TECHNICAL ASSESSMENT OF BIOMASS ENERGY RESOURCE POTENTIAL IN PETER BALLANTYNE CREE NATION COMMUNITIES, NORTHERN SASKATCHEWAN

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Abstract

Many rural and remote communities across Canada's North experience energy insecurity, owing to high energy prices, energy disruptions, or inadequate energy supplies. Local, community renewable energy resources have been expressed as potential solutions to energy security challenges in the North. Therefore, the research objective is to technically identify and assess community biomass energy resource potential near two member communities of the Peter Ballantyne Cree Nation namely Pelican Narrows and Southend. Using geospatial techniques, the expected result of the research is to generate a base map which delineates areas of potentially recoverable biomass resources near Pelican Narrows and Southend communities for community renewable energy production.

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1.0 Introduction

Many rural and remote communities across Canada's North experience energy insecurity, owing to high energy prices, energy disruptions, or inadequate energy supplies (Hunt et al., 2021). Local, community renewable energy (CRE) resources such as biomass, solar and wind have been expressed as potential solutions to energy security challenges in the North (Poelzer et al. 2016; Huang et al., 2021). However, CRE initiatives must be appropriate to community context (Menghwani et al., 2022) and not driven by 'outside' technologies or interest. This requires understanding local resource availability to develop and sustain CRE projects that meet local energy needs and aspirations.

2.0 Research Objective

This research will Identify and assess biomass energy resource potential in Peter Ballantyne Cree Nation (PBCN) communities, northern Saskatchewan. This research is part of the Community Appropriate Sustainable Energy Security (CASES) project initiatives and in partnership with QUEST Canada and Co-mapping Solutions, who are working with PBCN on community bioenergy facility feasibility assessment.

3.0 Research Design

The research uses geospatial techniques to identify and assess biomass energy resource potential near the study communities in PBCN territory. Data processing and analysis use geospatial tools in Esri software, specifically ArcGIS.

3.1 Data Source

The research relies on existing secondary data sources, such as the forest resource inventory (raster data which are 10m and 30m resolution pixel) from the Government of Saskatchewan Ministry of Environment, annual timber harvesting schedule data and plans from Mee-Toos, a PBCN local timber supply company operating in northern Saskatchewan, and local and provincial land use restrictions and regulatory literature.

3.2 Study Communities

The study communities for this research are Pelican Narrows and Southend, northern Saskatchewan (Figure 1). Both communities are part of Peter Ballantyne Cree Nation (PBCN) and partnered with QUEST Canada and CASES to undertake renewable resource assessments and longer-term community energy planning initiatives.

