Comprehensive Analysis: Forecasted Use of Renewable Energy "Biomass" Heat and Energy Production throughout the EU

Principles of 'Strategic Alliances' and 'Commitment and Trust Relationships' as Foundational Basis for Strategy-Driven, Integrated and Durable Trading Relations.

By: Arthur T. House; August 2018

Abstract: The production of energy from renewable energy sources is an advanced progressive imperative throughout the European Union (EU). Energy security, environmental integrity and climate change mitigation are essential components of European energy policy. The EU countries are mandated to meet by 2020 a target of 20% renewable resources in the energy supply and 10% renewable resources in energy in the transport sector[1] and the European Council has presented a long term target for the EU and other industrialized countries of 80 to 95% cuts in greenhouse gas emissions by 2050. A cornerstone in renewable energy projections of the European Union is biomass, which is expected to account for 56% of the renewable energy supply in the EU27a by 2020. The global perspectives for future energy production are on the use of more renewable resources in general and on biomass in particular.[2] In the European Union the overall target for renewable energy is higher than anywhere else.

This paper reviews extant literature on renewable energy initiatives, in conjunction with available biomass conversion technologies. The geographical scope is the European Union, which has set a course for long term development of its energy supply from the current dependence on fossil resources to a dominance of renewable resources. A consensus of studies point toward biomass and bioenergy as being cornerstones of European energy policies and strategies for the future. The annual demand for biomass for energy is estimated to increase from the current level of 5.7 EJ to 10.0 EJ in 2020. Opinions of bioenergy potentials vary substantively due to procedural inconsistency and assumptions applied by individual authors. Forest biomass, agricultural residues and energy crops constitute the three major sources of biomass for energy, with the latter probably developing into the most important source over the 21stcentury. Land use and the conversions thereof are also key concerns in sustainable bioenergy and biomass production and availability of long-term supply can be eventually limiting factors. Afforestation, reforestation and sustainability initiatives made available to this global challenge can be met with dedicated and forward thinking alliances.

Climate Change – Early Speculation - Scientific Research and Discovery

Climate change research is traced back to ancient times (c. 371 – c. 287 BC) where, for example, Theophrastus, a student of Aristotle lectured about changes in climate conditions caused by events such as draining a pond or swamp marsh thereby making the region susceptible to freezing. Another of his speculations was that lands became warmer when the clearing of forests exposed them to sunlight. Other scholars suggested that deforestation, irrigation, and grazing had altered the lands around the Mediterranean since ancient times; they thought it plausible that these human interventions had affected the local weather.[3]

Efforts to Mitigate and Reduce of Greenhouse Gas (GHG) Led to Mandated Compliance and Reliance upon Renewable Energy Sources Derived of the Kyoto Protocol

Early considerations focused on "international cooperation regarding the problems, the Earth's environment was facing"[4] when tackled in Stockholm in 1972 as part of the UN Conference on Human Environment. The emphasis placed on solving perceived and widely predicted global climate change dilemma was instrumental in developing a framework for international agreement to take on the task of harnessing, managing and mitigating damages to the environment as a result of global warming. Simultaneously this effort has led to mandated treatises and regulations that created a new world-wide market demand for the inevitable reliance upon renewable energy commodities. As the English-language proverb says, '*Necessity is the Mother of Invention*' roughly implying, that the primary driving force for most new inventions is a need.

In 1988 the United Nations created the 'Intergovernmental Panel on Climate Change' (IPCC). Their findings were published in 1990 and the international dialogue of a framework for action was begun. In New York in May 1992 the UN adopted a platform on Climate Change known as the United Nations Framework Convention on Climate Change (UNFCCC) and shortly thereafter in June of 1992 its body of work was presented in Rio de Janeiro designated as the "Earth Summit" where the Rio Declaration and Agenda 21 was formed as the 'Framework Convention on Climate Change' (FCCC) and Biological Diversity, both legally binding thus, "mandating that industrialized nations cut their greenhouse gas emissions."[5]

The UNFCCC mandate was to adopt covenants with objectives of avoiding hazardous man-made intrusion upon global climate systems. The goals of the UNFCCC were three-fold. It was envisioned that all nations would undertake necessary and appropriate actions to mitigate Greenhouse Gas emissions. By implementing a plan of mitigation there would be formed doctrines of "common but differentiated responsibilities and respective capabilities" (CBDRRC) that "acknowledges the different capabilities and differing responsibilities of individual countries in addressing climate change."[6] Finally, those countries designated as 'developed' countries would assist 'developing' countries in reducing Greenhouse Gas emissions and help them to fare with regional impacts of climate change.

In 1994 the UNFCCC is ratified and starts annual gatherings of the Parties known as the 'Conferences of the Parties (COP) with its first 'Annual COP-1' held in 1995. At this convention the parties acted to hasten climate change efforts by initiating concessions toward an agreement to establish "binding targets and timetables for reduce developed country emissions, but no new commitments for developing countries."[7] Subsequently the IPCC published its Second Report in 1995 the next COP-3 was held and it resulted in the adoption of the Kyoto Protocol in 1997. Kyoto incorporated a series of 'flexible,' or market-based, mechanisms enabling developed countries to use different forms of emissions trading to achieve their targets more cost-effectively. These 'mechanisms', under the Kyoto Protocol, "introduced three market-based mechanisms, thereby creating what is now known as the carbon market."[8]

The IPCC published its Third Assessment Report in 2001 but Kyoto was not ratified at that time as US President Clinton did not submit the protocol to the Senate and shortly thereafter next incoming US President, G. W. Bush announced that pursuant to lack of support by US Senate the US would not ratify Kyoto. Over the next four to five years the Kyoto Protocol was adopted and approved or ratified by many countries with the inclusion of Russia in 2005 which decreed the Kyoto Protocol binding. Significant differences of opinion and policy however beleaguered progress as UNFCCC parties worked to devise alternative strategies to facilitate an equitable solution to the differences of the varied countries as it related to expectations by both developed and developing nations.

It wasn't until 2007 when new efforts were made in the Bali Action Plan where talks were focused on UNFCCC's "full, effective and sustained implementation"[9]of a comprehensive protocol. With more than 100 world leaders converging on Copenhagen in 2009 it was still insufficient to overcome differences and the COP-15 failed to reach agreement. The accord provided for explicit emission pledges by all major economies – including, for the first time, China and other major developing countries – but charted no clear path toward a treaty with binding commitments.[10]

Key elements include: an aspirational goal of limiting global temperature increase to 2 degrees Celsius; a process for countries to enter their specific mitigation pledges by January 31, 2010; broad terms for the reporting and verification of countries' actions; a commitment by developed countries for $30 billion in 2010-2012 to help developing countries; and a goal for mobilizing $100 billion a year in public and private finance by 2020. The accord also called for the establishment of a new Green Climate Fund.[11]

On December 12, 2015 at COP-21 in Paris, parties adopted the Paris Agreement. The agreement establishes common binding procedural commitments for all countries, but leaves it to each to decide its nonbinding "nationally determined contribution" (NDC). The agreement entered into force in late 2016, much earlier than expected, and parties are now developing detailed implementing rules to be adopted at COP 24 in 2018.[12] In June of 2018 the US announced intentions to withdraw from the Paris Agreement while continuing to negotiate more equitable rules. Any withdrawal would not become effective until November 2019 and all rules and regulations would remain unchanged in the interim. In abundance of caution and with a margin of globally anticipated compliance and cooperation the US is likely to remain an active and productive member country for years to come.

Renewable Energy – Biomass – Phoenix of Fossil Fuel – Diminished use of Coal

In the context of this work we confine our thoughts to the cyclical regeneration of the source of energy and heat. The mythological depiction of the Phoenix is that the bird was associated with the sun and that it would be reborn or regenerated as it superseded its predecessor – in this case renewable energy 'Biomass' replaces fossil fuel – coal. In mythology the Phoenix dies in flame yet today it is also to be reborn into heat and combustion necessities.

Energy companies, combined of 26 of 28 EU member nations, except Greece and Poland, delivered the coup de grâce to the coal industry with a pledge to overhaul the EU energy generating future by vowing to implement a permanent moratorium on new investments in coal plants after 2020. Europe is on target for phasing out its coal plants by 2030 in accordance to its pledge made relative to the Paris climate accords. Global new coal plant development tumbled by almost 66% since 2016. The US and Europe lead in that decline.

While Poland and Greece did not join the moratorium alliance there are mitigating circumstances that likely affected their current stance. Poland recently completed Polaniec biomass power plant, located in southeast Poland, the world's biggest 100% biomass-fuelled power plant, indicative of their awareness of renewable energy. Long-term commitments also include the Law and Justice (PiS) government's wider plan to stick to coal as the basic source of energy.[13] Greece is itself the world's second largest producer of lignite which is a soft brownish coal showing traces of plant structure, intermediate between bituminous coal and peat. Most of Greece's electricity is produced from lignite and the largest producer in Greece is the government-owned Public Power Corporation (PPC). Greece recognizes and complies with its legally-binding clean energy targets of 18% of its energy consumption to come from renewables by 2020 yet it has to some extent differing investment criteria than others in the EU parties where they believe it is not wise to invest in coal.[14]

Biomass – A Renewable Energy Source

Renewable energy sources, or renewables, are energy sources that replenish themselves naturally such as solar energy, wind and biomass. This paper concentrates on organic, non-fossil material of biological origin – plants and animals - also called biomass feedstock or energy crops. It includes wide range of materials harvested from nature or biological portion of waste. The most typical example is wood (firewood, wood residues, wood waste, tree branches, stump and wood pellets), which is the largest biomass energy source. Other examples of biomass are grass, bamboo, corn, sugarcane, animal waste, sewage sludge and algae. Using biomass as a fuel is deemed carbon neutral as carbon was trapped from the atmosphere during its biomass life cycle.[15]

Biomass – Organic Materials – Wood Chips

Member States and stakeholders emphasized the need for climate and energy policy to continue to take into account the three prime objectives of energy policy: competitiveness, security of supply and sustainability. Wood chips are medium-sized solid material (typically 30–60 mm in size) made by cutting, or chipping, larger pieces of wood. Wood chips are easier than wood fuel to transport and store but can contain just as much moisture. The focus of this paper is on the production of "designer chips" made exact to specifications of the end user. Also, the wood chips to be exported will meet and exceed the requirements of the EU with regard to Heat Treatment or "Phytosanitation".[16] The process for Phytosanitation has been perfected, by TD Dryers of Topeka, KS and accomplished in a September 2014 full-cycle shipment of heat treated wood chips for paper manufacturing – to Germany. Biomass chips can meet and exceed the sample specification provided herein.

