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Energy profiles for Kyrgyz mountain villages as a basis for a targeted energy strategy – development of a survey method and pilot run in Jergetal

Bachelor thesis

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Abstract

Clean, reliable energy is an important factor for any village or areas development. Despite this, 1.2 billion people had no access to electricity and 2.8 billion people relied on traditional biomass for cooking and heating in 2016 according to the International Energy Agency.

One of the United Nations Sustainable Development Goals states that by 2030 everyone should have access to clean, sustainable energy.

In light of this, the aim of this project was to design a methodological approach to appraise the energy situation in a Kyrgyz mountain village in order to make it possible for that village to work towards the energy targets of the Sustainable Development Goals in a clear, focused way. To do this, two surveys – a questionnaire and an observational survey - were developed that included all energy related topics such as reliability, affordability, availability, quality and cleanness of energy as well as energy efficiency, and percentage of renewable energies.

The advantage of these surveys as a profiling method is that it is able to be used across a wide range of landscapes, energy situations and demographics. With it a clear picture can be painted as to what the energy situation is and what steps would have to be taken to ameliorate the situation.

The surveys were tested in a pilot run in a village called Jergetal, where the researchers spent ten days interviewing 16 households and taking notes and pictures on the state of the buildings and any energy efficiency measures or renewable energy technology.

The survey results showed that while all the households had access to electricity, the heating and cooking was mainly done with fire fueled by coal and dung bricks. The houses were not insulated and no renewable energies were being used.

The main reasons for this was lack of information and lack of funds.

According to the evaluated surveys, next steps would be to work on energy efficiency, doing courses in insulating houses with local materials and teaching villagers how to build energy efficient stoves.

The survey itself will be handed over to the local partners for further developing and testing.

Zusammenfassung

Eine gesicherte Energieversorgung ist ein wichtiger Entwicklungsfaktor für den ländlichen Raum. Im Jahr 2016 lebten laut der Internationalen Energieagentur trotzdem 1.2 Milliarden Menschen ohne elektrische Energie. Weitere 2.8 Milliarden Personen heizen und kochen ausserdem ausschliesslich mit Biomasse.

Eines der Nachhaltigkeitsziele der UNO verlangt, dass bis zum Jahr 2030 alle Menschen Zugang zu sauberer, nachhaltiger Energie haben sollen.

Um diesem Ziel näher zu kommen, lag der Fokus dieser Arbeit darauf, eine Methode zu entwickeln, mit der kirgisische Dörfer auf ihren Energiebedarf hin geprüft werden können. Dies sollte dazu dienen, allfällige konzeptionelle und zielgerichtete Verbesserungsmassnahmen zu ergreifen.

Die entwickelte Methode, in Form einer Erhebung, besteht aus zwei Fragebogen, welche diverse Energiethemen wie z.B. Zuverlässigkeit der Energieversorgung, ökonomische Aspekte, Sauberkeit und Qualität der Energie sowie Energieeffizienz und Anteil der Erneuerbaren Energien umfassen.

In einem Dorf namens Jergetal wurde die Erhebungsmethode getestet. Hier wurden 16 Haushalte zu ihrer Energiesituation befragt. Dazu wurden Fotos und Notizen zum allgemeinen Zustand der Gebäude und allfällige Energieeffizienzmassnahmen aufgezeichnet.

Die Ergebnisse zeigten, dass obwohl alle Haushalte ans elektrische Netz angeschlossen sind, die Stromversorgung nicht zuverlässig ist. Geheizt und gekocht wird mit Kohle oder Mistziegeln. Keines der untersuchten Häuser ist isoliert oder weist Massnahmen für eine verbesserte Energieeffizienz auf. Im ganzen Dorf werden keine erneuerbaren Energien eingesetzt, obwohl die Leute davon gehört haben und grundsätzlich auch daran interessiert sind.

Laut den Angaben der Umfrageteilnehmer wird dies hauptsächlich einem Mangel an Informationen und zu hohen Kosten zugeschrieben.

Die Auswertung der Erhebung in Jergetal zeigt, dass für eine verbesserte Energiesituation und eine gesicherte Energieversorgung in einem ersten Schritt an der Energieeffizienz der Gebäude gearbeitet werden muss. Dies könnte zum Beispiel durch Kurse unterstützt werden, in welchen die Interessenten lernen, wie sie mit lokalen Materialien ihre Häuser dämmen und energieeffiziente Öfen bauen können.

Die Erhebungsmethode, welche nach dem Pilotversuch im Jergetal weiterentwickelt wurde, wird an die lokalen Partner weitergegeben um fertig entwickelt und angewendet zu werden.

Contents

List of abbreviations and foreign words

Abbreviations

AGOCA	Alliance of Central Asian Mountain Communities
CHP	Combined heat and power plant
EE	Energy efficiency
kW	kilowatt
MDG	Millennium Development Goals
MSRI	Mountain Society Research Institute
MW	Megawatt
NGO	Non-government Organisation
PV	Photovoltaics
RE	Renewable energies
SDGs	Sustainable Development Goals
SRF	Swiss Radio and Television
UCA	University of Central Asia
UNDP	United Nations Development Programme

Foreign words

Ariston	Electric hot water heater
Bagna	Bathhouse
Feldsher	a paramedic or nurse
Jailoo	Summer pasture
Kazan	Big round cooking pots
Kelin	Youngest daughter-in-law. She’s in charge of the household
Kirpitsch	bricks made of a mix of clay and straw
Kumis	Traditional drink made of fermented mare’s milk
Mesh	Stove inside, usually between two rooms. Used to cook and heat in winter
Ochok	outside cooking place, used in summer, often in a small separate building
Pechka	Stove with a central heating system
Plita	Electric stove

Samovar	Kettle for heating water (usually for tea). Wood or dung bricks are used to make a fire in a hole in the middle to heat it
Tirichilik	all work related to house, garden, fields, cattle

Survey reference codes

1A	Interview survey
1B	Observational survey
A to K	Survey section
1, 2, 3…	Question number

1 Introduction

In November 2016 the Swiss Radio SRF broadcasted a radio programme on energy. One of the key points was that energy is a necessity for any village or area development. It also said that 1.2 billion people have no access to electricity, and 2.8 billion people rely on traditional biomass for cooking and heating. One of the United Nations Sustainable Development Goals states that by 2030 everyone should have access to clean, sustainable energy (Bonanomi, 2016). This broadcast, together with the World Expo held in Kazakhstan in the summer of 2017 brought up the idea for a thesis about renewable energy in rural areas, focused on Central Asia. The topic was finalized together with the University of Central Asia and a Kyrgyz NGO called AGOCA.

1.1 Energy goals

In September 2015 the United Nations set up and adopted the Sustainable Development Goals (SDGs), meant as a call for the world to improve the lives of people everywhere. These SDGs include a variety of different topics, among them hunger, poverty, health, education, peace, clean water, sanitation and energy (United Nations, 2017). These SDGs were the follow-up for the Millennium Development Goals (MDGs), the implementation of which showed a lot of improvement in areas such as global poverty, access to clean water and sanitation and education availability, but still left the world with a lot of problems, such as hunger, poverty, and gender inequality (UNDP, 2017).

One of the issues the SDGs would like to solve is the lack of clean, reliable energy. Without energy a lot of the other SDGs are not attainable, as lack of energy means no light for studying in the evenings, no reliable computer access, no water pumps for clean water or irrigation, no machines for efficient production, no electrical hospital equipment nor even refrigeration. In addition, no clean energy means that people have to rely on traditional biomass for everyday heating and cooking, which can result in deforestation or in animal waste being burned instead of being used as fertilizer, as well as many hours a day being spent on collecting and preparing fuels. Often this traditional biomass is burned in inefficient stoves, which also turns it into a health hazard for the people dealing with them every day (EDA, 2016; IEA, 2017; Karekezi, Lata, & Coelho, 2004).

According to the International Energy Agency 1.2 billion people didn't have access to electricity in 2016, and more than 2.7 billion people relied on traditional biomass for cooking and heating (IEA, 2017).

Knowing the big impact that energy has on people as well as on the planet, the World Expo 2017, to be held in Astana, Kazakhstan, chose the topic of 'Future Energy', with the self-declared goal of "appealing to the international community's sense of responsibility by way of institutions, organizations, corporations, and individuals, with the aim of generating debate and awareness regarding the decisive impact that energy management has on the lives of people and that of the planet" (Astana Expo, 2017).

1.2 Energy profiling

In order to reach the energy goals, clear, measurable targets need to be set, and strategic measures need to be placed in ways that these goals can be reached. In order to set these goals, the current energy situation needs to be known, so that the targets can be set realistically.

This can be done through assessing the current energy situation of a village, house or region and using this as an energy profile.

Once the profile is set measures can be determined to work towards the energy SDGs. This way the measures can be targeted and specific.

The SDG global energy targets as cited on UNDPs (United Nations Development Programme) website are as follows:

- "By 2030, ensure universal access to affordable, reliable and modern energy services
- By 2030, increase substantially the share of renewable energy in the global energy mix
- By 2030, double the global rate of improvement in energy efficiency
- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states, and land-locked developing countries, in

> accordance with their respective programmes of support" (United Nations Development Programme UNDP, 2017)

Based on this, the topics in this profiling tool would be: affordability, reliability and modernness of energy, share of renewables, energy efficiency, energy technology and energy infrastructure.

1.3 Research question, aims and scopes of the thesis

Based on these energy goals and targets, the question was raised about what a good method of profiling energy in rural areas could be. Together with the Mountain Societies Research Institute (MSRI) and AGOCA, a Kyrgyz NGO that works in village development (see chapter 1.3.1) the research task was specified*: to develop a method for profiling villages according to their energy situation, so that specific and appropriate energy projects can be devised and carried out.*

Due to the limited amount of time available, it was decided that within this project a survey would be developed that can be used in local villages and communities to more concretely specify the energy situation in that place. The survey would be tested in Jergetal, a partner village of AGOCA, then ameliorated and handed over to MSRI and AGOCA to complete and test more in depth.

The goal would be to have the developed survey as well as data from the first test village to assess the quality of the survey and therefore the profiling method.

The survey was developed and tested in Kyrgyzstan as a neighbour of the host country of the world expo, and done together with several partners.

1.3.1 Partnering Organizations

One of these partners, and the final recipient of the survey, is AGOCA, the Alliance of Central Asian Mountain Communities. Founded in 2003, AGOCAs goal was to "unite the efforts to achieve sustainable development of mountain regions of Central Asia and to improve the standard of living of the local population", as they state on their website. If a village wants to be a part of AGOCA, it needs to apply, stating their desire to be a part of the program and their willingness to contribute to ongoing projects. They also need to have a specific action plan for

the development of the village ready. The AGOCA board then decides if the village gets accepted or not (AGOCA, 2017)

AGOCA, as well as many other organisations, work mainly through educational seminars, courses and practical trainings. They also support the exchange of knowledge and information between villages (AGOCA, 2017).

So far renewable energies and energy efficiency are not priority with AGOCA, but with long, hard winters, with temperatures dropping down to -40 in some areas, and with the comparatively high energy prices and unreliable electricity supplies this is a fairly important topic (UNDP, 2013).

While other organizations have been working on energy efficient house insulation and more efficient stoves, this has not been implemented in most villages.

AGOCA works fairly closely with the Mountain Society Research Institute (MSRI), a part of the University of Central Asia (UCA). The objectives of MSRI are to “generate knowledge on mountain societies, to serve as a knowledge hub, to enhance regional capacity to conduct research relevant to mountain societies, to inform policy and practice through engagement with key development partners, and to disseminate knowledge among mountain stakeholders” (UCA, 2017).

MSRI will have a stand at the Expo in Kazakhstan at the end of August/beginning of September 2017. The topics to be presented are connected with the energy use in rural areas of Kyrgyzstan, and the data collected during the development and trial run of the survey will be used for that presentation. The initial survey was designed together with the contractor in charge of that exhibition.

