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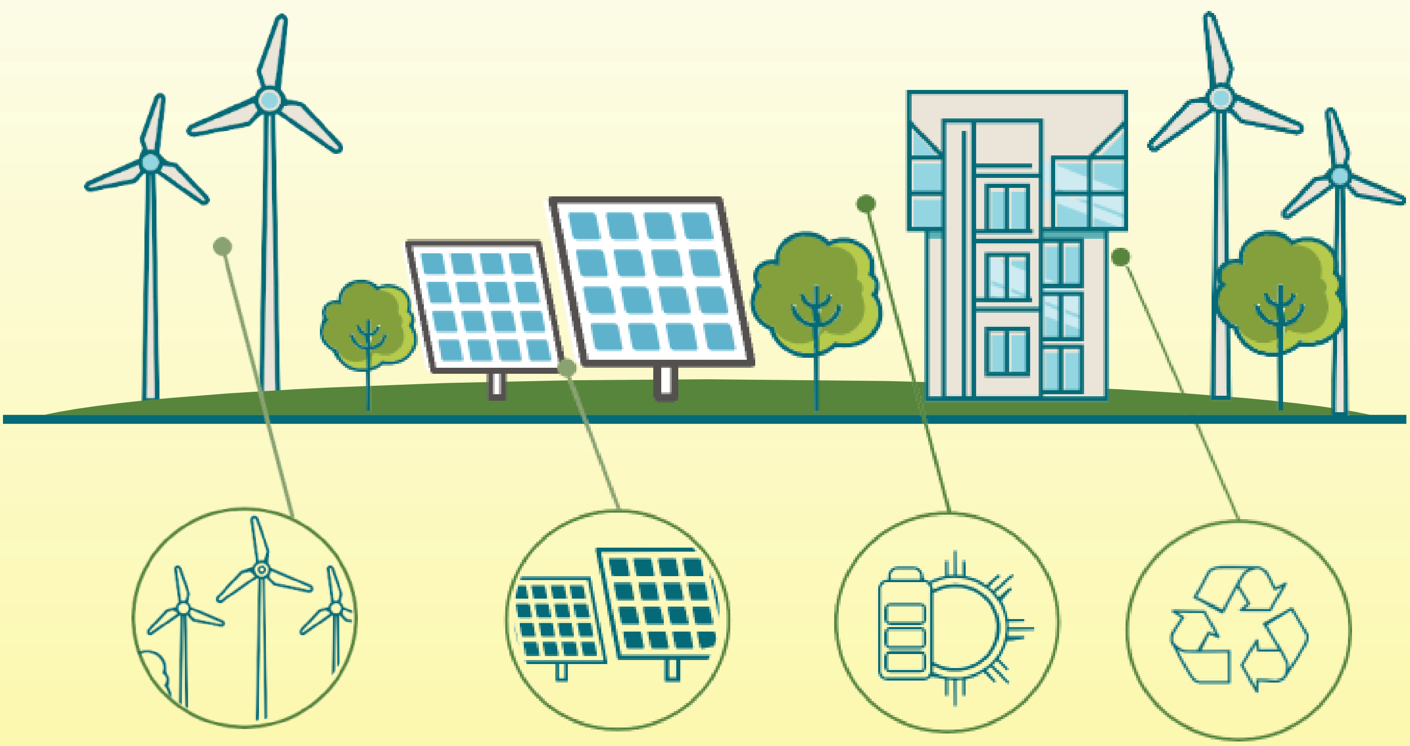
A Case for VAT Reduction on Solar PV and distributed generation

Policy Study



A Case for VAT Reduction on Solar PV and distributed generation

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This paper was originally written in English.

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1. Executive Summary

Kosovo's potential for the adoption of PV installations of less than 10kWp in residential homes is substantial. The country has adopted a net metering law for the licensed energy distributors in Kosovo which enables households to benefit from the installation of PV systems by rolling back their meters for energy produced. Additionally, over 60% of the country has the potential to generate 1,387 kWh/1kWp system annually. The installation of a 5kWp system would cause net zero bills for a substantial portion of the population, whose average annual consumption in 2019 was 4.8MWh of energy.

The study has been designed to estimate the total potential market of PV adopters as well as the effect that simple policy stimulation methods would have on the economy. In total, this study estimates that Kosovo has 90 thousand single detached houses with the available roof and / or yard space to install a 5kWp system of $32m^2$ to $36m^2$ area. This study uses an net-present-value approach to evaluate the financial likelihood for these houses/households to install a PV system.

Based on the NPV approach, in a baseline scenario, it would be financially beneficial for approximately 29 thousand houses to install PV systems of 5kWp in Kosovo. The installation of these systems equates to a total market of between € 121 million and € 144 million, depending on the price range of the system being installed (€ 4,200 vs € 5,000 per system). In total, this would equate to 144MW solar generation capacities in residential buildings alone, or 212 GWh of energy produced annually – a direct reduction on grid requirements. This baseline scenario assumes that prices remain constant, demand remains constant and no stimulation measures are taken for the sector.

In a 20% and 40% energy price increase scenario, 44 thousand and 52 thousand new people become likely to adopt a PV system – namely their NPV is positive and the break-even point in bill savings is 10 years or less. Respectively, this would mean between 220MW and 260MW installed residential solar generation capacity under these scenarios.

Under any scenario, the total potential market based on rational indicators such as NPV and break-even points indicates that PV diffusion among residential households should be more substantial than it currently is. The lack of more substantial PV diffusion indicates that the issue is related to non-financial related reasons.

Research conducted in countries such as Chile, Pakistan and Saudi Arabia indicates that there are non-financial factors at play that lead to lack of PV diffusion. The research points to a general lack of customer knowledge regarding the benefits of modern PV systems, coupled with an overall lack of developed market systems around PV that constitute the most serious issues to PV diffusion. This is consistent with key indicators in Kosovo, including the lack of more substantial government policies aimed at residential PV adoption, virtually inexistent customer acquisition efforts for residential clients by PV installers, lack of advertising campaigns by banks and

International Financial Institutions for loans destined for PV adoption and lack of awareness and education campaigns from governments and NGOs for benefits of PV for residential applications.

As an initiative to remedy these problems, this study found that removal of VAT for the purchase and installation of residential PV systems (less than 10kWp) would cause minimal losses to the Kosovo budget and substantially increase adoption. Additionally, this new adoption would create a minimum of 40 sustainable high and low skilled jobs in the first year of the policy in the most conservative scenario – somewhat alleviating the COVID-19 impact. Finally, coupled with proper education, awareness and advertising campaign, the potential for higher PV adoption and more impact on Kosovo's sustainable energy balance and local economy would be higher.