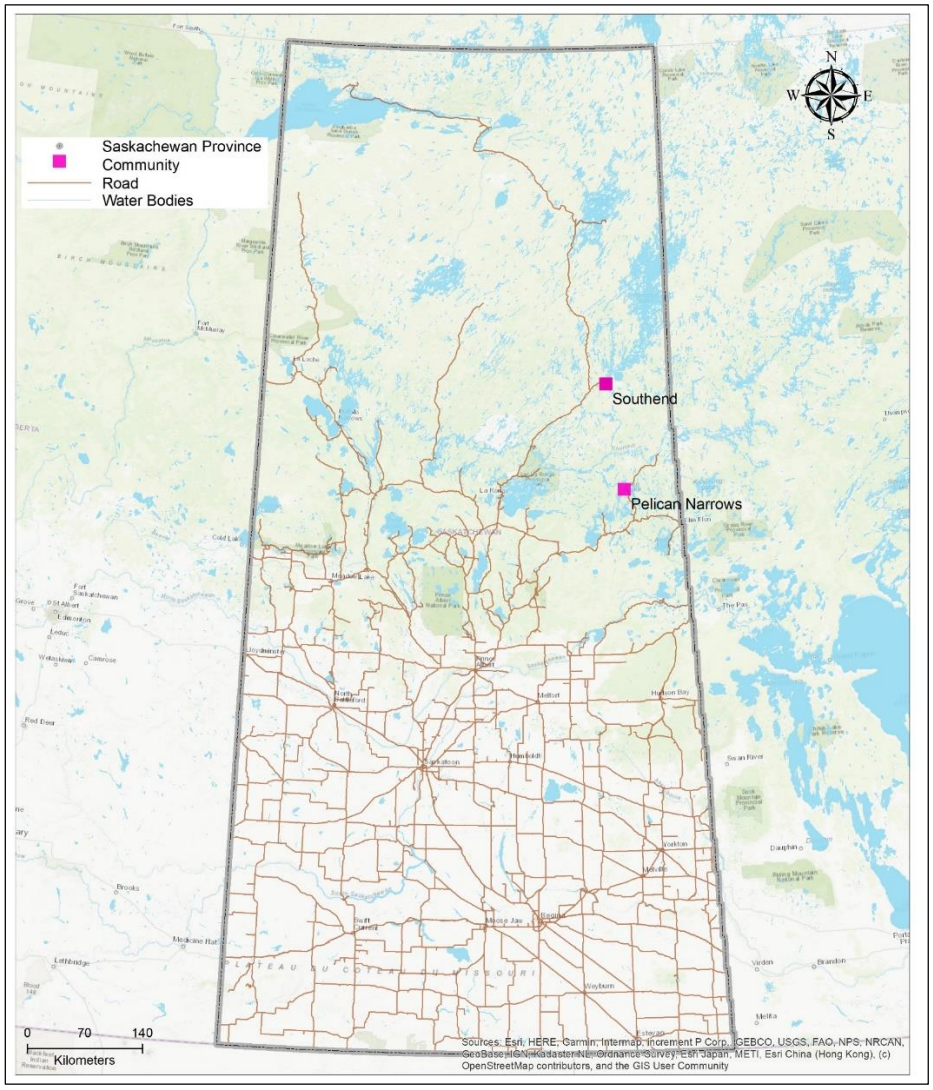

Figure 1: Geographical location of Pelican Narrows and Southend communities, Saskatchewan Province.

Pelican Narrows is located at 55° 11′ 18′′ N, 102° 56′ 3′′ W, has a population of 2,454 (as of 2021) over an approximately 9.21 km² land area and is located 388 km northeast of Prince Albert, the closet urban service centre. Southend is located at 56° 20′ 0′′ N, 103° 14′ 0′′ W, has a population

of 1,052 (as of 2021) over area approximately 43.55 km² land base, and is located 454 km north of Prince Albert and 222 km north of La Ronge (Statistics Canada, 2023).

Both communities are connected to the province's northern electricity grid, but neither community is connected to the provincial natural gas distribution network. The transmission lines connected to these communities are not grounded and as a result are vulnerable falling trees, due to storm events year-round ice storms and fire that can cause outages and leave communities without electricity service (and thus heat in the winter) for extended periods.

3.3 Technical Assessment

Geospatial tools, which include analysis tools, conversion tools, editing tools, and spatial analysis tools in ArcGIS software, have been used to identify and assess the biomass resource potential near the study communities. The technical assessment was based on the following steps (figure 2):

a) Identification of hypothetically recoverable biomass resources, based on landcover and forest age class;
b) Identification of potentially recoverable biomass resources, from non-commercial forest areas and land uses, and considering land use restrictions; and
c) Identification of technically recoverable biomass resources, which considers potential biomass sources and biomass recoverable from the commercial forest zone.

