Alaskan Community Ontology

A Book Made with Quarto

Liz Dobbins

Table of contents

1 Alaska Community Ontology

A Book Made with Quarto

1.1 Welcome

This repository aims to support needed conversations regarding a foundational element of Alaska Energy Data Gateway (AEDG): the creation of derived aggregates of socio-economic and energy data at upper levels such as administrative regions and grids.

To accomplish the computation of these aggregates in a reproducible way, a cross-walk between conceptual groupings of communities is required. This conceptual model will be applicable to diverse types of data. It will also guide the development of the algorythms that compute the aggregations and convert between them.

If possible, this cross-walk will be machine readable/actionable. But to establish with consensus between our various subject matter experts, we need to start with a single set of definitions and axioms (rules) expressed in a human readable form. This could happen in a wiki, but we should maintain a record of revisions so we can document discussions and final recommendations. The best format for this process is a GitHub repo.

1.2 Goal

To provide a basis for tranformation of data provided at different scales so that multiple groupings can be displayed on AEDG dashboards.

This is required because data will provided at different scales. For instance:

- Because of interties, electricity is not always reported by individual communities.
- Some ways of avoiding personally identifiable information (such as for building footprints) involve reporting by zip code.
- Existing analysis such as [somebody's] energy burden data is reported at census tract level.

Also, different audiences need data reported at different scales:

- Communities want a summary of their own data.
- Legislative Aides want summaries by legislative district.
- Agency leads might want to compare PCE communities with railbelt communities.

The assumption is that this needs to function **for the current time only**. Of course, boundaries change over time, and that these changes are of interest to researchers. However, the main users of AEDG have been defined as requiring current data to support future projects or to determine the success of existing projects. Researchers can download data and work out time-dependent issues for themselves. In a future time, we might want to support this with a time-dependent version of this system, but now is not that time.

1.3 Format

Development will begin with a series of web pages oriented around ontological concepts. The concepts are:

- **Classes**: Types of entities. Most are defined according to existing legal structures as described in the linked references. The main exception is Community, which is the organizational principle of previous versions of AEDG; we will define that one ourselves.
  - Classes could be translated to tables in a relational database, if that makes sense for development.
  - Instances of a Class are nodes in a graph, if you think about things that way.
- **Properties**: These are attributes of the Classes.
  - Properties could take the form of columns in tables in a relational database.
- **Relations**: These can be heirarchical (taxonomy) or could form a network or graph (semantic web) of the various entities. If they are based on domain specific rules (Axioms), then that is what distinguishs an ontology. Relations enable AI to infer new information without people having to explicitly define everything.
  - Relations are the edges in a graph.
  - In a relational database, Relations can be encoded using a lookup table with a combination of foreign keys.
- **Axioms**: Domain-specific rules that encapsulate what we know about the Classes.
  - Axioms could form the basis of quality checks to entered data or the definition of the ontology. For instance, if the axioms include `x = y` and `y = z`, trying to enter an `x` that isn't equal to `z` would fail a test.

1.4 Workflow

1. Liz drafted an initial versions based on discussions at the Nov 11, 2024, meeting of AEDG personnel. The intention was to track issues in this repo.
2. These were translated into a data model that serves as a translation layer between Ian who is creating the data tables and Nicole and Will who are building the Rails database.
3. As consensus is reached (often in direct messages or conversations during meetings), the resolution migrates to the data model and then if we are lucky to this ontology.

The original idea was to encode the ontology in OWL. However, as of Nov. 2024, it is unclear how to make use of an OWL formated ontology with code.

The second idea was a separate realational (or graph) database that would be queried during the table development. Instead, Ian built a self-contained ELT workflow as a way to experiment with different relations. His findings then feed back into the data model

Ontology specific work will be delayed to future development cycles, if it happens at all.

1.5 Possibly Applicable Standards

Whenever possible, we will rely on existing resources and resist defining our own ontology from scratch. Hopeful candidates are:

Schema.org is a widely used classification scheme built around web semantics - so more applicable to internet based services, of which AEDG is one.

Dublin Core Metadata Terms (DCMT) are limited to only the most necessary terms. For instance, dc:Location is defined to include both spatial regions and named places, and puts no qualifications on the type or context. Similarly, an dc:Agent is merely "a resource that acts or has the power to act". Wikipedia says: "Initially developed as fifteen terms in 1998 the set of elements has grown over time and in 2008 was redefined as **an** Resource Description Framework (RDF) vocabulary."

OEO is the Open Energy Ontology, which you access via this Terminology Service.

If the Census terms don't make sense, check the Census Glossary.

Terms describing Alaska Native representation are complex. The definitions here are based on ANCSA Regional Association's Overview, is a description of the different tribal entities in Alaska that includes links to more information.

