Aroostook County, Maine
Industry Cluster Opportunity Analysis

Renewable Energy

Northern Maine Development Commission

Aroostook Partnership for Progress

June 25, 2010

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Renewable Energy

Note to the reader*:* ViTAL Economy developed this *Opportunity Analysis Report* to assist Northern Maine in forming, managing and participating in a Renewable Energy Industry Cluster.

The Table of Contents outlines your journey through three sections:

First – the Executive Summary presents an overall review of the regional industry cluster and primary conclusions. The Executive Summary can be used as the basis for a presentation to community and industry leaders.

Second – General industry cluster background, analytical approach, and market analysis

Third – ViTAL Economy Alliance primary and secondary research is presented as the basis for assessment of each industry niche market. This analysis is followed by a cluster implementation strategy.

This document is to be used as a strategic tool and guide for determining action. Its focus and scope is to describe the business case for the industry sector and specific niche market opportunities, with general action recommendations. The guide is intended for those who are interested in pursuing business opportunities that can transform the Northern Maine regional economy. It describes how both the region and the industry sector can flourish through the creation of a *Renewable Energy Economy* in Northern Maine.

This document also provides an excellent communication tool for recruitment of additional industry cluster team members and for presentation to public officials and the community by NMDC and APP. As you move through this guide you will discover the roles of NMDC & APP, Cluster Teams, and entrepreneurs.

Table of Contents – Renewable Energy Opportunity Analysis

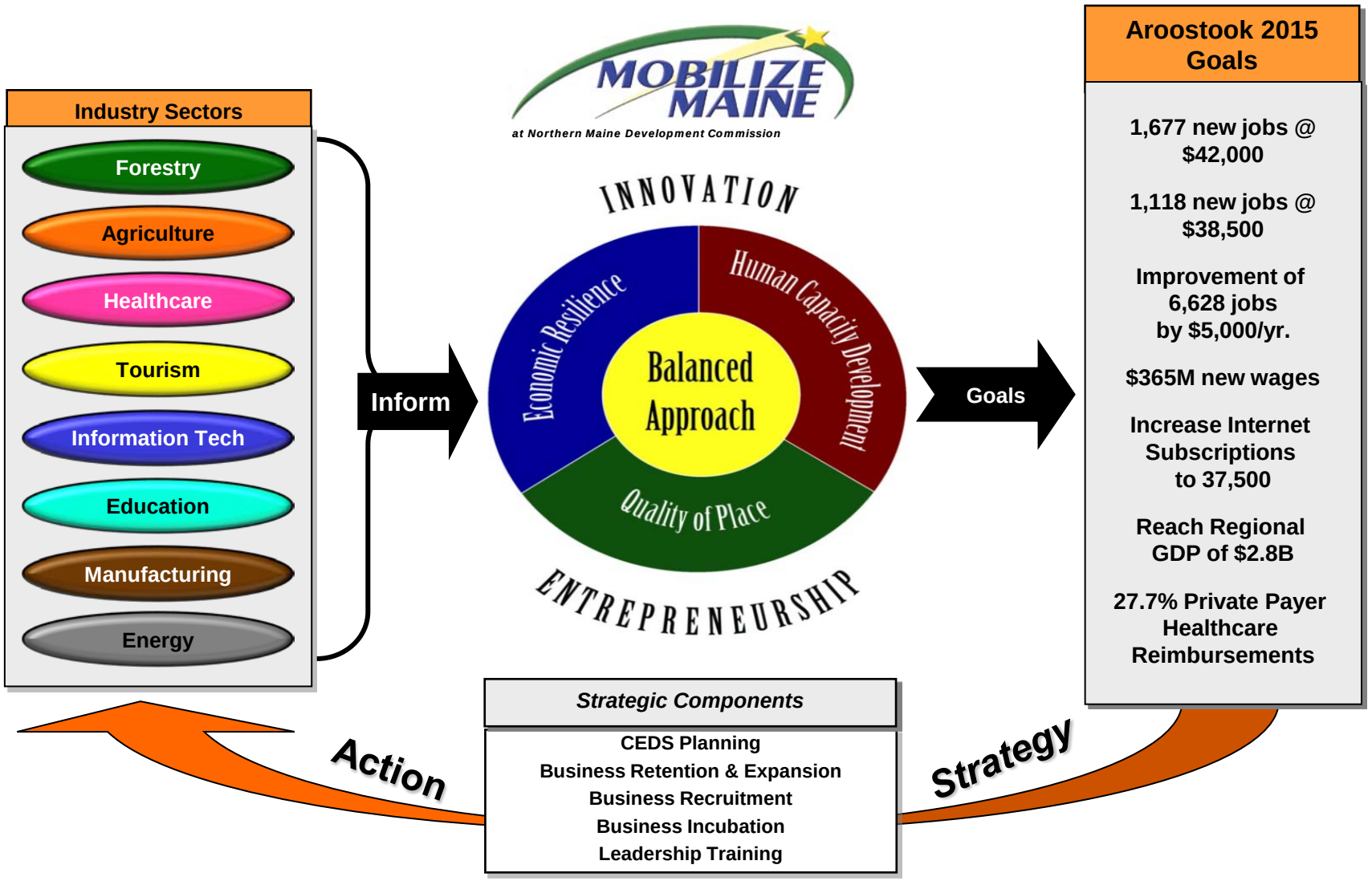
Renewable Energy

Executive Summary

Dirigo – "I Lead"

The opportunity values presented herein are based upon valuations and projections in the current economic environment. The impacts and outcomes may differ due to sequencing and speed of implementation or due to changing economic conditions.

Executive Summary



Aroostook County adopted the Mobilize Maine strategic approach beginning with setting specific 2015 economic goals to address the regions issues of challenge and opportunity. Information technology and energy sectors were select as the most promising for industry clusters.

Renewable Energy Industry Cluster Premise

- Aroostook County residents and businesses are burdened with high cost of electricity and dependence on the import of heating oil. This hampers the regions competiveness and exports wealth that reduces long-term economic potential.

Renewable Energy Industry Cluster Analysis Proposition

- The cluster can address this burden with locally available resources while creating and retaining jobs, inducing wealth creation/retention in the region, and contributing to the realization of Aroostook County's 2015 economic development vision and goals.

History and Regional Leadership

- The State of Maine has studied and endorsed industry clusters for over a decade.
- A statewide Energy and Environmental Technology industry networking group (E2 Tech) has been establish to help this industry sector grow and mature across the state.
- Aroostook County has successfully formed a public/private partnership, Aroostook Partnership for Progress (APP), with committed leadership to direct and support a transformational economic development strategy (Mobilize Maine)
- Aroostook County and Northern Maine Development Commission (NMDC) have been leaders in the principles and processes of the statewide asset based initiative, Mobilize Maine.
- Aroostook County has empowered business leaders, through action teams, to take a leadership role in the evaluation and implementation of strategies including data storage centers and network providers

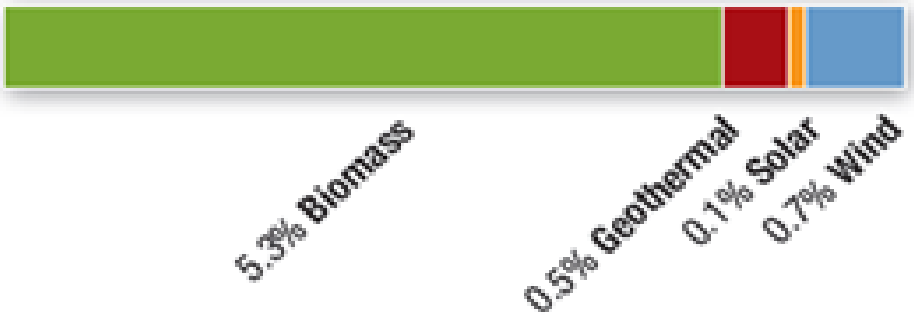
Global Energy Markets and Environmental Policy issues are significant drivers for creating an Aroostook Renewable Energy Economy

- Aroostook County residents carry twice the national average burden for residential energy cost (heating and electricity) compared to their household income.
- Aroostook County residents carry a 15% higher residential energy cost burden than their fellow Maine residents.
- Since 2004, Aroostook County electricity cost have risen over **48%** for residential customers and approximately **60%** for commercial customers.
- In 2007, Aroostook County businesses and homes spent $80.9 million for electrical energy and $52.1 Million for heating oil.

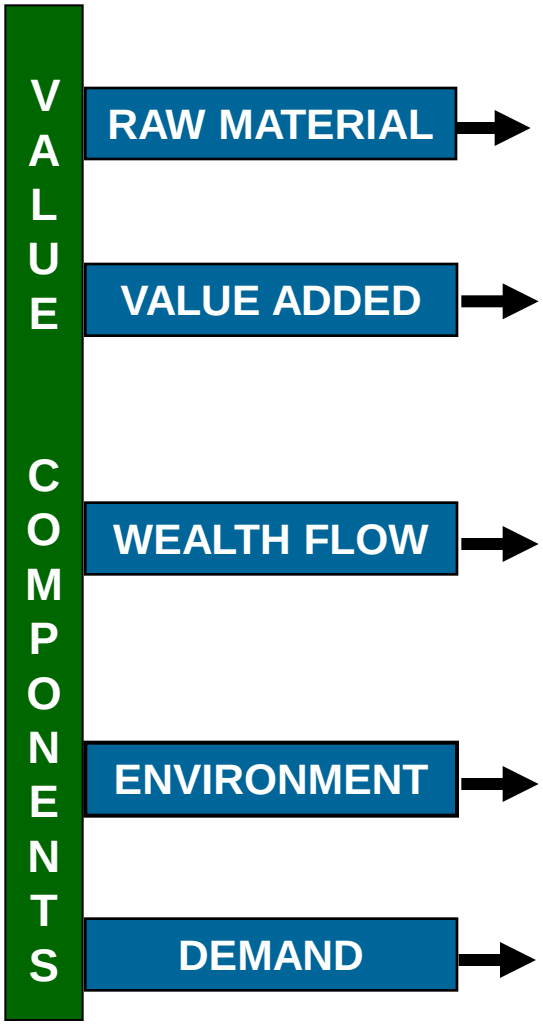
Aroostook has the assets to create a Renewable Energy Economy, especially from Farm and Forest biomass resources.

Renewable Energy Economy opportunities can create 666 direct jobs and 569 indirect and induced – more than 50% of the 2015 job goals

US Non-Hydro Renewable Energy Production: 4.9 Quadrillion Btu (2008)



Aroostook County Renewable Energy Economy Components



FARMERS - Utilize fallow land to produce additional income
FORESTRY – Renew industry and employment

PROCESSING/CONVERTERS – Mills, packaging, etc.
DISTRIBUTION – Storage, delivery trucks, convert oil retailers
MANUFACTURING – Specialized machinery, storage systems, mill equipment, stoves, etc.

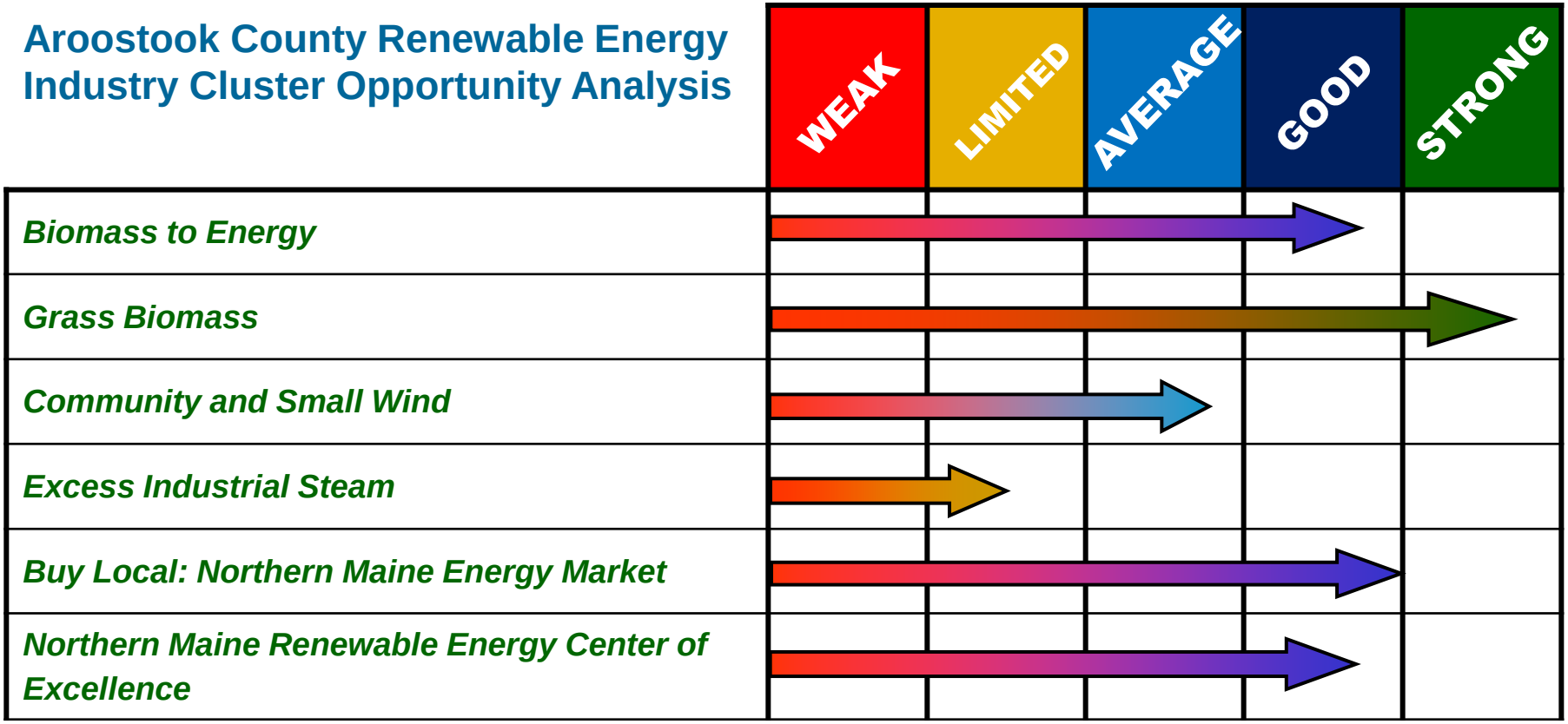
WEALTH CREATION Money stays in Aroostook for infrastructure improvements, improved curb appeal, new businesses and increased employment
Potential wealth creation, carbon credits, state and federal incentives, increased local tax generation

QUALITY OF LIFE - Air quality improvement from reduced home oil burners, pollution, land conservation, preservation, smart utilization of local resources

HOMEOWNERS Reduce heating costs, upgrade heat systems, added value to homes**.** State and federal incentives to offset installation costs

Aroostook County Renewable Energy Industry Cluster has identified six opportunities supporting the region's economic development goals

Aroostook County Renewable Energy Industry Cluster Opportunity Analysis



The strongest renewable energy opportunities in Aroostook County's come from biomass, both as a heating energy source and as a feedstock for generating electrical energy

Overall Market Rating → **GOOD**

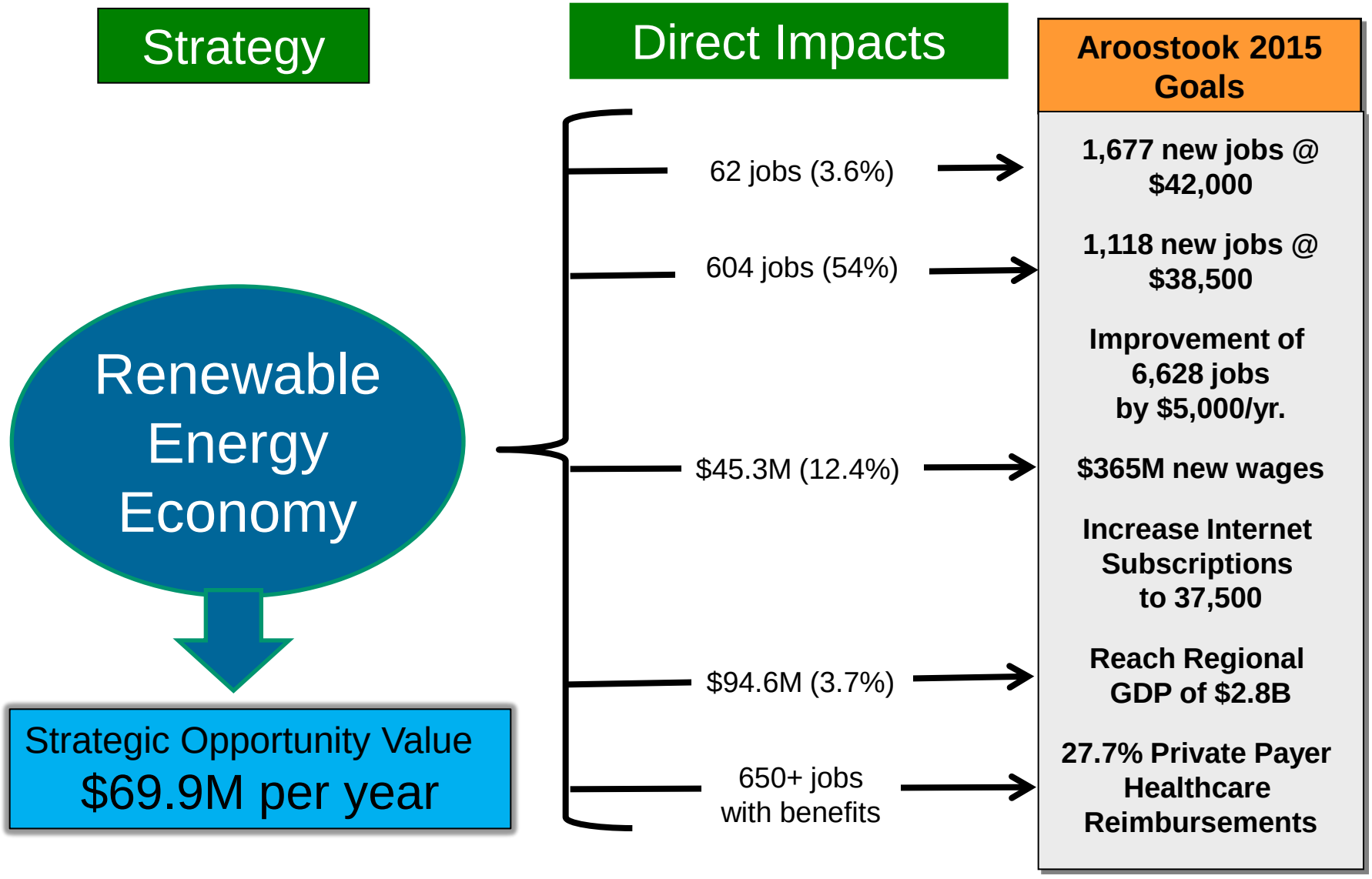
Renewable Energy Industry Cluster Vision & Economic Impact

Northern Maine will create a Renewable Energy Economy by utilizing alternative energy sources and being a innovation leader to capture wealth and stimulate the economy.

2014 Goals	Jobs	Value	GDP Impact
Develop 200MW of wind energy	Construction 224 Direct Jobs @ $35,900 168 Indirect Jobs @ $30,828 Operation: 12 Jobs @ $42,400 17 Indirect Jobs @ $25,738	Project Value 134 turbines @1500KW $389M Produced Energy value $52.5M 200MW x 30% = 60MW 60MW @ .10KW Direct & Indirect Earnings $14.2M	Construction $21M Operation $2.2M
Utilize 45,000 tons of locally sourced biomass for residential and commercial heating	Fuel sourcing & production: 90 Direct Jobs @ $35,000 67 indirect Jobs @ $26,601 Construction & installation 40 Direct Jobs @ $35,000 30 Indirect Jobs @ $30,829	Fuel Value $11.2M Direct & Indirect Earnings $7.2M Consumer wealth retention $6.9M	Fuel sourcing & production $8.4M Construction $3.7M Consumer wealth retention $6.9M
Capture and retain 50MW of locally generated power	250 Direct Jobs @ $34,386 250 Indirect Jobs @ $27,226	Energy value $12.2M Direct & Indirect Earnings $20.6M	Energy generation $46.5M
Realize 50 jobs at $42,000+ linked to renewable energy R&D	50 Direct Jobs @ $42,000+ 37 Indirect Jobs@ $30,517	Employment earnings $3.3M+	Local R&D $5.9M
Total	**666 Direct Jobs** **569 Indirect & Induced Jobs**	**Project investment value $389M** **Energy/fuel value $75.9M** **Earnings $45.3M**	**Total $94.6M** **Yearly $69.9M**

Economic impact estimates developed using the Northern New England Economic Scenario Model

Renewable Energy Industry Cluster Vision and Goals Support the Regions 2015 Economic Vision



Strategic Financial Requirements to Implement the Northern Maine Renewable Energy Economy

Investment Use	Uses of Financing	Amount of Financing Required	Potential Sources of Financing	Availability in Aroostook County
Biomass to Energy	New Business development and credit lines Heating equipment and weatherization construction	$60M Equity/Debt/Grants	• Efficiency Maine Trust • Home and building owner • NMDC • Local banks	
Grass Biomass	New business development and credit lines Processing capital equipment,	Plant & Equipment $2.3M (Equity/Debt)	• Angel investors • NMDC • Local banks • Maine Technology Institute	

Small 5MW
 	
Community Wind 20MW
	Small residential /commercial wind installations
	Development of large community wind installations
		$2.5M
		(Equity/Debt)
		
		$70M
		(Equity/Debt)
			• Small Wind
			  • Home/business owner
			  • NMDC
			• Community Wind
			  • Landowner
			  • Public
				

Buy Local: Northern Maine Energy Market	Energy Park: Engineering and installation of electrical distribution infrastructure	$400,000 (debt)	• NMDC • Banks	
Northern Maine Renewable Energy Center of Excellence	Program startup funding	$600,000 (Institutions $100,000/year) (Industry $50,000/year) (Grants $150,000)	• Energy industry leaders • Maine Technology Institute • Maine University and College System • National Science Foundation	

 = None  = Weak  = Average  = Good  = Strong

Aroostook County Renewable Energy Economy Strategic Elements

INNOVATION
UMPI, UMFK, UMaine & NMCC must lead in the develop of R&D and workforce training programs attracting young thinkers and linking to regional industry

FINANCE
The region must develop an integrated finance structure to supply specialty forms of financing for energy efficiency modifications and heating system conversions

CONNECTIVITY
The region must be leading the US in the availability and 24x7 boundary free uses and access to broadband services

NATURAL RESOURCE
Forest and Farm biomass resources form the foundation of this industry in Aroostook County

Aroostook Renewable Energy Economy

VALUE ADDED PROCESSING
Pellet and Chip manufacturers converting biomass for forest and farm into heating fuel material. Distribution systems deliver product to consumer.

ENTREPRENUERSHIP
The region must embed a climate of entrepreneurship from grade school education to community leaders

MARKETING & COMMUNICATIONS
A strategic and consistent internal and external communication plan must be implemented to promote the use of Aroostook energy products and resources

INDUSTRY NETWORKS
Informal and formal industry networks must be create locally, regionally, nationally and globally

Future of the Renewable Energy Industry Cluster: The renewable energy industry cluster exists today in Northern Maine as a disconnected group of assets and natural resources; and it may for many years to come. The key role of an industry cluster team is to connect and leverage these assets to achieve the region's economic vision.

Keys to Success of a Renewable Energy Industry Cluster Team

- **Establishment of Industry Cluster Team Leadership**
  - This industry cluster team identify and empower leadership to take the reins of the initiative immediately.
  - Cluster leaders are responsible for organizing the cluster, communicating the vision, recruiting cluster participants, and assuring the implementation of cluster actions and achievement of the goals.
- **Establish of Action Teams**
  - Cluster leadership should immediately establish action teams around each strategic opportunity identified in the first phase. Action teams should be comprised of key industry representatives who have a role or knowledge in the implementation of the action.
  - Action teams should be empowered to pursue clearly defined objectives

- **Build the Business Case (over the next 6 months)**
  - Each of the six opportunities require additional refinement and feasibility studies. This in many cases does not require significant funding or resources outside of the industry cluster team. The team possess the market knowledge, expertise and entrepreneur spirit to develop a strong business plan.
  - As the refined business plan is developed, it should always have a quantified opportunity value and be linked directly back to the overall Aroostook County vision and goals.
- **Role of Economic Development Professionals (Consistently)**
  - Regional economic development organizations and professionals are sponsors and facilitators of the industry cluster teams.
  - Industry cluster teams become an efficient and very effective point of contact for industry. Economic, educational, workforce development and others should tap the industry cluster team for strategic direction and the appropriate use of resources.
- **Celebrate Short Term Wins! (Appropriate times with communication and events)**
  - Short term wins come in may forms, typically starting small with growth in industry cluster team participants, to much larger wins such as new business starts or expansions.

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Background

Dirigo – "I Lead"

Aroostook County citizens have the opportunity to seize control of their economic destiny and lead Maine on a path to prosperity.

Aroostook County leadership adopted a path to prosperity with development of a measurable economic vision.

Achievement of the vision requires leveraging of assets within their control, and an entrepreneurial spirit that's empowers thousands of its citizens.

The time is now and the opportunity resides in *The County*!