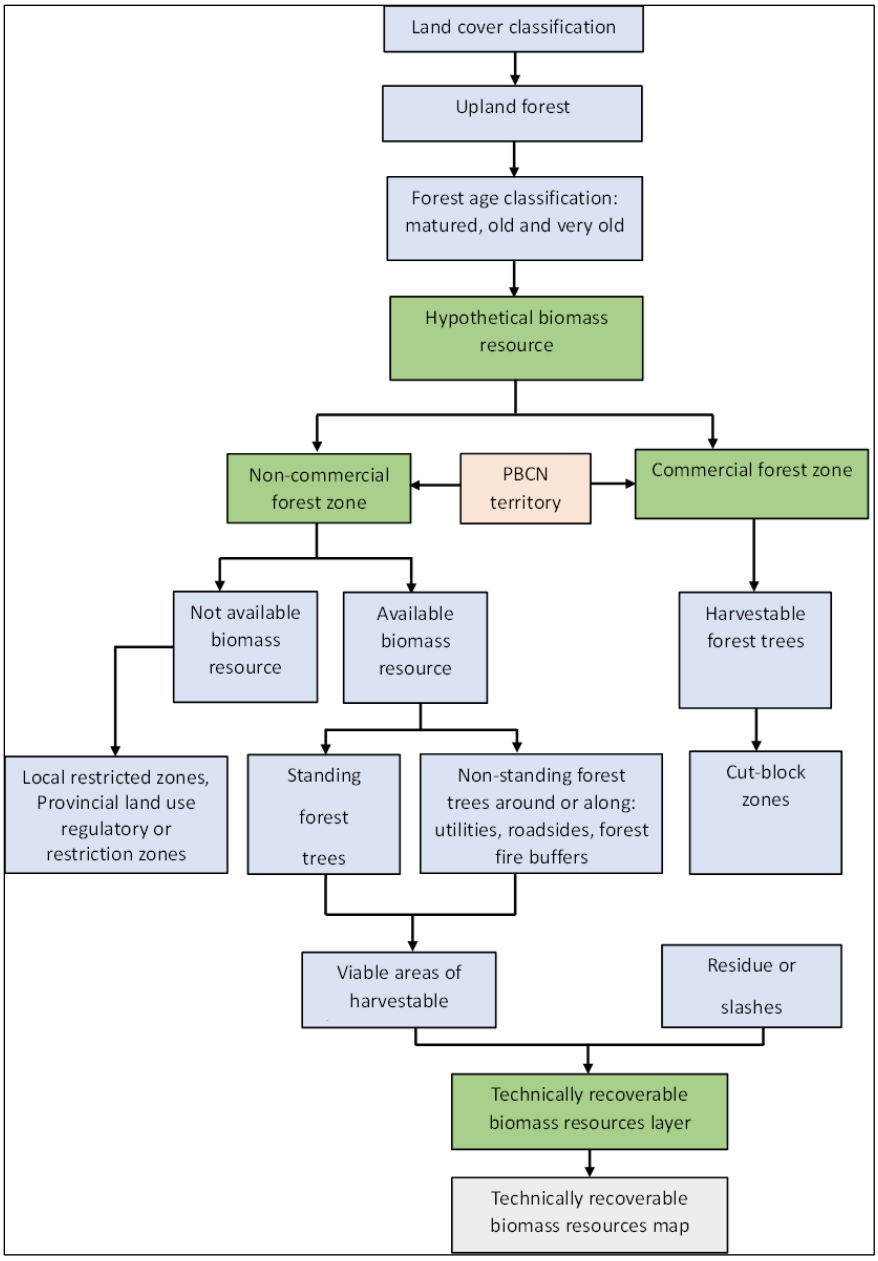

Figure 2: Flow chart of technical assessment of biomass resource potential

3.3.1 Identification of hypothetically recoverable biomass resources based on land cover and forest age class

To determine the hypothetical biomass resource base, land cover generalized data, which are raster data of 10m and 30m resolution pixel, were processed to extract various land cover classes. Upland forest land cover class was further processed to extract various classifications of the forest age layer based on mature (75–125 years), old (126–200 years), and very old (above 200

years) forest. This forest-age layer is considered a hypothetical biomass resource layer in that it assumes no further restrictions on resource access or suitability for bioenergy harvesting.
The hypothetical biomass resource layer was next cropped to the PBCN territory and delineated based on two broad classifications using a forest resource inventory (FRI) database from the Saskatchewan Ministry of Environment: i) the commercial forest zone, from which biomass is *technically* recoverable from forest harvest residue; and ii) the non-commercial forest zone, from which biomass is *potentially* recoverable subject to other land use designations or restrictions. This is the current stage of the data processing and analysis.

3.3.2 Commercial forest zones

The commercial forest layer (10m resolution pixel), which designates provincial timber supply zones, will be processed to determine, and estimate the number of harvestable trees within the PBCN Timber Supply Company's (Mee-Toos) operating area. Based on annual harvest plans prepared by Mee-Toos, a layer of harvestable forest trees will be overlain with forest cut-block zones delineating in annual harvest plans to determine the number of harvestable trees as well as slashes or residue generated in each cut-block zone. Only slashes and residues generated in each cut-block zone (i.e., non-standing timber) will be considered technically available biomass resources for bioenergy production.

