

Re-imagining Energy on the Colville Reservation

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Abstract

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Many abstract organizations and institutions influence our everyday behavior in modern life, making us less dependent and accountable to each other, and making it much more difficult for us to realize our collective goals. The lack of interaction between neighbors in the United States is a reflection of modernity's tendencies towards isolation and is emptying communities of meaning. We need a catalyst that empowers local communities by strengthening our interdependence and collaboration with each other. This thesis urges that we must take cues from the Danish Ecovillages to bring neighbors together spatially and socially in order to strengthen local communities through interdependence and collaboration. A framework for developing a community centered around shared energy production as a catalyst for increased collaboration is proposed. This framework is then applied to two hypothetical communities on the Colville Reservation in Eastern Washington.

This thesis is best viewed as a two-paged spread.

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CHAPTER 1

INTRODUCTION

1.1 PROBLEM STATEMENT

“The general lack of norms in society is increasing the demand for basic values, including architectural forms of expression, that correspond to our cultural experiences”.

– Ole Michael Jensen

Our direct reliance on our neighbors and communities has decreased in modern life. Unlike pre-modern societies, we only need superficial relationships to survive. Our decreased reliance and collaboration with our neighbors is deteriorating communities of cultural meaning. How can a community reinforce a sense of place if people do not collaborate in the same locale? This is causing two distinct, but connected, problems. The first problem is that identity is no longer tied to cultural experiences. The second problem is without strong relationships in daily life, it is difficult to realize collective goals.

This thesis urges that we must take cues from the Danish Ecovillages to bring neighbors together spatially and socially in order to strengthen local communities through interdependence and collaboration.

1.2 BACKGROUND

The Ecovillage movement began in the 1980s in Denmark and grew from the co-housing movement [1]. These communities vary in size and context, but households typically have separate incomes and maintain their private lives while collectively participating in community activities [2]. Like co-housing, most families in ecovillage communities have their own private units with bedrooms, kitchens, and baths, and also share a common building with a shared kitchen, dining, laundry facilities, meeting, and working spaces. These communities also cooperatively own land that is used for agricultural production, waste-water treatment, production of energy, or recreation.

The author of the current paper visited Denmark and saw firsthand how even the resident's most mundane everyday practices were full of intention. For example, imagine turning the lights on in your home. Does this act have any cultural significance to you? In an Ecovillage, using electricity has a lot of significance, because of their shared energy production and common values of reducing consumption. Several communities joked about how the households with the most teenagers would use the most electricity, and one Ecovillage was worried about their large population of girls that were soon to be teenagers.

Ecovillage residents come together to answer the question – How can we live a life that we imagine together? Their shared values were realized through their collective action and through the expectations they set on themselves and their neighbors.

1.3 CLAIM

This thesis argues that many abstract organizations and institutions influence our everyday behavior in modern life, making us less dependent and accountable to each other, and making it much more difficult for us to realize our collective goals. What we need is a catalyst that empowers local communities by strengthening our interdependence and collaboration with each other.

Michel Jensen said Ecovillages were intentionally unintentional [3], which means that it doesn't really matter what values brought them together, the important thing was that they were together. This project proposes a framework for how shared energy production could be used to catalyze a new way of life for communities, and will apply this framework to the Colville Reservation in Eastern Washington.



Figure 1. Old barn house re-imagined into housing community.

CHAPTER 2

THEORETICAL FRAMEWORK

2.1 THE PROBLEM WITH MODERNITY

Why don't people cooperate when it is in their best interest? For decades we have known that carbon dioxide and other greenhouse gas emissions are the primary cause of global warming [4]. Among a multitude of devastating results, global warming has accelerated the rate of species extinction, deteriorated the ocean ecosystem, increased the rate of wildfires, and has caused the sea-level to rise partially due to melting ice-sheets and glaciers [5][6][7]. And yet, we still go about our daily lives.

Modern life is full of these situations. We are knowledgeable of serious problems in our society, but not enough people have an incentive to do anything about it. In sociology, this type of problem was first addressed in the 1960s by Mancur Olson who described the phenomenon as the Collective Action Problem [8]. A Collective Action Problem occurs when it is difficult to share the costs associated with fixing a collective problem. A solution to the Collective Action Problem is collaboration and mutual agreements that assure costs will be shared.

Ecovillage residents come together to answer the question – “How can we live a life we imagine together?”. By living together social and spatially, the burden of their way of life is shared between the whole community, which allows them to realize their collective goals. The following chapter demonstrates how ways of life have shifted so that collective action is very difficult, ending with a proposition for how this can be solved with inspiration from Danish Ecovillages.

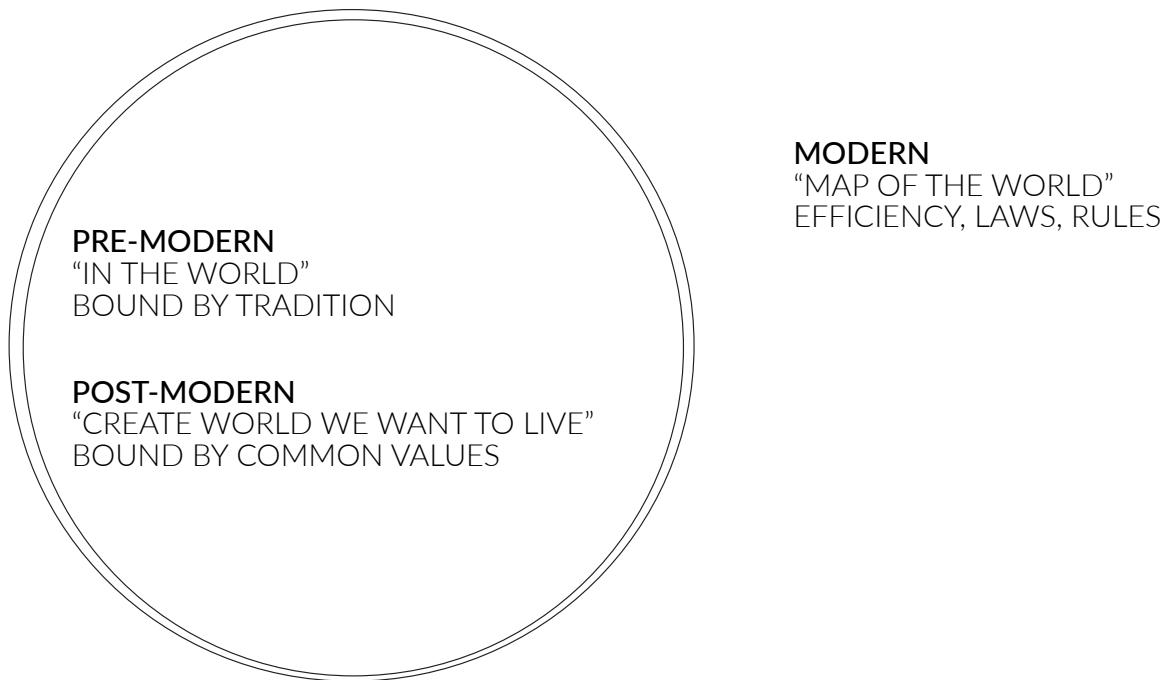


Figure 2. Modes of behavior that influence everyday life

MODES OF BEHAVIOR IN MODERN LIFE

The sociologist Ferdinand Tonnies' dual concept of *Gemeinschaft* and *Gessellshaft* demonstrates the shift from a way of life dependent on interpersonal relations to one dominated by institutions and organizations. *Gemeinschaft*, translated to community, is a way of life that was dominant in pre-industrial societies. The way people lived and understood the world was bound to locality and referred to traditions and customs. There was a high degree of interdependence, and everyone's role was understood. Social norms, gossip, and customs monitored people's behavior in a *Gemeinschaft*. A *Gessellshaft*, translated to society, on the other hand, maps a vision for human behavior guided by information. In a *Gessellshaft*, corporations, governments, and other institutions govern behavior through rules, regulations, and advertising. People aren't bound together by necessity and can express themselves more individually. Contemporary life is influenced by both forces, one which is rooted in locality and interpersonal relations and another which

creates a framework for human living guided by information [3].

Ecovillages demonstrate another mode of behavior, and are part of a grassroots movement, meaning they engage with people and local ecology on a small scale. Michael Jensen describes them as post-modern, in the sense that they are “self-aware” [3]. They intentionally create the world they want to live, and unlike pre-modern societies, they are bound by common values. Figure 1 demonstrates the modes of behavior that effect our lives. Pre-modern and post-modern modes are similar, in that they understand the world from the “inside”, or through personal interactions. The modern approach, instead, maps human behavior from the outside, guided by information and regulated by institutions. All three modes exist to varying degrees in our lives.

JUGGERNAUNT OF MODERN SOCIETY

Ecovillages form as a reaction against traditional housing options [9]. Anthony Giddens’s “juggernaut” analogy illustrates why Ecovillages set themselves apart from mainstream society. Giddens argues that the modern era is a “juggernaut”, a dynamic, unpredictable, and de-humanizing machine [10]. Giddens believes disembedding is one of the reasons modernity has become so chaotic. Disembedding is the “‘lifting out’ of social relations from local context of interaction and their restructuring across indefinite spans of time-space” [10], similar to the shift between *Gemeinschaft* to *Gesellschaft*. Money is one of the factors that causes disembedding, because it creates a very abstract exchange of human effort that can span space and time. Giddens argues that “expert systems” or systems of “professional expertise that organize large areas of the material and social environments” are also causing disembedding [10]. These “expert systems” create products and organizations of behavior that is applied across time and space. Gram-Hanssen describes that disembedding explains “how local communities are emptied of substance and strong social relations are replaced by abstract organizations” [11].

Another factor, reflexivity, also creates chaos in modernity. Reflexivity is a product of the scientific process, and is the notion that everything is under scrutiny in the modern world. Anthony Giddens explains “social practices are constantly examined and reformed in the light of incoming information about those very practices” [10], which can create an alarming amount of uncertainty and insecurity. Self-identity is also treated in this way. The individual is pressured to choose how to fit in an ever-changing modern society, as opposed to a *Gemeinschaft*, where identity is tied to community. Developing an identity in a modern society can be dehumanizing, since disembedding creates a society that is not a reflection of locally held cultures and beliefs.

PROBLEM WITH MODERNITY: EXAMPLE OF ECOLOGICAL CRISIS

In response to the ecological crisis, the concept of ecological modernization theory emerged in the 1980s. The economist Joseph Huber initially introduced the concept to describe the mutual benefit that occurs between economic growth and ecological practice [11][12]. Ecological modernization is a *Gesellschaft's* answer to the environmental crisis. It is not tied to locality, but is used to address problems in a “top-down” fashion. Despite ecological modernization playing a large role in shaping government’s and institution’s response to the ecological crisis, there is much criticisms about its capitalistic orientation, since growth and profit are the ultimate incentive [13]. Although government and other institutional agencies worldwide show awareness of the ecological crisis and impacts of carbon dioxide emissions, there is very little policy being implemented to address these problems [14][15].

In the United States, residential energy use accounts for 21% of total energy consumption and 20% of carbon dioxide emissions [16]. Despite efforts in reducing consumption with better insulated buildings and more efficient appliances, energy use in the residential sector has not decreased significantly since the 1980s, and homes are still

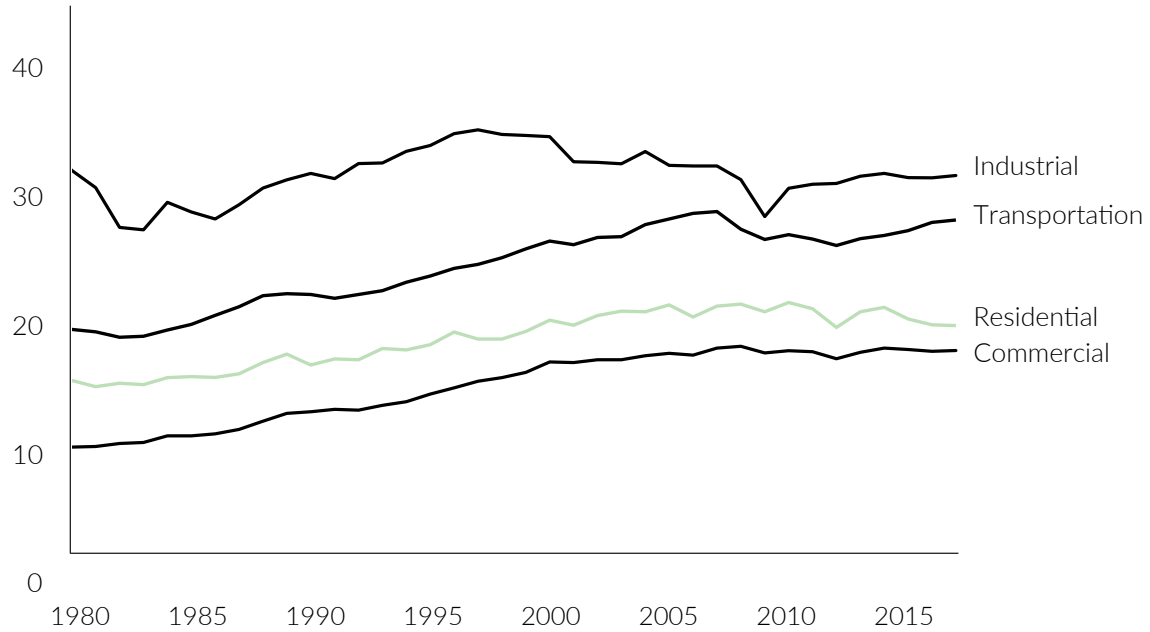


Figure 3. Energy Consumption in US (Quadrillion Btu)

being heated predominantly with burning of fossil fuels.

Similarly in Denmark, government regulation and policy has driven energy efficiency standards in homes [12][1], following a model of ecological modernization. The Danish Building Regulations have pushed for energy savings since the early 1980s, resulting in much better performing building envelopes [1]. While buildings and residential appliances are becoming more energy efficient due to ecological modernization, other societal forces, such as consumerism and cultural perceptions of quality of life are negating energy savings [17].

Regulating everyday practices that consume energy is difficult with ecological modernization. For example, a Danish study found that when comparing the heat load in homes of identical envelope and heating system, households using the least heat use a third less than the top users [17]. User behavior can also have a large impact on plug load consumption. The same study found that despite the fact that appliances are becoming more energy efficient, households now own and use more appliances, offsetting the impacts of more efficient technology [17]. Electricity use was also found to decrease per

person as the number of inhabitants in a household increased. Several socio-technical studies on heat-pump equipment demonstrate that the energy efficiency of heating technologies is offset partially by a change in occupant behavior [18][19]. Cheaper heating costs due to heat-pumps results in increased use for greater thermal comfort, with previous research describing a direct rebound effect of 20% in households [18].

Living with less density, using more appliances, and expecting higher thermal comfort are examples of social practice trends that cannot be easily addressed by ecological modernization. In fact, Princen argues that society's top-down approach to lowering carbon dioxide emissions through efficiency are not the solution to the ecological crisis, because it "help(s) key actors disguise, displace, and postpone true costs" [20]. Instead, a reassessment of everyday human behavior is necessary to truly influence the ecological crisis, with social restraint as the key driver [20].