Supply Specifications for Co-firing of CHP Plants UK

Targeted specifications can be met for preferential off-take.

Certifications:	Sustainability Forestry Initiative® (SFI) Standards and Certified Responsible Forestry® (FSC) Standards.		
Species:	Coniferous:	Spruce, Pine, Fir and Hemlock	
Bark Content	< 2%	Predicted to meet Ash requirement - can debark to < 1%	

Characteristics	Unit	Basis	Typical	Min.	Target	Max.	Table
Total Moisture	%	AR		30	35	40	
Ash Content	%	OD			< 1		
Greens							
Leaves	%	AR	None				
Pine Needles	%	AR	None				
Foreign Matter	%	AR	None				
Particle Sizes:	*mm*			*mm*			
Overs	%	AR		> 40 x 20		0	
Accepts	%	AR		≤ 40 x 20		95	
Unders	%	AR		≤ 1 mm		5	
Chlorine	%	OD				< .10	Trace Amt.
Sulpher	%	OD				< .05	
Nitrogen	%	OD				< .70	

For Buyer A. R. = As Received *(For Seller A. D. = As Delivered)*
Oven Dry = OD

The Impact of Bark Content of Wood Biomass on Biofuel Properties; Holubcik, Michael & Jandacka, Jozef Peer Reviewed Article; Bioresources.com Department of Power Engineering, Faculty of Mechanical Engineering, University of Zilma, Univerzitma 1, 010 26 Zilma, Slovakia Radovan.nosek@fstroj.uniza.sk Retrieve from: https://bioresources.cnr.ncsu.edu/BioRes_11/BioRes_11_1_44_Nosek_HJ_Impact_Bark%2
Finding: Ash content decreses in the range of .0333 to .0444% per 1% decrease in bark content.

Production and Delivery Methodology:

All processed materials shall be in accordance with Sustainability Forestry Initiative® (SFI) Standards and with Certified Responsible Forestry® (FSC) Standards.

Heat treatment as defined by the application of 56°C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core).

"On June 17, 2014 the European Union published amendments to its principle plant health directive (Council Directive 2000/29/EC) which regulates the import of plants and plant products including forestry products. Member countries of the European Union are to adopt the requirements within their laws, regulations, etc. by 30 September 2014. The Requirements will come into force for imports arriving on or after October 1, 2014. Wood must be: - heat Treated or…. by using approved processes. At present the E.U. has not approved any fumigation products. Heat treatment is defined as the application of 56°C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core)."

Biofuel – Wood Pellets

Pellet fuels (or pellets) are biofuels made from compressed organic matter or biomass. Pellets can be made from any one of five general categories of biomass: industrial waste and co-products, food waste, agricultural residues, energy crops, and virgin lumber. Wood pellets are produced by compressing wood material and extruding it through a die into cylinders (normally 6–8 mm in diameter and 10–30 mm in length). This process, together with the necessary drying of the wood, requires energy input, often derived from burning local mill or forest residues. Compared to wood chips, pellets are have a higher density and a lower moisture content, and are therefore better suited to transport and storage. At a rough approximation, two tonnes of green (recently cut, not dried) wood are needed to produce one tonne of wood pellets. Pellets can be made from any organic material, including agricultural wastes as well as wood wastes or round- wood (wood in its natural state as felled), and are widely used for both heating and power generation.[17]

Note: For the purposes of this paper, we do not focus on wood pellets as the preferred biomass/biofuel product to be generated and exported to the UK or the EU. Rather we see wood pellet manufacturers as an additional targeted market for the export of Phytosanitized wood chips for their supply chain. Traditional calculations and or projections regarding the ratio of wood chip demand to production of wood pellets vary with the quality of the wood pelt and or with regard to its intended market. Production balance of 1,000 green tons of fiber to produce wood pellets results in a final product weight of 490 US short tons.[18] A loss of 51% of the input feedstock results. A ratio of 2:1 green tons to wood pellets is the result. Subsequently, it would require 1 million tons of green wood chips to produce 490,000 tons of wood pellets.

Biomass – Carbon Neutrality – EU and US Perspectives

Biomass is a renewable energy source which can be used to produce electricity, heat and transport fuels. It accounts for roughly two thirds of renewable energy in the European Union (EU). Although biomass can come from many different sources, wood is by far the most common. Under EU legislation, biomass is carbon neutral, based on the assumption that the carbon released when solid biomass is burned will be re-absorbed during tree growth. Current EU policies provide incentives to use biomass for power generation. At present, there are no binding sustainability criteria for biomass at EU level, although some exist at national and industry level.[19]

The Department of Energy and the US-EPA recognizes the importance of the nation's forest resources and related industries, and the role that biomass can play in renewable energy strategies. These principles are core elements of provisions in the Consolidated Appropriations Act, 2018.[20] EPA's policy treatment of biogenic CO2 emissions associated with forest biomass use at stationary sources for energy production aims to provide clarity to forest and forest product industry stakeholders.

According to the Secretary of Energy, Scot Pruitt, the provisions explicitly direct EPA, the Department of Energy and the Department of Agriculture to establish policies that "reflect the carbon-neutrality of forest bioenergy and recognize biomass as a renewable energy source, provided the use of forest biomass for energy production does not cause conversion of forests to non-forest use." As directed by Congress and Executive Orders, this policy seeks to ensure that biomass from managed forests plays a key role in addressing the energy needs of the U.S., furthering U.S. energy dominance, in an environmentally and economically beneficial way.

EPA's policy in forthcoming regulatory actions will be to treat biogenic CO2 emissions resulting from the combustion of biomass from managed forests at stationary sources for energy production as carbon neutral.[21]

Land Use – Deforestation Effects on Regional Climate Change

A history of land use changes and transformation of portions of the North America Continent alone led science to assume that large scale human intervention could have an effect on regional climate changes. Tillers of the soil, 'sodbusters' moved to the mid-west regions of the United States in the late 1800's as homesteaders and settlers. The United States Government issued homesteads which granted applicants 160 acres of land in 1862. There were requirements such as the settlers had to be at least 21, and had to farm on the property for five consecutive years.[22] These 'sodbusters' were required to work their land by plowing 'busting sod' their land and planting crop. Some felt that by plowing the soils the "rain follows the plough."[23] Others did not agree and opined that clearing lands, tilling soil and large scale deforestation not only caused rainwater to run off rapidly causing landslides and floods, but reduced rainfall itself.

Extensive farming or deforestation was seen by many as the transformation from pristine and lush lands into impoverished deserts.[24] One needs only to reflect on the effect of the human intervention on Haiti.

> 'Ironically, agriculture may be partly to blame for the severity of the floods. Haiti is particularly susceptible to flooding because of large-scale deforestation on the Haitian part of the island where most trees have been cut down to make charcoal for cooking or to clear land for agriculture. Without trees to slow or stop rainfall, the water rushes over the sun-baked ground, filling low spots. … [while] thousands died after heavy rainfalls triggered widespread floods in southern Haiti."[25]

More than 98 percent of Haiti's forests are gone, leaving no topsoil to hold rains. "The situation will continue, and other catastrophes are foreseeable," Jean-Andre Victor, one of Haiti's top ecologists, said in the capital, Port-au-Prince. Less tree cover also means less regular rain, since trees "breathe" water vapor into the air. The result is a dropping water table, making for even poorer farmers, the backbone of Haiti's economy. Prime Minister Gerard Latortue, said, "The root of the problem is that we have to go and reforest the hills and until we do that, every two, three, four years after some heavy rain, the same thing could happen again." Projections of climate change indicate annual temperatures in the Atlantic Ocean and Caribbean Sea will increase between the decade of the 2020s and the 2080s, with the rate of increase accelerating over time…meaning that rainfall variability is also expected to increase, creating more extreme droughts in the dry season and more intense rainfalls in the wet season.[26]

Industrialization - Transformational Effects on Climate Change

Industrialization has been described as the process of transformational change of the human society socially and economically from an agrarian society into an industrial one. It generally involves technological innovations and is a part of a wider modernization process, where social change and economic development are closely related with these technological innovations.[27] Industrialization always seemed to be the key to wealth and better living but in reality, it has been shown that, although it leads to better conditions of living, it affects our environment and ultimately contributes to climate change.[28]

Climate change can be described as the persistent change in the weather pattern engendered by anthropogenic activities. One of the major drivers of climate change is the global warming. According to Shah[29], put simply, global warming and climate change refer to an increase in average global temperatures. The cause or causes of climate change is subject of intense global debate. There is no consensus on root or proximate cause. Although it is acknowledged that natural occurrences, industrial expansion, human behaviors and activities contribute collectively to an increase in average global temperatures.[30]

Global warming has been generally agreed to be caused primarily by the emission of greenhouse gases (such as carbon dioxide (CO^2), methane (CH^4) and nitrous oxide (N^2O)), chlorofluorocarbons and other chemicals into the atmosphere.[31] The accumulation of these gases in the atmosphere results in heightened "greenhouse effect" which leads to global warming…[32] Regardless the cause the global focus had to be placed on mitigating the climate 'problem' or 'climate change' – coined the "Global Warming" dilemma whether the drivers of greenhouse gas emissions are fueled by economic activity or population behavior.