Key Issues Facing US Economy Today

- Significant and dynamic changes in the national and global economic structure
  - Instability with sovereign nations has created worldwide trade and financial volatility
  - Increased government intervention in the private sector (Banking, Insurance, Auto industries)
  - Increasing debt to GDP in many countries may slow economic growth
  - Inflation and currency devaluation may be inevitable
- Awareness and focus on local and global environmental issues
  - Growing realization that natural resource have been exploited and poorly managed
  - Resources are now being recognized as important, wisely used and held in stewardship for future generations.
  - Life-cycle consciousness of transportation costs and environmental impacts shipping goods long distances.
  - Significant interest and investment in “Clean Technologies”.
- Prevailing high unemployment
  - “Jobless Recovery” is prevailing outlook for 2010-2012
  - Federal economic stimulus spending many not be enough to bridge the gap to economic recovery
  - New banking and credit lending practices are affecting business expansion and development
- Consumer confidence and spending is still flat
  - Consumer confidence is eroding as unemployment remains high
  - Business expansion, investment and R&D has been diminished

Impact of Economic Changes on Regional Economies

- Regional economies are competing against national economic strategies
  - The World is Flat...Boundaries are irrelevant...neighbors are not your competition
- Pace and volatility of change is increasing
  - Economic crisis is ultimate sense of urgency to drive desire to collaborate
- Environmental issues impact regional economies as much as economic crisis
  - Carbon footprint & security risks of extended supply chains are now in view presenting opportunities for regional economies to offer alternate solutions
- Trust in large scale capitalism has declined
  - Economic growth through innovation enabled by regional capital investment
  - New opportunities for sustainable regional economies (produce and consume locally)
- Current economic crisis is accelerating change in human capital requirements
  - Linkage of workforce & economic development is critical to regional growth
- The cavalry is not coming to save the day...regions control their destiny
  - CED is everyone's job, regional capital & funding structures are critical

How Can Regional Economies Respond to New Reality

- Establish measurable visions & goals to replace project driven strategies
  - Need collaborative systems & networks to drive sustainable regional transformation
- Re-orient traditional mindsets to respond to global 24/7 economic reality
  - Connectivity strategies are critical to create critical mass and economic expansion
  - Realization that your neighbor is not your competition, but rather a partner
- Replace traditional industrial attraction strategies with well managed asset-based CED
  - Quality of Place is critical in a “live where you want, work where you live world”
- Develop regional Innovation Eco-Systems to connect innovation assets
  - Silo mentality and operations in incubator, SBDC, tech transfer, R&D, finance resources inhibit growth
  - Implement industry cluster development strategies supporting local innovation
- Commit to collaborative funding structures to take control of regions destiny
  - Regions must move away from “grant dependence” that drives priorities

Background *(Cont)*

The State of Maine has studied and endorsed industry cluster strategies for almost a decade. In 2002, the Maine Science & Technology Foundation (MSTF) released a study of the seven sectors for focus by R&D programs. In 2006, the Brookings Institution's report identified clusters as key to Maine's economic development followed by Michael Porter's preliminary cluster assessment of the Maine Economy.

State of Maine's Seven Targeted Sectors

- Biotechnology
- Composites & Advanced Materials
- Environmental Technologies
- **Forest Products & Agriculture**
- Information Technology
- Marine Technology & Aquaculture
- Precision Manufacturing

In 2003, Aroostook County also completed an economic cluster report reviewing forest products, agriculture, tourism, IT and precision manufacturing industry clusters. The report highlighted four common themes across all the industry clusters; New Brunswick is a resource for Aroostook County's economic growth, the nascent IT industry sector is important and can support the success of other clusters, the region has three institutions of higher education that are great assets that should be leveraged and lastly that the regions geographic location results in significant transportation issues.

During the spring and summer of 2009, Northern Maine Development Commission (NMDC) and Aroostook Partnership for Progress (APP) joined with the other Economic Development Districts in Maine to launch a statewide Mobilize Maine initiative. An essential element of this asset-based approach to community economic development (CED) is the assessment of targeted Industry clusters and the establishment of industry cluster teams at a regional level. NMDC and APP decided to build off of previous efforts and lead Maine in industry cluster opportunity analysis.

Background *(Cont)*

Aroostook County has successfully formed a public/private partnership to lead the regions economic transformation and adopt an asset based economic develop strategy

- **Aroostook Partnership for Progress** (APP) mission is to attract additional jobs and investment to the county. Private sector companies committed to economic transformation include;

  Acadia Federal Credit Union
  Cary Medical Center
  Daigle Oil
  Dead River Company
  F. A. Peabody
  Fairpoint Communications
  Katahdin Cedar Log Homes
  Katahdin Trust Company
  Sheridan Corporation
  United Insurance
  Connect North America
  LEADers Encouraging Aroostook Development
  MMG Insurance
  Maine Public Service Company
  Northern Maine Development Commission
  NorState Federal Credit Union
  The Aroostook Medical Center
  KeyBank
  Northern Maine Medical Center
  The County Federal Credit Union

- Additionally**, Northern Maine Development Commission (NMDC)** provides federal and state services and brings together all cities and towns to the region in a number of groups
  - Aroostook County Tourism
  - Aroostook Partnership for Progress
  - Northern Maine Finance Corporation
  - Aroostook Washington County Local Workforce Investment Board
  - Northern Maine Solid Waste Management Committee
  - Aroostook Municipal Association
  - Leaders Encouraging Aroostook Development

- APP and NMDC embraced **Mobilize Maine** which is a statewide asset based collaborative grass roots community economic development process. This new partnership is building upon the strengths and unique assets of Aroostook County.

Background *(Cont)*

Purpose of Mobilize Maine

- Develop and expand CED leadership base within the EDD regions
- Create a consistent asset based CED process across the state
- Build a common set of goals and economic metrics across the state
- Assemble a statewide grassroots public private partnership to

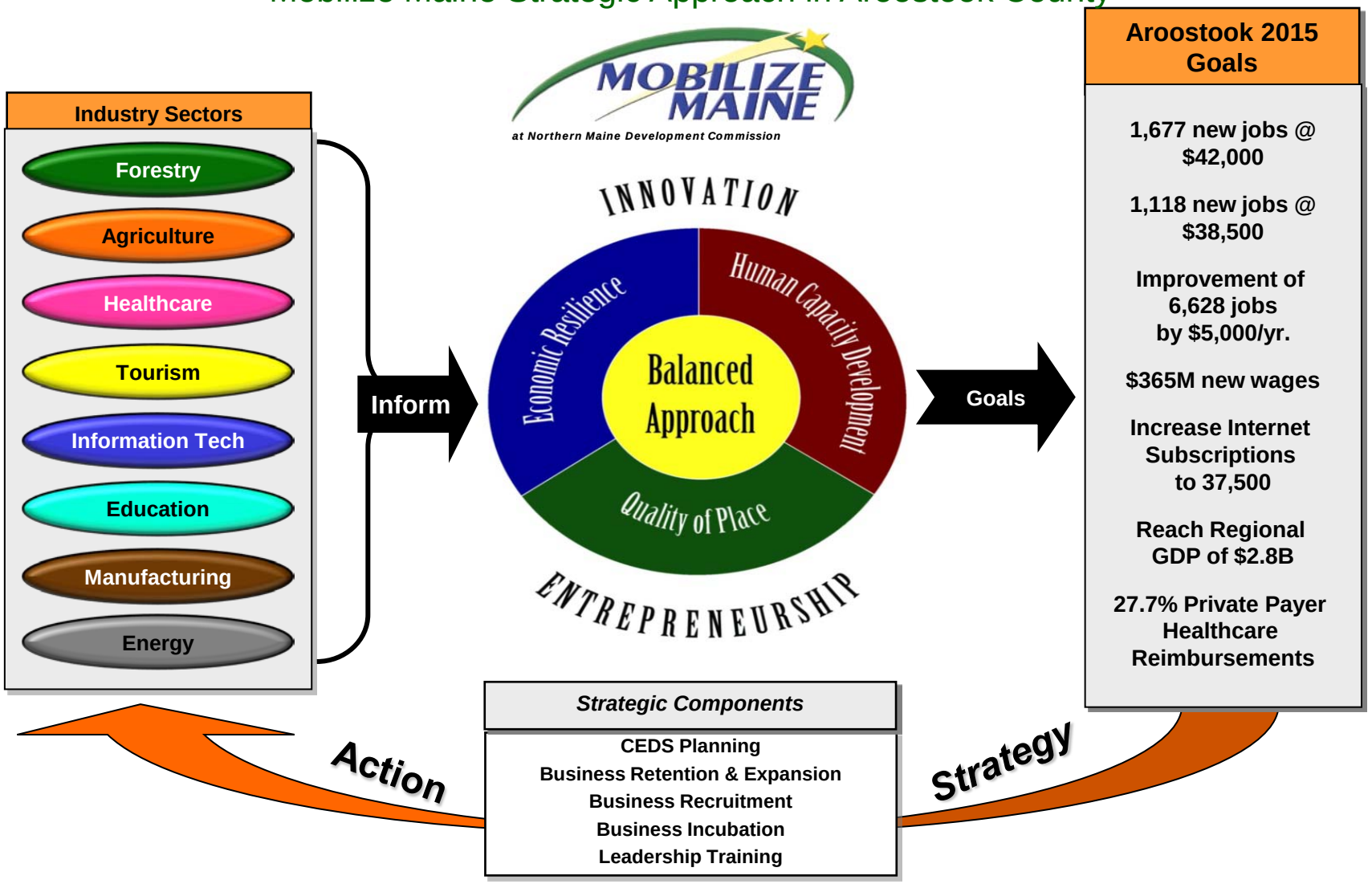
Mobilize Maine uses a “triple bottom-line” balanced approach supporting Maine values and priorities

- **Economic resilience** – diversification of the regions economy by leveraging their unique indigenous assets to withstand economic volatility
- **Human capital development** - strengthen the well being of the citizens with a priority on developing sufficient skills, knowledge and adaptability to compete in a 21st century economy
- **Quality of Place** – invest in adequate infrastructure, cultural assets and environmental attractiveness to support future enterprises

Asset based community economic development strategies require identification of a region’s key industry sectors that can drive the economy. These sectors form industry lead cluster teams that inform the strategic elements driving towards the economic goals. The goals become a filtering mechanism as the regions expand opportunities and need a method to prioritize them.

Mobilize Maine does not displace current economic development programs but enhances them by identifying the hidden potential within the regions. Economic development organizations, cities, town and businesses should utilize the robust data and information acquired to improve region and personal prosperity. Mobilize Maine encourages innovation and entrepreneurship in every aspect of the region’s culture and society.

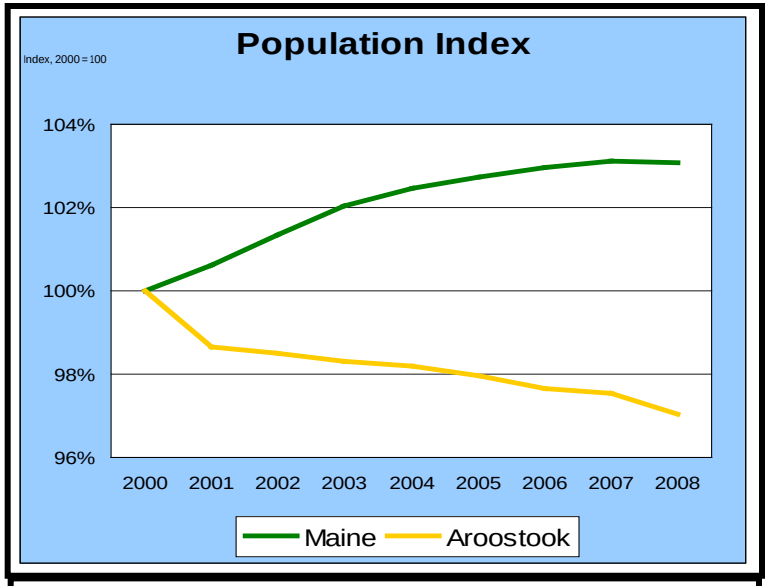
Mobilize Maine Strategic Approach in Aroostook County



Aroostook County adopted the Mobilize Maine strategic approach beginning with setting specific 2015 economic goals to address the regions issues of challenge and opportunity. Information technology and energy sectors were select as the most promising for industry clusters.

Aroostook Issues of Challenge

- Demographics, income, age and educational attainment
  - Per capita income 20% less than State average
  - Average age of 44 versus 42 in Maine
  - Trailing Maine in higher education completers 25 and older, 26% vs. 33%
- Three decades of economic decline punctuated by the Loring AFB closure and compounded by increased international forest products competition
- Aroostook County poverty rate has been 30% greater than the State of Maine for over two decades
  - 12,500+ Aroostook citizens living in poverty
- Aroostook County is paying a high price for energy exporting their wealth due to;
  - Over 2/3 homes use #2 heating oil
  - High electrical rates due to isolation on the Northern New England grid



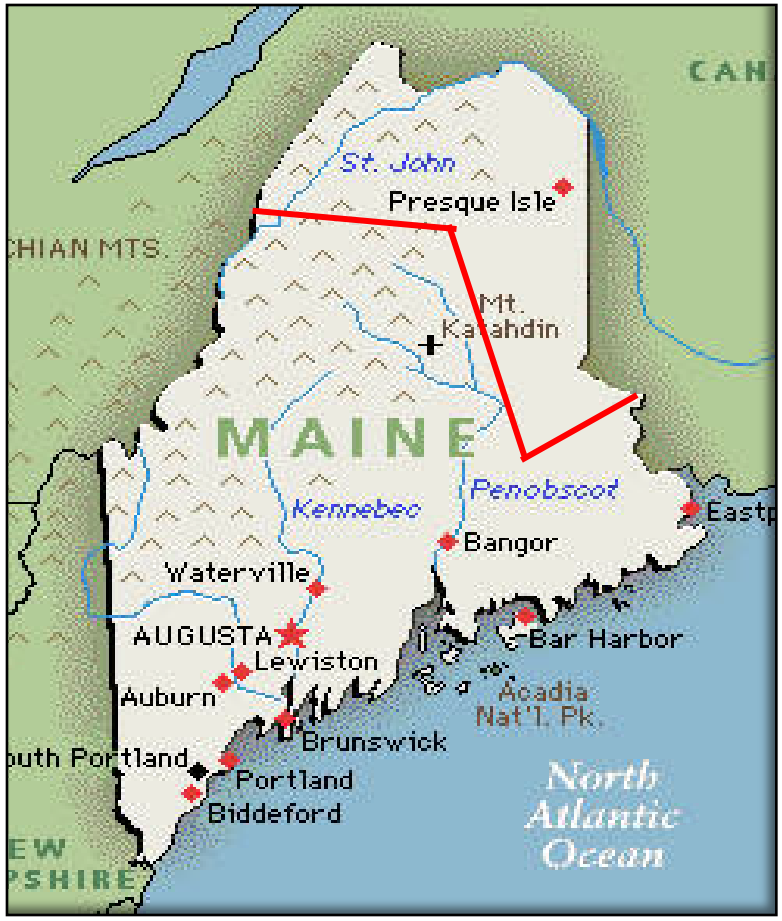
2000-2008 Population Change:
Maine 3.1% ↑ Aroostook 3.0% ↓

Source: US Census Bureau and NMDC

- Large geographic area and 2+ hours to urban service centers increases transportation costs
- Population outmigration over the last three decades
  - 1990 – 2008, 15% loss of 14,037 residents
  - Youth brain drain resulting in an average age increase from 33 to 44 years
- The declining economic and population base results in anxiety and uncertainty about the future

Aroostook Regional Strengths

- Aroostook County has strong committed and invested CED ***leadership*** consisting of private, public and non-profit sector representation
- Aroostook County, known as ***"The County"*** is acknowledged both internally and externally as being a unique place with special people and a reputation of honesty and quality workforce
- The ***workforce*** of Northern Maine is recognized as superior and "always willing to put in a full day of effort"
- Aroostook County has significant ***educational assets*** including three universities, a community college, nationally ranked charter high school and K-12 schools that can prepare the region for a knowledge based economy
- Aroostook County has multiple ***natural assets*** that if fully leveraged can provided increased economic value



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Analytical Approach

The ViTAL Economy regional industry cluster roadmap includes a unique analytical approach consisting of two component parts; **Regional Industry Cluster Formation** and **Targeted Industry Cluster Opportunity Analysis**.

The regions true competitive advantages are defined within industry cluster niche markets. It is specifically designed for rural economies and empowers local business leaders to take action by linking existing assets with market trends to build a business case attractive for investment.

ViTAL Economy Regional Industry Cluster "Roadmap"
narrows the efforts of private sector business leaders with proven methods and business practices that sustain involvement and effort to reach agreed measurable goals

The Guiding Principles in the VE Regional Industry Cluster Roadmap

"3 C's" for Transforming a Regional Economy

Collaboration

Sharing assets, talents, money and knowledge builds sufficient critical mass to compete globally, while informing emerging industry cluster strategies to assure regional growth

+

Connectivity

Links geographically remote resources increasing access creating opportunity, building diversification and achieving sustainability

+

Changed Spending

Funding and budgeting drives behavior which increases productivity , opens new markets and grows regional wealth and

People **Collaborate** through Industry Cluster Teams.

Research, Analysis, and Opportunity Business Cases development build **Connectivity**.

Changed Spending & regional transformation occur as the Cluster Teams and the community take action to implement opportunities.

Key Components of the Analytical Approach

Regional Cluster Formation is a formally organized effort to promote industry cluster growth and competitiveness through collaborative activities among cluster team participants made up of industry sector, business, community, and education leaders. A regional industry cluster initiative provides a proactive mechanism for boosting national and regional competitiveness by:

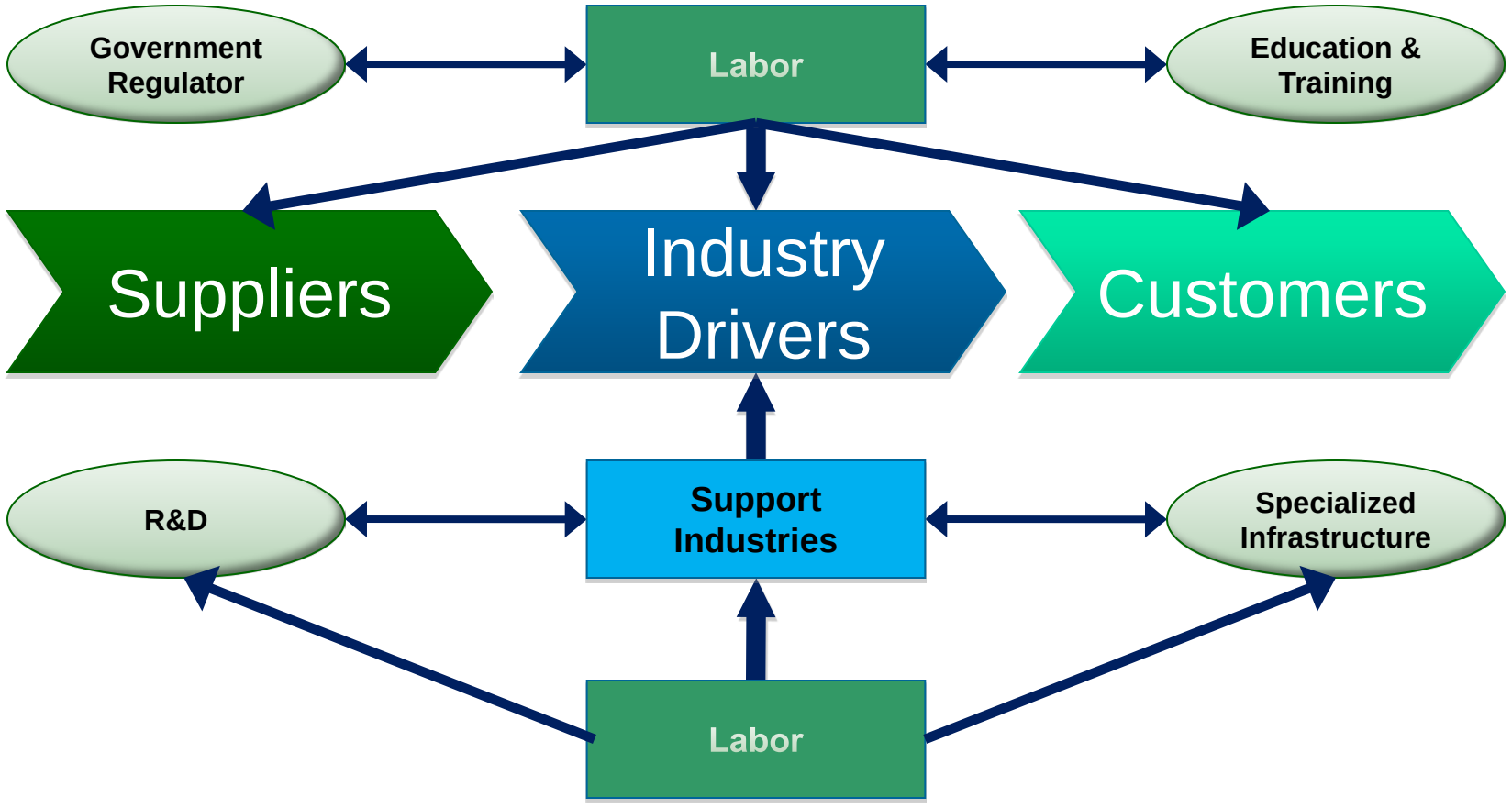
- Promoting product and process innovation;
- Facilitating technology transfer and other knowledge sharing;
- Improving access to specialized labor, materials, and equipment;
- Connecting industry leaders with regional stakeholders
- Cross links and efficiently uses regional assets

Targeted Industry Cluster Opportunity Analysis is more than just an inventory of what industry assets and relationships that currently exist in the region. ViTAL Economy assists local industry leadership in the:

- Development of relevant economic & market data such as local, state, national and global trends that affect the targeted industry sector in Aroostook County;
- Understanding of how these trends will impact the regions investment attractiveness;
- Mapping of local assets to identify competitive advantages that are in control of the region which can be linked to create or retain wealth and generate employment;
- Identification of market opportunities that have the high return on investment (ROI) potential for the region and which will help in achieving the 2015 Aroostook regional economic goals.
- Development of position papers on public policy where such policies and regulation create market inefficiencies or barriers.

ViTAL Economy Industry Cluster Definition

An Industry Cluster should establish core value linkages both within and across industry sectors. These linkages creatively leverage the indigenous strengths of a region. Clusters are assessed and prioritized in a collaborative process which insures that the critical challenges and opportunities of a region are continually addressed.



Source: Purdue Center for Regional Development

Analytical Approach *(Cont)*

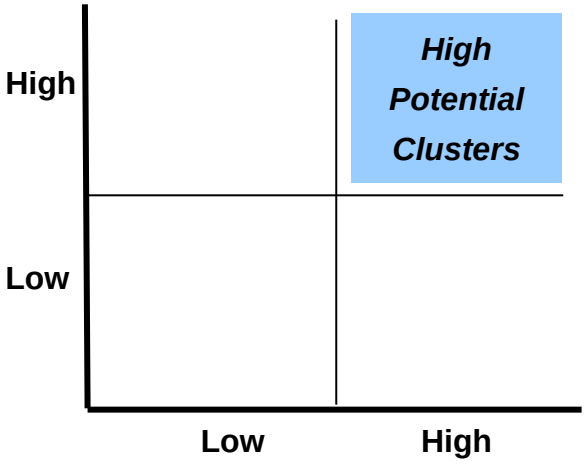
The analytical process begins by determining the high potential industry clusters that can achieve the regions economic goals. Only industry clusters that rank high in indigenous competitive advantage and market and trend attractiveness are considered for analysis.

HIGH POTENTIAL INDUSTRY CLUSTER OPPORTUNITY ANALYSIS APPROACH

Maximizing Economic Development Potential

INDIGENOUS COMPETITIVE ADVANTAGE

- People
- Location
- Indigenous Assets
- Infrastructure
- Technology



MARKET AND TREND ATTRACTIVENESS

- Consumer Demand
- Size and Growth
- Supply Demand
- High Value Product/Service
- Political Environment
- Regulatory Climate

RESULTS

Desired Economic Development Goals

- Diversify economy
- Create sustainable economic growth
- Create jobs which exceed average national wage
- Create jobs with associated benefits
- Increase workforce capabilities
- Attract outside capital
- Deepen and strengthen capabilities of existing industry clusters

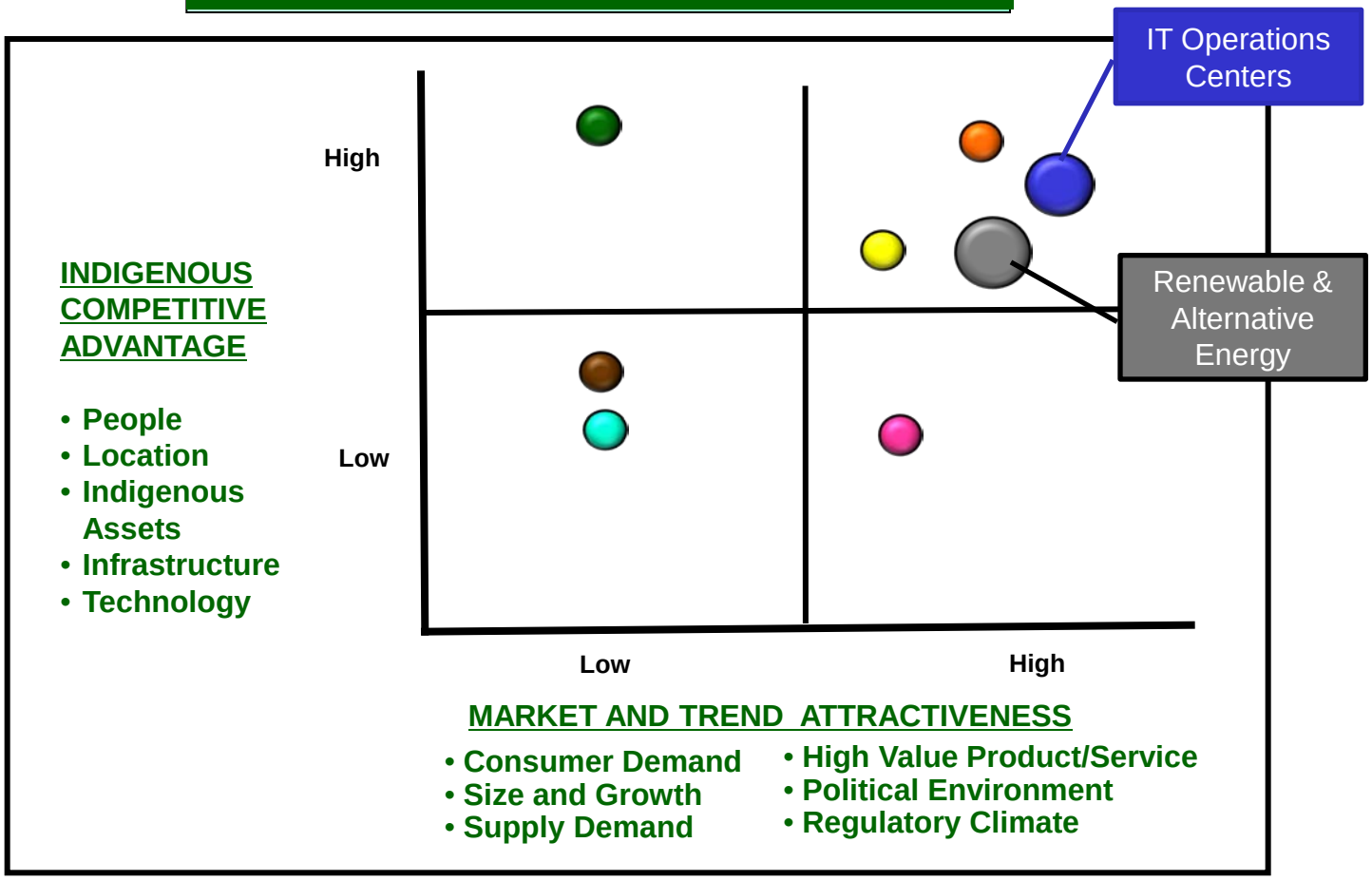
Analytical Approach *(Cont)*

Aroostook leadership conducted industry cluster potential analysis and prioritization and selected ***IT Operations Centers*** and ***Renewable Energy*** clusters, each high in ***Competitive Advantage*** and ***Market Attractiveness***. The size of the bubble represents the level of probability for this cluster to help achieve the regions goals.