CHOOSE COMMUNITY

Modernity has given us the blessing and the curse of being able to choose our own identities. With our daily lives increasingly being less dependent on interpersonal collaboration, it is difficult for us to realize our collective goals. Modern life has started to create soulless communities, devoid of shared cultural experiences. Fortunately, there is another path that we could choose. We could choose to intentionally engage with the social structure that effects our behavior to answer the question of "Who are we?"

2.1 THE DANISH ECOVILLAGE SOLUTION

Ecovillage residents solve the Collective Action Problem by coming together as a community and changing their everyday practicalities to solve the pressing issues in their lives. The author of the current study visited ten Danish Ecovillages during Fall 2017 to study how everyday practices and architecture resulted in reduced energy consumption in the Ecovillages. The Ecovillages visited are shown in Figure 4. Site visit durations ranged from several hours to two days. Information about the communities were obtained through interviews with the residents, guided tours, and site analysis (photographs, sketching, etc). The following chapter summarizes the findings.

RESEARCH FRAMEWORK

The research framework that was used to study energy use in Danish Ecovillages is shown in Figure 5. Ecovillage residents were observed to intentionally engage and design the elements of their social structure that shape their lives, which answers the question of “Who are we?”. Their intentional social structure would then become manifest in their every practices, answering the question of “How do we live?”.

Elements of the social structure that Ecovillages engage with are architecture, common values, and social norms. Common values are the moral beliefs that unite ecovillage residents and set them apart from mainstream housing. As a form of Giddens’ remoralization, common values catalyze notions of social obligation and expectations. They are the mission of the community, but can be reflexively changed by new information and understandings from mainstream society.

While common values are the morals that unite ecovillage residents, architecture and social norms are used to shape behavior to align with values. Unlike a *Gemeinschaft*, these ways of living are not bound by tradition, but are informed by both mainstream

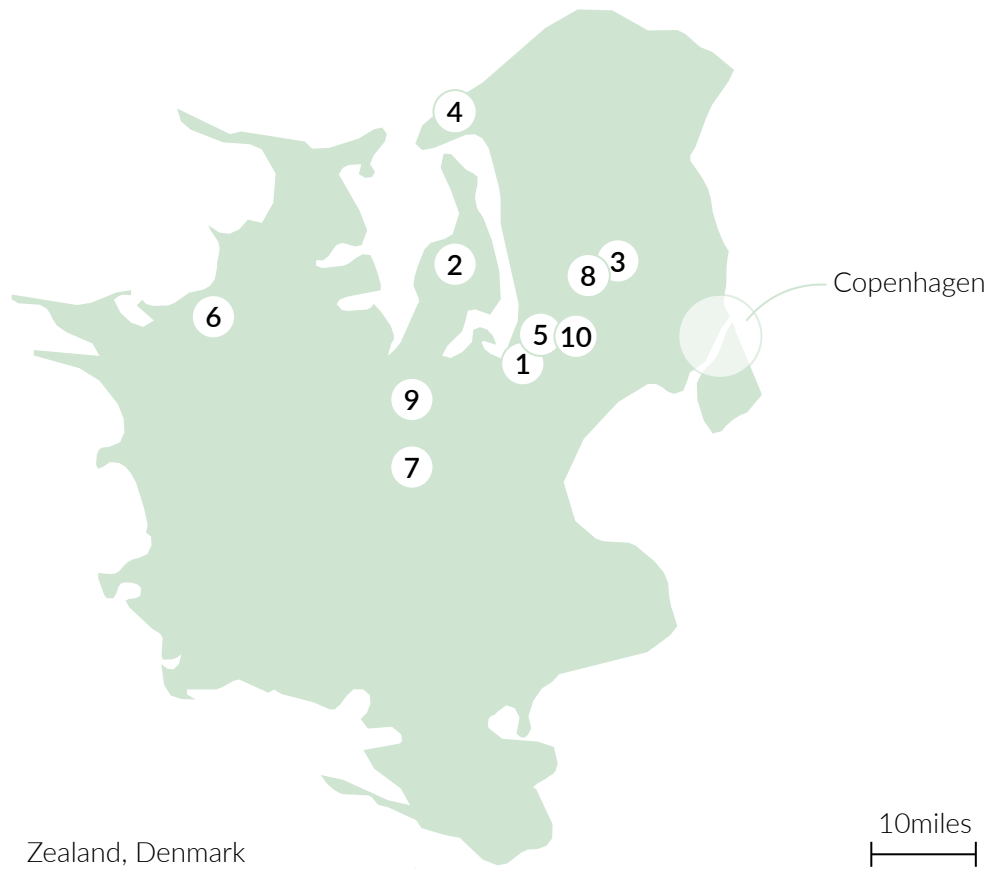


Figure 4. Ecovillages included in study

society and the common values of the residents. This study acknowledges that many of the everyday practices of the ecovillages residents are similar to residents of traditional housing models. The intentional departures in architecture and social norms of the ecovillage residents that abide to the common values of the community were assessed in order to understand differences in energy consumption.

COMMON VALUES

Remoralization played a large role in establishing the common values of ecovillage communities. Despite the various architectural forms and social norms observed in the ecovillages, when asked why they decided to live in an ecovillage, all interviewees

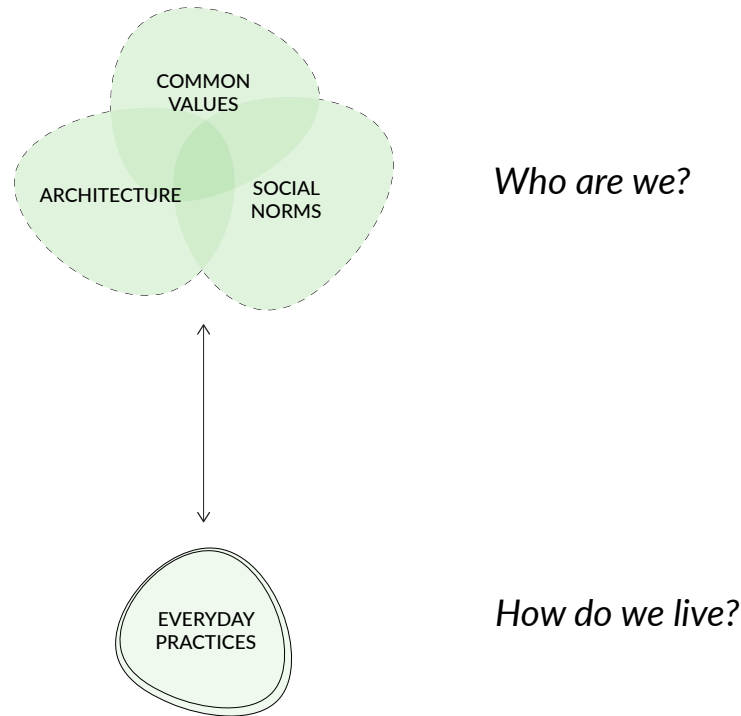


Figure 5. Dialectic relationship between social structures (architecture, common values, and social norms) and everyday practices is shown in this diagram.

responded with “I wanted to live differently”. There was a sense that mainstream housing was not fulfilling certain moral needs. In describing the mission of their communities, residents would repeat the same three general common values: collective living, self-reliance, and benefiting greater society. Some residents acknowledged all of these common values when asked to describe their communities.

When values do not align within a community, contradictions in expectations may leave some residents feeling unsatisfied. A resident of Dyssekilde explained how a weakened mission may deter communities from achieving higher levels of sustainability. *“Of course, everyone is interested in ecology, but on different levels... Progress may not be as quick as in other places, because it depends on the people moving in and people have different expectations”*

Common values informed the architecture and social norms related to energy use. But these things shape values. Social norms and architecture could affect common values

“I wanted to live differently”

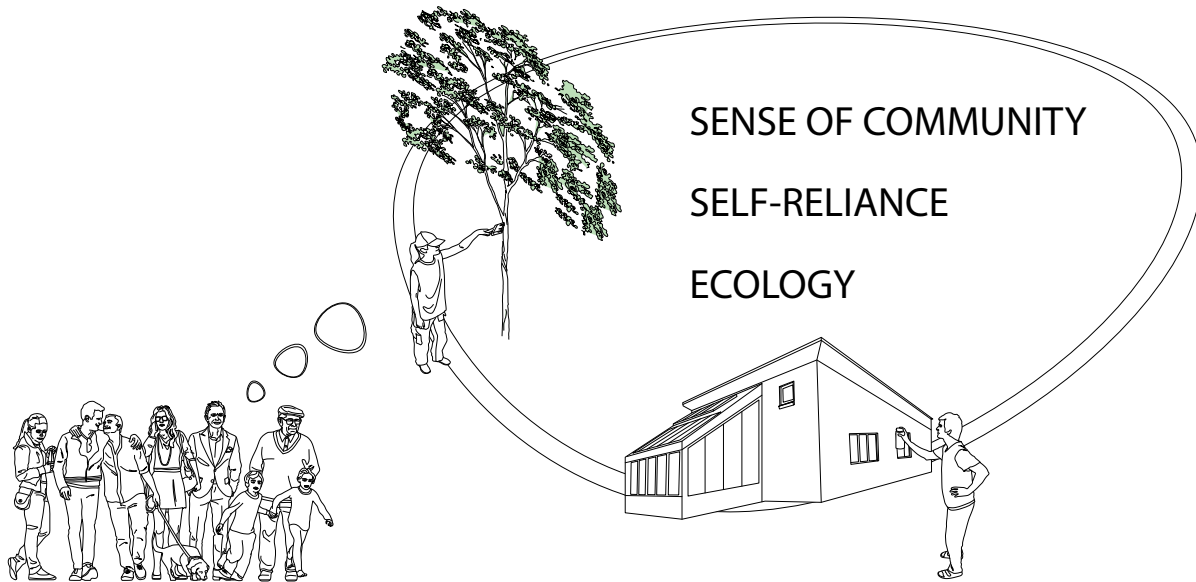


Figure 6. Common values unite Ecovillage residents and set them apart from modern society

as well. In all communities, reduction in energy consumption, and particularly energy produced by burning of fossil fuels, was viewed as a strong moral obligation that would benefit society and aide the environmental crisis. Common values of lowering energy consumption, along with collective living and self-reliance, set the identity of communities, answering the question “who are we?”. The architecture and social norms that will be discussed following sections tangibly reflect everyday practices, answering the question “how do we live?”.

ARCHITECTURE

Ecovillages show great variety in their architectural expressions, which correlate to different everyday practices associated with energy use. Three different architectural typologies were observed and categorized by the authors of the current study: retrofit,

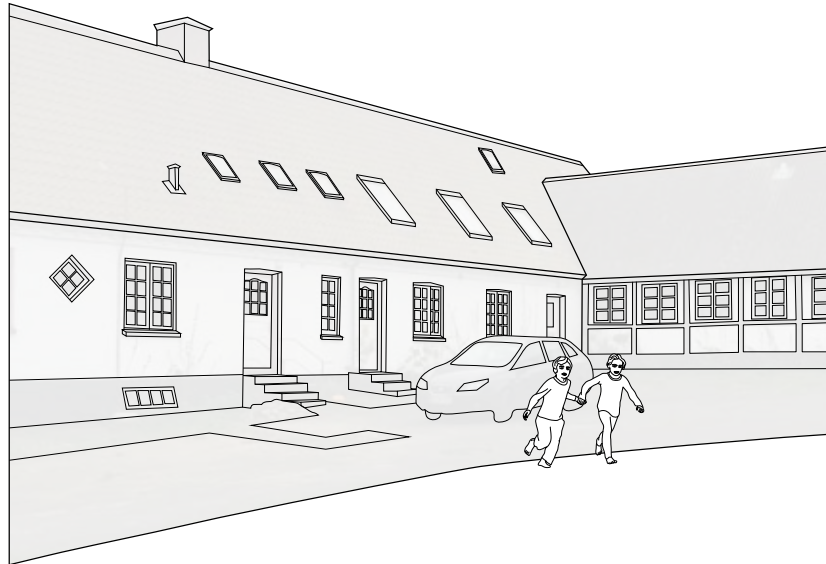


Figure 7. Retrofit ecovillages renovate existing buildings.

standalone, and joint development. The variation of architectural typologies was largely due to circumstantial factors such as location, finances of founding group, regulations of local municipalities, and the history of the community.

Retrofit Ecovillage

Retrofit ecovillages are renovated existing buildings that were converted to ecovillages. These buildings are re-purposed to reflect the community's common values and way of living. They are renovated to provide independent units for families, and have shared spaces for communal cooking, dining, clothes washing and storage, etc. They are poorly insulated buildings, and the residents constantly need to work on the buildings for better insulation and general maintenance. Tranehøj is in an old farm building complex renovated in 1984 that was initially built in 1822. The residents have improved insulation through various interventions, including adding paper wool to the air gap between the brick wall cavity, adding layers of rockwool insulation to the inside face of the walls, and



Figure 8. Tranehøj is an example of a retrofit Ecovillage (top). There is shared energy production (middle left). Each family has private units, accessed by shared hall (middle right). There are shared amenity spaces, like dining (bottom left) and shared kitchen (bottom right).

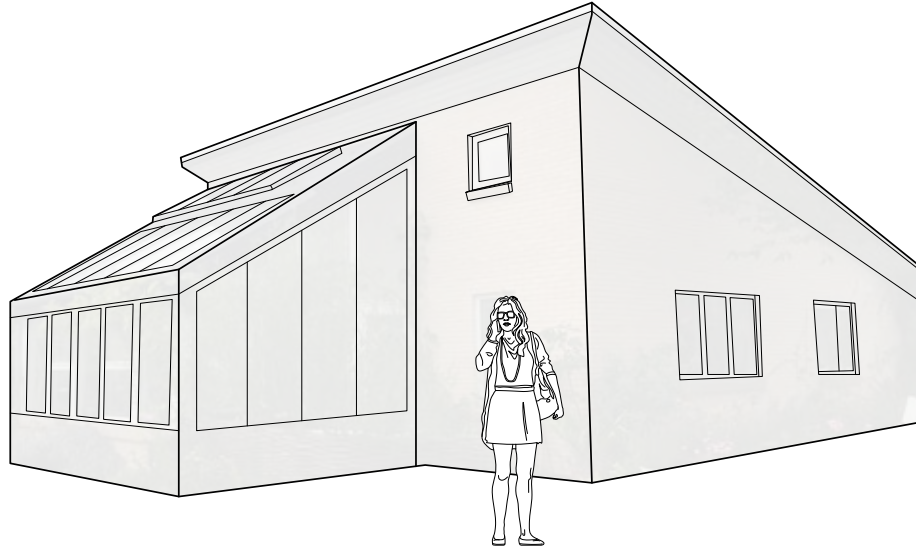


Figure 9. New standalone ecovillages are communities with experimental houses designed by owner or architect.

adding insulation to roof. The floor is not insulated, however. Renovations and upkeep in retrofit ecovillages is a continuous task, which requires constant engagement from the community. In both communities, there are communally produced sources of energy, and individual units are not metered separately.

