure 1.1: AWS Coastal Profile

Even with this low-priced competitive energy market Texas manages to have the largest installed wind capacity in the nation. Texas onshore wind farm developers through utilizing the Federal Production Tax Credit (PTC), building utility scale projects, utilizing good wind resources, more efficient energy capture with technologically advanced turbines, and access to development and construction capital have been able to achieve a competitive Levelized Cost of Electricity (LCOE). The GOWind Project is confident that it can achieve a LCOE that will be competitive in the ERCOT market through building on the lessons learned from onshore wind development in Texas and through utilizing the innovative opportunities outlined in the project reports to lower the LCOE

The keys to commerciality for offshore wind resources are (1) the ability to access a superior offshore wind energy resource, maximizing its capture and conversion by use of larger, marine multi-megawatt turbines; (2) the ability to constrain the balance of plant costs by minimizing the number of offshore installations (while maximizing output); and (3) the ability to capitalize on local, well-developed, skilled fabrication and installation capacity. This combination of attributes will produce a competitive LCOE, as close to parity with onshore wind developments and other competing energy resources as possible.

The GOWind Project will use the 6MW WTG to maximize capture of the excellent South Texas coastal wind resource. The GOWind Project has an estimated project net capacity factor (NCF) in excess of 45%. (see Energy Yield attached as Appendix B). GOWind anticipates that the NCF will increase in BP2 as we obtain actual offshore wind measurement. The current NCF estimate is based only on an AWS mesoscale study of the existing data. Sgurr's Galion LiDAR has not been deployed long enough to gain any true insight into the wind resource.

With the proximity of the Port of Brownsville, the GOWind Project and the subsequent commercial development will benefit from a local, skilled workforce experienced in shipbuilding and rig repair. With the active nearby oil and gas activity there are numerous vessels already in the Gulf of Mexico that can be retrofit for installation and available for maintenance vessels.

Additionally, during BP1 the GOWind partners made significant strides in reducing both the CAPEX and operations expenses (OPEX). With a WTG cost of $38,250,000, the estimated CAPEX is $109,901,569 and the OPEX is $33/MWh.

Through BP1 Baryonyx has been able to successfully conclude that the LCOE for the commercial scale project would be a close approximation of the LCOE for the demonstration project. The innovations demonstrated so far at the 50% FEED milestone of the GOWind Project are significant when scaled up. It shows quite clearly that offshore wind development, with the benefit of economies of scale and the ability to site in areas of greater wind resources, can be economically viable without grant funding or similar capital support mechanisms. Demonstration of this through the initial GOWind Project and a commercial scale build-out would have positive implications for the development of the wind resource of the US Continental Shelf and other international areas.

In accordance with the LCOE analysis guidelines, a 500MW development has been assessed on Baryonyx's 41,000 acre Rio Grande site taking advantage of the innovations, actual and prospective, encompassed and envisioned for and within the GOWind Project. With 80 6MW units, discounted by 25% for serial production, the WTG cost is $1,020,000,000 the CAPEX is $1,831,755,810 and the OPEX is $33.00/ MWh.

1.1 GOWind Budget Period 1 Achievements

Significant progress was made in Budget Period 1, including the following key achievements:

- Developing the required 50% Front End Engineering Design (FEED) to support the economic and financing activity (Sub-Task 1 – Design & FEED);
- Deploying the Acoustic Thermographic Offshore Monitoring System (ATOM), the Galion 2nd Generation Galion LiDAR, and the balloon-borne buoy-mounted measurement system, the "tethersonde" (Sub-Task 2 – Innovation)

- Advancing the EA and EIS Permits with the U.S. Army Corps of Engineers, receiving approvals for buoy installations and geophysical, and obtaining Determinations of No Hazard for the 3 turbines from the Federal Aviation Administration (Sub-Task 3 – Permitting & Environmental);
- Completed ERCOT screening study and executed Interconnection Study Agreement advancing the grid integration (Sub-Task 4 – Grid Integration)
- Assembly of wide-ranging expressions of interest from financial institutions and business entities for equity and structured project finance as well as off-take opportunities. (Sub-Task 5 – LCOE & Economic Analysis).

1.2 Innovations

The GOWind Project is actively pursuing a project finance structure, as discussed in detail the Finance Plan. Consequently, the extent to which innovation can be introduced is governed by what is insurable and bankable. This allows for some major innovations, but does not allow for GOWind to employ completely unproven technology as it would not be bankable and would likely lead to the GOWind Project not being built for lack of funding. Several of the innovations result in direct cost savings to the GOWind Project (e.g. wind measurement advances, and plated transition piece (TP)), while others lead to a more efficient process that will ultimately lead to cost savings in commercial build out of the industry (e.g. noise mitigation, allowing for an expanded construction window). Overall the key innovation is developing the design for turbine sub-structures that are capable of supporting large multi-megawatt turbines in a significant offshore wind resource area and achieving a cost of energy that is comparable with onshore developments. Overall, investment returns will largely determine to what extent the wind resource of the United States can be developed. The pressure is on the offshore wind industry to demonstrate that this form of resource capture can be economically efficient. Employment of the more technically sophisticated new generation offshore WTGs with direct drive and more efficient and larger blades is key to that objective.

The innovations are explored in detail in the specific project reports and outlined below:

- Increasing the U.S. based supply chain (see U.S. Manufacturing Plan attached as Appendix C)
- Tethersonde – balloon-borne buoy mounted offshore wind measurement system
- Galion LiDAR – 2nd generation scanning LiDAR
- ATOM – acoustic, thermographic offshore monitoring equipment
- High-Resolution Aerial Photography
- ODE Plated Transition Piece
- Hurricane resistant jacket
- Large 6 MW direct drive WTG – up to 8MW for commercial build out
- New noise mitigation equipment utilized during piling
- Vessel strategy – i.e., floating turbine out fully constructed
- IMPLAN Socio-Economic Study – attached as Appendix D.

1.3 GOWind Path Forward

In order to move from the concept stage at 50% FEED to operations and 100% FEED on or before Q4 2017, the team has developed a high-level work plan, which is attached as Appendix E, and discussed in more detail throughout the reports.

As discussed above, the significance of GOWind is that it derives economic benefit from being positioned in an area where, in common with the rest of the Gulf of Mexico and the Eastern Seaboard, offshore wind farms need to be capable of operating in tropical storm conditions. Ensuring the integrated design for jacket and turbines is fit for that purpose will be an on-going task as the FEED is brought to the 100% milestone.

Sub-Task 1 design activity in Budget Period 1 began the task of ensuring the appropriate design codes are employed. Work undertaken by NREL and presented at the AWEA Offshore Wind Conference (Appendix F) underlines the need to ensure that the site-specific physical meteorological conditions encountered over the design life are correctly assessed and the design codes and classifications are pertinent to those conditions.

Built into this work plan are contingencies based on the team's assessment of risks of both non-delivery of the operating offshore wind farm and catastrophic failure once installed. One issue of particular importance is assessment of tropical storm or hurricane risk. This assessment is demanding as the vast majority of tropical storm data is collected at no more than 10 meters above mean sea level (AMSL) and extrapolation to hub height is problematic through a lack of empirical data.

Given the uncertainty of the data, the project team has faced significant challenges in reconciling the American Petroleum Institute (API) and other engineering design codes, with IEC Class 1A turbine certification tolerances. Designing the turbine sub-structures in order to maintain structural integrity through these extreme conditions is well understood and benefits from much practical experience from the offshore oil and gas industry. However, extrapolation of the wind conditions prevailing at the proposed 110 meter hub height and up to 185 meters to the tip of rotation is challenging as there has been little relevant direct measurement. Extrapolation to hub height is a significant area of focus that will be addressed during the 100% FEED in order to avoid overly conservative assessments of the predicted wind speeds. Dealing with these storm conditions is an issue that will be critical for the overall development of the US offshore wind industry.

In the next phase of the project, in order to reduce the risk of non-delivery of the offshore wind farm and the risk of catastrophic failure once installed, a twin risk reduction strategy will continue to be followed. The two primary risk reduction strategies will be:

- Further investigation into physical characterisation of wind speeds and gust duration will be performed by construction of an atmospheric model grounded in existing data from multiple sources within the Gulf of Mexico proximal to the demonstration site,
- Evaluation of alternative technical solutions such as employment of smaller capacity turbines, such as the Siemens 4.0-130 deemed to have enhanced capability for dealing with extended gust periods.

1.4 500 MW Commercial Scale Project

In addition to the base case 500MW commercial build out with a 6MW turbine, the Rio Grande project proposed consent envelope permits the deployment of new market entrants such as the 7 and 8 MW turbines.

The Work completed in BP1 has lain a sound foundation to be built on in BP2 and beyond to construction. The GOWind Project is aggressively working in a challenging economic environment, with physical conditions that are at the outer limits of the current design codes and certifications imposed by metocean conditions (notably tropical storm (hurricane) occurrence) – with a stated goal of expanding those limits. GOWind has the potential to demonstrate how to open up millions of acres of the US Continental Shelf offshore wind resource to be developed through a) demonstrating solutions for operating with significant windstorm risk, b) introducing the jacket sub-structure for use in water depths up to approximately 60 meters and c) delivering energy at a competitive price.

2.0 SUMMARY OF CONTENT

2.1 Design

The GOWind Project is located in a site that may be exposed to tropical storm conditions. It is recognised that assessment of risk to WTGs in these tropical storm conditions presents a challenge as the vast majority of empirical data for tropical storm conditions has been collected at no more than 10 meters above mean sea level (AMSL). Extrapolation to hub height is a significant area of focus that will be addressed during the 100% FEED in order to avoid overly conservative assessments of the predicted wind speeds. Dealing with these storm conditions is an issue that will be critical for the overall development of the US offshore wind industry so the work done at this stage is an important step in this process.

Offshore Design Engineering Ltd (ODE) was responsible for the 50% FEED design. Input was provided by the project partners Siemens, Texas A&M University, and Ecology & Environment, Fugro GEOS. Oceanweather also provided guidance on metocean analysis. The basis of design, structural design basis and structural design brief have been continuously updated throughout the project.

A pre-conceptual Foundation Types Options Study was conducted in 2010 at the GOWind feasibility stage. The report reviewed and assessed various structure types, those being: gravity base, monopile, tripod and jacket. The study concluded that the quadrapod and/or jacket structures were the only viable structure types capable of taking the high-tension forces caused by the large overturning forces of the WTG.

Following from the pre-conceptual stage, the project team conducted a conceptual design that reviewed various TP and jacket configurations. Each configuration was assessed and evaluated for the costs and technical positives and negatives. The most appropriate and feasible combinations were confirmed to be a conventional jacket combined with either the plated TP or the conical TP (as depicted in the Design Report).

These transition pieces have been invented by ODE as an alternative solution to the conventional design of the TP. The design overcomes structural limitations, can be economically fabricated by conventional methods and will be relatively light. These attributes help to reduce the cost of wind turbine support structures and thereby lower the LCOE.

The most suitable TP is the ODE-1 plated, for which a patent has been applied. The principle characteristics are the efficient use of structural members for optimal global load transfer using plates and the optimal configuration of structural detail to relieve local stress concentrations at the end points of the plate connection, where high stress concentrations frequently occur.

Site survey work and soils analysis are pivotal to developing a successful design. A borehole was identified close to the GOWind site undertaken by Fugro (Referenced in Appendix 1 of the Design Basis), which provided soil strata data. The soil was shown to be stiff clay with layers of sand and was assumed to be consistent across GOWind site. An initial site reconnaissance survey was commissioned to Naismith Marine Services during Jan. 2014 to determine the preferred cable route and verify the proposed WTG locations (attached to the Design Report). The Naismith survey did not identify any areas of concern. A more detailed survey will be conducted during Budget Period 2

2.2 Installation, Operation & Maintenance

The 50 % Front End Engineering (FEED) Design for the GOWind Project is complete. The various tasks defined in Sub-task 1 in the Statement of Project Objectives for BP1 have been undertaken and the results are presented in the attached report for fabrication, transportation, installation, operations and maintenance, including the OPEX costs. Innovation and risks associated with these aspects of the project have been identified and assessed. For further information on any topic the reader should look at the specific document referenced in each section of the report.

This report includes fabrication, preliminary installation methods, and identification of operating and maintenance procedures and equipment suited to the site.

There is sufficient design developed and detailed to enable the CAPEX and OPEX budgets to be prepared, and to take the designs and the approach to installation and operations & maintenance forward to complete the second 50% FEED during BP2. These costs reflect the significant innovation that has been introduced into this project, and this has assisted in driving overall project costs down. Recommendations for the next phases of the GOWind Project are provided, in particular for the next 50% FEED phase of the project.

The Fabrication, Transportation and Installation and Commissioning Report provides preliminary fabrication and installation plans for GOWind. Information on the installation methods is provided for each of the components and the most suitable vessels to conduct the installation are identified. Information regarding the port facilities is also provided. The installation rates are presented and weather allowances discussed to support the project program and cost analysis.

The preferred contracting and procurement strategy is for Baryonyx to appoint a project management contractor and to adopt a multi-contracting philosophy. Key contracts for the fabrication and installation are highlighted. The potential contractors for each contract have also been identified through an initial information gathering exercise, including an Expression of Interest and a Request for Budget Quotation.

The O&M Philosophy outlines the approach to be adopted for the development of an efficient and effective operations and maintenance (O&M) strategy. The objective is for the optimisation of the O&M strategies to allow the LCOE for the GOWind Project to be minimised.

During the detailed design and manufacture phases it is important that experienced offshore O&M personnel are involved in the 'sign off' on key equipment specifications and layout that will impact the way maintenance is executed. This will enable the detailed strategies to be developed to ensure continued economic performance of the installed equipment throughout the life of the wind farm. A Computerised Maintenance Management System (CMMS) is an important tool in the management of the wind farm operations. This allows optimisation of future O&M activities and demonstration of compliance with regulatory and consent requirements.

The OPEX cost summaries provide business case simulations of the proposed O&M strategies. It is only through detailed life cycle cost analysis that understanding of the true O&M costs can be identified. The complexity of the process, component interaction and external influences makes it difficult to achieve best plant configuration to deliver maximum Return On Investment (ROI). Involvement of O&M personnel in the design phase allows the high upfront CAPEX expenditure to be in the areas that provide long-term protection of the asset.

OPEX costs for the management of the GOWind Project are high (as costs are spread over only 3 WTGs). However, this will enable capture of detailed knowledge and collation of historical data to further refine OPEX costs for the commercial scale development.

2.3 Environmental & Permitting Process

The Environmental and Permitting Process is well underway and on track to be completed by the third quarter of 2014, which will provide the necessary lead-time to ensure that the GOWind Project will be operational by 2017.

Baryonyx continues to work closely with the permitting and resource agencies at all levels of government to permit the GOWind Project and the commercial scale project on parallel paths. Baryonyx submitted an individual permit application to the USACE for the GOWind Project, and the permit was formally noticed in September 2013. No significant comments against the Project were received The USACE permit issued for the GOWind Project will likely contain a sunset clause requiring that the Project be decommissioned on a certain date if Baryonyx has not received a positive Record of Decision as part of the EIS process for the larger project.