Preliminary Industry Clusters

- Secondary Wood Products
- Agriculture
- Rural Healthcare
- Natural Resource Tourism
- IT Operations Centers
- Rural Higher Education
- Metal Fabrication
- Renewable & Alternative

Plot Maximizing Economic Development Potential



Industry Cluster Niche Market Analysis Sequence

Step 1. Industry Sectors identified through Mobilize Maine Asset Mapping

Step 2. Preliminary Industry Cluster Identified by local leadership with ViTAL Economy

Step 3. Clusters Selection by APP Board

Step 4. Initial Niche Markets Selected by Cluster Teams

Step 1	Step 2
Forestry	Secondary Wood Products
Agriculture	Agriculture
Healthcare	Rural Healthcare
Tourism	Natural Resource Tourism
Information Tech	IT Operations Centers
Education	Rural Higher Education
Manufacturing	Metal Fabrication
Energy	Renewable & Alternative

IT Operations Centers

1. Insurance, Accounting, Finance Outsourcing
2. Storage Data Centers
3. Customer Service Operations Centers

Renewable Energy

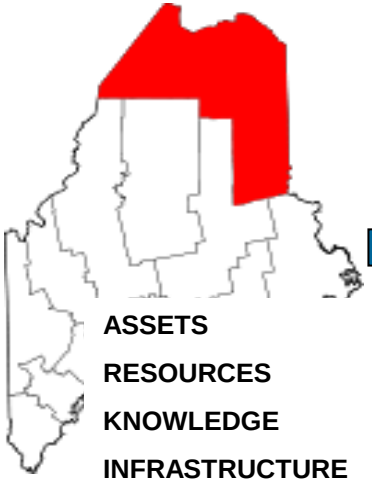
1. Biomass to Energy
2. Wind
3. Utilize Excess Energy

Framework to Uncover Regional Business Opportunities

The VE targeted industry cluster analytical approach utilizes hypothesis testing of sectors supply and demand; thereby identifying opportunities to capitalize on gaps in the value chain. Based on this analysis, cluster teams and local firms are positioned to ACT and create new economic opportunities and gain wealth in the region.

SUPPLY → **OPPORTUNITY** ← **DEMAND**

Aroostook County, ME



ASSETS
RESOURCES
KNOWLEDGE
INFRASTRUCTURE
COMPETITIVENESS

Industry Cluster Niche Market Gap & Opportunity Analysis

MARKET ATTRACTIVENESS

ACTION!

Realization of Aroostook County Economic Transformation

ViTAL Economy Fact –Based Hypotheses Testing

The ViTAL Economy process employs structured principles to generate fact-based hypotheses, followed by data gathering and testing to prove or disprove each hypothesis. This process is not simply about collecting and presenting data; it is research, analysis, and *"connecting the dots"*. VE focuses on insights, innovations, and opportunities that have the best potential to transform the region.

Step 1 – Characterize the primary issues of *"*Challenge or Opportunity*" to be addressed?* (Frame the *research question* properly)

Step 2 – Agree on hypotheses to be tested (no more than four), as well as the research purpose.

Step 3 – *"Data & Information"* – Compile and document research…test against each hypothesis

Step 4 – *"Knowledge"* – Integrate and communicate findings, describe the business opportunity and challenges as well as resource gaps for the client

Step 5 – Identify and agree on a hypothesis to refine the opportunity (if required)

Step 6 – *"Opportunity"* – Summarize business case from the research to initiate action

Step 7 – *"Action"* – Recommend implementation plan with leadership and resources required

Renewable Energy Industry Cluster Hypothesis Testing

Utilizing the VE analytical approach model, NMDC and APP leadership arrived at the following premise and proposition

Premise: Energy costs to Aroostook residents and business sector is an extraordinary burden that places the region at a disadvantage relative to New England.

Proposition: The Renewable Energy Cluster can address this burden with locally available resources while creating and retaining jobs, inducing wealth creation/retention in the region, and contributing to the realization of the Mobilize Maine vision and goals for Aroostook County.

Based on this premise and value proposition four initial hypotheses were built for testing:

Hypothesis 1: There is sufficient wind energy potential to justify investments in wind energy generation.

- **Conclusion - Yes.** Wind energy potential is not at the highest level, but is sufficient for small wind and in some areas for commercial/community wind.

Hypothesis 2: Wind energy generation is a feasible and viable method of addressing the premise and proposition.

- **Conclusion - Conditional:** This question has not been completely answered at this time. Small wind is likely viable for some land owners. Current transmission grid barriers were determined to be a limiting factor for large scale commercial wind development at the present time.

Renewable Energy Cluster Hypothesis Testing (cont)

Hypothesis 3: The electrical transmission grid into and out of northern Maine along with connections to the ISO New England have sufficient capacity to handle generation for export to Maine and ISO NE.

- **Conclusion - Failed**. There does not appear to be sufficient transmission capacity from Aroostook County to the rest of Maine and the ISO NE grid**.**
- **Conclusion - Failed**. The NE ISO grid is not robust enough to handle significant additional load generation, particularly the intermittent loads associated with large scale wind farms..

Decision: Since northern Maine faces significant regulatory and transmission grid barriers for near-term implementation of large wind and/or other electrical energy export market opportunities, further research into these niche markets is required and will not be addressed in this report.

Hypothesis 4: There is a sufficient biomass resource supply to support a biomass-to-energy niche market.

- **Conclusion - YES**. There is sufficient forest residue to support a wood biomass energy sector.
- **Conclusion - YES**. There is underutilized capacity for direct purchase of biomass energy from the existing Boralex plants.
- **Conclusion - YES**. There is a sufficient supply of wood biomass to support the expansion of pellet fuel production..

The answers to these four hypotheses questions led to further iterative questions of interest which are summarized later in this section.

Details of the Hypotheses Testing Process-

During research and testing of the initial hypotheses other questions and niche market opportunities were raised and investigated Among those are the following , warranting a brief explanation:

- Since northern Maine faces significant regulatory and transmission grid barriers to near-term implementation of large wind and/or other electrical energy export market opportunities further research into these niche markets was not conducted.
- The question of using biomass or other energy generation capacity as a basis for establishing commercial greenhouse operations in Aroostook was raised as an outgrowth of biomass to energy research. Commercial greenhouse growing operations are primarily market demand driven. Potential lower energy costs from steam co-gen, biomass, or direct energy connection does not constitute a sufficient advantage without establishment of product demand, thus further research was not warranted at this time.
- Energy cost analysis revealed a significant disparity between locally produced (wood biomass) and consumed energy versus imported energy (oil & electricity). Creation and purchase of locally produced energy constitutes a regional wealth inducing & retention opportunity. The following were researched and are reported later in this report.
  - Existing biomass supply and production facilities have excess capacity
  - Benefits exist to site industrial facilities adjacent to biomass generation (*Direct Connect*) thereby eliminating transmission and distribution costs for industrial energy consumers

Details of the Hypotheses Testing Process(cont.) –

- A opportunity exists for regional wealth retention through a program of heating system supplement or conversion from fossil fuel (oil) to biomass pellet heat (residential and institutional consumers). This niche market was investigated and is contained in this report (with additional detail referenced via the appendix.
  - Job creation for pellet manufacturers, system installers, and distribution system operations.
  - Andrew Plant with the UM-Cooperative Extension Aroostook County has been conducting research into the potential for grass biomass production in northern Maine. His investigation concluded there is potential for profitable conversion of fallow and under-utilized agricultural land to the production of grass biomass. This is identified as a sub-niche of the biomass to energy opportunity.
- A major discovery from the analytical process is the existence of, and yet unconnected, elements of a nascent *Renewable Energy Center of Excellence*. This idea has significant cross-sector elements that currently exist at near critical mass to support the creation of a Center of Excellence. This concept is applicable to both the Renewable Energy Cluster and the IT Operations Center Cluster and is presented in both reports.

Conclusion: Aroostook County has sufficient renewable energy assets and resources to help achieve the 2015 goals.

Table of Contents – Renewable Energy Opportunity Analysis

Renewable Energy

Market Description & Segmentation

Mankind has harnessed the energy from renewable sources such as water, wind, geothermal and biomass since the beginning of time. Only during the past century has electricity been generated from these sources and transmitted long distances away from the source.

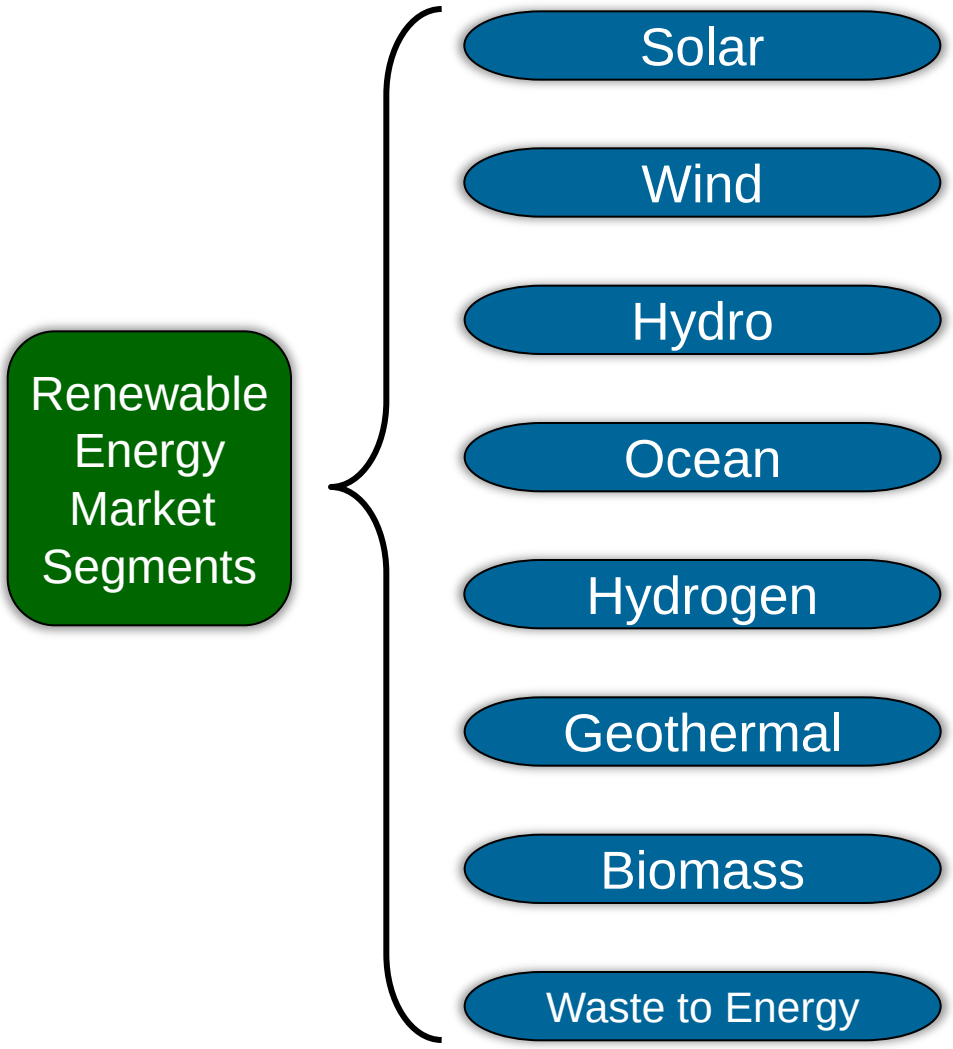
What did our ancestors understand about the benefits of DIRECT use?

Renewable energy comes from natural or manmade sources such as sunlight, wind, wood, grass, water, heat from the earth, waste and through natural or reoccurring processes whereby the source is replenished.

Direct Energy Market
Generation or capture of energy utilized or distributed in close proximity gaining higher efficiency and reduces loss

Indirect Energy Market
Generation or capture of energy used to produce electricity that is transmitted across the grid and used outside of the source region.

Segmentation



Market Description & Segmentation *(Cont)*

Public policy and societal concern regarding the long term health of the planet has spurred innovation and the creation of sub-markets within renewable energy. These markets have gained a stronger footing over the past decade and are predicted to grow substantially over the foreseeable future. Increased consumer desire and acceptance has improved these markets but technological advancements will continue to fuel market volatility. In addition to innovations submarket strength will be impacted by sustainability and average annual rate of return to the consumer.

Energy Efficiency & Storage

- Bio-battery
- Car pooling
- Chemical storage mediums
- Compact fluorescent light
- Electric scooters
- Electric trucks
- Energy efficient windows
- Green building certification
- Green building materials
- Green Shipping
- Hybrid motorcycles
- Net metering
- Retrofitting
- Small Scale gasifiers
- Smart Grid
- Smart meters

New Opportunities arising out of Environmental Trends

- Biocatalysts
- Bio-fertilizers
- Bio-plastics
- Desalination
- Eco-friendly music
- Green designer
- Local grown food
- Low-carbon groceries
- Sustainable clothing
- Sustainable farming
- Sustainable fisheries
- Sustainable furniture
- Sustainable tourism
- Urban farming
- Wastewater treatment

Note: the market segmentation list s are provided as examples and are not intended to present a complete listing of market niches.

Aroostook Renewable Energy Industry Cluster Description

1. Businesses that produce energy extracted or captured from on going natural processes, generated and regenerated naturally, and generally inexhaustible
2. Primary, secondary and supplier businesses that are commercially linked in the value chain in the generation or capture of energy
3. Agencies, organizations and individuals that support the generation of energy from renewable sources

Aroostook County Renewable Energy Industry Stakeholders

- Boralex
- First Wind
- Horizon Wind
- Twin Rivers
- Loring BioEnergy
- Northeast Pellets
- Northern Refrigeration
- John's Electric and Solar Services
- Watson Well Drilling
- Freeman Motor Company
- Oil Companies; Daigle, Dead River,
- Agri-Cal, Inc.
- UMaine Cooperative Extension Center
- NMCC
- UMaine Presque Isle & Fort Kent
- Timber Land Owners
- Maine Forest Service
- Wood Product Manufacturers

This is not intended to present a complete list, but rather an example of the variety of existing elements of the industry cluster

Northern New England Renewable Energy Industry Cluster Value Chain

NORTHERN MAINE RENEWABLE ENERGY CENTER OF EXCELLENCE

EXPORT

Transmission

- ISO New England

Distribution

Export Customers

Energy Sources

- Wind
- Biomass
- Solar
- Energy Capture

- Landowners
- Harvesting
- Transportation

Generation

- First Wind
- Boralex

Aroostook Industrial Customers

REGIONAL MARKET

Distribution

- Maine Public Service
- Houlton
- Van Buren

Northern Maine Customers

= Upstream = Midstream = Downstream

Table of Contents – Renewable Energy Opportunity Analysis

Renewable Energy

Market Attractiveness

Berlin, Paris, Beijing, Washington D.C., or Maine; current trends from around the globe read like a new roadmap to put the world on a new renewable energy economy that demands an integrated approach involving mandated measures for greater energy efficiency, rapid expansion of all types of renewable energy usage and a stronger focus on research and development into the next generation of green technologies.

"America's clean energy economy has emerged as a critical component of the nation's future",
Tom Vilsak, US Secretary of the Interior

Global Energy Market Factors and Trends

A 'Perfect Storm' of forces: *Energy Demand, Global Security Threats* and *Environmental Concerns* - is driving demand for alternative energy technologies and products around the world. Global alternative energy markets are experiencing annual growth rates of 14-22%, while investment is growing 45%/year.

Major demand exists for price competitive and technology-proven solutions in clean power generation and fuel production. Global markets want technologies demonstrating robustness in operation and price competitiveness; marketed by companies who have the scale to deliver and finance projects effectively.

World renewable-based electricity generation – mostly hydro and wind power – is projected to rise from 18% of total electricity generation in 2009 to 23% in 2030. At the same time, however, fossil fuel is still projected to maintain its lead as the largest electricity generation resource; in 2009 all fossil fuels combined equaled 67% of generation, and in 2030 it is forecasted to be 68%.

The total energy sector constitutes approximately 13% of GDP world-wide.

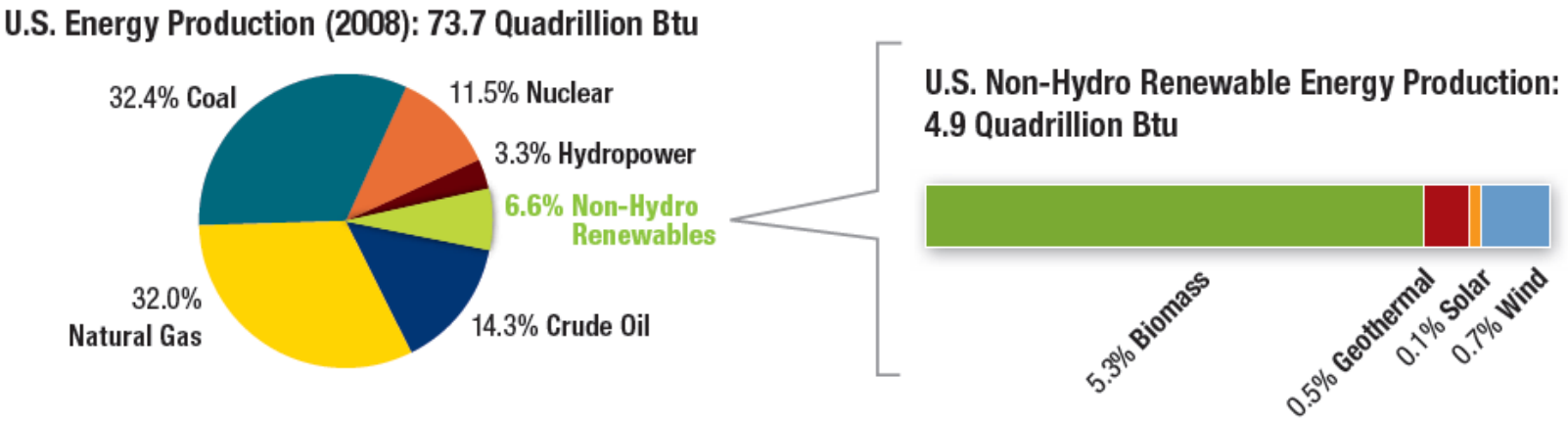
Between 2007 and 2009,

- Global revenue from renewable energy and energy efficiency industries increased forty percent, totaling $77 billion worldwide.
- Global investment in clean energy technologies expanded sixty percent to $148.4 billion.
- Venture capital investments in the U.S. quadrupled from $599 million in 2000 to $2.7 billion in 2009.

Investments in renewable energy supply in the period 2009-2030 are forecast to reach $5.5 trillion (in year 2008 dollars). New renewable-based electricity generation accounts for 48 % of total projected investments during the forecast period.

Sources: Renewable Energy Report, Washington State University, June 2009, US Energy Department, US - CIA

US Energy Market Statistics and Trends



U.S. energy production from renewable sources was 10% of total energy production in 2008, at 7,316,000 billion BTUs out of total energy production of about 73,711,000 billion BTUs. (In this case, "renewable" includes conventional hydroelectric and geothermal, along with solar, wind and biomass.) This is up from about 7.6% in 1970. Meanwhile, nuclear generation accounted for another 11.5% of total U.S. energy production, or 8,455,000 billion BTUs in 2007.

U.S. wind power generation grew dramatically from 29,007 billion BTUs in 1990 to 258,385 billion BTUs in 2006 and 514,000 billion BTUs in 2008.

Biomass energy (including the use of energy from waste streams, crop & forest residue, and the production of liquid bio-fuels [ethanol/diesel]) has been growing rapidly, both in the U.S. and elsewhere.

In 2008, biomass accounted for 53.2% of all renewable energy consumption in America.

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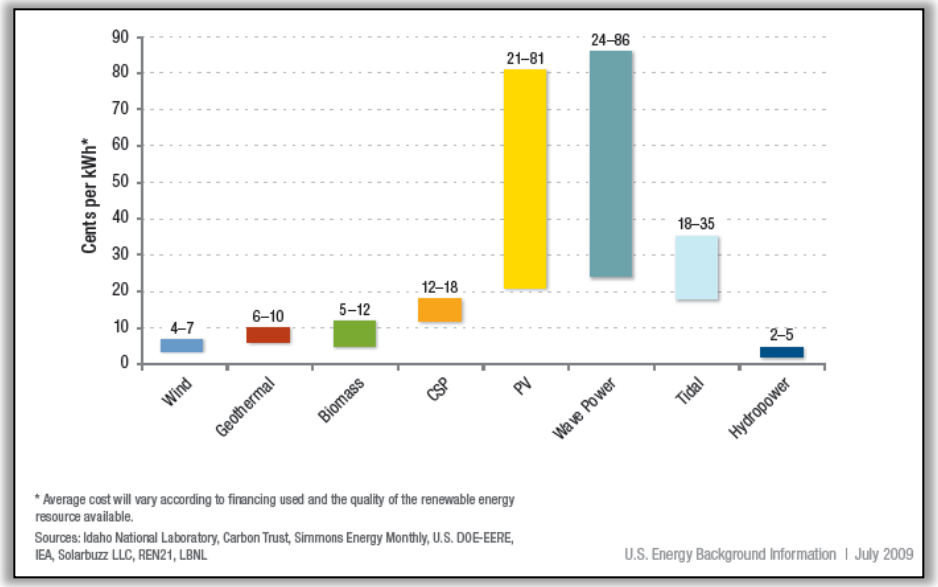
Sources: US Department of Energy, Energy Efficiency & Renewable Energy

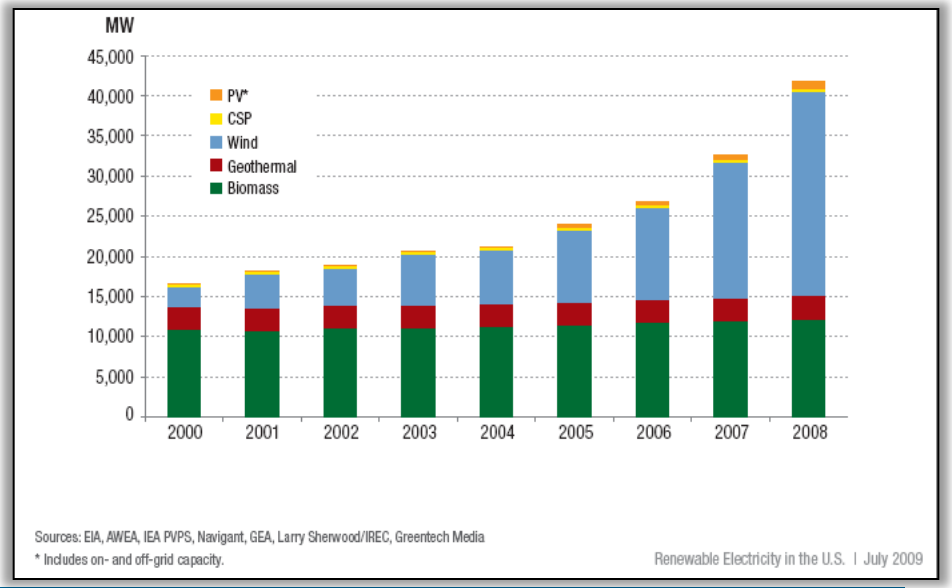
Renewable Energy Price and Generation



Since 2000, renewable energy installations in the US (excluding hydropower) have tripled and in 2008 represented 42 GW of capacity.

Renewable electricity (excluding hydropower) has grown at a compounded AAGR of 12% from 2000-2008

The average cost of renewable energy sources is in the range of the current Maine Standard Offer Price of 8.9224 cents per kW.

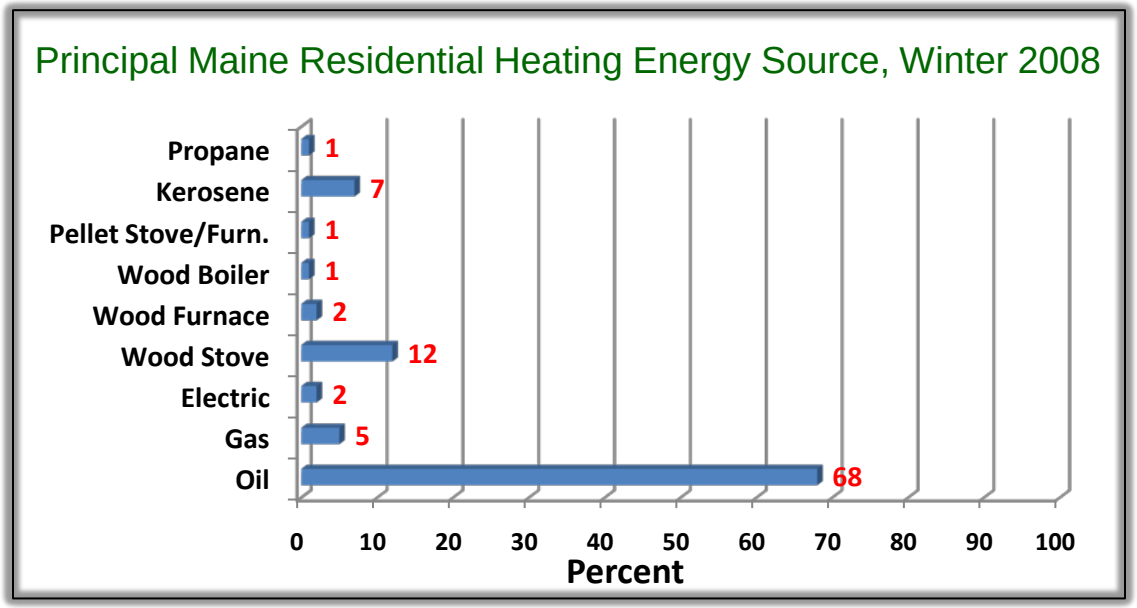


Sources: US Department of Energy, Energy Efficiency & Renewable Energy

Market Attractiveness *(Cont)*

Even though Maine is a leader in biomass energy production, there is still a consumer preference to purchase the convenience of oil heat at a higher cost per BTU.

This choice has significant economic implications.