New-Standalone Ecovillage

Standalone ecovillages are communities with experimental houses designed by a resident or an architect. The site plan expresses common values, but the owners decides how to design their own house in accordance with the mission of the community. Each owner owns their own parcel, but the community shares a common house and common amenities. Dyssekilde is a standalone Ecovillage that was established in 1989, and construction on the last parcels is still ongoing. There are seven housing groups, 60 houses already built, and 130 adults and 60 children presently living there. The site plan was intentionally designed so that individual parcels are oriented towards the south to provide



Figure 10. The parcels in Dyssekilde were arranged to allow auxiliary heating from sun (top). There are many communal paths (middle left) that connect various individual houses (middle right & bottom right). The common house is a place for gathering (bottom left).



Figure 11. New joint development Ecovillages are cohesive communities built at once. They are typically designed by an architect.

auxiliary heating from sun (Figure 3a). The community owns a windmill that produces three times the amount of electricity than the community consumes. Most houses are heated individually by wood pellets, heat pumps, or solar water heaters (Figure 3bc). The housing group shown in Figure 3d is heated by a geothermal heat pump system that is shared by all seven houses. The facades are made of wood, with cellulose paper insulation, and high-performance windows.

New-Joint Development Ecovillage

Joint Development ecovillages are cohesive communities built at once. An architect typically designs these communities, with input from the founding group. Munksøgård is an example of a joint development ecovillage. It was established in 2000, with five housing groups of 20 homes. Each housing group has different ownership structure and resident types. The owners, seniors, young adults, families, and collectively owned groups are arranged in a circular cluster with their own common houses (Figure 4a). The



Figure 12. Munksøgård was built with five housing groups that have their own common house (top). They have a shared biomass boiler for heating (middle left). They also have solar panels for electricity (middle right). Their common spaces include a common house for shared dining (bottom left) and agriculture spaces (bottom right).

private residences are wooden row-houses that exceeded building codes at the time they were built, with dividing walls made of non-burned compressed soil bricks. The walls have paper-based insulation, but over the years it was discovered that the basements are not insulated well. The buildings are heated by a central wood burning plant owned by the community (Figure 4), with auxiliary heating coming from solar water heaters. The community also jointly owns solar panels located on the roofs of the row-houses. The common house for the owner group is shown in Figure 4, and is made of straw bale construction. The common house has a shared kitchen, dining, laundry, freezers, and storage.

SOCIAL NORMS

Social norms are the cultural expectations that shape social behavior and everyday practices. The Ecovillages observed in this study intentionally designed their social norms to effect their everyday practices associated with the morals of the community. The major social norms observed were: participation in common meals, obligation to reduce energy consumption, and involvement in larger community.

Common Meals

Regular common meals are important community building practices that were present in all ecovillages. There were more common meals per week (three to six per week) observed in the retrofit and joint development ecovillages than in the standalone ecovillages (one to three per week). Many community members believed that the common meals were an important factor in reducing waste and energy consumption. Cooking in bulk minimizes waste, and cooking for many people at once increases the energy efficiency of the meal. While having people gathered at the same place at once could save on electricity.

Community Effort in Reducing Energy Consumption

All communities made a conscious effort to reduce energy consumption. One resident from a joint development stated the importance of this communal effort:

“I believe just being conscious about energy use, and discussing it as a community, makes the most difference”.

All Ecovillage communities share facilities for laundry and have areas for hang drying clothes. Many communities also share freezers and have common storage areas. Apart from sharing resources that consume energy, residents also monitor energy use and make a conscious effort to reduce their own electricity consumption. Residents make lifestyle choices to reduce energy use such as turning off standby devices, turning off lights, and taking short showers.

Involvement in Larger Community

There was a sense of obligation and duty related to supporting local towns and greater society in the Ecovillage communities. Two communities had opened elementary schools in their local towns. Tranehøj is a contact for refugees moving to their local town, and even has garden space for the refugees. Many of the communities have electric car sharing programs that is open to members of the local town. Outreach was seen as important in all Ecovillage communities. The Ecovillages increase awareness of their lifestyle by regularly attend conferences and hosting tours of their communities. Many communities host regular events that are open to residents of the local towns.

EVERYDAY PRACTICES

The everyday practices of the Ecovillage residents are the manifestations of the intentional built environment, common values, and social norms developed by the community. These everyday practices were integral to the identity of the Ecovillages. Table 1 documents common everyday practices of the residents with a corresponding design intervention. Since there is a dialectic relationship between social structure and every practice, these design interventions could establish a sense of community and embody dwelling.

Table 1. Design Interventions and Correlated Everyday Practices

<i>Design Intervention</i>	<i>Everyday Practice</i>
Communal Production of Energy	Collaboration on energy use
Shared parking areas Communal Paths Communal Production of Energy Meeting Spaces for Groups	Greater interaction with neighbors
Common Freezers Places to Hang Dry Clothes Communal Production of Energy	Less energy use
Common Kitchen and Dining	Shared meals
Shared storage structures	Share resources

ENERGY RESULTS

Energy data was recorded for Tranehøj, Dyssekilde, and Munksøgård. Heating load consumption and plug load were assessed separately, since heating load is largely dependent on building characteristics like heat transfer through building envelope, while plug load is associated with number of residents [9]. For heating load, the building baseline data represents buildings of similar type and year of construction. Data from the Danish Energy Agency for single family homes was used to compare plug load [21].

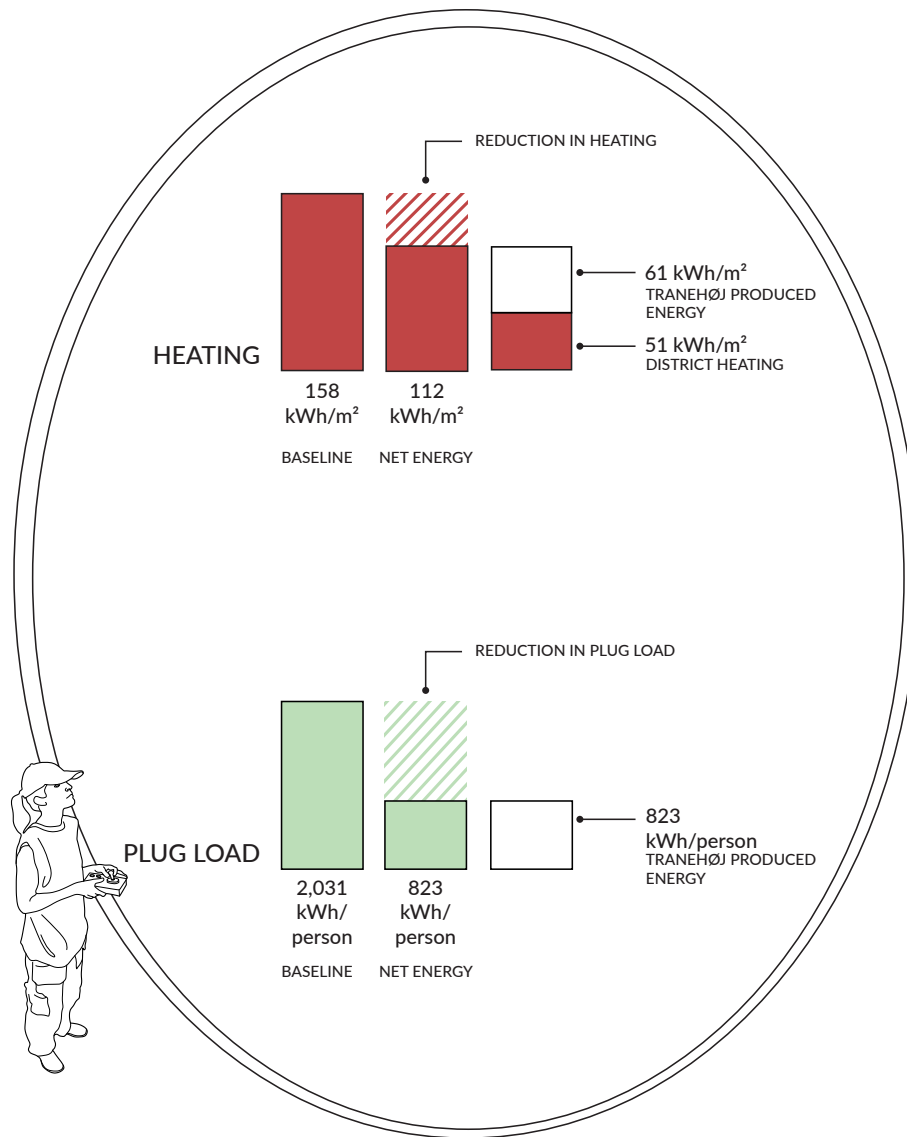


Figure 13. Heating and plug load energy use in Tranehøj in 2015

Reduction in Heating

All three ecovillages showed a reduction in energy consumption from baseline values. These reductions may be associated with everyday practices shared among all ecovillages of improving insulation and savings on heating laundry and storage rooms by bundling these spaces in the common houses. Reductions in heating was a less in Tranehøj, at 30% reduction, as opposed to Dyssekilde and Munksøgård, at 44% and 42% reduction respectively. This may be due to that fact that it is difficult to insulate retrofit

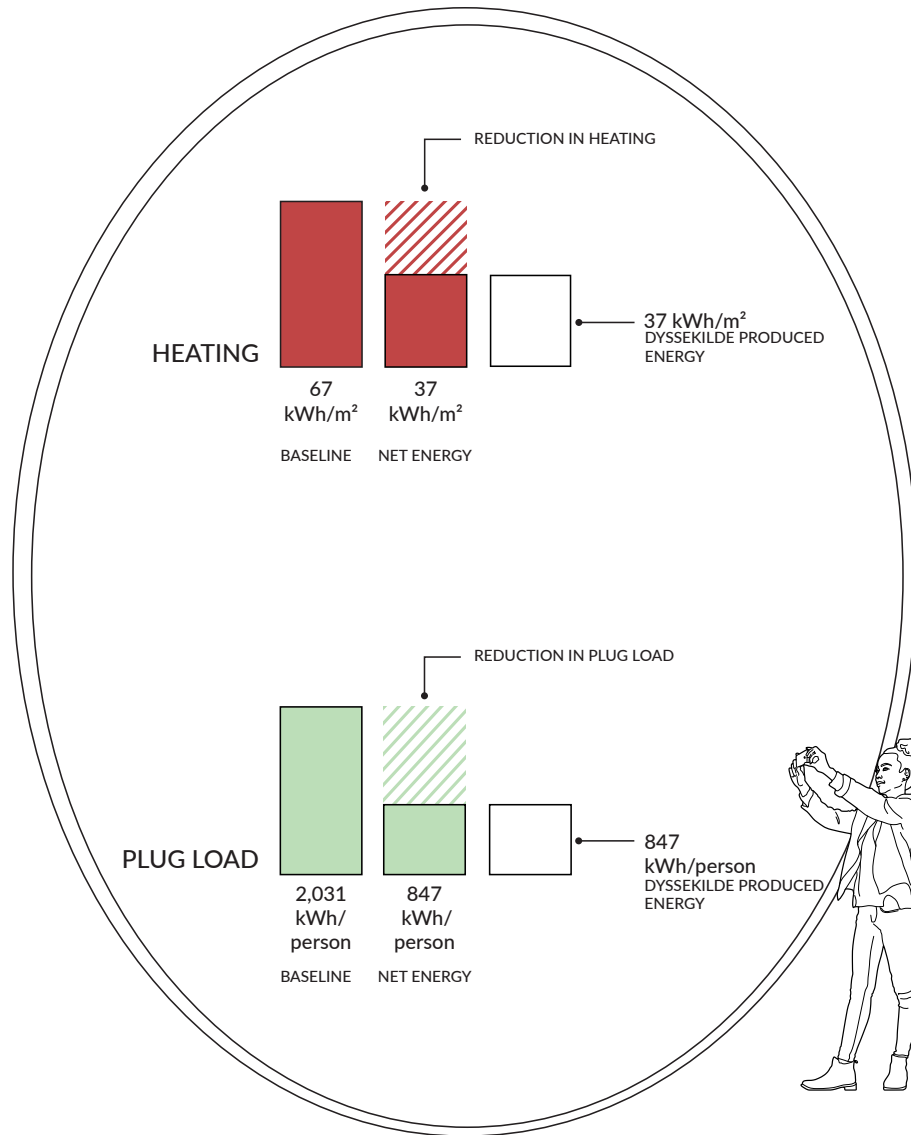


Figure 14. Heating and plug load energy use in Dyssekilde in 2015

ecovillages like Tranehøj, which still does not have insulation in the floor. Dyssekilde was design with passive solar strategies, with south facing windows, good insulation, and thermal mass, which has the potential to provide significant energy savings to heating [22]. This may account for why Dyssekilde showed the highest reduction in heating.

Reduction in Plug Load

All three ecovillages also showed significant reductions in plug load consumption,

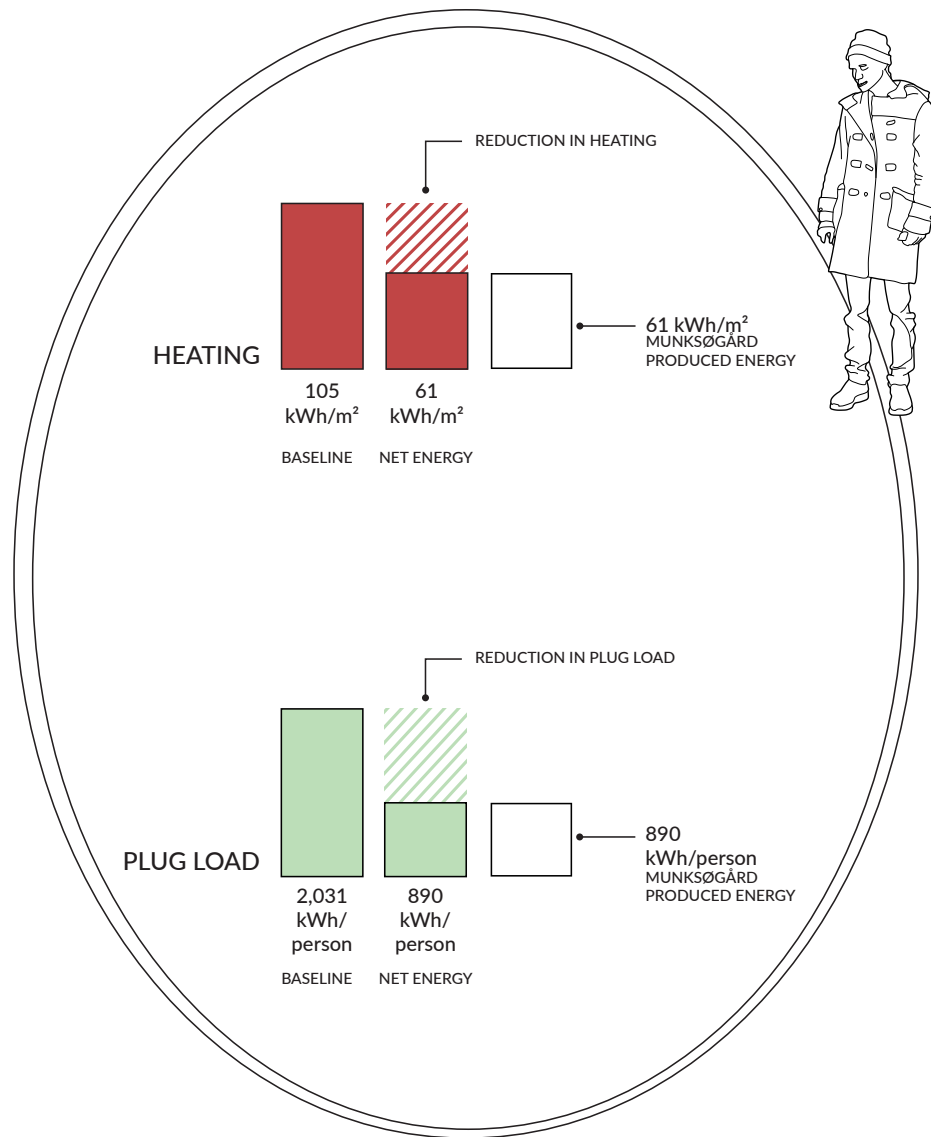


Figure 15. Heating and plug load energy use in Munksøgård in 2015

with all ecovillage showing a reduction of over 50% (Figure 5). Reduction in electricity could be attributed to a conscious effort to reduce electricity consumption by the residents. In Tranehøj and Munksøgård there are shared freezers that most of the residents use. In all of the ecovillages, there are shared laundry facilities, and most residents hang dry clothes their clothes. The regularity of communal dinners in Tranehøj and Munksøgård may also play a large role in reducing electricity consumption. The south facing windows in Dyssekilde may also contribute to less lighting load demand.