Baryonyx applied for and received all permits and approvals necessary to initiate data collection efforts in BP-1, including an innovative three-pronged approach for avian surveys, and geophysical/cultural resource surveys. Surveys completed to date do not suggest that significant adverse impacts would be expected to biological or archaeological resources in the Project area. Additional reports will be submitted as they are completed, including visual simulations of the Project. While DOE and USACE will be concurrently preparing separate EAs for the project, Baryonyx anticipates both processes will be completed by the third quarter of 2014.

In support of the USACE stakeholder engagement activities, Baryonyx coordinates closely with the USACE to engage federal and state agencies. Baryonyx is participating in Interagency Work Groups (IWGs) established by the USACE to ensure that resource agency concerns are adequately addressed. Separate from this process, Baryonyx has continued to meet with local public officials and organizations to keep these stakeholders apprised of Project progress.

Baryonyx is supporting both the USACE and DOE NEPA processes, preparing Environmental Reports and draft Biological Evaluations for agency use in consultation with NMFS and the USFWS. Species with the greatest potential to be impacted by the Project are the piping plover and sea turtles. Baryonyx is confident that specific project design (e.g, horizontal directional drilling (HDD) of the dune and beach complex, and use of marine observers during construction) will serve to avoid or minimize potential impacts. Avian impacts will be addressed through the development of an Avian and Bat Risk Assessment and Monitoring Plan. Baryonyx will continue to coordinate with the appropriate resource agencies to address any other concerns and to ensure that appropriate avoidance minimization and, if required, mitigation measures are integrated into the Project design.

Baryonyx will continue with data collection during Budget Periods 2 through 5 to ensure that adequate data has been collected both for permitting purposes, and to establish baseline conditions in advance of project construction and operation. Baryonyx will continue to coordinate with the USACE and other resource agencies to ensure that data collected benefits both projects, and ultimately improves the understanding of potential impacts (both positive and negative) arising from the development of the offshore wind resource in Texas.

2.4 Grid Interconnection

The GOWind Project will connect to the 138kV AEP South Padre substation (Project Substation) via an approximately 7-mile subsea cable from WTG 1. The subsea cable will be a 138kV cable that will operate at 33kV during the demonstration phase of the project. By incurring this incremental cost now for a larger cable, the first 150MW phase of the commercial project will benefit from a cost savings of approximately $12 million.

The GOWind Project has received the Screening Study from ERCOT and executed the Interconnection Study Agreement with AEP, as further described in the report. The Screening Study determined that there was up to 150MW of available transmission capacity at the Project Substation. The GOWind Project submitted their interconnection request early in the process and is ahead of schedule. It is expected that the Standard

Generator Interconnection Agreement (SGIA) for a two-phased 150MW project will be tendered on or before December 31, 2014. This will allow the GOWind Project to bring the initial 18MW online by the December 2017 deadline.

3.0 CONCLUSIONS LCOE ANALYSIS

Primary innovation within the GOWind Project is directed toward the ability to place technically advanced, more efficient wind energy converters in areas of superior wind resource in the offshore environment. In so doing the objective is to achieve an exponentially reduced LCOE that is relevant to the local market and as close as possible to that of onshore wind.

As a consequence the opportunity for offshore utility scale development on the US Continental Shelf will be extended, opening up significant areas of the US Continental Shelf to economically viable development at a pricing level that is acceptable to the consumer.

Our innovation is therefore primarily commercial in form and arises from the foundation technology, i.e. advanced or improved jacket sub-structures designed for deployment in tropical storm prone areas, capable of serial manufacture close to the site of deployment. This in turn enables the placement of more efficient Permanent Magnet, Direct Drive (PMDD) turbines in locations where they can efficiently convert a superior energy resource with attendant cost reductions and economic benefit.

Given the sheer size of the equipment, construction, transport and placement of these very substantive turbines, the marine environment is the only suitable location for deployment of these very large nameplate capacity WTG in significant numbers leading to the necessary economies of scale.

In order to evaluate the impact of the innovation on the LCOE, Baryonyx has analysed both the GOWind Demonstration Project and the Rio Grande Commercial Scale Project, with a range of turbines of 4, 6 and 8MW nameplate capacity. Currently the 6MW turbines represent the most optimal turbines for the development and the high level results of the analysis are presented below. The full results are attached as <u>Appendix G</u>.

The study shows that:

1) With the DOE grant funding the LCOE for the GOWind Demonstration Project developed with 6MW turbines returns a value of $0.0806 USD /kWhr. Without the grant the LCOE rises to $0.1322 USD / kWhr.

2) The LCOE for the commercial scale development, benefitting from economies of scale and more competitive pricing for equipment returns an LCOE value of $ 0.1069 USD / kWhr.

4.0 OVERVIEW

4.1 Work Plan and Schedule

The project program (attached as Appendix E) has been prepared to demonstrate the duration and processes required for the installation of the GOWind Project based on the information and assumptions available at the 50% FEED Stage of the Project. The program focuses on the critical path and the main tasks as defined within BP1 to deliver the wind farm into service. The program includes a 25% contingency for all onshore activities and 35% for the offshore activities to give a most likely (P50) duration and end date. The program shall be updated as part of the development of the following BP2 activities and as revised information is made available. A Resource Loaded Schedule (RLS) is attached as Appendix H.

Two internal project Go/No Go decision points have been identified; the first is the completion of the 100% FEED, programmed for January 2015, as this will confirm that the project risks have been sufficiently reduced to confirm that the project is technically and commercially viable. The second decision point is the issuance of the final EIS, currently programmed for June 2015, without any conditions that make the project unviable.

The key milestones in the attached schedule are:

MILESTONE	DATE EXPECTED
Project Consent	15-May-14
USACE Permit	28-Jul-14
DOE FONSI	1-Sep-14
100% FEED Complete	14-Jan-15
Appoint Main Contractors	25-Feb-15
Receive Final EIS	2-Jun-15
SGIA (Standard Generator Interconnector Agreement)	31-Dec-14
Financial Close	1-Jan-16
Start Onshore Installations	25-Feb-16
Start Offshore Installation	14-Jul-16
Offshore Installation Work Complete	15-Jan-17
Commercial Operation Date	5-Apr-17

Table 4.1: Key Milestones

4.2 Budget

The budget for BP2 – BP5 is attached hereto as Appendix I. The summary is as follows:

	BP2	BP3	BP4
Installation of WTG's & WTG Towers (Heavy Lift)	203,333	250,000	4,946,667
Wind Turbine Generators	1,275,000	16,415,625	20,559,375
Electrical Installations	684,200	4,579,616	591,100
Installation of Sub-sea Cable	65,789	2,057,895	3,590,916
Supply of Sub-sea Cable	907,500	0	9,204,929
Installation of WTG Foundation (Heavy Lift)	978,095	114,286	4,976,152
Fabrication of WTG Foundation	1,544,255	9,481,427	2,455,615
Foundation 100% FEED & Detail Design	1,040,000	0	0
Crew Boats	0	0	0
Temp generators & support for WTG mech completion	0	0	0
Offshore Logistics Centre (Incl Offshore Support)	40,000	153,489	1,592,011
CPT, Borehole & Cable Route Surveys	200,000	0	0
Insurance cost 2%	2,400,000	0	0
PMC (PM, QA, HSE, Commercial, Site Management)	3,350,933	4,284,800	3,350,933
Development, Permitting	2,625,327	3,356,975	2,625,327
	15,314,432	**40,694,113**	**53,893,024**
	15,314,432	**56,008,545**	**109,901,569**

Table 4.2: Budget

5.0 SUMMARY OF TOTAL PROJECT COSTS

The capital cost plan for the GOWind Project is attached hereto as Appendix J. The summary of costs are contained in the table below:

Task	Cost
Installation of WTG's & WTG Towers (Heavy Lift)	$5,400,000
Wind Turbine Generators	$38,250,000
Electrical Installations	$5,854,916
Installation of Sub-sea Cable	$5,714,600
Supply of Sub-sea Cable	$10,112,429

Installation of WTG Foundation (Heavy Lift)	$6,068,533
Fabrication of WTG Foundation	$13,481,297
Foundation 100% FEED & Detail Design	$1,040,000
Crew Boats	In Logistics
Temp generators & support for WTG mech completion	In Logistics
Offshore Logistics Centre (Incl Offshore Support)	$1,785,500
CPT, Borehole & Cable Route Surveys	$200,000
Insurance cost 2%	$2,400,000
PMC (PM, QA, HSE, Commercial, Site Management)	$10,986,667
Client (Licenses, Permits, Consents, Commercial, Legal & 3rd Parties)	$8,607,628
Total CAPEX	**$109,901,569**

Table 5.1: Capital Cost Plan

5.1 Operations & Maintenance (O&M)

The O&M plan is explained in detail in the Installation, Operations and Maintenance Report. The projected overall OPEX per/Mwh is $32.50. The GOWind Project was able to achieve this reduced OPEX assumption, reduced from the DOE produced study range of $40 – 50/MWh, though savings post-WTG manufacturer service period. In the latter part of the service contract there is a handover to the operator's team who are local recruits. A lower cost base and operating experience is assumed to further reduce OPEX to 50% of the start-up rate. In the latter period we assume there is a reduction in cost due to operating experience and transfer to the local operators team.

6.0 SUMMARY OF FINANCING PLAN

GOWind will fund a portion of BP2 activities with grant funding, matched by cost share of project partners. Potential equity partners have withheld commitment pending grant selection and discussions continue. However, once selection is confirmed, equity participation discussions will resume in earnest immediately. Initial conversations with lenders indicate that project finance funding is available to the appropriately structured transaction.

Baryonyx will fund GOWind through a combination of grant, equity from project stakeholders and, non-recourse project finance debt. The financing structure has been designed by Green Giraffe Energy Bankers (GGEB), acting as financial advisor to the Project.

The offshore wind sector is new in the US, but the design of the financing is based on a straight-forward structure which has been successfully implemented in the industry and benefits from over 20 years experience in Europe. It combines the local knowledge of GOWind stakeholders with the offshore wind experience of European partners.

GGEB has assisted GOWind in obtaining letters of intent from multiple banks in the US project finance market, providing a high level of confidence that the financing can be closed on the terms described in the Financing Plan (Appendix K).

6.1 Sources of Equity

All potential sources of financing have made the continuation of the DOE funding a condition precedent to moving forward with providing equity. In addition, equity providers are looking for pari passu treatment with other equity providers, leaving final commitments until all costs and a fair economic return can be determined. GOWind will require approximately $20 million in equity. On that basis, Baryonyx, through its principal shareholder, Enterprize Energy Pte, is in discussion with both a strategic and a financial investor. ODE, as principal contractor, is undertaking to commit up to $2 million in cost share.

It is common for the captive finance entity of the manufacturer to provide some financial support to the project. In this context, Siemens Financial Services has provided a letter of intent to support the project, were Siemens turbines to be selected for project deployment. A similar approach would be taken in the event alternate equipment is acquired for GOWind,

Baryonyx management has both approached and been approached by other equity participants who have indicated some interest at this stage. These discussions will be resumed immediately after selection is confirmed.

6.2 Sources of Debt

It is clear that financing offshore wind projects has become a “strategic” market for many lending European and Japanese institutions and many are also active in the U.S. project finance market. These institutions have an active track-record in financing renewable energy projects in North America. The project finance process should therefore not be seen as a new hazardous experiment but as a well-known and well-understood predictable way of financing. In fact the GOWind Project has received 8 letters of interest from reputable lending institutions, attached as Annex 1 of the Financing Plan.

6.3 Insurance

Upon selection, GOWind will engage Aon Risk Solutions to perform a full risk assessment that will identify the risks during construction and operations phases and will form the basis for seeking insurance that will complement and supplement the warranty provided under the Turbine Supply Agreement and any guarantee supplied under the Turbine Maintenance Agreement from the turbine manufacturer. A summary of insurance coverage and advisor qualifications are contained in Appendix L.

7.0 SUMMARY, PROGRESS TOWARD SECURING POWER OFF-TAKE AGREEMENT

GOWind has approached the market on numerous occasions, and to date has been able to receive a non-binding letter of interest from a boutique broker in Texas, MP2 Energy. This LOI provides a first year contract price of $40.04/MWh, as further described Appendix M. While this LOI provides pricing that is above the current market, it does not quite achieve the pricing needed by the project at this 50% FEED stage. With time and refinement we are confident we can bring our required pricing down to meet the market at the time when we will need to contract for the off-take, which would be on or before the anticipated financial close date of January 1, 2016. GOWind has also received a letter of interest from University of Texas in Brownsville. This is not conclusive but does indicate that there might be a “specialist” market for the project output.

ERCOT is a highly competitive low-cost energy-only power market, whose prices are set by the very low cost of gas. Although it is an energy only market it has found itself capacity constrained. Because the GOWind Project has a better match to the system load, it should be a desirable addition to a market flooded by off-peak West Texas wind. Given the competitive nature of the market, it is premature at the 50% FEED stage of development to secure a binding PPA, as any price would be inflated to account for uncertainties. One of the GOWind Project’s main objectives is to demonstrate that offshore wind energy is competitive with other generation sources onshore and it is imperative that we achieve the lowest LCOE reasonable. GOWind will use the time associated with developing the remaining 50% FEED to reduce the overall costs associated with developing the project. Therefore, it is better for this project to delay a bit until the benefits of further design can be realized.

Provided GOWind is successful in developing an offshore wind energy project that is price competitive in ERCOT the implications for other offshore wind energy projects in the US and beyond would be enormous. If other offshore wind energy developments are able to replicate the cost savings achieved by GOWind the offshore wind industry becomes a legitimate competitor to traditional fossil fuels.

As discussed further in the Grid Interconnection Report, the ERCOT market currently has extremely low prices due to the low price of natural gas. Two recently announced long-term onshore wind Power Purchase Agreements (PPA) in the South Hub, where the GOWind Project is located, were in the range of $26 – 33/MWh. It is assumed that these projects benefited from the Federal Production Tax Credit (PTC). These were traditional PPAs with Austin Energy for South Texas, coastal projects. The majority of traditional PPAs announced publicly in the last several years have been coastal projects as the coastal wind profile, similar to the GOWind Project, provides generation that is more coincident with load than West Texas wind.

Additionally, in ERCOT there is no requirement that a generator execute a PPA. Provided you have the funding to absorb the risk a generator can connect in ERCOT and receive the Market Clearing Price for Electricity (MCPE).

Looking at the NYMEX and DOE forward curves for natural gas, showing natural gas in the range of $4.77 - $6.00/MMBTU, the ERCOT pricing in 2017 should be in the range of $47 - $60/MWh, assuming the base case implied heat rate of 10. The current price as modelled for the GOWind Project is $61.00/MWh without the PTC and $45.00/MWh with the PTC both prices near to or within the forecasted ERCOT pricing for 2017.

Therefore, given the low prices and unique market structure, GOWind has adopted a multi-faceted market strategy, including the following:

- Keeping potential utility purchasers and large equity partners fully-informed on the project progress
- Canvasing the traditional wholesale purchasers for interest.
- A university or hospital or other large "service type" organization that is willing to purchase the power at an above market price as a strategic participant, seeking to support its academic research or involvement in the community.
- A municipal or government entity that is interested in the long-term potential value of offshore wind and able to blend it with their other power purchase products;
- A major company interested in the advancement of renewable power, taking lessons learned from early participation in US offshore wind and applying it to other markets where siting onshore is a greater challenge;
- A coastal strategic investor interested in the potential long-term benefits of offshore wind to coastal development value or combining with other infrastructure such as water.
- Creative deal structures that provide upside potential on revenues (e.g. a financial hedge indexed to price of natural gas).

