Enhancing the sustainability of community-based biomass production and use for local energy through university-community partnerships

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Project Description:

This project advanced local understanding of opportunities and constraints for expanding the use of wood biomass energy. It initiated community discussions on the sustainability of wood biomass energy, provided data on availability and demand, piloted a cooperative approach to providing residential firewood, and promoted sustainable management of a forest owned by a local institution heating with wood chips. More generally, the project highlights the importance of fine scale analysis, institutional issues in sustainability, community-university partnerships, and local engagement in pursuing alternative sources of energy.

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http://www.nsrcforest.org

Project Summary

High energy costs and environmental concerns have prompted many communities in the Northern Forest to explore options for producing energy from local forests. Both homeowners and public facilities are interested in wood as a source of low carbon and locally accessible energy. While foresters and ecologists have developed harvest guidelines, communities still struggle to sort out the technical, economic and social aspects of sustainable energy. This action research project seeks to understand the institutional partnerships and decision support needs of local communities as they pursue wood biomass energy options that are sustainable, efficient, local and equitable.

We worked in two clusters of communities in Washington and Addison Counties, Vermont to explore potential demand, supply and sustainability issues for providing residential and institutional forest-based thermal energy from local sources. We used a mixed methods approach to understand the varied issues that affect local sustainability of wood biomass energy from an institutional perspective. We conducted a demand survey of local residents, a supply survey of local forest landowners, a GIS study of potential supply, and a procurement study of a local wood-heated school. We interviewed area loggers to understand supply and delivery issues and interviewed project participants to better understand how community-university partnerships can assist communities in addressing these issues. The focal action project in Addison County was the piloting of a community-supported firewood program in which community members were engaged and data collected before, during and after trees were harvested and firewood was sold. The focal action project in Washington County was a forest sustainability partnership between the University of Vermont and Harwood Union Middle and High Schools in which a management plan for the school forest was created, students received field instruction, and teachers participated in educational workshops. Results of these efforts were disseminated at community meetings, posted to the project website, and prepared as journal manuscripts.

Overall, this project found that interest is high in expanding use of wood energy, but a number of technical and institutional issues (including market-based factors) can affect the options for energy that is sustainable, efficient, local and fair. Local communities appreciated technical information and other decision supports that address their particular situation and concerns. Once sustainability “screens” were considered, there was less wood available locally for biomass energy than residents anticipated. Also, the ability to support local businesses by sourcing wood locally met constraints related to cost, scale and technology. Community members were eager to engage in educational and cooperative approaches to sustaining local forests while pursuing energy alternative.

Background and Justification

- With rising fuel prices, concern for environmental impacts, & desire to “buy local”, interest in energy alternatives is high.
- Individuals, businesses and public facilities in the Northern Forest region are looking to their forests as a source of local, affordable, renewable energy.
  - In Vermont alone, 45 schools now heat with wood.
  - Vermont aims to double its current production of 1.5 million green tons by 2025 to include at least one million tons of “chunk wood” (e.g., firewood), chips, and pellets. (*see Notes)
- Under what conditions is local wood energy “green”? An important question currently being explored and debated.

Background and Justification continued

- Foresters, scientists and policymakers have:
  - Sought to assess supply at a regional level
  - Sought to establish guidelines for sustainable harvesting
  - Modeled the climate impacts of wood energy options

- Community members throughout the region have formed energy committees or other local initiatives to explore energy options. Such groups often have:
  - Additional "sustainability" criteria, such as affordability, equity, efficiency, education, and support of the local economy
  - Unique & valuable local knowledge
  - Need for local data and access to technical information
  - Questions about how to assess options with conflicting or incomplete information

Background and Justification continued

As communities grapple with these issues, the following questions arise:

- What kind of information, support and resources do communities want and need to make informed decisions about biomass energy?
- What kind of partnerships can support local efforts? What are the roles for researchers and universities?

To get at those issues, we designed an place-based, action research project with the following objectives:

- Help communities assess local woody biomass (thermal) energy options*
- Improve practices in community biomass production and use
- Develop models for community-university partnerships for exploring wood biomass energy options.