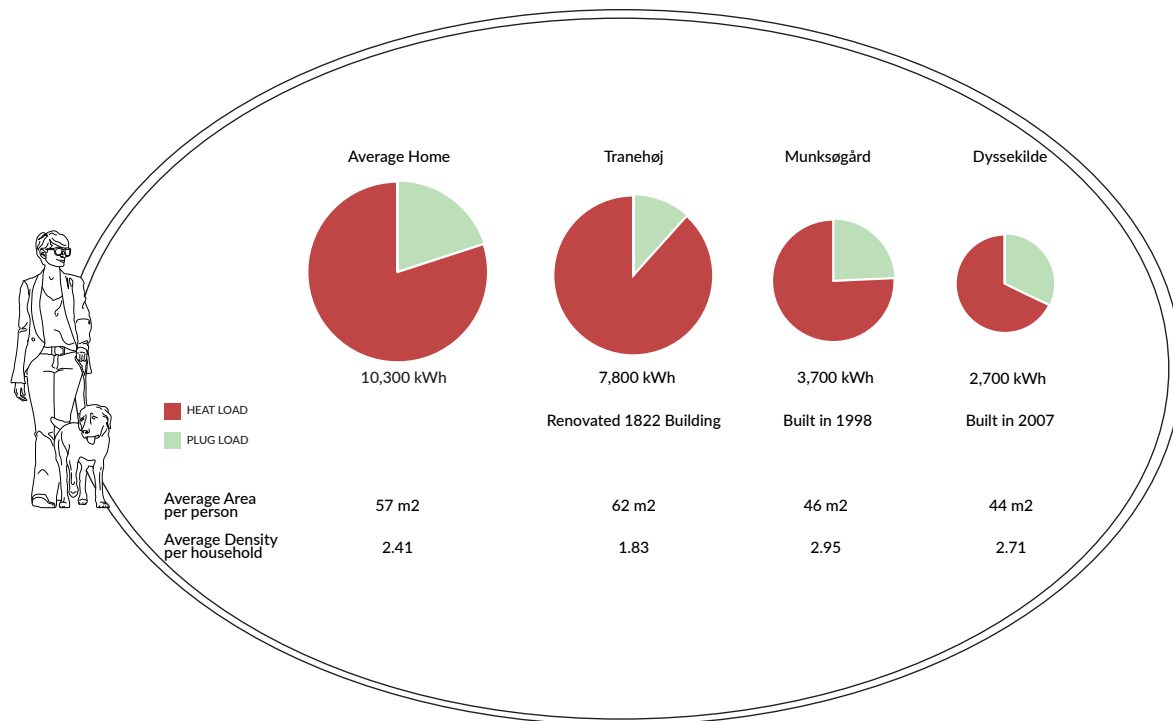


Figure 16. Energy use per person in all three Ecovillages compared with the national average consumption in Denmark.

Domestic Energy Per Person

Domestic energy consumption per person in Denmark compared with the Ecovillages is shown in Figure 6. All three ecovillages showed a reduction in energy use compared with the Danish national average. Year of construction was shown to play a large role in energy consumption for heating in the ecovillage. The heat load per person for the retrofit ecovillage was 89% of the total energy consumption, and is shown to decrease as year of construction increases. This suggests that as building envelope increases in efficiency, plug load starts to play a much more significant role in energy consumption.

HOW CAN THE ECOVILLAGE EXPERIENCE APPLY TO THE US?

These ecovillages were formed in response to unhappiness with conventional housing and the ecological crisis. The residents came together and intentionally decided

on who they are by defining what their values are, what their homes and communities are like, and what are their expectations are for each other. Their ideals were then manifest in how they live, which added meaning to their everyday practices.

I was very inspired by what I learned in Denmark, and started to think, how can this way of life apply to the US? I realized that communities needed a catalyst to reorganize ways of life that are rooted in shared values. Through my research, I realized housing communities centered around shared energy production could be used as a catalyst, because it brings people together spatially and socially. With shared energy production, people would need to collaborate on a common goal, and ways of life rooted in personal relationships and shared values would emerge.

2.2 CASE STUDY LOCATION: COLVILLE RESERVATION

COLVILLE RESERVATION

The Colville Reservation was an appropriate location for a case for many reasons. It is in rural Washington, and like other rural locations, there is a lack of diversity of employment and lack of employment in general. Poverty on the reservation is the highest in the State. The reservation is suffering from a disproportionate amount of alcoholism, domestic violence, and health problems than the rest of Washington State.

The Colville Reservation was established by executive order in 1872. Twelve tribal groups make up the reservation - the Colville, Wenatchi, Entiat, Chelan, Methow, Okangoan, Nespelem, San Poil, Lakes, Moses Columbia, Palus and Chief Joseph Nez Perce. There is a sense of community, but it is under threat with people needing to move away to find work [23].

The Colville Tribal Federal Corporation is the government and the largest employer on the reservation, with up to 1,500 employees depending on the season [23]. Their highest economic driver is timber harvesting. Energy use is one of the highest expenditures on the reservation. In a 2013 feasibility report, the reservation has expressed interest in becoming energy autonomous by purchasing the utility lines that run through the reservation [24]. The report concluded that it would not be economically feasible for the reservation to purchase and maintain the utility lines, but they still desire to be energy autonomous.

RECENT HISTORY OF THE COLVILLE RESERVATION

The natives living near and on the present-day reservation were nomadic people. Their way of life completely changed because of energy. When the Grand Coulee Dam

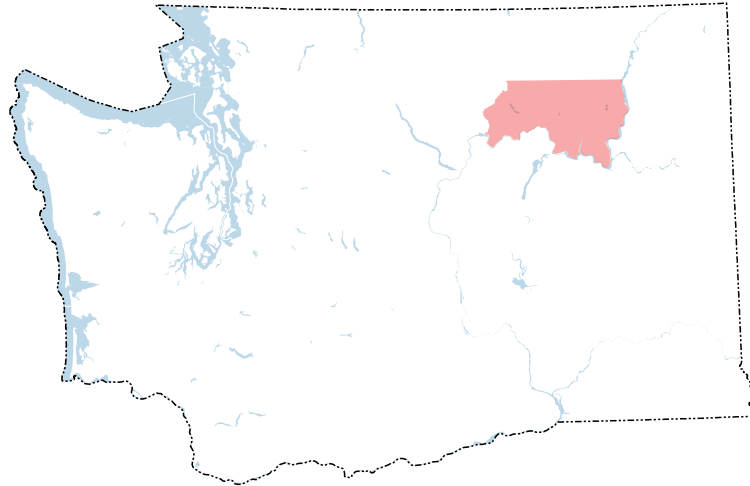


Figure 17. Colville Reservation is a 1.4 million acre reservation in Easter Washington State

was completed in 1942 at the southern tip of their reservation the good flat land on the reservation became flooded. Their fishing sites, root digging sites, traditional camping sites were destroyed by flooding. Since the Dam was built without a fish ladder, the salmon also disappeared, and with the disappearance of the salmon, their traditional economy and way of life was suddenly lost. The disappearance of the salmon on the upper Columbia is still a deep pain that is felt by the Colville people [25].

The author of the current study met with planning employees of the reservation to discuss the feasibility of a project like this. The reservation is interested in having the reservation become energy autonomous and is interested in the idea of developing communities centered around shared energy production.

CHAPTER 3

DESIGN FRAMEWORK

This thesis has developed a vision for what kind of community could emerge with shared energy production being the catalyzing idea with inspiration from Danish Ecovillages as precedent. Although this is a circular process, this chapter outlines a framework for establishing an intentional community in three steps.

The first step is studying the ecological and human systems on the site. The Ecovillages directly engaged and re-imagined these systems that define identity and impact behavior, so understanding these systems is imperative.

3.1 STEP ONE: STUDY SYSTEMS ON THE SITE

SYSTEMS ON THE COLVILLE RESERVATION

Natural Resources

The present-day reservation's legal boundaries are very defined by 49th parallel to the north and the Okanogan and Columbia River to the east, south and west [23]. This is despite the fact that all of the tribes forced on the reservation were nomadic people, whose territories extended far beyond the reservation. The west side of the reservation is very dry and arid characterized as steppe, while the east side gets more rainfall and is populated with dense coniferous forests. The trees are mostly Ponderosa Pine, Douglas Fir, Lodge Pole Pine, and Western Larch. Logging these trees is the main economic driver of the community.

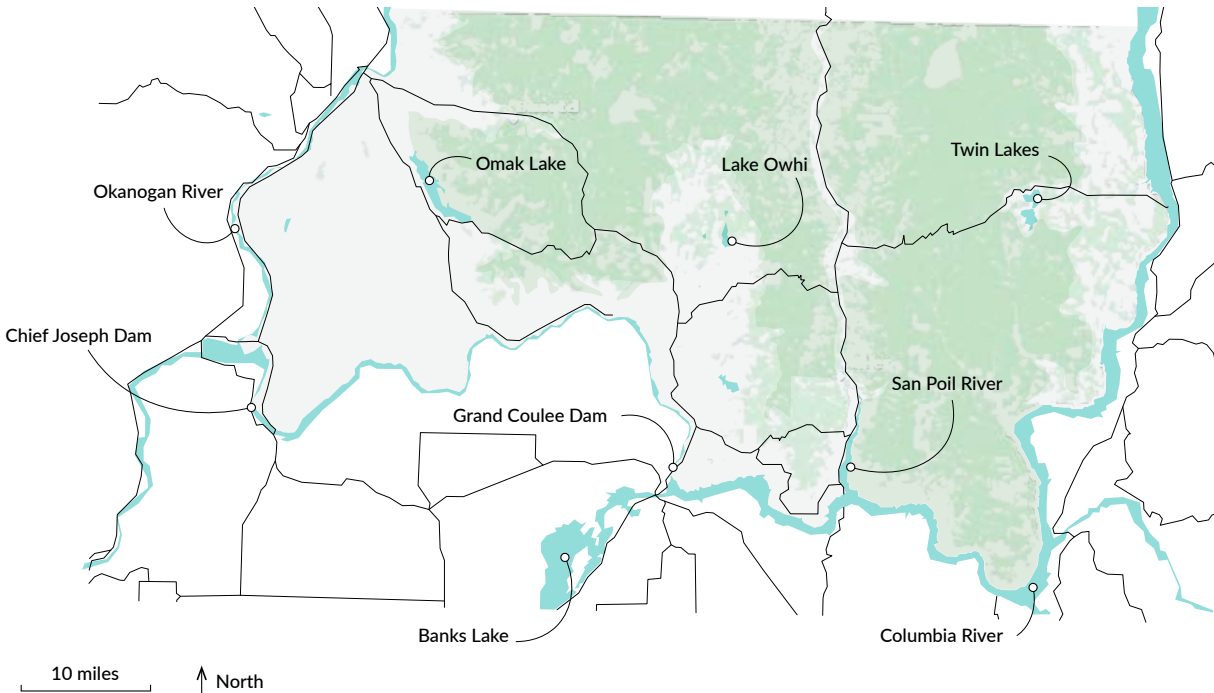


Figure 18. Natural and man-made landforms on the Colville Reservation.

Climate

Much of the climate on the reservation near population centers is described as semi-arid, with cold winters, hot summers, and very little precipitation [26]. Figure 18 shows the climate on Nespelem, located in the south west portion of the reservation. The psychrometric chart reveals that there are significant diurnal temperature swings between day and night, which indicates that thermal mass could be used for passive heating and cooling. Shading and cross ventilation could be appropriate cooling strategies in the summer time, along with night flushing of thermal mass. Since Nespelem enjoys many days of sunshine, auxiliary heating from the sun could significantly reducing heating required from mechanical equipment. According to MEEB, there is a potential savings in energy of 68% for heating compared with conventional housing if passive heating strategies like southern glass, thermal mass, and proper insulation are employed [27].