1.4 Overview

The procedure for the thesis was as follows: after the research question was finalized and some background questions answered, the survey was composed together with two local researchers and the contractor in charge of the exhibition at the expo. Once the survey was completed, it was carried out in Jergetal over the course of two weeks. The data was then translated, entered into an excel spreadsheet and analyzed.

With the given data an average household in the area of Naryn was described, and conclusions about the energy situation, as well as to the current form of the survey were drawn. The survey was then ameliorated and will be given back to MSRI and AGOCA for further development and usage.

This thesis is structured in a similar way. After a more in-depth look at Kyrgyzstan in general and the energy situation in Kyrgyzstan in chapter two, the survey is described in chapter three: development, location, execution, and evaluation methods are expounded. Chapter four portrays the results, both of the method and the survey, and finally, in chapters five and six the results are analysed and discussed, potential next steps are mentioned and conclusions are drawn.

2 Background

Before the survey could be designed, some background information had to be gathered. This background information is summarized and presented in this chapter, split into the subchapters Kyrgyzstan in general and energy in Kyrgyzstan.

2.1 Kyrgyzstan: general information

Kyrgyzstan is a small country in Central Asia, covered to 95% with the Tien Shan mountain range. Bordered by Kazakhstan, Uzbekistan, Tajikistan and China (see Figure 1), Kyrgyzstan is a landlocked country with 41% of its land over 3000 meters above sea level (Terenteva, Jorde, & Biegert, 2009), resulting in glaciers and permanent snow covering roughly 8100 km^2 – about 30% of the total land area of Kyrgyzstan, providing the country with large water resources (Advantour, 2017)

Figure 1: Map of Central Asia

Independent since 1991, the Kyrgyz Republic was once a part of the Soviet Union, the falling apart of which left the country struggling to deal with its newfound independence. Under its first president Askar Akayev, Kyrgyzstan quickly gained the title “island of democracy”, surrounded by “dictatorships and countries ravaged by civil strife” (Anderson, 1999). In those first years Kyrgyzstan developed many of the establishments of a modern democracy, such as a free press and an elected government (Sinor & Allworth, 2017).

This promising start was not without challenges, and some of the main problems faced were very weak Soviet-era education systems, a lack of basically any experience in dealing with other countries, no basic infrastructure like banking systems, defense ministries and postal systems. In addition, each country of the Soviet Union was specialised on a very specific task, usually the production of raw materials for the Soviet Union (cotton in the case of Central Asia). Because of this they had very little experience or infrastructure for doing anything besides these tasks (Hays, 2013; Kleingeld, 2015).

Over the following years, Kyrgyzstan, along with her neighbours, had to learn to assume full responsibility for political organization, for economic policies and for the well-being of its

citizens. Due, among other things, to several economic recessions, development was slow, and even today (as of 2015) over 30% of the population live under the national poverty line (World Bank, 2017). The GDP per capita is at 3'521 International Dollars (2016), which is a big increase from 1997 (1'464 international dollars) at a growth rate of 4.78%, but still leaves the country's GDP on rank 147 out of 195 (Weltdatenatlas, 2017; World Bank, 2017).

2.2 Energy situation in Kyrgyzstan

As mentioned in the previous chapter, Kyrgyzstan is covered to 95% with the Tien Shan mountain range, and up to 8100 km^2 are comprised of glaciers and permanent snow (Advantour, 2017; Kaliyev, 2014). This results in enormous water resources, estimated to add up to 700km^3. The Naryn River itself has an average annual flow of 27 km^3, making it the main waterway in the country as well as one of the most important energy resources of the country (Kaliyev, 2014). In addition to hydropower resources, Kyrgyzstan has large amounts of coal reserves, estimated at 6.73 billion tons, and a gold mine providing the country with up to 10% of its GDP.

Other than that Kyrgyzstan has few natural resources, which is a reason why the country quickly developed a strong hydropower sector, making it a major producer of electricity in the early eighties. Today hydropower accounts for between 80 and 90% of the country's energy production (CIA, 2017; Kaliyev, 2014). Besides that there are two combined heat and power plants (CHPs) that account for 8.8% of the electricity output, one in Bishkek with an installed capacity of 678 MW and one in Osh with 50 MW, though both run under the installed capacity due to age and deterioration of equipment (Kaliyev, 2014; Terenteva et al., 2009).

The huge hydropower capacity has not always been a blessing over the last 25 years. During the soviet era the resources were managed throughout the Soviet Union. For Kyrgyzstan, this meant that their hydropower dams were opened in summer, allowing the water to first produce electricity, then flow farther downriver where it was used to irrigate fields in Uzbekistan and Kazakhstan (see Figure 2). In winter then, when the water reserves were fairly empty, Kyrgyzstan received coal, gas and oil from other soviet states in order to fill the higher winter energy demands (Antipova, Zyryanov, McKinney, & Savitsky, 2002; Hall, 2016).

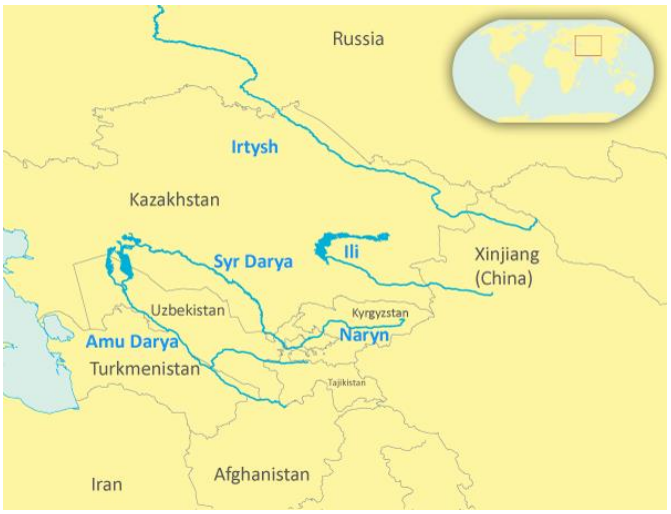


Figure 2: rivers in Central Asia

After the collapse of the Soviet Union in 1991, the situation changed. Intergovernmental relations had to be defined, national currencies were introduced and oil, coal, natural gas and the transportation of these items got more expensive. Through this, the supply of fuel and electricity to Kyrgyzstan from its neighbours got reduced. The entire fuel-energy balance in Kyrgyzstan was disrupted. The energy demand in winter increased by over 25% in the course of 6 years. To provide this extra energy, the hydropower plants were run in winter instead of in summer, running the water, once irrigation water, through the downstream countries in a season when irrigation was not necessary (Antipova et al., 2002).

In 1998 agreements were made between Kyrgyzstan, Kazakhstan, Uzbekistan and later Tajikistan, meant to combine energy and water needs. These agreements were only mildly effective, and fell out of use after a few years. Now the most common agreements are annual bi- or multilateral agreements (Antipova et al., 2002; Hall, 2016).

2.2.1 Energy distribution

This centrally produced electricity is distributed by four distribution companies, set up on a regional basis. Together they own and manage 65'000 km of local distribution lines, serving more than one million households (Kaliyev, 2014; Terenteva et al., 2009).

95% of the population is estimated to have access to fairly stable electricity (Terenteva et al., 2009), though cooking and heating is still done with traditional biofuels in over 75% of rural households (see Figure 3 in chapter 2.2.2) (Energypedia, 2015; Terenteva et al., 2009).

A big problem with the energy distribution is that there are enormous losses of electricity between the production and the actual usage, attributed to weak power lines, old, soviet-era transmission systems and also energy being sold on the black market. According to Zozulinsky the losses between 2006 and 2009 were around 30%, then in 2014, according to Temiraliev they amounted to 20%, and, according to an article in easttime.info, it was at only 13% at the beginning of 2016 (easttime.info, 2016; Temiraliev, 2015; Zozulinsky, 2010).

Table 1 shows a simplified electricity balance of the years 2008 to 2014, exemplifying what happens to the produced electricity.

Table 1: Electricity balance within Kyrgyzstan. (Data from Temiraliev, 2015)

Electric energy system, MM kWh	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Produced electric energy	11 790	11 092	12 074	15 195	15 167	14 011	14 639
Internal consumption	7 334	7 135	7 447	9 132	10 143	10 825	11 310

Import	102	52	116	174	177	29.6	36
Export	869	1 251	1 828	2 848	1 840	375	307
Losses	3 690	2 758	2 915	3 389	3 361	2 841	3 058

2.2.2 Energy usage

At the moment electricity is heavily subsidised by the Kyrgyz government, allowing it to be sold for 0.7 Som per kW (equivalent to 0.00981 CHF) for the first 1000 kW per month, then the prices double to 1.4 Som/kW. According to the World Bank Group only 2.3 to 2.6 percent of an average household's expenditure consists of electricity. If other energy costs are added (without alternative sources like firewood) households spent between 6.4 and 7% of their expenses on energy (World Bank Group, 2017).

Despite this allegedly low percentage of income spent on electricity, especially in rural areas electricity is still expensive enough that households have to find alternative ways of heating and cooking, such as wood, dung bricks or coal. According to 'Energypedia', while urban households use mainly electricity and natural gas for cooking (78%), only 35% of rural households used these as of 2010. Alternately, coal, wood, dung, charcoal or crop waste is used (see Figure 3) (Energypedia, 2015; World Bank Group, 2017). In these households up to 50% of the annual income is used on energy (Baibagyshov, Giger, & Meessen, 2013).

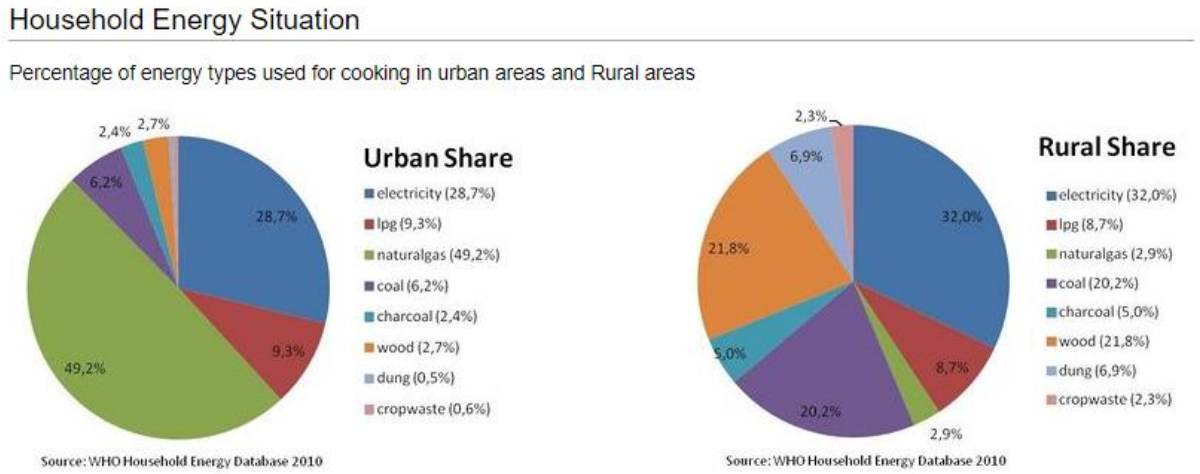
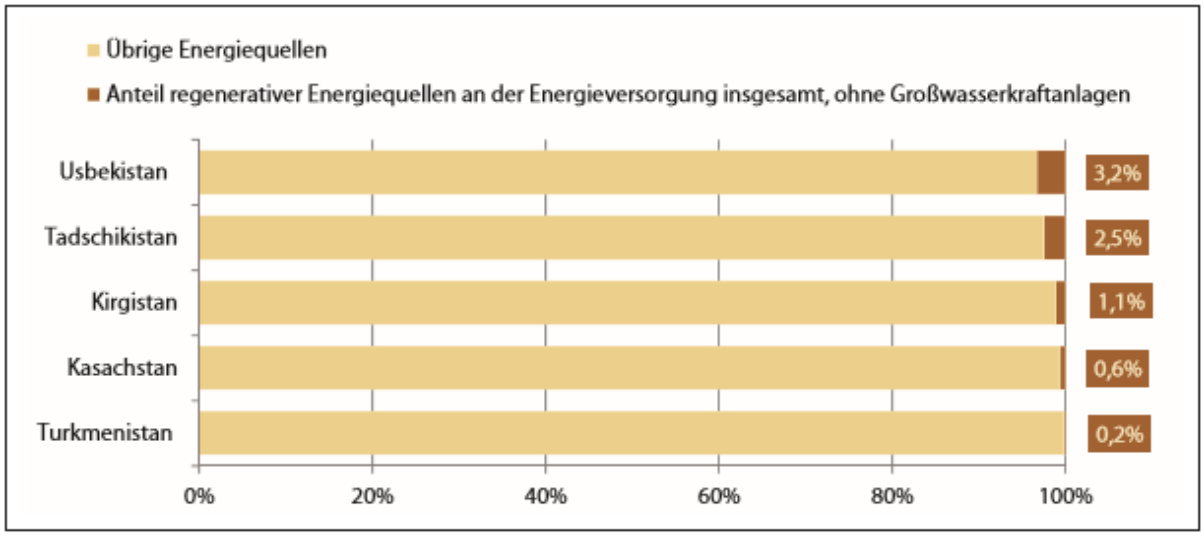