1.6 This is a stoat
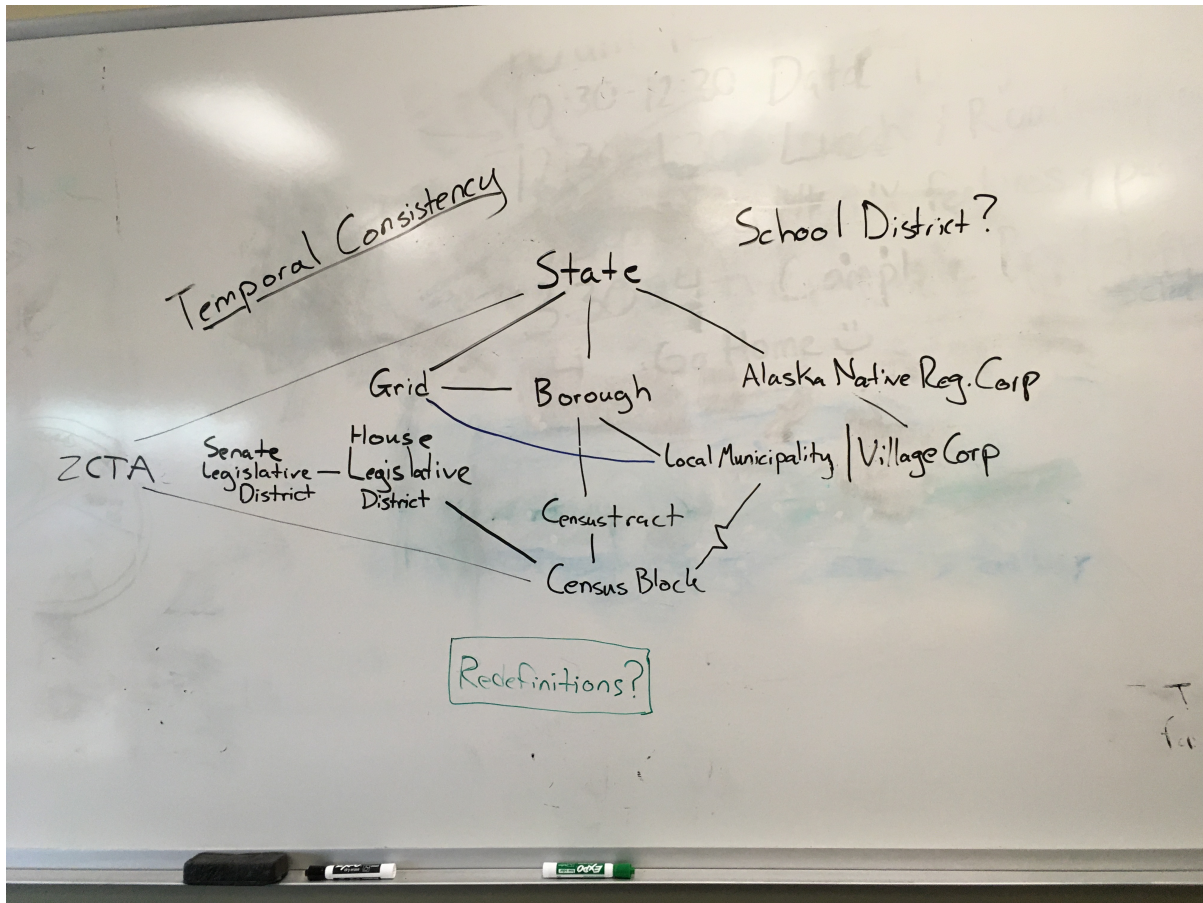
Figure 1.1: Initial Brainstorming.

2 Classes

Types of entities in the Alaska Community Ontology

2.1 Classes

Classes are types of entities. Most are defined according to existing legal structures as described in the linked references. The main exception is Community, which is the organizational principle of previous versions of AEDG; we will define that one ourselves. It is likely we can use established standard vocabularies to define all Classes. Which standard we use will depend on the level of specificity we want.

- Classes could be translated to tables in a relational database, if that makes sense for development.
- Instances of a Class are nodes in a graph, if you think about things that way.
- Classes are typically capitolized to differentiate them from instances or objects of that class, which are lower case.

This page also includes Properties, which are attributes of the Classes.

- Properties could take the form of columns in tables in a relational database.

2.2 Common Properties

These are attributes shared by all Classes

- id (int): All Classes should have an id column for inclusion in lookup tables.

    - How we determine these is a whole 'nother thing.

- label (string): Human readable name. This cannot be the key of the table becaues multiple Classes could have the same label (example: Fairbanks the Municipality and Fairbanks the Borough)

- classModificationDate (time): Classes will evolve as we evaluate their effectiveness, so we should record when the class definition changes to identify which Classes might need reevaluation.
- entityModificationDate (time): This is to allow evolution in time.
- geometry (geom): As it is developing, each of these entities seems to have spatial component, though it might be a Point, Polygon, or Line.

3 List of Classes

3.1 AEDG Context Only

3.1.1 Communities

- **Definition**: Construct of AEDG that is the fundamental unit of displays and dashboards.
- **SpatialRelationships**:
- **Analogous Standards**:

    - https://schema.org/Place
    - dc:Location

- **Properties**:

    - geometry (WKT Point): longitude, latitude of the Community for convenience of display. Perhaps the centroid of the Municipality or a commonly accepted "place".
    - geometry (WKT Polygon): boundary of the administrative bounds of a Community available from a DRCA PCE dataset.

3.2 ANCSA or Indigenous Context

3.2.1 FedRecognizedTribes

- **Definition**: For the purposes of tracking energy in Alaska, the definition [should|will|could] be restricted to the 229 Federally recognized Tribes - sovereign governments. The 1975 Indian Self-Determination and Education Assistance Act allows tribes to contract with the federal government to provide services in place of federal agencies.
- **SpatialRelationships**:
- **Analogous Standards**:

    - https://schema.org/GovernmentOrganization
    - dc:Agent
    - OEO:provider - A provider is an agent (organization) that transfers commodities or a OEO:Service to other agents.