Forest Industry's Responsibilities for Efficient Biomass Use:

The forest products industry is the largest producer and user of bioenergy of any industrial sector in the U.S. The making and use of biomass energy in the forest industry is integral and incidental to the manufacture of wood products while converting biomass residuals to energy and producing biomass products useful to society and for exports to the EU and UK. The organic use of forest residuals for energy delivers substantial greenhouse gas benefits by avoiding the emission of about 181 million metric tons of carbon dioxide - equivalent to the emissions of about 35 million cars.[33] The forest products industry has created a highly efficient, market-based system of managed forest use with significant carbon benefits including:

1. Providing biomass power by utilizing forest and mill residuals;
2. Efficiently using biomass residuals through combined heat and power systems to assure forest biomass resources minimize total forest system GHG emissions;
3. Reducing the industry's and our nation's reliance on fossil fuels and reducing GHG emissions while simultaneously meeting society's needs for forest products;
4. Reducing potential GHG emissions that otherwise would result from residual disposal (e.g., methane from decomposition);
5. Balancing forest supply and demand through market-based systems for biomass due to forest planting and re-growth, as evidenced by net increases in forest carbon stocks over most of the last 50 years; and
6. Robustly recycling paper to reuse valuable biomass resources.
7. These carbon benefits can be perpetuated if forests continue to remain abundant and well managed, with forest use and growth balancing supply and demand.

The Future of Biomass for Combined Heating and Power (CHP) generation in the EU

Biomass currently provides 38% of the UK's renewable energy[34], although this only contributes about 15% to the country's overall energy production.[35] By 2050, up to 44% of the UK's energy could be produced from household and agricultural waste and home-grown fuels, says a study published today in the Energy Policy journal.[36] The potential of biomass could help to wean the UK off fossil fuels, says Andrew Welfle, the author of the study. "The UK has legally binding renewable energy and greenhouse gas reduction targets, and energy from biomass is anticipated to make major contributions to these," he said.[37]

EU Objectives - Competitiveness, Security of supply and Sustainability

EU Member States emphasized the need for climate and energy policy to continue to take into account the three prime objectives of energy policy: competitiveness, security of supply and sustainability. There is great awareness that the EU climate and energy policy should give greater consideration to the consequences of the on-going economic crisis, international developments and, in particular, their potential adverse effects on European competitiveness. A vast majority of stakeholders also point out that the EU should increase efforts to diversify energy supply sources and routes in a 2030 perspective.[38] One of the most likely energy supply sources and routes will from its neighbor in the US. Maine is the closest deep water port from the US to points in the EU and specifically in the UK.

EU Targets for 2030

1. Achieve a 40% cut in greenhouse gas emissions compared to 1990 levels
2. Achieve at least a 27% share of renewable energy consumption
3. Meet the indicative target for an improvement in energy efficiency at EU level of at least 27% (compared to projections), to be reviewed by 2020 (with an EU level of 30% in mind)

EU Sustained Demand for Woody Biomass for Combined Heat and Power

The demand for wood and biomass in the EU continues to be the leading source of global demand. In 2016, energy from solid biomass (about 70 per cent wood[39]) accounted for about 7.5 per cent of EU gross final energy consumption and about 44 per cent of total renewable energy consumption. Most of the biomass consumed was for heat, accounting for 78 per cent of total consumption of heating and cooling from renewable sources; biomass supplied about 10 per cent of total generation of electricity from renewable sources.[40] Biomass used to produce heat, both in district heating and in residential use, is exempt from energy and carbon taxes, which provides an important stimulus for switching from fossil fuels to biomass. Indeed, it even favors biomass over electric heating generated from renewable sources such as wind, which is still subject to the energy tax, though at a lower rate than fossil fuels.

This paper focuses on sourcing off Phytosanitized – Heat Treated woody biomass from the US, for export and use in the EU and more proximately to the UK. Across the UN Economic Commission for Europe region (Europe, North America, and north, west and central Asia), forest-based industries form the largest end-use sector, consuming over 40 per cent of wood energy.[41] The use of woody biomass for heat and power is growing more quickly, particularly in the EU, and imports from outside the EU, chiefly from the US and Canada, have risen sharply in recent years. It is estimated that, if it is to achieve its aim of providing 27 per cent of its energy consumption from renewable sources by 2030, the amount of biomass the EU will need is the equivalent to the total EU wood harvest for all purposes in 2015.[42]

The informal reference to a "Perfect Storm" is associated with a rare chance or combination of individual elements, circumstances, or events that together form a disastrous, catastrophic, or extremely unpleasant problem or difficulty. This research seized upon a different understanding where that "Perfect Storm" is a convergence of the precise elements at the exact place, the correct time, and under the specific circumstances where an opportunity develops in an industry across continental divides to form an exponentially significant new market and where simultaneously that market provides a path to the reinvigoration of a dying industry at home. The genesis of this Maine to UK model is grounded in recognizing that "Perfect Storm" and acting upon its potentials before others either would or could be able to act.

EU demand for Wood Pellets in 2013 was 19 mMT annually.[43] In 2015 EU Wood Pellet consumption or demand is 25 mMT annually[44] or a 31% increase from 2013. EU demand will increase to between 50 and 80 mMT annually by 2020[45] or a minimum of 100% increase over 2015 or 220%[46] United States currently accounts for nearly 45 % of the Exported Wood Pellets to the EU annually.

With divergent market conditions existing, each market has a problem to solve. In Maine, we witnessed the decimation of a paper manufacturing industry since 2011 when 5,700 factory workers were employed in paper mills throughout Maine. Between 2011 and 2013 roughly 2,300 jobs were lost. Since 2013 an additional 1,911 jobs were lost to plant closures. With 15 major mills closed since 2011 the industry shrunk by a total of 79% or 4,211 jobs. The latest plant closure in Bucksport, Maine saw 570 jobs lost during the last days of December 2014.

With the closure of paper mills, there was also a corresponding collapse of a state-wide power plant industry, inextricably linked to the functional operation of paper mills. In tandem with the paper mill closures there was a shuttering of 7 power plants throughout Maine which caused an additional loss of 755 direct jobs. The cumulative loss of these facilities across the vast state of Maine has not only left factory towns barren of its jobs, its tax base and the fruits of economic contributions to local towns derived from an employed society.

Thrusting another set of circumstances upon the problem is with the loss of paper manufacturing production, and the power plants, an obvious underutilization of the raw material – fiber – used both to generate power and to produce paper now exists. The cumulative loss of these plants has left the forest industry with an annual overabundance of underemployed raw fiber in the likes of harvestable trees, paper quality pulp wood and locally consumable biomass fiber.

Biomass Demand – to 2030 - EU and Beyond

The justification for building a Phytosanitation Heat Treatment Plant, expanding Wood Chip processing facilities and providing Biomass exports from the US is best articulated by providing insight derived of global biomass industry experts and leading organizations with empirical knowledge of energy needs, and biomass supply trends worldwide. While it may be anecdotally characterized, it is certainly evidence of a trend with regard to the future reliance upon wood chips in the EU for the production of energy. Germany may opt to close its nuclear facilities and enhance its co-fired energy production capacities. The use of coal will remain strong however the co-fired materials will be wood chips. GDF Suez recently constructed the largest biomass power plant in the world, which will is solely fuelled 80% by wood chips and 20% by agricultural waste. The PLN 1bn ($290m) Polaniec biomass power plant is being constructed at the site of the existing 1,800MW Polaniec power station in Polaniec, Poland. [47]

Published References to Expanded Demand for Renewable Energy – Biomass Supply

GDF Suez constructed the "the fifth largest electricity plant in the country and the largest plant in south-eastern Poland.", fuelled 80% by wood chips and 20% by agricultural waste. In 2016 GDF SUEZ Energia Polska SA, became a part of Engie. In December 2016 the plant was sold for $255M USD14. The PLN 1bn ($290m) Polaniec biomass power plant is being constructed at the site of the existing 1,800MW Polaniec power station in Polaniec, Poland. Construction of the biomass fuelled power plant is being undertaken to complement the European Union's target to generate 15% of energy from renewable sources by 2020. The plant will cut down carbon dioxide emissions by about 1.2 million tons (mt) annually. Poland produces about 35mt/y of wood waste and 14mt/y of agricultural waste. The new biomass power plant will exploit these wastes to produce renewable energy. It is expected to use up to 890,000t of wood chips and 222,000t of agricultural waste annually.[48]

Biomass 2020: Opportunities, Challenges and Solutions; the *Union of the Electricity Industry–EURELECTRIC***:** Biomass has the capability to contribute strongly to meeting the European Union's renewable targets for both heat and electricity in 2020. We estimate a feasible increase of 82 Mtoe (equivalent to 42.217 GJ [gigajoules]) in 2010 to 120 Mtoe by 2020 (with an additional import of up to 40 Mtoe). A 46.3% increase. This increase shall rely on a 40% increase of imported Biomass. Opening international markets is required to ensure the long-term security of supply for biomass imports into the EU. Even if EU growth in their own production occurs, there will still be a biomass supply gap of around 25-40 Mtoe leaving lucrative opportunities for US firms to enter the market early.

UK's Drax opens biomass conversion plant: By Henning Gloystein; LONDON Mon Dec 9, 2013 11:36am GMT (Reuters) - Britain's coal-fired power producer Drax opened its coal-to-biomass conversion plant on Monday as part of a 700 million pound project to clean up emissions from the country's biggest coal power station. Drax secured financing at the end of last year enabling a 700 million pound ($1.1 billion) investment plan involving a switch to using wood pellets instead of coal, which produces more carbon for generating electricity than wood pellets. The biomass conversion will see three of the six generating units at the power station converted to burn sustainable biomass in place of coal. Each converted unit will provide enough renewable electricity to meet the annual needs of over 1 million homes, Drax said. [49]

UK's Drax power group boosted by support for biomass switch: By Michael Kavanagh; December 4, 2013; Shares in Drax jumped on Wednesday after the owner of Britain's biggest electrical power station, in North Yorkshire, confirmed the government go-ahead for revised price support to enable it to switch half its capacity from coal to biomass.[50]

Drax steams ahead with £700m biomass conversion: Yorkshire power plant's green transformation continues as new systems to support first biomass unit are opened; By Will Nichols; 09 Dec 2013; Drax power station is set to transform from the UK's biggest carbon emitter into its largest green electricity generator following a £700m coal-to-biomass conversion project. The Yorkshire site is currently the largest single emitter of carbon dioxide in the UK and provides about seven to eight per cent of the UK's total power. [51]