Figure 3: Household energy situation for cooking (Energypedia, 2015)

A recent survey done by the World Bank Group on public awareness of energy reforms showed that most households feel like energy is very expensive. 65% of the respondents said tariffs should be decreased (World Bank Group, 2017).

2.2.3 Renewable Energies

Like its neighbouring Central Asian countries, Kyrgyzstan has not implemented many renewable energy technologies. According to data from the UNDP, Kyrgyzstan has a total of 1.1% renewables, consisting only of small hydropower plants (not counting big hydropower plants). In comparison, the other Central Asian countries were somewhere between 0.2 and 3.2% by 2013 (data from 2010 to 2013) (see Figure 4) (Nabiyeva, 2015).



Quelle: UNDP (2014) Renewable Energy Snapshots: Kazakhstan <www.scribd.com/doc/224004894/Renewable-Energy-Snapshot-Kazakhstan>; *Kyrgyzstan;* <www.scribd.com/doc/224004908/Renewable-Energy-Snapshot-Kyrgyzstan>; *Tajikistan* <www.scribd.com/doc/224005031/Renewable-Energy-Snapshot-Tajikistan>; *Turkmenistan* <www.scribd.com/doc/224005040/Renewable-Energy-Snapshot-Turkmenistan>; *Uzbekistan* <www.scribd.com/doc/224005054/Renewable-Energy-Snapshot-Uzbekistan>

Figure 4: percentage of renewables without big hydropower plants. Source: (Nabiyeva, 2015)

Despite the lack of existing renewable energy systems, the potential is estimated to be big enough that 51% of the current energy demand could be covered by renewables, 20% would be technically feasible, and nearly 5% should be practicable in the next few years (Kaliyev, 2014).

Reasons for this underdevelopment of renewables, despite a lack of energy especially in winter, are stated to be the long-standing tradition of fossil fuels, the lack of faith in new renewable systems, high initial costs for any renewable energy plant, highly subsidised electricity costs, and no real incentive for RE development in general (Kaliyev, 2014).

Following is a brief overview of the most feasible RE sources with their estimated potentials.

Photovoltaics

The rough potential for photovoltaics in Kyrgyzstan is estimated to be around 267 000 MW with an average of 2,600 hours of sunshine per year and a solar radiation of 1,500–1,900 kW/m2 per year (Nabiyeva, 2015; Terenteva et al., 2009).

Hydropower

With its many rivers and streams, the potential for small hydropower plants is estimated to be between 1.6 and 1.8 thousand MW. Currently the entire 1.1% of renewables that is being used consists of small hydropower plants, and it is estimated that only 3% of the potential is currently in use (Kaliyev, 2014; Nabiyeva, 2015; Terenteva et al., 2009).

Big hydropower plants are already in use, with a huge potential for more. Figure 5 shows the main current hydropower plants, as well as planned ones and ones that are currently under construction.

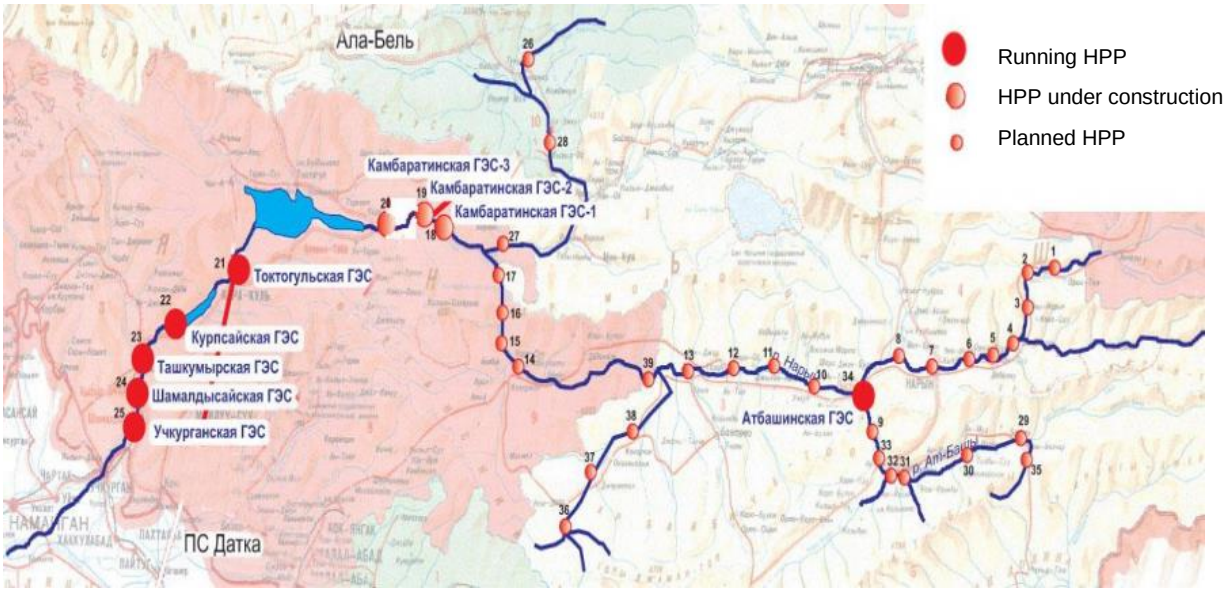


Figure 5: Active, under construction, and planned hydropower plants. (Temiraliev, 2015)

Wind energy

There are basically no studies on the potential of wind energy in the country, though there is a nationwide wind atlas, which shows that there are places with strong enough wind speeds for wind energy. The estimated technical potential is at 1.5 thousand MW (Nabiyeva, 2015; Terenteva et al., 2009).

Biogas

The potential of biogas is estimated to be at 200 MW. There are several biogas installations throughout the country, though about half of them are known to not be in use. Most of these biogas installations are constructed by individuals without proper design, manufacture or maintenance. They are mainly designed for producing gas for cooking and for fertilizers (Nabiyeva, 2015; Terenteva et al., 2009).

2.2.4 Energy efficiency

The potential of energy efficiency is also very big. A typical village house in Kyrgyzstan is built with no insulation on either walls, roof, floor windows or door. According to estimates and tests, up to 70% of household energy could be saved through proper house insulation or energy efficient stoves (Baibagyshov et al., 2013; Nabiyeva, 2015).

Figure 6 shows how much energy is lost from different parts of a house according to studies from the Center for Development and Environment (CDE) in Bern (Meessen, n.d.).

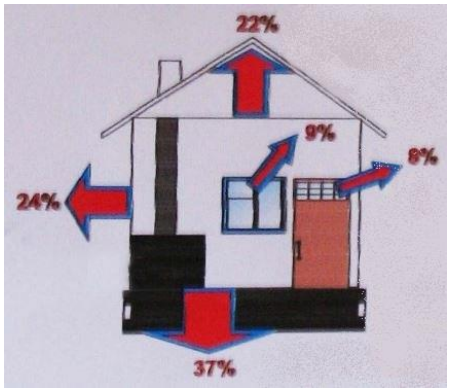


Figure 6: Estimated energy losses in a typical building (Meessen, n.d.)

3 Survey

With the background information, the survey was developed. This was done together with the contractor in charge of preparing the presentation for the world expo as well as with two local researchers who know the language and culture in Kyrgyzstan. One of the two researchers' lives close to the surveyed village, so he was able to help out a lot in regards to weather and local building and heating systems.

After starting with only a questionnaire, it was decided that a second, observational survey would also be prepared to help the researchers take notes on the building state as well as on any EE measures or implemented RE technology.

3.1.1 Survey development

There are different aspects to consider before being able to assess energy needs. They are summarized well by Reza Kowsari and Hisham Zerriffi in a paper titled "Three dimensional energy profile: A conceptual framework for assessing household energy use". In this paper they list economic possibilities, household size, age, education, income, behavioural aspects (such as what gets cooked), the physical environment (temperatures, weather, length of winter), various policies and regulations, energy supply factors (affordability, availability, accessibility and reliability of energy) and energy device characteristics (energy conversion technology, initial costs, adaptability to material already being used (i.e. cooking pots)) as important factors to consider before profiling a village. (Kowsari & Zerriffi, 2011)

All of these aspects were considered in the surveys, one of which was then adapted from D-Lab, a website from the Massachusetts Institute for Technology (MIT) (D-Lab, n.d.), the other, the observational survey, was written in accordance with what the researchers thought was relevant.

In the final version, the interview survey was split into several parts, the topics including: buying and supply chain, transportation, cooking, electricity access, lighting, heating and hot water (See appendix 1: survey 1A).

In every part questions to the current state of this topic were asked, as well as questions to possible future perspectives (i.e.: have you heard of energy efficient cooking stoves, would you be interested in learning how to build one). One of the thoughts behind this was trying to find out what reasons there might be for not changing the current situation.

The observational survey included any obvious EE or RE measures, but also had slots to write down what state the walls, windows, doors, floor and roof were in. A few questions were asked of the house owners, such as what year the house was built in, had there been renovations

since then, what materials are floor, walls, ceiling and roof made of, how thick are these elements, are there any obvious places where cold air comes in.

3.1.2 Survey location

The partner village for the pilot run of the survey was recommended by the chief secretary of AGOCA. He suggested Jergetal by Naryn, because it is within 3.5 hours drive from Bishkek, the capital city and headquarters of MSRI and AGOCA, easily accessible, and is a partner village of AGOCA with several running projects as well as several completed projects (see Figure 7).

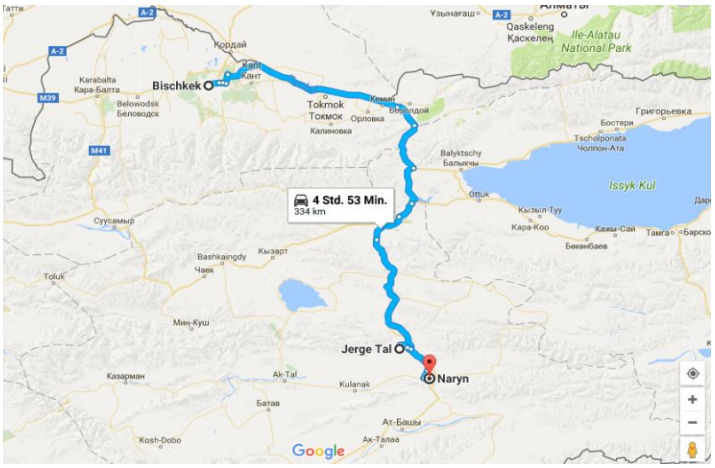


Figure 7: Jergetal location, with road Bishkek to Naryn. (Google Maps, 2017)

UCA also has a campus in Naryn with a few courses in renewable energies.