Heating Fuel Comparison - December 2009 Prices

Fuel	Heating Value	Fuel Price per Unit	Efficiency	$ per MBTU
Wood Pellets	16.5 million BTU per Ton	$250	68%	$22.28
Firewood	22 million BTU per Cord	$150	55%	$12.40
Coal	25 million BT per Ton	$285	75%	$15.20
Fuel Oil #2	138,690 BTU per Gallon	$2.71	78%	$25.05
Natural Gas	100,00 BTU's per Therm	$1.36	78%	$17.44
Propane	91,333 BTUs per Gallon	$2.51	78%	$35.23
Electricity	3,412 BTU per kWh	0.17	98%	$50.69

Source: Maine Residential Heating and Energy Survey, Critical Insights, 2008, Energy Information Administration

Aroostook County Energy Market

2007 Aroostook Electric Market*	Customers	MWh	Total Cost
Residential	35,305	215,681	$34.9M
Small Commercial	6,794	108,233	$17.6M
Med. Large Commercial	451	339,504	$28.3M
	Total Electricity Cost		$80.9M

Aroostook Energy Market

excluding transportation fuels

$147.4 Million

Market includes Maine Public Service, Houlton Water Company and Van Buren and 2007 electric and T&D rates

2007 Household Heating Projections – 31,015 households	%	# Households	Average Yearly Usage	Aroostook Annual Usage	Price	Total Cost
Oil	62%	19,229	1,000 gal.	19,229,000 gal.	$2.71	$52.1M
Wood 80% Firewood	21%	5,210	6.5 cords	33,865 cord	$150 cord	$5.0M
20% Pellets		1,302	8.54 tons	11,119 tons	$250 ton	$2.7M
Kerosene	8%	2,481	1009 gal.	2,503,329 gal.	$2.69	$6.7M
				Total Home Heating Cost		$66.5M

Note: only includes residential heating not commercial

Sources:

Maine Home Heating Report 2007 Southern Maine Renewable Fuels Maine Public Service

Maine Residential Heating and Energy Survey, Critical Insights for American Lung Association of Maine

Aroostook County residents carry twice the national average burden for residential energy cost (heating and electricity) compared to their household income.

Aroostook County residents carry a 15% higher residential energy cost burden than their fellow Maine residents.

Since 2004, Aroostook County electricity cost have risen over **48%** for residential customers and approximately **60%** for commercial customers

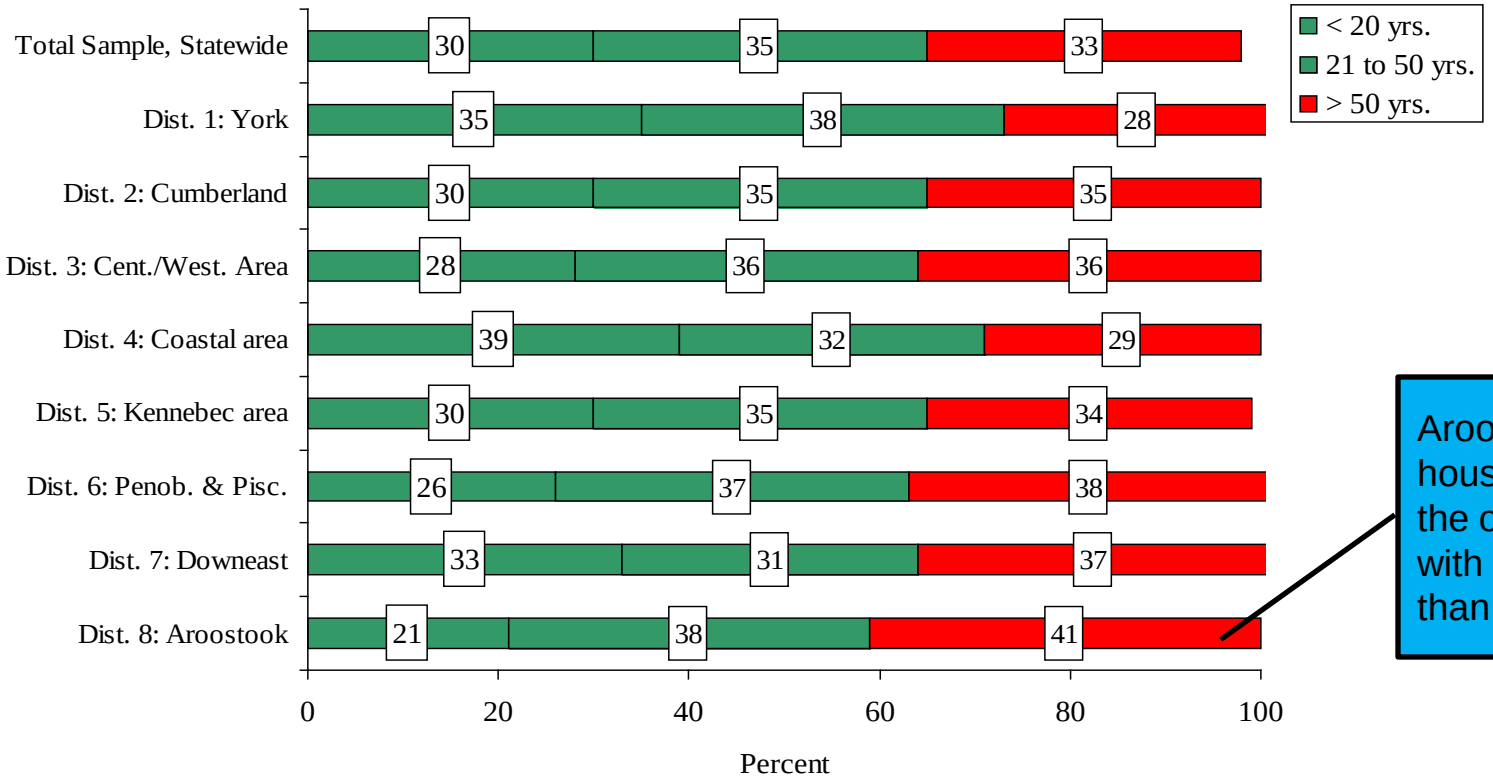
Total Residential Energy - 2007					
	Households	Total Residential Energy Cost	Ave. Annual Residential Cost	Median Household Income	Percent of Household Income
US	112,377,977	$238.6B	$2,124	$50,740	4.2%
Maine	543,952	$1.9B	$3,538	$45,888	7.7%
Aroostook	31,015	$101.5M	$3,272	$35,452	9.2%

Aroostook Assumptions: $2.71/gal. heating oil., $150 cordwood, $250/ton wood pellets

Source: US Energy Information Administration, Independent Statistics and Analysis
US Census, 2007 American Community Survey
Maine Home Heating Report

Market Attractiveness *(Cont)*

The age of Aroostook County housing stock compounds the high residential energy cost burden. Older homes typically have not upgraded insulation, mechanical heating systems or windows and building envelopes have not been sealed against the harsh northern Maine winters.



Aroostook County's housing stock is the oldest in Maine with 41% greater than 50 years old.

% of Maine residential primary heating devices > 20 years old

- Oil 18%
- Gas Propane Burner 9%
- Wood Stove 24%
- Kerosene Burner 9%

Industry standards estimate a 3% boiler/burner replacement in a market every year.

Source: Critical Insights, Maine Residential Heating Survey, November 2008

Northern Maine Regional Market Factors

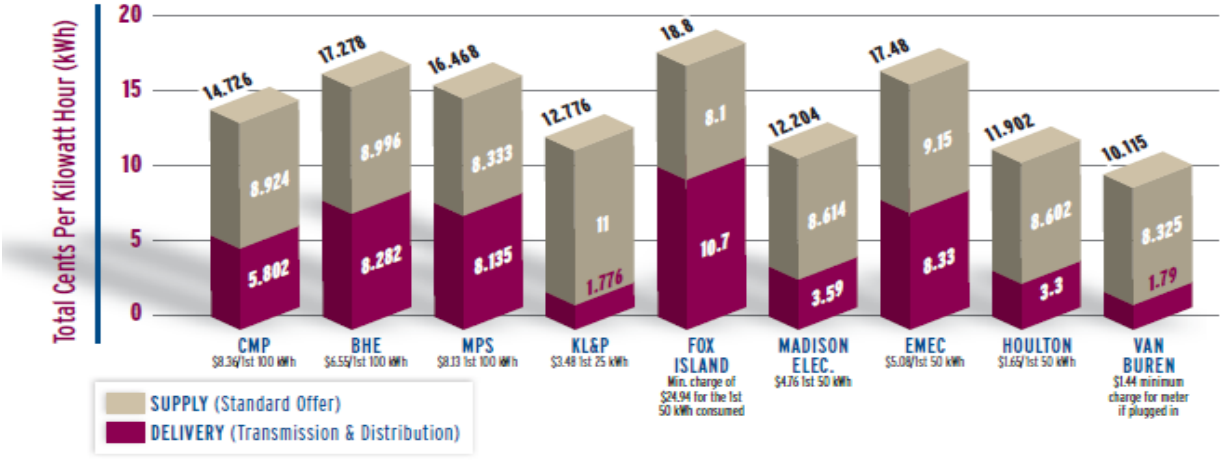
Electrical Energy Rates

Maine residential kWh rates vary widely across the state, with the largest disparity being in transmission & distribution costs. Aroostook County could realize significant regional wealth retention by utilization of locally produced energy.

ISO New England

ISO New England is the *Independent System Operator* responsible for ensuring the reliable operation of the New England electric grid, administration of the region's wholesale electricity markets, and administration of the regional Open Access Transmission Tariff, including regional system planning. Maine is interconnected to the New England ISO electric grid, an 8,000 mile, high-voltage transmission system that connects electric utilities, publicly-owned electric companies, power generators, suppliers, alternative resources, and end users. **Aroostook county has limited connection capacity to the ISO-NE.**

Current Maine Residential Total kWh Rates

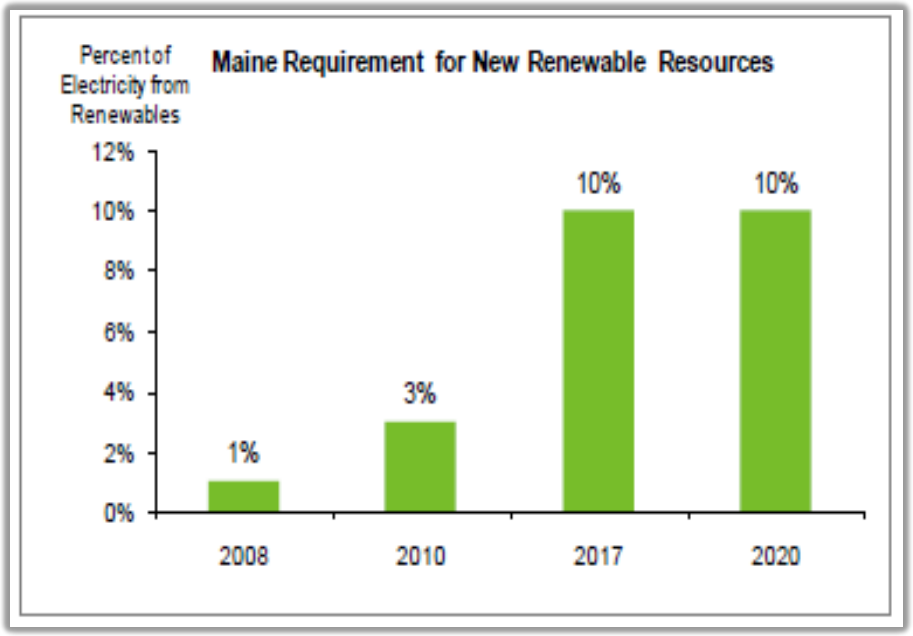


Source: State of Maine Public Advocate Office, Electricity Guide, Vol. 16, September 2009.

Maine Renewable Portfolio Standard (RPS)

Utilities and competitive suppliers must obtain specified percent-ages of the electricity they provide to customers from renewable sources to meet Maine's state-mandated renewable portfolio standard.

Maine requires 30% of total retail electricity sales to come from renewable resources, and this requirement is met with existing resources. In addition, Maine requires development of new renewable resources defined as resources developed after 2005. The requirement for new renewable resources increases 1% annually from 1% in 2008 to 10% in 2017.



Renewable Energy Certificates

Renewable Energy Certificates (RECs), also known as Renewable Energy Credits, Renewable Electricity Certificates, or Tradable Renewable Certificates (TRCs), are tradable, non-tangible energy commodities in the United States that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource (renewable electricity) such as wind, solar, biomass, etc. These certificates can be sold, traded or bartered, and the owner of the REC can claim to have purchased renewable energy.

Source: ISO New England

Aroostook County does not currently have a REC market, although interest has been expressed in forming one.

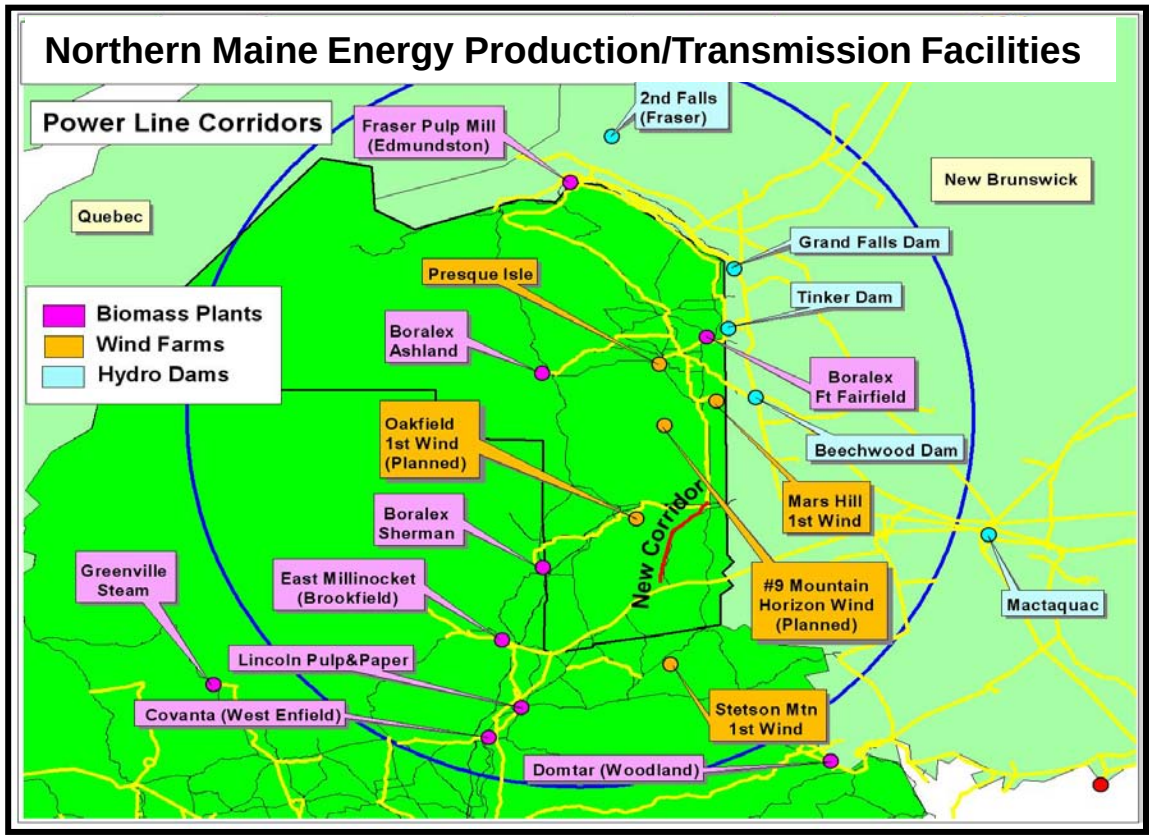
Table of Contents – Renewable Energy Opportunity Analysis

Aroostook County Renewable Energy Enabling Environment

Northern Maine possesses the critical and abundant resources necessary to control their own future energy economy, thus overcoming the extraordinarily high burden of energy costs borne by residents and industry alike.

Competiveness must be enabled through policy and leverage to create additional local wealth.

Aroostook County Renewable Energy Enabling Environment



Source: NMDC

Transmission & Distribution Barriers:

- 200MW transfer capability with the New Brunswick system
- Maximum peak demand approximately 140MW
- Power flow through the New Brunswick system is subject to significant transmission charges

Source: Maine PUC

Aroostook County renewable energy indigenous resources:

- Wind
- Wood
- Water
- Soil
- Sun
- Knowledge

Renewable Energy Generation Capacity, saleable:

- Boralex Fort Fairfield – 31MW, biomass
- Boralex Ashland – 33MW, biomass
- Boralex Sherman – 18MW biomass (currently shutdown, but functionable)
- Tinker Station – 35MW, hydro
- Mars Hill – 13MW
- Excess industrial Energy - TBD

Aroostook County Renewable Energy Enabling Environment (Cont)

There are sound historical and objective reasons for formalizing Aroostook County as the premiere hub of Maine's Renewable Energy industry. The formation of this cluster has been an evolution that just needed the catalyst of Mobilize Maine to energize a series of disconnected, but deliberate and serendipitous events, to forge a critical mass of industry, technical expertise, and cross-sector collaboration.

In the sections that follow, this report will examine the following enabling environment elements for six niche market opportunities:

- Aroostook's abundant natural resource base to meet the renewable energy demand needs of the County through:
  - Diverse wood basket with ample biomass residue resources
  - Fallow agricultural land base and production capacity
  - Adequate wind energy potential for Community and Small Wind and commercial wind energy generation
- Biomass to energy production facilities and technical expertise that already exist; thus lowering initial industry capital investment requirements
- The County's rich heritage and workforce experience in natural resource harvesting and production
- UMPI, UMFK, Husson College, and NMCC are poised and capable of enhancing workforce technical training
- UM-Orono and the UMaine Cooperative Extension Center in The County are active partners with R&D expertise explicitly directed at renewable energy applications and technologies
- Consumer demand and financial capacity to adopt/implement new energy systems.

Table of Contents – Renewable Energy Opportunity Analysis

Niche Market Strategic Direction
Aroostook Opportunities

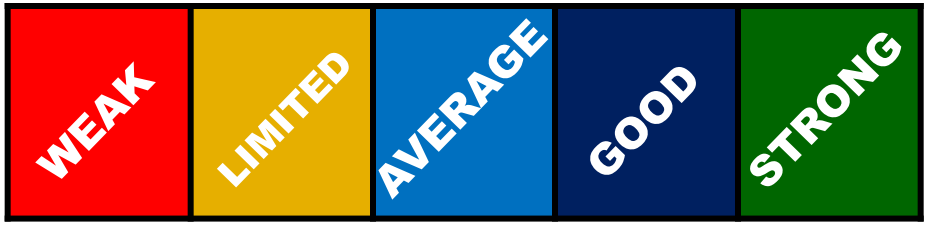
Northern Maine Renewable Energy Economy

I. Biomass to Energy
II. Grass Biomass
III. Community and Small Wind Energy
IV. Excess Industrial Energy
V. Buy Local: Northern Maine Energy Market
VI. Northern Maine Renewable Energy Center of Excellence

*The **Niche Market Strategic Opportunities** section of this report presents the business case for each of the six identified niche markets, along with a graphical assessment of the that opportunity.*

Each opportunity is evaluated for:

- Market Attractiveness
- Aroostook Competitiveness
- Technology Capacity
- Workforce, Skill and Knowledge
- Enabling Environment
- Location Advantages
- Financial Feasibility



Conclusion:

Based on our research and assessment we find that Aroostook County has a **GOOD** opportunity to establish a regional Renewable Energy Economy which will contribute to the transformation of the regional economy.

1. Sufficient fuel and generation capacity
2. No significant regulatory barriers impeding implementation
3. Considerable knowledge assets and entities to drive innovation
4. Clearly defined value proposition
5. Sophisticated and committed regional leadership in place

Renewable Energy Economy
Biomass to Energy

In the context of Aroostook County's renewable energy opportunity, there exists latent indigenous assets with the potential to transform the regions economy in the short term and sustain it in the long term.

Creating a Northern Maine Renewable Energy Economy

As fossil fuel prices rise, oil insecurity deepens, and concerns about climate change cast a shadow over our future, a new energy economy is emerging. The old energy economy, based largely on fossil fuels (oil, coal, and natural gas), is being replaced with wind, solar, biomass and geothermal energy. This global transition is moving at a pace and on a scale that perhaps could not have been imagined even five years ago.

Unless we diversify our energy sources, unless we upgrade our energy networks, unless we pay as much attention to energy efficiency as we do to energy production, then our energy supplies will be neither secure nor sustainable.

David Cameron – UK Prime Minister

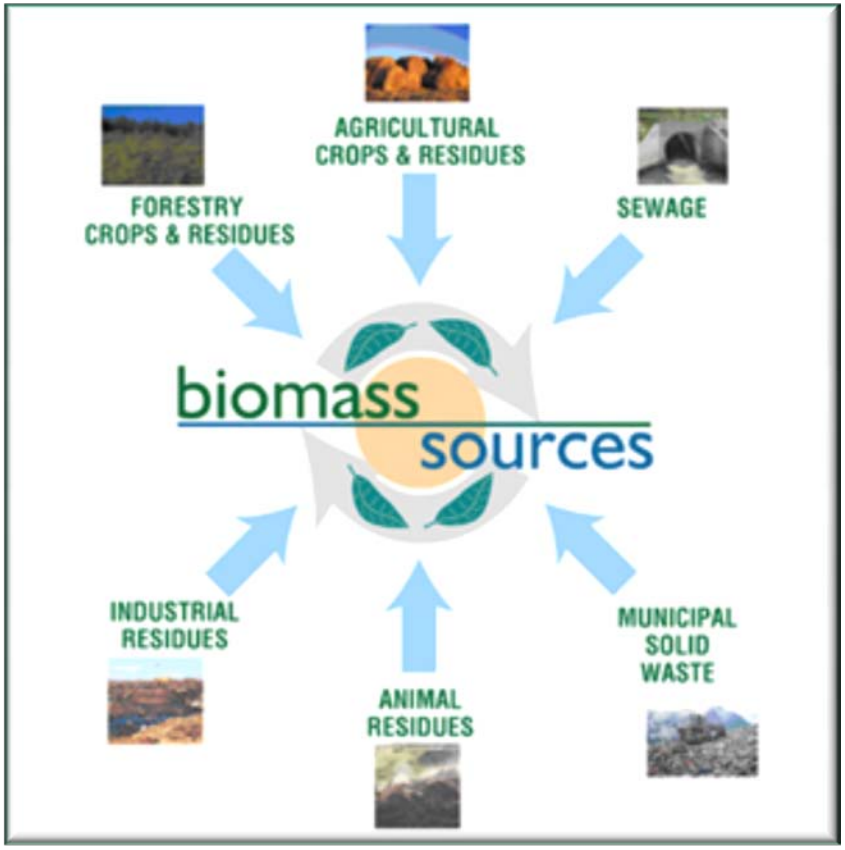
The Aroostook Renewable Energy Cluster team has set forth a proposition that through collaboration we can address this trifecta of rising energy prices, fossil fuel dependency, and environmental issues by utilizing locally available resources while creating and retaining jobs, inducing wealth creation/retention in the region, and contributing to the realization of the Mobilize Maine vision and goals for Aroostook County.

Creating a Northern Maine Renewable Energy Economy in a region separated by distance and infrastructure barriers from other energy centers suggests that direct local production and use of renewable energy resources within the regional economy should be a centerpiece of public policy and consumer behavior.

Northern Maine Renewable Energy Economy – Biomass to Energy

Biomass energy uses organic matter such as wood or plants (called “biomass”) to create heat, generate electricity and/or produce fuel for cars that is dramatically cleaner burning than oil.

As biomass energy use increases, it helps America reduce toxic pollutants in the air and decreases our dependence on foreign oil.



Modern biomass energy recycles organic waste from forestry and agriculture such as corn stovers, rice husks, wood waste and pressed sugar cane, or uses special, fast-growing "energy crops" like willow and switchgrass, as fuel.

This section focuses primarily on the use of wood pellets/chips and/or grass pellets as an alternative residential and commercial heating fuel.

Aroostook County Renewable Energy Economy Components

VALUE COMPONENTS

RAW MATERIAL →

FARMERS - Utilize fallow land to produce additional income
FORESTRY – Renew industry and employment

VALUE ADDED →

PROCESSING/CONVERTERS – Mills, packaging, etc.
DISTRIBUTION – Storage, delivery trucks, convert oil retailers
MANUFACTURING – Specialized machinery, storage systems, mill equipment, stoves, etc.

WEALTH FLOW →

WEALTH CREATION Money stays in Aroostook for infrastructure improvements, improved curb appeal, new businesses and increased employment
Potential wealth creation, carbon credits, state and federal incentives, increased local tax generation

ENVIRONMENT →

QUALITY OF LIFE - Air quality improvement from reduced home oil burners, pollution, land conservation, preservation, smart utilization of local resources

DEMAND →

HOMEOWNERS Reduce heating costs, upgrade heat systems, added value to homes**.** State and federal incentives to offset installation costs

Biomass Means REAL Economic Value to Maine Residents

22% of each dollar spent on heating oil remains in the regional economy, while 100% of each dollar spent on regionally produced wood pellets benefits the regional economy.

Maine Department of Conservation, Maine Forest Service

Maine = Producing and burning an additional 300,000 tons a year of wood pellets could generate $150 million in benefits for Maine linked to harvesting revenue, lower heating costs and local spending.

Maine Forest Products Jobs Created by Pellet Production
(per 100,000 tons per year of pellets)

Chipping Jobs	17
Pellet Mill Jobs	24
Logging Jobs	341
Trucks per day (365 days/yr) to Deliver Pellets to Retailers	13
Trucking Jobs (Logs and Chips)	68
Trucking Jobs (Pellets to Retailer)	7
Total	**470**

Maine citizens have a CHOICE!

Source: Maine Forest Service

Biomass to Energy Opportunity Definition and Value

- **Issue** -- High cost of energy issue facing residents, organizations and businesses in the region
- **Issue** – Dependency on fossil fuels as an energy source for residential and commercial heating
- **Issue** – 78% of the expenditure for heating oil purchases leaks out of the local economy

Opportunity – Reduce dependency on fossil fuels by purchasing an energy source within the region

- Replace oil as the primary heating source with biomass
  - 4,500 residential units, 20% of Aroostook housing stock in five years
  - 10 commercial facilities within four years
- **Estimated Aroostook wealth retention value = $6.9M per year**

Opportunity - Produce 45,000 tons of wood biomass pellets for residential and commercial heating

- Northeast Wood Pellets has capacity to produce 45,000 tons per year of premium quality pellets
- Proximity to wood source and consumer markets lowers pellet cost per ton
- **Estimated Aroostook opportunity value = $9M per year in locally sourced and produced biomass within five years**

The November 2007 Margaret Chase Smith Policy Center study stated that due "to Maine's low population size and abundance of woody biomass, it has the potential to replace a large percentage of its own non-renewable energy use with renewable energy from its forest and become a much more energy self-sufficient state."