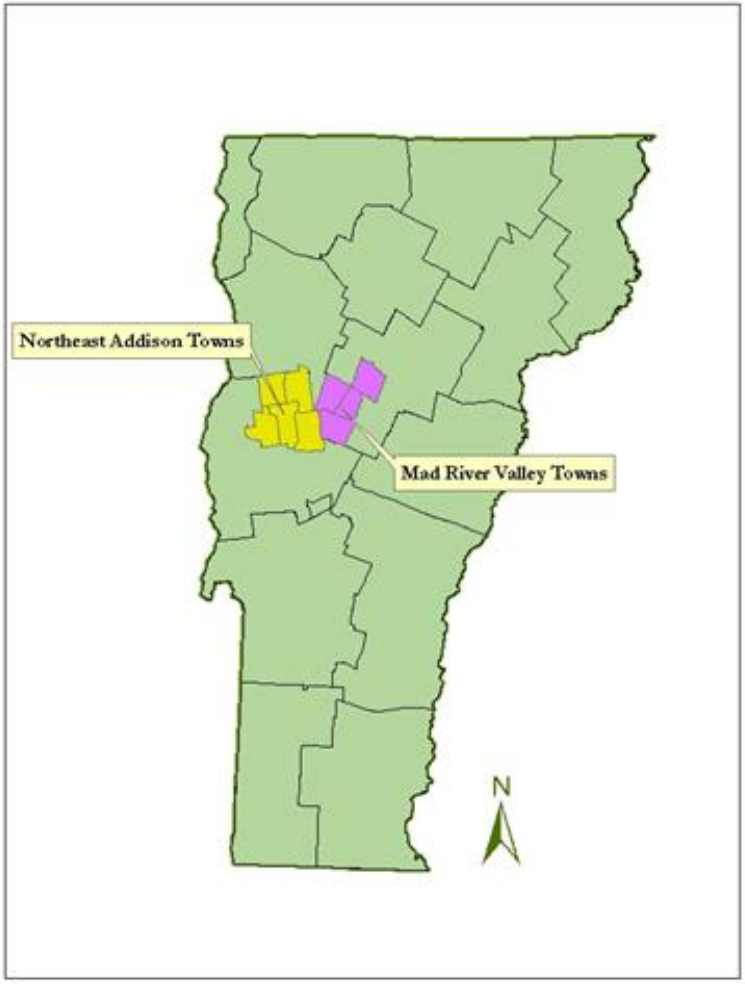
Methods

Study Sites & Partners:

NE Addison County "Five Town Forest"
Bristol, Lincoln, Starksboro, New Haven, and Monkton (3,845 households)
Lead: Vermont Family Forests (VFF)

Mad River Valley
Warren, Waitsfield, Fayston and Moretown (1,960 households)
Lead: Northern Forest Alliance (Tara Hamilton)

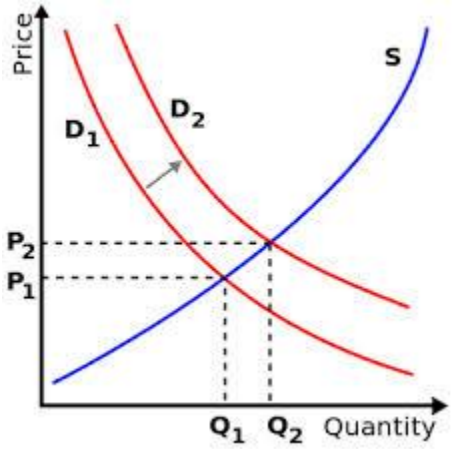
Technical Partners
Biomass Energy Resource Center
The Forest Guild



Methods, continued

What local data are needed to assess options for “sustainably” producing, procuring & utilizing local wood for thermal energy? The team identified:

- Demand:
  - Wood Demand (Consumption) Survey
  - Institutional Procurement Study
- Supply
  - Wood Supply Study
  - Landowner Survey
  - Local Supply Chains
- Sustainability
  - Local Criteria & Indicators
- Integrative Models
  - Pilot Residential Firewood Project (5TF)
  - Institutional Partnership (MRV)
  - Community-University Partnership Studies