Jergetal is on the road between Bishkek and Naryn (see Figure 7) about 40 km from Naryn and 300 km from Bishkek. It is located at 2380m above sea level, and the winters are fairly long and cold. According to the village head (the local authority) a winter easily lasts six or seven months with temperatures going down to -40°C.

Jergetal is actually a village community, consisting of three villages: Jergetal, Jalgyz-Terek and Kara-Chii (see Figure 8: Jalgyz-Terek and Kara-Chii aren't visible on the map. Their rough location was added by the author). Among them there are 1136 households and about 5700 people, the majority of which lives from farming. Jergetal, the main village, was originally built by the soviets as a communal farm, which shows itself in its above average infrastructure, including wells and water pumps. Jalgyz-Terek and Kara-Chii were developed into villages later.

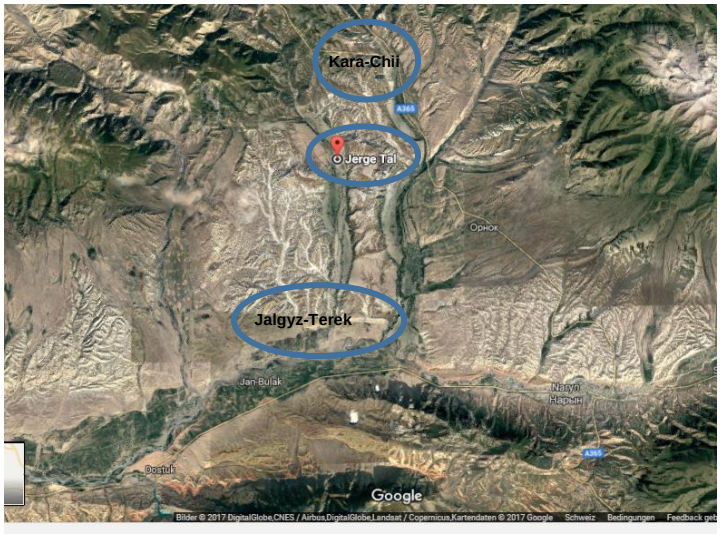


Figure 8: three villages of Jergetal (Google Maps, 2017)

Besides having cows, sheep and horses, the people plant potatoes, onions, and some wheat and barley for themselves to eat, as well as alfalfa for the animals. A lot of time in summer is spent on making hay for the animals and dung bricks to heat the houses in winter.

When money is needed, i.e. to pay for coal, electricity or general groceries, an animal gets sold to provide the necessary funds.

All the villages have at least one small local store, where villagers can buy sweets, tea, sugar or fresh fruit. The stores were described by all the interviewed households as very expensive and having only necessities, but very useful because the villagers can buy things on credit. This means that especially when there's feasts or occasions like weddings or funerals people can spontaneously buy what is needed and pay it back later, when the necessary means are available.

3.1.3 Survey execution

For the execution of the survey the author and a local researcher from MSRI spent 8 days in the village. Several extra days were spent in Naryn to prepare, finish translating, and print the surveys. Before actually going out to Jergetal the surveys had already been tested on a few people to see if the sequence was logical and the questions made sense. Only then was the preparation finished and the printing done.

After arriving in the village, the researchers, together with the driver, also a researcher from MSRI who comes from Naryn, started right away with asking people on the roads if they could be interviewed, or knocking on doors. The start was daunting, with most people saying no. This continued until the village head joined the group. Instantly the first three households invited the group in.

The Kyrgyz researcher would then ask the questions on the qualitative interview, taking notes and recording the interview. In the meantime the author would take notes on the building and state of the building, filling in the observational survey. After finishing the questionnaire and drinking tea the researchers would be led around the house, taking pictures of heating systems, kitchens, windows, or the homemade dung bricks that serve as fuel for heating and cooking, thus adding more information to the observational survey.

After the interview the surveyees always got a thank you gift consisting of chocolate and tea.

The following days the researchers spent finding households to interview and interviewing them. When it was only the two women interviewing, the rate of getting invited in was much higher than when the male driver/researcher joined, which happened on the first day and on the two days spent in Jalgyz-Terek. In Kara-Chii the driver's brother took over the task of bringing the researchers out to the village and back. He didn't join the researchers.

Out of the three villages, 16 households were interviewed, 8 in the main village Jergetal, and four each in Jalgyz-Terek and Kara-Chii. Per household roughly 1.5 hours were used – about 45 for the main survey, 25 for the observational survey and the rest for drinking tea or *kumis* (traditional drink made of fermented horse milk) and talking.

In order to get as much of a scope of the village as possible, households from various parts of the villages were interviewed, so that as many differences as possible might be noted. Figure 9 shows the households interviewed in Jergetal. All the houses in all three villages got recorded like this.

Figure 9: Map of Jerge-Tal with the surveyed houses marked

Not only different locations in the village, but also even amounts of men and women, as well as an even distribution between rich and poor families were sought for. Table 2 shows the range of the income level/wealth status, as judged by the surveyees themselves and by the researchers based on a comparison between the different households as well as the state of the building and visible property and equipment (i.e. a tractor, kid's toys, kitchen equipment).

Table 2: income level/wealth status of the interviewed households

Income level/wealth status	Stated by the surveyees	Judged by the researchers
Very poor	1	2
Poor	1	3
Medium	14	5
Rich	0	5
Unknown	0	1

For the most part the people were very welcoming and open about being interviewed, though often they were working and didn't have time. Especially the men were often out on the fields, which is why out of the 16 interviewed households only five were given by men. One was given by a husband and wife together, though the husband left halfway through.

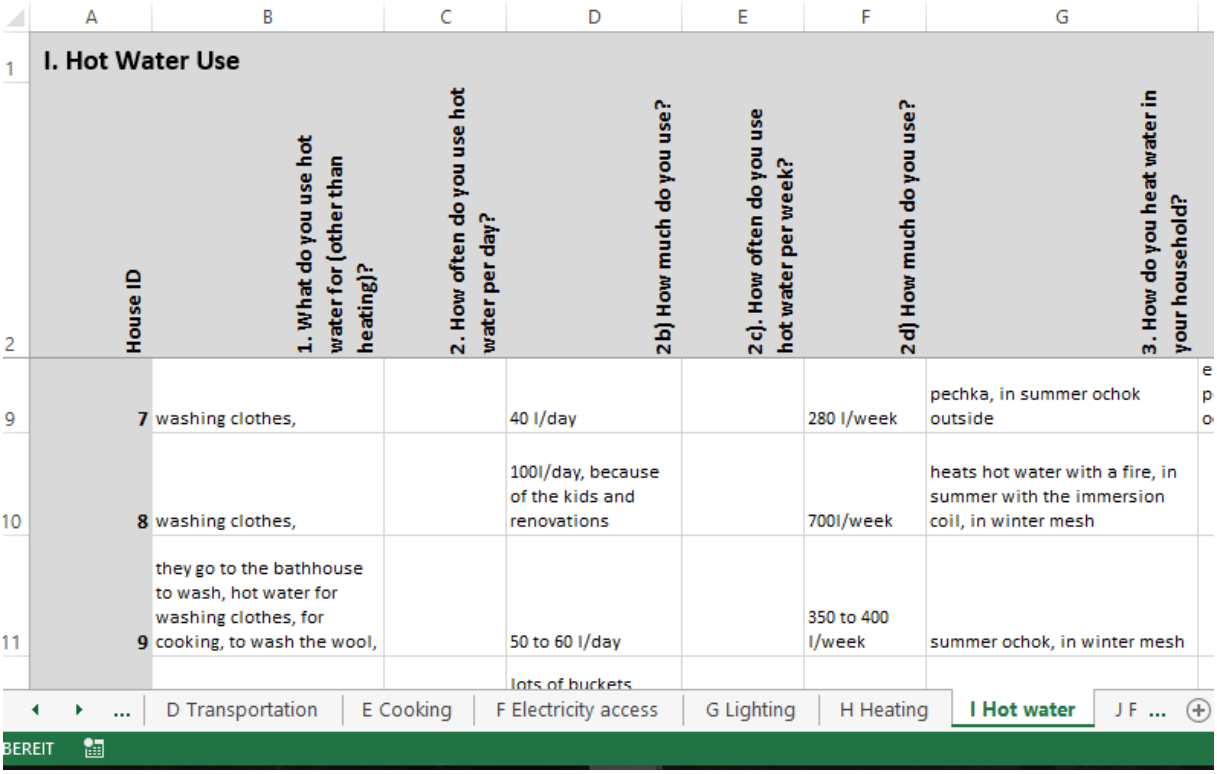
In all, eight days were spent in the village.

3.1.4 Data evaluation

Because the data was mainly qualitative, an evaluation system had to be used that portrayed the answers in a clear, logical way, at the same time still making it possible for data to be sorted according to certain answers or criteria.

Because only 16 households were interviewed, and because the author was most familiar with excel as a method of portraying results according to the necessary requirements, that is the program that was chosen.

Separate documents were set up for the observational survey and for the questionnaire, and the different topics each got their own excel page, so that i.e. heating had its own spreadsheet, as did cooking or the general condition and the infrastructure in the observational survey. Each household got an ID, so that the data could be assigned unambiguously to the other spreadsheets, to the other survey, and to the photos taken. Figure 10 gives an example of one of these spreadsheets.



	A	B	C	D	E	F	G
1	I. Hot Water Use						
2	House ID	1. What do you use hot water for (other than heating)?	2. How often do you use hot water per day?	2b) How much do you use?	2c). How often do you use hot water per week?	2d) How much do you use?	3. How do you heat water in your household?
9	7	washing clothes,		40 l/day		280 l/week	pechka, in summer ochok outside
10	8	washing clothes,		100l/day, because of the kids and renovations		700l/week	heats hot water with a fire, in summer with the immersion coil, in winter mesh
11	9	they go to the bathhouse to wash, hot water for washing clothes, for cooking, to wash the wool,		50 to 60 l/day		350 to 400 l/week	summer ochok, in winter mesh
				lots of buckets			

... | D Transportation | E Cooking | F Electricity access | G Lighting | H Heating | I Hot water | J F ...

BEREIT

Figure 10: example of data entry spreadsheet

The data was verbally translated and simultaneously entered into the spreadsheet in English.

4 Results

After the results of both the questionnaire and of the observational survey were translated and entered into an excel spreadsheet, they were summarized to portray an average house in Jergetal. This average house is described in the next chapter to give an overview of the situation.

All the data used to describe it comes from the surveys, from personal observations, or from speaking with the locals.

Living space

Most households consist of around 4 to 8 people – the mother and father, their youngest son (who is bound by tradition to take care of his family) and his wife – called the *kelin*, who is in charge of all the work in the household – and several children.

Figure 11: one of the interviewed households in Jergetal

The houses consist of two to six rooms – an entrance, a kitchen/dining room/living room, and a couple of sleeping or living rooms. The outhouse is usually located far enough from the house to keep the smell and insects away.

A couple of the houses have running water in the house – though the water tank needs to be refilled manually. The other households carry the water from the closest pump or a creek.

When asked what the main tasks of the day were, the response was usually: *tirichilik* (all work related to house, garden, fields, cattle). This consists mainly of baking, getting and heating water, maintaining the fire while cooking for the women and field work (irrigation, weeding, and making hay and dung bricks) for the men.

