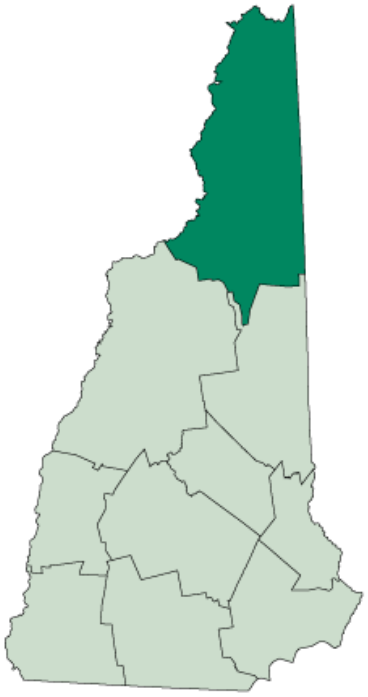
Preliminary Heat Supply Plan
Coös County, New Hampshire

Northeast
District Energy
Corporation



Coös County, New Hampshire is the largest and most northern of ten counties in the state and also has the smallest population of 33,111. The county is bordered on the north, east, and west by Vermont, Maine, and Quebec, and Carroll and Grafton counties to the south. The area is approximately 1,831 square miles, of which over 90 percent is forested.

Nearly ninety percent of building heating in Coös County is done with fuel oil. The only natural gas service in the county is provided to the former Wausau Paper cogen plant in Groveton. The 16 MW Whitefield Biomass Power Plant was recently purchased by Marubeni Sustainable Energy, Inc. This plant consumes about 185,000 tons of green wood annually and is one of the cleanest biomass plants in the United States. A second 16 MW power plant, Pinetree Power, is located just outside Coös County in Alderbrook, Bethlehem Township, Grafton County.

Local and regional heat supply planning has played a key role in reducing energy consumption and imports in Scandinavian countries since the oil shocks of the 1970s. This preliminary heat supply plan will identify basic opportunities that can be implemented throughout Coös County (and eventually to other counties in the state) to achieve three separate but closely interrelated goals:

- Increase efficiency of energy production, distribution, and consumption
- Begin the process of migrating from imported fossil fuels to local renewable resources
- Reduce demand on the strained electric networks by shifting electric heating and cooling apparatus to thermally-driven technologies.

Although the region's ample biomass resources are see as a viable renewable energy resource, several other resources are available and could be employed where appropriate and cost effective. These include solar thermal, methane gas recovery from landfills and water treatment plants, and ground source heat pumps. Although the latter would increase electric consumption, they could be suitable for smaller isolated buildings that may not be efficiently served by a biomass fuel supply network. One additional energy resource commonly used in Europe is waste-to-energy plants, which would probably face significant local opposition without extensive source separation and emissions control. If such a project was successfully developed in the region it could certainly contribute heat to the local community, but for the purposes of this plan it will be assumed that this is unlikely in the near future.

Biomass from existing forest resources could be provided in three forms to accommodate various sizes of heating apparatus:

- Whole tree chips require the least processing, have the lowest cost, and highest moisture content (40 to 60%). Although these will be the preferred fuel, they can only be burned cleanly and efficiently in boilers with a heat output greater than 1 million btus/hr (1 mmbtu/hr) with larger units being better.

- Dried whole tree chips with a moisture content no greater than 30%. These chips can be burned in a wide variety of modular apparatus ranging in size from 300,000 btu/hr up to several million btu/hr. The additional handling required to dry these chips results in a higher price.
- Pellets are generally completely dry and have been processed to a uniform size. These are the most expensive form of wood fuel but can be burned cleanly in small residential scale systems.