Methods continued

- Wood Demand (Consumption) Survey
  - Community distribution (school, store, town meetings)
  - n = 410, 7 % of households
- Institutional Procurement Study (led by Adam Sherman, BERC)
  - Harwood Union Middle and High Schools, South Duxbury VT
  - Wood chip boiler installed 2008
- Wood Supply Study (led by Marc Lapin, Middlebury College)
  - GIS-based analysis for both study areas
  - Sustainability screens include slope, wetlands & buffer, and legal restrictions
- Forest Landowner Survey
  - N=238, 20% response rate
- Local Supply Chains
  - 15 phone interviews with all local loggers active and available in study areas
  - Calculated wood harvested from current use records for the study areas
- Local Criteria & Indicators
  - Reviewed national and international certification standards as models for C&I
  - Asked community members in meetings and surveys for their criteria
- Community-University Partnership Model Studies
  - Participation observation, key informant interviews, document review

Results: Demand

Consumption Survey (n=410)

- 69% of respondents heated with wood products (primary or supplemental)
- Used 4.2 cords per household per year on average (varied by community and income)
- 73% bought wood last year; avg $232 per cord dry, spent $458 per year
- 62% harvested themselves; 55% from own land
- 50% interested in expanding residential & public facility use of wood energy

Preferences for wood biomass they use:

- Protect environmental quality: 86%
- Protect aesthetic & recreational values: 80%
- Provide “fair” price to landowners & loggers: 78%
- Come from local sources: 66%

Landowner Survey (n= 238)

- 66% harvested firewood from their land; 40% let others harvest
- 34% harvested or sold timber
- Top planned uses for next 5 years: #1 harvest firewood (64%), #2 recreation (45%)

In sum: Substantial use of wood fuel now; high interest in sustainability & increasing use in the future

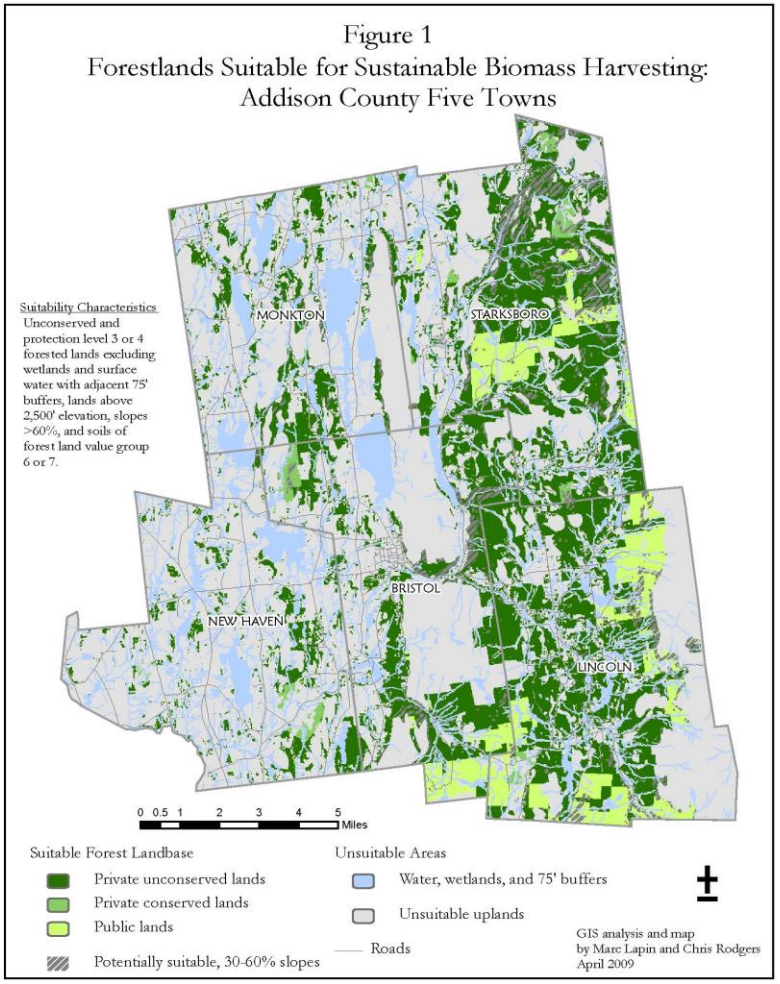
Results: Supply

Addison Five Town Forest

- 37,000 ac (47% of forest land) is "suitable" for biomass production, which grows 17,000-37,000 green tons per year of low value wood (6,800-14,800 cords) (*see criteria in notes)
- Approx. **1.8-3.8 cords per household** could be produced annually if 100% of growth on "suitable" land is harvested and utilized
- Note: From survey, avg. annual use by wood-burning households is currently 4.9 cords/yr, and nearby Middlebury College consumes 20,000 tons/yr (about 8,000 cords).