Building

An average house in Zhergetal will be built out of bricks made of *kirpitsch* (see Figure 13 and Figure 12). Kirpitsch is a mixture of clay and straw, mixed and pressed in a form, roughly 12 x 15 x 25 cm. These bricks are then left to dry for two to five days. After the walls are made the cracks are filled with clay, then the walls are whitewashed on both the inside and outside. Usually there is no further insulation, though often carpets are hung on the walls to help against the cold.

Figure 13: kirpitsch bricks being made. Front: mixture of clay and straw, back: bricks laid out to dry

The average floor consists of wooden boards placed 30 to 50 cm above the ground. There too no insulation is added except carpets. The ceiling is similar to the floor: wooden boards, then an open space under the roof. Though everyone said that there was nothing above the boards, some of the ceilings looked like they had a layer of clay on top.

Figure 12: house being built

The roof is made of wooden beams, usually about 12 x 15 cm, then the older and poorer houses had eternit plates on top, the newer and richer ones had switched to metal sheets (see Figure 14: roof structure).

Figure 14: roof structure

The windows are usually double pane, with about 4-6 cm of space in between. Basically all of them are cracked, some broken, most covered or fixed with scotch tape. The window frames are usually wood, often in similar shape as the windows: old, broken, set directly into the walls. Often there were cracks between the window frames and the walls, sometimes filled with newspapers, often not (Figure 15).

Figure 15: Window set directly into wall

The doors were usually wood, roughly 3 to 5 cm thick. These, as well as the door frames were often old, crooked and cracked. Almost always the houses had a separate porch, with a door to the outside and only then from this room into the actual house. We were told that often people hang curtains in the entry ways in winter for added protection.

Figure 16: mesh for cooking and heating in winter

Heating

Often families close off part of the house in winter to minimize heating spaces. The houses are mainly heated by fire, with coal or homemade dung bricks as fuel, usually with a *mesh* – a stove that is placed in the wall between two rooms, conveniently heating two rooms at the same time as showed in Figure 16. Some of the newer and richer houses have a *pechka* with a hot water battery system. This is a stove that heats water which then gets pumped around the house and is used to heat the rooms (central heating).

Sometimes families will use electric heaters for extra warmth, but very few households said they were able to do that regularly because the electricity was too expensive.

Cooking

All of the surveyed households have a *plita*, which is a small, single or double plated electric stovetop (Figure 17). In addition most of the households have an equally small electric oven. Both of these get used regularly in summer and when there's enough electricity. Otherwise and more traditionally, food gets cooked on the mesh in winter, when it's used for heating anyway, and in a big outdoor kitchen in summer, called the *ochok*, also with fire (Figure 18).

Figure 17: Electric plita

Especially when the electricity is not too reliable, heating water for tea is a big job. Even if it does get heated with electricity it usually takes a very long time, which is why the old *samovar* still gets used often: this is a big kettle with a hole in the middle, in which a small fire is made.

Figure 18: Ochok for cooking in summer (kitchen in a separate building)

Fuel

The main fuel for fires is coal or dung bricks. The coal gets delivered directly to the villages by trucks, where the villages can buy whatever they need and are able to pay for at that moment. One ton costs between 3500 and 4000 som, the surveyed households used between two and seven tons each winter.

Figure 19: Dung bricks stacked to dry

The dung bricks are homemade. When the animals go up into the *jailoo* (mountain pasture) for the summer, the dung from the winter gets cut and dried, then stacked in a dry place until it is used to heat or cook (Figure 19).

Electricity

The electricity in all the surveyed villages was said to be fairly reliable and steady, though weak at times. They get it from the grid, mainly through old transformers left over from soviet times (see Figure 20). In the houses it is used mainly for lighting, refrigeration, cooking, baking, charging cell phones and watching TV, though some of the richer households had devices like electric heaters, semi-automatic washing machines and vacuum cleaners.

Figure 20: transformer in Jergetal

The electricity costs 0.7 Som for the first 1000 kW per month, then the cost doubles to 1.4 Som. The surveyed households spend between 100-600 Som per month in summer and between 200 and 5000 Som per month in winter on electricity.

Even though the electricity was said to be reliable, people also often complained about voltage fluctuations. One family tried to serve us tea and it took the water well over an hour to heat in the electric kettle. They said that was because the electricity was weak at the moment. Another family said that just recently they had to replace all their electric devices because the voltage suddenly got so high that all the devices broke from a short circuit. As one man said: “We have a transformer –there’s 4 or 5 in the village - that has too high voltage, that's why sometimes there's sparks. That's a problem because we have 1 refrigerator, 2 tv sets and one vacuum cleaner that were burned out because the cables sparked. The problem is that the cables and transformer is very old. The second problem is that lamps burn out really fast. We use 10 light bulbs per month because they burn out so fast because of the high voltage. We don't have a regular level of electricity, it always goes up and down. They need to change the equipment…” (Survey 1A, Question B8)

There is also no street lighting or other lighting within the village, even though there was lighting during the soviet times.

Hot water

The main way of heating water is on the fire, meaning on the ochok in summer and on the mesh in winter. It is used for bathing, and for washing clothes, dishes and other small things around the house. The households used between 10 and 100 l of hot water per day, though the family that used 100 l said they only needed so much right now because of the children and because they were renovating the house. One of the households stuck out: they had a hot water heater, an *ariston*, as they are called after the only available brand. Pretty much all the

families said they wished they had an ariston, and this family also used a good deal more hot water: 300 l/day.

For their personal hygiene, the families would go to the public *bagna* about two or three times per month. This is a small sauna where the people will sit inside for about half an hour, after which they can scrub off all the dead skin and dirt, as well as use water and soap for washing. Here too one of the families stuck out by having their own private bagna (a different family than the one with the ariston).

Besides this, there are two main reasons for heating water, both were mentioned in previous chapters: for one, heating the houses with hot water pipes, the other is for tea. According to almost all the households heating water for tea is a main task during the day. This is done either with electricity on the plita, in an electric kettle, or with the samovar.

4.1.1 Other results

Besides the expected results and answers given in the surveys, two other things kept being mentioned. One of them was water.

The question from A1 B8 was “Are there any needs related to energy in your community?” but instead of talking about energy needs, at least half of the households mentioned that they had no pure water. After talking with the community head and other surveyees it was established that while the main village of Jergetal has water pumps in several locations, they are still only in certain parts of the village, and still need to be carried fairly far for some households. That’s still better than the other villages: both Jalgyz-Terek and Kara-Chii have no access to clean water. At the moment they get their water from ditches, open canals and the river On Archa.

Something else that came up several times in conversation was health care. There is a *feldsher* – something like a paramedic or a nurse – in the village, but she isn’t allowed to sell any medicine. She inspects the patient, consults them and writes prescriptions. The patient then has to take this prescription and go to either Naryn or Bishkek to get what he or she needs.

4.1.2 Energy efficiency courses through CAMP Alatoo

The village head as well as a professor from the Naryn University talked about energy efficiency courses that had been done in Jergetal. Research showed that CAMP Alatoo, the parent organisation of AGOCA, had conducted courses and research in this area in 2011 together with several international partners. At least 140 houses in the Naryn region built new

energy efficient stoves and insulated or partially insulated their buildings. (Baibagyshov et al., 2013; *CAMP Alatoo Annual Report 2011*, 2011.)

5 Discussion

The survey had to be adjusted in several ways both during and after the initial survey execution.

Already during the first few interviews people complained about the questions “Have you heard about new or alternative technologies for … [heating, lighting, cooking etc.]”, “Would you like to/or are you planning to try any of these?” “Why would you like them?” and “What would you use them for?”. They claimed, rightfully, that they were repetitive and always the same. And since always the same answers were given, disregarding the current topic, all those questions were summarized and put at the end of the survey.

In section G, “Lighting” the questions 4 and 5 (“How much MONEY does your household spend per month on lighting?” and “Where does your household buy fuel/energy or equipment for your lighting?”) were taken out because with question 4 people didn’t know because it is a fairly small part of the electricity bill, and question 5 the fuel/energy was always electricity anyways, and that had already been asked.

Later during translation and data entry a few other things came up that needed to be adjusted.

For example there were questions to which the answers didn't match up at all, showing that they had not been understood properly. For example to the question “What date do you usually start heating in the wintertime” (see Appendix 1: Survey 1A Question H2a) people gave answers such as “November to March”, which usually ended up being the same as the following question (What months of the year do you generally use heating? (1A H3).

There were also questions which, despite the survey being carefully tested with locals before using it, seemed inappropriate or just not answerable. Sometimes the surveyees clearly showed that they did not like the questions or even thought them insulting. For example some responses to the question “Since when have you been using your primary source of electricity?” (Survey 1A Question F5) were:

- “since my mother gave birth to me”
- “since ancient times”
- "go away with your questions!"
- “hahaha”
- “Since there is electro energy. Stupid question.”

A couple of the questions were consistently answered differently than intended or not answered at all. Some of them were probably translated differently, while others were simply

not clear enough. For example question F4 from 1A: “How many hours per day does your primary source of electricity provide you with electricity?” was consistently answered with statements to the reliability of the electricity. For example one person said: “when the transformer doesn't work the electricity gets turned off until evening. In the evening they give electricity”. Another response was “They have no problems with electricity, it is reliable. They had problems 2 years ago, the electricity turned off. Now they have no problems with the electricity, only with the high voltage. They need more steady electricity”. Though this wasn’t how the question was intended, it did somehow reveal the answer: “it provides us with electricity all day unless there’s problems.”

Some of the questions came across as very repetitive. For example the question was asked how much money is spent for energy for cooking, the same for heating, for electricity access and for lighting. Usually these were the same answers, since people either wouldn’t know the percentage of how much energy was used for what, or since especially for heating and cooking in winter the same fuel was used.

The observational survey also proved to be much more extensive than was useful. Before going into Jergetal the researchers had been told that most people used a different house for winter and for summer, with the winter one being much smaller so that there was less space to heat. So the observational survey was prepared with two houses per household: one for the winter house and one for the summer house (see appendix 2: Survey 1B). Out of the 16 households interviewed all but two said they used the same house all year round. Of the two that said they didn’t, one family was on the jailoo, the mountain pasture, all summer so they counted that as the second house, and the other family said that they had a separate building for cooking in summer because otherwise it got too hot in the house.

This misinformation led to a lot of extra paper being printed and carried along that was never used.

Another section that was deleted out of the observational survey was the room size (section C), since this information doesn’t seem to be necessary to assess the energy situation, and also made people uncomfortable if they noticed how detailed the information gathered was.

What was changed in the observational survey was section F, Animal housing was that a question was put in as to how many animals there are, since that could be useful for both assessing income/wealth level and potential for i.e. biogas.

6 Conclusion and Outlook

6.1.1 Method

The point of this project was to develop a method to help a Kyrgyz village work towards the SDG energy goals. In the process of the project the authors developed a survey based methodology that would be practically feasible to roll out even in the geographic, developmental and cultural context. With this methodology, a village can assess its current energy usage and develop methods with which it can apply targeted measures to work towards accessible, reliable and affordable energy as well as ameliorate the situation with the share of renewables, energy efficiency, energy technology and energy infrastructure.

The developed survey covers the whole range of energy usage, including things like energy infrastructure. It also includes an observational survey, which is helpful especially if the surveyor is experienced in the field of energy. That way not only local people's opinions are used, but also a comparison with the outside world can be made.

During the development and testing of the survey, several challenges had to be faced, such as the fact that Kyrgyzstan has a wide range of geographical landscapes, which means that the survey has to be broad enough to cover the different climates, temperatures, stages of development, and also cultural differences. At the same time it had to be specific enough that concrete measures can be drawn out of its results.

Another major challenge was the language barrier. Conducting the survey only works via a translator or a local researcher. In the case of the test village it was done by a local researcher, which meant that questions through the author weren't possible until later, when the data was being translated and transcribed. At that point it was too late to ask more specific questions or go deeper into certain topics.