Kosovo's lack of residential PV diffusion is not related to financial reasons. PV adoption in the country is financially beneficial to at least 29 thousand households in the most conservative scenario – in more realistic scenarios up to 44 thousand adopters are likely. At minimal market penetration rates, installers could benefit by at least € 1 million in revenue a year from the residential sector alone, with enough client base to sustain the business and grow for decades. The reasons for lack of PV adoption seem to be related to lack of market knowledge, market systems, awareness of financial incentives and credit options and government involvement in the proper stimulation of the sector. Tackling these barriers, however, is a relatively easy task due to the already existent mechanisms in the market (business, government entities tasked with renewables and credit options). Increased adoption of residential PV systems is also beneficial for the economy and employment. Improving diffusion of PV in the residential sector is, therefore, a matter of the willpower of private, government and non-governmental actors to do so.

2. Introduction and Methodology

The study focuses on the analysis and options for the stimulation of the installation of household level photovoltaic systems in the country. The stimulus recommendations target the institutions of the Republic of Kosovo, mainly focusing on the Government of Kosovo and related agencies as well as the Assembly of Kosovo.

The stimulation of self-consumption based photovoltaic systems is dependent on a number of factors outside the typical considerations of generation capacity. The potential market for household-level PV installation in Kosovo is a complex function of energy consumption patterns, energy cost, household earnings, cost of PV installations, incentive systems (including credit availability), and awareness regarding solar capacity. These main factors, combined with a number of smaller other specific considerations, indicate the likelihood of households to adopt PV systems as well as the rate of such adoption.

The development of household-level PV stimulating policy initiatives requires the careful balancing of all aforementioned factors. To date, there has not been a thorough study of the current market potential in Kosovo regarding the adoption of household-level PV systems, outside of the technical understanding of solar radiation and total solar capacity in the country. To appropriately design policy initiatives and level of intervention, this study seeks to develop an evaluation model to assist in the estimation of the policy impact on PV installation.

The estimation model built for the purposes of this analysis seeks to create a modelling environment that takes into account several key factors in estimating policy impact on household PV adoption. The model provides for contextually responsive estimations based on the following criteria:

1. Household Size
2. Household Type (apartment complex vs single-family house)
3. Household Income
4. Energy Price
5. Energy Consumption
6. Incentive Policies
7. Credit Conditions
8. Installation Company Efforts
9. Cost of installation of a 5kWp system
10. Generation Capacity based on insolation statistics for Kosovo.

In addition to the criteria above, the literature on the adoption of PV systems with countries currently aiming to increase adoption of PV installations in households indicated several softer, unquantifiable cultural barriers to PV adoption.

These criteria are used to create and determine the key outputs of the model: the net present value (NPV) of installing PV systems and the breakeven point of the installation of a 5kWp solar system in an individual house. The NPV analysis has been selected as the first key determinant due to the need to evaluate the currently held belief that PV systems are not profitable as an investment. The break-even point of a 5kWp system (which is the generally recommended system for installation in a home in Kosovo)[1] has been selected as a key critical determinant of the estimation of market penetration of PV systems in Kosovo due to the negative past experience of installers in trying to sell systems with break-even points of longer than 10 years. Additionally, both determinants provide for quantifiably and measurably reliable factors to determine whether the lack of PV diffusion is due to rational cost-benefit decisions or other factors.

For the purposes of this study, INDEP has evaluated a number of potential incentive systems that could affect the likelihood of households adopting solar energy generation capacities. The research into incentives focused on desk research of past lessons from countries which successfully pushed the adoption of household PV generation capacities, countries that failed in securing widespread adoption and interviews with local PV installation companies. However, the one key determinant of the likelihood of a household to adopt PV systems remains the NPV and break-even point (in years). Nonetheless, break-even points that justify widespread adoption - the perception of how long is too long for return on investment - vary by country due to cultural and normative reasons.

Specific NPV and break-even point impact on adoption of PV systems in Kosovo, based on the model, and the resulting adoption statistics are then used by the model to estimate the total number of sales, engineers and resulting fiscal impact on Kosovo budget (through VAT, Personal Income Tax, and Profit Tax).

The model is divided into four separate sections. The first section is concerned with the estimation of the total households in Kosovo living in houses and apartments. This section also develops a set of assumptions regarding the potential growth rates of households and uses official statistics in estimating the populations numbers for the country going forward. Specific assumptions and considerations regarding this section of the model have been provided in the appropriate section in this study.

The second section of the model focuses on the analysis of the energy consumption pattern for households as well as the distribution of the consumption by consumption size per each household. Understanding the consumption groups is important since the group of the population with the higher usage of electrical energy has a higher likelihood of installing PV systems since the return on investment will be faster in these scenarios.

[1] INDEP interviews with two photovoltaic panel installation companies indicating that a 5kWp system provides the most optimal payback period for residential users while also generating enough capacity to power the average home.

The third section of the model focuses on forecasting the various scenarios of price increases. This is essential since Kosovo's current electricity price is the lowest in Europe and is unlikely to remain so in the future. Energy price increase scenario forecasting is critical in understanding the potential for the adoption of PV systems and as such a special section is devoted to understanding the potential scenarios.

The fourth section of the model is concentrated on analytics of the outcomes of the three previous sections, including the translation of varying break-even points into PV installation rates.

A key consideration in the analysis of the potential translation of earlier break-even point for the installation of PV panels is the translation of NPV values and break-even points into new installation numbers. In practical terms this means how many new households would consider installing PV systems if the NPV is positive and the breakeven point drops to 10 years and less.

The most generally reliable form of establishing these benchmarks is to conduct a nation-wide representative survey that would accurately measure population perceptions around break-even points and NPV of PV installations. However, based on conversations with installers of PV systems, there are some concerns regarding the accuracy of a mass survey due to the lack of education of citizens regarding small-scale PV generation, lack of understanding of break-even points in energy generation, and general lack of understanding of PV capacity output. As a result of these concerns regarding the potential accuracy of a widespread PV survey, this study uses two alternative methods for estimating the likelihood of adoption of PV systems based on break-even point.

This study has used interviews with PV installers in order to evaluate their perceptions of the determinants of increasing PV diffusion in the residential sector in Kosovo. The interviews were focused on identifying key determinants, in quantitative terms, of increased adoption. However, the interviews yielded only one determinant – breakeven point – which indicated a lack of understanding or deeper dive into household decision making factors for PV adoption in Kosovo by PV installers.