Table 2. Temperature, snowfall, and precipitation information for Nespelem, Wa

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	34.4	41.3	55.3	65.9	73.7	82.4	88.6	89.7	78.7	63.1	46.1	32.3	62.6
Average Min. Temperature (F)	23.2	25.2	32.3	38.6	46	53.8	57.6	57.8	47.6	37.6	32	22.1	39.5
Average Total Precipitation (in.)	1.03	0.96	1.27	0.74	1.13	1.16	0.74	0.5	0.49	0.54	1.78	1.47	11.8
Average Total SnowFall (in.)	3.2	2.4	0	0	0	0	0	0	0	0	3	6	14.6
Average Snow Depth (in.)	5	2	0	0	0	0	0	0	0	0	0	3	0.8

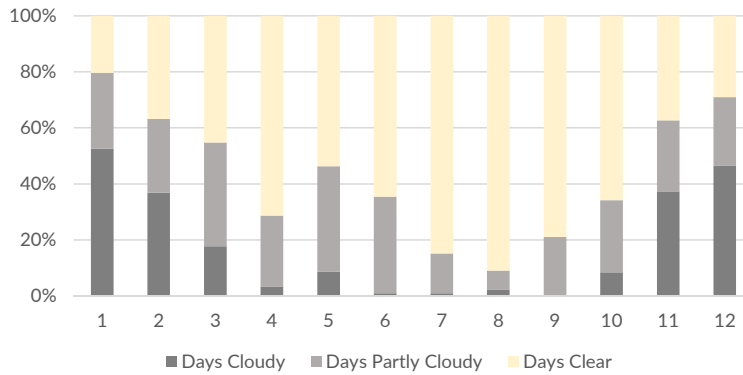


Figure 19. Cloud cover in Nespelem, WA

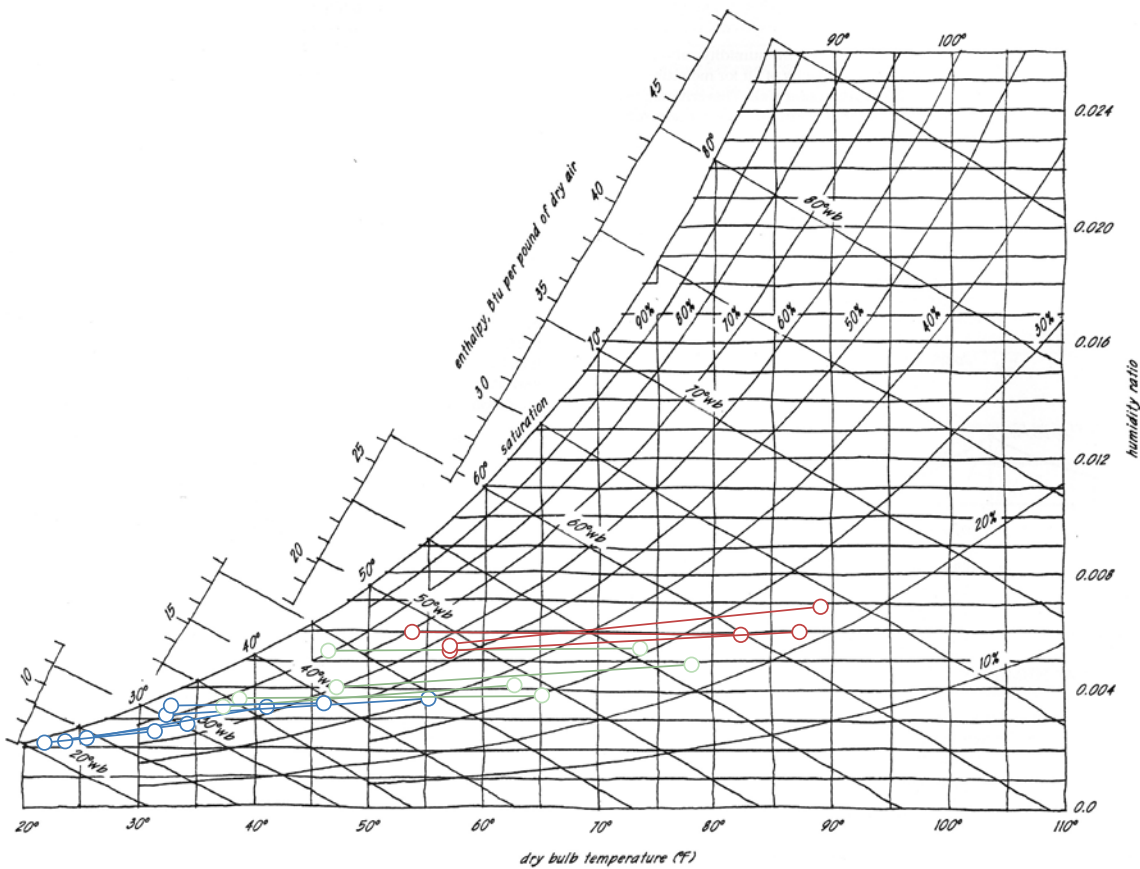


Figure 20. Psychrometric Chart for Nespelem, WA

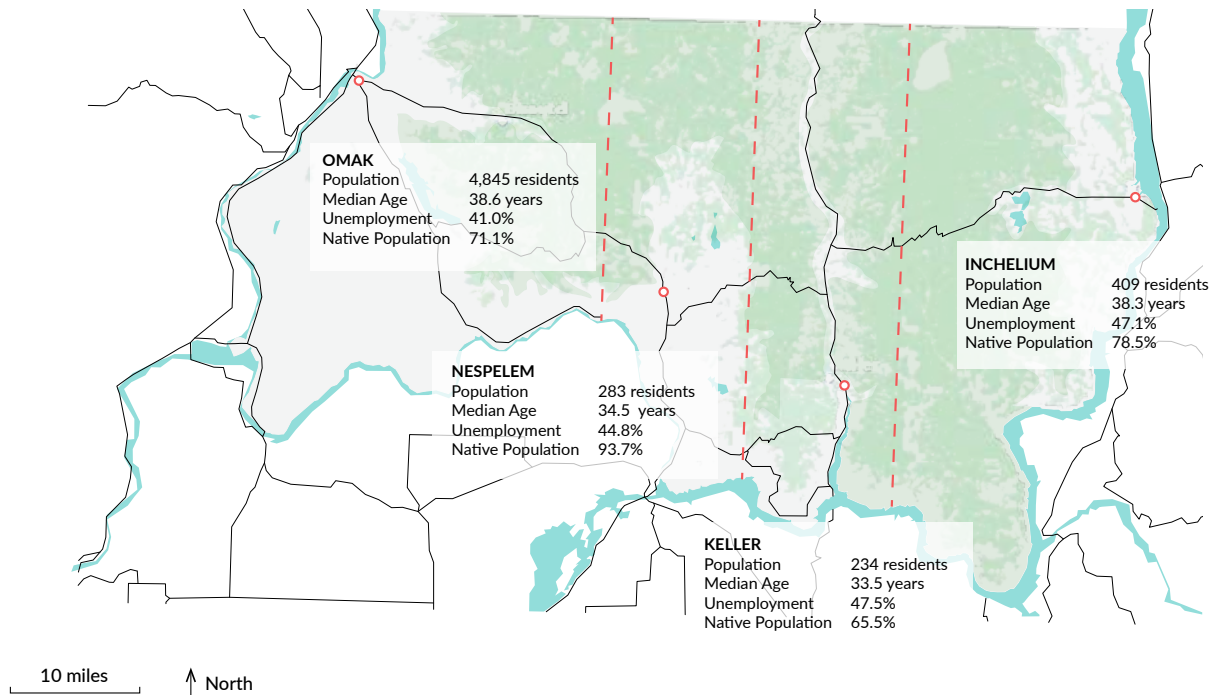


Figure 21. Population centers of the Colville Reservation

Social Systems

The population of the reservation is near 8,000 [23]. The reservation is split into 4 districts: Omak, Nespelem, Keller, and Inchellium. Most of the population live near the corresponding towns of those districts, denoted by circles. As you can see, there is a staggering amount of unemployment on the reservation. Because there are few retail or community stores, money generated on the reservation typically goes into Spokane markets.

A 2012-2016 Community Economic Development Strategy demonstrates the need for an investment in infrastructure and housing in all of the districts [23]. There is a housing shortage on the reservation, and homelessness is creating over-crowding in homes as relatives and friends start to live with each other. This has put significant stress on the people of the reservation.

It is difficult to get housing projects started on the reservation, because it takes a

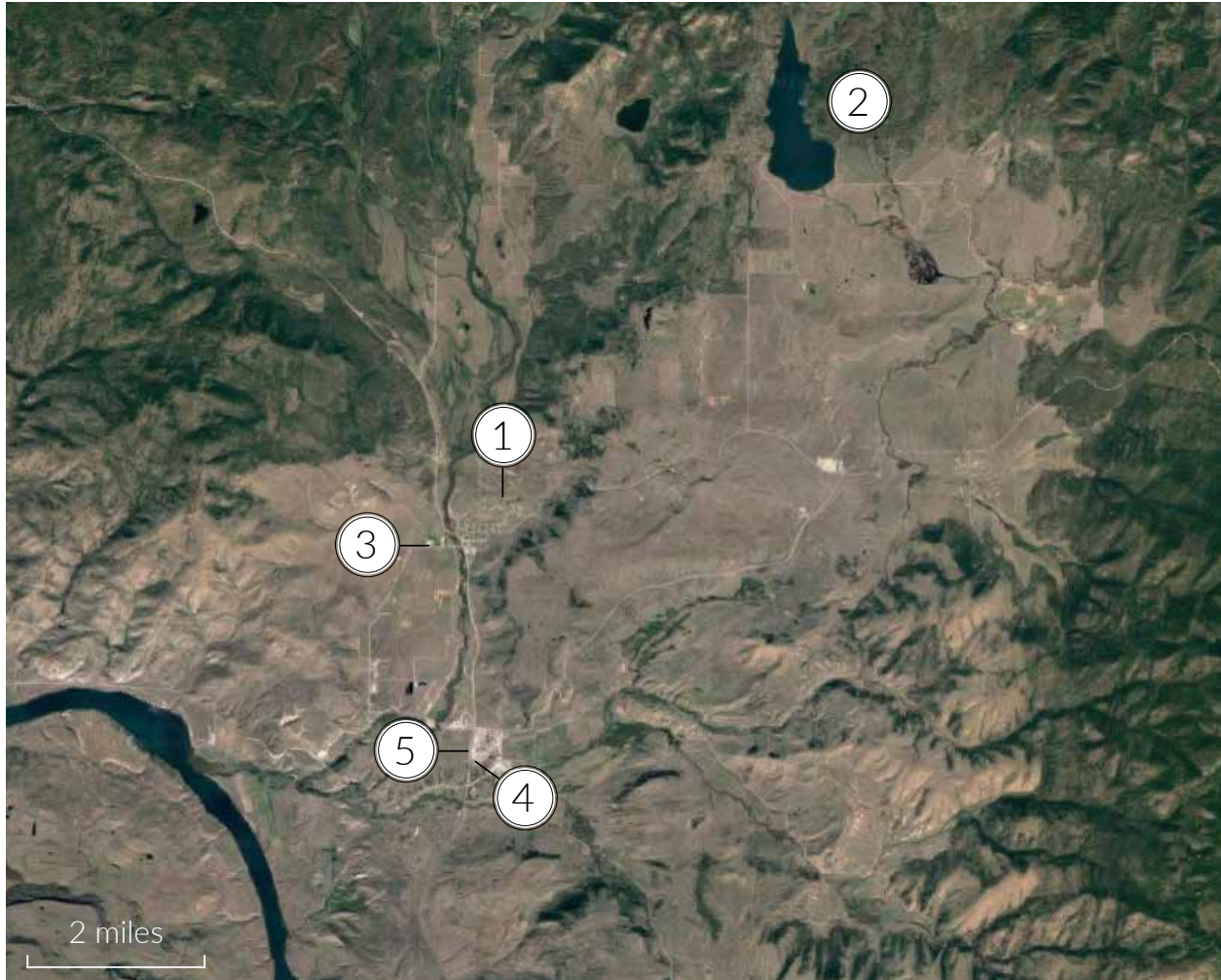


Figure 22. Community landmarks on the Colville Reservation

lot of money to set up power, water, and sewage. Apart from that, waste water facilities are at capacity level, which is also stunting development.

The reservation suggested the case study be focused on Nespelem. The reservation believes this community has the most potential for growth, because of a new government center that is located in Nespelem, and the fact that it is close to the Grand Coulee dam and closest to Wenatchee.

Nespelem is nationally known for being the final resting grounds for Chief Joseph of the Nez Perce. Despite this, it is a very sleepy town, consisting mostly of single family neighborhoods, with a few apartment buildings owned by the reservation. There are no restaurants, but the Nespelem Trading Post next to the gas station is a locally owned store that does have groceries and some prepared foods. Owhi Lake is the largest lake in the area, which is a popular destination for trout fishing. Nespelem School is a K-8 school with 166 students.

The Lucy F Covington government center in Nespelem is the government headquarters of the tribes and was built in 2016. The center holds government offices, but also has places for public meetings and cultural exhibitions.

Community Values

Understanding the values of the community were very important because these are the goals that they want to realize. In a community development report, the residents of Nespelem have voiced their vision for the future. They believe that investing in the people of the community, and particularly investing in youth could help the community. They believe that youth have very little to do in Nespelem, which creates social problems and also prevents families from wanting to move there. Other opportunities for investing in people were developing a senior recreation center that could have swimming facilities and providing more mid-level spaces for gathering.

Sovereignty was also viewed as a high value for Nespelem. They want the

reservation to remain an autonomous nation and want more direct control over their lives. They also value cultural and natural sustainability. They understand that sustaining their life on the reservation means that they need to look for economic opportunities. They believe tourism could be promising.

3.2 STEP TWO: CONNECT PEOPLE TO SHARED ENERGY

Step 2 of the framework is to find ways to connect people to shared energy production. Three options were investigated for the Colville Reservation, shown in Figure 23-25. The first option was utilizing micro-hydro and solar panels for electricity. This solution may not be feasible, because it could be difficult to identify appropriate streams with a sufficient water drop. A second option could be shared solar panels for electricity, but individual solutions for heating. This could be utilized in a location of scattered homes. The most promising solution, option three, is an electricity and combustion system.

Shared Solar Panels and Combustion System for Community on Reservation

Similar to the heating system in Munksøgård, a biomass boiler that burns wood chips generates hot water that can be delivered to homes through insulated pipes for heating and domestic hot water. The natural resource director of the reservation said a potential source of wood could be the smaller trees they cut to thin forests to prevent wildfires.

Solar panels perform well in Eastern Washington because of the sunshine and could work as a source of electricity. This system would be connected to the grid and be a source of income for the community in times of surplus.