Mad River Valley

- 50,300 ac (68% of forestland) "suitable" for biomass production, growing 23,000-50,000 green tons/yr of low value wood (9,200-20,000 cords) (*see criteria in notes)
- Approx. **4.7-10.2 cords per household** could be produced annually if 100% of growth on "suitable" land is harvested and utilized
- Note: From survey, avg. annual use by wood-burning households is currently 3.7 cords/yr, and Harwood school campus consumes 900 tons/yr (about 360 cords)



In sum: Less available local wood than expected; varies by community.
Expanding wood consumption substantially could exceed sustainable local supply.

Results: Community-Supported Firewood

Vermont Family Forests engaged community members in testing the feasibility of practices to enhance restoration, ecological sustainability, energy efficiency, localness and fairness to all stakeholders * see notes for criteria

- 25 acre test site on 177 ac private family forest land
- Harvested 40.4 MBF of timber and 106 cords of fuelwood
- Landowner netted $5 per green ton for fuelwood and $26 per green ton for timber or only $6 per acre per year.
- Logger paid $80 per cord ($32 per green ton) to harvest firewood, or 66% less than for timber
- Fuelwood sold log length at $150/cord (purchasers processed into firewood)
- Community meetings and field demo sparked interest in a NeighborWood Heating Cooperative to pursue goals at reduced cost through cooperation.

In sum: When following best practices for environmental and socioeconomic sustainability, financial returns from fuelwood to landowner and logger are relatively low. "Sustainable" firewood would likely be more expensive than at present, but interest among some community members remains high.

Results: Harwood Union Forest Partnership

- The campus of Harwood Union Middle and High School in S. Duxbury, VT includes a 180 acre forest.
- In 2008, they installed a wood chip -fueled heating facility.
- In 2010 they initiated a partnership with the University of Vermont to:
  - Develop a forest management plan
  - Develop forest-based education opportunities
  - Explore potential to supply some of their own wood chips

Outcomes:

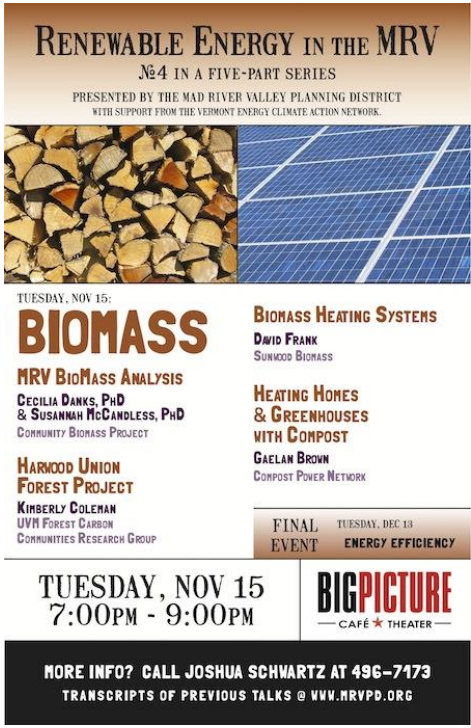
- School forest management plan
  - Used inventory data collected in part by students
  - Incorporated stakeholder input from survey of forest uses and goals and plan review
  - Began implementation of actions identified in plan
- Forest-based curriculum for Harwood
  - Field labs developed by UVM students
  - Implemented with middle and HS students in 3 courses
  - Additional training workshops for teachers
  - Symposium exhibit & presentations on forest-river ecology
- Service-learning (SL) experience for UVM
  - 2 masters theses
  - Projects for 4 undergraduate SL courses
- Insights on wood chip procurement
  - Stand characteristics and competing uses make school forest unsuitable as main source of chips
  - Demo harvests and "greening" of supply from elsewhere still considered in Action Plan
- Forest data & improvements
  - Recreational trails mapped and signage installed
  - Riparian canopy mapped with GIS

In Sum: Identified conditions under which investment in collaborative partnerships yields tangible results quickly, which may enhance long term sustainability.