8.0 OVERVIEW, PROJECT PARTNERS & ROLES

Offshore Design Engineering (ODE) is the GOWind Project's engineering partner responsible for the FEED process. ODE is an international engineering contractor to the oil, gas and renewable energy markets.

Ecology and Environment (E&E) is the GOWind Project's environmental consultant. E&E is a recognized global leader in environmental management. They have successfully completed over 50,000 projects in 122 countries.

SgurrEnergy is a leading renewable energy consultant, providing engineering and technical advisory services in onshore and offshore wind, solar, wave, tidal and hydro projects. They assist clients at every phase of a project, from the early stages of site selection, feasibility and design, through project management of the construction phase and also during operation and maintenance. Sgurr has assessed over 110 GW of renewable energy developments internationally. Sgurr is responsible for developing the wind data measurement plan and the GOWind Project's energy yield analysis, as well as layout design.

Anemometry Specialists Inc. & Iowa State University (ASI/ISU) have teamed up to deploy a new cost-effective offshore wind measurement tool – the balloon-borne buoy mounted measuring system (tethersonde) to the GOWind Project.

Green Giraffe Energy Bankers (GGEB) is the GOWind Project's financial consultant. GGEB is a financial advisory boutique focused on the renewable energy sector and in particular offshore wind.

Aon Risk Solutions will be the GOWind Project's insurance arranger. AON has an extensive track record in offshore wind insurance, and is currently responsible for 6,350MW of offshore wind projects with projects in UK, Germany, Netherlands, Denmark, Sweden, Ireland, Belgium, France, US, Taiwan.

Narrow Gate Energy has been engaged to assist in exploring the market and securing the off take. Narrow Gate Energy was established to provide executive advisory, strategic consulting, and project development services to participants in the US power industry. Mr. Hayslip, President, has more than 20 years of experience in numerous areas of the power industry, including sales & marketing, asset management, public relations, regulatory affairs & market policy, business development, and project development for leading gas-fired, renewable, and energy storage companies.

GOWind has engaged the Professional Engineering services of RnR Engineering, LLC to assist in the ERCOT interconnection process. RnR Engineering is experienced in this process with full knowledge and understanding of the ERCOT requirements, bringing over 20 years of direct experience with integrating wind generation resources into the ERCOT transmission system. RnR Engineering has been working on transmission interconnection issues in the Rio Grande Valley since the first South Texas on-shore windplants were announced, and has strong working relationships with both ERCOT and the local Transmission Service Providers.

A full description of the project partners and roles is attached as Appendix N. Letters of commitment form main project members and local supporters are attached as Appendix O.

9.0 CONCLUSION

GOWind has completed 50% of its Front End Engineering and Design and has identified a number of issues to be addressed. At this stage, such identification is normal and in terms of overall development, it is still relatively early to have resolved the major outstanding issues of PPA, supply, financing and hurricanes. The team has already approached possible power purchasers, potential strategic equity partners, and project finance lenders and has elicited enthusiasm from these potential participants.

The team is working actively to resolve the recent disappointment with respect to turbine supply and in so doing, may have stimulated some important competition in the turbine supply market. Comparing published alternative turbine price information with verbal indications provided over the past several months suggest that our goal to lower the LCOE may already be happening.

The issue of severe storm conditions is not new and with longer and more sophisticated and appropriate data collection it will be easier for all to assess the risk and to design solutions to meet that risk.

All team members, especially at Baryonyx, ODE, E&E, Keppel AmFELS, and GGEB are looking forward to continuing our work with DOE to advance a relatively untested industry in the US.

Thank you for taking the time to review our documentation.

APPENDICES

APPENDIX A	SIEMENS PRICING
APPENDIX B	SGURR ENERGY YIELD
APPENDIX C	US MANUFACTURING PLAN
APPENDIX D	IMPLAN SOCIO-ECONOMIC STUDY
APPENDIX E	WORK BREAKDOWN STRUCTURE (WBS), WORK PLAN AND PROJECT SCHEDULE
APPENDIX F	NREL HURRICANE STUDY
APPENDIX G	LCOE ANALYSIS
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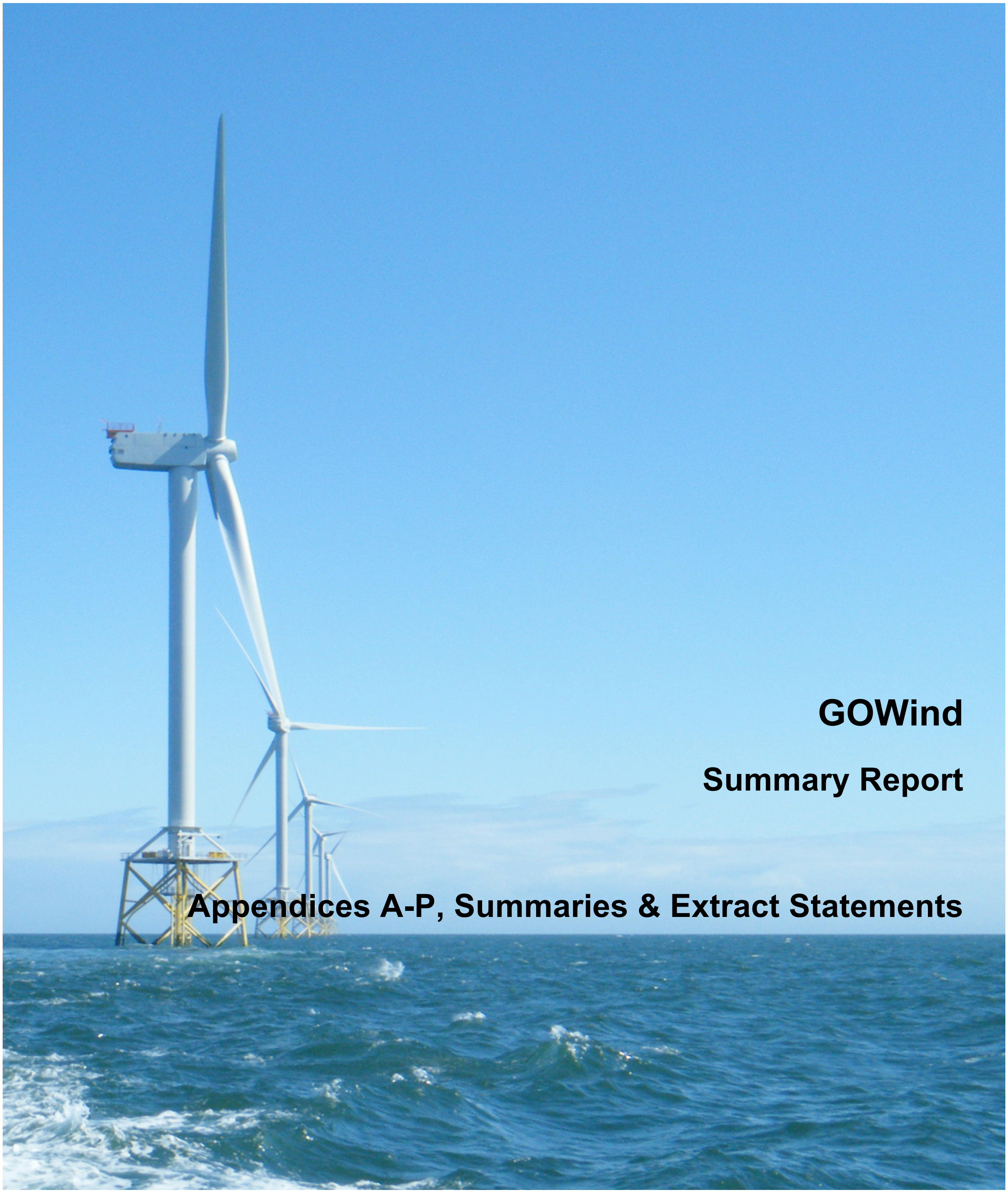
APPENDIX M	LOI MP2 ENERGY & UTB
APPENDIX N	DESCRIPTION, PROJECT PARTNERS ROLES
APPENDIX O	LETTERS OF COMMITMENT
APPENDIX P	INTELLECTUAL PROPERTY MANAGEMENT PLAN



GOWind

Summary Report

Appendices A-P, Summaries & Extract Statements

US Offshore Wind Advanced

Technology Demonstration Project

DOE – EE0006103

Baryonyx
CORPORATION

August 2014

FINAL REPORT APPENDIX

APPENDICES A-P SUMMARIES & EXTRACT STATEMENTS

Please note that Third Party commercial information has been omitted as directed by the Department of Energy.

1.0 APPENDIX A – SIEMENS PRICING

Commercial Information not included under terms of Non-Disclosure Agreement with Siemens.

2.0 APPENDIX B – SGURR ENERGY YIELD

Summary Extract from Energy Yield Analysis.

8 SUMMARY

8.1 The Project is located in the Gulf of Mexico, approximately 13km east of South Padre Island and 20km northeast of the City of South Padre Island, Texas. One Galion lidar unit LR60 has been installed on the site since August 2013, four months of data collected from this lidar has been evaluated in SgurrEnergy's analysis. The short dataset and periods of poor data coverage negated the capability to assess the Project's energy yield using lidar-measured site data.

8.2 The long-term wind speed distributions at the Project site were modelled from two virtual offshore masts, North Rio and South Rio. The virtual offshore mast data were provided by the Client and are the result of Mesoscale modelling conducted by AWS TruePower[5].

8.3 The combined topography and roughness of the site is considered to be of low complexity due to the Project's offshore location.

8.4 An energy yield prediction has been carried out using the Siemens SWT-6.0-154 at a 110mm hub height.

8.5 The predicted long-term hub height mean wind speeds at the three WTG locations of the demonstration project is 8.84m/s. The predicted long-term hub height mean wind speeds at the proposed WTG locations of the full build-out layout are between 8.77m/s and 8.97m/s and are 8.87m/s on average.

8.6 The preliminary P50 energy yield prediction for the Project's demonstration layout is 72.9 GWh/annum with a capacity factor of 46.2%. The preliminary P50 energy yield prediction for the Project's full build-out layout is 4025.1 GWh/annum with a capacity factor of 40.1%.

9 RECOMMENDATIONS

SgurrEnergy recommends updating the Project's energy yield assessment once an additional six months of Galion lidar data has been accumulated and a preliminary long-term correction of the measured data is possible.

3.0 APPENDIX C – US MANUFACTURING PLAN

GOWind Project – U.S. Manufacturing Plan

One significant hurdle in achieving a cost competitive LCOE for the GOWind Project is the lack of a U.S. based supply chain. The main project components and their assumed countries of origin for the demonstration project and commercial project are listed in the table below.

Component	Country of Origin	
	Demonstration Project	Commercial Project
WTG – nacelle*	Denmark	Denmark
WTG – blades*	Denmark	USA
WTG – tower*	Denmark	USA
Cables** - 33kV	Europe/S. Korea/USA	USA
- 138kV	Europe/S. Korea	USA
- 225 kV	Europe/S. Korea	USA
Cable installation	USA	USA
Electrical Substation	USA	USA
Foundations*** - steel supply	USA	USA
Foundations - fabrication	USA	USA
Installation vessels	USA	USA

*Offshore WTG manufacturing is exclusively a European or Asian industry at this point. In order for the turbine manufacturers to establish plants in the U.S. they would require a reasonable development pipeline. It is estimated that an offshore industry in the range of 3 gigawatts of development would entice some manufacturers to establish plants in the U.S. Turbine components could be manufactured in the U.S. prior to this development pipeline materializing, e.g. towers, and blades. The WTG manufacturers we've spoken with are not willing to source blades or towers locally for the demonstration project, but would be willing to consider upon the commencement of commercial scale development.

**Currently there are no U.S. manufacturers capable of supplying the lengths of high voltage cable (>33kV) needed for the GOWind Project. They are capable of supplying the 33kV array cables, but given the relatively small size of the project it may not make sense to split out the array cable order from the high voltage due to transportation costs. We will continue to try and source the cable from a U.S. manufacturer, but again this may not be a possibility for the demonstration project and will only become viable when a viable development pipeline exists.

*** The steel for the foundations could be supplied locally from the USA Steel supply could be U.S., but it will depend on grades and dimensions required. The design will be developed to attempt to use U.S. available steel.

Supply chain limitations aside, the GOWind Project is unique in that it has local large scale fabricator in the KeppelAmfels who is capable of fabricating the foundations at the Port of Brownsville. Further, the GOWind Project is fortunate in that it has easy access to two large ports, the Port of Brownsville and the Port of Corpus Christi, both of which are able to accommodate the delivery and laydown requirement of the GOWind Project.

GOWind has commissioned the attached Socio-economic study that studies the direct impact of the GOWind Project to the local community. This is an innovative study approach in that it looks at the discrete impacts of the project.

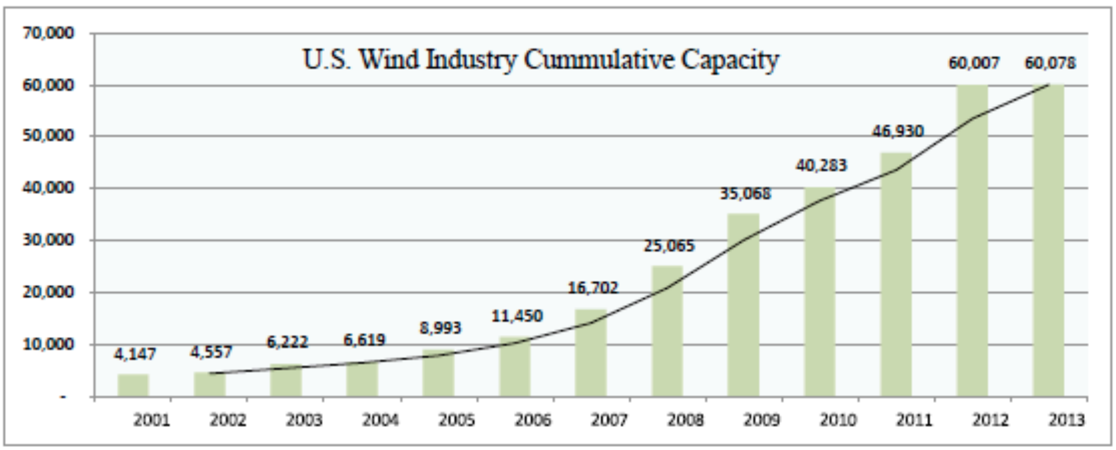
4.0 APPENDIX D – IMPLAN SOCIO-ECONOMIC STUDY

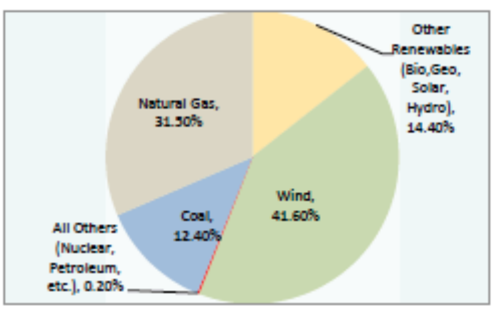
Economic Impact of GoWind Project Construction Phase

Prepared by: Jude Benavides, Ph.D. and Mostafa Malki, Ph.D.