Source: Maine Forest Service

Biomass to Energy Opportunity Value

Economic Flow of Expenditures on Home Heating Oil

Purchase of #2 Heating Oil
5.9M gallons @ $2.71 (4/5/10)
$15.9M

78% of expenditures leaks out of the economy → $12.4M

22% of expenditures retained for distribution and service → Aroostook Impact $3.5M

Economic Flow of Expenditures on Biomass Heating

45,000 tons local sourced and processed wood pellets @$200/ton
$9M

100% →

Aroostook Biomass Economic Impact
Biomass = $9M/year
Equip/Install. = $19M over 5 yrs

← 30%-50%

Equipment and Installation Value over Five Years
$63.5M

Job Creation Categories	Direct Jobs	Indirect & Induced	Economic GDP Impact Value
Acquisition & Production of biomass fuel	90	67	$8.4M
Installation & Admin	40	30	$3.7M
Wealth Retention			$6.9M
Total	130	97	$19.0M

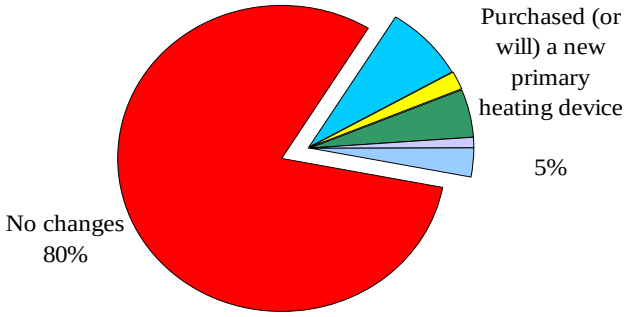
Economic impact estimates developed using the Northern New England Economic Scenario Model

Aroostock Market Receptivity to Biomass Fuel

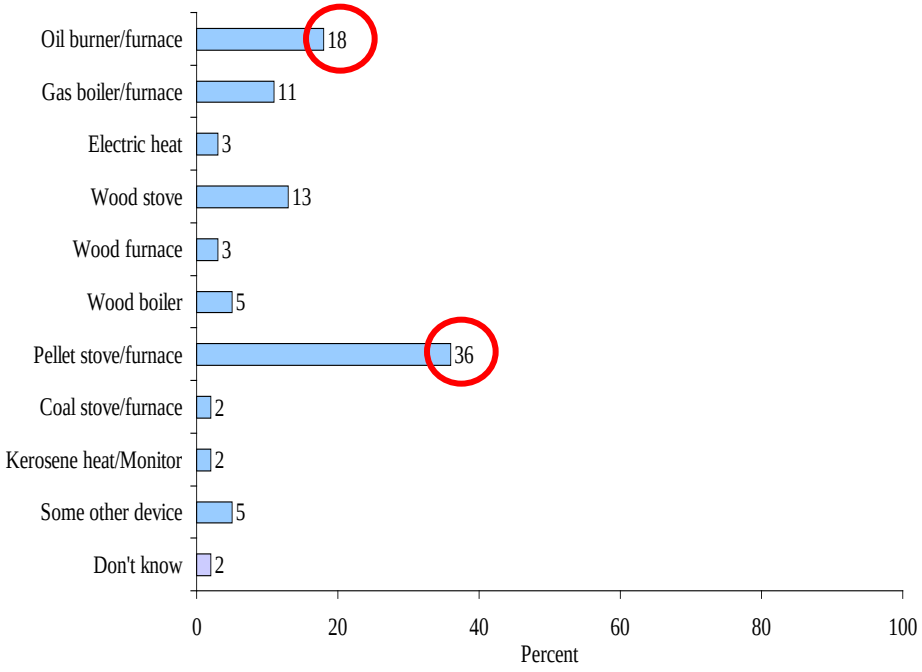
Statewide surveys show strong interest in pellet stove heating, especially in Aroostock

Please tell me which best matches what you have done or plan to do this coming winter.

Would you say you…?



What have you or will you purchase as a new primary heating source or device?



- Among those adding a new primary system, the most common changes include either pellet stoves or new oil burners.
  - Planned installation of new pellet stoves is particularly common in Aroostock County.
- Most will use a contractor to install the new device.

Source: Critical Insights, Maine Residential Heating and Energy Survey, November 2008

Wood Biomass Availability in Maine

Maine Ranks 5th in Total Forest Residues (dry tons)

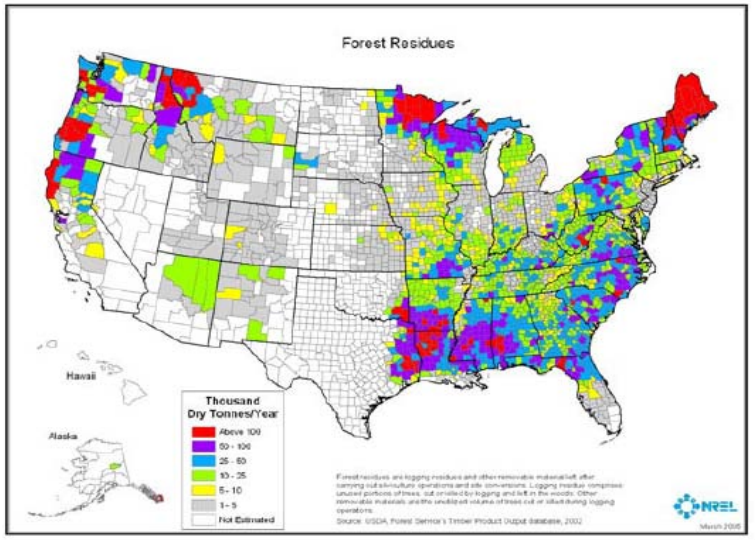
• Georgia	3,556
• Louisiana	3,384
• Mississippi	3,825
• North Carolina	2,995
• Maine	2,890

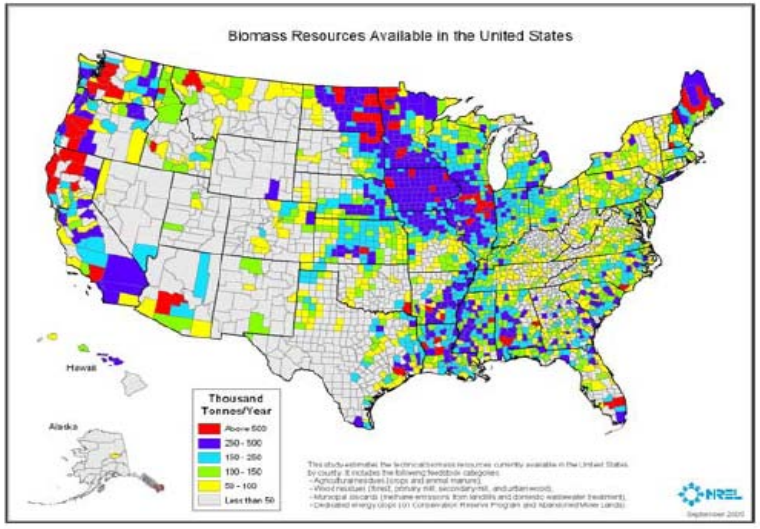
Maine Ranks 31st in total biomass resource available
3,489 dry tons (83% forest residues)

Source: NREL, A Geographic Perspective on the Current Biomass Resource Availability in the US, December 2005

Accounting for biodiversity conservations measures, we estimate that stands currently harvested could yield an additional 3.8 million green tons of residuals annually, of which 1.8 million green tons are of sufficient quality to be used for production of premium pellets.

1.8M green tons = 900,000 dry tons
Source: Maine Forest Service Assessment of Sustainable Biomass Availability, July 17, 2008





Aroostook County Biomass Availability Analysis

The table below sets a baseline for determining the current harvest levels and additional residues for Aroostook County. The table calculates that on a statewide basis Aroostook County accounts for 16% of total state harvest which then creates the conclusion below.

Harvest in Region	Sawlogs	Sawlogs	Pulpwood	Biomass chips	Sawmill residue	Firewood / Pellets	2008 harvest
	MBF	GT = 4.6	GT	GT	GT	cords	GT
Maine	877,827	4,038,004	7,353,129	3,047,731	350,706	36,551	14,300,000
Aroostook	192,021	883,297	918,714	550,139	21,423	7,031	2,295,002
% of State Harvest	21.9%	21.9%	12.5%	18.1%	6.1%	19.2%	16.0%
Aggregate GT %				16.0%			

Source: Vital Economy Analysis

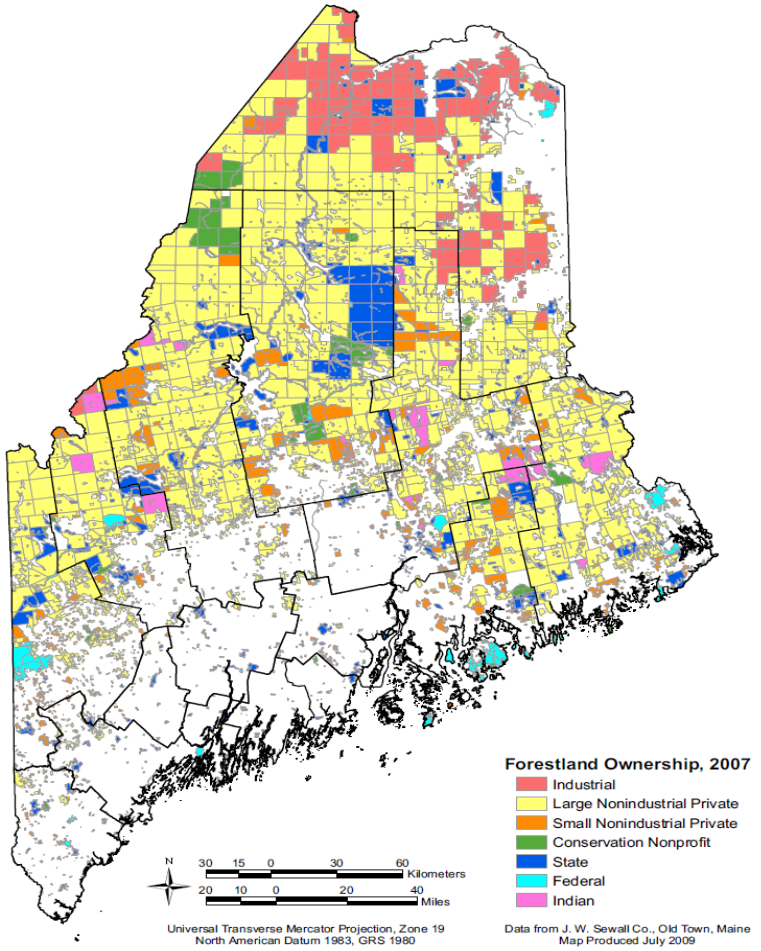
Key: MBF – Million Board Feet, GT – Green Ton

Based upon the Maine Forest Service Assessment of Sustainable Biomass Availability Study, the State of Maine has 1.8M green tons (900,000 dry tons) of additional harvest residuals of sufficient quality for production of premium pellets.

Conclusion = Aroostook County has 144,000 dry tons/year in addition to current wood harvest (45,000 tons = 31.2% of this source)

Aroostook County Competitiveness – Wood Pellet Production

- Supply factors and local capacity (Aroostook County)
  - 45,000 tons of wood pellet production
    - preferably supplied by sawmill residues supplemented by pulpwood, 80% hardwood, 20% softwood, no bark
  - Wood supply can be accessed within 60 miles of local production reducing product cost
  - 21,000+ tons of sawmill residue in Aroostook
- Regional pellet production capacity = over 350,000 tons
  - Primary producers
    - Cornith
    - Energex, Canada
    - Strong
    - Mainewoods Pellets
    - Northeast Pellets



Maine Forestland Ownership, 2007

Source: 2008 Wood Processor Report, Matt Bell

Key factors to realize the opportunity

- Create retail pellet fuel demand. Currently there are not enough pellet users to fully utilize the regional production capacity.
- Create a 'Consumer Ready Package' from currently available resources - biomass heating equipment, weatherization, financing, tax credits & other incentives, conversion & installation, distribution, and system maintenance in Aroostook County
- Build a collaborative of suppliers, product producers & distributors, system installation/maintenance firms and lending/incentive agencies to execute the strategy
- Stability of raw material pricing. This could enhanced by the development of a long term wood supply contract for the Aroostook Biomass to Energy Initiative
- Maintain premium quality wood pellets
- Support current and future Maine state legislation for biomass incentives

Key barriers to realize the opportunity

- Cost of conversion, heating equipment and installation
- Consumer objections to fuel handling - (switch from bags to automated bulk storage handling)
- Weak consumer understanding/acceptance of biomass heating technology
- Pellet quality control. Consumers demand premium quality pellets – BTU content, low ash residue, ash fusion, fines, dust, durability, moisture. (See appendix for PFI Pellet Grade Standards table)

As this report is being prepared the high school in Caribou, Maine is retrofitting their heating system with a 1,000,000 BTU wood chip fired system.

Projected conversion schedule with costs and savings – Residential

Residential Installations					
Year	2011	2012	2013	2014	Total
Full Conversion	250	500	1000	1250	3000
Partial	250	250	500	500	1500
Cost	$6.2M	$10.0M	$20.0M	$23.75M	$50M
Yearly Oil Heating Cost	$1.01M	$1.69	$3.38M	$4.05M	$10.13
Yearly Biomass Cost	$781,250	$1.31M	$2.625M	$3.15M	$3.15M
Accumulated Biomass Usage/Tons	3,125	8,375	18,875	31,500	31,500
Accumulated Savings	$228,750	$608,750	$1.59M	$3.32M	

Assumptions: Full system conversion – Equipment & Installation Cost - $15,000
Partial system addition – Equipment & Installation Cost - $10,000
Full home oil heating cost – 1000 gallons @$2.71
Supplemental oil heating cost – 500 gallons @$2.71
Pellet utilizing, full installation – 8.5 tons/year, supplemental – 4 tons/year
Pellet cost - $250/ton

Projected conversion schedule with costs and savings – Commercial

Commercial / Institutional Installations					
Year	2011	2012	2013	2014	Total
Full Conversion	1	1	2	1	5
Partial	1	1	1	2	5
Cost	$2.5M	$2.5M	$4.25M	$4.25M	$13.5M
Yearly Oil Heating Cost	$243,900	$243,900	$420,050	$311.650	$1,219,500
Yearly Biomass Cost	$135,000	$135,000	$232,500	$172,500	$675,000
Accumulated Biomass Usage/Tons	750	1500	2,791	3,750	
Accumulated Savings	$108,900	$217,800	$514,250	$980,100	$544,500

Assumptions: Full system conversions – Equipment & Installation Cost - $1,750,000
Supplemental system addition – Equipment & Installation Cost - $750,000
Installation – 65,000 gallons heating oil @ $2.71
Supplement – 25,000 gallons heating oil @ $2.71
Biomass cost - $180/ton
1 ton biomass = 120 gallons

Enabling Factors to Support the Successful Achievement of Biomass to Energy Initiative

- Efficiency Maine American Recovery and Reinvestment Act (ARRA) - $35M
  - Efficiency Maine, soon to be the Efficiency Maine Trust was awarded on time Federal Stimulus funding to achieve the following goals
    - Create and retain jobs in Maine
    - Achieve energy savings and greenhouse gas reductions
    - Encourage energy efficiency improvements in all sectors
- In April, Maine approval of a Local Option- Property Assessed Clean Energy (PACE) Program
  - Receipt of $30M Retrofit Ramp-up federal grant
  - Initial capital will provide funding for a revolving loan program which can be lent to Maine homeowners
  - Municipalities must approve ordinance allowing them to enter into agreements with homeowners to collect payments via property taxes
- Maine Home Performance Program
  - 25% savings = $1,500 incentive
  - 50% savings = $3,000 incentive
- Federal Energy Tax Credits
  - 30% of the cost up to $1,500

Potential Project Impact

$15,000 weatherization and heating improvement

Adjusted Project Cost = $11,500
PACE Payment = $988/year – 20 years @ 6% int.
Energy Savings = approx. $1,200/year

Biomass to Energy Residential/Commercial Weatherization and Heating Funding and Construction Model

Efficiency Maine Trust Funds
$30M

Further fund proformas and budgets need to be researched and developed based upon secured funding levels, cost of funds (if applicable) and implementation projections

NMDC
Fund Management
Project Coordination
Marketing/Promotion

P.A.C.E
Property Assessed Clean Energy Program

Small Commercial

Property Tax Payment

Northern Maine Energy Economy Fund

P.A.C.E.
Property Assessed Clean Energy Program

Property Tax Payment

Indirect Payment

Direct Re-Payment

Project Payments

Direct Re-Payment

Indirect Payment

Certified Contractors
Auditors - Installers

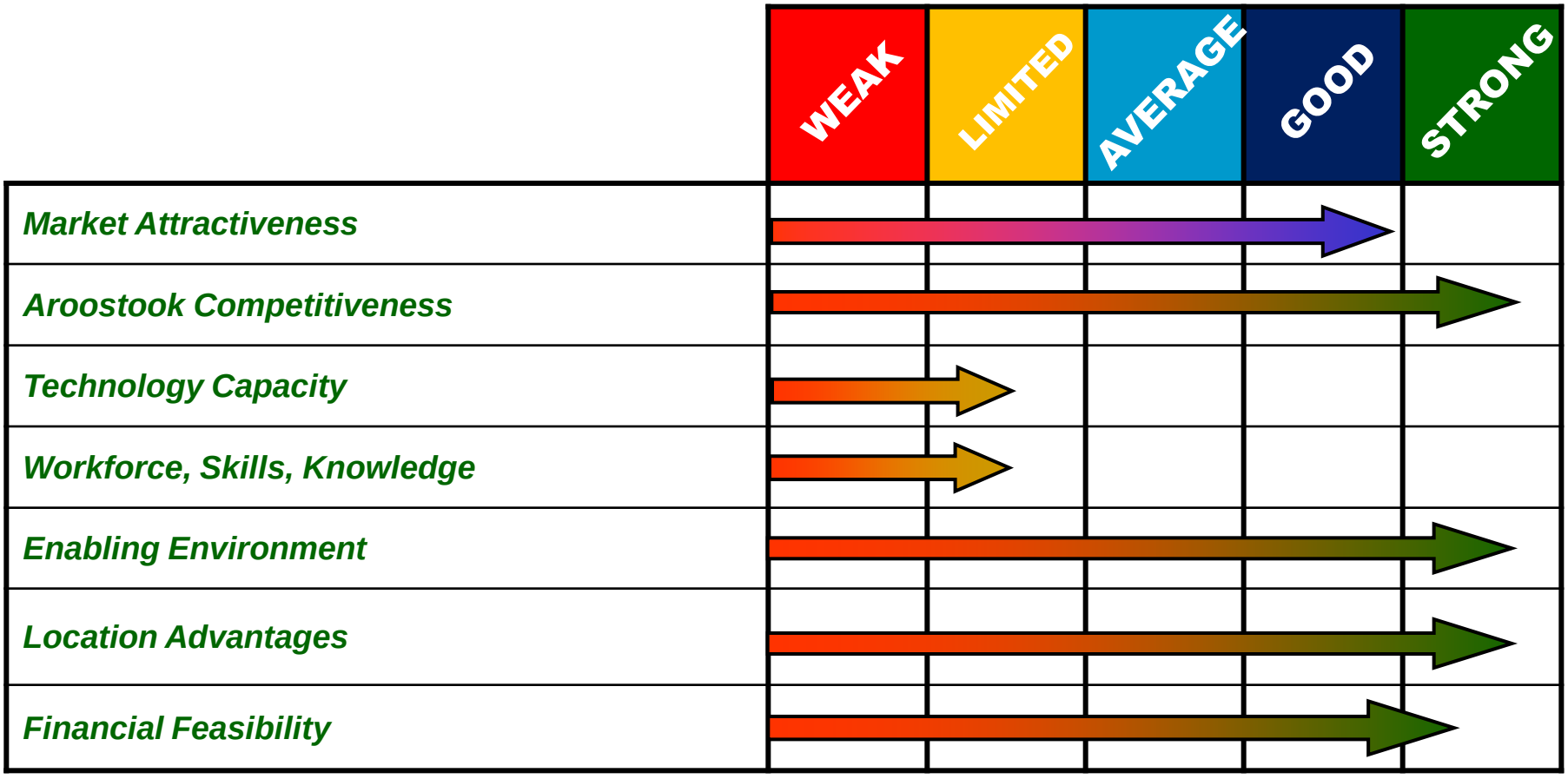
Commercial/Institutions

Project: $750K - $1.75M
Weatherization
Mechanical

Project: $10,000 - $20,000
2nd Position Mortgage
20 year term
Weatherization
Mechanical

Residential

Northern Maine Renewable Energy Economy – Biomass to Energy



Implementing a strategy to convert residential and commercial heating systems has an potential annual impact of $23M+ in Aroostook County (slide 58)

Overall Opportunity Rating → **GOOD**

Biomass to Energy Implementation Plan

Implementation of a Biomass to Energy strategy in The County will involve multiple stakeholders and the coordination of public policy, industry collaboration and an ongoing campaign to change consumer preferences.

First Three Months

A. Assemble a Biomass to Energy action team of following stakeholders with staff support from NMDC:
   - Aroostook woodland and farmland owners
   - Pellet fuel producers and distributors
   - Education and training entities
   - Stove/boiler equipment sellers and installers
   - Energy efficiency assessment & modification contractors
   - Finance and incentive entities

B. Approve the biomass to energy industry cluster goals

C. Consult with Efficiency Maine Trust on development of model ordinances and contracts for the statewide PACE program and other efficiency programs

D. Refinement of the initiative plan and budgets

E. Introduce and secure adoption by Aroostook municipalities of ordinances to implement the PACE program.

F. Establish initiative funding support from Efficiency Maine Trust

Biomass to Energy Implementation Plan (Cont.)

Months 3 – 6

A. Complete a detailed implementation plan including roles, responsibilities and budgets.
   Implementation plan elements:
   - Community/consumer education and awareness
   - Biomass fuel sourcing, production and distribution systems
   - Residential and commercial facility energy efficiency and heating equipment assessment
   - Equipment selection and installation options
   - Energy efficiency modification options
   - Contract negotiation and administration
   - Finance & incentive coordination and administration

B. Complete the Aroostook Biomass Heating package of products and services
C. Launch the Aroostook biomass Heating program

Ongoing over five years

A. Pursue and secure addition fund capitalization
B. Biomass to Energy action team continues to meet to assess strategy effectiveness & consumer response and measure economic impact.

Table of Contents – Renewable Energy Opportunity Analysis

Renewable Energy Economy
Grass Biomass

Biomass for energy may be produced in a variety of forms. Aroostook County has a strong farming heritage including significant fallow acreage that can be suitable for unique grass species. Andrew Plant, University Maine Extension Aroostook County has conducted substantial research and has concluded its feasibility.

Grass Biomass Opportunity and Value

The Grass Biomass niche market opportunity can be viewed as a subset of the preceding wood biomass to energy opportunity. Grass biomass can be produced on any agricultural land in Aroostook and converted to fuel.

In addition, to the regional benefit outlined in the preceding section, grass biomass production offers significant benefits to farm operators.

Grass biomass production is assumed to supplement the 45,000 tons/year of wood biomass production in Aroostook County.

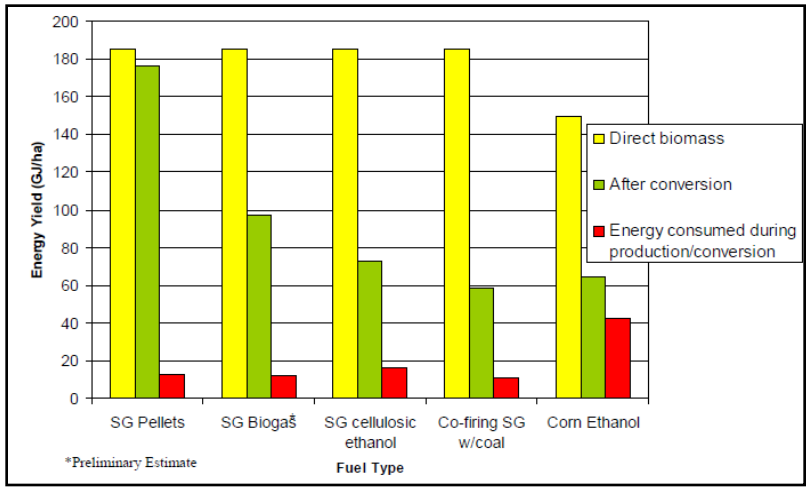
- Retail target price $140-$180 per ton bulk, $155-$195 per ton bagged
- 4,843 acres @ yield 3.7 tons per acres = 17,919 tons @ $165 = $2.95M
- Gross revenue potential by participant
  - Farmers = $36/ton = $558M
  - Processors = $155/ton = $2.5M (bulk fob plant)
  - Distribution/Retail = $165/ton = $2.95M

Key factors to capture the opportunity

- Educate farm operators on the business case and predictable financial benefits of grass biomass production.
- Reach critical mass of acreage in grass biomass production to support a grass pellet production operation (either in conjunction with or independent of wood pellet producers)
- Research and determine optimum stove technology for residential and commercial heating systems which will develop necessary demand

Grass Biomass Benefits and Attractive Characteristics

1. Lower moisture, thus less water to extract for processing than wood
2. Renewable and grows well on marginal soils
3. Not subject to market pricing fluctuations unlike wood
4. Existing hay production equipment works with grass crops
5. Efficiently stores solar energy for high BTU yields
6. 40-pound bag of pellets produces only three ounces of ash
7. Eligible for carbon credits and offsets to lower costs
8. Good long term option in temperate climates like Maine
9. Takes 70 days to grow a crop of grass for pellet production
10. Grass biomass industry can be completely independent from, but complimentary to, the production of food or animal feed
11. High rural economic development impact (wealth creation)
12. Less air pollution than home heating oil



Source: Resource Efficient Agricultural Production (REAP) - Canada

Aroostook County Competitiveness and Regional Assets

- Total farm land in Aroostook county 205,000 acres
  - Currently harvested 126,000 acres
- Idle land (recoverable with small cost) 67,000 acres
- Land in CRP 28,000 acres
- Broad base of farming technology, culture and expertise
- Aroostook acreage is inexpensively converted to grass corps
- Farm machinery already exists to grow and harvest grass.
- Andrew Plant and the University of Maine Cooperative Extension

Potential barriers

- Primary barrier for grass biomass strategy is farming enterprise receptiveness
- Entrepreneurs launching local grass pellet production capability
- Production process and equipment modifications from wood pellet production due to different physical characteristics of grass
- Heating equipment capable of handling grass pellets may not currently be available from local suppliers.