Outreach

Public Forums

- MRV Public Meeting: Interim Results and Community Discussion, Waitsfield, VT (June 2009)
- Panel at Addison County Regional Planning Commission Meeting (Sept. 2009)
- MRV Renewable Energy Series, Waitsfield, VT (Nov. 2011)
- Project Presentations & Field Tour of harvest and processing sites, Addison County (May 2011)
- 6 public meetings for Harwood Union Forest Project (2011-13)



Outreach continued

Workshops

- 5 Town Forest Community Wood Biomass Energy Workshop, Addison County, VT (July 2009)
- Project Learning Tree Teacher Workshop, October 2011
- Google Earth and Google Maps Teacher Workshops, July 2011
- The Forest as a Learning Tool Teacher Workshop, April 2011
- Hogback Neighborwood Heating Charette, Bristol, VT (Nov 2012)

Public Reports, Articles and Online Resources

- 5 technical reports developed for community use
- 5 fact sheets handed out at events and field trips
- Field Forestry Skills Curriculum Guides
- 3-part series of articles in local newspaper
- 2 press releases
- Website: www.uvm.edu/forestcarbon/biomass/ with project documents, reports and general information

Implications for the Northern Forest Region

What information, support & resources do communities need to make informed decisions about local wood biomass energy?

The team of community & research partners identified 4 key questions that are relevant to communities throughout the Northern Forest:

- Is wood biomass being grown and harvested in ways that are ecologically sustainable?
- Is the wood biomass being used efficiently?
- Is a sustainable, local supply adequate to cover expected demand?
- Is the system fair and equitable for all participants?

In seeking answers to theses question we found that:

- If communities desire local sources, they **need local data** on supply, demand and market chains for their communities. Regional data on supply and demand is useful but not sufficient.
- In developing local data, we found that **a suitable, local supply** – even in this heavily wooded and lightly populated area – may not sustain a significant increase in demand.
  - Current harvest of low grade material is below current residential consumption
  - Harvesting 100% of low grade wood is probably unrealistic due to landowner preferences and price signals
  - Increase in local institutional use or exports from the area could affect quantity available for residential use
- Given that even heavily wooded, rural areas may already be near their sustainable harvest limits, **attention to efficiency** (conservation, improved combustion technologies, insulation/weatherstripping) will be important to meet growing demand.

Implications for the Northern Forest Region

continued

Woody biomass may be neither local nor green

- The sustainability of forest management practices from which institutional and some residential supply comes, is not fully known and/or highly variable.
- While small-scale loggers can supply chunk firewood, special processing equipment is needed for clean wood chips and other fuels used by institutional facilities. If such capacity is not available locally, it may diminish the expected economic benefits of "buying locally".

Institutional fixes – not just technological fixes -- are needed

- to solve sustainable supply problems (e.g. to expand sustainable harvesting on private lands)
- to moderate demand through efficiency (e.g. through education and financial assistance)
- to promote equitable local supply chains (e.g. Hogback Heating Cooperative)
- to promote sustainability through both formal education and social learning (e.g. field trips, charettes, working with schools, supporting school teachers)

Investments in Social Capital Can Pay Off for Sustainability

- Examples of the kinds of iterative interactions that build social capital can be seen in Hogback Neighborwood Heating Cooperative and the Harwood Union Forest Project

Future Directions

- Decision support for communities
  - Assess, share and provide feedback on recently developed tools
- Statewide and multi-case study of inputs to decision-making process for community-scale wood biomass energy projects
  - Objectives and sustainability criteria
  - Types and sources of technical information
  - Unmet information needs
- Explore opportunities to enhance efficiency for rural communities
- Continue to collaborate with Harwood Union Schools
  - ongoing SL partnership and
  - implementation of Forest Management Plan (e.g. apple tree release in fall 2013)
- Hogback Neighborwood Cooperative
  - VFF pursuing Action Plan
  - Sept 2013 meeting planned

List of Products

Technical Reports

- Marc Lapin, Chris Rodgers, David Brynn. 2009. Assessment of the Landbase Suitable for Sustainable Forest Biomass Harvest and the Wood Biomass Resource Supply Addison County Five Towns and Mad River Valley Towns. A Technical Report of Vermont Family Forests and the Community Biomass Project. 24 pp.