Utilizing these renewable fuels to produce useful energy requires installation of new apparatus, which will vary with the size of the application:

- Combined Heat and Power (CHP or cogeneration) plants can deliver the highest thermal efficiency, which can exceed 90% with flue gas heat recovery apparatus. Although biomass CHP systems as small as 200 kWe have been installed in New England, experience suggests that a 600 to 900 HP boiler producing 20,000 to 30,000 pounds of steam will operate much more efficiently and reliably than smaller units. A 900 HP boiler producing steam at 600 psig/750°F will cogenerate 2 MW of power while exhausting steam at 10 psia to produce 30 mmbtu/hr of 190°F hot water, with an additional 5 to 6 mmbtu/hr of hot water available from flue gas heat recovery if hot water return temperatures are low enough. Multiple units would be installed to provide additional heat to meet thermal demand where required and air cooled heat exchangers would be included to allow the full output of the generator to be available at any time to maximize participate in ISO-NE Forward Capacity Markets.
- Heat-only hot water generators can be installed in biomass CHP plants to provide backup and peaking thermal production, and can also be installed as stand-alone units in applications which are not large enough to support cogeneration. The size of the unit will determine the type of wood fuel that is required (wet wood chips, dry wood chips or pellets).

Except for systems serving a single building, heat would be distributed as low temperature hot water to participating consumers in each community from one or more plants sited in appropriate locations. From the above analysis, it is possible to determine the application of each fuel and technology option based on the potential heat load, which is shown here as "Equivalent Housing Units" representing a peak heating demand of 50,000 btu/hr which is roughly equivalent to an actual heat demand of about 40,000 btu/hr (roughly what one small single-family house would need on a cold winter day). One house by itself, for instance, would represent one unit, a small elementary school approximately 10 to 15 housing units, and so on.

Equivalent Housing Units	Fuel and Heating Options (Note: Solar thermal can be used with all options)
1	Pellets in wood stove, insert, or boiler; or ground source heat pump
2-25	Pellets in hot water generator
10-100	Dry (<30% moisture) wood chips in heat-only plant
50-750	Wet (40-60% moisture) wood chips in heat-only plant
500+	Wet (40-60% moisture) wood chips in combined heat & power

Implementation Strategy

Biomass is currently used in the Concord Steam System, at Middlebury and Bennington Colleges in Vermont, and at the Vermont State Capital Complex in Montpelier. New biomass district energy networks are currently being developed in Brattleboro, Vermont, and another opportunity has been identified in Groveton that may prove large enough to support combined heat and power. Separate heat-only systems could be suitable for the community of Northumberland and perhaps other areas in

the Town of Northumberland. New heat-only networks will also become ideal candidates for demonstration of smaller scale biomass CHP technologies as they become commercially available.

Simultaneous development of additional district energy systems in other communities in Coös County could deliver economies of scale in the engineering, material purchasing, and fuel supply. Utilizing heat from existing sources such as biomass power plants could also be very beneficial in establishing new systems. These new biomass systems would also require a local labor force to build, operate and maintain them, which could be facilitated by standardizing the design of these systems as has been done in Europe.

In addition, the large biomass resources available in Coös County could be used to establish a new renewable fuel delivery system that could serve the remainder of the state. Although it is often stated that renewable energy resources such as biomass need to be consumed near their source, much of the biomass used for energy systems in northern Europe actually comes from Canada, New England, and other locations. The key is to utilize low cost transportation such as rail or water to move the biomass fuel close to the end user, which could be new biomass district energy systems serving each New Hampshire community. What might be very difficult for a single community to do might become very viable if done in many communities.

The Northeast District Energy Corporation (NDEC) is a not-for-profit 501(c)(3) formed by the union-sponsored Economic Development Group, Inc. in Buffalo specifically to establish new district energy systems in the northeast US on a build, operate, and transfer basis. By pursuing several projects in the region, this group has attracted widespread support and is currently seeking significant funding support from a variety of governmental and private sources. Ownership would be transferred to local or regional entities as might be appropriate in each location, which could be new not-for-profit, municipalities, or other entities. The NDEC will also provide on-going metering and billing services, consulting, underground utility locating, customer service, and system monitoring to anyone who wishes to establish such systems. For instance, a group of homeowners might agree to build and operate a small biomass heating network, for which the NDEC could provide metering services to allocate costs.