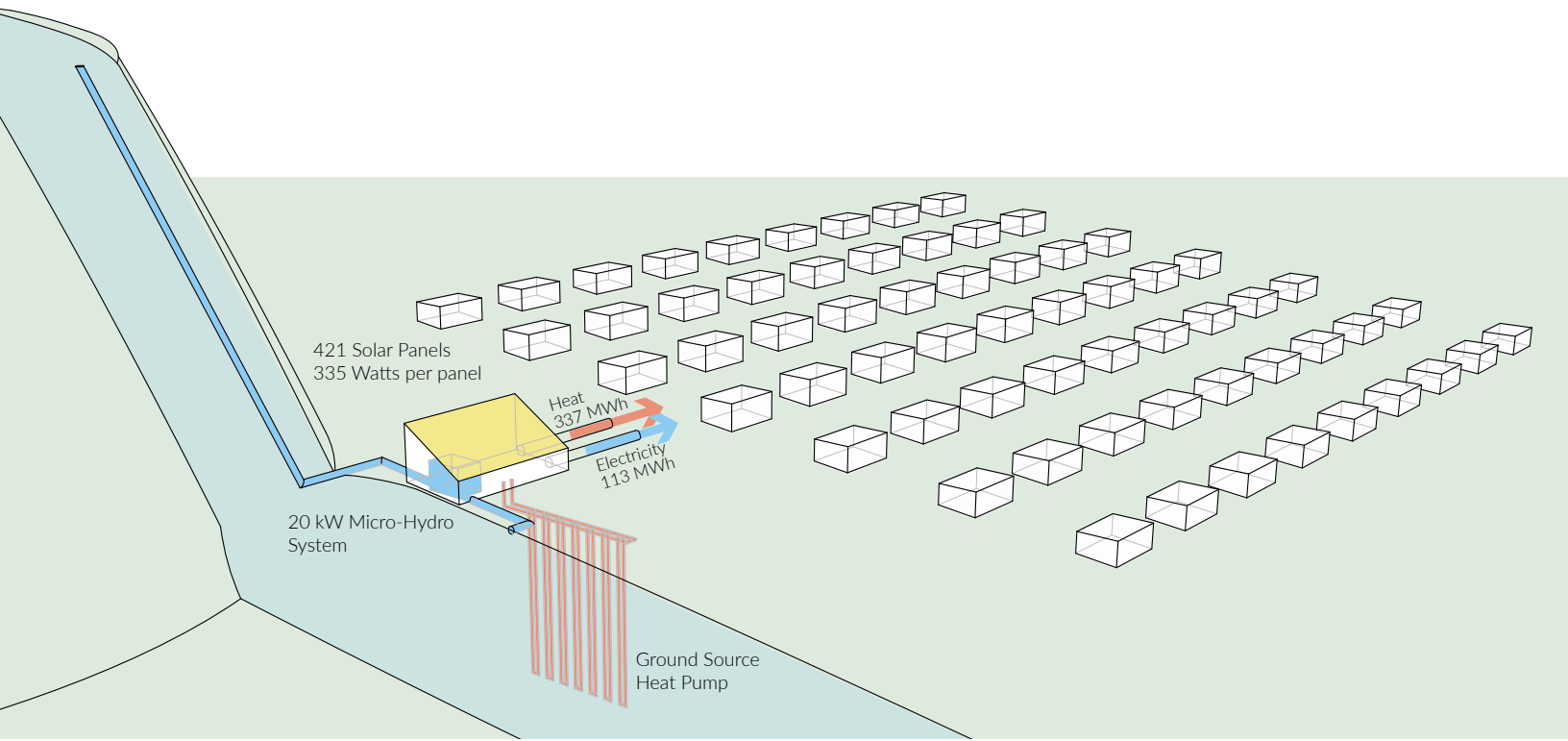


Figure 23. Energy option with Micro-Hydro and ground source heat pump

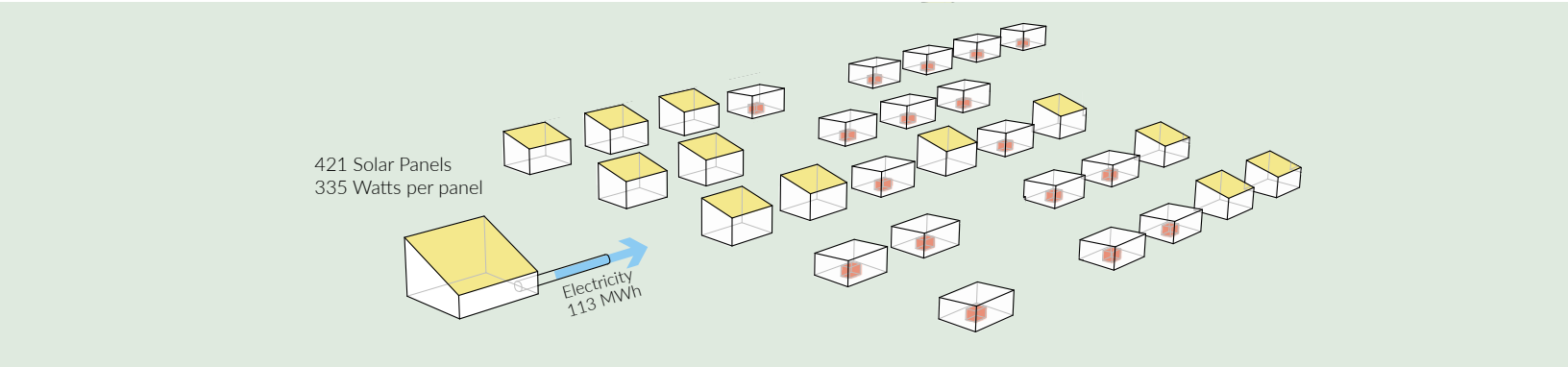


Figure 24. Energy option with shared solar panels and individual solution for heating

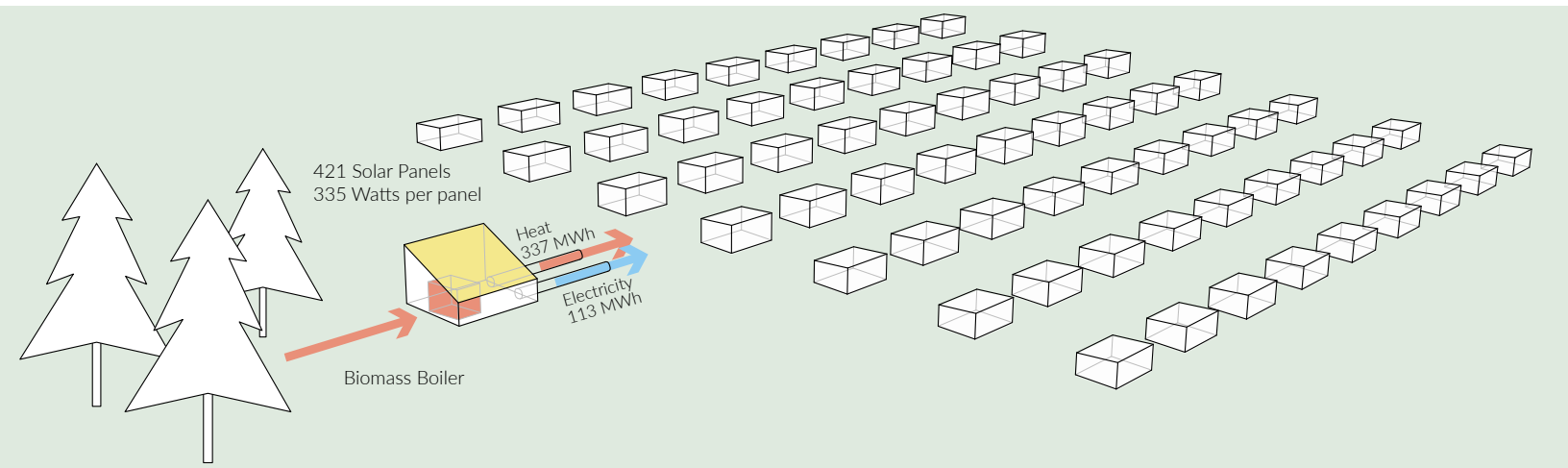


Figure 25. Energy option with biomass boiler for heating and shared solar for electricity

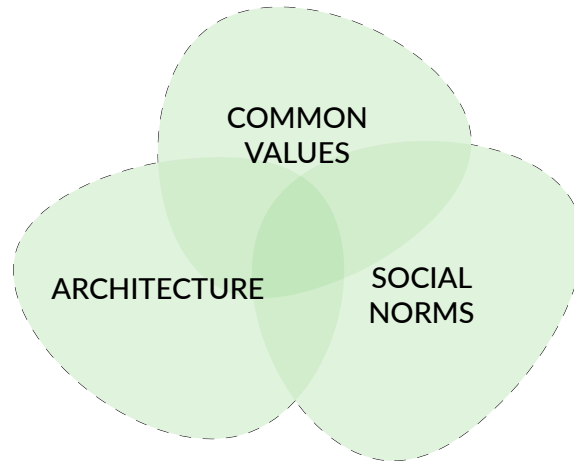


Figure 26. Architecture, Common Values, and Social Norms are the elements of the social structure that Ecovillages intentionally engage with and that create sense of identity

3.3 STEP THREE: DESIGN FOR A COHESIVE SOCIAL STRUCTURE

Step 3 of the framework is to be intentionally unintentional, or to design for a cohesive social structure. By intentionally aligning architecture with shared values and social norms, a strong sense of identity and way of life rooted in strong social connections may emerge. This thesis investigated how a tectonic language and a responsive site plan can establish a sense of community on the reservation.

TECTONIC LANGUAGE

A tectonic language could become a source of identity in these communities. The tectonic system shown in Figure 28 is inspired by the natural resource of wood on the reservation. It is also inspired by the skin and structural frame systems of the traditional houses. The skin is a wood shingle siding, which could be easily made by scrap wood. The process of making, installing, and repairing the structure could become a cultural practice.

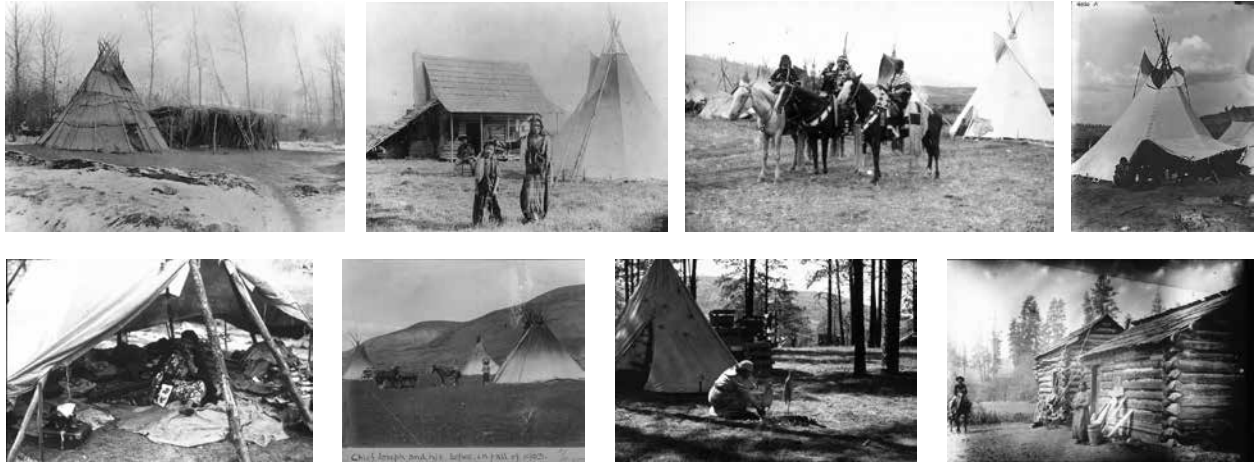


Figure 27. Images of indigenous houses that inspired tectonic structure

The structure would be a frame made of wood as well. Similar to the traditional campsites, the sense of establishing even ground could be achieved through concrete slabs, which could also be used for radiant floor heating and thermal mass.

SITE PLAN

I received some input from the reservation on what the site plan of these communities should look like. They believed that having clustered homes would be beneficial, because it would be easy to establish a fire boundary around the homes in case of wildfire. They also told me people on the reservation are rural Americans and most like having their own parcel and parking close to their house. I am imagining that the reservation could first establishing infrastructure such as sewage and power to draw people to the community. The parcels and a piece of the communal energy production and common areas could then be purchased, and people could build their own homes. This is very similar mechanism of development to the New - Standalone Ecovillages such as Dyssekilde.

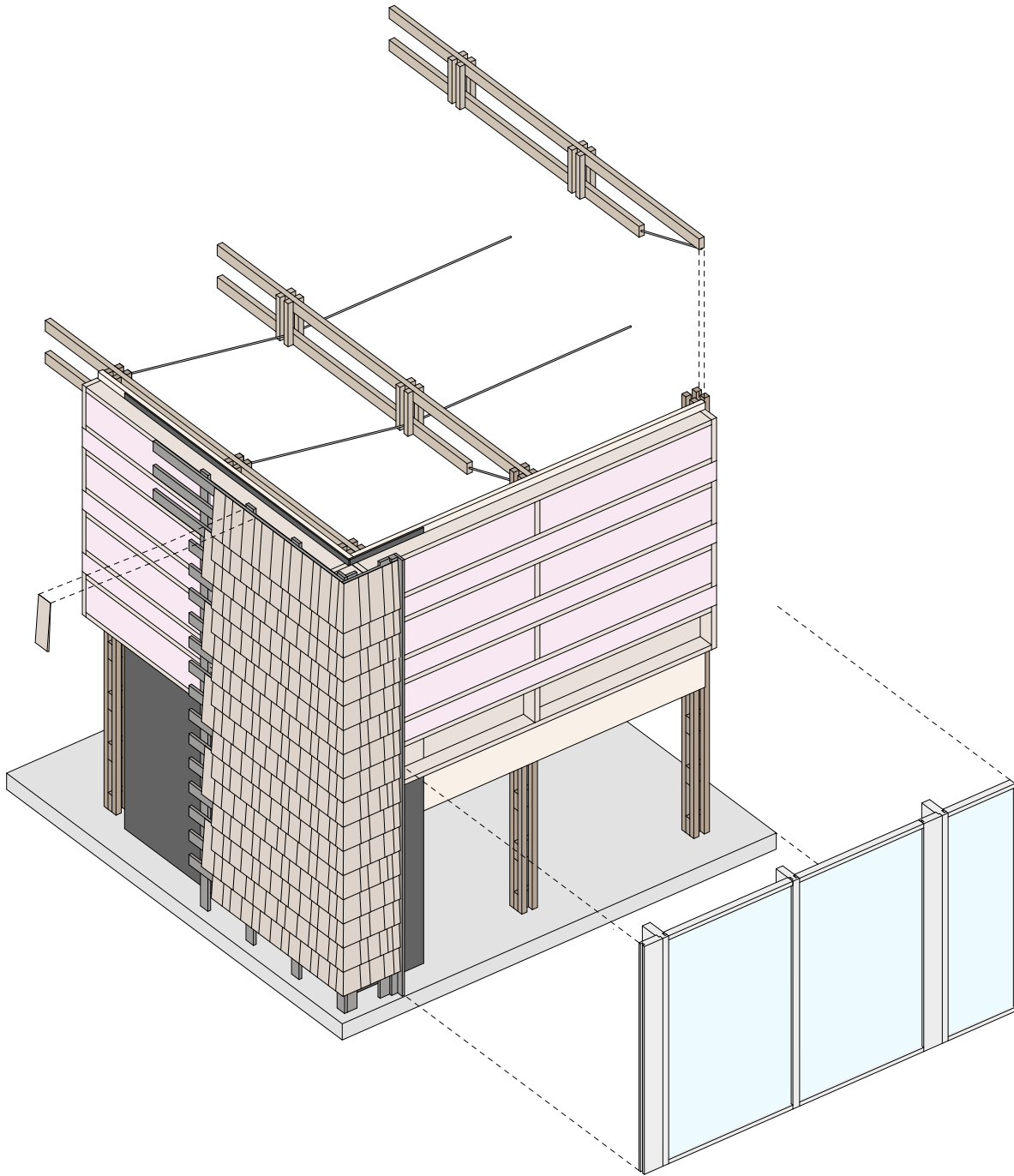


Figure 28. Tectonic concept of housing communities on Colville Reservation

CHAPTER 4

DESIGN PROPOSAL

4.1 SITE DEVELOPMENT

This thesis applied the design framework to two potential communities in Nesepelem, shown in Figure 29. The first is a completely new, standalone option. This community is near Owhi Lake, on a plot of land the reservation is selling for development. The second is community developed in an existing neighborhood in Nesepelem.

NEW COMMUNITY

The new community is orientated East-West, as shown in Figure 30, to allow for more southern exposure. The community could be accessed from the southern entrance, and residents or visitors could travel the community by car or foot on the solid paths. Each parcel has a shared parking structure with one neighbor, which could facilitate more chance encounters. Each parcel is also adjacent to a pedestrian path, which could be used for walking around the community. These pedestrian would have much more vegetation and would act as an outdoor room. There is ample shared outdoor space throughout the community that could serve communal outdoor functions. This flexibility allows the residents to decide how to use the community the way they see fit.

Communal buildings are essential for meeting neighbors and facilitate collaboration. The communal buildings of the community are shown in Figure 31. The common facilities are a building for a wood shop and boiler room, a community house for meeting spaces,



EXISTING COMMUNITY

2,000'
└──────────┘



NEW COMMUNITY

Figure 29. Location of existing community and new community locations in Nespelem

communal laundry, and a kitchen, and a barn and food storage structure.