- **References**:

  - https://biamaps.geoplatform.gov/BIA-Opendata/Data/ - terrible. no way to link to dataset.
  - https://www.fws.gov/sites/default/files/documents/Map-Federally-Recognized-Tribes-In-Alaska.pdf
  - https://www.scotusblog.com/2021/04/are-alaska-native-corporations-indian-tribes-a-multimillion-dollar-question
  - https://biamaps.geoplatform.gov/Tribal-Leaders-Directory/

- **Properties**:

  - geometry (WKT Polygon): boundary of Tribe
  - Additional properties should be determined by what is important to the people. i.e. language?

3.2.2 VillageCorps

- **Definition**: Alaska Native village corporations were created by the Alaska Native Claims Settlement Act (ANCSA) and are organized around small communities in Alaska that typically stemmed from traditional Alaska Native land. Village corporations were intended to select lands on which any part of the village was located. Their importance in the energy context is that they might operate as Independent Power Producers that sell power to the Communities' utilities.
- **SpatialRelationships**:

  - WITHIN Alaska

- **Analogous Standards**:

  - https://schema.org/Corporation
  - dc:Agent
  - OEO:provider - A provider is an agent (organization) that transfers commodities or a OEO:Service to other agents.
  - Is an foaf:Organization that is foaf:based_near a Community - "A location that something is based near, for some broadly human notion of near."

- **References**:

  - https://dcra-cdo-dcced.opendata.arcgis.com/datasets/DCCED::native-village-corporations/ (215 records)
  - https://ancsa.lbblawyers.com/1602.htm (definition)
  - https://ancsa.lbblawyers.com/native-corporations.htm (list of 179)
  - https://ancsaregional.com/about-ancsa/#mandates

- **Properties**:

- geometry (WKT Point): longitude, latitude of tribal leadership location
- related to Communities via the `is_based_near` lookup table.
- Additional properties should be determined by what is important to the people.

3.2.3 RegionalCorps

- **Definition**: Alaska Native regional corporations were created by the Alaska Native Claims Settlement Act (ANCSA) and are organized around geographic areas defined by the common heritage and shared interests of the indigenous peoples. The boundaries of these areas do not directly represent land ownership, but instread define the areas in which each regional corporation could select lands to be conveyed under the provisions of ANCSA.
- **SpatialRelationships**:

  - WITHIN Alaska

- **Analogous Standards**:

  - https://schema.org/Corporation
  - dc:Agent
  - OEO:provider - A provider is an agent (organization) that transfers commodities or a OEO:Service to other agents.

- **References**:

  - https://www.arcgis.com/home/item.html?id=c78df0004ab845a9a32697d9c20d09e0
  - https://catalog.data.gov/dataset/tiger-line-shapefile-2017-state-alaska-current-alaska-native-regional-corporation-anrc-state-ba
  - https://ancsa.lbblawyers.com/native-corporations.htm (list of 13)
  - https://ancsaregional.com/about-ancsa/#mandates
  - https://maps.commerce.alaska.gov/server/rest/services/ANCSA/ANCSA_Corporations/MapServer

- **Properties**:

  - geometry (WKT Polygon): boundary of the RegionalCorp.
  - Additional properties should be determined by what is important to the people.

3.3 Administrative Context

3.3.1 IncorporatedPlaces

- **Definition**: Incorporated places are legally incorporated under state law, have a legally defined boundary, and an active functioning governmental structure. Examples of incorporated places include cities, towns, villages, etc. (Not boroughs in Alaska)

- **SpatialRelationships**:

  - WITHIN Boroughs
  - WITHIN Precincts
  - WITHIN HouseDistricts
  - WITHIN SenateDistricts

- **Analogous Standards**:

  - https://schema.org/GovernmentOrganization
  - has an https://schema.org/AdministrativeArea
  - dc:Location for the place
  - dc:Agent for the government
  - OEO:provider - A provider is an agent (organization) that transfers commodities or a OEO:Service to other agents. Governmental ok?

- **References**:

  - https://www.census.gov/programs-surveys/bas/information/cdp.html
  - https://www2.census.gov/programs-surveys/popest/tables/2020-2023/cities/totals/SUB-IP-EST2023-POP-02.xlsx 2023 populations for Alaska incorporated places

- **Properties**:

  - geometry (WKT Polygon): boundary

3.3.2 CensusDesignatedPlaces

- **Definition**: CDPs are statistical equivalents of incorporated places and represent unincorporated communities that do not have a legally defined boundary or an active, functioning governmental structure. They are locally recognized and identified by name. Examples of CDPs include unincorporated communities, planned communities, military installments, university towns, resort towns, etc.
- **SpatialRelationships**:

  - WITHIN Boroughs
  - WITHIN Precincts
  - WITHIN HouseDistricts
  - WITHIN SenateDistricts

- **Analogous Standards**:

  - https://schema.org/Place
  - dc:Location

- **References**:

  - https://www.census.gov/programs-surveys/bas/information/cdp.html

- **Properties**:
  - location (WKT Point): longitude, latitude points of whereever the census says it is (does not have legal boundary, therefore not a polygon?)