Financial Requirements

- Average farmer finance – Minimal
- Home heating conversion - similar to wood biomass conversion
- Grass pellet production plant – 16,128 tons per year = $1.5M
- Bulk distribution equipment – Minimal for conversion of traditional oil delivery trucks
- See Appendix for UM Cooperative Extension report:
  - *On-farm Biomass Production – Grass Energy*, Andrew Plant

Row Crop production Compared to Grass Biomass Production

Based on single crop production costs, yield, and prices, it appears that the average Aroostook crop farmer has its highest net income per acre when growing potatoes.

Crop	Average Production Cost/Ac	Average Yield/Ac units	Average Sale Price/unit	Average Net Income/Ac
oats	$ 200.00	70 bu	$ 1.40	($ 102.00)
barley	$ 225.00	60 bu	$ 2.50	($ 75.00)
wheat	$ 250.00	50 bu	$ 4.00	($ 50.00)
canola	$ 250.00	0.75 ton	$ 400.00	$ 50.00
Grass biomass	$ 238.00	3.5 ton	$ 85.00	$ 60.00
potato	$ 2,277.00	284.3 cwt	$ 8.53	$ 148.00

However, typical potato farm operations in Aroostook County involve some type of crop rotation. The table below therefore represents average **Total Farm Net Income per Acre** when crop rotations are taken into consideration. Note that highest total net income per acre comes from grass biomass. Grass crops require seed planting once with no rotation, thus high returns per acre.

Rotation	Net Income/Ac
Potato-oats	$23.00
Potato-barley	$36.50
Potato-wheat	$49.00
Potato-wheat-canola	$49.33
Grass biomass	$60.00

Source: 1. Andrew Plant, UM-Cooperative Extension
2. Planning Decisions, Inc.
3. OMAFRA Crop Budgets

Aroostook County Grass Biomass Economic Analysis

Fuel Prices for Analysis

- Grass Pellets = $165/ton retail bulk
- Wood Pellets = $250/ton
- #2 Heating Oil = $2.71

Residential Heating Systems Costs

- Grass Pellets = $11,000 - $15,000
- Wood Pellets = $11,000 - $15,000
- Oil = $8,500

Average Fuel Use per Year

- Grass Pellets = 10.74/tons = $1,611
- Wood Pellets = 8.54/tons = $2,135
- Oil = 1,000 gallons = $2,710

Source: Andrew Plant, U Maine Cooperative Extension, VE analysis

Aroostook Economic Opportunity Value within two years

$2.95M/Year
without multiplier effect

Aroostook Grass Pellet Mill

- 2.0 tons/hour = 16,128 tons/year
- Mill Capital Cost = $1.56M
- 8 employees @ $30,000 w/benefits
- 16,128 ton revenues = $2.5/year
- Plant Payback - 3.5 years

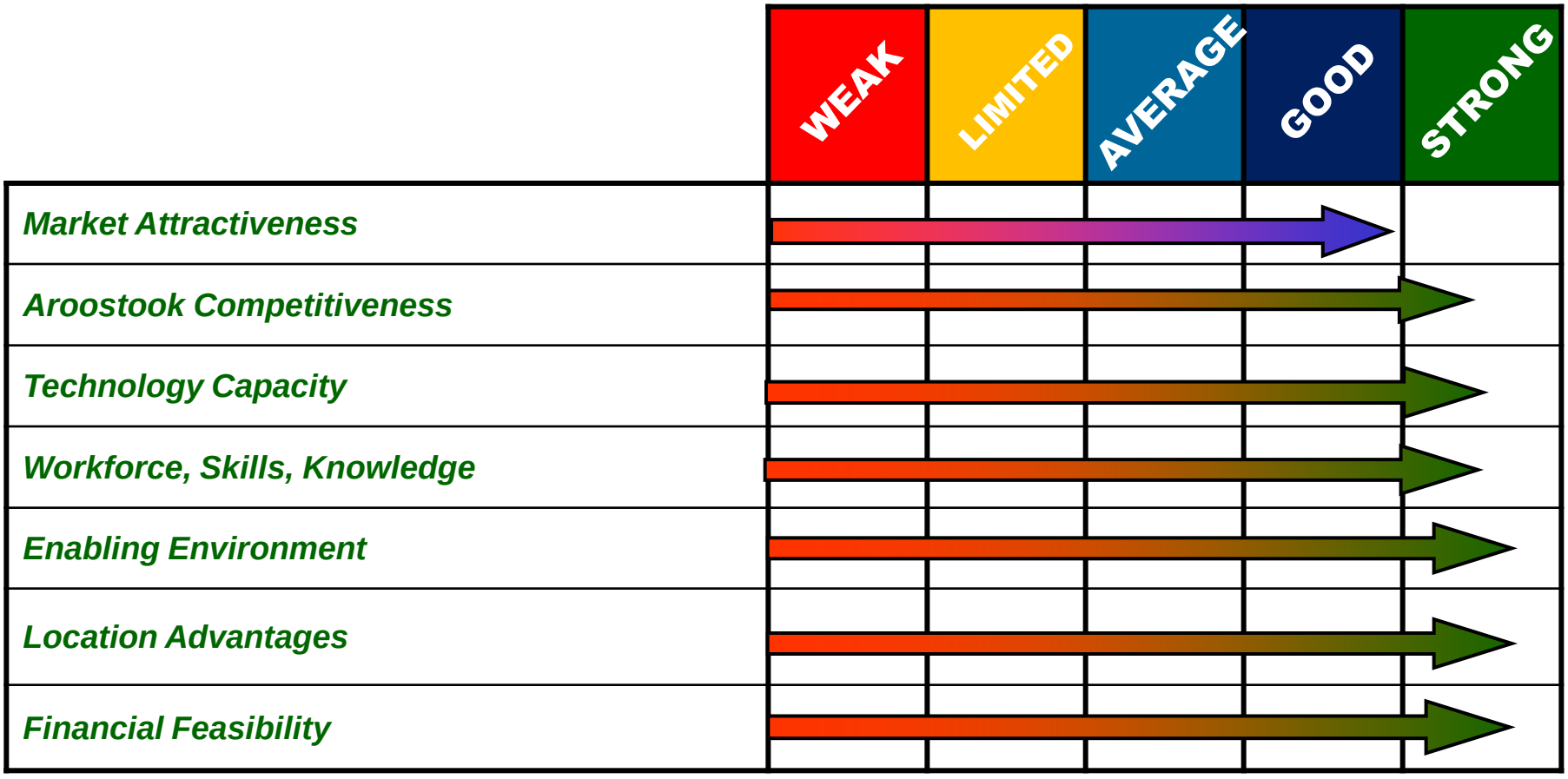
Aroostook Farm Production

- 4,843 acres of marginal land
- 3.7 tons/acre @ $36/ton
- $558K revenue/year for farmers

Residential Conversion Benefits

- 16,128 tons = 1.5M gal. heating oil
- 1,500 homes
- Savings = $1.6M/year ($1,099/home/year)

Northern Maine Renewable Energy Economy – Grass Biomass



Reestablishing 4,843 acres of idle farmland in Aroostook County can generate $2.95M in economic value to the region. Biomass to energy pellet demand must be created initially.

Overall Opportunity Rating → **STRONG**

Grass Biomass Implementation Plan

Grass biomass farm operations and potential pellet producers should be part of an Aroostook County Biomass to Energy action team.

- The grass biomass implementation plan is included within the previous biomass to energy implementation plan
- Grass biomass should be a sub-action team to focus specifically on the development of market demand and understanding of grass biomass versus wood biomass
- Work in conjunction with UMaine Cooperative Extension Center to provide land owner and farmer education on grass biomass production opportunity and financial proforma.
- Work with pellet producers on equipment and processing requirement for grass feed stock.
- Work with heating equipment suppliers on equipment specifications for grass pellet.

Table of Contents – Renewable Energy Opportunity Analysis

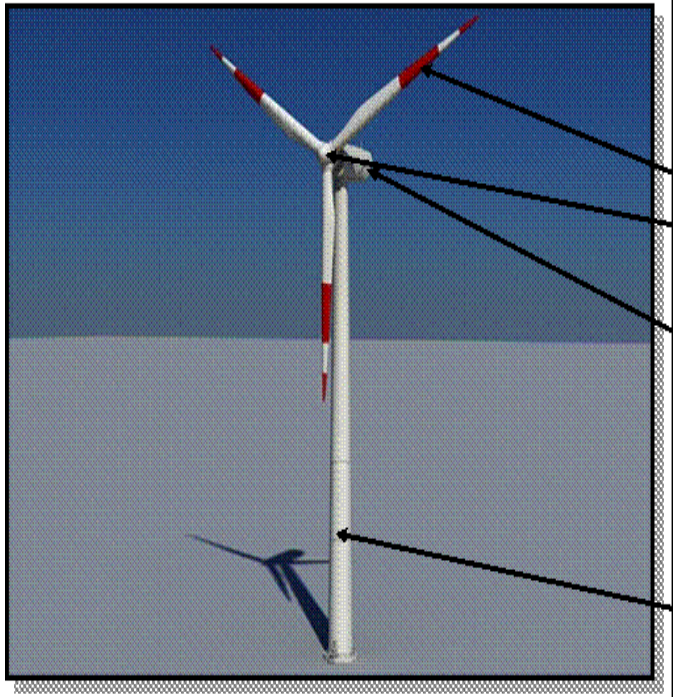
Renewable Energy Economy Community and Small Wind Energy

Wind energy has received significant attention and investment across the US and in Maine. Regional leaders should analyze the complete economic cost/benefit analysis before investing in wind generation.

The Aroostook Renewable Energy Industry Cluster has set a five-year goal of 200 Mw of installed wind energy facilities. Individual small wind facilities are defined as being less than 5 Kw, and therefore it is unrealistic to expect to achieve that goal entirely through small wind operations. Community Wind shares characteristics of both small and large wind, but is under local community ownership.

Northern Maine Renewable Energy Economy – Community and Small Wind Energy

The United States faces the challenge of meeting an increasing demand for electricity while simultaneously responding to the need to reduce carbon emissions. The electricity sector is the largest, single contributor to greenhouse gas emissions. Wind power is attractive because it is a widely-available and a renewable source of energy that produces neither pollution nor climate-changing greenhouse gases, diversifies the national energy portfolio and is predictably-priced. Industry experts estimate that the U.S. has more than 8,000GW of available land-based wind resources that can be captured economically.



Component	% of Machine Weight	% of Machine Cost
Rotor Blades and Rotor Hub *(up to 40 tons)*	10-14	20-30
Nacelle *(up to 70 tons)* enclosing:	25-40	25
Gearbox	*5-15*	*10-15*
Generator	*2-6*	*5-15*
Electrical Controls	*N/A*	*N/A*
Tower *(more than 100 tons)*	30 - 65	10-25

Wind turbines convert wind energy to electricity. Wind turbines range in size from 5 Kw to 3 Mw with rotors (i.e., blades) up to 110 yards in length. Wind turbines are comprised of four main components but can contain more than 8,000 component parts. Typically, the rotor is the highest cost item and the tower is the heaviest part of the turbine.

Wind Farms or Power Plants

Wind turbines capable of generating 0.5Mw – 3Mw are sited in large numbers in one location to generate electricity to supply the grid. These turbines can be up to 350 ft tall. Power plants are also referred to as wind farms or utility-scale wind projects and require many acres of space. This market segment can be subdivided as follows:

- **Community wind** - Single turbine to commercial-scale wind project that includes an opportunity for local investment, control and involvement. One definition of community wind is a wind generation project owned by farmers, businesses, schools, governments, or locally owned utilities in the area where the wind power is used. Community wind projects generate electricity for local consumption and/or for sale to an electric utility and are typically smaller in scale (often less than 50MW).
- **Onshore utility-scale wind power plants** - 10 or more turbines generating electricity to supply the grid. A power plant can also be one or more mega-machines.
- **Offshore utility-scale wind power plants** - Larger, fewer turbines located offshore supplying electricity to the grid.

"Wind energy works and makes environmental sense—more so today than ever before—but consumers have to be on their guard,"

– Paul Gipe, wind energy pioneer, expert, and advocate

Economic Opportunity Definition and Value

- **Issue** – High cost of electricity facing residents, organizations and businesses in the region
- **Issue** – Dependency on imported electrical energy

Opportunity – Community owned wind energy generation for local consumption.

Community wind can range in scale from single turbine to commercial-scale wind farm projects that includes an opportunity for local investment, control and involvement. The distinguishing difference between Community and Commercial wind is ownership and usage – which for Community Wind is all local.

Opportunity – Small or Distributed Wind

Smaller wind turbines capable of generating 0.5 – 4.9Kw are used to supply power for residential or business use. The average height of a small wind turbine is about 80 ft. Generator size and tower height are not generally related. This market segment can be subdivided as follows:

- **Off-grid home installations** - Homes located too far away from the main grid for economical connection.
- **Behind-the-meter farm/ranch/home systems** - On-grid users who wish to cut energy costs by installing their own wind power unit.
- **Institutional and business** - On-grid universities, hospitals, industrial plants, etc. using a wind power unit to reduce energy costs.

The smaller-scale option is referred to as “small wind” or “distributed wind” while the more intensive operations are a “wind farm” or “power plant.” Understanding the differences between these types of opportunities is important to understanding the potential opportunities for Northern Maine.

Fundamentals of Wind Energy

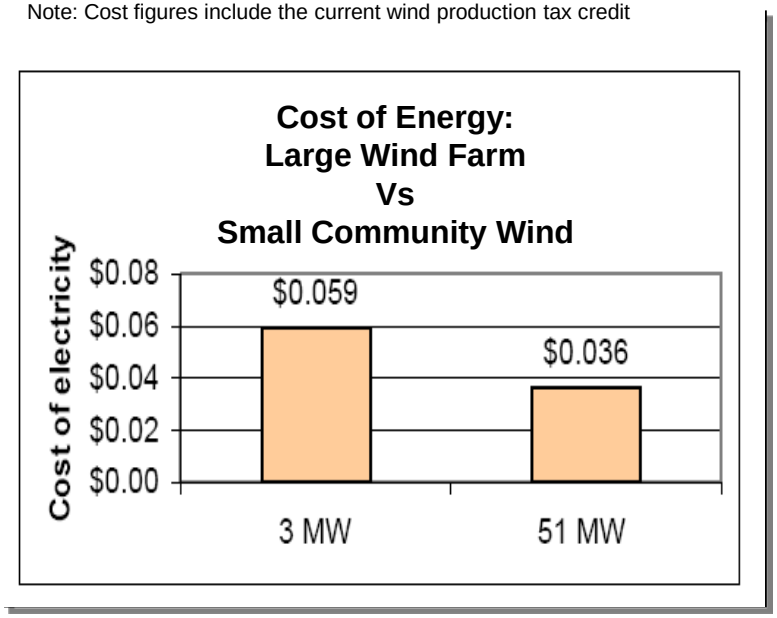
1. Energy generation from wind is proportional to the cube of the wind speed
2. The taller the turbine tower and the larger the blade sweep the more powerful and productive the turbine
3. Wind farms are capital intensive, so the cost of financing is a large variable in project ROI
4. Transmission and generation deviations have significant impacts on a project feasibility

Assumptions:

- Average wind speed of 18 knots
- Identical wind turbine size
- 3MW vs. 51MW

It is beyond the scope of this report to characterize investment or ROI for a "typical" Community Wind project.

Note: Cost figures include the current wind production tax credit



Conclusions:

- 51MW farm will produce electricity at 40% less cost
- Larger farms have lower O&M costs per KW and other efficiencies

Small community wind projects have economy of scale hurdles that will require creativity and collaboration to reach feasibility

Source: American Wind Energy Association, The Economics of Wind Energy, February 2005

Three Scenarios for Wind Development

1. **Leasing Your Land:** The least risky way to harvest the wind is to let someone else put up the capital and operate the wind project. You receive payments for the use of your property, while another party constructs and maintains the project.
2. **Investing With Others**: You can share the risks of a wind energy project by investing with others. The advantage to this approach is that you can share responsibilities and costs.
3. **Investing On Your Own**: The most risky method is to install and maintain your own turbine or turbines. You assume all the costs and responsibilities, but you also reap all the profits.

Source: Windustry

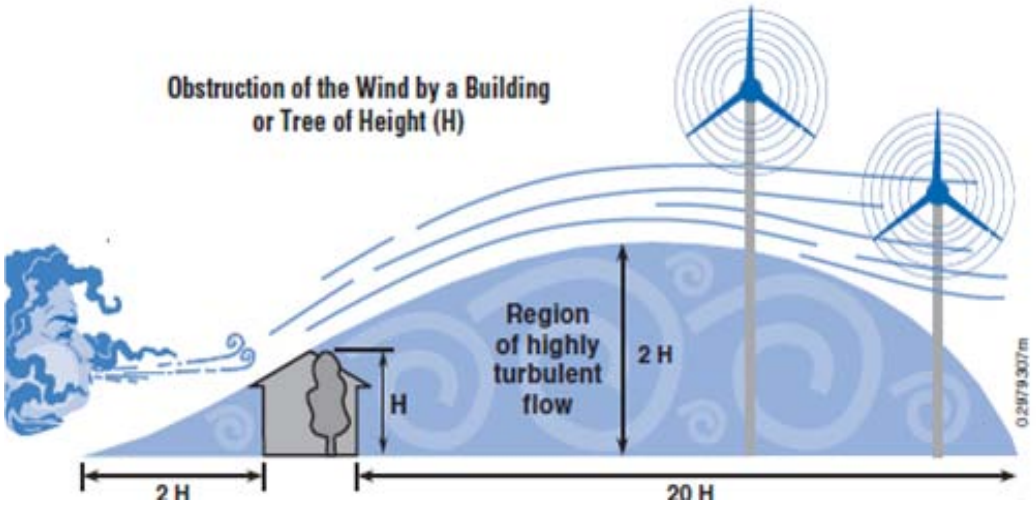
Like every investment ,wind energy has a variety of risk and reward scenarios that must be understood and analyzed before launching into a project

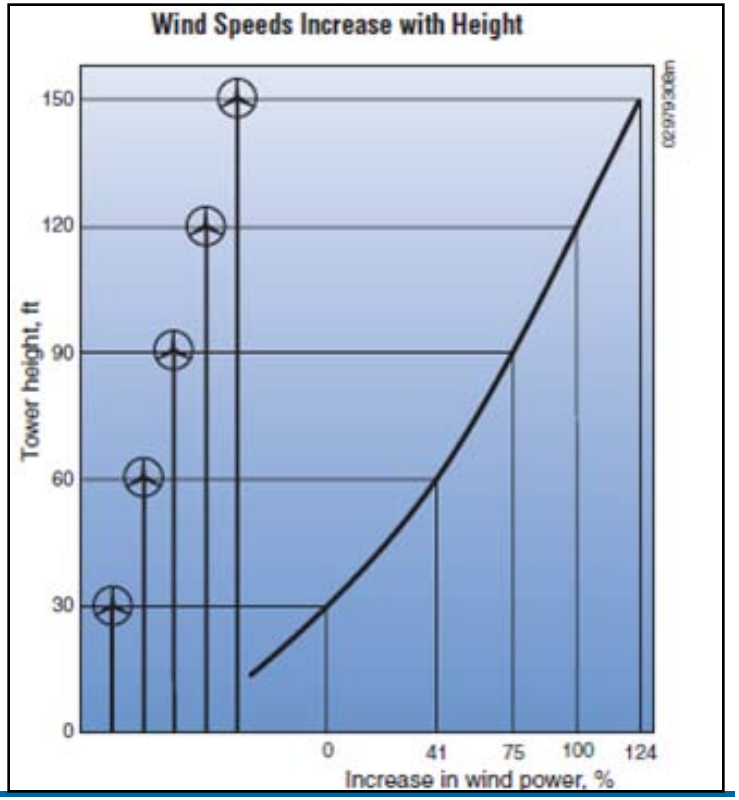
Installation Considerations
Local wind speed, Height of Tower, Surrounding Obstructions

Small Wind Turbine Productivity Estimates*

Wind Power Class	Productivity per m² of swept area** (kWh/year)	Wind Power Density at 33 ft (10 m) (W/m²)	Wind Speed at 33 ft (10 m) (mph)	Wind Speed at 33 ft (10 m) (m/s)
1	< 350	<100	< 9.8	< 4.4
2	350 - 500	100 - 150	9.8 - 11.5	4.4 - 5.1
3	500 - 610	150 - 200	11.5 - 12.5	5.1 - 5.6
4	610 - 690	200 - 250	12.5 - 13.4	5.6 - 6.0
5	690 - 770	250 - 300	13.4 - 14.3	6.0 - 6.4
6	770 - 880	300 - 400	14.3 - 15.7	6.4 - 7.0
7	880 -1170	400 -1000	15.7 - 21.1	7.0 - 9.4

Aroostook County
2 - 2.7 wind power class =
11.5 – 12.5 avg. wind speed

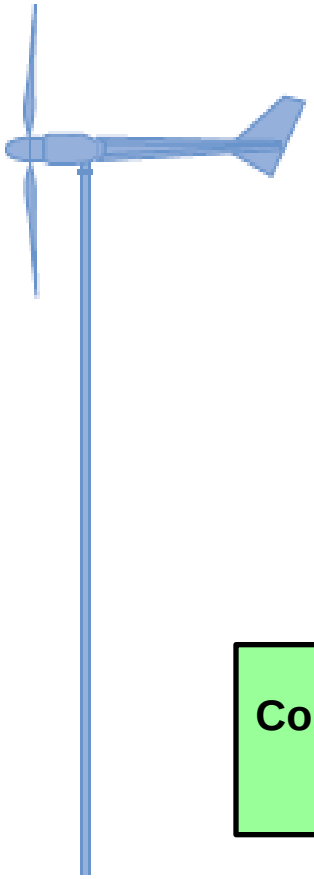




Source: US Department of Energy, Energy Efficiency and Renewable Energy

Residential Application for Small Wind Turbines

Although small turbines cost less initially than solar, but are proportionally more expensive. The cost of an installed 80 foot tower, batteries, and inverter, typically range from $15,000 to $50,000 for a 3KW to 10KW wind turbine.



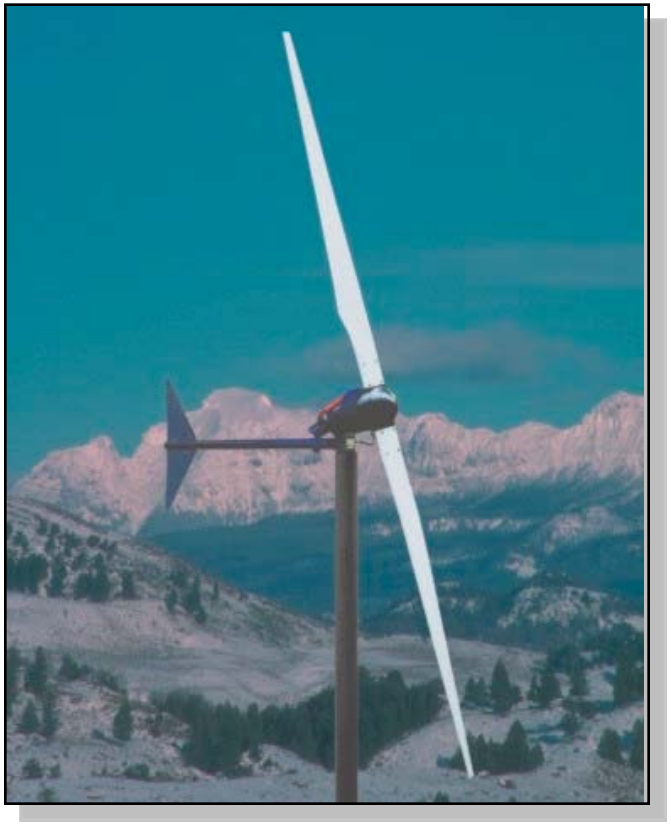
Typical Residential Small Wind Application Scenario

- A typical US home uses approximately 10,000 kWh or electricity per year.
- A typical Maine home uses 6,000 kWhs per year.
  - Maine residential use is less due to significant heating from oil, kerosene and wood.
- Depending on the average wind speed in the area, a 5 to 15 kW small wind turbine would be required to make a significant savings contribution.

Source: US Department of Energy, Energy Efficiency and Renewable Energy

Conclusion: a typical Maine residence requires at least a 3kW wind turbine in a location with 14 mph annual average wind speeds.

Southwest Windpower
Renewable Energy Made Simple
Whisper 175



Source: Southwest Windpower

3 Kw Residential Small Wind ROI	
Payback Period (SPB)	**17**
Rate of Return (IRR)	**8%**
Net Present Value (NPV)	**$2,809**
Summary Assumptions	
Power Output (kWh/year)	5,797
Average Cost of Electricity ($/kWh)	$0.16
Nominal Electricity Escalation Rate (%/year)	2%
Total Installed Cost	$13,500
Down payment (%)	33%
Debt Term (years)	15
Interest Rate (%/year)	8%
Marginal Effective Tax Rate (%/year)	30%
Variable Cost ($/kWh)	$0.01
Nominal Variable Cost Escalation Rate (%/year)	2%
Rated Power (kW)	3
Fixed Cost ($/kWh)	$0.00
Nominal Fixed Cost Escalation Rate (%/year)	2.00%

Financial Incentives Wind Energy System Installations

Federal Residential Renewable Energy Tax Incentives

The American Recovery and Reinvestment Act of 2009 extended many consumer tax incentives originally introduced in the Energy Policy Act of 2005 (EPACT) and amended in the Emergency Economic Stabilization Act of 2008 (P.L. 110-343). Consumers who install residential small wind systems with a nameplate capacity of not more than 100 kilowatts can receive a **30% tax** credit for systems placed in service before December 31, 2016. There is no maximum credit for systems placed in service after 2008.

Maine Solar and Wind Energy Rebate Program

Wind energy systems are eligible for a financial rebates;

- Residential - $500 per 500 watts, $2,000 max
- Commercial - $500 per 500 watts, $4,000 max.

Wind energy systems must be grid-tied and installed by a factory trained and approved dealer and working under the supervision of a Master Electrician. This program is set to expire December 31, 2015. $500,000 in total rebates are available on a first come first serve basis.