Shared energy production would be a jointly owned commodity in these communities. The location of the shared energy production are shown in Figure 32. Solar panels are on the community house and parking structures, and a biomass boiler is in the boiler room, which would provide district heating to all the houses.

Flow of waste and rainwater is shown in Figure 33. Rainwater would mostly be collected in troughs in the pedestrian paths, which would allow for increased vegetation in these areas. Waste would be collected and separated into solid and liquid water. The liquid waste would be treated and then additionally purified in a willow biofiltration.

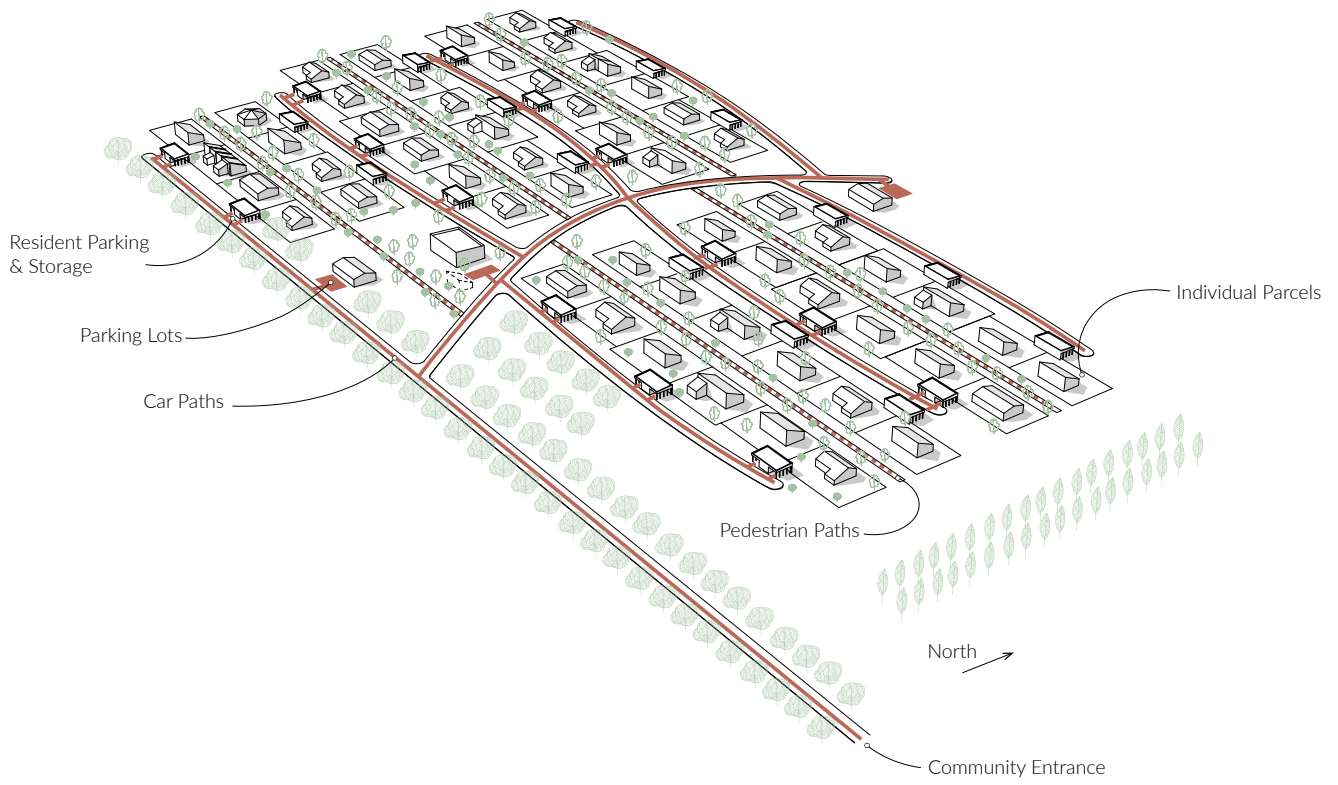


Figure 30. Common paths in new community

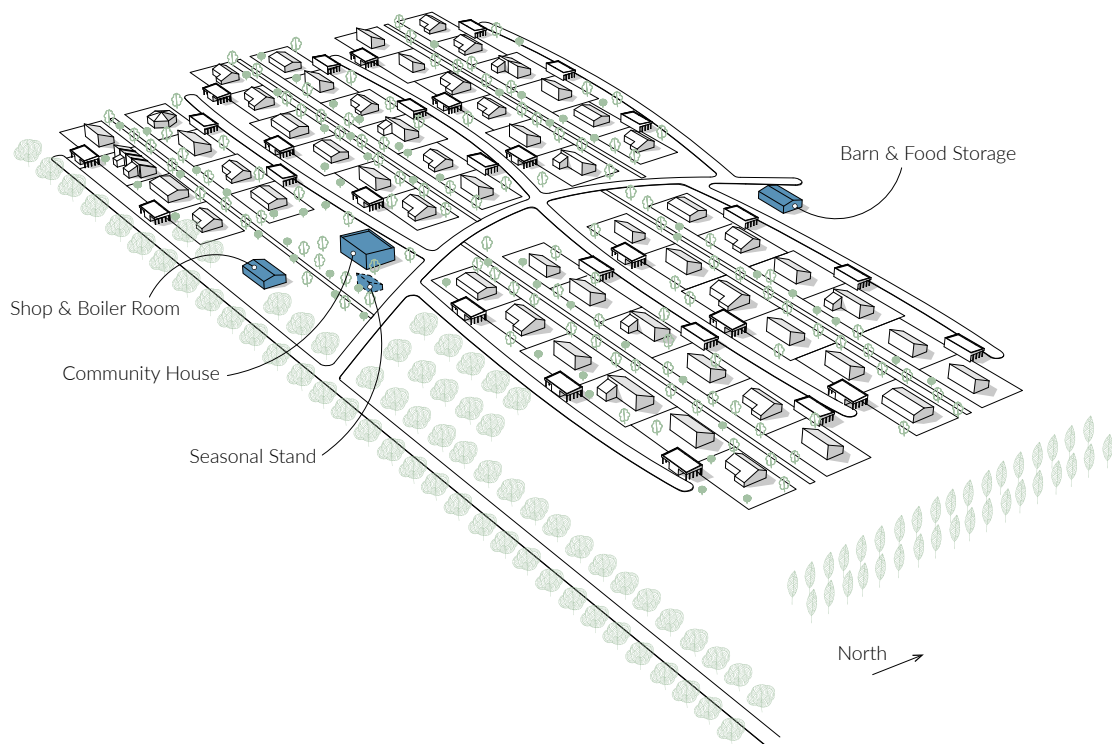


Figure 31. Common buildings in new community

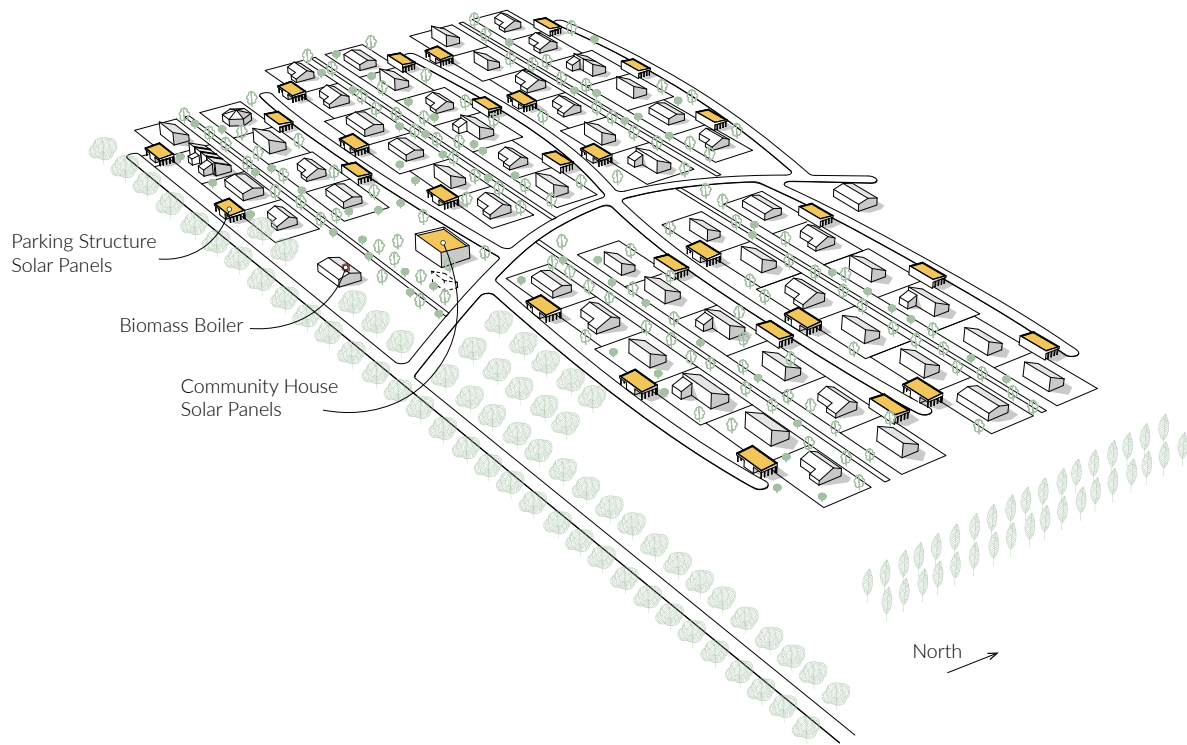


Figure 32. Common energy production in new community

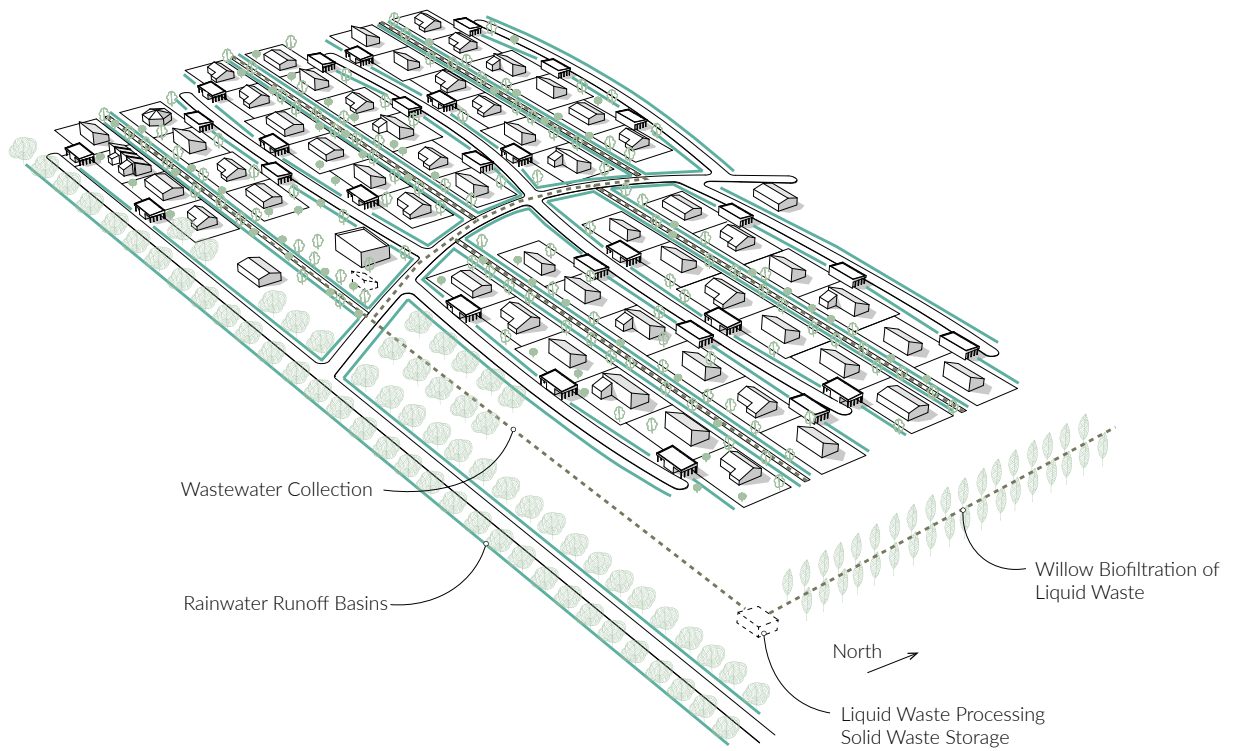


Figure 33. Rainwater and waste treatment in new community

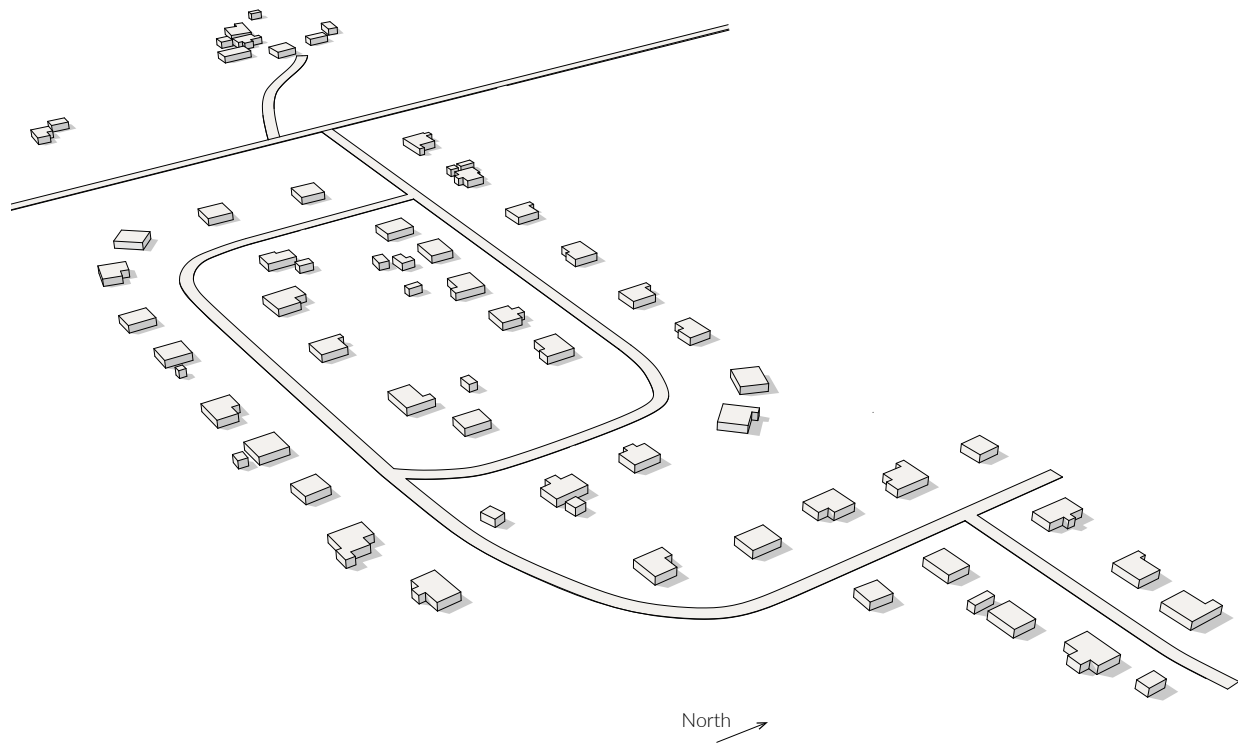


Figure 34. Existing community in Nespelem

EXISTING COMMUNITY

A similar framework was also applied to the existing housing community in Nesepelm. Figure 34 shows the existing conditions. The existing community is an old HUD development, with 40 existing homes. All of the homes in the community are heated with electricity. Figure 35 shows how the community can be transformed by adding the pedestrian paths and some additional units of rowhouses on the North. The pedestrian paths create boundaries and series of spaces, which could add visual interest in the community and establish a sense of place.