3.3.3 Non-commercial forest zones

The non-commercial forest layer (30m resolution pixel) will capture potentially available biomass for bioenergy production. It will be overlain with PBCN land use controls and provincial land use regulatory restrictions that protect or preserve the forest resource base. The biomass in these zones will be considered unavailable for harvest for bioenergy production. The remaining biomass consists of standing trees and non-standing forested areas created around utilities, roadsides, reserved parks, protected forest zones, and communities due to wildfires. These buffer zones will be classified as part of the map layer to indicate viable areas of potentially harvestable biomass resources.

3.3.4 Identification of technically recoverable biomass resources

The technically recoverable biomass resource base will be comprised of the non-commercial forest resource that is designated as standing trees and technically available for harvest, other areas of non-commercial forest where biomass may be harvested, and slashes / residue generated from the harvestable forest trees within cut-block zones. These layers will be processed and exported as a technically recoverable biomass resource base map.

4.0 Expected Results

The expected results are:

1. A biomass layer depicting the technically recoverable biomass for CRE production from the commercial forest zone in PBCN territory using a 10m resolution pixel (Figure 3, Table 1).

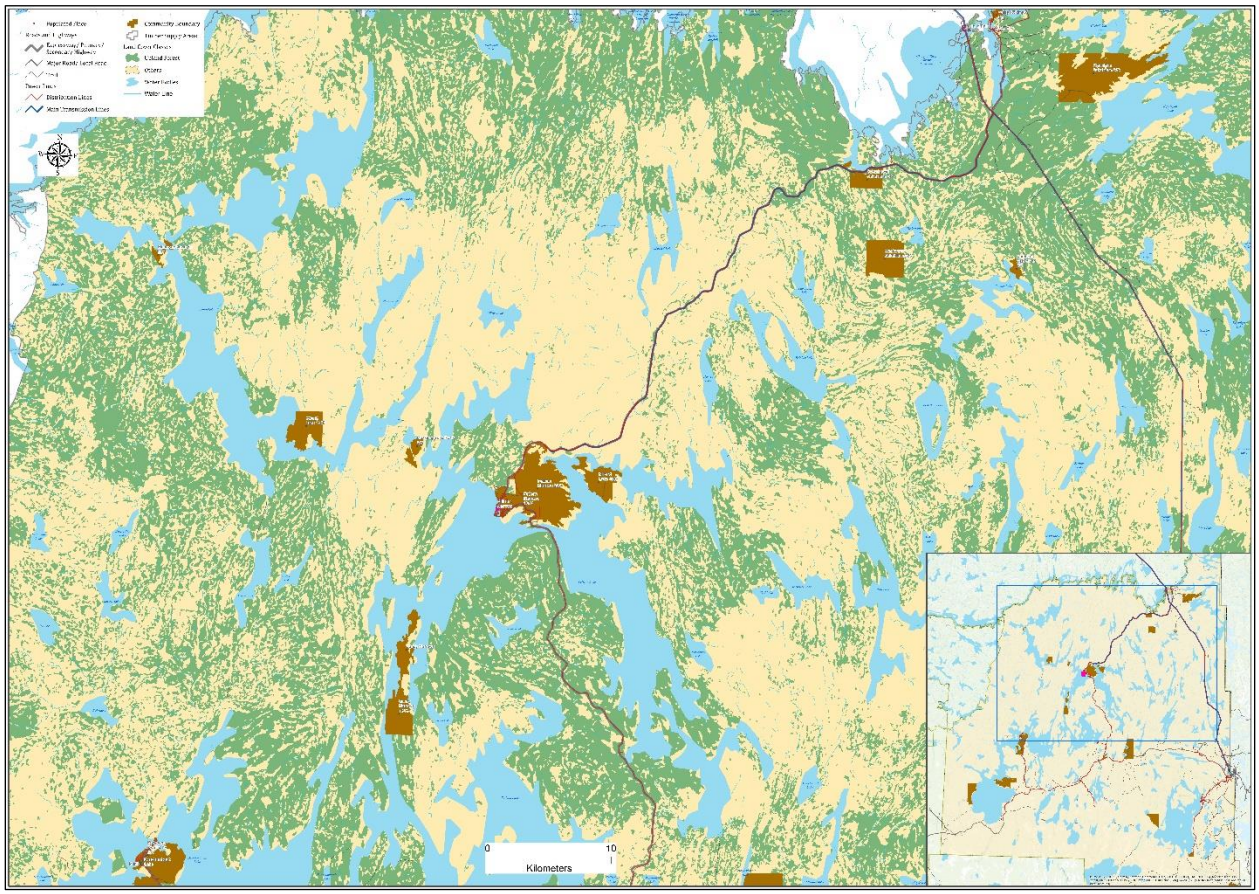

Figure 3: Biomass layer depicting technically recoverable biomass from the commercial forest zone.