A question that would also have to be thought about is, should the survey be done on paper, as it was in the test village, or in some electronic form. The paper version took several days for entering data after collecting it, and when some of the questions were modified during the testing everything had to be done by hand, as there was no access to a printer. IPads for writing down information during the data collection could cut down on the time a lot, provided the village has the necessary energy infrastructure for charging them. If the survey were to be done electronically the question of language would still have to be answered: should the data be entered in the language in which it was given, which would mean that it still has to be translated later, or it could be entered directly in the language in which it would be used later, which means that it would still need a translator rather than a local researcher.

What also has to be kept in mind while planning the survey execution is the necessary time frame. While the questionnaire took about 35 to 50 minutes in the test village and the observational survey roughly 15 to 25 minutes, extra time always had to be planned for drinking tea or kumis. In addition not all the households said yes to being surveyed, and some didn't properly finish it, so extra time had to be calculated for finding households to interview. Some times of the day weren't good for doing the survey because people were eating, preparing for the day or out working, which also had to be considered.

In the test village between two and five surveys were done per day. On average a household took between 1.5 and 2 hours. Presumably 8 to 10 surveys per village would be enough, since all of them gave very similar answers. What was interesting was the differences in answers that were given by men and women, and also the different opinions and perspectives given by rich and poor households were worth noting.

6.1.2 Survey

The survey showed that the test villages are connected to the central grid (Appendix 1 Survey 1A), the grid is good and electricity is fairly stable and usually reliable. Despite, or maybe because of the low electricity costs, a major part of a rural family's income is spent on energy (electricity and coal), and it is felt to be fairly expensive.

Because of the low income in most of the families (Appendix 1, section B), the investment costs of renewable energies may be a big hurdle towards renewables, as well as the lack of information. If renewable energies were to be implemented, it would have to be, as much as possible, done with local materials and costs would have to be kept as low as possible in order to be carried by the villagers. But since the electricity from the grid is fairly good and comes mainly from centralized hydropower plants, therefore already consists of clean energy, it would most likely be more effective to change the soviet-age transformers to keep the voltage more stable and to renew the power lines to stop the regular power outages (section F).

With this situation, implementing renewable energies doesn't seem to be a major priority right now. Rather, finding ways to lower the energy consumption and therefore energy costs would be more urgent and would show the bigger impact. Because the houses are made out of kirpitsch and aren‘t insulated at all, the energy efficiency rate is very low.

The energy consumption can therefore be lowered through energy efficiency, and since there are technologies for insulating houses with local materials and energy efficient stoves have

been installed or even built by locals, this still seems to be the best way to work on the energy problems in Jergetal (Appendix 2, Observational survey)

Of course then the question would have to be raised of why CAMP Alatoos previous attempts at energy efficiency courses didn't succeed. What would have to be done differently for these courses to make a difference and how could villagers be moved to do something about these huge energy losses?

However, even while looking at possible measures to work on energy needs, there are other topics that kept coming up in the survey that beg for attention. For one, the topic of clean water came up over and over again (i.e. A1 B8) even though it wasn't even directly asked for. According to villagers, there are groundwater resources in both Kara-Chii and Jalgyz-Terek, but no one has actually ever attempted to dig a well or to lay water pipes.

Another topic that came up was healthcare availability. Again according to villagers, there is only one doctor in the area, and she isn't allowed to sell any medicine. All she is allowed to do is inspect the patient and recommend the proper medicine. The patient then has to take this prescription and go to either Naryn or Bishkek to get what he or she needs.

6.2 Outlook

6.2.1 Method

As a next step, the adapted survey will be given back to MSRI and AGOCA. In order to refine it as a baseline survey that can be used by villages around Kyrgyzstan, it is recommended that the survey be tested on at least two more villages, preferably in areas that have very different climatic conditions than the Naryn region, such as Batken, Issyk-kul, Osh or the Bishkek region. Through this extra testing the survey can be further developed so that irrelevant questions or topics are dropped or others added.

In the end the survey should be able to be applied in partner villages of AGOCA or other organizations to check the status of energy and renewable energies. With the results of the survey a path could then be developed to help that village to improve its situation.

6.2.2 Survey

As to the results of the survey, an important next step would be to do further research on why previous attempts at implementing energy efficient house insulation and stoves in Jergetal didn't work. A method of doing that would be to find the houses that actually got insulated, as well as people who participated in the courses, and finding out what happened after the

courses. Did they change things, did they pass on the information, do they notice a difference in their own homes?

Renewable energies in general could also be looked at more in detail. Tests and measurements could be done to assess resources such as hours of sunshine, water flows for small or micro hydropower plants or wind speeds. Using available village passports (information and statistics on villages) potential for biogas could be assessed or some method of studying the village's financial situation or the villager's income could be added. This would then give a clearer picture of the actual feasibility of renewables.

The social aspect of this should be studied. What would have to be done before renewables would have a bigger chance of actually getting implemented: would they have to be cheaper, or would people just have to have a steadier, higher income? Is it mainly the information that's missing? Or is there simply no incentive to change anything, because it does work the way it is? Since electricity has become fairly stable, are there more important topics to look at?

List of sources and references

Advantour. (2017). Kyrgyzstan Glaciers [Travel Agency]. Retrieved July 7, 2017, from http://www.advantour.com/kyrgyzstan/glaciers.htm

AGOCA. (2017). Альянс горных общин Центральной Азии (АГОЦА). Retrieved July 7, 2017, from http://agoca.kg/

Anderson, J. (1999). *Kyrgyzstan: Central Asia's Island of Democracy?* (1 edition). London: Routledge.

Antipova, E., Zyryanov, A., McKinney, D., & Savitsky, A. (2002). Optimization of Syr Darya Water and Energy Uses. *Water International*, *27*(4), 504–516. https://doi.org/10.1080/02508060208687038

Astana Expo. (2017). EXPO 2017 Astana. Retrieved August 21, 2017, from https://expo2017astana.com/en/page_id=582

Baibagyshov, E., Giger, M., & Meessen, H. (2013). ENERGIESPAREN AUF GRASS-ROOTS-EBENE IN KIRGISTAN. *Zentralasienanalysen*, (Nr. 66).

Bonanomi, K. (2016, November 19). «Label Energie-Stadt»: der neue Schweizer Export-Renner. *Radio SRF Trend*. Retrieved from http://www.srf.ch/sendungen/trend/label-energie-stadt-der-neue-schweizer-export-renner

CAMP Alatoo Annual Report 2011. (n.d.).

CIA. (2017, June 21). The World Factbook — Central Intelligence Agency. Retrieved July 7, 2017, from https://www.cia.gov/library/publications/the-world-factbook/geos/kg.html

D-Lab. (n.d.). D-Lab's Off-Grid Energy Group | D-Lab. Retrieved August 12, 2017, from https://d-lab.mit.edu/off-grid-energy

easttime.info. (2016, August 28). Kyrgyzstan Cuts Electricity Losses In The Power System | http://easttime.info. Retrieved August 31, 2017, from http://easttime.info/news/kazakhstan/kyrgyzstan-cuts-electricity-losses-power-system

EDA. (2016, November 10). Agenda 2030 für nachhaltige Entwicklung. Retrieved August 21, 2017, from https://www.eda.admin.ch/agenda2030/de/home/agenda-2030/die-17-

ziele-fuer-eine-nachhaltige-entwicklung/ziel-7-zugang-zu-bezahlbarer-verlaesslicher-nachhaltiger-und.html

Energypedia. (2015, December 9). Kyrgyzstan Energy Situation. In *Energypedia*.

Hall, K. p. (2016). *Investigating the energy crisis in post-Soviet Kyrgyzstan: How could technical innovation support a transition to sustainability?* University of Eastern FInland.

Hays, J. (2013). CENTRAL ASIA AFTER THE BREAK UP OF THE SOVIET UNION | Facts and Details. Retrieved July 7, 2017, from http://factsanddetails.com/central-asia/Central_Asian_Topics/sub8_8d/entry-4521.html

IEA, I. E. A. (2017). WEO - Energy access database. Retrieved August 21, 2017, from http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/

Kaliyev, A. (2014, April 14). Scaling-Up Renewable Energy Program for Low Income Countries (SREP). Letter.

Karekezi, S., Lata, K., & Coelho, S. T. (2004). *Traditional Biomass Energy: Improving its Use and Moving to Modern Energy Use*. Bonn: International Conference for Renewable Energies.

Kleingeld, E. (2015). *Third party involvement in fostering transboundary cooperation in Central Asia*. Linnegatan 87D, Stockholm: Global Water Partnership.

Kowsari, R., & Zerriffi, H. (2011). Three dimensional energy profile: *Energy Policy*, *39*(12), 7505–7517. https://doi.org/10.1016/j.enpol.2011.06.030

Meessen, H. (n.d.). *Energie-Effizienz im ländlichen Raum Kirgistans*. CDE/Uni Bern. Retrieved from file:///C:/Users/Elizabeth/OneDrive/ZHAW/Semester%206/Bachelorarbeit/Research/Energieeffizienz%20im%20ländlichen%20Raum%20Kirgistans.pdf

Nabiyeva, K. (2015). Energiewende in Zentralasien? Neue Entwicklungen bei Erneuerbaren Energien und Energieeffizienz. *Zentralasienanalysen*, (Nr 89). Retrieved from http://www.laender-analysen.de/zentralasien/pdf/ZentralasienAnalysen89.pdf

Sinor, D., & Allworth, E. (2017, April 5). Kyrgyzstan | People, Language, & History | Britannica.com [Encyclopedia]. Retrieved July 7, 2017, from https://www.britannica.com/place/Kyrgyzstan

Temiraliev, U. (2015). *ENERGY SECTOR OF KYRGYZ REPUBLIC OVERVIEW*. Retrieved from http://www.energycharter.org/fileadmin/DocumentsMedia/Events/KICW_Brussels_2015_P4_Temiraliev.pdf

Terenteva, O., Jorde, D. I. K., & Biegert, A. (2009). *Regional Reports on Renewable Energies: Kyrgyz Republic*.

UCA. (2017). Mountain Societies Research Institute - University of Central Asia. Retrieved August 30, 2017, from http://www.ucentralasia.org/Research/MSRI

UNDP. (2013). *Naryn Area - Based Development Programme, Kyrgyzstan*. Bishkek. Retrieved from https://info.undp.org/docs/pdc/Documents/KGZ/PRODOC%20Naryn%20ABD_Feb%2714.pdf

UNDP. (2017). Background of the Sustainable Development Goals. Retrieved August 21, 2017, from http://www.undp.org/content/undp/en/home/sustainable-development-goals/background.html

United Nations. (2017). United Nations sustainable development agenda. Retrieved August 21, 2017, from http://www.un.org/sustainabledevelopment/development-agenda/

United Nations Development Programme UNDP. (2017). GOAL 7 TARGETS. Retrieved September 22, 2017, from http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-7-affordable-and-clean-energy/targets/

Weltdatenatlas. (2017). Kirgisistan GDP per capita based on PPP, 1980-2016 - knoema.com. Retrieved August 22, 2017, from http://knoema.de//atlas/Kirgisistan/GDP-per-capita-based-on-PPP

World Bank. (2017). Kyrgyz Republic | Data. Retrieved August 22, 2017, from https://data.worldbank.org/country/kyrgyz-republic?view=chart

World Bank Group. (2017). *Kyrgyz Republic: Economic Update. A resilient economy on a slow growth trajectory*. Macroeconomics & Fiscal Management Global Practice. Retrieved from http://documents.worldbank.org/curated/en/710331496766602711/pdf/115684-WP-PUBLIC-add-series-SpringKGZBEUFinal.pdf

Zozulinsky, A. (2010). *Kyrgyzstan: Power Generation & Transmission*. Retrieved from http://photos.state.gov/libraries/kyrgyzrepulic/328656/pdfs/Kyrgyz%20Power%20Industry%20Report%20_2_.pdf

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Appendix 1: Survey 1A

1A Household qualitative interview (v1.0).docx

Approximate time: 65-85 mins

Give general overview of the study and get consent. *(Please tick boxes below)*

- ❑ I have explained the research and purpose of the study to the participant
- ❑ I have explained that the information will be kept confidential and will be stored in a secure place
- ❑ The participant has given her/his consent to participate in this survey
- ❑ I am recording the interview with a voice recorder (please speak into the voice recorder the number of the household)

A. IDENTIFICATION AND BASIC DEMOGRAPHICS

1. Interview date: _____
2. Interviewer name: _____
3. Respondent name: _____
4. House no# (assign to match photos): _____
5. Community (which village in Zhergetal?): _____
6. Location of household (centre, fringe): _____
7. Gender: Male / Female
8. Age of respondent: _____

B. GENERAL HOUSEHOLD ASSESSMENT (10 minutes)

I would like to ask some questions about your household

1. What is your position in the household?
   [Example: Father / Mother / Son / Daughter / Grandfather / Grandmother / Other]

2. How many people live in your household?

3. How many people are under 18 years old?

4. What is the primary source of livelihood or income in your household?

5. Within Zhergetal, how would you classify your household income level? E.g. Does your household earn more, less, or the same as the average household in Zhergetal?