Finally, using both data sets the study aimed to create a heatmap of potential adopters for a 10-year period based on policy-measure scenarios. These scenarios provide an idea on the potential impact range that national policies can have into the adoption of PV systems by households and the overall grid-load in the next 10 years.

3. Demographics

This study uses three primary methods of estimating the total base of owner-inhabited or owner-rented households with potential for PV systems. Primarily, it uses official Kosovo data on households and population to extrapolate potential households for Kosovo throughout the years. Secondarily, it uses official data on registered and installed household energy metering units submitted to the Energy Regulator's Office by the KEDS – the company licensed to service most of Kosovo.

The use of the two different variants of potential households is necessary due two reasons. Primarily, the last Kosovo census was in 2011, with the latest reliable household data poll being taken in 2013 and published in 2014. Additionally, a registration of Kosovo dwellings was last conducted in the 2011-2012 period and was published by the Kosovo Agency of Statistics (KAS) in 2012. This means that the aging data might not represent a full picture of the inhabited single-household houses versus the apartments in the country as well as the potential uninhabited houses. The second reason for using the two data sets is that the number of registered metering units submitted to the ERO by KEDS is almost twice the number of households registered in the country. As a result of these two divergent factors, use of both data sets and estimations based on both (giving a range of potential adopters, rather than single numbers) provides for a less accurate, but more comprehensive, picture of the potential adopters of PV systems.

In addition to the considerations above, the final demographics and household data sets are adjusted by the dwelling registration statistics of KAS as of 2013. This provided another adjustment factor due to several factors. Primarily, due to cultural factors, several families will still inhabit single-family houses in the country. This means that the total number of households in the country might not preset the full picture of potential PV installation targets. Secondarily, apartments and apartment complexes house multiple households and as such, these households cannot be individually considered as potential PV installation targets (due to lack of space for installation) and therefore must be taken as single units for potential to install PV systems. Finally, a considerable number of dwellings remain unoccupied, either by owners or renters. Therefore, the total household estimation for potential to install PV systems must take into account the balance between the aforementioned statistics.

Kosovo's last population census was finished in 2011, with another census due in 2021. Since 2011, the Kosovo Agency of Statistics provides an annual estimation of the population of Kosovo based on registered deaths, births, emigration and immigration numbers, as well as a forecast of the populations shifts since. The census in 2011, as well as a new workforce survey conducted throughout 2013 by KAS, provide for the starting base for the estimation of total households with potential to install PV systems.

As of 2013, Kosovo had a total 322,612 households as declared by the KAS. These households had a reported average members per household of 5.71, for a total population count estimation of 1.842 million people.[2] The total number of residential buildings in Kosovo as of 2011 was estimated at 266,680, with 247,949 considered to be in livable conditions.[3] Of all the buildings in the country, 60% are inhabited – this number including apartments. In total, in 2011 Kosovo had around 2,600 apartment buildings – that is buildings that have separate entrances for separate complete living quarters.[4]

Table 1: Housing types in Kosovo, Kosovo Agency of Statistics

Building Types	2011	% of total
Separate House	248,680	93.5%
Semi-separate House	11,717	4.4%
Row of houses, with separate entrances	2,851	1.1%
Apartment complexes	2,850	1.1%
Total	**266,098**	**100%**

Living buildings by number of floors	2011	2011
1	81,342	32.8%
2	140,081	56.5%
3	22,421	9.0%
4	2,412	1.0%
5	761	0.3%
6-9	765	0.3%
10-14	140	0.1%
15+	27	0.0%
Total	**247,949**	**100%**
Unihnabited	**99,808**	**40%**

Table 2: Estimation of inhabited houses with residential PV installation potential

Building Type	Number
Base Buildings	266,098
Total Occupied Buildings	158,984
Total Occupied Houses	154,879
Houses with surface for PV installation	**92,927**

There are two major constraints in this study that limit the accuracy of the estimation of the total potential household market. Primarily, the apartment vs house occupancy rate data is outdated, with the construction sector in the country having witnessed a considerable expansion since 2011. This construction sector expansion has almost entirely been focused on apartment blocks, and those apartment blocks have been mainly built in the capital – Prishtina. Due to these developments, and a lack of available information on the exact number of apartments as well as their occupancy rate, there are limitations to the total estimated market. A cursive count of Google Earth photography of Prishtina apartment blocks and floor estimation indicates that there is an almost tripled amount of apartment blocks in Prishtina alone (as compared to KAS data). This could drastically affect the total number of potential household installers estimated using

[2] Kosovo Population Forecast, 2017 – 2061, Kosovo Agency of Statistics, December 2017, http://ask.rks-gov.net/media/3925/parashikimi-i-popullsis%C3%AB-2017-2061.pdf (accessed on 02/06/2020)
[3] Apartments and Buildings by Municipality, Kosovo Agency of Statistics, December 2013, https://ask.rks-gov.net/media/1598/banesat-dhe-nd%C3%ABrtesat-sipas-komunave.pdf (accessed on 07/06/2020)
[4] Ibid

the 2011-2013 data available from KAS. As a result of this, an adjustment of occupied single-household houses has been made in the final model estimations of available client base.

The second major constraint in the estimation of the total potential households in the country and how that number has evolved throughout the years. According to KAS population projections and population counts, there is a downward population trend affecting Kosovo mainly as a result of emigration.[5] According to INDEP, this downward trend is conservative, considering that Kosovo witnessed a considerable outflow of illegal immigration in the 2016 to 2019 period – a trend that continues to some extent to date. This affects the total household number for Kosovo considerably, including the population count for the country.

This obstacle is further complicated by the lack of official statistics and projections regarding the total household size in the country. Kosovo is subject to shifting cultural norms and traditions, shifting earning structures and other demographic changes. In other post-communist transitional economies, a reduction in household size was common through the transition and post-transition periods. As such, an expectation of reduction of the household size in Kosovo would be natural over the past decade.

These two obstacles as a result represent potential limitations to the accuracy of estimation of the population, household and building type base used to estimate the total potential market size. Nonetheless, this study makes several assumptions in order to potentially compensate for the total number of households and buildings in the country.

Primarily, the study accounts for the new apartment building block building in the country by doubling the total number of apartment buildings as compared to 2011 KAS statistics, while maintaining single-household houses constant compared to 2011. Additionally, this study considers the fact that 40% of the available houses were uninhabited and reduces the vacancy number to the apartment buildings. This step is crucial in estimating the total number of apartment buildings and houses in the country in order to estimate the total potential client base.