Table 1: Area coverage of upland forest within the commercial forest zone.

Land cover classes	***Pixel Count (10 X 10 m)***	***Area (sq.km)***
Upland forest	63,235,672	632.35

2. A biomass layer depicting the potentially recoverable biomass for CRE from the non-commercial forest zone in PBCN territory using a 30m resolution pixel (Figure 4, Table 2).

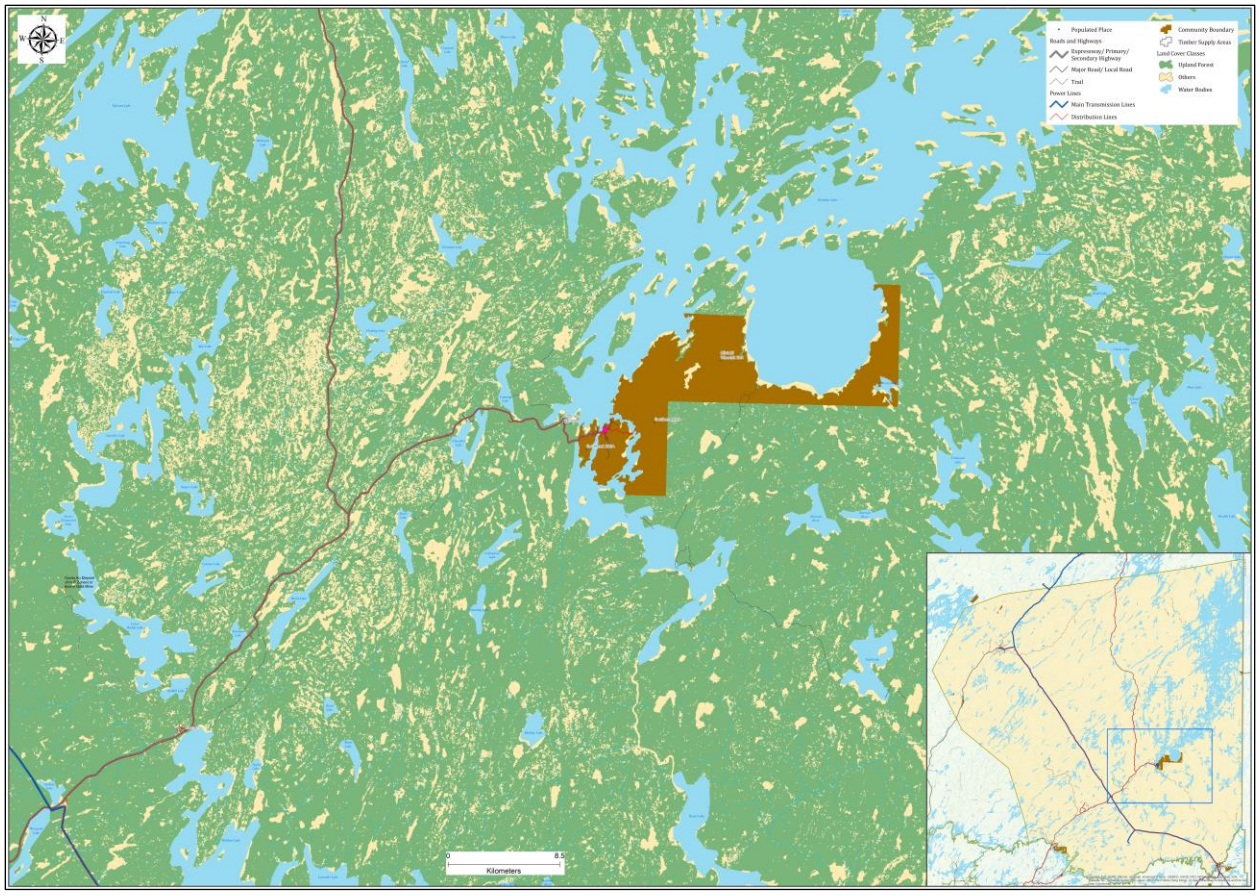

Figure 4: Biomass layer depicting potentially recoverable biomass from the non-commercial forest zone.