6. Do you or others in your household have any other jobs or roles in the community?

7. I’d like to understand more about your day-to-day life. Can you tell me what you do during a typical day? [**Bullet point please; this is to probe for energy-related activities]**

    a. What is your most time-consuming task?

8. Are there any needs related to energy in your community?

C. BUYING BEHAVIOR AND SUPPLY CHAIN (5 minutes)

1. Where do you buy most of your household products?
   [Prompt with examples if needed: a new type of soap, cooking fuel, appliances, etc.]
   [Write down the name of the business and the location if possible]

    a. What type of products do you buy at this location and why?

    b. How long does it take you to get to this location? [Enter in hours or minutes]

    c. What type of transportation do you use to get there?

    d. How often do you or someone from your household go to this location?
       [Enter in number of times per day or week or month]

2. What other options are available for buying household products?

    a. Why don't you shop at these locations?

3. Who makes most of the buying decisions in your household?

D. TRANSPORTATION (5 minutes)

1. What are all the types of transportation that your household uses?
   [Enter as many answers as given]

2. Which is the ***primary (main)*** type of transportation? [Select one of the above]

3. What does your household use these types of transportation for?
   [Ask for all types of transportation mentioned]

4. How much MONEY does your household spend per week on transportation related expenses (fuel or fees)? [Ask for all types of transportation mentioned]
   [Enter the time units the respondent uses, conversion will be made during data analysis]

5. Would you prefer another type of transportation?
   [If no, enter “none”]
   [If yes] What other type of transportation would you prefer?

    a. [If yes] Why would this type of transportation be beneficial to your household?

E. HOUSEHOLD COOKING (5-10 minutes)

1. What do you use for daily cooking in your household?
   (ie what appliance, e.g. cooking stove with gas burner; *pechka* with wood, otchok, mesh)
   [List all mentioned; ASK: "in winter and in summer?"]

Summertime: …

Wintertime: ….

Autumn: ….

Spring: …

2. Since when has your household been using this cooking equipment (pechka, kazan, gas stove)?
   [Enter the number of weeks, months, or years]

3. Did you buy this cooking equipment (kazan, pechka, gas stove)? [Yes or No]
   [NB: fuel is asked later]

   a. [If they bought it:] How much did the cooking equipment (kazan, pechka, gas stove) cost?

   b. [If they bought it:] Where did you buy this cooking equipment (kazan, pechka, gas stove, etc)?

4. Who is responsible for cooking meals in your household?

5. How many hours do you or someone in your household spend cooking on a typical day?
   [Enter the total number of **hours** spent cooking in one day;
   ASK: “in winter and in summer?”]

6. What types of cooking fuel/energy (e.g. wood, gas, electricity) does your household use?
   [List all the fuels mentioned; ASK: “in winter and in summer?”]

Winter: …

Summer :...

Autumn: ...

Spring: …

7. How much of this ***primary*** fuel/energy does your household use per season/ per month (kW, tons of coal, of dung brick, etc)?
   [Write answer in the units respondent uses; ASK: “in winter and in summer?”]

   Summer:

   Winter:

8. Do you buy this (***primary***) fuel/energy? [Yes or No]

   a. [If they buy] Where does your household buy this fuel?

b. [If they buy] How much does your household spend per week (or per month) on this fuel/energy?

c. [If they do NOT buy] Where does your household get this fuel/energy?

d. [If they do NOT buy] How many hours a week does someone from your household spend to get this fuel?
[Write answer in the units respondent uses: hours/day, hours/week, days/year, etc.; ASK: “in winter and in summer?]

e. [If they do NOT buy] Do you buy a ticket/licence for collecting wood? If yes, how much do you pay for this ticket?

9. In **recent years/the last 12 months**, has your household had difficulty with access to cooking fuel/energy for your *primary* cooking source?
[Yes or No; ASK: “in winter and in summer?”; PROMPT: last 12 months, and further back (up to 2000)]

    a. [If yes] What months of the year did you have difficulty with access to cooking fuel/energy? [Enter specific months]

    b. [If yes] What was the reason that you had difficulty accessing this cooking fuel/energy?
    [Examples: supply, income, family emergency, etc.]

10. Can you show us the place where the cooking is done for your family? [ASK: “in winter and in summer?

11. What are the things you ***like*** the most about your current cooking situation?
[If nothing is liked, enter “none”]

12. Is there anything that you would like to change about your cooking situation? If so, what?
    [If no changes desired, enter “none”]

F. HOUSEHOLD AND COMMUNITY ELECTRICITY ACCESS (5-10 minutes)

1. What are the sources of electricity in your household?
   [Prompt with examples if needed: electricity grid, generator, battery-inverters, disposable/rechargeable batteries, solar lantern/panel/home system, or none; ASK: “in winter and in summer?”]

2. What is the ***primary (main)*** source of electricity in your household? [Select one of the above; ASK: “in winter and in summer?”]

   Summer:

   Winter:

3. What does your household use these electricity sources for?
   [e.g. lighting, TV, cooking, heating; ASK: “in winter and in summer?”]

   Summer:

   Winter:

4. How many hours per day does your ***primary (main)*** source of electricity provide your household with electricity? [PROMPT: in different seasons]

   In winter: …

   In summer: ...

a) What time of day do you use the most electricity? (e.g. “when do you use the most electricity at one time, e.g. ‘in the morning before breakfast’ or ‘at night when I’m cooking and we’re watching TV, etc’)

5. Since when have you been using your ***primary (main)*** source of electricity in your household?
   [Enter weeks, months, or years, the units will be converted during data analysis]

6. Where does your household buy your ***primary (main)*** source of electricity? (Who do you pay for your electricity)? (e.g. ‘I pay the head of the Ail Okmotu at the Ail Okmotu’)

   Pay where?:…

   Pay to whom?:…

7. How much MONEY does your household spend on your ***primary (main)*** electricity source?
   (per week, month, season, or initial buy) ASK: “in winter and in summer?”]
   [Please try to keep the units the same, ie, for electricity: ask in MONTHS; for coal, ask per season]

8. What are the things you ***like*** most about your ***primary*** electricity source?
   [If nothing is liked, enter “none”]

9. Is there anything that you would like to change about your household electricity access?
   [This question is for all sources of electricity;
   ASK: “in winter and in summer?”
   [If no changes desired, enter “none”]

   [If yes] What would you change?

10. Are there places outside of your home where you have access to electricity?
    [If no, enter “none”]
    [If yes] Where are these places?

11. Is there street lighting in your community?
    [If no, enter “none”]
    [If yes] What is the source of street lighting in your community?

12. If you had more electricity what would you use it for?
    [Ask open ended first, then follow up asking specifically]

    a. What activities, appliances or devices would you use if you had more electricity available?

G. HOUSEHOLD LIGHTING (5 minutes)

1. What kind of lighting do you use in your household? [List all the sources mentioned]

    a. What is your household’s ***primary (main)*** source of lighting? [Select one of the above]

2. Is there anything that you would like to change about your household lighting?
    [If no changes desired, enter “none”]
    [If yes] What would you change?

H. HOUSEHOLD HEATING (10-15 minutes)

1. Do you live in the same house or the same house area all year round? (ASK: in winter do you live in this house? do you use all these rooms during wintertime?)

   [if not in the **same house** all year]: Please describe the house you live in during wintertime (e.g. the same house? or a smaller house; how many rooms?):

   [if not in the **same house area** all year:] Please describe the house area you live in during wintertime (e.g. how many rooms? which rooms?):

   What months of the year do you generally use heating?

   J F M A M J J A S O N D

   a. What date do you usually start heating your home for the wintertime?

2. During wintertime, what time of day do you use the most heating?

3. What are the main ways (the devices) you heat your house?
   [Prompt with examples if needed: dung bricks, electric heaters, hot water battery heaters, wood fires, fire in pechka]

4. What are the sources of the fuel/energy for these heating sources?
   [Prompt with examples if needed: town electricity supply for electric heaters, own / neighbours animals for dung bricks, own/ town supply for hot water battery heaters, wood from *leskhos* for firewood]

5. Please list these sources in order, starting with the most important:

- What is the ***primary (most important)*** source of heating in your household? (e.g. coal)

  _____How many percent of the heating does it cover? _____%

- What is the ***secondary (2nd most important)*** source of heating in your household?

  _____ How many percent of the heating does it cover? _____%

- What is the ***tertiary (3rd most important)*** source of heating in your household?

  _____ How many percent of the heating does it cover? _____%

- What is the ***quaternary (4th most important)*** source of heating in your household?

  _____ How many percent of the heating does it cover? _____%

- What is the ***guinary (5th most important)*** source of heating in your household?

  _____ How many percent of the heating does it cover? _____%

6. How long have you been using these sources of heating in your household? [Enter weeks, months, or years, the units will be converted during data analysis]

- *Primary (most important)* heating source (e.g. coal_____): _____

- *Secondary (2nd most important)* heating source (_____): _____

- *Tertiary (3rd most important)* heating source (_____): _____

- *Quaternary (4th most important)* heating source (_____): _____

- *Quinary (5th most important)* heating source (_____): _____

7. Where does/did your household buy (who do you pay to) your heating sources?

- *Primary (most important)* heating source (e.g. coal_____):
    - Buy at (e.g. Ail Okmotu)_____
    - from (e.g. head of Ail Okmotu) _____

- *Secondary (2nd most important)* heating source (_____):
    - Buy at (e.g. Ail Okmotu)_____
    - from (e.g. head of Ail Okmotu) _____

- *Tertiary (3rd most important)* heating source (_____):
    - Buy at (e.g. Ail Okmotu)_____
    - from (e.g. head of Ail Okmotu) _____

- *Quaternary (4th most important)* heating source (_____):
    - Buy at (e.g. Ail Okmotu)_____
    - from (e.g. head of Ail Okmotu) _____

- *Quinary (5th most important)* heating source (_____):
    - Buy at (e.g. Ail Okmotu)_____
    - from (e.g. head of Ail Okmotu) _____

8. How much MONEY does your household spend on heating sources?
   - PLEASE TRY TO KEEP UNITS THE SAME ACROSS INTERVIEWS.
   (e.g. COAL: how much per winter - tonnes?)
   - CIRCLE MONTHS OF THE YEAR HEATING SOURCE IS USED.