Table 3: Total Population, Household and household number forecast. Kosovo Agency of Statistics, INDEP

	2019	2020	2021	2022	2023	2024	2025	2026	2027
Total Population Forecast	1,797,434	1,803,705	1,809,458	1,814,461	1,818,378	1,821,147	1,823,396	1,824,756	1,825,035
Household Member Number	5.51	5.46	5.41	5.36	5.31	5.26	5.21	5.16	5.11
Households	**326,214**	**330,349**	**334,466**	**338,519**	**342,445**	**346,226**	**349,981**	**353,635**	**357,150**

The study also forecasts the total households in the country by using the official KAS population forecasts. The total population of the country is divided by the average household size number in order to arrive at the final total household numbers. However, this study accounts for the

[5] Kosovo Population Forecast, 2017 – 2061, Kosovo Agency of Statistics, December 2017, http://ask.rks-gov.net/media/3925/parashikimi-i-popullsis%C3%AB-2017-2061.pdf (accessed on 23/06/2020)

potential reduction in household member size by reducing the 2013 household member size by 0.05 annually for the forecasting horizon.

As can be seen in the table above, this estimation provides for a total number of households in the country. This indicates that there are less habitations available than total households in the country, indicating the need to use habitations as they statistic for estimating potential PV Adopters, since it is the more restrictive number.

In addition to the statistics above, this study also uses a secondary, hybrid household / residential building, statistic to measure the total number of households in the country. The ERO annually publishes a range of statistics concerning the energy sector in Kosovo. These statistics also include the total number of residential metering units currently deployed in the country, as reported to the ERO by companies licensed for energy distribution in Kosovo. For 2019, the ERO reports a total of 517,486 metering units deployed in Kosovo – an indicator regarding the total overall size of the buildings in the country. This statistic also helps justify the decision to double the number of apartment buildings in Kosovo for the purposes of the study as a way to reconcile the 2011 data with construction sector developments in the last decade.

4. Energy Consumption

The household energy consumption data for Kosovo are available from two sources: Kosovo Agency of Statistics and the Energy Regulator's Office. The KAS obtains energy use data from the ERO and prepares the data for further publication. Despite the fact that the energy data of the KAS are obtained by the ERO, the KAS is the ultimate authority in publishing official data for Kosovo. This study elected for the use of the information provided in the ERO annual reports in terms of household usage of electricity due to the higher available data granularity, longer term availability of the data and more detailed reporting (MWh vs GWh).

In total, Kosovo's household sector use of electricity for 2019 was 2,515 GWh. This usage marked a 5.94% consumption growth over 2018, or a 3.5% Compound Annual Growth Rate since 2010.[6] Overall, household sector energy usage in Kosovo has seen a marked increase throughout the years, despite the improvement of energy efficiency measures and the introduction of district heating in the capital. As such, electricity usage will be expected to increase in the future years.

A key determinant of the NPV and break-even point of the average household in terms of installation of PV equipment remains the forecast energy usage for the average household. This energy usage forecast relies on the total households in the country as the primary significant indicator and the overall energy usage pattern for the future.

It is crucial to clarify here that despite the fact that this study uses houses to forecast client base, we distribute energy use according to ERO's household number due to their provision of average use statistics. This has been done for three reasons. Primarily, estimations of energy users lie between the given 517 thousand energy measuring device statistic of the ERO and the 266 thousand building statistic of the KAS. This provides for some potential error correction regarding the total number of **active** energy users in the country. As a result, potential average energy use per household is very likely higher than the 4,860 kWh estimation provided by the ERO. Usage of this statistic, instead of using the resulting 7,810 kWh/household/year statistic if we used official households as a denominator enables us to err in the direction of conservative estimates.

Currently, no public institution in the country produces long term forecasts of energy usage for the residential sector. As a result of the lack of official publications regarding residential sector energy consumption forecasts, this study has developed an internal analysis on potential energy use forecasts for the future. There are several methods available for energy use forecasting, however, three methods prevail.

[6] Energy Regulatory Office, (2019), Annual Report for 2019, Prishtina: ERO. https://www.ero-ks.org/zrre/sites/default/files/Publikimet/Raportet%20Vjetor/Raporti%20vjetor%202019_ZRRE_final_alb.pdf (accessed on 03/06/2020)

An analysis of the consumption of energy for the residential sector in Kosovo reveals a growth trajectory, with considerable swings from the mean. The mean growth rate for the 2010 to 2019 period for residential energy use is 3.55% while the standard deviation is 2.85 percentage points, almost an entire mean of difference. However, a closer look at the growth rates indicates that the standard deviation of the data stems from three main years – 2011, 2014 and 2019. 2011 marks a 7.92% increase over 2010, 2014 marks a -2.88% decrease whereas 2019 marks a 5.92% increase over the previous years. Excluding these three outliers, the other readings are within 0.7 percentage points of the mean.

This study's final decision on the best forecasting method for energy usage for the residential sector, therefore, depends on understanding data outliers in energy usage. The 2011 spike is the easiest outlier to explain – post 2009 global financial crisis recuperation seems to have driven both an increase in domestic energy use and an increase in the number of emigrants both visiting and having returned permanently which fueled residential energy use.

The 2014 demand drop on the other hand seems to have been widely fueled by an expected increase in the energy prices that was widely debated and protested in the national conversation throughout the second part of the year. This development is also a strong indicator of energy price sensitivity of consumers, particularly seeing as the 2015 growth rate (2.48%) was the lowest in the past 5 years.

The 2019 positive spike, however, remains unexplained as no marked conversations around energy usage have been noted during the year. Two potential explanations could be the substantial increase in economic growth noted in 2019 (4.1% real GDP growth) or the possibility of data classification issues as a spike in office businesses occupying residential classified spaces used more energy in 2019.

The three outlier data points in the already small 9-year sample of energy usage patterns for the residential sector strongly indicated that a quantitative forecast method would be unreliable in Kosovo's case. Additionally, a correlation analysis between GDP growth in the country and energy use in the residential sector yielded inconclusive results.

As a result of the aforementioned considerations, this study elected to use a moving averages forecasting method for the next 10-year forecast period. The moving average period of forecast is 5 years to account for some of the seasonality in usage patterns. Overall, the average growth rate for the next 7-year horizon (the scope of this study) ends at 4.63% which is in line with expected GDP growth. Despite this, it is necessary to mention that forecasts of energy usage for the residential sector were not the primary scope of this study and as such limitations to the forecast growth rates remain.