Installing new hot water district heating networks also provides an opportunity to create new fiber optic networks in the same trench, allowing delivery of giga- and even tera-bit data to individual residences and businesses.

Successful development of these systems will require a strong commitment from local communities and potential consumers, which could be achieved by educating appropriate individuals in each community on the technology, benefits, and application.

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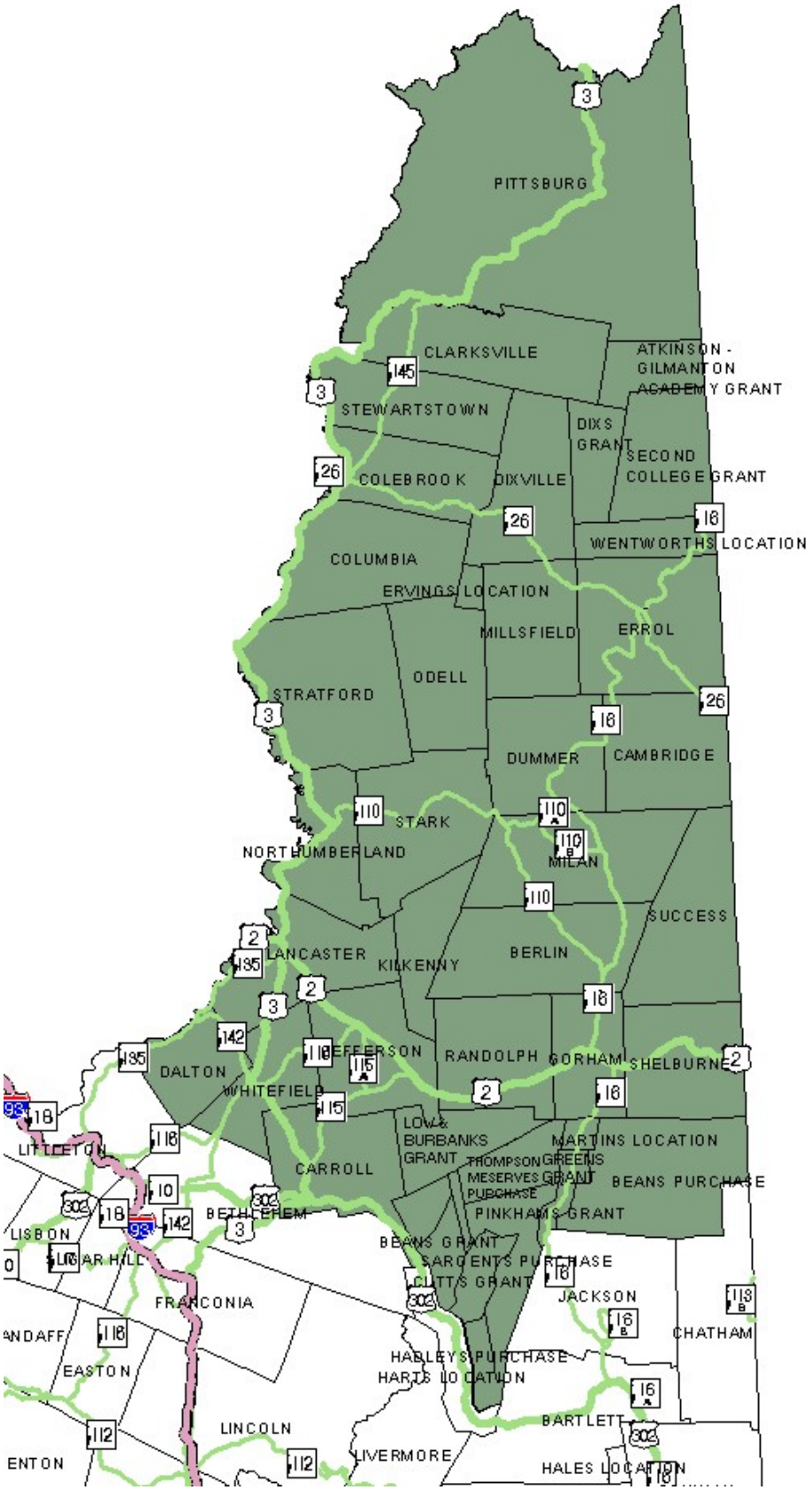
PITTSBURG
CLARKSVILLE
ATKINSON - GILMANTON ACADEMY GRANT
STEWARTSTOWN
DIXS GRANT
SECOND COLLEGE GRANT
COLEBROOK
DIXVILLE
WENTWORTHS LOCATION
COLUMBIA
ERVINGS LOCATION
MILLSFIELD
ERROL
ODELL
STRATFORD
DUMMER
CAMBRIDGE
STARK
NORTHUMBERLAND
MILAN
SUCCESS
LANCASTER
KILKENNY
BERLIN
DALTON
JEFFERSON
RANDOLPH
GORHAM
SHELBURNE
WHITEFIELD
LOW & BURBANKS GRANT
MARTINS LOCATION
CARROLL
THOMPSON & MESERVES PURCHASE
GREENS GRANT
BEANS PURCHASE
PINKHAMS GRANT
BETHLEHEM
LISBON
BEANS GRANT
SARGENTS PURCHASE
CUTTS GRANT
JACKSON
CHATHAM
FRANCONIA
HADLEYS PURCHASE
HARTS LOCATION
EASTON
LINCOLN
BARTLETT
LIVERMORE
HALES LOCATION