3.3.3 Boroughs

- **Definition**: Boroughs are analagous to a county in other places. Organized boroughs were formed in those areas where economies were better developed. The remaining areas are the unorganized borough, which is divided into census areas; these areas exist for statistical analysis and do not have a government of their own. There are also consolidated city-borough governments.
- **SpatialRelationships**:
  - CONTAINS IncorporatedPlaces
  - CONTAINS CensusDesignatedPlaces
  - OVERLAPS Precincts
  - OVERLAPS HouseDistricts
  - OVERLAPS SenateDistricts

- **Analogous Standards**:
  - https://schema.org/GovernmentOrganization
  - has an https://schema.org/AdministrativeArea
  - dc:Location for the place
  - dc:Agent for the government
  - OEO:subregion - a region of relevance that is in every respect a component of a region of relevance, but never encompasses the entire extent of a region of relevance. (of Alaska)
  - OEO:provider (an organization with a role) provides a governmental OEO:service

- **References**:
  - https://gis.data.alaska.gov/datasets/DCCED::alaska-borough-and-census-area-boundaries/about
  - https://www.commerce.alaska.gov/web/dcra/LocalBoundaryCommission
  - https://en.wikipedia.org/wiki/List_of_boroughs_and_census_areas_in_Alaska
  - https://live.laborstats.alaska.gov/cen/maps/state/current/AlaskaBorCA.pdf
  - https://live.laborstats.alaska.gov/cen/maps/bor/current/090.pdf map of FNSB with cities and census

- **Properties**:
  - type (string): "Unified Home Rule", "Non-unified Home Rule", "First Class", "Second Class"
  - geometry (WKT MultiPolygon): boundary of the Borough

3.3.4 HouseDistricts

- **Definition**: The Alaska State House is the lower house in the Alaska State Legislature. Its districts are determined on the basis of population and shall be "contiguous and compact territory containing nearly as possible a relatively integrated socioeconomic area"
- **SpatialRelationships**:
    - CONTAINS IncorporatedPlaces
    - CONTAINS CensusDesignatedPlaces
    - CONTAINS Precincts
    - WITHIN SenateDistricts

- **Analogous Standards**:
    - https://schema.org/AdministrativeArea
    - dc:Location
    - OEO:subregion - a region of relevance that is in every respect a component of a region of relevance, but never encompasses the entire extent of a region of relevance. (of Alaska and of SenateDistrict)

- **References**:
    - https://maps.commerce.alaska.gov/server/rest/services/Govt_Related/Govt_House_and_Senate_
    - https://www.elections.alaska.gov/doc/forms/H07.pdf list of senate and house districts
    - https://www.elections.alaska.gov/doc/forms/H32COM.pdf   community/district lists
    - https://akleg.gov/pages/legbranch.php

- **Properties**:
    - district (int): digit that denotes the district
    - geometry (WKT MultiPolygon): boundary of the district.

3.3.5 SenateDistricts

- **Definition**: Alaska State Senate is the upper house in the Alaska State Legislature. Its districts are composed of two contiguous house districts, if possible.
- **SpatialRelationships**:
    - CONTAINS IncorporatedPlaces
    - CONTAINS CensusDesignatedPlaces
    - CONTAINS Precincts
    - CONTAINS HouseDistricts

- **Analogous Standards**:
  - https://schema.org/AdministrativeArea
  - dc:Location
  - OEO:subregion - a region of relevance that is in every respect a component of a region of relevance, but never encompasses the entire extent of a region of relevance. (of Alaska)

- **References**:
  - https://maps.commerce.alaska.gov/server/rest/services/Govt_Related/Govt_House_and_Senate_

- https://www.elections.alaska.gov/doc/forms/H07.pdf list of senate and house districts
- https://www.elections.alaska.gov/doc/forms/H32COM.pdf community/district lists
- https://akleg.gov/pages/legbranch.php
- **Properties**:
  - district (character): Capitol letter that denotes the district
  - geometry (WKT MultiPolygon): boundary of the district.

3.4 Statistical or Research Context

3.4.1 CensusBlocks

- **Definition**: Census blocks are the smallest level of geography you can get basic census demographic data for, such as total population by age, sex, and race.
- **SpatialRelationships**:
  - WITHIN CensusTracts

- **Analogous Standards**:
  - https://schema.org/DefinedRegion - Arbitrary! haha
  - dc:Location
  - OEO:study subregion (of CensusTract)

- **References**:
  - https://www.census.gov/newsroom/blogs/random-samplings/2011/07/what-are-census-blocks.html
  - https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-geopackage-file.html
  - https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html
  - https://live.laborstats.alaska.gov/article/maps-gis-data

- **Properties**:

– geometry (WKT Polygon): boundary of the census block.

3.4.2 CensusTracts

- **Definition**: Census tracts are small, relatively permanent statistical subdivisions of a county or statistically equivalent entity that provide a stable set of geographic units for the presentation of statistical data.
- **SpatialRelationships**:

  – CONTAINS CensusBlocks

- **Analogous Standards**:

  – https://schema.org/DefinedRegion - Arbitrary! haha
  – dc:Location
  – OEO:study region - "A study region is a region of relevance that has the study region role and consists entirely of one or more subregions."