Finally, a note on the impact on energy usage to be caused by the COVID-19 virus. This study considers that the COVID-19 crisis will largely manifest in an increase of energy usage in the country for the residential sector for 2020 due to the extensive stay at home orders and isolation measures. Despite this, barring any substantial economic recovery measures, the resulting unemployment and economic impact of the COVID-19 crisis is likely to yield energy usage decreases in the household sector for the winter 2020-2021 period and further decreases during 2021 as households economically recover from the crisis. As a result of this, a manual intervention to reflect these assumptions has been included in the model, manually decreasing growth rates for 2021 by a whole 2 percentage points.

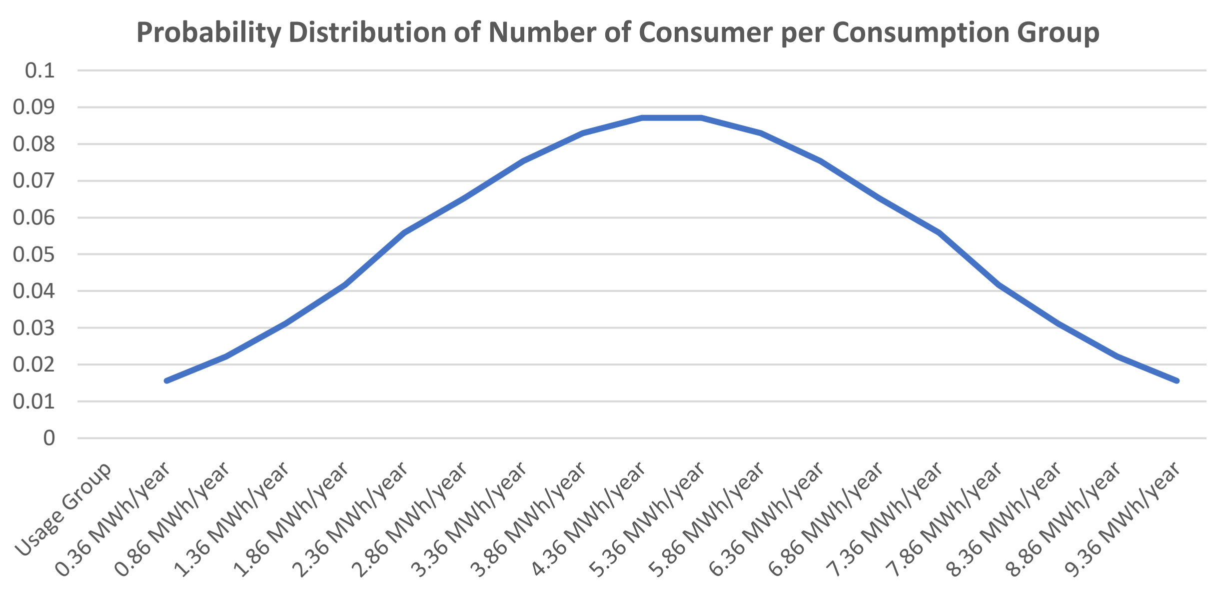
The final outcomes of the forecasts, growth rates and total expected usage patterns can be found in the table below:

Table 4: Total Residential Sector Consumption Forecast (INDEP)

	2019	2020	2021	2022	2023	2024	2025	2026	2027
Residential Consumption (Gwh, annual)	2,515	2,628	2,690	2,801	2,920	3,031	3,141	3,265	3,393
Growth Rate [Annual]	5.94%	4.48%	2.39%	4.12%	4.23%	3.81%	3.64%	3.95%	3.91%
Consumption / household (KWh)	**4,860**	**5,060**	**5,165**	**5,362**	**5,577**	**5,781**	**5,984**	**6,215**	**6,457**

The other key consideration when forecasting energy usage and household use patterns in order to estimate likelihood to install a PV system based on break-even point analysis is the distribution of usage patterns. Currently, the ERO and KEDS do not provide statistical data regarding the mode, standard deviation or any other significant nuance regarding household energy usage patterns. However, the ERO does report the average household energy usage which for Kosovo as of 2019 stands at ~4,800kWh annually.

The distribution scenario, depicted in the table below, assumes that the annual household energy consumption patterns falls squarely on normal statistical distribution. Under this scenario, the study assigns 10 percentile incremental values to usage patterns, with a minimum of 360kWh/year and a maximum of 9,360kWh/year with an assumed incremental of 500kWh/year



between each group. Each of these groups of usage is assigned a specific probability based on the z-score of the percentile and household numbers from the demographic projections are distributed per each usage category. The resulting usage groups, total households per group and total new households per group based on demographic forecasts can be seen in the tables below.

These distribution tables exclude apartment buildings, seeing as the individual use of each apartment unit is inconsequential to the analysis as apartments buildings are forced to install a joint PV installation system.

Based on the aforementioned chart, and the distribution of total Kosovo single standing houses according to the usage groups outlined above, and the reduction on the number of eligible houses in Kosovo for PV installation (uninhabited, lack of surface area) the following table indicates number of houses by usage groups:

Table 5: Households per Household consumption group

	0.36 MWh/yea	0.86 MWh/yea	1.36 MWh/yea	1.86 MWh/yea	2.36 MWh/yea	2.86 MWh/yea	3.36 MWh/yea	3.86 MWh/yea	4.36 MWh/yea	5.36 MWh/yea	5.86 MWh/yea	6.36 MWh/yea	6.86 MWh/yea	7.36 MWh/yea	7.86 MWh/yea	8.36 MWh/yea	8.86 MWh/yea	9.36 MWh/yea
Number of houses per consumption Group	1,463	2,083	2,927	3,912	5,244	6,117	7,073	7,777	8,171	8,171	7,777	7,073	6,117	5,244	3,912	2,927	2,083	1,463

This statistic is used to estimate the total potential market based on the NPV and break-even point of installation of PV panels for each consumption group further in the model.

5. Energy Price

Energy prices in Kosovo are a highly sensitive issue. In 2017, an attempt to increase the price of electricity by 20% by the ERO was met with substantial public backlash and protests.[7] As a result, subsequent ERO attempts to raise the energy price in the country have been severely restricted. Kosovo's current energy price structure is highly related to its supply structure. Despite this, energy prices are expected to increase in the future, seeing as the country's energy prices are some of the lowest in Europe. Energy price increase could have a positive impact in the adoption of PV installations for households and as a result, an accurate energy price scenario forecast is required for this study.