1. Introduction

Wind power is an important and reliable energy resource. Wind energy is forecast to produce electricity at lower costs than other renewable resources for decades (de Vries et al., 2007; EREC, 2008). In addition to its lower cost of production relative to other renewable energy resources, wind energy production cost is stable because wind power does not require feedstock, and as such does not have to contend with the fluctuating prices of feedstock. Furthermore, wind power does not emit any harmful pollutants or greenhouse gases; does not use water for cooling or steam; and does not generate any radioactive or other hazardous waste (Brittan, 2002; Warren et al., 2005; Schiermeier et al., 2008). Public support for expanding wind energy development is often high because of these environmental advantages (Swofford and Slattery, 2010). Because of growing concerns over climate change and energy security, social and political support for wind energy has made it one of the fastest growing sources of power generation in the world (Wiser and Bolinger, 2010). Figure 1 shows that between 2007 and 2013 wind energy capacity grew at an annual rate of 23.78%. Wind energy represented 41.6% of new capacity in 2012 followed by natural gas (21.5%), other renewable energy (14.4%), and coal (12.4%)





Source: AWEA, 2013

According to the American Wind Energy Association (AWEA), the U.S. had 60,078 MW of total installed wind capacity in 2013 with another 2,327 MW under construction. In 1978, the United States Congress passed the Public Utility Regulatory Policies Act as part of the National Energy Act to promote greater use of renewable energy. Currently 29 states and the District of Columbia have established renewable portfolio standards (RPS), which require an increasing percentage of electricity generated in the state to come from renewable resources. Wind energy has been the renewable energy of choice to meet the RPS requirements, fulfilling 86% of RPS requirements through 2011.

Texas is currently (as of 2013) the national leader in wind energy with 12,214 MW of installed wind capacity and 20,147 wind capacity in queue. Wind energy provided 9.2% of electricity on ERCOT, one of the nation's independent system operators that manages 85% of Texas's electrical load. (AWEA, 2013).

For wind energy to supply 20% of U.S. electricity by 2030, an energy scenario modeled by the U.S. DOE (DOE, 2008), it must address technology, manufacturing, and transmission and grid operations challenges. In addition, uncertainty over federal policy may affect future growth rates of wind energy.

While there is often broad-based support from both public and political sectors for wind energy projects at the state level, interests located near the actual property where wind turbines are to be built often raise concerns about a variety of potential impacts. For local elected officials, the primary concern is the economic impacts on the host community in terms of tax revenue and employment. Wind energy advocates often argue that host communities are net gainers, while critics argue that these projects have little lasting local economic impact, while disproportionately exposing the host community to a myriad of potential, local impacts such as viewshed disruption, noise, and others.

While many wind energy studies have focused on the substational economic impacts and benefits derived at the state level (Lantz, 2008; Lantz and Tegen, 2011; Pedden, 2006; Tegen, 2006; Reategui and Tegen, 2008), few studies have tried to estimate these impacts at the county or more local level. Our analysis uses IMPLAN to estimate economic impacts from the GoWind pilot project on communities within Cameron County, Texas. Modeling is completed both with GoWind supplied project specific data and default IMPLAN data. The economic impacts from the pilot project can be scaled up proportionally to estimate the total impacts of the GoWind project. The primary question addressed in this study is how this project affects the economy of Cameron County (the host county) and local communities. Results presented here include economic development impacts such as job creation, labor compensation, output, economic value added, and tax revenue impacts in the communities where the wind projects are located.

1.1. Estimating local impacts

Cameron County and many of the communities in south Texas have faced economic challenges long before the most recent recession. The development of new wind generation creates the opportunity for construction, manufacturing, operations and maintenance jobs, as well as increased tax revenues. Moreover, the GoWind project can help improve the competitiveness of the region by increasing the electrical capacity in Cameron County, thereby creating the opportunity for large scale investments requiring additional, local electrical capacity. In fact, limited electrical capacity has been a significant roadblock to attracting large, energy intensive investments in the region.

The magnitude of a project's impact depends on available resources and the ability of local businesses to participate in wind energy projects as well as the preferences of individual contractors (Lantz and Tegen, 2008). Local ownership of relevant industries along with the sourcing of large capital items (e.g., blades and towers) can significantly impact the scale of economic impacts (Lantz and Tegen, 2008; 2009). In the most extreme cases, the economic benefits can be negligible when wind farms are built in remote, sparsely populated rural areas, where relevant industries are not locally present in any form. Mapping the distribution of impacts within and around a study area is essential to understanding the value of wind energy projects for host communities; it can also help in designing policies that ensure that host communities capture a fair share of the impacts and benefits such projects may generate.

1.2. Literature review

Historically, economic impact analysis of wind energy projects in the U.S. has focused on how the state or national economy are impacted (DOE, 2008; Lantz and Tegen, 2008; Reategui and Tegen, 2008). Some research has looked at comparing wind energy technology to other power generation technologies (Tegen, 2006; Lantz and Tegen, 2008). More recent research has tried to understand the impacts of local ownership (Costanti, 2004; Lantz and Tegen, 2009; Kildegaard and Myers-Kuykindall, 2006). The economic impact of wind energy projects varies from state to state depending on the level of integration of the wind industry and supply chain in each state.

The average total investment of a typical 100MW wind power plant is approximately $200 million (Lantz and Tegen, 2008). The same 100MW wind plant requires, on average, between 80 and 100 construction workers on site for a period of one year during the construction phase and between 6 and 8 operations and maintenance (O&M) workers annually throughout the life of the plant (NREL Database).[1] Economic impacts of wind power directly impact the project site and its immediate surrounding area. These impacts are referred to as *direct impacts*. Additional types of economic impacts include both *indirect* and *induced* impacts. These additional impacts can be substantial because the largest wind project costs are the purchasing of equipment and hardware components – activities that may not directly impact the project area. The cost of turbines alone can range between 70–75% of total project cost. Most of the economic benefits accrue to manufacturers and the suppliers within the industry supply chain. This being established, it is possible that host communities with the capacity and capability to supply turbine components directly, can substantially increase the local, direct impact during the construction phase. It is estimated that increasing the share of turbines supplied by in-state manufacturers from 0% to 50% increases the construction period economic output from wind energy investments by more than a factor of three, (Lantz and Tegen, 2008). Local ownership of components in wind projects increases construction and operation period jobs impacts by a factor of 1–3 times (Lantz and Tegen, 2009). In addition, the hospitality industry, and retail industry also experience increased economic activity because of the additional income generated by the project (direct) and by the supply chain (indirect). At the national level, analyses of the economic impact of wind projects estimate that job impacts can be in the hundreds of thousands of jobs (DOE, 2008).

2. Methodology

2.1. Model structure

To evaluate the economic impacts of the GoWind energy project in Cameron County, Texas, this study uses the Minnesota Implan Group (MIG) IMPLAN model. The IMPLAN modeling system combines the U.S. Bureau of Economic Analysis' Input-Output Benchmarks with other (project-specific) data to construct quantitative models of trade flow relationships. These trade flow relationships are between businesses, as well as between businesses and final consumers. From these data, one can examine the effects of a change in one or several economic activities to predict its effect on a specific state, regional, or local economy (impact analysis). The IMPLAN system uses a user-friendly interface for customizing

[1] The construction period generally determines the actual number of workers employed; however, in terms of man-hours a 100MW project typically supports the equivalent of 80–100 full-time workers for a period of one year. Construction workers may or may not be from the state where a project is located. O&M employees more frequently reside in the state and often the community where projects are sited

that accrue in other regions or states, as a consequence of a change in demand, are not counted as impacts within the economic study area.

The IMPLAN model reports gross economic impacts in the form of jobs (full time equivalents (FTE) for a single year), compensation (wages, salaries, and associated benefits), output, value-added, and tax revenue. The model does not consider potential impacts on electricity prices or potential worker displacement from other sectors. Model results are categorized as impacts occurring either during the development and construction phase or the O&M phase. Further, each of these categories consists of three tiers: *direct impacts* (onsite); *indirect impacts* (supply chain); and *induced impacts* (household).

Specific data relevant to the GoWind project are shown below:

Construction Phase Cost & Man-Hour Estimate

		Per WTG $1.6/£	Total WTG $1.6/£	Package % of Overall Cost
1	Installation of WTG's & WTG Towers (Heavy Lift)	$1,106,667	$3,320,000	4.3%
2	Supply, Mech Comp & Hand Over of WTG's & WTG Towers	$12,800,000	$38,400,000	49.3%
3	Installation of WTG Foundation (Heavy Lift)	$1,938,133	$5,814,400	7.5%
4	Supply of Sub-sea Cable	$1,665,707	$4,997,120	6.4%
5	Installation of Sub-sea Cable	$1,613,333	$4,840,000	6.2%
6	Independent Verification	In PMC	In PMC	In PMC
7	Fabrication of WTG Foundation	$4,085,760	$12,257,280	15.7%
8	Installation of Electrical Package	$805,333	$2,416,000	3.1%
9	Supply & Installation of Onshore Cable	Onshore Elec	Onshore Elec	Onshore Elec
10	Offshore Logistics Centre	$676,267	$2,028,800	2.6%
11	CPT & Borehole Surveys	$80,000	$240,000	0.3%
12	Crew Boats	In Logistics	In Logistics	In Logistics
13	Temp generators & support for WTG mech completion	In Logistics	In Logistics	In Logistics
14	Insurance cost	$133,333	$400,000	0.5%
15	PMC (PM, QA, HSE, Commercial, Site Management, Foundation Design)	$960,000	$2,880,000	3.7%
16	Client Costs (predominantly corporate costs & not project delivery costs)	$106,667	$320,000	0.4%
	Grand Total	$25,971,200	$77,913,600	100.0%

		Estimate of Total Man Days
1	Installation of WTG's & WTG Towers (Heavy Lift)	522
2	Supply, Mech Comp & Hand Over of WTG's & WTG Towers	1,080
3	Installation of WTG Foundation (Heavy Lift)	924
4	Installation of Sub-sea Cable	1,432
5	Fabrication of WTG Foundation	7,800
6	Installation of Electrical Package	4,080
7	Offshore Logistics Centre	5,060
8	CPT & Borehole Surveys	400
	Total US based direct man-hours excl supply chain and manufacturing	**21,298**

Note that these costs and man-hour estimates have not been market tested and are based on previous experience in the OWF market plus adjustments the US market
Costs have been converted at a rate of $1.6 / £

Approximate Breakdown of Costs For Wind Farm Developments	
Installation of WTG's & WTG Towers	5.22%
Supply of WTG's & WTG Towers	43.66%
Installation of WTG Foundation & SSP	7.38%
Supply of Sub-sea Cable	4.04%
Installation of Sub-sea Cable	2.85%
Independent Verification	0.06%
Design & Fabrication of WTG Foundation	14.63%
Installation of Electrical Package	6.22%
Installation of Sub-sea Cable	3.26%
Supply & Installation of Onshore Cable	0.67%
Control Building Works	0.36%
Offshore Logistics Centre	1.39%
Fabrication of SSP Jacket, Piles & Deck	1.40%
Supply of Cranes	0.46%
WTG Small works contracts	0.51%
CPT & Borehole Surveys	0.19%
Gen Small works - cardinal buoys, marine coordination, general supplies, CTV Fuel	0.27%
Crew Boats	0.51%
Temporary Laydown Areas - Piles	0.05%
SSP Transportation - Bifab ex works to Barrow & to site post fit out	0.24%
Marine Warranty Surveyors / Env Monitoring	0.11%
Temp generators & support for WTG mech completion	0.11%
Foundations Small Works Contracts	0.20%
Transmission Small Works Contracts	0.60%
Insurance cost	1.04%
PMC & SSP Design	3.57%
Client Costs (predominantly corporate costs & not project delivery costs)	0.81%
Grand Total	**100%**

2.2. Other modeling considerations

We assessed the wind industry supply chain in Cameron County in order to model and capture the impacts of existing industries that have the capabilities and capacities to produce components for the project. A review of the literature yielded two studies that map and estimate the costs of constructing wind turbines to specific NAICS codes. The first study, *Wind Turbine Development: Location of*

Manufacturing Activity (Sterzinger and Syrcek, 2004) was produced by the Renewable Energy Policy project (REPP). The REPP study breaks down a wind turbine into five components and 20 subcomponents. The REPP study identified 12 different NAICS codes associated with the production of wind turbine components. Each subcomponent is matched up with its corresponding 5- or 6- digit NAICS code.

The second study, *Wind Turbine Design Cost and Scaling Model* (Fingersh et al., 2006), was produced by the National Renewable Energy Laboratory (NREL). We used information from these two studies to identify industries that manufacture specific components of a wind turbine by their 5 or 6-digit NAICS code, in addition to the percentage of total costs of each component. The NREL study breaks down a wind turbine into four components and 16 subcomponents. Some subcomponents are then further disaggregated based on specific materials used to produce them. Each of the disaggregated subcomponents is then matched up with its corresponding NAICS code.

Table 1 shows the list of typical wind turbines components, their corresponding industry NAICS and IMPLAN codes, the component's cost share, and whether or not the industry is present in Cameron County. Although the table shows that many of the industries are currently present in Cameron County, few (Keppel/Amfels-Tower, and Border Manufacturing Contractors a division of GOBAR Systems) have the capability and the capacity to support the GoWind Project.

Table 1: NAICS Code Mappings and Component Cost Share

Component				
	NAICS	IMPLAN code	Industry Present in Cameron County	Share of cost
Rotor				
Baseline Blade Material				
Fiberglass Fabric	326199	149	Y	0.088
Vinyl Type Adhesives	325520	137	N	0.034
Other Fasteners	332722	196	N	0.012
Urethane/Foam Products	326150	147	Y	0.013
Hub				
Ductile Iron Castings	33151	179	N	0.041
Pitch Mechanisms and Bearings				

Bearings	332991	200	N	0.018
Drive Motors	335312	267	Y	0.007
Speed Reducer, i.e., Gearing	333612	223	Y	0.007
Controller and Drive	334513	251	Y	0.004
Drive Train, Nacelle				
Low-speed Shaft				
Cast Carbon Steel Casings	33151	179	N	0.02
Bearings				
Bearings	332991	200	N	0.012
Gearbox				
Industrial High-Speed Drive and Gear	333612	223	Y	0.148
Mechanical Brake, High-Speed Coupling, etc.				
Motor Vehicle Brake Parts/Assemblies	333613	224	N	0.003
Generator				
Motor and Generator Manufacturing	333611	222	Y	0.095
Variable-Speed Electronics				
Relay and Industrial Control Manufacturing	335314	269	Y	0.115
Yaw Drive and Bearing				
Drive Motors	335312	267	Y	0.01
Ball and Roller Bearings	332991	200	N	0.01
Main Frame				
Ductile Iron Castings	3151	179	N	0.09
Electrical Connections				
Switch Gear and Apparatus	335313	268	N	0.014
Power Wire and Cable	335929	272	N	0.035
Hydraulic System				
Fluid Power Cylinder and Actuators	333995	233	N	0.017
Nacelle Cover				
Fiberglass Fabric	326199	149	Y	0.011
Vinyl Type Adhesives	325520	137	N	0.006
Assembly Labor				
Control, Safety System				
Controller and Device, Industrial Process	334513	251	Y	0.034

Control				
Tower				
Rolled Steel Shape Manufacturing-Primary Products	332312	186	Y	0.142

3. Results

Economic impact results are reported for full time equivalent jobs (FTE), earnings, economic output, value-added, and tax impacts. The construction phase is divided into the following 8 separate sub-phases which are expected to take 3 years to complete:

Sub-phase 1: Installation of WTG's & WTG Towers (Heavy Lift);
Sub-phase 2: Supply, Mech Comp & Hand Over of WTG's & WTG Towers;
Sub-phase 3: Installation of WTG Foundation (Heavy Lift);
Sub-phase 4: Installation of Sub-sea Cable;
Sub-phase 5: Fabrication of WTG Foundation;
Sub-phase 6: Installation of Electrical Package;
Sub-phase 7: Offshore Logistics Centre;
Sub-phase 8: CPT & Borehole Surveys.