Source: Database of State Incentives for Renewables & Efficiency

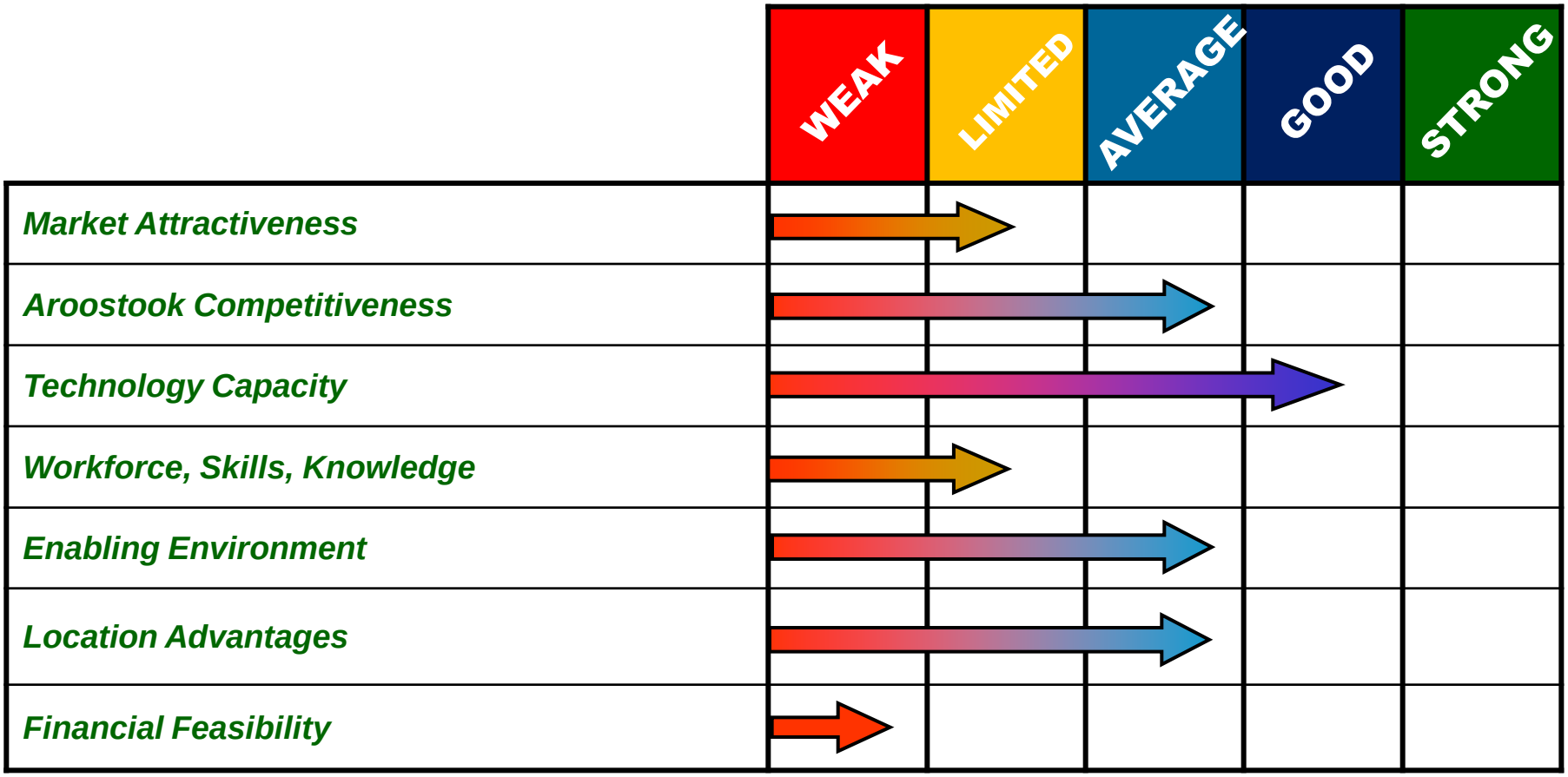
Key Factors to Realize Opportunity

- **Transmission grid** - Wind projects are often located in rural areas without the required access to the grid. Aroostook County has a transmission grid infrastructure barrier that currently limits the number of new wind plants that can be built because there is insufficient transmission capacity to carry the electricity produced to the NE ISO.
- **Distribution Grid** – Maine Public Service distribution grid has location specific capacity limitations for accepting energy inputs. In addition to capacity limitations any significant energy input must also comply with the Northern Maine electrical energy load management capabilities.
- **Predictable policy environment** - Existing incentives have a short-term duration and renewal is not assured.
- **Public concerns** - Negative perceptions related to bird fatalities, visual and noise pollution and perceived safety concerns.
- **System Equipment and Installation Cost**
- **Predictable Zoning ordinance**

- **Factors that effect Wind Turbine Efficiency**
  - **Wind Speed**: Wind turbines are usually designed to run at a specific wind speed and any variation in wind velocity can lower their efficiency.
  - **Temperature Changes:** Extreme change in temperature can affect the running of a wind turbine. Although this issue is being addressed with improved designs, variations in temperature will cause changes in energy conversion efficiency.
  - **Loss of Energy:** As in any machine there is a loss of energy, due to friction and resistance. Though work is being done to improve turbine designs to reduce and limit this energy loss, 20%-30%.

Source: US Department of Energy, Energy Efficiency and Renewable Energy

Northern Maine Renewable Energy Economy – Community and Small Wind Energy



Each home or land owner must conduct a feasibility study to determine whether a wind energy system is physically and financially feasible for their particular location and situation.

Overall Opportunity Rating → **AVERAGE**

Recommended steps in developing a Wind Energy Project

Feasibility Phase:

Conduct a feasibility study

Before committing significant resources to a wind project, conduct a feasibly study using an outside consultant with expertise in wind development. The study should assess the need for the project, market potential, supply of key inputs including labor, development schedule, capital requirements, projected operating costs and net revenue, economic feasibility of the project and financial plan for the project.

Conduct a wind resource assessment

The wind resource assessment is the basis for initial feasibility and cash flow projections, both of which are critical for obtaining project financing. The assessment also identifies the best site for wind farm development. Wind maps and GIS mapping are used to identify potential sites. Further detailed analysis for a due diligence assessment is required, e.g. computer modeling using data collected from anemometers for up to two years, long-term validation of the data, detailed production estimates and cash-flow projections.

Develop the site layout, design and planning

Once a site is selected, there are a number of other issues to consider when planning the layout and design of the project within the site. These include setbacks, turbine layout and project design.

Recommended steps in developing a Wind Energy Project (cont.)

Permitting and Entitlement Phase:

Apply for the appropriate permits

Wind systems must receive the relevant municipal zoning, and industry permits from state and/or local communities. Federal permits may also be required, e.g. FAA permission if the project falls in an airport's flight path, if the project poses potential impacts on wildlife protected under the Endangered Species Act, etc.

Negotiate for the required leases and easements

As applicable a land lease may be required for the project. Legal agreements are required to cover the period of the project, the land required and potential land for expansion. Adjacent land may also be required for wind easement, i.e. to provide adequate exposure of a wind power system to the winds.

Negotiate a Power Purchase Agreement

A power purchase agreement (PPA) is a contract to buy the electricity generated by a power plant. The agreement is critical to the success of a project as it secures a long-term stream of revenue for the project.

Apply for interconnection to the grid

For a large project this is a complex process which can be greatly assisted by utilizing the services of an experienced consultant. For a small wind system of less than 5 Kw it is usually fairly simple.

Secure financing and incentives

To be financially viable, the cost to buy, install, and operate the wind turbine must be offset by the value of the energy that can be produced. Begin the process of securing any State and/or Federal incentives.

Recommended steps in developing a Wind Energy Project (cont.)

Development, Installation and Operations:

Select and purchase turbines

Turbine selection is based on the available wind resource, the project goals, size of the project, price, equipment reliability and the proximity of operation and maintenance (O&M) services.

Prepare site and install turbines

Once all of the project elements are in place, the site is prepared (access roads, foundation laying, etc.) for delivery and the turbines are installed.

Operate the wind project and conduct maintenance

Once operational, routine maintenance is required to maximize the project's efficiency and turbines' lifespan.

Table of Contents – Renewable Energy Opportunity Analysis

Renewable Energy Economy
Excess Industrial Energy

Regional economies have industrial and mechanical processes that produce surplus energy in a variety of forms; steam, heat, hot water, air pressure, material by-products, etc. Over the past decade, volatile and rising energy costs and increasing interest in sustainability, innovative regions have captured the value of this energy for local benefit.

Economic Opportunity Definition and Value

- **Issue** – High cost of electricity facing residents, organizations and businesses in the region
- **Issue** – Dependency on imported electrical energy

Opportunity – Capture steam or other excess energy to support business operations

Boralex produces 900lbs of 950 degree steam that could be tapped and sent to local companies to dry wood, heat facilities or power other equipment. Boralex cost to tap this energy would require an extensive and expensive engineering and feasibility study. Each recipient would also need an engineering and feasibility study to determine their ROI.

Value and payback requires a more detailed study for each user

Opportunity – Capture and utilize Boralex heated water

Heated water could be captured and directed to local companies for space heating. After boiling, the steam must be cooled and condensed to return to the closed system of Boralex operation. In this cooling function there is 70 to 85 degree @ 28 inches of vacuum available that could heat several greenhouses or an expansive work area. There is plenty of land available (50 to 100 acres) near the Boralex plants for several operations.

Value and payback requires a more detailed study for each user

Aroostook County Competiveness and Regional Assets

- Boralex must compete within the Maine energy market. Long term, will Boralex be able to remain competitive and able to partner in Standard Offer Bidding?
- Should their current contract to supply Standard Offer Providers be lost and ISO NE, the local companies depending in the supply from Boralex may have their operations jeopardized.

Financial Requirements

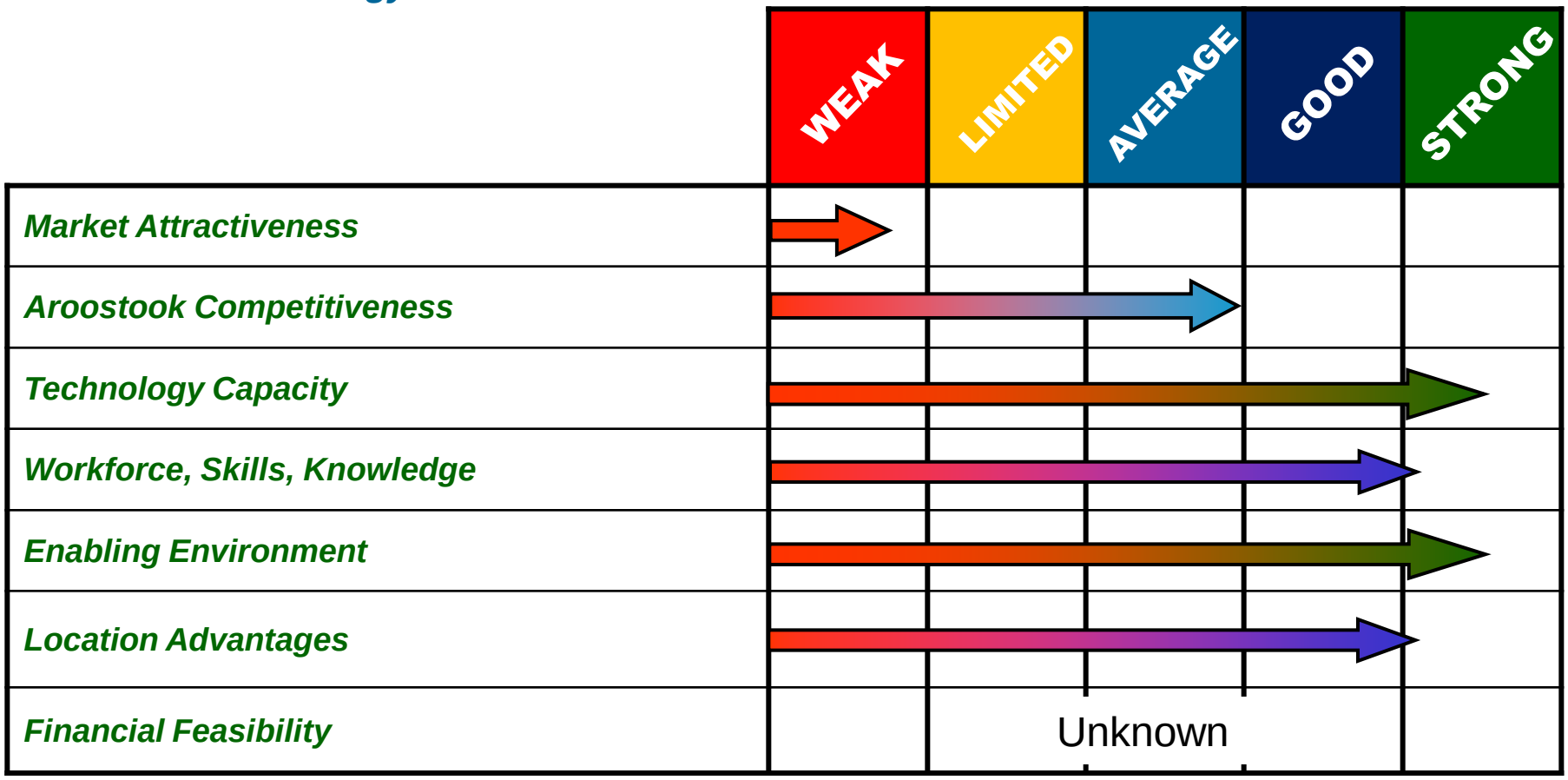
- Cost to convert and capture excess energy to surrounding plants will require significant capital. Numerous funding sources will be need to be researched as all parties currently could not fund a project like this alone.

Conclusion:

There does not appear to be a economic opportunity to capture either steam or hot water from the Boralex biomass plants in Aroostoook County at this time. This determination is based upon dependability of the energy source, significant engineering and equipment costs and electrical market uncertainty surrounding Boralex biomass energy.

The next section in this report, BuyLocal: Northern Maine Energy Market, is a more feasible opportunity and can support the long term viability of the Boralex plants.

Northern Maine Renewable Energy Economy – Excess Industrial Energy



This opportunity requires additional study and feasibility analysis to determine opportunity value

Overall Opportunity Rating: LIMITED

Table of Contents – Renewable Energy Opportunity Analysis

Renewable Energy Economy
Buy Local: Northern Maine Energy Market

Buy local = supporting yourself. This is a common and promoted economic development theory today. Many “buy local” campaigns are challenged by their ability to quantify the economic impact, thus changing consumer behavior. These campaigns are driven by the following prioritized motivations; personal economic, environmental, and regional economic.

Fundamentally, “buy local” strategies are driven by consumer choice.

What choice is Aroostook going to make?.

Northern Maine Renewable Energy Economy – Buy Local: Northern Maine Energy Market

The Aroostook County economy faces higher than national average residential electrical energy cost burden. In addition to the burden on residential customers, these rising electrical energy rates reduce the competitiveness of commercial and manufacturing firms in the region.

The majority of the electrical energy consumed in Northern Maine is generated and purchased from outside of the Aroostook economy causing 60-80% of the customer purchase value to leak out of the regional economy. The exporting of over $40M of local wealth on a yearly basis is an huge issue, but one that can be overcome by local production of energy.

The ***Buy Local: Northern Maine Energy Market*** opportunity consist of two components:

- Direct industrial connection to Aroostook generation (Industrial Energy Park),
- A "buy local" market strategy for residential and commercial customers to purchase standard offer electricity directly from local generation.

This regional opportunity consists of residential, commercial and industrial customers purchasing standard offer electricity directly from the Boralex biomass fired power plants resulting in a stabilizing $40M in economic impact and potentially adding $20M

"The people of **Aroostook County** know all too well that electricity rates are unjustly high in northern Maine. One or two players are dominating the northern Maine electricity market. We believe their prices should be set in response to their **costs** and not because they have the upper hand in a hard-to-reach market." ~Kurt Adams Source: Bangor Daily News

Economic Opportunity Definition and Value

- **Issue** – High cost of energy issue facing residents, organizations and businesses in the region
- **Issue** – Dependency on imported electrical energy
- **Issue** – Isolation on the NE grid places Aroostook into a weak energy market position

Opportunity – Industrial Energy Park with direct connection to electrical generation capacity

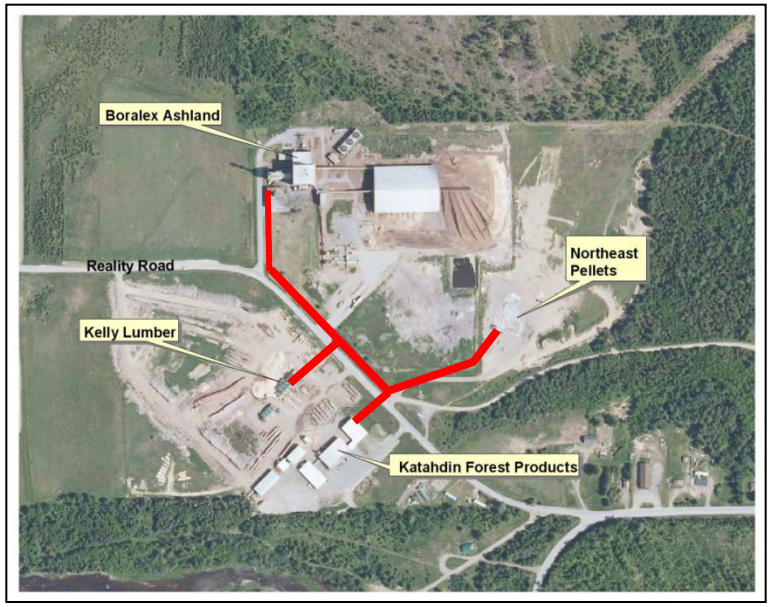
Aroostook County has multiple assets to support an Industrial Energy Park strategy. The region has multiple opportunities under development including a direct energy connection between the Ashland Boralex plant and three industrial companies supporting 100+ employees. The Houlton and Van Buren Municipal Energy Cooperatives provide an additional opportunity to reduce electrical costs to industrial customers.

Opportunity – Residential/commercial purchase of Aroostook County. electrical generation

Aroostook County has significant renewable electric energy generation in the region including the three Boralex plants; Ashland, Fort Fairfield (both active) and Sherman (idled), plus hydro and wind generation. This opportunity focuses specifically on the three biomass plants that have a generation capacity of approximately 82MW toward the 100-125MW demand in the area served by Maine Public Service (MPS).

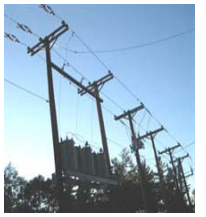
Economic Opportunity Definition and Value

- **Value –** Energy Park **-** Direct connection of industrial customers to local biomass generation
  - Ashland Energy Park enabling direction connection by Katadin Log Homes, Northeast Wood Pellets and Kelly Lumber
  - Projected energy demand, 4MW per year
  - Energy savings by removing T&D charge = $1.2M+
- **Value** – Boralex plants selling electricity at standard offer prices to Aroostook County customers
  - Ashland, Fort Fairfield and Sherman plant have a combined output potential of 82MW
  - Each plant generates $20M in local impact (wages, benefits, purchases)
  - Industry standard - 5 jobs per 1MW = 410 jobs
  - New jobs at idled Sherman plant = 90 jobs
    - $4.1M earnings plus benefits
    - 125 indirect and induced jobs, $3.2M
    - Total new GDP impact approx. $16M



Potential Ashland Energy Park

The opportunity value is in addition to the Biomass to Energy opportunity previously presented in this report.



Key Factors to Realize the Opportunity

- Sense of urgency
  - Since 2004 Aroostook County electricity costs have risen over 48% for residential customers and approximately 60% medium and large users.
  - 2011 standard offer bid (2009 awarded to New Brunswick Power) could displace Ashland and Fort Fairfield generation, loss of $40M in economic impact in the region and 300+ jobs
- Facilitate the infrastructure connection from Ashland plant creating the Ashland Energy Park.

Aroostook County Competiveness and Regional Assets

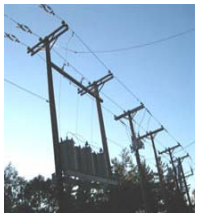
- Supply factors and local capacity
  - Three Boralex Biomass fired power plants with combined output potential of 82MW
  - Boralex has adequate biomass supply capacity under contract
    - Chipper crews and equipment to provide biomass
    - Additional 350,000-400,000 tons of biomass per year available
  - Regulatory requirements
    - Boralex must become a Certified Energy Provider in the State of Maine to sell directly to residential and commercial customers
  - Growth potential:
    - 50 to 60 acres adjacent to the Ashland plant, zoned industrial with rail nearby
    - 50 acres behind Fort Fairfield plant with rail to the back of the plant

Aroostook County Competiveness and Regional Assets (cont.)

- Municipal cooperatives in the region which have lower electrical rates than MPS Standard Offer
  - Houlton Water Company
    - Standard offer: $ .08602
    - Distribution charge: $ .02116
  - Van Buren
    - Standard offer: $ .086071
    - Distribution charge: $ .03194
- Demand Factors
  - Aroostook 100-125MW demand yearly, existing system max. capacity 140MW.
  - Ashland, four business able to use 4MW energy, now
- Enabling environment
  - Boralex can startup the Sherman plant within weeks
  - All elements of this strategy reside within Aroostook County
  - Boralex is willing, interested, and currently motivated to stabilize power sale contracts
- Finance Requirements
  - Ashland Energy Park equipment and installation costs for direct connection, approx. $400,000
  - Boralex funding requirement to become a CEP, $100

Primary challenge to the Northern Maine Energy Market

- Combination of grid capacity and load balancing.
  - The grid can only allow approximately 25MW of additional power in/out of the regional grid.
  - In addition due to isolation of Northern Maine from the New England ISO grid, load balancing is challenging due to demand fluctuations.
  - Load balance will require additional costs of operation to Boralex.

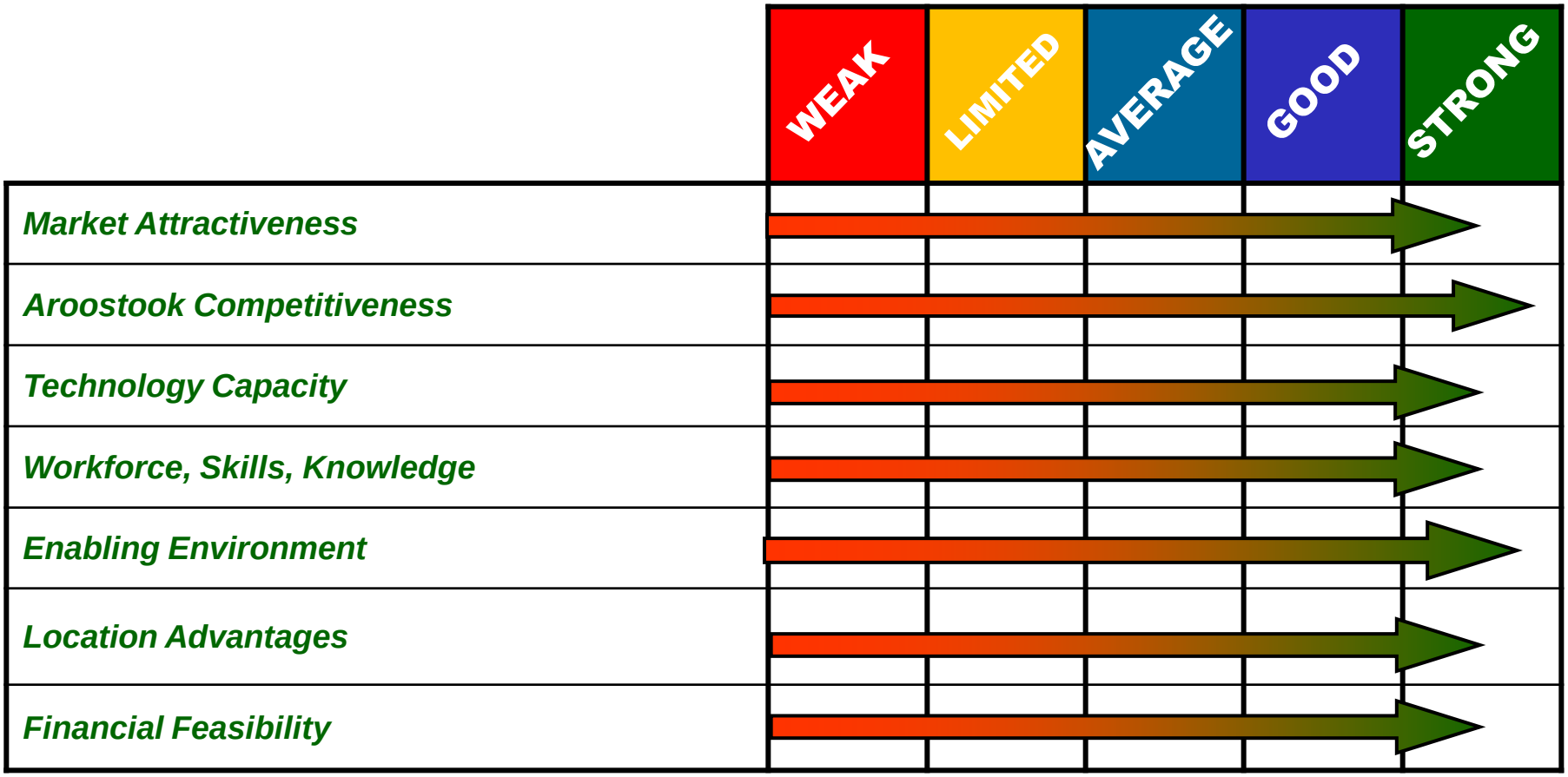


Regulation and Public Policy

- Maine PUC regulations
  - Industrial Energy Park
    - Direct connection under current wholesale license in Maine.
      - Ruling by the PUC supports the ability to serve customers not considered "public" without a retail license if customer relationship is not considered a "public service".
      - This relationship does not require a special license from the Maine PUC

- "Buy Local" preference for electrical energy by residential and commercial customers
  - This strategy can occur in three different scenarios
    1. Boralex becoming a Certified Energy Provider, (CEP) and obtains retail license, selling *directly* to customers that select to purchase power from them. This would require customer service, billing and load balancing costs to Boralex.
    2. Boralex can partner with another retail provider allowing all of the Boralex generation to be sold to Aroostook customers, with the partner providing load balancing services.
    3. Boralex is able to sell it entire output to the Standard Offer provider serving the MPS service area. (MPS Standard Offer tender cycle is separate for the rest of Maine)

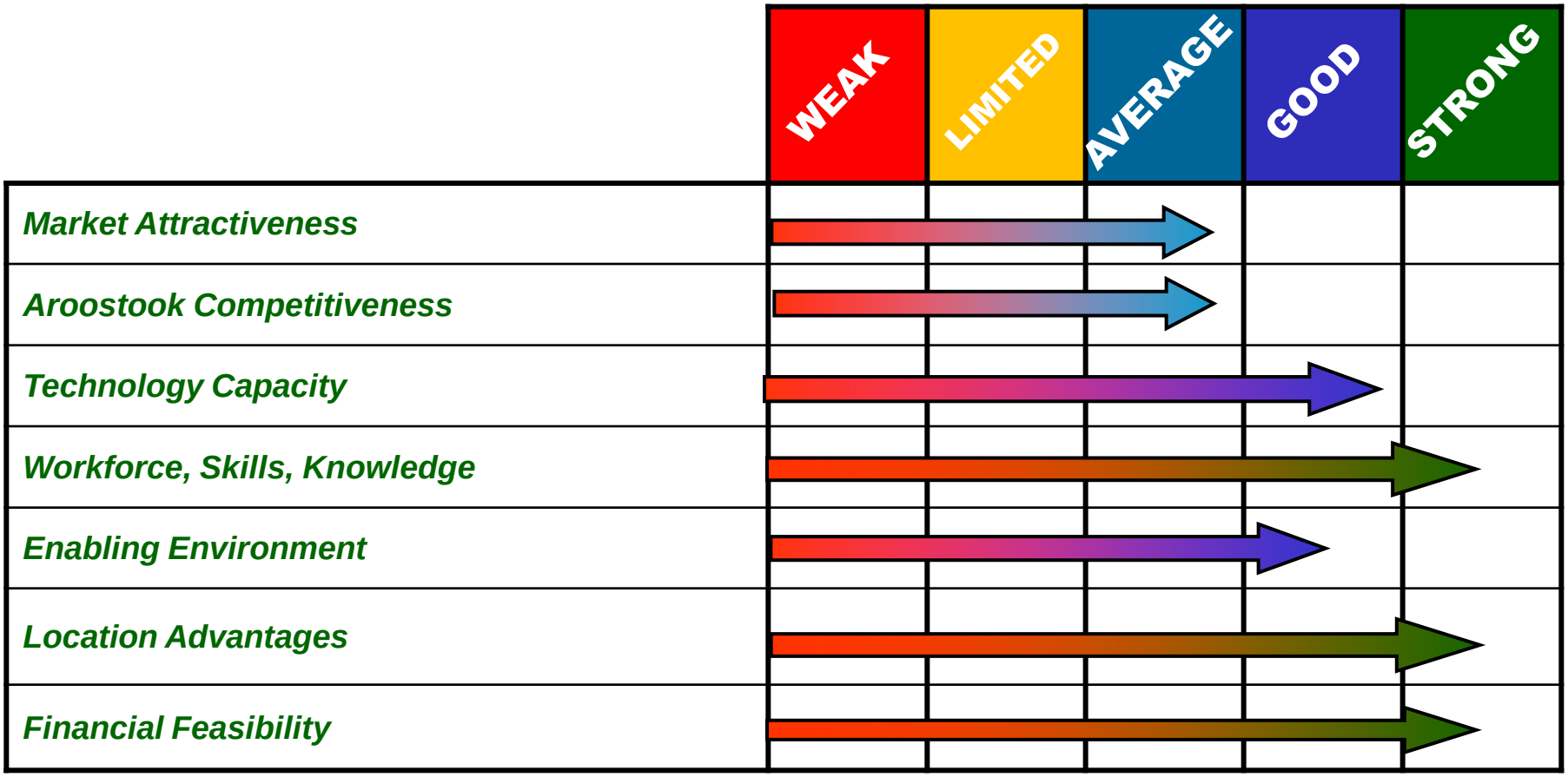
Northern Maine Renewable Energy Economy – Industrial Energy Park



There are no significant PUC regulatory barriers to selling locally generated electricity to "non-public" industrial users in an adjacent energy park.