- **References**:

  – https://www.census.gov/programs-surveys/geography/about/glossary.html#par_textimage_13
  – https://esri.maps.arcgis.com/home/item.html?id=20f5d275113e4066bf311236d9dcc3d4
  – https://live.laborstats.alaska.gov/article/maps-gis-data

- **Properties**:

  – geometry (WKT Polygon): boundary of the census tract.

3.4.3 Regions

- **Definition**: Communities have been grouped into Regions in order to summarize energy trends in the Energy Statistics Workbooks or the Alaska Electricity Trends Report (2024). If new regions are defined, they can be included, but this is intended to be either AEA's 11 regions or ACEP's 3 regions (Coastal, PCE, or Railbelt). Note: if we need to translate between AEA and ACEP regions, we will need to separate these.
- **SpatialRelationships**:
- **Analogous Standards**:

  – https://schema.org/DefinedRegion - Arbitrary! haha
  – dc:Location
  – OEO:study region - "A study region is a region of relevance that has the study region role and consists entirely of one or more subregions."

- **Properties**:

  – organizaton (string): 'ACEP' or 'AEA' as the organization that defined the region.

– ~~boundary (WKT Polygon):~~ A spatial boundary does not make sense because these were used to group communities together, and in the case of ACEP's regions, they were intended to be discontinuous. Meaning, there are some PCE communities that are pretty near the coast because the designation is based on power costs and not geography. Could be solved with multipolygon or lookup table.
– geometry (WKT MultiPolygon): proposed geometry

3.5 Optional

3.5.1 CensusArea

- **Definition**: Census areas are subdivisions of the unorganized borough that are only used for statistical analysis and do not have a government of their own. These are typically undeveloped areas, so I'm not sure how relevant they are for AEDG.
- **SpatialRelationships**:
- **Analogous Standards**:
    – https://schema.org/DefinedRegion - Arbitrary! haha
    – dc:Location
    – OEO:subregion - a region of relevance that is in every respect a component of a region of relevance, but never encompasses the entire extent of a region of relevance. (of the unincorporated Borough)

- **References**:
    – https://gis.data.alaska.gov/datasets/DCCED::alaska-borough-and-census-area-boundaries/about

- **Properties**:
    – boundary (WKT Polygon): longitude, latitude points that denote the boundary of the census area.

3.5.2 ZipCode

- **Definition**: Postal zip codes as available from [link] (ZCTA)
- **SpatialRelationships**:
- **Analogous Standards**:
    – https://schema.org/DefinedRegion - properties of which were designed for zip codes
    – dc:Location
    – OEO:subregion - a region of relevance that is in every respect a component of a region of relevance, but never encompasses the entire extent of a region of relevance. (of the United States and of Alaska)

- **References**:
  - https://www.geonames.org/postal-codes/US/AK/alaska.html (place = town, Admin2 = borough?)

- **Properties**:
  - boundary (WKT Polygon): longitude, latitude points that denote the boundary of the house district.

3.5.3 SchoolDistrict

- **Definition**: Community based school districts. This might be out of scope or better handled as research.
- **SpatialRelationships**:
- **Analogous Standards**:
  - dc:Agent for the governmental organization.
  - OEO:subregion - a region of relevance that is in every respect a component of a region of relevance, but never encompasses the entire extent of a region of relevance. (of what?)

- **Properties**:
  - boundary (WKT Polygon): longitude, latitude points that denote the boundary of the school district. This is too much to expect, probably.

4 Classes

Types of entities in the Alaska Community Ontology

4.1 Classes

Classes are types of entities. Most are defined according to existing legal structures as described in the linked references. The main exception is Community, which is the organizational principle of previous versions of AEDG; we will define that one ourselves. It is likely we can use established standard vocabularies to define all Classes. Which standard we use will depend on the level of specificity we want.

- Classes could be translated to tables in a relational database, if that makes sense for development.
- Instances of a Class are nodes in a graph, if you think about things that way.
- Classes are typically capitolized to differentiate them from instances or objects of that class, which are lower case.

This page also includes Properties, which are attributes of the Classes.

- Properties could take the form of columns in tables in a relational database.

4.2 Common Properties

These are attributes shared by all Classes

- id (int): All Classes should have an id column for inclusion in lookup tables.

    - How we determine these is a whole 'nother thing.

- label (string): Human readable name. This cannot be the key of the table becaues multiple Classes could have the same label (example: Fairbanks the Municipality and Fairbanks the Borough)

- classModificationDate (time): Classes will evolve as we evaluate their effectiveness, so we should record when the class definition changes to identify which Classes might need reevaluation.
- entityModificationDate (time): This is to allow evolution in time.
- geometry (geom): As it is developing, each of these entities seems to have spatial component, though it might be a Point, Polygon, or Line.

5 List of Energy Classes

5.1 Energy Context

5.1.1 Grids

- **Definition**: An Electric power grid is "A system of synchronized power providers and consumers connected by transmission and distribution lines and operated by one or more control centers. … In Alaska and Hawaii, several systems encompass areas smaller than the State (e.g., the interconnect serving Anchorage, Fairbanks, and the Kenai Peninsula)" (EIA)
- **SpatialRelationships**:

    - CONTAINS PowerLines (transmission and distribution lines)
    - CONTAINS PowerStations (power providers)
    - CONTAINS Communities (consumers) demand, load ?

- **Analogous Standards**:

    - dc:PhysicalResource
    - OEO:electricity grid - "An electricity grid is a supply grid that distributes electrical energy / electricity." It is an aggregate of material entities that has parts: power stations and power lines.