REA welcomes opening of Drax biomass power plant: Welcoming the opening of the Drax coal-to-biomass conversion plant by Ed Davey today [1], REA Chief Executive Dr. Nina Skorupska said: "Biomass is exactly what the UK energy mix needs". Through converting old coal plants and building new biomass plants, we can have electricity when we need it and keep the lights on this decade using sustainable wood fuel instead of polluting coal power. "The Government actually plans to withdraw support for new biomass power-only plants – which is a grave mistake. This makes it all the more vital that Government provides effective support for biomass conversion and combined heat and power under the new EMR package, to reassure investors that it understands the benefits of this cost-effective, base load source of renewable energy." [52]

Drax surges on biomass subsidy news despite uncertain markets: Investors stay cautious on equities amid doubts about Federal Reserve stimulus measures; Drax, the power station owner, surged 59p or nearly 9% to 743p after the UK government set its subsidy prices for renewable energy projects. The company is aiming to convert three of its six generating plants to produce energy from biomass rather than coal, and the government confirmed a strike price of £105 per megawatt hour from 2015 for biomass generation. This is in line with a provisional announcement, but there had been some suggestions it could be scaled back. Exane BNP Paribas analyst Iain Turner told Reuters:[53]

European Biomass Review: Renewable energy policy in Europe will see biomass demand grow by almost 50% between 2010 and 2020 with increased use of biomass not only in the energy sector but also in industrial and residential sectors[54]

European biomass demand to more than treble by 2020-report: * *European wood pellet demand to rise to 29 mmt in 2020** Europe to import 66 pct of biomass from abroad * Global biomass power production to rise 9 pct per year. LONDON, Jan 11 (Reuters) - European demand for wood to produce electricity is seen rising more than three-fold by 2020, as governments offer subsidies for greener energy sources.[55]

European Biomass Demand to Grow 44% Between 2010 and 2020: *Unless new sources are developed, Europe faces an acute shortage* Energy policy in EU will generate an increase in biomass demand of 44% between 2010 and 2020.[56]

Maine's Biomass Supply Potential thru 2030 and Beyond

Statistical data – Overview of Maine Forest Ownership:

The forests of Maine stretch from Kittery to Fort Kent and from Jackman to Lubec. In fact, forests cover 90% (17.7 million acres) of Maine, making it the most heavily forested state in the country. Northern and eastern Maine regions have the largest tracts of undeveloped forest in the eastern United States. In the western United States, large blocks of forest are publicly owned and overseen by the federal government. Maine is unique in that the public owns just 6% of forest in the state. The other 94% (16.7 million acres) is in private hands.[57]

Bankable and sustainable supply chains for feedstock, and stand-by back-up of fiber exists throughout Maine, with projections of available feedstock of "overstocked" inventory of up to 5.1 million US green tons per year. Production of Heat Treated Wood Chips would require roughly 9.8% of the total available overstocked inventory annually for the Phytosanitation project. While relying on a 9.8% availability of overstocked feedstock in the total available, that would provide a net available feedstock of approximately 500,000 green tons. Empirical studies reported by Forest Industry Analysis professionals concluded that timber harvesting in general was occurring on approximately 530,000 acres annually and yields approximately 15 to 17.5 million green tons of forest products (biomass, saw logs, pulp and firewood) and that harvests have been steady for the past 21 years and "considered merchantable and sustainable".

Referencing further studies by Kenneth Lausten of U-Maine, the estimated green ton yield in Maine is 88.2 green tons per acre.[58] To put this in perspective, this project would require a mere 5,500 acres per year to meet its needs. That is roughly 1% of the 530,000 reported acres being utilized by respondent landowners.

According to studies conducted by Maine Forest Service on Sustainable Biomass Availability there are 13.1 million acres of "overstocked" stands in Maine that are candidates for forest thinnings. This segment of the overstocked regions alone would account for as much as 11.9 million green tons of

"Merchantable" materials and 5.1 million green tons or residuals that could be used as biomass wood chips.[59] This feedstock supply source is the basic underpinning of this program.

Wood Species:
The mix of species in Maine average over time to approximately 40% Hardwood and 60% Softwood Species.
Typical Softwood species and the percent by Softwood species are:
Spruce & Fir 67% - White & Red Pine 7% - Hemlock 25% - Cedar 1%

Typical Hardwood species and the percent by Hardwood species are:
Beech 2% - White/Yellow Birch 29% - Sugar Maple 12% - Red Maple 8 % - Ash 2% - Aspen 47%

Wood Chips (raw feedstock):
HS Tariff Classification is 4401210000 - Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms; wood in chips or particles; sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms: Hog fuel product originates from Northern Maine, USA from a region stretching from Mid-Coast Maine to the Canadian Border to the north. The removal of biomass material from timber stands, ranches and plantation lands meets all current State and Federal laws.

Compliance to G50 Spec (Typical):
Typical: 50mm x 50mm x 20mm [1.965" X 1.965" X 7/8"].

Particle Distribution *(Material as sent to Germany for Paper)***:**
> 28.5mm - 6% max
9.5mm -28.5 mm - 70% max
3.2mm - 9.5 mm – 20% max
< 3.2mm - max 4 %

Moisture: 40% max Heat Treatment could reduce this to 30%
MC will dictate GJ value, compaction capacity, density and baling sizes.

Bark Content: <2% If debarked – this can be reduced to <1%

Sampling, Testing, Phytosanitation Assurances & Analysis:
1. Biomass Energy Lab (*primary testing lab of choice for in-state testing*)
1641 Sigman Road Telephone: 1-770-922-8000 Ext 164
PO Box 919 Conyers, GA 30012
www.biomassenergylab.com

2. SGS North America Inc (*primary testing lab of choice for international testing and for physical testing while in port and in the process of loading to vessel in US.)*
201 Route 17 North Telephone: 1-201-508-3000
Rutherford, New Jersey, 07070

3. USDA-APHIS, PPQ
Iron Road, Suite #1 Telephone: (207) 848-5199
Hermon, Maine 04401

Heat Treatment Plant – Solution to Fumigation

The Heat Treatment technology was patented and built by TDC, the only USDA-APHIS approved system. The Heat Treatment Facility will be warranted, including 1st year of O&M, over seen by a leading construction management firm and one of the largest engineering firms in the world. When exporting wood chips to EU destinations, fumigation issues were crucial to success. The process of fumigation is the single hardest obstacle to solve before exports could be concluded. Appropriate fumigation applications have varied widely from the classification of products to the import country and its particular requirements over the years.

Methyl bromide (MeBr), the long-time accepted fumigation process, is an odorless, colorless gas that has been used as a soil fumigant and structural fumigant to control pests across a wide range of agricultural sectors. Because MeBr depletes the stratospheric ozone layer, the amount of MeBr produced and imported in the U.S. was reduced incrementally until it was phased out in January 1, 2005, pursuant to our obligations under the Montreal Protocol on Substances that Deplete the Ozone Layer (Protocol) and the Clean Air Act (CAA). Under the Montreal Protocol and the Clean Air Act, because Wood Chips are not a critical need commodity, the production and import phase-out for methyl bromide terminated its approval status in 2005.

The next fumigation process utilized for wood chip export to the EU was "In-transit shipboard fumigation" to treat wood chips to eradicate insects and transferable impurities from several pine species, infested with the pine wood nematode, Bursaphelenchus xylophilus. Using aluminum phosphide tablets producing 4 g m^{-3} phosphine, the percentage of infested samples was reduced from 79 to 6% during the voyage from the USA to Sweden. While USDA-APHIS still lists this as an acceptable fumigation process, many EU countries shy away from the process – while others claim that it is acceptable – if the import country issues the appropriate documentation asserting its approval.

Because this is a very hit-or-miss methodology of avoiding shipping risk, Company has opted to develop the first in the US Heat Treatment facility to not only address the issue but, to resolve it once and for all – this provides the assurances needed for Buyers to lock into long-term transactions.

The EU emergency measures allow three treatment options for wood chips: (1) Heat Treatment (the overall globally approved process), (2) Fumigation (if host country deems appropriate) or (3) Chemical pressure impregnation (for such items as pallets). In all cases treated wood must be accompanied by evidence of treatment process and documentation indicating the organization that treated the wood material and the location of that organization. The APHIS (Animal and Plant Health Inspection Service) is recommending heat treatment because it is the only long-term measure currently listed.

The most widely used method used to comply with ISPM15 is heat treatment. This is achieved by maintaining the constant core temperature of wood chips at 56° Celsius for a minimum of 30 minutes. TD's Phytosanitation Heat Treatment System and process is the only recognized system and process approved by USDA-APHIS. Heat Treatment is literally recommended as the approved wood chip fumigation process – in every category and species of wood chips for destinations around the world and most specifically to any location in the EU. Significant to the underlying objectives of the Company plan is to construct and commission the first such Heat Treatment System in the US before any other company recognizes that Company is ahead of the entire biomass production curve in the US.

TDC – Proprietary System Design – Patented and USDA-APHIS Approved
Procurement, Construction and Implementation of TD Systems - Throughout Maine is authorized to Osahada of Maine, LLC. See EXHIBIT "A" Part of the unique design is a re-application of technology TDC (Thompson Dehydrating Company -Stan Thompson) developed in the 1970's. Portions of this technology were used in the development of a drying technique using only water vapor in what is called „airless drying". Airless drying uses only ambient pressure steam (water vapor) that is generated in the drying process. With airless drying there is so little air in the system that the generated wet bulb temperatures are very close to the boiling point of water which makes these gases ideal to recover the energy used in the drying process using evaporators or some other like device. The dryer drums are fabricated to be round without flexing.

Another key feature of the Thompson Dehydrating/ Phytosanitation systems is a proprietary manufacturing technique TDC uses to create the rolling surfaces on the drum and how they are ten able to resurface the drum and trunnions rolling surfaces in the field. They use a grinding system that they developed over (30) thirty years ago that is a special case of „centeless „ grinding that allows them to surface the drum tracks and round them to a few thousands of an inch of total runout. They do their surfacing between the trunnion wheels not above them. To our knowledge TDC is the only company doing this in the world. This technology makes it possible to get the track round and when the tracks are round then they can grind the sealing surfaces round. They have a dryer drum using this technology operating with negative pressures of 17-inches of WC since the mid 1980's.