Table 6: Energy price forecast for the residential sector

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Average Price / kWh [ERO]	€ 0.048	€ 0.047	€ 0.049	€ 0.052	€ 0.052	€ 0.056	€ 0.057	€ 0.060	€ 0.057	€ 0.070

The country generates most of the electrical energy from 2 coal power plants – Kosovo A (1960s) and Kosovo B (1970s). For a substantial part of the lifetime of the power-plants post-war, the maintenance and operation of the power plants was largely subsidized by taxpayer money. As a result of this, the energy price in Kosovo remained highly subsidized – keeping energy prices low. Additional to the subsidization of the sector, energy remains a highly political issue. Primarily, energy price control is of priority to the government as a result of the necessity to boost economic growth. Secondarily, due to low average wages and high cost of living (in comparison to wages and due to an import-dependent economy) citizen sensitivity to energy prices is very high, leading to lack of political readiness for price increases. Finally, there is a disparage of energy billing in the country, with historically preferential energy debt forgiveness for certain actors, and the fact that the north of Kosovo pays no electricity bills despite using Kosovo's energy grid. This means that while energy price increase scenarios remain unlikely in the country, they are also unavoidable.

Kosovo energy production and import structure is also of primary importance to the overall cost of energy in the future. The average import price of the past 14 years (2005 – 2019) has been twice the average export price over the same period, with the export price close to the production price. Additionally, Kosovo tends to export in low price season (summer) while it

Table 7: Energy Import and Export Prices per MWh, Kosovo. Energy Regulatory Office

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Import Price [EUR/MWh]	€ 58	€ 70	€ 79	€ 62	€ 52	€ 52	€ 46	€ 59	€ 66	€ 56
Export Price [EUR/MWh]	€ 26	€ 45	€ 31	€ 28	€ 33	€ 33	€ 30	€ 37	€ 36	€ 40

[7] Krasniqi, Naim, "Protesta kunder rritjes se çmimit te energjise elektrike", Kallxo.com, 20 December 2017. https://kallxo.com/shkurt/protesta-kunder-rritjes-se-cmimit-te-energjise-elektrike/

tends to import at peak season (winter). This high disparity between the prices clearly indicates that the current energy price structure is unsustainable, and an adjustment of up to 200% in order to reach market prices is not unlikely. Despite this, the study has conducts three price scenarios – a base scenario with an average of historical growth rates for prices, a 20% increase scenario and a 40% price increase scenario as compared the baseline scenario.

The first baseline price increase scenario (20%) aims to reflect the potential entrance into force of either of the EU carbon cap trade scheme or a local carbon tax for Kosovo to prepare the local market for the eventual entrance into force of the EU carbon cap trading scheme. This conversation has been increasing in intensity in the EU regarding the Western Balkans, seeing as energy prices in the Western Balkans distort energy trade in the European market due to the lack of a carbon trading scheme.[8] Additional to the market distortion issue, Western Balkans countries are all jointly vying to eventually join the EU. This would eventually also mean the adoption of the EU Emissions Trading System (ETS) which imposes a certain cap of emissions that each entity can produce and substantially taxes emissions over this limit. Currently, the EU is in phase 4 of the emission reductions, which reduces the cap level annually by 2.2% and limits the amount of carbon taxes that can be traded.[9] By 2024, analysts expect that the price for emissions above the cap in the EU is expected to increase to € 40 / tCO2e.[10] Additionally, the EU has entirely removed the allocation of free CO2 allowances for the energy production sector, despite certain allowances made for energy producers in low-income EU countries (Bulgaria, Romania) up to 2030. In either scenario – whether the initial instatement of a local carbon tax, or adoption of the EU ETS – energy prices in Kosovo will increase substantially due to the dominance of coal-based energy generation and the heavily polluting old power plants. In fact, as of 2014, Kosovo produced 1,054,674 tCO2eq of pollutants – almost all of which due to power plants - which at current market prices for allowances equates to € 26 million in surcharge.[11] [12] [13]

With the 40 EUR price tag per tCO2eq, this would mean a € 42,186,960 surcharge on carbon profits alone. For comparison, total commercial **billing** for electricity in 2019 was € 277 million.[14] A € 42.2 million surcharge on price would mean an immediate ~15 - 20% in price increase, without

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[8]Peltegrova, I. (2019), 'Energy Community mulls carbon tax for thermal plants'. *Independent Commodity Intelligence Services*. https://www.icis.com/explore/resources/news/2019/09/18/10418454/energy-community-mulls-carbon-tax-for-thermal-plants (accessed on 03/07/2020)

[9] European Commission, (2015), 'EU Emissions Trading System (EU ETS)' https://ec.europa.eu/clima/policies/ets_en (accessed on 08/07/2020)

[10] Peltegrova, I. (2019), 'Energy Community mulls carbon tax for thermal plants'. *Independent Commodity Intelligence Services*. https://www.icis.com/explore/resources/news/2019/09/18/10418454/energy-community-mulls-carbon-tax-for-thermal-plants. (accessed on 15/07/2020)

[11] Business Insider, Markets Insider, CO_2 European Emission Allowances. https://markets.businessinsider.com/commodities/co2-european-emission-allowances (accessed on 15/07/2020)

[12] Greenhouse Gas Emissions in Kosovo 2014-2015, Kosovo Agency of Statistics, September 2016, https://ask.rks-gov.net/media/2471/ghg-emissions-in-kosovo-2014-2015.pdf (accessed on 19/07/2020)

[13] The tCO2eq is driven higher by the high amount of N_2O pollution which has a 298 times multiplier for CO_2 pollution equivalency under the EU ETS scheme.

[14] Annual Report of 2019, Kosovo Energy Regulatory Office

accounting for the indirect costs of measurement, transparency, reporting, transaction fees and potential further increases.

Table 8: Kosovo Power Plant Emission Cost calculation under European Union Carbon Tax Scheme

Pollutant	Lignite GG [Gigagram]	Bituminous GG [Gigagram]	Total GG	in metric ton	Ton CO2 Equivalent (tCO2eq)		Note
CO2	56.70	34.17	90.87	90,870.0		90,870.00	
CH4	0.0008	0.0036	0.00	4.4		369.60	[84x multilier]
N2O	0.003	3.230	3.23	3,233.0		963,434.00	[298x multiplier
			Total tCO2Eq			**1,054,674**	
			Cost at 40 EUR / tCO2eq		**€**	**42,186,944**	
			Cost at 40 EUR / tCO2eq		**€**	**26,366,840**	

As a result of the aforementioned analysis, this study estimates that the 20% and 40% price increase scenarios are realistic and in line with potential real developments in the energy price markets in the country.