The following tables show the economic impact of the construction phase of the GoWind pilot project. The results can be scaled up proportionally to arrive to the impact of the full-scale project. The estimated impacts as currently shown may seem small because of the following factors:

1. The estimates are for the construction and installation of 3 wind turbines associated with the current pilot project only;
2. Although it appears that part of the supply chain is present in Cameron County, only a few of the local industries in the county have the capability to supply components locally and directly. In addition, some of the skills necessary in this emerging sector are not present in the local area.

Factor number two above leads to significant impact leakage from the study area. In spite of these leakages, there remain significant advantages to the proposed pilot project:

  a. It could provide an incentive for some of the industries in Cameron County to adapt and expand their capacities and capabilities to supply the wind industry;
  b. It could also provide the foundation for developing the skills and the know-how locally;

c. As the project moves to full-scale implementation it could attract additional companies (suppliers) to the region.

The currently proposed pilot project is expected to generate 70 jobs paying an average annual salary of $44,000. This salary is 35% more than the median household income in Cameron County ($32,558) and 3 times the current per capita income ($14,405).[2] The top three sectors impacted are Construction of other new nonresidential structures, Architectural, engineering, and related services, and Specialized design services. The pilot project will generate more than $10 million in added economic activity and will have $4 million in value added. The largest impact will be in Brownsville due to the size of its economy relative to the rest of the county.

The economic impact of each sub-project depends on the availability of critical skills needed. For example, Cameron County will capture a larger share of the offshore logistics sub-project, tower manufacturing (because of Keppel Amfels), and a smaller share of the installation of sub-sea cables or the installation of electrical packages. There is also the potential for some locally owned industries that have the capability and the capacity, to supply some of the components (Border Manufacturing Contractors a division of GOBAR Systems).

Tables 2.1-2.7 show the total impact summary of the project construction phase.

[2] U.S. Census

Total Impact Summary

Table 2.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	43	$1,973,605	$2,171,212	$6,657,443
Indirect Effect	10	$436,051	$657,145	$1,693,218
Induced Effect	16	$637,096	$1,075,702	$1,835,261
Total Effect	69	$3,046,752	$3,904,058	$10,185,921

Table 2.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	29	$1,302,232	$1,432,618	$4,392,741
Indirect Effect	7	$287,717	$433,600	$1,117,226
Induced Effect	10	$420,371	$709,774	$1,210,949
Total Effect	46	$2,010,320	$2,575,991	$6,720,916

Table 2.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	9	$399,351	$439,336	$1,347,107
Indirect Effect	2	$88,233	$132,971	$342,616
Induced Effect	3	$128,914	$217,664	$371,358
Total Effect	14	$616,498	$789,971	$2,061,081

Table 2.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$56,049	$61,661	$189,068
Indirect Effect	0	$12,384	$18,663	$48,086
Induced Effect	0	$18,093	$30,549	$52,120
Total Effect	2	$86,526	$110,873	$289,275

Table 2.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$37,772	$41,554	$127,415
Indirect Effect	0	$8,345	$12,577	$32,406
Induced Effect	0	$12,193	$20,588	$35,125
Total Effect	1	$58,311	$74,719	$194,946

Table 2.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	3	$135,859	$149,461	$458,284
Indirect Effect	1	$30,017	$45,236	$116,557
Induced Effect	1	$43,856	$74,049	$126,335
Total Effect	5	$209,732	$268,747	$701,176

Table 2.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$42,342	$46,581	$142,828
Indirect Effect	0	$9,355	$14,098	$36,326
Induced Effect	0	$13,668	$23,078	$39,374
Total Effect	1	$65,365	$83,757	$218,528

<u>Top Ten Industries Impacted</u>

Table 3 Cameron County

Sector	Total Employment	Total Labor Income	Total Value-Added	Total Output
Construction of other new nonresidential structures	31	$1,339,911	$1,414,642	$4,737,031
Architectural, engineering, and related services	8	$481,600	$488,326	$1,094,282
Specialized design services	4	$167,689	$239,501	$535,408
Food services and drinking places	2	$42,561	$63,756	$144,346
Wholesale trade businesses	1	$48,168	$83,213	$118,295
Offices of physicians, dentists, and other health practitioners	1	$65,709	$76,589	$121,027
Employment services	1	$19,173	$20,693	$31,629
* Employment and payroll only (state & local govt, non-education)	1	$38,116	$43,172	$43,172
Retail Stores - General merchandise	1	$20,566	$30,630	$49,028
* Employment and payroll only (state & local govt, education)	1	$44,147	$50,002	$50,002

Bearings	332991	200	N	0.018
Drive Motors	335312	267	Y	0.007
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Wholesale trade businesses	1	$48,168	$83,213	$118,295
Offices of physicians, dentists, and other health practitioners	1	$65,709	$76,589	$121,027
Employment services	1	$19,173	$20,693	$31,629
* Employment and payroll only (state & local govt, non-education)	1	$38,116	$43,172	$43,172
Retail Stores - General merchandise	1	$20,566	$30,630	$49,028
* Employment and payroll only (state & local govt, education)	1	$44,147	$50,002	$50,002

3.1. Economic impacts to Cameron County and Local Communities

The estimated annual tax impacts from the construction phase to Cameron County the City of Brownsville, and the City of South Padre Island are summarized in Tables 4.1, 4.2, and 4.3. The estimated property tax and sales tax impacts for Cameron County are approximately $73,000, and $69,000 respectively. Brownsville captures the largest share of the tax impacts ($49,000 and $46,000) because of its size relative to the other communities in Cameron County. South Padre Island tax impacts are estimated at $17,000 for property tax and $16,000 for sales tax. South Padre Island's impact will be almost exclusively related to the hospitality and tourism industry.

State and Local Tax Impact by Total

Table 4.1 Cameron County

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Dividends					$8,015
Social Ins Tax- Employee Contribution	$2,020				
Social Ins Tax- Employer Contribution	$8,692				
Tax on Production and Imports: Sales Tax			$68,584		
Tax on Production and Imports: Property Tax			$71,233		
Tax on Production and Imports: Motor Vehicle Lic			$1,243		
Tax on Production and Imports: Severance Tax			$12,482		
Tax on Production and Imports: Other Taxes			$8,787		
Tax on Production and Imports: S/L NonTaxes			$5,549		
Corporate Profits Tax					
Personal Tax: Income Tax					

Personal Tax: NonTaxes (Fines-Fees				$13,289	
Personal Tax: Motor Vehicle License				$2,454	
Personal Tax: Property Taxes				$1,790	
Personal Tax: Other Tax (Fish/Hunt)				$727	
Total State and Local Tax	$10,712		$167,878	$18,261	$8,015

Table 4.2 Brownsville

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Dividends					$5,408
Social Ins Tax- Employee Contribution	$1,363				
Social Ins Tax- Employer Contribution	$5,864				
Tax on Production and Imports: Sales Tax			$46,273		
Tax on Production and Imports: Property Tax			$48,060		
Tax on Production and Imports: Motor Vehicle Lic			$839		
Tax on Production and Imports: Severance Tax			$8,421		
Tax on Production and Imports: Other Taxes			$5,928		
Tax on Production and Imports: S/L NonTaxes			$3,744		
Corporate Profits Tax					
Personal Tax: Income Tax					
Personal Tax: NonTaxes (Fines-Fees				$8,966	
Personal Tax: Motor Vehicle License				$1,656	

Personal Tax: Property Taxes				$1,208	
Personal Tax: Other Tax (Fish/Hunt)				$490	
Total State and Local Tax	$7,227		$113,265	$12,320	$5,408

Table 4.3 South Padre Island

Description	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Dividends					$186
Social Ins Tax- Employee Contribution	$47				
Social Ins Tax- Employer Contribution	$202				
Tax on Production and Imports: Sales Tax			$1,591		
Tax on Production and Imports: Property Tax			$1,652		
Tax on Production and Imports: Motor Vehicle Lic			$29		
Tax on Production and Imports: Severance Tax			$289		
Tax on Production and Imports: Other Taxes			$204		
Tax on Production and Imports: S/L NonTaxes			$129		
Corporate Profits Tax					
Personal Tax: Income Tax					
Personal Tax: NonTaxes (Fines- Fees				$308	
Personal Tax: Motor Vehicle License				$57	
Personal Tax: Property Taxes				$42	
Personal Tax: Other Tax (Fish/Hunt)				$17	
Total State and Local Tax	$248		$3,893	$423	$186

Personal Tax: Property Taxes				$1,208	
Personal Tax: Other Tax (Fish/Hunt)				$490	
Total State and Local Tax	$7,227		$113,265	$12,320	$5,408

Table 4.3 South Padre Island

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Corporate Profits Tax					
Personal Tax: Income Tax					
Personal Tax: NonTaxes (Fines- Fees				$308	
Personal Tax: Motor Vehicle License				$57	
Personal Tax: Property Taxes				$42	
Personal Tax: Other Tax (Fish/Hunt)				$17	
Total State and Local Tax	$248		$3,893	$423	$186

Gowind PMC Sub-phase

Table 5.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	4	$166,634	$237,994	$532,038
Indirect Effect	1	$30,167	$48,721	$108,562
Induced Effect	2	$64,828	$106,968	$181,702
Total Effect	7	$261,628	$393,683	$822,302

Table 5.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	3	$99,730	$142,439	$318,425
Indirect Effect	1	$18,055	$29,160	$64,974
Induced Effect	1	$38,800	$64,020	$108,749
Total Effect	5	$156,585	$235,620	$492,148

Table 5.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$27,473	$39,238	$87,717
Indirect Effect	0	$4,974	$8,033	$17,898
Induced Effect	0	$10,688	$17,636	$29,957
Total Effect	1	$43,134	$64,906	$135,572

Table 5.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$7,663	$10,945	$24,468
Indirect Effect	0	$1,387	$2,241	$4,993
Induced Effect	0	$2,981	$4,919	$8,356
Total Effect	0	$12,032	$18,105	$37,817

Table 5.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$2,840	$4,056	$9,066
Indirect Effect	0	$514	$830	$1,850

Induced Effect	0	$1,105	$1,823	$3,096
Total Effect	0	$4,458	$6,709	$14,013

Table 5.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$11,629	$16,609	$37,129
Indirect Effect	0	$2,105	$3,400	$7,576
Induced Effect	0	$4,524	$7,465	$12,680
Total Effect	0	$18,258	$27,474	$57,386

Table 5.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$17,299	$24,707	$55,233
Indirect Effect	0	$3,132	$5,058	$11,270
Induced Effect	0	$6,730	$11,105	$18,863
Total Effect	1	$27,161	$40,870	$85,366

GOWIND Offshore Logistics

Table 6.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$44,174	$86,519	$423,716
Indirect Effect	1	$40,888	$61,674	$107,015
Induced Effect	1	$34,661	$55,298	$93,341
Total Effect	2	$119,724	$203,491	$624,072

Table 6.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$26,438	$51,782	$253,594
Indirect Effect	0	$24,471	$36,912	$64,049
Induced Effect	0	$20,745	$33,096	$55,864
Total Effect	1	$71,655	$121,790	$373,507

Table 6.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$7,283	$14,264	$69,858
Indirect Effect	0	$6,741	$10,168	$17,643
Induced Effect	0	$5,715	$9,117	$15,389
Total Effect	0	$19,739	$33,549	$102,890

Table 6.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$2,032	$3,979	$19,487
Indirect Effect	0	$1,880	$2,836	$4,922
Induced Effect	0	$1,594	$2,543	$4,293
Total Effect	0	$5,506	$9,358	$28,701

Table 6.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$753	$1,474	$7,221
Indirect Effect	0	$697	$1,051	$1,824
Induced Effect	0	$591	$942	$1,591
Total Effect	0	$2,040	$3,468	$10,635

Table 6.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$3,083	$6,038	$29,570
Indirect Effect	0	$2,853	$4,304	$7,468
Induced Effect	0	$2,419	$3,859	$6,514
Total Effect	0	$8,355	$14,201	$43,552

Table 6.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$4,586	$8,982	$43,987
Indirect Effect	0	$4,245	$6,403	$11,110
Induced Effect	0	$3,598	$5,741	$9,690
Total Effect	1	$12,429	$21,125	$64,787

GOWIND Installation WTG

Table 7.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	4	$163,872	$173,011	$579,341
Indirect Effect	1	$38,468	$57,579	$160,448
Induced Effect	1	$51,660	$87,558	$149,510
Total Effect	6	$254,001	$318,148	$889,299

Table 7.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	3	$98,077	$103,547	$346,736
Indirect Effect	1	$23,023	$34,461	$96,028
Induced Effect	1	$30,919	$52,404	$89,482
Total Effect	5	$152,019	$190,412	$532,246

Table 7.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$27,017	$28,524	$95,515
Indirect Effect	0	$6,342	$9,493	$26,453
Induced Effect	0	$8,517	$14,436	$24,650
Total Effect	1	$41,877	$52,453	$146,618

Table 7.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$7,536	$7,957	$26,644
Indirect Effect	0	$1,769	$2,648	$7,379
Induced Effect	0	$2,376	$4,027	$6,876
Total Effect	0	$11,681	$14,632	$40,899

Table 7.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$2,793	$2,948	$9,873
Indirect Effect	0	$656	$981	$2,734

Induced Effect	0	$880	$1,492	$2,548
Total Effect	0	$4,328	$5,422	$15,155

Table 7.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$11,436	$12,074	$40,430
Indirect Effect	0	$2,685	$4,018	$11,197
Induced Effect	0	$3,605	$6,110	$10,434
Total Effect	0	$17,726	$22,202	$62,061

Table 7.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$17,012	$17,961	$60,143
Indirect Effect	0	$3,994	$5,977	$16,657
Induced Effect	0	$5,363	$9,090	$15,521
Total Effect	1	$26,369	$33,028	$92,321

GOWIND Installation of Sub-Sea Cables

Table 8.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	6	$247,714	$261,530	$875,751
Indirect Effect	1	$58,150	$87,038	$242,538
Induced Effect	2	$78,092	$132,356	$226,005
Total Effect	9	$383,956	$480,923	$1,344,293

Table 8.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	3	$148,257	$156,526	$524,137
Indirect Effect	1	$34,803	$52,092	$145,159
Induced Effect	1	$46,738	$79,215	$135,264
Total Effect	5	$229,798	$287,833	$804,560