TDC design also incorporates a modulating exhaust gas recycle (EGR) which they have used since the late 1960's. They also use very low excess air burners and low NOx burners. You may want to know that with the way they recycle the exhaust gases into the combustion chamber that the water vapor in the gases is optic to the radiant energy from the burning natural gas or propane burners and actually absorbs thermal energy from the combustion process which lowers the flame temperature enough that the NOx generation is decreased. They have taken some burners from measuring nearly a hundred parts per million to a measurement (by EPA test methodology) to between 8 and 9 parts per million, very low NOx. Additionally with the design they can generate and maintain high wet bulb temperature drying (over 180 degrees F) using direct fired systems or near water boiling temperatures using airless systems if required.

A critical part of the technology is that until the wood reaches these very high wet bulb temperatures no drying can take place. So if they do some drying in the Phytosanitation process of specific sized chips at these high or very high wet bulb temperatures they will know that all the wood has reached and exceeded the needed temperatures. While all the wood is the wettest it has the greatest heat transfer capability to transfer thermal energy to the core of the wood particle. With their **patented technology of particle retention** they keep the wood particles in the drying system until they reach these very high wet bulb temperatures. They maintain this condition **by sealing up the system which limits any air** in the system between the drum and the **WPS PHYTOSANITATION RETENTION VESSEL / SILO** which retains the wood at and well above the required temperatures for the time required. This is all done using thermal energy and is very efficient. The WPS silo is insulated and is designed to retain the wood above the needed temperatures well in excess of the time required to eliminate any risk. TDC has even worked out tests that can be performed frequently that prove the time is being met. The **wood temperatures are all electronically monitored** through specifically designed proprietary computer programs which demonstrate /prove the EU time and temperature requirements have been met. TDC has combined these technologies into a patented product that meets USDA's requirements: simply stated - “it works“.

EPC – Construction Management

Arthur House has 35 plus years of high-level, international and domestic, Construction Management experience with a resume in excess of $1.5 billion of projects; he will act as the facilitator for this entire project and oversee the project’s Engineering Advisory, Engineering, Preconstruction Budgeting & Construction Management Oversight responsibilities to C&M Commercial Contractors and Builders, to coordinate all aspects of the project. Under their management they will oversee engineering, construction and local Civil Engineering anticipated to be Mid-South Engineers of Orrington, ME. Both firms were selected, and expected to be imminently engaged. AECOM (the largest Engineering Firm in the US – with professional ties to Arthur House) is bringing its top team of engineers to Maine to accept an offer to represent this project as its executive oversight EPC/Engineering Consultants and to act as a special liaison between all parties to this project.

Baling/Wrapping of Micro Chips – Capturing an Export Advantage

Solving the fumigation problem on the front end of the export supply chain is only one step in getting ahead of the competition and putting clients in a better purchasing position than their counterparts in the EU. Producing sufficient commodities for international clients, for some, is a philosophy of ‘good enough’. The HT production process intends to also compress the fibre by up to 40% (or more as may be required for bale sizing – compaction also depends on MC) and offer wood chips baled. The wrapped bales will also document the absolute chain of custody, sustainability, quality, date and time and duration of Phytosanitation and assure maximum density from the forest to the vessel.

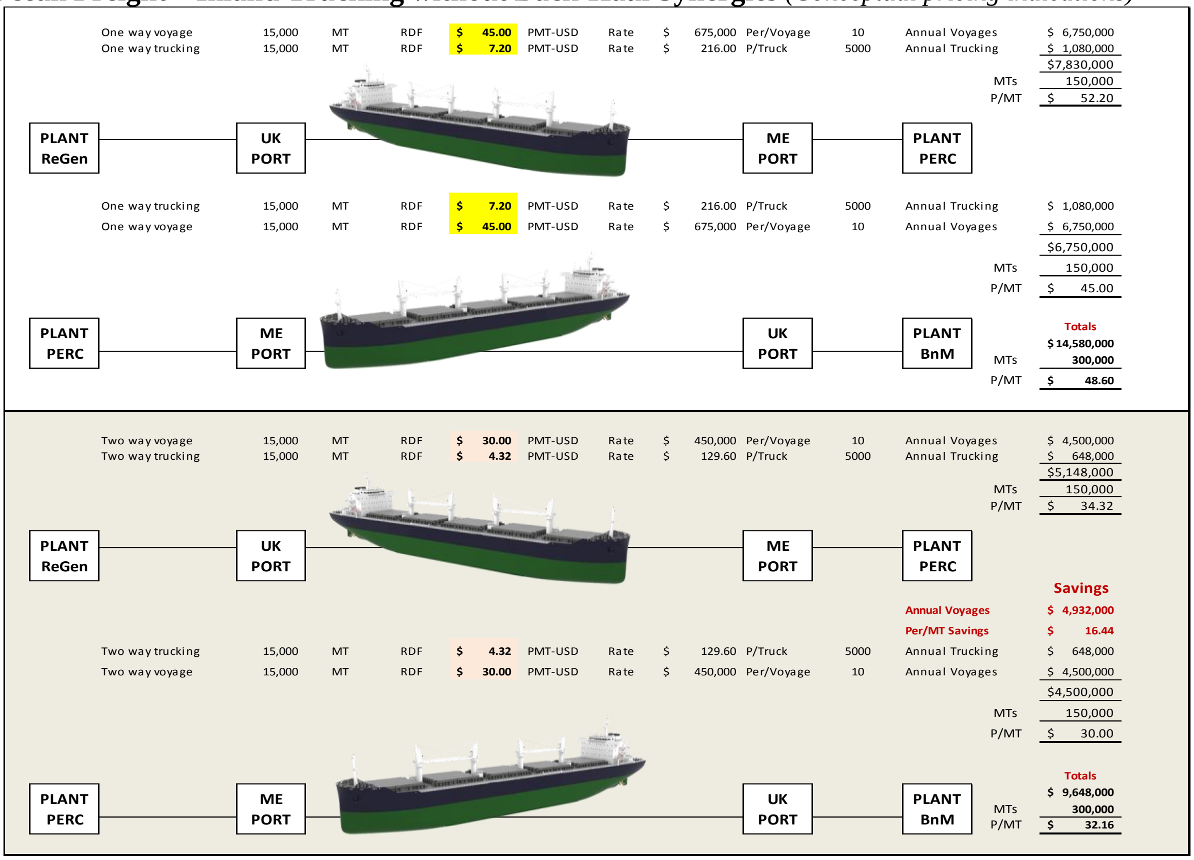
Bales of micro-chips are compressed to increase ocean freight transport density of up 1.4 or greater than loose wood chip loads. It is projected that about 40% more tonnage of chips can be loaded into the hold as compressed and baled as would be possible with loose bulk loading. On the wrapper there will be barcode labels with each bale's complete history from cut site to vessel loading, together with Phytosanitation info, species mixture, MC, Certificates of Origination, Forest Sustainability documentation and chain of custody history for buyers to download at will. A sophisticated buyer would be linked to the digital monitoring system to have access to the production data on a live – real time basis. For the purpose of this example we would propose a bale sized 48" x 42" (standard bale size) x 60" to obtain 1.05 MT of compressed chips per bale at a 14.4 GJ value at 25% MC or 13.3% GJ value at 30% MC.

Wood Chip Calculations - Bales @ Various Sizes and MC									Art House		MC 25% Bale		MC 30% Bale	
Width		Height		Length							GJ-T	MWh-T	GJ-T	MWh-T
Inches	Feet	Inches	Feet	Inches	Feet	CF	Lbs/Bale	US Ton	M-Ton	CBM	13.64	3.79	12.57	3.49
45	3.8	36	3.0	45	3.8	42.2	1401.0	0.70	0.64	1.19	8.7	2.41	8.0	2.22
45	3.8	45	3.8	45	3.8	52.7	1751.2	0.88	0.79	1.49	10.8	3.01	10.0	2.77
45	3.8	30	2.5	45	3.8	35.2	1167.5	0.58	0.53	1.00	7.2	2.01	6.7	1.85
43	3.6	29.5	2.5	63	5.3	46.2	1535.8	0.77	0.70	1.31	9.5	2.64	8.8	2.43
52	4.3	32	2.7	76	6.3	73.2	2430.3	1.22	1.10	2.07	15.0	4.18	13.9	3.85
48	4.0	30	2.5	72	6.0	60.0	1992.5	1.00	0.90	1.70	12.3	3.42	11.4	3.16
42	3.5	30	2.5	48	4.0	35.0	1162.3	0.58	0.53	0.99	7.2	2.00	6.6	1.84
48	4.0	36	3.0	72	6.0	72.0	2391.0	1.20	1.08	2.04	14.8	4.11	13.6	3.79
54	4.5	36	3.0	60	5.0	67.5	2241.5	1.12	1.02	1.91	13.9	3.85	12.8	3.55
RDF Inbound														
48	**4.0**	**36**	**3.0**	**60**	**5.0**	**60.0**	**1992.5**	**1.00**	**0.90**	**1.70**	**12.3**	**3.42**	**11.4**	**3.16**
Bio-Bales Outbound														
48	**4.0**	**42**	**3.5**	**60**	**5.0**	**70.0**	**2324.6**	**1.16**	**1.05**	**1.98**	**14.4**	**4.00**	**13.3**	**3.68**

RDF and Phytosanitized Chip Bales

Export of baled - Biomass Wood Chips provides benefits to buyers: Compacted bales increase density on vessel and reduce unit ocean freight costs. Baled wood chips do not require the construction of storage buildings at either the port of origination or discharge port. Secured, wrapped bales provide extended Phyto-Certificate life cycle. Bales would each be bar coded to provide details regarding origin and complete, seamless chain of custody, all sustainability certifications, Phyto processing, specific species and mixture of fiber - this could provide for design blends of biomass or paper chips quality.

Ocean Freight – Inland Trucking without Back-Haul Synergies *(Conceptual pricing indications)*



Savings could be much larger if the bales could be shipped on vessels in excess of 15,000 MT P/Vessel.
With densities as high as they are anticipated to be the weight could reach 17,000 - 18,000 MTPer Vessel.