The residents of Nespelem have expressed interest in more places for community gathering. In a response to this, a swimming pool and community house has been added to this community, which could be open to the whole town. There is also a shared shop and boiler room. The existing houses in the community could slowly be updated with radiators



Figure 35. Common paths in existing community

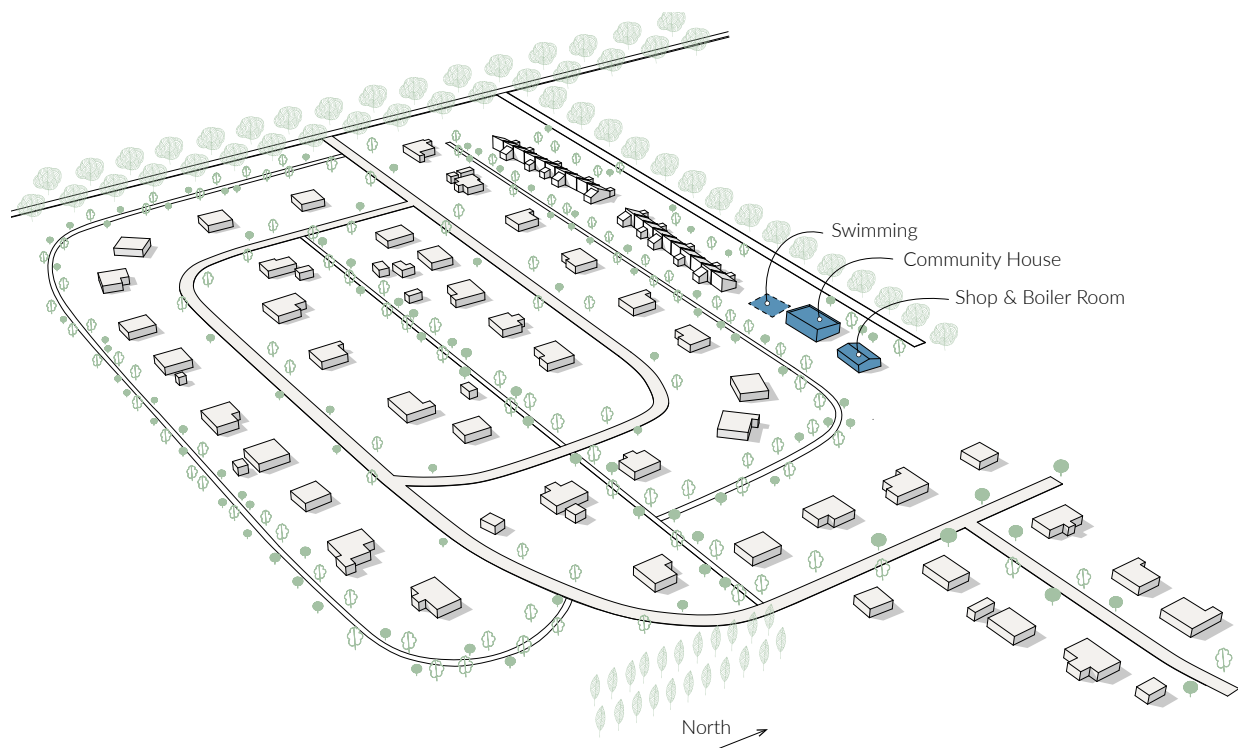


Figure 36. Common buildings in existing community

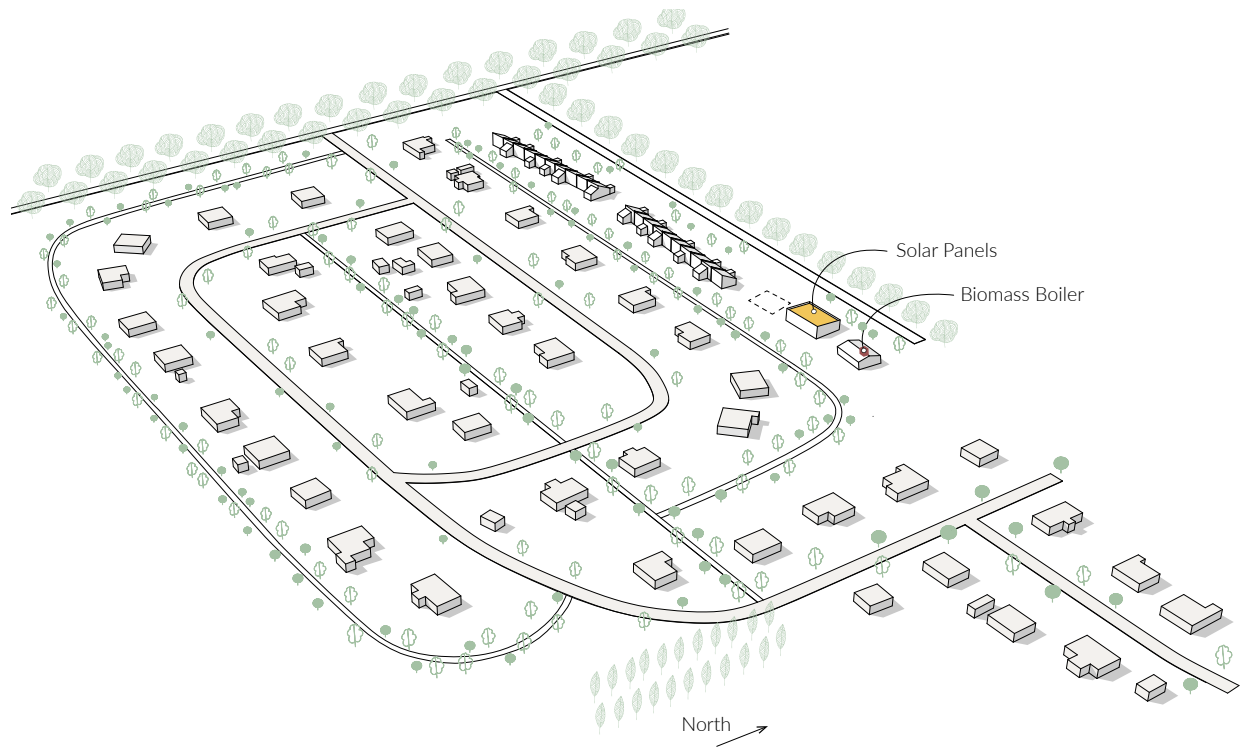


Figure 37. Common energy production in existing community

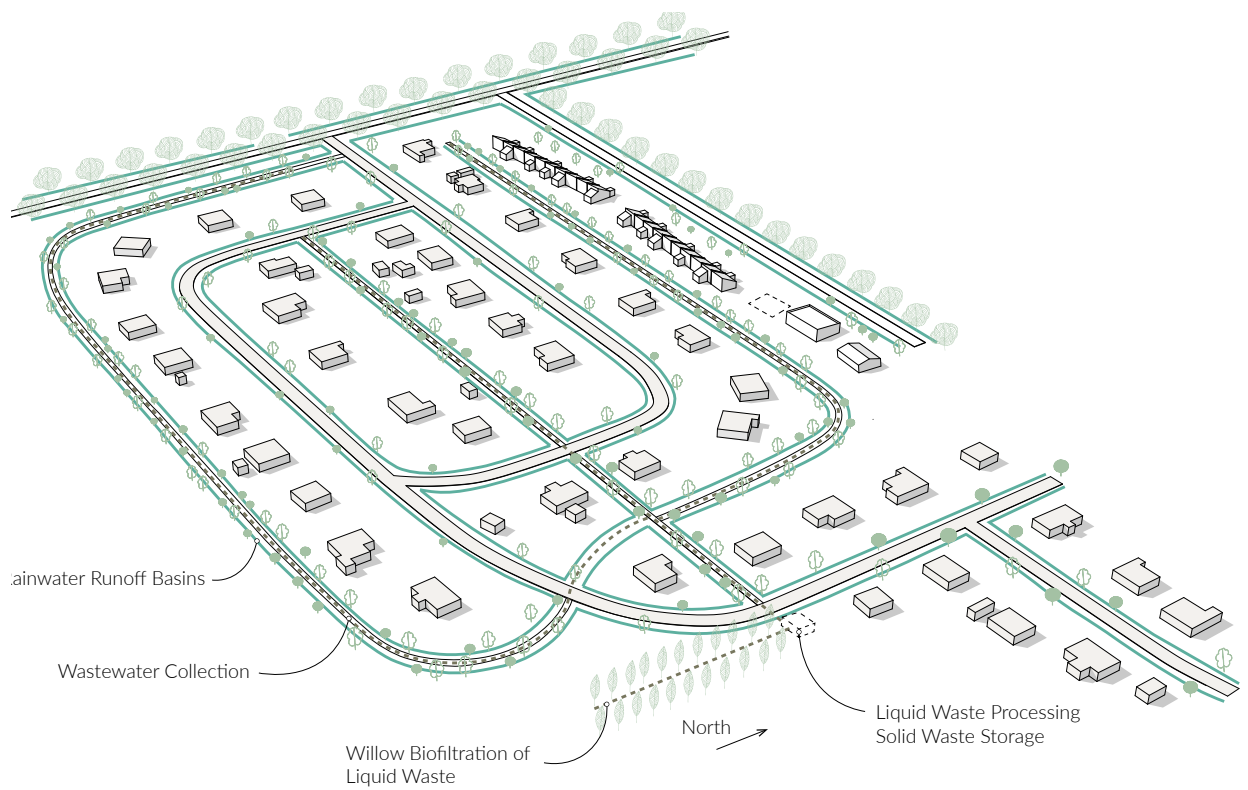


Figure 38. Rainwater and waste treatment in existing community

to receive their energy from the biomass boiler, instead of the inefficient electric heaters that they are currently using. Similar to the Retrofit Ecovillages, the community could also help to slowly update insulation in the homes.

Rainwater basins and wastewater collection and treatment would work similarly to the New Community Proposal.

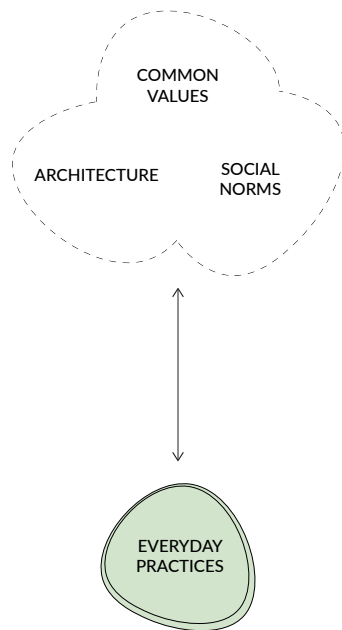


Figure 39. Everyday practices are manifestations of architecture, common values, and social norms

4.2 COMMUNITY VISION

The design framework discussed in Chapter 3 is intended to create a cohesive social structure, or architecture that aligns with the common values in the community. The framework also attempts to bring people together and collaborate so that strong social norms may exist. As shown in Figure 39, everyday practices are a manifestation of the social structure, which answer the question of “How do we live?”.

The renderings on the following pages are a vision for what kind of everyday practices can emerge on a community built around shared energy production on the Colville Reservation. The tectonic language, site plan, and communal values are all reflected in these renderings, which aims to create a sense of identity. The renderings show how everyday practices rooted in communal values may emerge through living in a community like this.



Figure 40

THE SHOP

The shop is a place where people experiment and pass cultural knowledge of making. The shop makes it easier to share tools and is a good place for people to work together on building improvements in the community.



Figure 41

EXTERNAL LOUVERS

On sunny, winter days people can adjust their external louver to let the sun in to warm up their house. The pedestrian paths are a way to get around the community, but also provide opportunities for chance encounters and conversations.



Figure 42

THE KITCHEN

This man is freezing his meat in the communal freezers. He comes in to the communal kitchen to grab some meat, and sees a young boy that looks disappointed that there is fruit where people usually leave freshly baked sweets for sharing. Communal dinners happen often here, and it is a place for people to share cooking techniques and spend time with neighbors.



Figure 43

WORKING GROUPS

The Ecovillages in Denmark brought money to their local communities by the visitors that would come for tours. Here, a member of the community is showing a group of visitors around the community outside of the common house. There are two small rooms in the common house that could host outside visitors or friends of the community.



Figure 44

SHARING STRUCTURES

This woman has just finished making some apricot jam from the trees near her house and is leaving them in a structure along a pedestrian path to share with her neighbors. People leave anything from books to snacks here to share with the community.



Figure 45

PEDESTRIAN PATHS & CHILD SAFETY

Two kids are walking to a friend's house on the pedestrian paths, as a neighbor keeps an eye out. The community is a fun, large place to play for the kids, and everyone knows each other very well so parents have piece of mind knowing people will make sure the children stay safe.



Figure 46

COMMON HOUSE

The energy group is finishing up their monthly meeting about energy consumption in the common house. Many of the members of the group did not know much about the technicalities about energy before joining the group, but now they manage the community's energy consumption and relay information to the rest of the community. Sometimes the younger members of the community join the meetings, which has inspired some to pursue engineering degrees.



Figure 47

COMMUNITY POOL

The community pool in Nespelem is a place for anyone to come, relax, and exercise. Two granddaughters are waiting for their grandma to finish her exercise.



Figure 48

COMMUNAL OUTDOOR SPACES

The yards adjacent to the driving paths get a lot of sun exposure in the summer and are perfect for growing vegetables. Since some people have more experience growing vegetables, people exchange tips and share their produce with the community.

CHAPTER 5

CONCLUSION

Modernity has given us the blessing and the curse of being able to choose our own identities. With our daily lives increasingly being less dependent on interpersonal collaboration, it is difficult for us to realize our collective goals. Modern life has started to create soulless communities, devoid of shared cultural experiences. Fortunately, there is another path that we could choose. We could choose to intentionally engage with the social structure that effects our behavior to answer the question of “Who are we?”.

I believe greater collaboration in everyday life can strengthen communities and give them power to live a way they imagine together. In the Danish Ecovillages, I saw how this contributed to thriving communities and local towns. In these communities, people chose to give up their independence to live according to their shared values. They shape their built environment and even their social norms to reflect who they are. They understand the world through each other, instead of subscribing to a one-size-fits-all framework for how to live.

It is time that we start to live a life that reflects our values. Intentional housing communities can bring us spatially and socially together and can be a catalyst for communities to realize their shared goals.



Figure 49. Walking path through Ecovillage Dyssekilde

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