Overall Opportunity Rating: STRONG

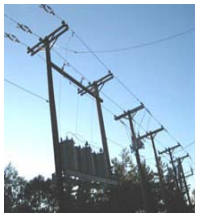
Northern Maine Renewable Energy Economy – Buy Local: Northern Maine Energy Market



Two key factors to this opportunity:

A. Shift in Boralex business model
B. Change in consumer preference to "Buy Local" energy

Overall Opportunity Rating: **GOOD**



Buy Local: Northern Maine Energy Market Implementation Plan

Boralex plays the primary role in launching this strategy through adopting new business practices

- Ashland Industry Energy Park
  - Bring together Ashland Energy Park stakeholders to assess current status of engineering and costs
  - Commit stakeholders to an MOU for long-term direct connection energy strategy
  - Research and secure capital funding
  - Complete engineering and construction of connection
  - Complete a project assessment and ROI to be used in attracting other companies to the Park

- Buy Local: Northern Maine Energy -Region-wide residential and commercial campaign
  - Boralex determines which of three business scenarios to pursue to sell under a “Buy Local” strategy
  - Develop appropriate partnerships to address load balancing issues
  - Develop a consumer education and marketing campaign to encourage consumers to “Buy Local” for their electrical energy needs.
    - This should be done in conjunction with the biomass to energy action team, supported by NMDC

Table of Contents – Renewable Energy Opportunity Analysis

Renewable Energy Industry Cluster

Renewable Energy Economy Northern Maine Renewable Energy Center of Excellence

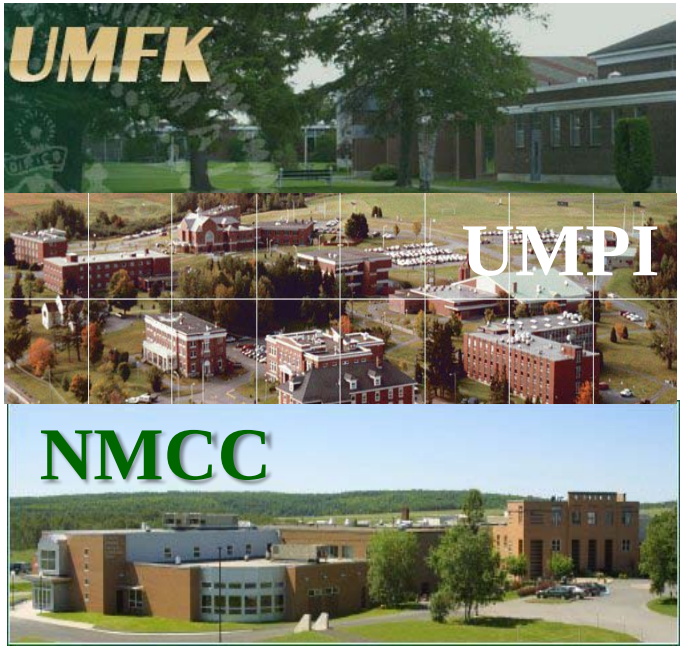
.A sustainable Northern Maine Renewable Energy Economy must include a body of knowledge, driven by innovation, research and development, that provides local expertise for industry. Aroostook County is blessed with abundant natural resources, but in a 21st century knowledge based economy the Universities and Community College resources need to play a economic leadership role

Northern Maine Renewable Energy Economy – Center of Excellence

Aroostook County has exceptional higher education assets that can and should increase their linkage to local industry sectors. They can drive innovation and provide leadership for the economy. The creation of a *Northern Maine Renewable Energy Center of Excellence* will align University Maine Fort Kent (UMFK), University Maine Presque Isle (UMPI) and Northern Maine Community College (NMCC) assets and knowledge to focus on regional industry cluster expansion.

Center of Excellence strategies in rural economies integrate teaching, research and service. Through this integration undergraduate and graduate students gain experiential learning and industry benefits from a local body of knowledge, research and education supporting their competitiveness.

The Aroostook County opportunity resides in the presence of significant mature and emerging renewable energy assets and nationally recognized capabilities within the two Universities and the Community College.



Economic Opportunity Definition and Value

The opportunity to link educational resources into a *Northern Maine Renewable Energy Center of Excellence* was a major finding resulting from cluster assessment and initial hypotheses testing.

- **Opportunity** – Combine existing Northern Maine renewable energy knowledge assets to create a Center of Excellence
  - Aroostook County has a unique set of existing assets that provide an opportunity to link education, research, innovation and workforce development together with industry to create a body of knowledge that will be pursued by individuals, organizations, and businesses from both within and outside the region.
  - Center of Excellence strategic components:
    - Education
    - Research & Development
    - Training
    - Consulting

- **Value** – 25 center staff @ $53,000 avg. annual wage = total earnings of $1.3M
  - 22 indirect and induced jobs earnings $865K
  - GDP impact $5.2M
  - Attraction of R&D funding in 3 years = $2.5M/year

Northern Maine Renewable Energy Economy – Center of Excellence

Centers of Excellence have been catalysts for regional economies by supporting business and industry. Research concluded that there are not an abundance of renewable energy centers of excellence in the US, especially in the NE. The following are three examples of relevant centers of excellence.

Cleantech Innovation Center at Oroville

The CleanTech Innovation Center at Oroville, CA showcases green and sustainable building practices in their 42,000 sq. ft. facility. The Center consist of three components; Alternative Energy Resource Center, Alternative Energy Research Lab and The Cleantech Worker Training Center. The program sponsorship is provide by the private sector, public sector, academia and community at large through the BayTECAlliance.

- Alternative Energy Resource Center is a one stop shop access to business and individuals to demonstrate new advances in green construction materials and techniques. Technical assistance is provided by Living Elements, Valley Contractor Exchange, Russell Gallaway Assoc. and Meta Graphics
- Alternative Energy Research Lab is sponsored by the California State University Chico Lab providing space for alternative energy and startup companies with focus on alternative energy. Current research includes Wind and Weather, Energy Management and Control and The Zero Energy Home.
- CleanTech Worker Training Center focuses on worker training and readiness
- Building America Lab House project is a effort between California State University (CSU), Chico; ConSol, energy consultants and a team leader for the Department of Energy's (DOE) . Building America is an industry-driven research program with a primary goal that an affordable, production-ready solar home can achieve net-zero energy on an annual basis for the hot, dry climate region of Northern California.

Syracuse Center of Excellence in Environmental & Energy Innovations

Syracuse's Clean Tech Center ranks No. 6 on the top 10 of :"cleantech clusters" in the world as identified by venture capitalist that specialize in financing green technologies..

- Primary areas of focus include, Clean and Renewable Energy, Indoor Environmental Quality and Water Resources
- The region has branded itself "New York's Creative Core" with a green apple as its symbol
- In 2004 it expanded its core mission to include renewable and clean energy sources from wind and solar to geothermal and fuel cells.
- The Center has a strong connection to New York State Energy Research and Development Authority (NYSERDA)
- The Center promotes network connections from business and institutions through a membership system with sponsorship levels from $100- $10,000.

The Northern Maine Renewable Center of Excellence should pursue a strong relationship with SryacuseCOE

Northern Maine Renewable Energy Economy – Center of Excellence

CENTERS FOR RENEWABLE ENERGY & BIOMASS UTILIZATION

University of North Dakota, Energy & Environmental Research Center, Center for Renewable Energy & Biomass Utilization, Grand Rapids, ND

- Center facilities and capabilities include;
  - Full scale field testing experience for fossil and biofuels
  - Pilot scale gasification, combustion equipment
  - Complete biomass processing equipment for preparation and testing of biomass feedstocks
  - State of the art, bench scale laboratory equipment
- The Center conducts critical research, development, demonstration and commercial deployment of technologies utilizing biomass, wind, solar, geothermal and hydroelectric energy sources. Also, research and development of energy efficiency products.
- Specific areas of focus are, biomass feedstocks, biopower, bioproducts, biofuels for transportation, wind energy, renewable hydrogen and building efficiency.

Key Factors and Assets to Capture the Opportunity

- Create a strategic higher education and research collaboration
  - Three higher education entities, UMFK, UMPI and NMCC have existing programs to provide a foundation to build the Northern Maine Center of Excellence upon.
    - UMFK – Center for Rural Sustainability Development,
      - Environmental studies with three PhD faculty
      - Lichen R&D studies
      - Forest technology program
    - NMCC –
      - Plumbing and Heating, HVAC,
      - Wind Power Technician Training
      - Heavy Equipment with alternative fuels
      - Future – Building materials science
    - UMPI – Renewable Energy Programs
  - UM Presque Isle Cooperative Extension
  - UM-Orono –
    - College of Engineering
      - Renewable Energy and Electricity Production program
      - Bioengineering program
    - Advanced Nanocomposites Laboratory in Renewable Energy (ANLRE)

- Endorsement and commitment industry leaders such as:
  - Boralex
  - First Wind
  - Fraser Papers
  - MPS
  - New Brunswick Power
  - Irving
  - Horizon Wind

Northern Maine Renewable Energy Center of Excellence

University of Maine at Fort Kent
- *Center for Sustainable Development*

University of Maine at Presque Isle
- *Environmental Studies*
- *GIS*

Northern Maine Community College
- *Wind Power Tech*
- *Plumbing & Heating*
- *Welding & Metal Fabrication*

University of Maine Coop Extension
- *Applied science research*

NORTHERN MAINE RENEWABLE ENERGY CENTER OF EXCELLENCE

Work force training - Academic education programs - Future R&D Capacity


WIND


BIOMASS


SOLAR


GEOTHERMAL


MANUFACTURNG

Enabling environment

- Aroostook County enjoys a positive enabling environment for innovation for a center of excellence –
  - Innovative leadership from College and University Presidents
  - Proven record in renewable energy innovation
  - Evolving State and Federal policy for renewable energy technology R&D and training
  - U Maine system has precedence of centers of excellence –
    - Center for Teaching Excellence,
    - Prevention Center of Excellence,
    - Center of Excellence in Developmental Disabilities Education, Research and Service

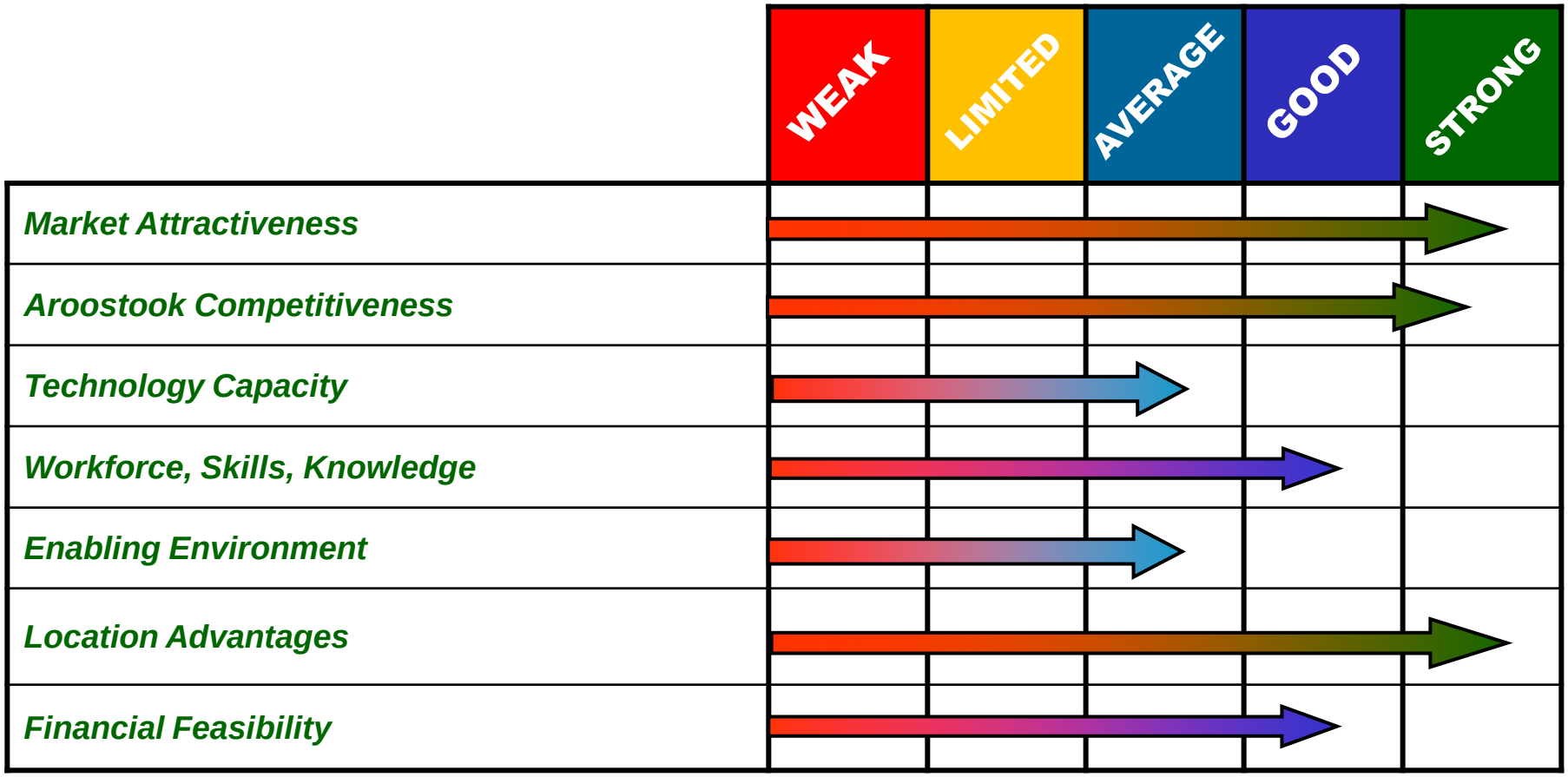
Finance Requirements

- Initial investment – $200,000/year for three years in seed capital
- Must become self-sustaining in three years through:
  - R&D grants
  - Fee for services
  - Training programs

Potential Barriers and Policy Issues

- Industry trust and investment
- Initial seed capital investment funding
- Maine University and Community College System adoption and support

Northern Maine Renewable Energy Economy – Center of Excellence



The foundation elements of the Northern Maine Renewable Energy Center of Excellence exist today, the Aroostook leadership's challenge will be to innovate for the regions economic future.

Overall Opportunity Rating → **GOOD**

Table of Contents – Renewable Energy Opportunity Analysis

The Strategic Financial Requirements and Future for the Renewable Energy Industry Cluster in Northern Maine

- **Transformation:** Aroostook County has begun the economic transformation process by having citizens take control of their economic destiny. Changing the direction of the economy , population loss and wealth decline is challenging and scary, but it is necessary. Transformation is a process of behavior change not a series of projects.

- **Change:** Mobilize Maine and the formation of industry cluster teams is the vehicle for everyone in Aroostook County to be involved in managing their economic change. For Aroostook County to succeed in its transformation, every action taken by the cluster team should be in the context of the agreed economic strategy. How to manage change has been taught over many years by business schools and published by the Harvard Business School. When the NMDC, APP, LEAD Boards and every industry cluster team understands and keeps these eight steps in mind, the entire county will be empowered to be positive forces for change.

1. Establish a Sense of Urgency
2. Form Powerful Guiding Coalitions
3. Create a Vision
4. Communicate the Vision
5. Empower Others to Act on the Vision
6. Plan for, create and Communicate Short Term Wins
7. Consolidate Improvements & Produce More Change
8. Institutionalize New Approaches

Aroostook County has successfully achieved steps 1-3 with the formation of APP, adoption of Mobilize Northern Maine and the implementation of industry cluster strategies. The leadership and economic development professionals role is to solidify the base and ensure focus on the remaining five steps

Strategic Financial Requirements to Implement the Northern Maine Renewable Energy Economy

Investment Use	Uses of Financing	Amount of Financing Required	Potential Sources of Financing	Availability in Aroostook County
Biomass to Energy	New Business development and credit lines Heating equipment and weatherization construction	$60M Equity/Debt/Grants	• Efficiency Maine Trust • Home and building owner • NMDC • Local banks	
Grass Biomass	New business development and credit lines Processing capital equipment,	Plant & Equipment $2.3M (Equity/Debt)	• Angel investors • NMDC • Local banks • Maine Technology Institute	

Small 5MW
 	
Community Wind 20MW
	Small residential /commercial wind installations
	Development of large community wind installations
		$2.5M
		(Equity/Debt)
		
		$70M
		(Equity/Debt)
			• Small Wind
			  • Home/business owner
			  • NMDCorp
			• Community Wind
			  • Landowner
			  • Public
				

Buy Local: Northern Maine Energy Market	Energy Park: Engineering and installation of electrical distribution infrastructure	$400,000 (debt)	• NMDC • Banks	
Northern Maine Renewable Energy Center of Excellence	Program startup funding	$600,000 (Institutions $100,000/year) (Industry $50,000/year) (Grants $150,000)	• Energy industry leaders • Maine Technology Institute • Maine University and College System • National Science Foundation	

 = None  = Weak  = Average  = Good  = Strong

- **Purpose of Clusters:** Industry cluster teams represent the essence of collaboration and naturally breakdown barriers that have artificially separated resources. Industry cluster teams connect people and resources which create critical mass upon which expanded and more efficiently economic opportunity will occur. Industry cluster teams build long-term understanding of how interdependence and collaboration are more effective and create an environment of economic opportunity.

- **Realizing Benefits Already:**
  - **"***This is the first time the entire Aroostook energy economy has been in the room at once, and this is powerful,"* industry cluster team member.
  - Discovery of grass biomass research being conducted by Andrew Plant, University Maine, Aroostook Cooperative Extension.
  - Increase in awareness and the building of relationships between Aroostook County and external resources like Maine Energy Systems, Maine Public Utility Commission, Efficiency Maine Trust.
  - Building awareness and cross communication within the community and industry
  - Placement of Aroostook County municipal leaders in the forefront of PACE program rules and policies

Future of the Renewable Energy Industry Cluster: The renewable energy industry cluster exists today in Northern Maine as a disconnected group of assets and natural resources; and it may for many years to come. The key role of an industry cluster team is to connect and leverage these assets to achieve the region's economic vision.

Keys to Success of a Renewable Energy Industry Cluster Team

- **Establishment of Industry Cluster Team Leadership**
  - It is imperative that this industry cluster team identify and empower its leadership to take the reins of the initiative immediately.
  - The cluster leaders are responsible for organizing the cluster, communicating the vision, recruiting cluster participants, and assuring the implementation of cluster actions and achievement of the goals.
  - A leadership group should consist of a chair or co-chairs and 2-3 other relevant key industry leaders willing to work as the cluster teams core.
- **Establishment of Action Teams**
  - The leadership should immediately establish action teams surrounding each of the strategic opportunities identified in the first phase.
  - The action teams should be comprised of key industry representatives that have a role or knowledge in the implementation of the action.
  - These action teams should be empowered to pursue a clearly defined objective and timeline with regular updates to the entire industry cluster team

- **Build the Business Case**
  - Each of the six opportunities presented in this document require additional refinement and feasibility studies. This in many cases does not require significant funding or resources outside of the industry cluster team. The industry cluster team possess the market knowledge, expertise and entrepreneur spirit to develop a strong business plan.
  - Unleashing the business plan within the industry cluster team is a key role for local economic development professionals and local governments. Typically, a business case will have a component that requires local or state governments to "enable" the private sector to proceed with an investment.
  - As the refined business plan is developed, it should always have a quantified opportunity value and be linked directly back to the overall Aroostook County vision and goals.
- **Recognition of Cluster Team Members**
  - Cluster team members are business leaders, not employees, and their time should be highly valued. The commitment these individuals and organizations are making to improve the economic well-being of themselves, their family, their organization and the community must be continually recognized and celebrated.
  - Enthusiastic volunteers are subject to burnout and frustration. The way to minimize this situation is to make sure that each participant is focused on an action plan that has specific interest to him or her. Furthermore that the workload of a industry cluster team is spread around the participants, each becoming responsible for a small piece.
  - Strong industry cluster team participation can be achieved by making sure that new skills being acquired which are transferrable to other aspects of their personal and professional life.

- **Role of Economic Development Professionals**
  - Regional economic development organizations and professionals are sponsors and facilitators of the industry cluster teams. CED professionals should leverage the strengths of programs like TechSharp and Tech Maine to support industry clusters. Empowerment of the industry cluster team is critical, and as such, professionals should support, fill in resource gaps, but always enable the participants to achieve outcomes.
  - Industry cluster teams become an efficient and very effective point of contact for industry. Economic, educational, workforce development and others should tap the industry cluster team for strategic direction and the appropriate use of resources.
- **Celebrate Short Term Wins!**
  - Cultivation of business leaders and building empowerment is achieved by identification and communication of progress, also known as “short term wins”.
  - Short term wins come in may forms, typically starting small with growth in industry cluster team participants, to much larger wins such as new business starts or expansions.
  - Celebration of short term wins have three strategic purposes with regard to industry cluster team development
    - Reinforcement of positive behaviors or actions that will lead to the regions transformation, i.e.new collaborations within or across industry sectors or utilizing resources that exist in the region versus outside
    - Through communication and broadcast of the short term wins a climate of economic opportunity is built resulting in investment attraction.
    - Growing a sense of community empowerment and realization that they control their economic destiny and that their efforts “truly” have impact.

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Aroostook County, Maine Industry Cluster Opportunity Analysis

Renewable Energy Industry Cluster

Appendix

Bibliography

PFI Pellet Grade Standards Table

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Eric Dummond, Boralex

Scot Linkletter, Plant Manager, Maine Woods Pellets, Co.

Matt Bell, Northeast Wood Pellets

Sue Jones, Community Energy Partners

Mark Goughan, farmer and entrepreneur, Caribou, Maine

Geoff Clark, Account Representative, Automation and Control Solutions, Honeywell

Matt Smith, VE Strategy and Business Development, Backyard Farms

Wood Pellet Association of Canada

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4 Tell Solutions

Country Store Shop

EverGreen Heat

Corinth Wood Pellets

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PFI Pellet Grade Standards Table

Source: USDA, North America's Wood Pellet Sector

Table 5—Pellet Fuel Institute[a] 2008 fuel grade standards

Property	Super premium	Premium	Standard	Utility
Bulk density (kg/m^3)	533–613	533–613	506–613	506–613
Diameter (mm)	6.35–7.25	6.35–7.25	6.35–7.25	6.35–7.25
Durability	> 97.5	> 97.5	> 95.0	> 95.0
Fines (%)	< 0.5	< 0.5	< 0.5	< 0.5
Inorganic ash	< 0.5	< 1.0	< 2.0	< 6.0
Moisture (%)	< 6.0	< 8.0	< 8.0	< 10.0
Chloride (ppm)	< 300	< 300	< 300	< 300

[a] PFI 2008.

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