Inland Transportation Efficiencies

Inland transportation for the purposes of this document refers to the full-cycle portal to portal movement of materials from the processing facility to a transfer station at the Port of Searsport. The movement from transfer station to alongside the vessel for loading is calculated as well. To understand the costs associated with bale movement we first focus on the transport of baled wood chips to the transfer station as a single operation, without benefit of a back-haul from the transfer station to the heat treatment center. A second observation with subsequently be addressed herein to provide a snapshot of the efficiencies provided with a backhaul operation for inland trucking. With the following assumptions, we will provide an overview.

Statistics for bale handling narrative:

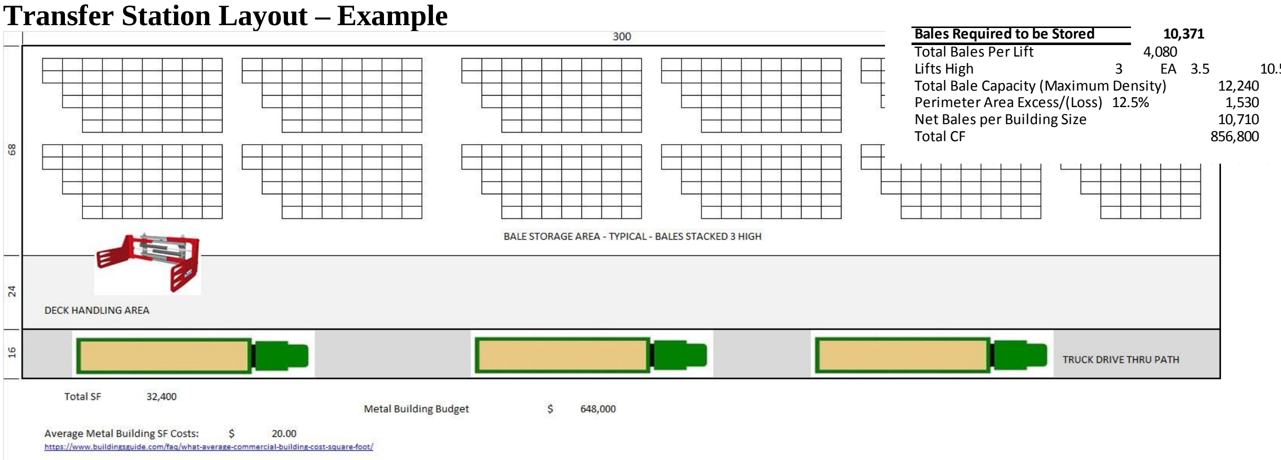
Vessel arrives with 15,000 MT of bales at about (1) MT per bale at about 70 CF per bale. Vessel arrives with about 1,050,000 CF of cargo. Projected unload rate is (3) days or 5,000 MT per day at 24 hour operation. This dictates an unload rate from vessel to awaiting flatbed trucks at a rate of 208.3 MT per hour. At legal over the road weights for flatbed trucks at 27 MT or 30 US Ton this will require an unloading from vessel rate of 3.5 MT per minute. To load direct to flatbed, therefore is 7.8 minutes or 7.7 flatbed truck and trailers alongside the vessel per hour. Movement from the vessel at 7.7 trucks per hour at 24 hours per day for 72 consecutive hours will move 555 loads away from the vessel. The limiting factor is the unloading rate from the vessel to the awaiting truck and trailer. For trucks not leaving the port or adjacent laydown yard, the load per trailer may be as much as 45 to 50 US tons per trip. But, that would only effect the movement to the transfer station on site.

PERC is (23.8) miles from the transfer point. Driving time per leg is estimated at (35) minutes each way. Transport is to be conducted on a drop and hook basis with very little driver down time. Drop and hook adds (14) minutes to an entire turn around. Combined time per load is (84) minutes. Each load is (27) MT. With an (84) minute cycle and maximum (27) MT per cycle the net hourly delivery to the PERC facility is (19.3) MT per truck. Utilizing a (16) hour day for truck deliveries to PERC (this may be enhanced) the daily per truck transport is (308.6) MT. Instituting a (5) truck performance team the total movement of MT to the PERC site from vessel during a (3) day period is (4,629) MT. That would leave a balance of (10,371) bales or about (726,000) Cubic Feet of bales.

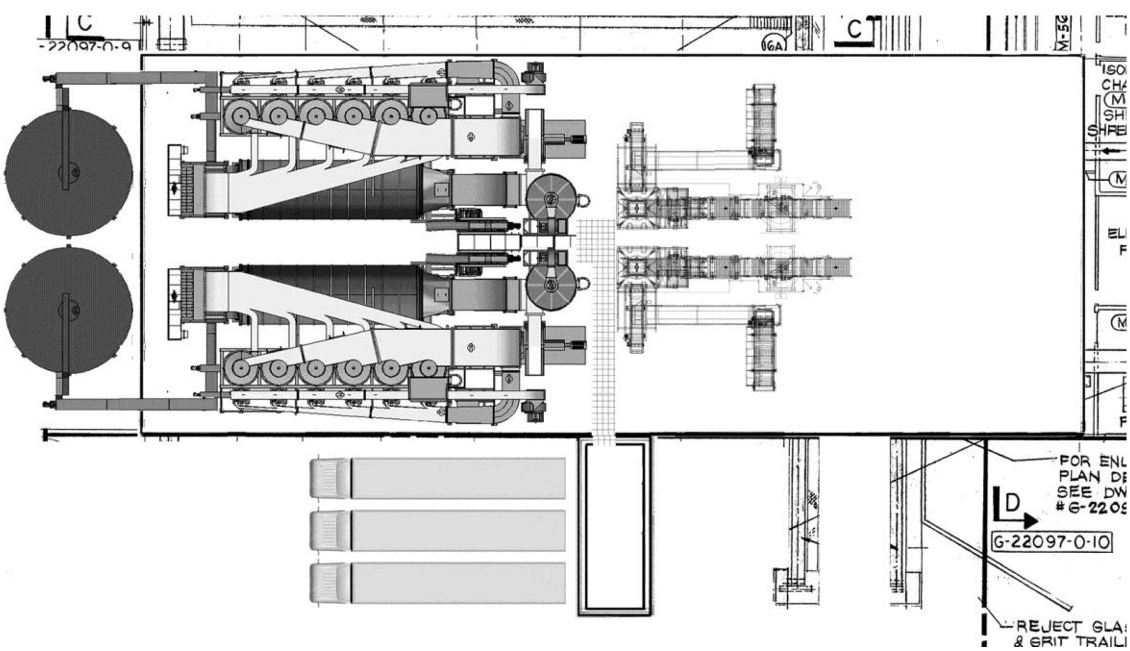
This amount (726,000) Cubic Feet of bales would be stored 3 bales high at about (3.5’) high per bale. The other dimensions of the bales are (5’ long) and (4’ wide) equaling, (3.5’ x 5’ x 4’ = 70 CF) per bale. Floor space required to store bales only (not including handling area and air and void spacing is roughly (68’ x 300’ – 20,400 SF) for a floor load of about (1,120 Lbs. per SF) on a (4”) slab with about (3,000 *psi*).

A truck drive path represents about (16’) wide and will stage (3) trucks and trailers at a time. Handling and stacking equipment inside the building will require (4) handlers for the (3) day vessel unloading duration but then drop to (2) necessary handlers and operators for the balance of the month between vessel loads.

Transfer Station Layout – Example



HT - Facility Layout – Example – Existing Plant



Capacity potential of 620,000 MTPY output with side by side TD Dryer systems and inline Apollo baling equipment.

Existing Views of Power Plant – Orrington, Maine

Truck tipping station is removed. The Phyto-HT facility to be commissioned inside yellow lined area and the silo towers to be erected outside and up against the west (true-southerly) wall.

Bale Transport to or from Vessel

Assumptions:				
Total Inbound Load RDF	15,000	MT		
Unload Rate*	5,000	MT		
Days to unload	3			
Hours Op Per Day	24	Hours		
Total Unload Hours	72			
Unload Rate Per Hour	208.3	MT Per Hour		
Unload Rate Per Minute	3.5	MT p/Min		
Truck Capacity	27.0	MT		
Time to load each truck	7.8	Minutes		
Trucks Required	7.7	Per Hour		

Unload Calculations - Trucking

(8 Trucks per hour) x (24 hours per day) x(27 MT per load) ≈ (5,184 MT per day) * (3 Days) ≈ (15,552 MT Unload task)

Unloading Rate Daily	5000.0	MT	Per	24
Truck Capacity	27.0	MT	Per	Load
Loads Required	185.2	Loads	Per	Day
Loads Per Hour	7.7			
MT moved to PERC	**4,629**			
Miles to PERC	23.8	Miles		
Drive Time (Truck/Trailer)	35.0	Minutes		
Round trip (Drive only)	70.0	Minutes		
Hook (per Task)	7.0	Minutes		
Drop (per Task)	7.0	Minutes		
Total Per Cycle	84.0	Minutes		
Cycles per Hour	0.71	P/Hr.		
MT Per Load	27.0	MT		
MT Per Hour to PERC	19.3	Net MT P/Hr		
Hours per day	16.0	Hours		
Via Truck Per Day	308.6	MT	to PERC	
Drivers	5.0			
Days Vessel Unloading	3.0			
Delivered to PERC p/Vessel	4,629	MT to PERC		
MT Per Truck	27.0			
Truck Loads Required	171.4			
Hours per day	16.0			
Days Vessel Unloading	3.0			
Total Hours	48.0			
Trucks Per Hour	3.6			
Minutes per truck drop	16.8	Turn around per truck		

Balance to move to Transfer Station		
MT remaining to move to TS	10,371	MT
Per Day Move	3,457	MT
MT moved to Transfer Station	**15,000**	
Trucks per hour load rate	7.7	
Trucks to TS per hour	7.7	
MT Per Load (assume min. M1	27.0	
MT Per Hour to TS	208.3	
Hours of Unloading	72.0	
MT to TS	**15000**	
Move to PERC	4629	
Remain at TS	10,371	
Bale Weight MT	1	
Bale CF Per	70	
Total CF Bales to TS	726,000	
Vessel Load Per Vessel	15,000	
Moved to PERC per Vessel	4,629	
Stored in Transfer Building pe	10,371	