- *Primary (most important)* heating source: (e.g. coal) _____

Months of the year this is used: 1 2 3 4 5 6 7 8 9 10 11 12

How much MONEY do you spend ***per heating season***?: _____

How much MONEY do you spend ***per month*** on this?: _____

- *Secondary (2nd most important)* heating source: (e.g. electricity)
  _____

  Months of the year this is used: 1 2 3 4 5 6 7 8 9 10 11 12

  How much MONEY do you spend ***per heating season***?: _____

  How much MONEY do you spend ***per month*** on this?: _____

- *Tertiary (3rd most important)* heating source: (e.g. dung bricks)_____

  Months of the year this is used: 1 2 3 4 5 6 7 8 9 10 11 12

  How much MONEY do you spend ***per heating*** season?: _____

  How much MONEY do you spend ***per month*** on this?: _____

- *Quaternary (4th most important)* heating source: _____

  Months of the year this is used: 1 2 3 4 5 6 7 8 9 10 11 12

  How much is used per season?: _____

  How much MONEY do you spend ***per heating*** season?: _____

  How much MONEY do you spend ***per month*** on this?: _____

- *Quinary (5th most important)* heating source: _____

  Months of the year this is used: 1 2 3 4 5 6 7 8 9 10 11 12

  How much MONEY do you spend ***per heating season***?: _____

  How much MONEY do you spend ***per month*** on this?: _____

9. What are the things you ***like and dislike*** about your heating sources? [If nothing is liked, enter “none”]

- *Primary (most important)* heating source (e.g. coal_____):

- *Secondary (2nd most important)* heating source (_____):

- *Tertiary (3rd most important)* heating source (_____):

- *Quaternary (4th most important)* heating source (_____):

- *Quinary (5th most important)* heating source (_____):

10. . Do you heat animal stalls or animal living areas in winter?

[if does not own livestock animals, mark ‘no animals’]

[if own livestock animals]: Which animals/ animal stalls do you heat?

What method do you use to heat animal stalls?

I. HOT WATER USE (NON-HEATING) (5 mins)

1. What do you use hot water for, other than for heating? (note: not tea, only household uses e.g. washing, cleaning, etc)
   Prompt: for washing, cooking, showers outside in summer
   If they do not use hot water, enter 'none' and skip this section.

2. How often do you use hot water (for non-heating purposes)?
   a. Per day?:

   b. (How much do you use? in litres)?

OR

   c. Per week? (or per month):

   d. (How much do you use? in litres)?

3. How do you heat water in your household? [List all that apply, e.g. over fire, with gas, solar thermal, simply in the sun in summer (e.g. for 'summer showers')]

   a. What is your household's *primary (main; most important)* way of heating water? [Select one of the above]

4. Is there anything that you would like to change about your hot water situation? [If no changes desired, enter "none"]

   [If yes] What would you change?

5. Have you heard about new or alternative technologies for hot water heating? [e.g. solar water heaters]

   a. Are there new or alternative technologies for hot water heating that you ***would like*** to try, or are planning to try?
      Why?

J. ASPIRATIONAL USES OF ENERGY (5-10 minutes)

1. Are there any **energy related items (for cooking, heating, lighting, hot water or other)** that you wish you had **in your household**?
   [If no items are desired, enter "none"]
   [If yes] Which items would you like to have?

   a. Why do you want to have them?

2. Are there any **energy related items** that you wish you had **for your work**?
   [If no items are desired, enter "none"]

   [If yes] Which items would you like to have?

   a. Why do you want to have them?

3. Are you aware of solar lighting, small solar panels, or other solar technology? (Gulbara to explain what these are if people do not know).
   [If no, enter "not aware"]

   [If yes] Would your household be interested in buying or CREATING a solar product?

4. In three years, what changes would you like to have in your household?

K. WRAP-UP (5 minutes)

1. Is there anything else we haven't asked that you'd like to tell us?

2. Do you want to get updates on the results of this interview and future activities? [Yes / No]

    a. [If yes] What type of communication would be best? [Examples: text message, phone call, email, in-person visit]

    b. [Write contact information below]

SAY: Thank you for your time.

3. *Field for notes from enumerator on observations and interview context*

Appendix 2: Survey 1B

Household observational survey

❑ Consent given to take photos *(Please tick)*

1. House description:

- House ID:_____
- How many people live in the house? _____
- Is the house used all year round? _____ If no: winter or summer? _____
- Is part of the house closed off in winter?_____ If yes how many rooms are open? ____/_____
- Year of construction: _____
- Were any rooms added later? _____
- Was any part of the building renovated? _____ If yes, room numbers: _____

2. Rooms (in summer or all-year house)

Nr	Room use	Photo	Size	Heating? If yes, how?	Notes and description
1					
2					

3					
4					
5					
6					
7					

3. Rooms in winter house (if applicable)

Nr	Room use	Photo	Size	Heating? If yes, how?	Notes and description
1					
2					
3					

4					

4. General condition (in summer or all year house):

Nr	Item	Photo	Construction material(s) (if possible including sketch of materials/thickness)		Condition (bad-med-good); and notes *(e.g. cracks in wall, household members say that drafts come in, etc)*	Thermal bridges? (If yes, describe in chapter 12)	Year of construction	EE measures implemented? (If yes, describe in chapter 4)
8	Roof (see also chapter 8)				Bad Medium Good			
9	Floor / flooring (insulation)				Bad Medium Good			
10	Walls				Bad Medium			

					Good			
11	Doors				Bad Medium Good			
11 a	Door frames				Bad Medium Good			
12	Windows				Bad Medium Good			
12 a	Window frames				Bad Medium Good			

5. Implemented energy efficiency measures (number and description):

6. General condition in winter house (if applicable):

Nr	Item	Photo	Construction material(s) (if possible including sketch of materials/thickness)		Condition (notes: e.g. cracks in wall, household members say that drafts come in, etc)	Thermal bridges? (If yes, describe in chapter 7)	Year of construction	EE measures implemented? (If yes, describe in chapter 7)
8	Roof (see also chapter 8)				Bad Medium Good			
9	Floor / flooring (insulation)				Bad Medium Good			
10	Walls				Bad			

					Medium Good			
11	Doors				Bad Medium Good			
11 a	Door frames				Bad Medium Good			
12	Windows				Bad Medium Good			
12 a	Window frames				Bad Medium Good			

7. Implemented energy efficiency measures (number and description):

8. Infrastructure in summer or all year house

Nr	Infrastructure	Photo (device + fuel/energy source)		Type(s)/Appliances	Condition/Notes	Year of construction	EE measures implemented? (If yes, describe in chapter 6)
13	Cooking infrastructure				Bad Medium Good		

14	Heating infrastructure				Bad Medium Good		
15	Lighting infrastructure				Bad Medium Good		
16	Electricity				Bad Medium Good		
17	Water/hot water infrastructure				Bad Medium Good		
18	Other				Bad Medium Good		

9. Implemented energy efficiency measures (number and description):

10. Infrastructure in winter house (if applicable)

Nr	Infrastructure	Photo (device + fuel/energy source)		Type(s)/Appliances	Condition/Notes	Year of construction	EE measures implemented? (If yes, describe in chapter 11)
13	Cooking infrastructure				Bad Medium Good		
14	Heating infrastructure				Bad Medium Good		
15	Lighting infrastructure				Bad Medium Good		
16	Electricity				Bad Medium Good		

17	Water/hot water infrastructure				Bad Medium Good		
18	Other				Bad Medium Good		

11. Implemented energy efficiency measures (number and description):

12. Thermal bridges (i.e. concrete steps going from outside to inside, window frames, pillars or beams going from inside to outside)

	Yes/no	Photo	Material	Description/notes
steps				
window frames				
pillars				
beams				
Other				

13. Animal housing

Nr	Type of housing Housing for?	photo	Size?	Building material?	Insulated (I)? If yes how? Heated (H)? If yes how?	Condition/notes
19					I H	Bad Medium Good

20					I H	Bad Medium Good
21					I H	Bad Medium Good

14. Notes on roof and ceiling construction: (Beams (thickness?), insulation, material of both roof and ceiling)

15. Other notes:

Energy profiles for Kyrgyz mountain villages as a basis for a targeted energy strategy - development of a survey method and pilot run in Jergetal

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Introduction

According to the International Energy Agency 1.2 billion people had no access to electricity in 2016, and 2.8 billion people relied on traditional biomass for cooking and heating. One of the United Nations Sustainable Development Goals (SDGs) states that by 2030 everyone should have access to clean, sustainable energy (EDA, 2016; IEA, 2017).
In view of that the aim of this project was to design a methodological approach to appraise the energy situation in Kyrgyz mountain villages in order to make it possible for them to work towards the energy targets of the Sustainable Development Goals in a direct, targeted way. To do this a survey was developed that included all energy related topics such as reliability of energy, affordability of energy, availability of energy, quality of energy, energy efficiency, cleanness of energy, and percentage of renewable energies.

Energy profiling

In order to reach these energy goals, clear, measurable targets need to be set, and strategic measures need to be placed in ways that these goals can be reached. In order to set the goals, the current energy situation needs to be known, so that the targets can be set realistically. This can be done through assessment of the current energy situation of a village, house or region. Once this energy profile is determined measures can be set to work towards the energy SDGs.

Figure 1: transformer in Jergetal

Figure 2: traditional stove used for heating and cooking in winter

Figure 3: house in Jergetal with typical open roof and visible bricks

Figure 4: bricks being made and dried for building a house

Methods

To assess this energy situation, two surveys - a questionnaire and an observational survey - were prepared together with a local university and AGOCA, an NGO working on mountain village development. These surveys included the topics of buying and supply chain, transportation, cooking, electricity access, lighting, heating and hot water, as well as building and infrastructure style, state of the building and any implemented energy efficiency measures or renewable energy technology.
The surveys were tested in a village called Jergetal, where 16 households were interviewed over the course of eight days. The interviews were all done with the help of a local researcher who knows the language and culture.
While the results of the survey were important, the major goal was to test the survey so that it could be further developed.

Results

The survey results showed that the houses in the village were mainly built out of local materials. This consisted of bricks made out of a mixture of clay and straw. Normally neither the walls, nor ceilings, roofs or floors were insulated. There seemed to be no energy efficiency measures and no renewables. Though the villages were connected to the energy grid, the electricity was unstable and the voltages fluctuated a lot. Heating and cooking was done mainly with fires fueled by coal or dung bricks.

The results of the method left several things to be adapted in the survey. Even though it was carefully designed together with two local researchers who know the culture, several of the questions had to be changed or adjusted, at the latest after translation of the data and data entry. There were questions that were irrelevant, repetitive, or unanswerable. These were changed so that the surveys could be given back to AGOCA for further development and testing.

Figure 5: summer cooking area in a separate building

Figure 6: dung bricks stacked to dry

Figure 7: house being built

Conclusion and Outlook

The survey method should serve its purpose - to profile a village according to its energy situation so that clear, targeted energy measures can be pursued in order to ameliorate the situation – fairly well. This profiling method shows the advantage that it is able to be used across a wide range of landscapes, energy situations and demographics. With it a clear picture can be painted as to what the energy situation is and what steps could be taken next. It covers the whole range of energy usage, including things like energy infrastructure. It also includes an observational survey, which is helpful especially if the surveyor is experienced with energy.
According to the evaluated surveys, next steps in Jergetal would be to work on energy efficiency, doing courses in insulating houses with local materials and teaching villagers how to build energy efficient stoves.
As to the survey, its next step will be to be handed over to the Kyrgyz partners for further developing and testing, and finally to be used on a broad scale.

Sources: EDA. (2016, November 10). Agenda 2030 für nachhaltige Entwicklung. Retrieved August 21, 2017, from https://www.eda.admin.ch/agenda2030/de/home/agenda-2030/ziele-17-ziele-fuer-eine-nachhaltige-entwicklung/ziel-7-zugang-zu-bezahlbarer-verlaesslicher-nachhaltiger-und.html
IEA, I. E. A. (2017). WEO - Energy access database. Retrieved August 21, 2017, from http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/