- **References**:

    - https://www.eia.gov/tools/glossary/index.php?id=electric_power_grid
    - https://en.wikipedia.org/wiki/Electrical_grid
    - https://www.nrel.gov/grid/microgrids.html
    - https://en.wikipedia.org/wiki/Microgrid

- **Properties**:

    - microgrid (boolean): True/False (need a definition for this)
    - capacity (int): megawatts MW
    - geometry (WKT Polygon): All grids are continuous. Could this be a shape that includes all the PowerPlants and PowerLines?

5.1.2 Utilities

- **Definition**: "A corporation, person, agency, authority, or other legal entity or instrumentality aligned with distribution facilities for delivery of electric energy for use primarily by the public. Included are investor-owned electric utilities, municipal and State utilities, Federal electric utilities, and rural electric cooperatives." (EIA) Certified utilities in Alaska have a certificate of operation issued by the RCA.
- **Analogous Standards**:

  - https://schema.org/Corporation
  - dc:Agent
  - OEO:provider - A provider is an agent (organization) that transfers commodities or a OEO:Service to other agents.
  - OEO:power plant operator - "an agent that operates an electric utility generation station."

- **References**:

  - https://www.eia.gov/tools/glossary/index.php?id=Electric%20utility

- **Properties**:

  - coop (boolean): True/False is it organized as a member owned co-operative?
  - private (boolean): True/False is it a private company? Public owned utility (POU)?
  - certificate_number: RCA Certificate of Public Convenience and Necessity (CPCN) number
  - certificate_name: RCA's name for the utility
  - geom: could be determined by the look-up table `provides_electricity_to`. For instance, AVEC and Alaska Power and Telephone serve isolated communities so their sevice regions are discontinuous. However, RCA does certify service areas for certified utilities - we need to find out if these are available as a spatial data set.

5.1.3 PowerLines

- **Definition**: The transmission and distribution lines that create a Grid that includes multiple Communities. In Electric North, there was a distinction between the voltages of transmission and distribution lines, but that was arbitrarily defined and changed as needed.
- **SpatialRelationships**:

  - WITHIN Grids
  - TOUCHES PowerStations
  - TOUCHES Loads

- **Analogous Standards**:

- OEO:electricity grid component (a material entity that includes power plants)
- or more specifically OEO:power line
- dc:PhysicalResource

- **Properties**:

  - owner (string): Who owns it?
  - maintainer (string): Who maintains it? Is this the same as Owner?
  - voltage (int): voltage of line in kV (by definition above 69 kV for transmission lines, but not always in Alaska)
  - type (string): buried, underwater, overhead
  - geometry (WKT MultiLineString): polyline that traces an acceptible, if not accurate, route of the lines.

5.1.4 PowerStations

- **Definition**: Entities that generate electricity for grids.
- **SpatialRelationships**:

  - TOUCHES PowerLines
  - WITHIN Grids

- **Analogous Standards**:

  - dc:PhysicalResource
  - OEO:power plant - "an energy transformation unit consisting of power generating units and a grid component that feeds electric energy into an electric grid."

- **Properties**:

  - fuel (string): OK. now I know this belongs elsewhere, because fuel type should be a lookup table and that doesn't belong with communities. Perhaps already handled by the Open Energy Ontology.
  - geometry (WKT Point):

5.1.5 PceEntities

- https://gis.data.alaska.gov/datasets/DCCED::power-cost-equalization-pce-program-eligible-entities-1/about says "Communities served by entities that are eligible for the Alaska Energy Authority's Power Cost Equalization program."

- PCE authorizes payment to the electric utility (not the community). CSV is a link between communites and the utilities that serve them.
- Also includes ineligible like Fairbanks and Barrow. Wha?
- Map shows points but CSV is an X,Y projection?

- Data Year - points with different times. Maybe

5.1.6 PceCommunities

- https://gis.data.alaska.gov/datasets/DCCED::power-cost-equalization-pce-program/about says "Alaska Energy Authority Power Cost Equalization (PCE) program by community."
- CSV links PCECommunity + CommunityName + EntityName where Entity is maybe the utility?
- Single PCECommunity can link to multiple communities, i.e. "Tok; Tanacross PCE"
- This is the big CSV from AEA with columns for population and rates.

5.1.7 IPP

- **Definition**: An independent power producer (IPP) is a private entity that owns or operates facilities to generate electricity. It could be a person, agency, authority, corporate, cooperative, or tribal. It could sell power to a utility or generate power for a privately held facility.
- **SpatialRelationships**:
- **Analogous Standards**:
- **References**:

    – https://www.eia.gov/tools/glossary/index.php?id=Independent%20power%20producer

- **Properties**:

6 Relations

Domain-defined ways that entities relate to each other in the Alaska Community Ontology

Relations can be heirarchical (taxonomy) or could form a network or graph (semantic web) of the various entities. These are based on domain specific rules (Axioms), and that defines an ontology. Relations enable AI to infer new information without people having to explicitly define everything.

- Relations are the edges in a graph.
- In a relational database, Relations can be encoded using a lookup table with a combination of foreign keys.