6. Kosovo Solar Generation Capacity & Technical Issues

Solar generation capacity is a hotly debated topic currently in Kosovo – part fueled by a prevailing local loyalty to coal due to Kosovo's historical reserves and partly due to a lack of accurate up-to-date information on solar generation. Despite the overall lack of public awareness regarding Kosovo's insolation as well as total general capacity for generation, actual Kosovo-wide data on solar generation capacity are both ample and reliable.

Primarily, Kosovo's total available solar radiation is substantial for approximately 60% of the overall surface of the country, and over 75% of the total populated surface of the country.[15] For this portion of the territory, Kosovo generates on average 1,461 kWh/m^2 of solar radiation annually. According to the world bank this equates to a total of 1,387 kWp annual generation capacity for a grid-connected 1kWp solar generation power plant with 3.5% losses due to panel soiling and another 7.5% losses due to other cumulative effects. For the purposes of this study, which takes under consideration that the standard installed system is 5kWp this equates to a total generation capacity of 6,935kWh / year – well above the average consumption for households. This study uses this statistic in order to estimate the total generation capacity for a solar installation system. Additionally, over 90% of the surface of Kosovo receives between 1,314 and 1,387 kWp, providing no justifiable reason to adjust the estimation lower. Therefore, for the average household in Kosovo which uses 4.8mWh of electricity annually, a 5kWp system under the scenario assumptions would be enough to offset all annual energy use.

However, other technical considerations remain that pose a potential barrier to installation. The key most problematic technical issue is the availability of surface area for the installation of a 5kWp system and the availability of the optimal orientation for installation of such systems. Currently, PV panel technology requires between 32m^2 and 36m^2 of surface area (roof or ground) for the installation of a 5kWp system. The availability of said surface area, whether on rooftop or ground, in Kosovo houses is currently unknown due to the lack of reliable statistics and measurements. Additionally, inclination and orientation of the solar panels also contributes to the achievement of peak generation capacity – the proper orientation and tilt is south-facing for Kosovo for the measurements in the study. These two considerations require an automatic reduction of potential houses with optimal technical criteria for the installation of solar rooftops when estimating total market potential. This study undertakes the assumption that 30% of total houses in Kosovo lack the appropriate orientation and / or the appropriate rooftop or ground-based space to house solar panels for optimal energy generation – making it unfeasible for them to install these systems. As such, the final market size of potential adopters has been adjusted down by 40% for each consumption group as will be shown in tables further below.

A detailed map of the solar radiation estimation for Kosovo can be found below.

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[15] INDEP calculations based on World Bank Global Solar Atlas GIS data on Kosovo Solar radiation.

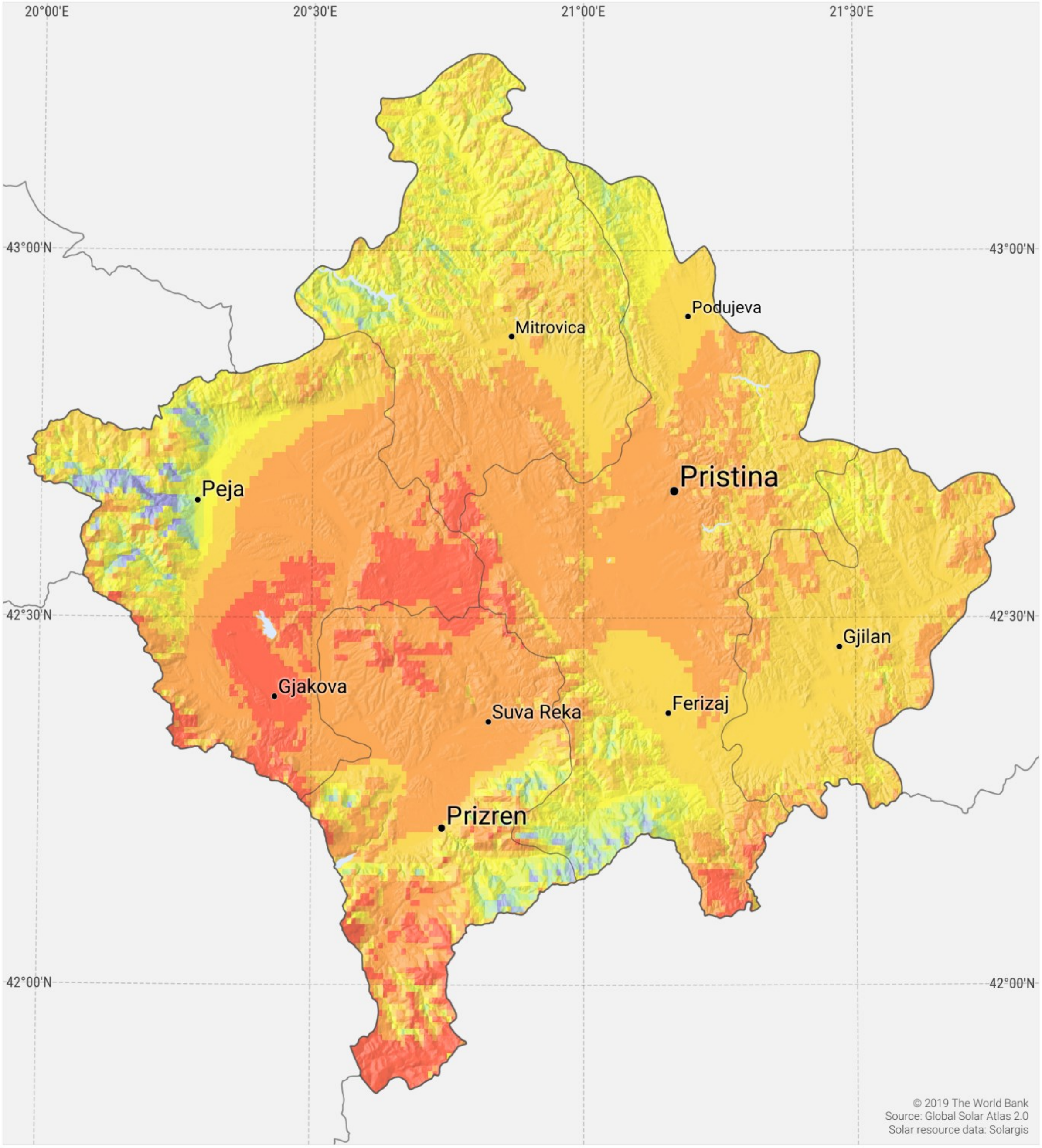
SOLAR RESOURCE MAP

PHOTOVOLTAIC POWER POTENTIAL

KOSOVO

WORLD BANK GROUP

ESMAP SOLARGIS



Long term average of PVOUT, period 1994-2018

Daily totals:	3.0	3.2	3.4	3.6	3.8	kWh/kWp
Yearly totals:	1095	1168	1241	1314	1387	

This map is published by the World Bank Group, funded by ESMAP, and prepared by Solargis. For more information and terms of use, please visit http://globalsolaratlas.info.