Table 8.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output

Direct Effect	1	$40,840	$43,118	$144,384
Indirect Effect	0	$9,587	$14,350	$39,987
Induced Effect	0	$12,875	$21,821	$37,261
Total Effect	1	$63,302	$79,289	$221,632

Table 8.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$11,392	$12,028	$40,275
Indirect Effect	0	$2,674	$4,003	$11,154
Induced Effect	0	$3,591	$6,087	$10,394
Total Effect	0	$17,658	$22,117	$61,824

Table 8.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$4,221	$4,457	$14,924
Indirect Effect	0	$991	$1,483	$4,133
Induced Effect	0	$1,331	$2,255	$3,851
Total Effect	0	$6,543	$8,195	$22,908

Table 8.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$17,287	$18,251	$61,116
Indirect Effect	0	$4,058	$6,074	$16,926
Induced Effect	0	$5,450	$9,237	$15,772
Total Effect	1	$26,795	$33,562	$93,814

Table 8.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$25,716	$27,150	$90,915
Indirect Effect	0	$6,037	$9,036	$25,179
Induced Effect	0	$8,107	$13,740	$23,462
Total Effect	1	$39,860	$49,926	$139,556

GOWIND Installation of Foundation

Table 9.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	7	$297,584	$314,181	$1,052,059
Indirect Effect	2	$69,857	$104,561	$291,366
Induced Effect	2	$93,813	$159,002	$271,505
Total Effect	11	$461,254	$577,744	$1,614,930

Table 9.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	4	$178,104	$188,038	$629,658
Indirect Effect	1	$41,809	$62,580	$174,383
Induced Effect	1	$56,147	$95,163	$162,496
Total Effect	6	$276,061	$345,780	$966,536

Table 9.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$49,062	$51,799	$173,452
Indirect Effect	0	$11,517	$17,239	$48,037
Induced Effect	0	$15,467	$26,215	$44,763
Total Effect	2	$76,047	$95,252	$266,252

Table 9.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$13,686	$14,449	$48,384
Indirect Effect	0	$3,213	$4,809	$13,400
Induced Effect	0	$4,314	$7,312	$12,486
Total Effect	0	$21,213	$26,570	$74,270

Table 9.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$5,071	$5,354	$17,928
Indirect Effect	0	$1,190	$1,782	$4,965
Induced Effect	0	$1,599	$2,710	$4,627
Total Effect	0	$7,860	$9,845	$27,520

Table 9.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$20,767	$21,926	$73,420
Indirect Effect	0	$4,875	$7,297	$20,333
Induced Effect	0	$6,547	$11,096	$18,947
Total Effect	1	$32,189	$40,319	$112,700

Table 9.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$30,893	$32,616	$109,218
Indirect Effect	0	$7,252	$10,855	$30,248
Induced Effect	0	$9,739	$16,507	$28,186
Total Effect	1	$47,884	$59,978	$167,651

GOWIND Installation of Electrical Packages

Table 10.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	6	$363,458	$368,534	$825,842
Indirect Effect	1	$42,640	$63,886	$140,028
Induced Effect	2	$98,051	$168,267	$287,777
Total Effect	10	$504,149	$600,687	$1,253,647

Table 10.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	4	$217,530	$220,568	$494,267
Indirect Effect	1	$25,520	$38,236	$83,807
Induced Effect	1	$58,683	$100,708	$172,235
Total Effect	6	$301,733	$359,512	$750,308

Table 10.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$59,923	$60,760	$136,156
Indirect Effect	0	$7,030	$10,533	$23,086
Induced Effect	0	$16,166	$27,742	$47,446

Total Effect	2	$83,119	$99,035	$206,688

Table 10.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$16,715	$16,949	$37,980
Indirect Effect	0	$1,961	$2,938	$6,440
Induced Effect	0	$4,509	$7,739	$13,235
Total Effect	0	$23,186	$27,625	$57,655

Table 10.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$6,194	$6,280	$14,073
Indirect Effect	0	$727	$1,089	$2,386
Induced Effect	0	$1,671	$2,867	$4,904
Total Effect	0	$8,591	$10,236	$21,363

Table 10.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$25,364	$25,719	$57,633
Indirect Effect	0	$2,976	$4,458	$9,772
Induced Effect	0	$6,843	$11,743	$20,083
Total Effect	1	$35,183	$41,920	$87,488

Table 10.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$37,732	$38,259	$85,733
Indirect Effect	0	$4,427	$6,632	$14,537
Induced Effect	0	$10,179	$17,468	$29,875
Total Effect	1	$52,337	$62,359	$130,145

GOWIND Fabrication of WTG

Table 11.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output

Direct Effect	14	$627,334	$662,322	$2,217,835
Indirect Effect	3	$147,265	$220,424	$614,226
Induced Effect	5	$197,767	$335,191	$572,357
Total Effect	22	$972,366	$1,217,937	$3,404,418

Table 11.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	9	$375,460	$396,400	$1,327,376
Indirect Effect	2	$88,138	$131,924	$367,614
Induced Effect	3	$118,364	$200,612	$342,556
Total Effect	14	$581,962	$728,936	$2,037,546

Table 11.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	2	$103,428	$109,196	$365,652
Indirect Effect	1	$24,279	$36,341	$101,267
Induced Effect	1	$32,606	$55,263	$94,364
Total Effect	4	$160,313	$200,800	$561,283

Table 11.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$28,851	$30,460	$101,997
Indirect Effect	0	$6,773	$10,137	$28,248
Induced Effect	0	$9,095	$15,415	$26,323
Total Effect	1	$44,719	$56,012	$156,568

Table 11.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$10,690	$11,287	$37,794
Indirect Effect	0	$2,510	$3,756	$10,467
Induced Effect	0	$3,370	$5,712	$9,754
Total Effect	0	$16,570	$20,755	$58,015

Table 11.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output

Direct Effect	1	$43,780	$46,221	$154,775
Indirect Effect	0	$10,277	$15,383	$42,865
Induced Effect	1	$13,801	$23,392	$39,943
Total Effect	2	$67,858	$84,996	$237,583

Table 11.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$65,126	$68,758	$230,241
Indirect Effect	0	$15,288	$22,883	$63,765
Induced Effect	0	$20,531	$34,797	$59,418
Total Effect	1	$100,945	$126,438	$353,424

GOWIND CPT and Borehole Survey

Table 12.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$36,105	$36,609	$82,037
Indirect Effect	0	$4,236	$6,346	$13,910
Induced Effect	0	$9,740	$16,715	$28,587
Total Effect	1	$50,081	$59,671	$124,534

Table 12.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$21,609	$21,911	$49,099
Indirect Effect	0	$2,535	$3,798	$8,325
Induced Effect	0	$5,829	$10,004	$17,109
Total Effect	1	$29,973	$35,713	$74,534

Table 12.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$5,953	$6,036	$13,525
Indirect Effect	0	$698	$1,046	$2,293
Induced Effect	0	$1,606	$2,756	$4,713
Total Effect	0	$8,257	$9,838	$20,532

Table 12.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$1,660	$1,684	$3,773
Indirect Effect	0	$195	$292	$640
Induced Effect	0	$448	$769	$1,315
Total Effect	0	$2,303	$2,744	$5,727

Table 12.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$615	$624	$1,398
Indirect Effect	0	$72	$108	$237
Induced Effect	0	$166	$285	$487
Total Effect	0	$853	$1,017	$2,122

Table 12.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$2,520	$2,555	$5,725
Indirect Effect	0	$296	$443	$971
Induced Effect	0	$680	$1,166	$1,995
Total Effect	0	$3,495	$4,164	$8,691

Table 12.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$3,748	$3,801	$8,517
Indirect Effect	0	$440	$659	$1,444
Induced Effect	0	$1,011	$1,735	$2,968
Total Effect	0	$5,199	$6,195	$12,928

GOWIND Client Costs

Table 13.1 Cameron County

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$26,730	$30,511	$68,823
Indirect Effect	0	$4,380	$6,916	$15,126

Induced Effect	0	$8,483	$14,346	$24,476
Total Effect	1	$39,594	$51,773	$108,426

Table 13.2 Brownsville

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$15,998	$18,261	$41,191
Indirect Effect	0	$2,621	$4,139	$9,053
Induced Effect	0	$5,077	$8,586	$14,649
Total Effect	0	$23,697	$30,986	$64,893

Table 13.3 Harlingen

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$4,407	$5,030	$11,347
Indirect Effect	0	$722	$1,140	$2,494
Induced Effect	0	$1,399	$2,365	$4,035
Total Effect	0	$6,528	$8,536	$17,876

Table 13.4 Los Fresnos

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$1,229	$1,403	$3,165
Indirect Effect	0	$201	$318	$696
Induced Effect	0	$390	$660	$1,126
Total Effect	0	$1,821	$2,381	$4,986

Table 13.5 Port Isabel

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$456	$520	$1,173
Indirect Effect	0	$75	$118	$258
Induced Effect	0	$145	$244	$417
Total Effect	0	$675	$882	$1,848

Table 13.6 San Benito

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	0	$1,865	$2,129	$4,803
Indirect Effect	0	$306	$483	$1,056

Induced Effect	0	$592	$1,001	$1,708
Total Effect	0	$2,763	$3,613	$7,567

Table 13.7 South Padre Island

Impact Type	Employment	Labor Income	Total Value-Added	Output
Direct Effect	1	$2,775	$3,167	$7,145
Indirect Effect	0	$455	$718	$1,570
Induced Effect	0	$881	$1,489	$2,541
Total Effect	1	$4,110	$5,375	$11,256

4. Discussion

Construction phase impacts for wind energy projects represent a significant part of the total economic impacts, especially at the county and local levels. This is due to the relatively high capital costs for such projects. The development of wind farms can inject a significant amount of money into local economies. The benefits to local communities vary widely among projects and among developers, especially in rural regions where the local construction labor may not be qualified to work on wind projects or may not be readily available. Rural communities that lack a qualified labor force receive between 15 to 20% of overall construction phase impacts (Pedden, 2006). Pedden's study showed that, in communities with few other industries, the installation of wind farms can create a significant new industry that becomes a large percentage of the local tax base and contributes to local businesses (Pedden, 2006). In larger communities where there is an industrial base, the share of the impacts captured can be substantial.

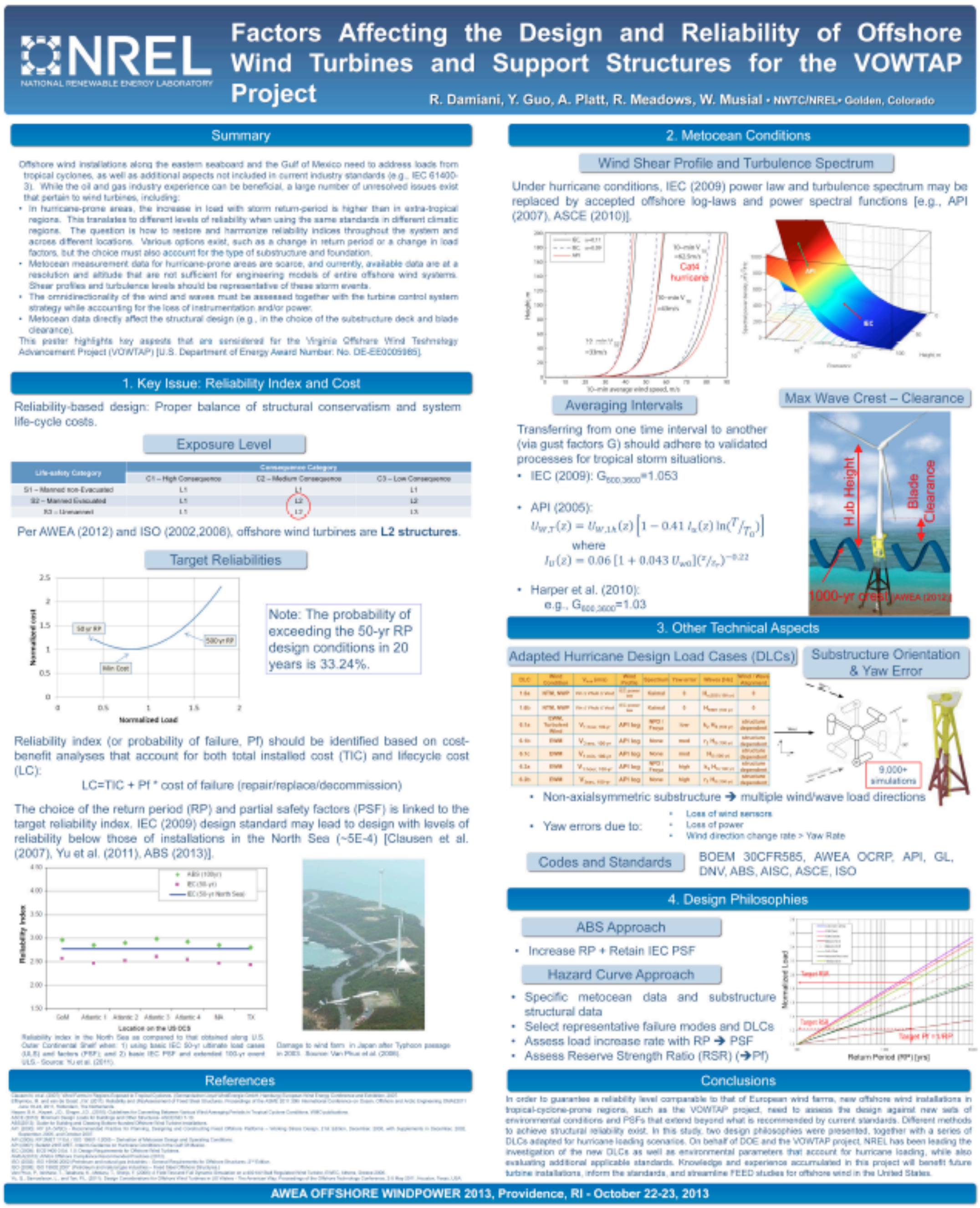
The potential benefits of a full-scale GoWind project can be can to be significant. First, the GoWind project will not be located in a sparsely populated rural area but within the Brownsville-San Benito-Harlingen metropolitan area and in proximity to manufacturing and logistics centers. Second, IMPLAN data show that industries that could potentially be part of the supply chain for the wind industry are already present in Cameron County. Developing policies that incentivize the realignment and expansion of these industries, and their capacities and capabilities, could raise the local purchasing coefficient from less than 15% to more than 60%. This would in turn reduce "leakage" and help directly capture a larger share of the project's benefits. Leakage of dollars translates into smaller multipliers and less indirect and induced impacts from a wind energy project. Third, the GoWind Project could provide the incentive, and be a catalyst for, Cameron County in general and Brownsville in particular to develop a competitive advantage in wind energy and electrical power generation and transmission equipment.

5.0 APPENDIX E – WORK BREAKDOWN STRUCTURE (WBS) – WORK PLAN AND PROJECT SCHEDULE

Not included as per DOE instruction.

6.0 APPENDIX F – NREL HURRICANE STUDY

The referenced NREL Hurricane Study, summarized in poster form for the AWEA Conference in Rhode Island, October 2013.