6.1 Applicable Standards

ArcMap spatial relations

- ST_Contains
- ST_Crosses
- ST_Disjoint
- ST_Equals
- ST_Intersects
- ST_Overlaps
- ST_Relate
- ST_Touches
- ST_Within

GeoSPARQL - same except for Relate

- geor:sfContains
- geor:sfCrosses
- geor:sfDisjoint
- geor:sfEquals
- geor:sfIntersects
- geor:sfOverlaps

- geor:sfTouches
- geor:sfWithin

OBO Relations Ontology "is a collection of OWL relations (ObjectProperties) intended for use across a wide variety of biological ontologies." It is a foundational element of the Open Energy Ontology.

On the other hand, in the OEO Terminology Service, I could only find one instance of a straight-up `RO` usage: is homeomorphic for (which I don't even understand).

7 Relations

7.1 Spatial Relations

Most relationships can be established dynamically through spatial relations. We do not need to have a lookup table of Communities in Boroughs, say, because we can select all the Community points that the Borough CONTAINS. The primary relationships are sketched out on the Classes pages, but the combinations are really unlimited.

7.2 Lookup Tables

Some classes are legal or corporate entities and so do not have an intrinsic spatial component. But they serve other entities that *do* have a spatial component, so we will use look-up tables to attach spatial info to them.

It would be great if the table names could be based on an established ontology. Liz is currently looking into this. However, in the meantime, table names are very specific so that they describe the exact relationship between the entities. This will self-document the queries when those are written.

Here are the look-up tables that will do this:

7.3 provides_electricity_to

Utilites provide electricity to Communities. Liz added some columns that might be useful, but she doesn't know where these data will come from, so the table schema will change. This is just an example of what *could* be.

- **Analogous Standards**:
- OEO:Service - "A service is a process that is an intangible activity performed by some agent for the benefit of another agent."
- Schema.org:Service - "A service provided by an organization, e.g. delivery service, print services, etc."

id_provides	id_utility	id_community	year_established
integer	integer	integer	integer

7.4 is_intertied_with

Grids are connected to each other with interties. Interties are the physical power lines (transmission or distribution) that make the connection, but "intertie" is also the action of making two separate Grids into a new Grid. An intertie can be multiple lines going on different routes so if a geometry was defined, the line might be quite complex; for our puposes, we will start by representing interties with lines that join the Community points. Interties have a start date that could be defined in multiple ways - date of construction or date when billing changed. (This needs clarification.)

- **Analogous Standards**:
    - OEO:electricity grid component (a material entity that includes power plants)
    - or maybe more specifically OEO:power line
    - dc:PhysicalResource

- **Properties**:
    - owner (string): Who owns it?
    - maintainer (string): Who maintains it? Is this the same as Owner?

This is just an example of what *could* be. Schema should be based on Neil's work?

id_intertie	id_grid1	id_grid2	new_grid_id	year_established	owner	maintainer
integer	integer	integer	integer	integer	string	string

7.5 is_based_near

Alaska Native village corporations are organized around small communities in Alaska that typically originated as traditional Alaska Native land. Village corporations were intended to select lands on which any part of the village was located. Therefore, they aren't the same as a Community but manage lands in possibly disjointed parcels inside and around the Community.

The DCRA dataset explicitly links these two with the columns `EntityName` and `CommunityName`. The addresses are for the corporate headquarters, which might be in Anchorage or somewhere, so those aren't reliable links.

- **Analogous Standards**:

  – The VillageCorp is an foaf:Organization that is foaf:based_near a Community - "A location that something is based near, for some broadly human notion of near."

- **References**:

  – https://dcra-cdo-dcced.opendata.arcgis.com/datasets/DCCED::native-village-corporations/ (215 records)

id_near	id_village_corp	id_community
integer	integer	integer

8 Axioms

Domain-specific rules that describe entity relations in the Alaska Community Ontology

Axioms are domain-specific rules that encapsulate what we know about the Classes.

- Axioms could form the basis of quality checks to entered data or the definition of the ontology. For instance, if the axioms include `x = y` and `y = z`, trying to enter an `x` that isn't equal to `z` would fail a test.
- An Axiom should describe only one quality because it will eventually have a code-based test, and we want to keep those independent of each other.

8.1 State

- The State is defined to be Alaska
- All Communities are in the State

8.2 Community

- Communities are primarily determined by the expectations of the AEDG audience.
- Communities should be equal to a single entity (preferred)
- Communities could be collections of entities (example: Fairbanks should include College and Farmers Loop, which are separate Community Designated Places in the census)

8.3 Indigenous

- Tribes are nations and should be federally recognized (but sometimes are not)
- Native corporations are not nations, they are corporations that are a uniquely Alaskan entity.

– Gregory Ablavsky, Are Alaska Native corporations Indian tribes? A multimillion-dollar question, SCOTUSblog (Apr. 16, 2021, 8:18 PM), https://www.scotusblog.com/2021/04/are-alaska-native-corporations-indian-tribes-a-multimillion-dollar-question/ descibes an area where the distinction between tribe and corporation is murky.

- Native Village Corporations are not a subset of the Native Regional Corporations. They are a separate type of entity.

8.4 Legislative Districts

- A Senate election district is composed of two contiguous house districts, if possible.
- Districts are redefined every 10 years after the federal census, and may change itermittantly due to court challenges.
- HouseDistricts can contain multiple Communities.
- A single Community might intersect several HouseDistricts (example: Fairbanks)

    – Therefore: HouseDistrict population cannot be determined from a sum of Community populations.