- Grahm Leitner. 2013. The Harwood Union School Forest Stewardship Plan. 43 pp.

- Matthew Peters, David Brynn, Jenn Colby, Cecilia Danks, Tara Hamilton, Susannah McCandless, and Eva Wollenberg. 2010. The Role of Loggers in Providing Vermont's Wood Energy. A Technical Report of the Community Biomass Project. 11 pp.

- Matthew Peters, Eva Wollenberg, David Brynn, Jenn Colby, Cecilia Danks, Tara Hamilton, Susannah McCandless. 2009. 2005-2008 Forest Harvest Summary for Selected Towns in Addison and Washington Counties, Vermont. A Technical Report of the Community Biomass Project. 27 pp.

- Adam Sherman and Biomass Energy Resource Center. 2010. Developing Wood Fuel Procurement Strategies for Harwood Union High School. A Technical Report of BERC and the Community Biomass Project. 40 pp.

- Vermont Family Forests. 2013. Hogback NeighborWood Heating Cooperative: Overview, Charette Findings, Action Plan, and Follow-up. A Technical Report of Vermont Family Forests and the Community Biomass Project. 21 pp.

- Lini Wollenberg, Cecilia Danks, Susannah McCandless, David Brynn, Tara Hamilton, Matt Peters, Jenn Colby, Adam Sherman, Carl Demrow. 2009. Community Wood Biomass: Enhancing the sustainability of community-based biomass production and use for local energy. A presentation poster used at community meetings.

List of Products, continued

Presentations and Workshops

- David Brynn, Lini Wollenberg, Marc Lapin. 2009. Enhancing the sustainability of community-based biomass production and use for local energy through university-community partnerships. Addison County Regional Planning Commission Meeting, Middlebury, VT. Sept. 24, 2009.
- Kimberly Coleman. 2011. Harwood Union Forest Project, MRV Renewable Energy Series, Waitsfield, VT. Nov. 16, 2011.
- Cecilia Danks and Kimberly Coleman. 2011. Community-based wood biomass energy: decision support through participatory research and service learning. Association for Environmental Studies and Sciences Annual Meeting, Burlington, VT June 24, 2011.
- Cecilia Danks and Kimberly Coleman. 2011. Woody Biomass Energy Research of the Forest, Carbon and Communities Research Group. Northern New England Forests Research Symposium, Burlington, VT. Dec. 16, 2011.
- Cecilia Danks and Susannah McCandless. 2011. Vermont Community Woody Biomass Energy Project, MRV Renewable Energy Series, Waitsfield, VT. Nov. 16, 2011.
- Grahm Leitner. 2013. Harwood Union Forest Plan. Harwood Union School Board Meeting. June June 2013.
- Walter Poleman. The Forest as a Teaching Tool: A Workshop for Educators. Harwood Union Library, South Duxbury, VT. April 12, 2011.
- Walter Poleman. GoogleEarth and GoogleMaps Workshop for Harwood Union Teachers, Harwood Union High School, South Duxbury, VT July 26, 2011.
- Rebecca Phelps. Project Learning Tree Teachers Workshop. Harwood Union High School, South Duxbury, VT. October 13, 2011.

List of Products, continued

Masters Theses

- Kimberly Coleman. 2013. The Role of Service-Learning Parterships In Building Social Capital fFor Natural Resource Management: A Case Study of The Harwood Union Forest Project. University of Vermont.
- Grahm Leitner. 2013. The Harwood Forest Project: Community-based Forestry in Vermont Public Schools. University of Vermont.

Journal Manuscripts

- Kimberly Coleman and Cecilia Danks. In Prep. Conditions under which service-learning supports social capital development for collaborative natural resource management. Expected completion Sept 2013.
- Kimberly Coleman, Cecilia Danks and Susannah McCandless. In prep. Contrasting approaches to community-university partnerships for research and education. Expected completion Dec. 2013
- Cecilia Danks, Susannah McCandless and Eve Wollenberg and others. In prep. Local wood: developing community-based wood energy systems. Expected completion June 2014.
- Matt Peters, Cecilia Danks, Eva Wollenberg. In prep. Local supply chains for wood biomass energy in Vermont. Expected completion June 2014.

Website: www.uvm.edu/forestcarbon/biomass/