Summary Statement from poster:

Offshore wind installations along the eastern seaboard and the Gulf of Mexico need to address loads from tropical cyclones, as well as additional aspects not included in current industry standards (e.g., IEC 61400-3). While the oil and gas industry experience can be beneficial, a large number of unresolved issues exist that pertain to wind turbines, including:

- In hurricane-prone areas, the increase in load with storm return-period is higher than in extra-tropical regions. This translates to different levels of reliability when using the same standards in different climatic regions. The question is how to restore and harmonize reliability indices throughout the system and across different locations. Various options exist, such as a change in return period or a change in load factors, but the choice must also account for the type of substructure and foundation.
- Metocean measurement data for hurricane-prone areas are scarce, and currently, available data are at a resolution and altitude that are not sufficient for engineering models of entire offshore wind systems. Shear profiles and turbulence levels should be representative of these storm events.
- The omnidirectionality of the wind and waves must be assessed together with the turbine control system strategy while accounting for the loss of instrumentation and/or power.
- Metocean data directly affect the structural design (e.g., in the choice of the substructure deck and blade clearance).

This poster highlights key aspects that are considered for the Virginia Offshore Wind Technology Advancement Project (VOWTAP) [U.S. Department of Energy Award Number: No. DE-EE0005985].

7.0 APPENDIX G – LCOE ANALYSIS

(Text extracted from full LCOE analysis)

PROJECT OVERVIEW

Baryonyx has 40,000 acres under lease from the State of Texas within which the GOWind Demonstration Project is located. The contiguous lease also hosts the 'Rio Grande' commercial Project, which has the potential to reach an installed capacity of some 1,000 MW.

In accordance with the LCOE analysis guidelines, a 500MW development has been assessed on the Rio Grande site using the innovations, actual and prospective, encompassed and envisioned for and within the GOWind Project.

The GOWind Project has a mission objective of installing and operating three technically advanced wind turbines upon jacket-type substructures engineered for an environment that may expose the development to tropical storm (hurricane) conditions during its operating life.

In addition to the normal technical challenges posed by offshore wind resource development, the Project is being developed as a commercial venture, albeit aided substantially by the provision of U.S. Department of Energy grant funding that offsets the lack of opportunity for economies of scale and the resultant commercial leverage that ordinarily can be derived by larger, commercial or 'utility' scale projects.

By proposing to sell electricity into the ERCOT market, GOWind has to be able to meet economic imperatives dictated by the most competitive electricity market in the world. In ERCOT electricity pricing is determined by the price of natural gas, which, thanks to the exploitation of shale gas resources, is lower than that in any other market in the United States. There are no capacity revenue benefits and no environmental pricing for carbon-free generation.

However, in this commercial environment, Texas onshore wind farms are able to provide competitively priced energy through the combination of utility scale projects, good wind resource, more efficient energy capture with technologically advanced turbines, access to development and construction capital. Development has generally been timed to benefit from the Production Tax Credit when available.

The key to commerciality for offshore wind resource development in any area, and more so within the ERCOT market, is through the ability to access a superior offshore wind energy resource, maximizing its capture and conversion by use of larger, marine multi-megawatt turbines and constraining balance of plant costs by minimizing the number of offshore installations to produce a competitive Levellised Cost of Energy (LCOE) as close to parity with onshore wind developments and other competing energy resources as possible.

LCOE STUDY SUMMARY

		Comparative LCOE		
Case	**Turbine**	**Number**	**Installed Capacity (MW)**	**LCOE $/kWhr**
GOWind Demonstration (With Grant)	6MW	3	18	0.0806
GoWind Demonstration	6MW	3	18	0.1322
Rio Grande Commercial	6MW	83	498	0.1069

Table 0.1. Comparative LCOE, 'GOWind' Demonstration Project & 'Rio Grande' Commercial Project.

APPROACH TO LCOE ANALYSES

Method & Approach

This study has been prepared in accordance with the Levelized Cost of Energy (LCOE) Calculation Guidance for U.S. Offshore Wind Advanced Demonstration Projects dated May 28, 2013 and issued by the Department of Energy on May 29th 2013.

The method of preparing LCOE analyses for the Demonstration Project was as follows:

Firstly, ODE were tasked to prepare Capex and Opex estimates based upon a traditional request for quotation process addressing both North American and global vendors and compiled the information received into a report for Baryonyx.

Secondly, Baryonyx reviewed the estimates and the factors affecting potential price movements from 50% FEED to 100% FEED stages. Based upon these approaches to the market and recognition of the opportunities for cost reduction, a matrix of estimates was prepared (see appended LCOE Workbook) with the Capex estimate as currently compiled together with three additional cases reflecting a range of prospective cost reduction opportunities grouped as 'Low' 'Mid' and High' cases, reflecting the level of prospective cost reduction.

The reductions may arise from specific noted opportunities, for example, with respect to the heavy lift crane barge, sourcing such a vessel from the Gulf of Mexico rather than utilizing the quoted vessel, which would require mobilization from the US East Coast.

Elsewhere straight percentage cost reductions in those categories of 5%, 7.5% and 10% anticipate a straightforward competitive tendering process, local sourcing and the effects of recognition of a ‘real’ business opportunity rather than a theoretical one. The prospective changes have been based upon specific quotations for the Project, from public information, or knowledge held by the team concerning previous projects.

Importantly there has to be recognition that as a project becomes perceived as ‘real’ rather than theoretical, a degree of renegotiation takes place to facilitate all prospective suppliers to proceed with the project rather than all parties losing the opportunity.

Nowhere does the latter observation apply more than in the pricing of turbine supply. Since the inception of the GOWind Project competition in the turbine market has been muted to non-existent for large multi-megawatt turbines, particularly those considered financeable. As with onshore turbines, manufacturer’s pricing policy has been very much based on a ‘cost of alternative minus’ approach where project economic returns to the investor are purposefully constrained to a level that allows for the project to proceed but maximizing the price paid for the equipment.

Competition for supply is the only means to counter that situation. In the past twelve months competition has emerged in the large offshore wind turbine market. Our project was conceived around the Siemens 6.0-154 PMDD turbine. Since that turbine has begun at sea testing in European waters, other manufacturers products have entered the market which in nameplate capacity are the equivalent or larger.

Those units include:

- Alstom 6.0 MW – offshore prototype in operation offshore Belgium, now contracted for supply to the US East Coast Block Island project replacing the Siemens 6.0 MW previously announced,
- Repower 6.25 MW - an enhanced version of the 5.0 MW utilized on the Ormonde Project and the subsequent 6.0MW variant.
- Samsung 7.0 MW – now deployed at the Methil test site, Firth of Forth, Scotland,
- Vestas 8.0 MW – prototype now erected on land in Denmark and anticipated to be available for demonstration projects in 2016/17
- Areva 8.0 MW – a development of the Areva-Multibrid 5.0 MW unit
- Aerodyn SCD 8.0 MW – an enlarged version of the 3.0MW onshore and 6.0MW offshore units deployed in China. This is a down-wind, two-bladed turbine specifically designed for operation in areas prone to tropical storms.

Energy yield analyses have been prepared for the following turbines:

- Vestas V164-8.0 (8 MW)
- Samsung SHI 7.0-171 (7 MW)
- Alstom Haliade 150-6.0 (6 MW)
- Siemens 6.0-154 (6 MW)
- Siemens 4.0-130 (4 MW)

The yield analysis is included as an Appendix to this report.

The analysis presented in this document was conducted using data for the Siemens 6.0-154 turbine.

Commentary on Inputs to the LCOE Analysis

Overall, it is the considered experience of the Baryonyx team that the most advantageous time to go to the market for competitive bids for goods and services is subsequent to the conclusion of the down-select process. When the market perception is that there is a firmer prospect of securing a contract more vendors are expected to respond to the tender process. This is a common phenomenon in the post-recession market place. Contractors will not allocate resources to preparation of bids on a speculative basis. Correspondingly it is the policy of the project to proceed with formal tendering after the down-select process complete on the assumption that this team is a successful party.

At that time Baryonyx will make the final turbine selection. Which is the largest cost-driver. Prior to the final turbine selection, the FEED work has been based on the Siemens 6.0-154m turbine. Although this 50% FEED design report and its supporting all-encompassing documents are based on the Siemens 6MW WTG, the impact of changing WTG or type will have minimal impact on the conclusion of the 50% FEED design. This is because ODE's innovative jacket and transition piece designs can be easily adapted to suit other WTG models.

This approach is essential to securing the most cost-effective supply of generating equipment, which, in the absence of a competitive market is priced by the manufcturers on a 'cost of alternative-minus' basis as opposed to a 'cost plus' one.

Turbine pricing is also market specific and the availability of high electricity pricing and or renewable energy incentives are all part of the turbine vendors pricing analysis with those prices set at level to provide a sufficient Rate of Return that justifies the project proceeding. There is anecdotal evidence in the industry, particularly in Europe that the price of offshore wind has reached a level that is deterring development and negatively affecting public opion.

GOWind is set in the very competitive ERCOT market where pricing expectations are far below eastern and western US markets. It is therefore significant on a national and potentially global scale that this project has the ability to demonstrate a path to an LCOE that is substantially below developer requirements in the offshore sectors of those markets.

Capital Expenditure (Capex)

This LCOE analysis is based upon the capital cost projections prepared by ODE for the Project. In addition, Baryonyx prepared a sensitivity analysis by compiling 'Low' Mid' and 'High' cost reduction opportunity cases.

This assists in the formation of judgements concerning the relative values of cost reductions derived from variations in the base case assumption.

Examples of potential major cost reductions are:

- Removal of some or all heavy crane barge mobilisation fees from the East Coast to the Gulf of Mexico on the assumption that a vessel is available in the Gulf at the time it is required for the turbine installation work,
- Competitive pressure on the turbine suppliers to reduce the cost of equipment,
- In extremis, use of the self-installing Titan 200 sub-structure that would enable elimination of the heavy lift crane barge for all activities other than Sub-Station Platform installation,
- Use of a self-installing Sub-Station Platform to eliminate a heavy crane barge for that activity.
-

Operating Expenditure (Opex)

An Operating Expense (OPEX) report was prepared for the Project by ODE. The assessment was based upon both market indicative information from turbine vendors and other suppliers. Previous analyses by DOE were also accessed.

Baryonyx then compiled an OPEX expenditure profile that assumed competitively tendered:

- Warranty level support in the initial five year period,
- A vendor service contract for the first fifteen years,
- A knowledge transfer and training by the vendor of local company personnel to assume full O&M control of the project in years ten to fifteen of the service contract.

This produces a project life average O&M cost of $ 0.032 cents / kWh ranging from $ 0.055 cents/kWh at the beginning of the project and through the transfer of knowledge and responsibility to a low-cost local team in the final years of operation to a level of $ 0,025 cents / kWh.

This type of operating expense profile is similar to that observed in the oil and gas sector with long-life producing assets where it is possible to methodically and substantially reduce the cost of operations over the operational period.

Assumptions

Table 1 lists the input assumptions for the LCOE analysis. There are three cases presented. They are the reference case, the proposed demonstration project and the 500MW Project.

Table 0.1: Description: Operating Parameters for the Turbine & Wind Plant			
Description	***Baseline Case***	***Proposed Project***	***500 MW Farm with Proposed Project Innovations***
Wind Plant Rating	500 MW	18 MW	493 MW
Number of Turbines	139	3	83
Turbine Spacing		1.0 km	0.8 km
System Design Life	20 years	25 years	25years
Turbine Rating	3600 kW	6,000kw	6,000kW
Rotor Diameter	107 m	154 m	154 m
Hub Height	90 m	110m	110m
Gearbox Type	3-stage geared	n/a	n/a
Generator	Asynchronous	Asynchronous	Asynchronous
Foundation Type	Monopile	Jacket	Jacket
Distance to Shore	20 km	12km	12-16km
Water Depth	15 m	16m	22 m
Wind Speed @ Hub Height	8.9 m/s	8.95m/s	8.95m/s
Weibull K Factor	2.1	2.81	2.81
Base Wind Shear	0.1	01.	0.1
Air Density	1.225 kg/m^3	1.225 kg/m^3	1.225 kg/m^3
Max Rotor Cp	0.47	0.43	0.43
Tip Speed Ratio at Max Cp	8	n/a	n/a
V_{cut-in}	3	3	3
$V_{cut-out}$	25	25	25
Losses (from Eqn. 5)	15%	14%	14%
Availability (from Eqn. 5)	96%	96%	96%

Table 0.2: Initial Capital Cost of Wind Energy Systems

Analysis Level	*Representative Categories*	*Baseline Case ($/kW)*	*Proposed Project ($/kW)*	*500 MW Farm with Proposed Project Innovations ($/kw)*
1 TURBINE CAPITAL COST, TUR_{CC}		**1,789**	**2,133**	**1,700**
2	**Rotor, Drivetrain, Nacelle**	1,789		
2	**Tower**	*Incl*		
1 BALANCE OF SYSTEM CAP COST, BOS_{CC}		**2,918**	**3,403**	**1,319**
2	**Development:**	58	***547***	***62***
3	Permits			
3	Engineering		58	6
3	Site Assessment			
3	Geotechnical/Geophysical Surveys (including cable route)		11	8
3	Environmental Monitoring		478	48
3	Research and Development			
3	Interconnection Agreement			
3	Contracts			
3	Certification			
3	NEPA/Agency Consultations			
2	**Project Management**	117	610	104
2	**Support Structure:**	1,021	653	595
3	Foundation or Floating Platform		284	274
3	Transition Piece (if applicable)		133	115
3	Secondary Steel (decks, j-tubes...)		64	56
3	Anchoring System (if applicable)	*N/A*	173	150
	TABLE 3.2 CONTINUED			
4	Anchors			
4	Mooring Lines			
2	**Port and Staging**	73	99	44

3	Equipment (i.e. cranes)			
3	Facilities (i.e. staging space)			
3	In-port Assembly		99	
2	**Transportation:**	*Included in Install for baseline*	0	0
3	Turbine			
3	Foundation			
3	Substation/Interconnection			
3	BOS Hardware			
2	**Installation/Development:**	1,109	**690**	**202**
3	Foundation (including transition piece if applicable)		248	17
3	Turbine Installation (including tower)		253	129
3	Mooring System			
3	Cable Installation		189	56
4	Export Cables			
4	Inter-array Cables			
3	Scour Protection			
2	**Electrical Infrastructure:**	540	**749**	**313**
3	Inter Array Cables		68	105
3	Export Cable(s)		437	113
Table 3.2 Continued				
3	Offshore Substation			
4	Substation Structure			27
4	Substation Electrical			25
3	Onshore Substation and Transmission Facilities			

4	Land Transmission Cable			15
4	Onshore Control Center			6
4	Onshore substation		177	11
3	Pre-design analysis and planning			
3	Permitting			
3	Interconnection Application			2
3	Design and Engineering		26	2
3	Electrical Construction		43	5
2	**Other:**	0	***53***	
3	Control, Safety System, and Condition Monitoring	0		
3	Condition Monitoring			
3	Personal Access Equipment	0		
1 SOFT COSTS, S_C		893	248	
2	**Insurance (during construction)**	94	85	72
2	**Surety Bond (Decommissioning)**	165		
2	**Contingency**	471		
2	**Construction Financing Cost**	163	163	163

Table 0.3: Additional Cable Information

GOwind Demonstration Project – 18MW					
Cable Type	Rating, kV	Length	$/length	Total Cost ($)	
Inter Array	33	3,000.00	405.00	1,215,000.00	
Export	138	12,000.00	655.00	7,860,000.00	

Rio Grande Commercial Scale Project - 500MW					
Cable Type	Rating, kV	Length	$/length	Total Cost ($)	Total Cost Less Bulk Factor 10% ($)
Inter Array	33	143,975.00	405	58,309,875	52,478,888
Export	220	33,000.00	1,638	54,037,500	48,633,750
Export Onshore	345	17,000.00	500	8,500,000	7,650,000

Table 0.4: Weight Summary of Wind Energy Systems				
Analysis Level	***Representative Categories***	***Baseline Case (kg/kW)***	***Proposed Project (kg/kW)***	***500 MW Farm with Proposed Project Innovations (kg/kw)***
WEIGHT TOTAL				
1	**Turbine:**		2,218,800	64,800,000
2	Rotor		555,000	14,800,000
2	Drive train, nacelle		585,000	18,800,000
2	Tower		1,078,800	31,200,000
1	**Support Structure:**		2,715,000	53,365,500
2	Primary Steel		1,095,000	10,165,500
2	Secondary Steel (decks, j-tubes...)		378,000	10,080,000
2	Transition Piece (if applicable)		75,000	2,000,000
2	Anchoring System (if applicable)		1,167,000	31,120,000
PRICE OF STEEL			**$/kg**	**$/kg**
	Raw Steel Price		1.76	1.76

Table 0.5: Detailed Foundation Installation Costs (Example)

Please see appended LCOE Workbook – 'Expanded Installation costs' tab.