8.5 Boroughs

- Communities can be unencorporated, meaning they are not in a Borough.
- If encorporated, a Community can only be in a single Borough
- There is one unencorporated Borough

    – The unencorporated Borough is split into CensusAreas for statistical purposes (not administrative)

8.6 Census

- Census blocks are not permanent through the decades. If a block is split, a suffix is added to the block number.
- Census blocks are not required to have population. They could be water-only.
- Census blocks nest within a census tract.
- Census tracks nest within state
- Census tracks nest within county, or the statistical equivalents of counties
- The optimum population of a census track is 4000 and the size is adjusted to accomplish that
- Census tracts occasionally are split due to population growth or merged as a result of substantial population decline.

- A Census Designated Place (CDP) can be located in more than one county (does that mean they might be in multiple census tracts?)
- A CDP cannot cross state boundaries.
- A CDP has a name that is different from adjacent places, but is not unique and can change.

8.7 Zip Codes (Optional)

- A ZipCode can contain multiple Communities, especially in rural areas.
- A single Community can contain multiple ZipCodes, especially in urban areas.

9 Energy-Related

9.1 Grid

- Is a physical structure that supplies electricity to Communities

  - A Grid has the physical entities of PowerStations and PowerLines

- If isolated, is called a microgrid (check this)
- Can be composed of multiple Grids connected by interties

  - Interies are established on particular dates, so Grid definition can change over time

- A Grid generates power to supply a load.

9.2 Utility

- A Utility can operate a single Grid (KEA)
- A Utility can operate multiple Grids (AVEC or AP&T)
- A Utility can operate a subset of a Grid. In other words, a Grid could be operated by multiple Utilities

  - The Railbelt is serviced by 5 different utilities: Golden Valley Electric Association (GVEA), Matanuska Electric Association (MEA), Chugach Electric Association (CEA), Homer Electric Association (HEA), and the City of Seward Electric System (SES).

- Anchorage Municipal Light & Power (ML&P) used to make that 6, but they were absorbed by CEA
- Utility service areas are regulated by the RCA so they do not overlap.
- Utility service areas are measured in the Public Land Survey System (PLSS) - township, range, and section.
- Utility service areas are documented by the RCA with PDF maps. KML also?

  - CPCN 17: Kotzebue Electric Association, Inc.

9.3 IPP

- A Tribal Independent Power Producer (IPP) can develop and own renewable energy assets
- A local utility can buy renewable energy power from the Tribal IPP
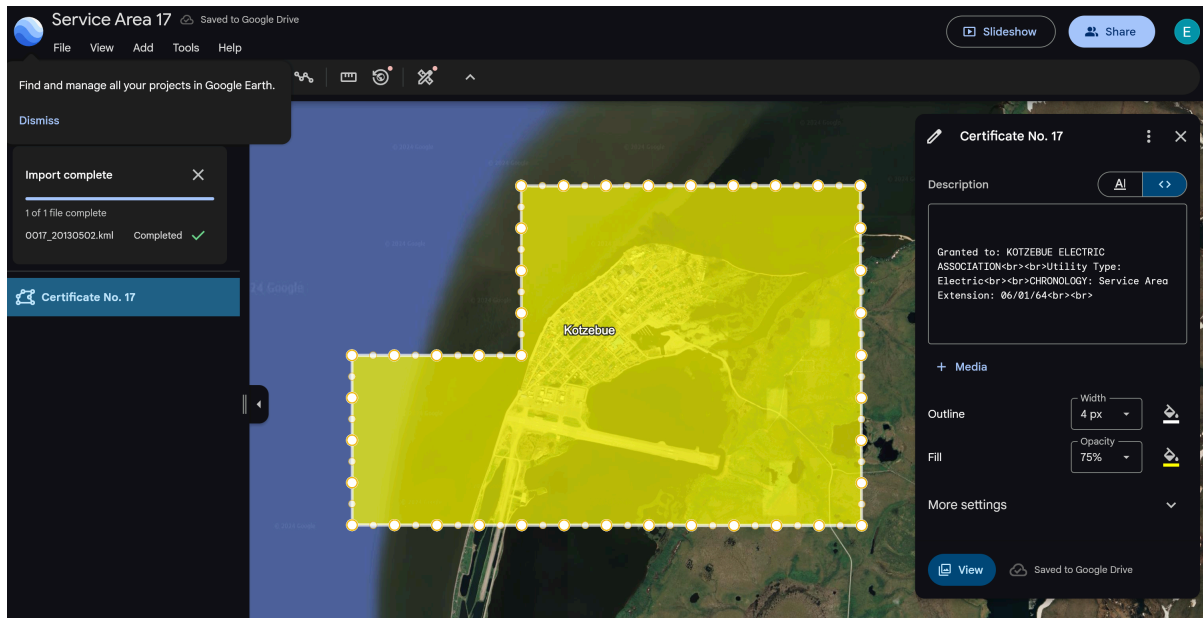- The cost of that power becomes a fuel cost that is an eligible PCE expense

Figure 9.1: KEA in Google Earth

A About

This respository exists to support development of the Alaska Energy Data Gateway by the Alaska Center for Energy and Power (ACEP), UAF, and the Institute for Social and Economic Research (ISER), UAA. It does not exist to be its own thing. If it ceases to be applicable to the AEDG project, it should be archived.