Table 2: Area coverage of upland forest within the non-commercial forest zone.

Land cover class	***Pixel Count (30 x 30 m)***	***Area (sq. km)***
Upland forest	47,362,715	4,262.64

5.0 Next Phase of the Research

Phase two of this research is a community participatory mapping process and workshop in each of the study communities to identify and map local land use values, constraints, place-specific conditions, and other factors that may further constrain (or enable) biomass resource harvesting from areas delineated on the technically recoverable biomass resource base map (Figure 5). The overall expect result of this research is to generate a base map which delineates areas of potentially recoverable biomass resources to facilitate the feasibility assessment of community

bioenergy production in Pelican Narrows and Southend communities to meet local energy demands.

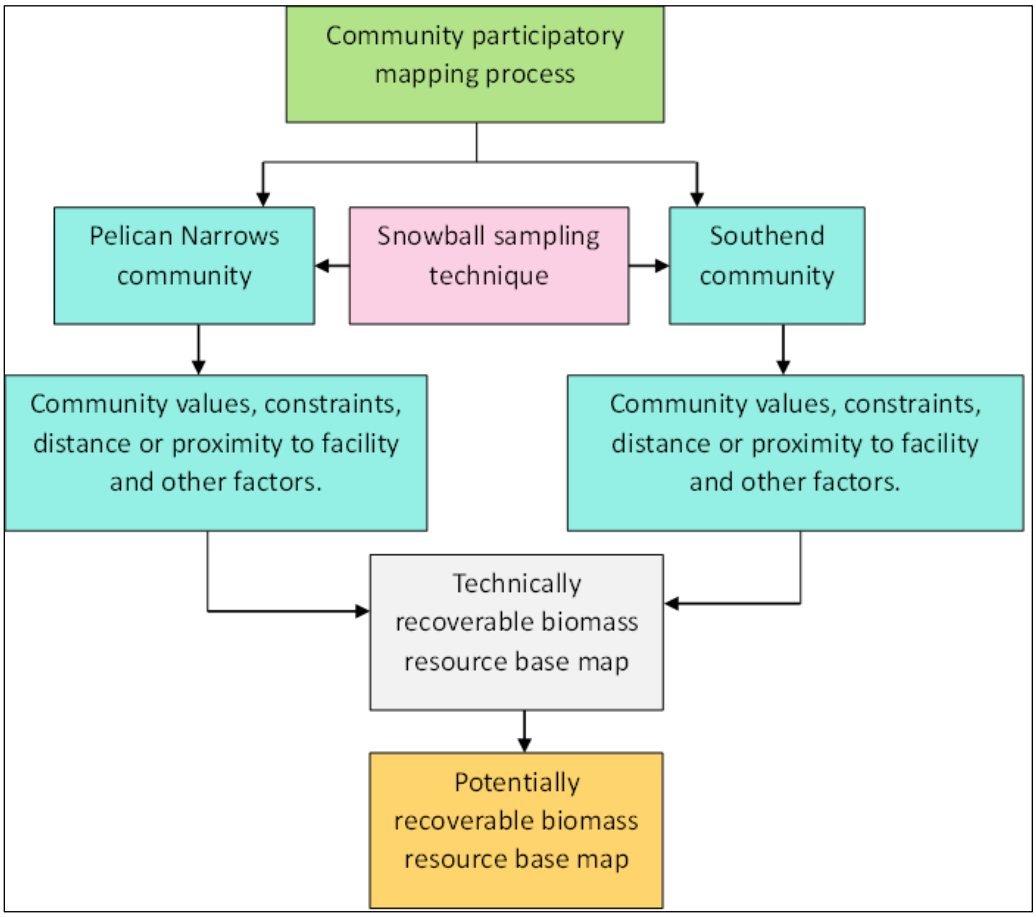

Figure 5: Community participatory mapping process and workshop.

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