* Estimated Conservative

Analysis: Land Transportation One Way Loads - 150,000 MT Annual

System Design Name Plate		310,000	Annual	
Plant Throughput	MT	35.7	Per Hour	
	US Ton	39.3	Per Hour	
Operating Hours		4,500	Annual	
Annual Production	MT	160,650	51.82% As % of Capacity	
	US Ton	176,715		
One way transport:				
Trip distance		23.8	Statute Miles	
Trailers 8' x 45'				
Metric Tons Per Load		27.0		
US Ton Per Load		29.7		
Average MT Per Vessel		15,000	Per Vessel	
Trailer Loads Per Vessel		555.56	Loads Per Vessel	
Miles Portal to Portal		23.8	Plant to Transfer Station	
Timed Trip Duration		33.0	Minutes to Transfer Station Loaded	
Dead Load Back		33.0	Minutes to Facility Empty	
Total Minutes		66.0	Round Trip	
MT Moved by Truck - Timing		0.41	Per Minute	
MT Moved by Truck - Per Hour		24.55	Per Hour	
Vessel Loads Volume		15,000	MT	
Driving Hours Required		611	Hours Per Vessel	
Drivers	4	In-house employees		
Hours Per Week	40	Per Driver P/Wk		
Weekly Driver Hours	160	Total Weekly Hours - Drive Time		
MT Delivered Weekly	3,927			
Monthly Movement	15,709	Potential Movement		
Annual Movement	188,509	(-Deficit/Surplus)		27,859
Notes:				
Tractors	3	Owned/Leased/Subcontracted		
Trailers	6	Owned/Leased/Subcontracted (2) on the road, (2) at Facility loading & (2) at Transfer Station Unloading		

Annual Off-Take Demand: Inland Transport Calculations to Meet Demand

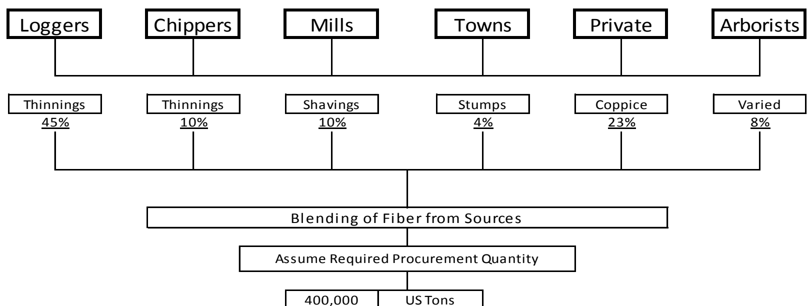
Annual Throughput	160,650	KMTPY Per Yr. Produced	
Base Contract	150,000	KMTPY Base Increments	
(-Deficit/Surplus)	10,650	Annual	
Independent Drivers		*One Way*	*Round Trip Loaded*
Transport Cost Per MT		$ 9.00	$ 5.40
Vessel MT Each		15,000	15,000
Vessel One Way Transport		$ 135,000	$ 81,000
Cost Per Truck Loan		$ 243.00	$ 145.80
In-House Drivers			
Transport Cost Per MT		$ 7.20	$ 4.32
Vessel MT Each		15,000	15,000
Vessel One Way Transport		$ 108,000	$ 64,800
Cost Per Truck Loan		$ 194.40	$ 116.64
Per MT Savings	Savings	$ 1.80	$ 1.08
Per Truck Savings	Savings	$ 48.60	$ 29.16
Per Vessel Savings	Savings	$ 27,000	$ 16,200

* *All numbers are estimated and for budgeting purposes.*

Fiber Handling – Processing Efficiencies

Maine is the ideal fiber hub for supply to the EU and UK. Deep water ports are closest to any destination in the UE from the US. The port facility is situated at the deep water port of Searsport, Maine and the potential for a privately owned deep water port is available six miles from Searsport (in the town of Bucksport) where the old Verso paper Mill was shut down in 2015. Bucksport is closer to the UK and has deeper waters and has potential for dedicated service with international investment potentials. This project is situated at the port, and all of its feedstock sources are evenly distributed throughout the deep forest supply network, and along the only rail line that terminates at a deep water port and with supply hubs at the Golden Road in Millinocket and from the Canadian township of Lac Megantic.

Wood chips would arrive by rail and by truck. The dominate transport method preferred is by rail as the carbon footprint would be reduced by elimination of as much of the inbound trucking activity as possible. It is anticipated that in excess of 70% of fiber can be sourced by rail transport. The logistical and supply efficiency benefit of rail movement is two-fold. Typical logging operations incur extraordinary challenges in disposing of thinnings and residual fiber while they are cutting for merchantable timbers. With rail sidings situated throughout the Maine fiber basket the reliance upon rail sidings as collection points is greatly enhanced and every logger would be closely situated to a rail siding so that disposal of residual becomes a matter of "waste management" and not a long-haul transportation problem. Further the delivery of fiber by truck ranges from a low of $8.00 to a high of $19.00 per US short ton, depending on distance to the processing hub. Transportation modeling for inbound fiber sourcing, by rail, to fiber hub centers averages $6.50 per US short ton and rail car payloads range from 70 MT to 80 MT depending on the equipment and the particular track to be traversed.



Source	Fiber	%	Volume	Fiber $	Budget
Loggers	Thinnings	45%	180,000	$ 29.00	$ 5,220,000
Chippers	Thinnings	10%	40,000	$ 29.00	$ 1,160,000
Mills	Shavings	10%	40,000	$ 24.00	$ 960,000
Towns	Stumps	4%	16,000	$ (45.00)	$ (720,000)
Private	Coppice	23%	92,000	$ 24.00	$ 2,208,000
Arborists	Varied	8%	32,000	$ -	$ -
			400,000		$ 8,828,000
As received to fiber yard				Average P-US Ton	$ 22.07

Blended - Estimated Fiber	$ 22.07	68.8%
Processing: Handle, Sort, Debark, Chips, Deliver JIT	$ 6.75	21.0%
OP/OHP	$ 3.25	10.1%
Delivered JIT	$ 32.07	

Note: The above is a general overview of the process of collection, selection, handling and distribution of fiber from forest to furnace at the HT plant. These numbers are indicative of the process utilized to ensure cost containment principles at the same time ensuring JIT delivery is not just a timely operation but also a critical component of quality control at the burner.

<u>Wood chips are produced from a number of sources:</u>
(1) Short roundwood, produced as part of forestry harvesting, as the smallest diameter part of the recovered timber – typically from 5cm (2") to 15cm (6").
(2) Secondary processing from sawmills and lumber yards will produce various supplies of timber materials which can be processed and blended into wood chips.
(3) Logging residues from primary forestry harvesting comprise the top and side branches of the trees; these are usually left in the forest and are not recovered for use.

(4) Short Rotation Coppicing of suitable species of energy crops – hybrid pines from afforestation, plantations and reclamation plantings on underutilized farmlands.
(5) Chipped and or ground wood from municipalities (paying a tipping fee) disposing of stumps.
(6) Chipped and or ground wood from arborists disposing of trimmings derived from utility line clearing, road side cuttings, weather related storm cuttings and home-owner clearings.

Introduction to Business Development Strategy and Commitment
Three of the most important characteristics integral to strategic competitiveness are “Cost Leadership” - “Differentiation” and “Focus”.[60] In pursuing an advantage across market scope and abroad this writer promotes a blended adherence to all three strategies. *Cost leadership* in the context of this paper refers to a strict adherence to obtaining and maintaining “Low Cost Provider” status. Next, we create a position of *Differentiation* where we pursue creating a uniquely desirable product. Finally, we *Focus* on a hybrid ‘Focused Low-Cost’ strategy, to deliver a specific product, manufactured with proprietary technology, where the offering applies to a defined niche market, within the Combined Heat and Power (CHP) industry centered in a precise geographical region. The implementation of two or more of these strategies – in measured levels – will produce the best results. However, there is no path to a long-term, sustainable relationship unless each and every party to the transaction has its own level of equity in the deal. Reaching that point where each party can commit to the other is the point where a true relations begins.

Low Cost Provider:
The objective of a company using a low-cost provider strategy is to sell its products at the lowest possible price to attract customers. This provides a unique price advantage. The entire philosophy relies on low costs not low price. Where low price infers discounting a product at lower margins, low cost means a product can be delivered at a lower price but with desired margins that can tend to be wider than traditional Proforma. A dollar cut from the top reduces profit margins. In bottom up pricing – the margin can be maintained because the dollar cut from cost goes directly to the bottom-line. The result is the ability to create a wider margin that can be shared with a client which in turn increases the potential of more market share. This strategy is best implemented in an ‘Open Book’ relationship where cost items are analyzed by the parties to determine where the best advantages are gained and what can be done to adjust or enhance those advantages. This requires a ‘Commitment’ to each other built upon ‘Trust’. Commitment and trust are, per se, desirable qualitative outcomes. In addition they may lead to other qualitative outcomes like reduced propensity to leave, reduced functional conflict and uncertainty and increased cooperation. These outcomes promote improved marketing results.[61]

Differentiation:
Heat Treated – Phytosanitation (pasteurization) of wood chips, manufactured and processed to exacting designer specifications, densified by compaction and baling, derived of proprietary technology, delivered by utilization of lowest carbon footprint ‘forest to furnace’ methodologies and streamlined infrastructure modalities provides a unique resource and capability difficult to easily replicate.[62]

Focused Low-Cost:
The focused low-cost strategy creates a price advantage. The company aims to be the most economical supplier in this niche but not necessarily in the overall market.[63] In this strategy a provider can offer to a very narrow market-buyer (one early committed buyer) the opportunity for below market rate pricing, for longer term, stronger and more durable contracts while still achieving a fair desired margin and favorable pricing for the buyer at the same time. Here, the objective is to reach equity for all parties. This strategy is likely to be the one that builds the most durable and long-term Alliances and Trading Relationships preferred.

Project Summation and Implementation Commentary:
Four structural dynamic are necessary for the achievement of any major goal. The project developer must recognize an opportunity for the establishment of a project, venture or development of significance – well in advance of others. In the instant project we have the obvious before us. A mandated driven, exponential demand for renewable energy materials (woody biomass) for Combined Heat and Power generation throughout the EU and the UK, and that demand imposing ever increasing strain on regionally proportion to the regulatory controls placed upon regional fiber sourcing at the plant. Couple this market condition with the demise of the paper manufacturing industry throughout Maine, which saw 73% of its plants closed in the past 5 to 7 years along with 50% or more of power plant closings paralleling the paper demise. The result is 5 million US tons annually of fiber with little or no place to go – and this fiber is derived of other operations that impose no new cutting or utilization of net gained forest growth and expansion.