The following table shows the number of housing units in each structure in each Coös County municipality. Communities with large numbers of multi-unit housing, dense residential areas, and large institutional, governmental, or industrial heat consumers would probably be good candidates, but with rising heating oil prices it is likely that any group of buildings could be economically served by new district energy networks.

Housing Units in Structure	Housing units	1, detached	1, attached	2	3 or 4	5 to 9	10 to 19	20 to 49	50 or more	Mobile home
Berlin city	5,111	2,454	43	1,072	824	415	78	33	102	90
Carroll	799	406	159	17	107	52	27	0	0	31
Clarksville	335	262	3	2	0	0	0	0	0	68
Colebrook	1,314	771	15	94	125	163	9	2	0	135
Columbia	433	350	0	8	3	0	0	0	0	72
Dalton	515	356	0	11	2	0	0	0	0	146
Dixville	31	21	0	0	0	3	2	0	0	5
Dummer	293	251	0	2	0	0	0	0	0	40
Errol	395	346	3	0	0	0	0	0	0	46
Gorham	1,484	782	14	177	102	79	35	29	0	266
Jefferson	568	441	0	14	5	22	0	0	0	86
Lancaster	1,501	992	7	102	66	117	42	48	0	127
Milan	749	615	0	16	6	0	0	0	0	112
Millsfield	37	37	0	0	0	0	0	0	0	0
Northumberland	1,109	747	4	68	84	31	34	6	0	135
Pittsburg	1,220	1,059	2	7	0	5	2	0	0	145
Randolph	241	224	4	4	0	0	0	0	0	9
Shelburne	195	168	3	5	0	0	0	0	0	19
Stark	406	334	0	9	5	0	0	0	0	58
Stewartstown	733	489	5	21	19	38	0	0	2	159
Stratford	521	329	9	18	14	52	3	4	0	92
Wentworth	130	117	0	0	0	0	0	0	0	13
Whitefield	1,155	817	6	71	27	86	0	62	0	86
Total	19,275	12,368	277	1,718	1,389	1,063	232	184	104	1,940
Percent		64.2%	1.4%	8.9%	7.2%	5.5%	1.2%	1.0%	0.5%	10.1%