Table 0.6: Operations and Maintenance Costs of Wind Energy Systems

Please see appended LCOE Workbook – 'Expanded O&M' tab.

Table 0.7: Expanded Scheduled Turbine Maintenance Cost Reporting

Please see appended LCOE Workbook -'Expanded O&M' tab.

Table 0.8: Levelized Replacement/Overhaul Costs Itemized Table

Please see appended LCOE Workbook – 'Expanded O&M' tab.

Table 0.9: Turbine Power Curve and Site Specific Wind Speed

Please see appended LCOE Workbook – 'Wind Speed Calculations 3x6 & 83x6', and also Appendix I

Table 0.10: Annual Energy Wind Farm Production Summary			
Representative Categories	***Baseline Case***	***Proposed Project***	***500 MW Farm with Proposed Project Innovations Only***
Total Installed Capacity (MW)	**500**	**18**	**498**
AEP_{TOT} (MWh/y)	**2,081,153**	**88,872**	**2,458,795**
EL (total losses %)	**15%**	**13.6%**	**22.7%**
Availability (%)	**96%**	**96%**	**96%**
AEP_{NET} (MWh/y)	**1,698,221**	**73,714**	**1,824,623**
Capacity Factor: AEP_{NET}/(Rated Power *8760 hours)	**38.8%**	**46.7%**	**41.8%**

Table 0.11: Wind Energy Systems LCOE Summary			
Representative Categories	***Baseline Case ($/kWh)***	***Proposed Project ($/kWh)***	***500 MW Farm with Proposed Project Innovations Only ($/kWh)***
		6MW Turbine	**6MW Turbine**
Turbine Capital Cost*	**0.0421**	**0.0417**	**0.0371**
Balance of System Cost*	**0.0687**	**0.0665**	**0.0288**
Soft Costs*	**0.0210**	**0.0048**	**0.0195**
Operations & Maintenance Cost**	**0.0241**	**0.0192**	**0.0215**
Total System:	**0.1560**	**0.1322**	**0.1069**

EXPLANATION OF RESULTS

As noted in the Project Overview, the primary objective of the GOWind Project is to demonstrate how it is possible to achieve a reduced cost of energy by accessing areas in the marine environment that possess a superior wind resource, and to harvest that resource using the most technologically advanced offshore multi-megawatt wind turbines available.

By comparison to the baseline case, GOWind appears to be meeting that objective where even without the impact on LCOE of the DOE grant funding, the Project is indicating the potential to obtain an 18% reduction on system cost, from $0.1560 USD /kWhr to $0.1322 USD /kWhr.

Transferring that effect to the prospective Rio Grande Commercial Scale Project, the comparative reduction is potentially more dramatic at a 45% reduction to $0.1069 USD / kWhr. Here the project is projected to take advantage of scale allowing for series production of both turbines, towers and sub-structures. Normal market competition will enable further cost reductions and further step changes are possible through reduction in mobilisation costs assuming vessels are sourced from the Gulf of Mexico.

Pricing of the jacket type sub-structures is believed to be robust as other designs and cost estmates have been provided to the project at the 50% FEED stage such as Keystone Engineering's 'Twisted Jacket', and Offshore Wind Power Systems of Texas's Titan 200 self-installing jack-up sub-structure, which has the potential to eliminate the need for heavy lift vessels. They are all priced to within $1M USD of each other on a per unit basis.

Consequently at the 50% FEED milestone, the current cost construct of the project indicates that the objectives of the Project are achievable with more potential cost reductions possible with full commercial contracting.

Having evaluated to varying extents the performance and cost of both 4MW and 8MW turbines, the 6.0 MW capacity turbine at this point in time is the most cost-effective. We maintain an ability to use larger turbines through the permitting of the GOWind site to a height of 650 feet in order to future-proof the development.

8.0 APPENDIX H - RESOURCE LOADED SCHEDULE

Not included as per DOE instruction.

9.0 APPENDIX I - BUDGET PERIOD 1&2 PMC 123.1 & DETAILED BUDGET BP 3-5

Not included as per DOE instruction.

10.0 APPENDIX J - CAPITAL COST PLAN

ode	BARYONYX CORPORATION Capital Cost Plan Estimate	Doc No:	252301-1-ODE-PJM-CT-10113
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EXECUTIVE SUMMARY

The Project Capital Cost Plan has been prepared to demonstrate the cost of installing the base case solution for the GOWind project of 3 6MW wind turbines installed offshore with a 138kV export connection cable to shore. The 138kV shore connection cable is not a technical requirement for the demonstration project to generate electricity but it is expected to reduce the cost of the 1st phase of the main project, as it will save in the region of $12m (twelve million dollars) on export cable supply and installation costs plus the abandonment and/or recovery of a 33kV export cable. ODE has also included two other costed options, one with a 33kV export cable and one with 2 turbines and a 33kV export cable.

The Budget Period 1 CAPEX is considered to be at the level required for this phase and so falls within the range of +/-25% cost certainty. All costs are based on January 2013 prices and are quoted in US dollars.

ODE has produced a CAPEX for which the GOWind project can be delivered. It must be recognised that the prices contained herein are based on 50% FEED and that the quotations received from the market are non-binding budget quotations. Due to the uncertainties associated with the nature of the funding process a lack of multiple quotations for the work packages were received. Once funding is secured the market will be more willing to engage with the project and so more options with a greater level of cost certainty will be available.

The CAPEX will be developed as part of Budget Period 2 with greater certainty as more detailed technical information will be available. The costs for the 3 options considered during this period are shown in the table below:

3 WTGs & 138kV Cable	3 WTGs & 33kV Cable	2 WTGs & 33kV Cable	
$109,901,569	$106,396,183	$83,833,142	Grand Totals

The main cost saving opportunities that have been identified during this period that will be actively pursued early in Budget Period 2 are:

1) Potential reduction in turbine pricing given serial production;
2) Further refinement of the foundation design and review alternative foundation designs with particular attention to be paid to cost savings from pre-piling or the use of market innovation;
3) Combined heavy lift contractor for the foundation and WTG installations
4) Utilization of vessels located in the Gulf of Mexico;
5) Sourcing array cables from US manufacturing. .

The main risks to the CAPEX are the potential costs associated with:

1) Excessive weather down time;
2) Heavy lift vessel rates including mobilisation and demobilisation costs;
3) Unforeseen restrictions within the licenses, permits and consents (e.g. restricted working window).

11.0 APPENDIX K - FINANCING PLAN

Commercial information - not included as per DOE instruction.

12.0 APPENDIX L – INSURANCE

Commercial information - not included as per DOE instruction.

13.0 APPENDIX M - LOI MP2 ENERGY & UTB

Expressions of interest for purchase of energy from the GOWind Project.

Commercial information - not included as per DoE instruction.

14.0 APPENDIX N - DESCRIPTION, PROJECT PARTNER'S ROLES

Commercial information - not included as per DOE instruction.

15.0 APPENDIX O - LETTERS OF COMMITMENT

Commercial information - not included as per DOE instruction.

16.0 APPENDIX P - INTELLECTUAL PROPERTY MANAGEMENT PLAN

Intellectual Property Management Plan

Purpose

In order to facilitate compliance with the terms and conditions of the Financial Assistance Agreement awarded Baryonyx Corporation by the Office of Energy Efficiency and Renewable Energy - U.S. Department of Energy (the "**DOE**"), Award Number DE-EE0006103.00 (the "**Award**"), and expedite the commercialization of offshore wind energy and the dissemination of any scientific data associated therewith, Baryonyx proposes to establish an Intellectual Property Management Plan (the "**Plan**") as described below.

Baryonyx and all of the project partners and subcontractors are currently subject to the Special Terms and Conditions under the Award, specifically including the provisions of the "Intellectual Property Provisions (CDSB-1003) Cooperative Agreement – Special Data Statue Research, Development, or Demonstration Domestic Small Business" (the "**DOE IP Provisions**").

Subject to the DOE IP Provision, Baryonyx proposes the following:

I. Preamble

1. This Plan is established by Baryonyx, and the Project Participants to address management of Intellectual Property that may be developed as a result of work performed under the Award.

2. The general purpose of the Plan is to address the protection and disposition of Intellectual Property developed under the Award, within the framework of the DOE IP Provisions.

3. The Plan objectives include:

    a. Promoting the patenting, licensing, and rapid commercialization of Subject Inventions developed under the Award, and

    b. Promoting the rapid dissemination of scientific data for the public good.

II. Definitions

1. "**Award**" refers to the Assistance Agreement granted to Baryonyx Corporation from the Office of Energy Efficiency and Renewable Energy – U.S. Department of Energy, DE-EE0006103.000.

2. "**Award Work**" means any work or activity performed by a Participant pursuant to and funded by the Award.

3. "**Background Technical Data**" means information, in hard copy or in electronic form, including, without limitation, documents, drawings, models, designs, data memoranda, tapes, records, and databases developed before or independent of

performance under the Award that is necessary for the performance of Award Work.

4. "**Intellectual Property**" means technical information, Inventions, developments, discoveries, know-how, methods, techniques, formulae, algorithms, data, processes and other proprietary ideas (whether or not patentable or copyrightable). Intellectual Property also includes patent applications, patents, copyrights, trademarks, mask works, trade secrets, and any other legally protectable information, including computer software.

5. "**Invention**" means any discovery or a new device, method, or process developed from study and experimentation that is or may be patentable or otherwise protectable under Title 35 of the United States Code.

6. "**Owner**" means a party, public or private, holding legal title to Intellectual Property, consistent with Federal laws and regulations.

7. "**Participant**" means a Recipient who contributes to the execution of Award Work as part of a Project Team.

8. "**Project Intellectual Property**" means and includes all Intellectual Property first conceived, discovered, developed, reduced to practice and/or generated in the performance of the Award.

9. "**Project Team**" refers to a collective of Participants working in a collaborative manner to execute the project funded pursuant to the Award.

10. "**Project Technical Data**" means information (in hard copy or in electronic form) including, without limitation: documents, drawings, models, designs, data, memoranda, taps, records, and databases developed during the performance of Award Work.

11. "**Recipient**" means an individual or entity who, directly or indirectly, receives money from DOE pursuant to the terms of the Award for the purpose of performing Award Work.

12. "**Subject Invention**" means any Invention of a Participant that is conceived or first actually reduced to practice in the performance of work under the Award.

III. Ownership of Project Intellectual Property.

1. Subject to the DOE IP Provisions, title to the Subject Inventions and Project Intellectual Property shall be as follows:

   a. Each Participant shall retain title to any Subject Inventions and other Project Intellectual Property made or conceived solely by its employees and agents.

   b. Unless agreed otherwise, the Participant filing a patent application shall pay all preparation and filing expenses, prosecution fees, issuance fees, post issuance fees, patent maintenance fees, annuities, interference expenses, and attorneys' fees for that patent application and any resulting patent.

c. Participants shall be joint owners, via an undivided interest, of any Project Intellectual Property made or conceived jointly by those Participants.

IV. Licensing

1. A Participant shall promptly disclose any Project Intellectual Property to Baryonyx in sufficient detail as to allow Baryonyx's evaluation ("Invention Disclosure"), and Baryonyx shall have a time-limited option to negotiate a license to such Project Intellectual Property.

2. For a period of 90 days from the receipt by Baryonyx of an Invention Disclosure, Baryonyx shall have, to the extent that the disclosing Participant has the legal right to do so, an exclusive option to negotiate a commercial license, to the Disclosing Participant's interests in the disclosed Project Intellectual Property ("**Option Period**").

    a. At any time during the Option Period, Baryonyx may exercise its option by written notice to the disclosing Participant. Upon exercise, the Parties shall negotiate diligently and in good faith, for a period not to exceed 90 days ("**Negotiation Period**"), an exclusive, sublicensable (or nonexclusive and non-sublicensable, at Baryonyx's option) royalty-bearing commercial license to the disclosing Participant's interest in the Project Intellectual Property. The terms of such license shall be commercially reasonable and shall provide, in the case of an exclusive license, for diligent development of the Project Intellectual Property towards commercialization by Baryonyx.

    b. During the Option Period or Negotiation Period, the disclosing Participant may, at its sole election and expense, file for statutory intellectual property protection for the optioned Project Intellectual Property. Baryonyx may also request that the disclosing Participant file for statutory intellectual property protection for the optioned Project Intellectual Property.

    c. If the Option Period elapses without exercise, or the Negotiation Period elapses without the execution of a license agreement, Baryonyx shall have no further rights to the Project Intellectual Property. However, the Parties may extend either the Option Period or Negotiation Period by written agreement.

3. Any license that a Participant may grant will reserve the option to permit private or public educational institutions to us the Project Intellectual Property on a royalty-free basis for research and education, but not for commercial purposes, subject to confidentiality requirements. internal research and development use only.

4. Any licensing of the Project Intellectual Property shall be conducted pursuant to and in accordance with the terms of the Award. Licensing of the Project Intellectual Property shall not inhibit performance of Award Work.

V. Data Sharing

Each Participant shall have the right to use other Participants' Project Technical Data and related Background Technical Data for the sole purpose of carrying out Award Work. Each Participant shall establish and implement specific measures and protocol to protect such data from disclosure.

VI. Dispute Resolution

Any dispute between Participants relating to the management of Project Intellectual Property, as provided for in this Plan, or to the interpretation of this Plan, shall be referred to the Participants' respective officers, as designated below. Through the designated officers, Participants' agree to first attempt informal resolution of disputes, within a reasonable period of time and in a fair and equitable manner, taking into consideration the objectives of the Award and any laws, statutes, rules, regulations or guidelines to which the involved Participants are subject.