Put two ends of the spectrum together and situate the supply at the mouth of one of the closest deep water ports to the UK or EU and that port is at the base of the rail line that traverses the entire State of Maine. And, the fiber yard is at the port, on the immediately adjacent land mass of the port operator, and the land owner has the capacity both financially and physically, to build a transfer station for handling and storing of renewable fuel products for import or export. Taking into consideration the supply and demand components speak for themselves and the opportunity is obvious – next we review the necessary component resources to make the project successful.

The referenced Phytosanitation Heat-Treatment (HT) facility will be built inside the existing walls of a major power plant, operating in excess of 30 years and situated near the port. The power plant generates steam, which produces hot air for wood chip drying. It produces power, and that power can be provided the HT plant with below market electricity. The drying of wood chips is a function of steam which is a clean heat source, absent reliance upon wood fired burners, natural or compressed gas, and fossil fuel of any type. Construction of the HT facility within the envelope of the existing power plant will streamline construction costs and time frame significantly. Add to this the inland transport of fiber to the dryer from the fiber hub and the resulting back-haul of HT wood chips to the same yard prior to shipping. A fully trained and available skilled workforce can be mobilized to manage the HT facility from the ranks of paper manufacturing employees originally displaced by plant closures.

The above only takes into consideration the singular transaction of producing and supplying biomass to a CHP plant in the UK or EU. It does not yet consider a key component that so significantly impacts the project that it is inconceivable for one not to fully comprehend the perfect storm of opportunities ahead. The power plant that will house the HT facility is in and of itself an electric generating plant that runs on a source of its own renewable energy material known as refuse derived fuel (RDF). This power plant intends to secure its energy source from the UK in the form of bales of RDF. This RDF will come from Ireland in vessel loads of approximately 15,000 MT per vessel. It will arrive at the deep water port that will be utilized for shipping biomass wood chips also destined for the UK on the identical vessel type with identical loading and loading characteristics. Both the RDF need and the Biomass Demand are – at the very least – similar is quantity and term of supply. Baled wood chips are produced and condensed to obtain the maximum density necessary to obtain reduced ocean freight cargo costs for the buyer.

Back to back vessels of at a minimum of approximately (150,000 to 180,000) MT of renewable fuel shipped each way, on (10 to 12) vessels per year for a period not less than (10) years. The advantageous back haul synergies of this ocean voyage are beyond the need for explanation. In addition to this, the transfer station at the port can be utilized for storage and handling of both products both ways – and the 24/7 delivery of RDF to the plant will be accompanied by an equal back haul of wood chips to the port. This reduces inland transport costs by about 40%. Both market demands are elastic and self-supporting because supply is in abundance at both ends. To produce more wood chips, the facility with demand more stream. To produce more steam the power plant will require more RDF. RDF is in large supply and the movement of RDF to the power plant will provide for a larger supply of biomass. Name plated production capacity of the HT facility is 310,000 MTPY for one line and a scale up of a second line is immediately and imminently possible to implement – and a marginal increase in CAPEX especially in the first nine months of the construction build-out.

An aggregation of components gives us; Exponential demand, an abundant fiber supply, efficiently blended and processed fiber at reduced costs, low carbon foot print rail transportation, direct rail line access to deep water port, deep water port closest to any location in the UK or EU from the US, significantly reduced CAPEX and construction schedule, available and highly skilled workforce, inland transport savings enhanced by back haul synergies – ocean freight savings enhanced by back haul synergies, built in demand and supply characteristics for both sides of the equation.

Additionally, the capital resources for the project must be either fully or at least partially available to implement the overall project plan – or they must be attainable upon proving-out milestones in the project planning and progression. Rarely is there a huge block of cash or capital just sitting and waiting for a project to come about. However, the parties to any development must be able to accumulate necessary seed funding for research and development and then be able to enhance the funding stream incrementally until such time it becomes obvious that the project 'has legs' and it warrants in-depth financial review and analysis. If it is decided that the project has sufficient merit to go forward, then the funding work must commence with earnest.

Typically, if a project is envisioned from within the walls of a key stakeholder or a primary project benefactor, there is likely to be an essential focus on raising sufficient and timely capital. For some project developers this is akin to Nietzsche's look into the abyss. However, for enlightened and progressive thinking developers without Nietzsche's affliction of monsters and meaninglessness, there are bridges over any abyss. The abyss facing many projects is the Catch-22 of "If you build it they will come" often countered by the school of thought that "We will build it only after they come" – the two concepts do not coincide well unless there is a strategy that depends on both.

As an example, a project similar to the instant facility is scrutinized to assess the incremental costs necessary for stages of development. Assume projected budgets and the availability of funds for the entire project as broken out in stages of development. Where do we look for the funding? Do we utilize equity or debt financing? What portion of the entire project can be raised in-house and or by strategic alliances, lenders or investors? What can be used as collateral to obtain funding as needed?

A stand-alone project and budget is reviewed, from virgin soil up the entire construction and development budget for a 310,000 MTPY facility would approximate $13.5 million. Building it inside an existing facility would reduce CAPEX by $2.5 million. Establishing a JIT supply system will cut further capital requirements by $.5 million and utilizing steam and low cost electric would reduce the budget again by $.3 million. Expedited construction scheduling further reduces the budget by $.2 million. A $10 million budget is now established. Project developers could invest $2 to $3 million and obtain $7 to $8 million in loan commitments. Off-take contracts or binding LOI can secure added funds. Interested or motivated buyers may have incentives to participate in a project such as this in order to secure a dedicated – sustainable and affordable source of supply. Strategic alliances will often participate in partial funding to obtain preferential pricing or long-term supply exclusivity. Alliance partnering could be established in the form of partial equipment financing such as the purchase of necessary baling and handling equipment of $1 million – leased back to developer for a period of time – ensuring price preference and exclusivity would be the purpose.

Finally, the developer has to be willing and able to execute. This is the most important task yet under looked in many cases. Many projects are born of great ideas, with all of the components in place and plenty of funding – but, absent commitment from a developer/owner – the project goes nowhere.

Concept	Components	Funding	Execution	Probability
10	10	10	10	100%
10	10	9	10	90%
10	8	10	10	80%
9	8	10	10	72%
10	10	5	10	50%
10	10	10	5	50%
10	10	5	10	50%
10	10	5	8	40%
10	10	2	10	20%
10	10	10	0	0%

On a scale of 1 to 10 with 1 being lack of merit to the concept and a lack of ability to realize component, funding or execution tasks.

The above is a considered analysis of a project that is currently underway, and the content and discussion of the same is meant as an overview of the structural parameters of the project and its implementation plan. The content is meant to be used as an introduction and drill down into the remarkable opportunities provided with its implementation.

For inquiries please contact its author by utilizing the contact information below.

Arthur T. House,
EJD – Purdue Global Law School - Executive Juris Doctorate - (target graduation) May 2019
ABD - Nova Southeastern University, Fort Lauderdale, FL – International Marketing and Business Strategy, 2001
MBA - New Hampshire College, 1995 - Master of Business Administration; Marketing Management Specialty, 1995
Cornell University, Operation Management – Distance Learning Certificate, 1992
BS & AS - Keene State College, 1985 - Major: Business Management; Minor: Mathematics, 1985

Respectfully;

Arthur House
www.ArthurHouse.com
Belfast, Maine
Tel: 207-930-5168
E: art@arthurhouse.com
LinkedIn: https://www.linkedin.com/in/arthur-house-9220175/

EXHIBIT "A"

THOMPSON DRYERS

Osahada of Maine, LLC
177 East Main Street
Searsport, Maine 0497 4

August 1, 2018

Attn: Arthur T. House,
Renewable Energy Consultant

Re: "Exclusivity Authorization" to Represent & Resell TD Products and Oversee Construction and Implementation of TD Systems - Throughout Maine

Dear Mr. House;

This letter is to confirm this "Exclusivity Authorization" in support of your long-term personal and professional efforts to assist Thompson Dryers in establishing and constructing its Phytosanitation Systems for Heat Treatment of Wood Chips for Biomass production or for the production of Heat Treated Medium Density Fiber (MDF) Quality Chips and or KRAFT Quality Paper Chips similar to those processed for one of your previous projects in September 2014 for a Germany based paper manufacturer. This document further authorizes you to select and designate a company or companies that you will prequalify as capable to build a TD System and who you may further transfer or assign your exclusive authorization to for the construction and commissioning of a TD System on a particular project.

You are hereby notified of our authorization for you to develop and implement an opportunity for TD to manufacture, produce and install a TD Phytosanitation System for one or more of your potential entities and or facilities in the near future as we have discussed. TD is motivated to assist your efforts in finalizing a potential HT System - for EU production at the PERC facility in Orrington, Maine and or upon the 20-acre parcel of land we visited in Stockton Springs, Maine a while ago. Our authorization requires you to be named and contractually engaged as the TD Dryers regional program/project management and overseer of any TD System installation under your development.

Your "Exclusivity Authorization" extends to Penobscot Energy Recovery Company (PERC) and its business agent, Mr. Stephen Kaminski, Esq. and now also particularly inclusive of Eastern Fuels, LLC and owner James Cox of Kentucky and or to their assigns as well as any future companies or project developers you register with TD in the state of Maine. TD does have the right to not register a future company or project developer if they are already a lead or customer of TD. TD understands that there exists a multiple unit potential to be installed over the 2018 - 2019 time-frame - pursuant to significant proven demand for production of HT Biomass for the EU market. Both regional territory and time frames for this authorization may be modified upon approval of TD if additional project sites are presented, registered, and approved.

The term of this authorization is two (2) years from the date of this letter.

Best regards,

Ted Thompson
CEO
Thompson Dryers

PH: (785) 272-7722 • FAX: (785) 272-4797 • ThompsonDryers.com

"Equipment should work like it's supposed to." - W. T. Thompson

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