7. Indicators of PV Adoption based on Break-Even Point

This study relies on a net-present-value (NPV) of the energy bill savings as a result of PV panel installation in households versus the present value cost of the installation of the PV system to evaluate whether a household, strictly due to financial benefit, will become an adopter of PV systems. The full considerations of the NPV approach are detailed in the end of this section. However, several other considerations have been considered – specifically:

1. The break-even point of the installation of a PV system in years – a breakeven point of more than 10 years for the purposes of this study is considered too long for installation.
2. The perceptions of PV system installers on the main contributors to the likelihood of households to install PV systems in their house as well as shortcomings to their approach.
3. The experiences of other countries regarding the main indicators for PV panel installation and their track record with stimulating PV panel installations.

PV Solar Installers

PV solar system installers in Kosovo currently have created a substantial track record of experience with PV systems locally. However, most current installations of PV generation systems are heavily concentrated on businesses, with most of them concentrated in industry / manufacturers. PV solar systems installers individually install at most 20 systems annually in individual households. The main reason that their potential household clients cite for lack of adoption of PV systems is the long break-even point of installation of a system. At current cost levels, the break-even point for the energy use pattern of most households is at 10+ years, depending on consumption. Previous installer efforts to expand into the residential sector were met with challenges mainly due to the break-even point.

Installers also listed the following soft reasons that often play a role in decision making for households, the impact of which has not been quantified in this study:

1. Level of knowledge and information regarding PV systems and their function;
2. Level of lack of government issued information campaigns for the installation of systems
3. Overall understanding of the concept of break-even point based on PV energy consumption
4. Reservations regarding the strength of the power as well as belief that solar generated power can fully run electrical home appliances
5. Details regarding the specifics of obtaining permits from the Distribution company and how to maintain those permits functionally
6. General lack of understanding of the effects of global warming and their role in the reduction of greenhouse gas emissions
7. General lack of readiness to navigate the credit financing framework for PV systems currently available in Kosovo, including a lack of bank outreach for financing options

Despite the aforementioned challenges, installers currently believed that there is potential for a market for the installation of residential / household PV systems. The key metric, indicates that the initial reduction of the break even point by 1 year would yield around 200 new installations annually per installer, with the number doubling for every reduction of 1 year.

There are several issues, however, with this statistic. Primarily, the statistic reflects a general lack of readiness of installers currently in the market to pursue the retail (residential) sector actively. The 200 installations / year benchmark constitutes 0.1% of total inhabited, single-family homes in Kosovo according to this model's estimations. Considering the usage statistics, even without any stimulation methods, based on current consumption patterns and distribution of consumption in the population alone, around 5,000 households in Kosovo (which is comprised of households with over 10,000kWh/year spending) would see a break-event point of 8.0 years for the installation of PV systems. As such, this study assumes that installer estimations of potential installations at a 1-year reduction in break-even point for the average users are based entirely on walk-in customers. This is further compounded by the lack of any mass-media advertisements for PV systems for residential households or apartments, any education campaigns, and the lack of dedicated sales staff and marketing strategies for the residential sector.[16]

As a result of the aforementioned analysis on the immediate potential market for PV systems installation based on financial benefits alone, an adjustment to the initial estimation of PV installers was made. Considering that 5,000 households would see a break-even point of 8 years based on current usage statistics alone, and considering that PV installers estimate that the reduction of the break-even point of installation of PV systems (for a 5kWp system) by 1 year would quadruple their current 20 installations per year – the revision estimates that a minimum of 1/3 of each spending category as detailed in the consumption schedule above would immediately be contenders for installation of PV systems if the break even point fell under 10 years. Another 1/3 would be contenders for immediate adoption of the break-even point for their category fell under 8 years, with the final 1/3 lagging in terms of adoption due to credit availability, household income and other factors discussed throughout this paper and therefore not being calculated toward the total potential adopter scenario.

While these estimations do not directly influence the way that this study estimates the likelihood of adoption of PV systems for households (NPV approach) – it does influence the calculations of impact on government revenues in the tax-incentive and policy incentive scenarios. Under these scenarios, this study makes a list of assumptions such as removal of VAT for PV installations and interest-free loans to households for installations of PV systems. The strict financial government return on investment from the boost on installation systems is calculated through the increased sales and installations of PV systems and resulting benefits from Personal Income Tax and Corporate Income Tax increases as a result of increases in sales for PV systems installers. This is highly influenced by PV systems' installers ability to leverage the incentive structures to attract

[16] As confirmed to INDEP by installers.

new customers made available to them. As a result, an estimation of the market penetration rate of these installers under the aforementioned scenarios is crucial to calculating appropriate government benefits to PV installations and is influenced by their perceptions, current steps and efforts and likelihood to expand on current efforts to attract new household clientele.

Other countries

Countries that have made efforts into expanding PV solar installations on households have usually done so with a concerted effort between the private sector and government incentives. These government incentives, by and large, have been mainly targeted toward the clients as the key bottleneck in the adoption of PV solar installation systems. Most western countries started the implementation of policies toward stimulating the adoption of PV installation systems early on in the PV panel innovation systems, when panels were less efficient and the benefit and pay-back period (partially due to the high initial cost of installation) was substantially longer.

Germany began the design and adoption of PV solar system panels as early as the late nineties. In 2000, the German government started a system of feed-in tariffs to stimulate the growth of PV systems across the country as part of their target to reduce fossil fuel use for energy generation. For small roof-top installations, the feed-in tariff price in 2005 was € 0.55/kWh, while this price has been reduced to a current € 0.1 / kWh, a reflection of the reduction of the cost of installation of PV systems as well as the increase in the efficiency of generation. However, Germany's feed in-tariff system is not a tax sponsored system – the system is financed through an EEG Surcharge – which is an extra charge on energy prices used to finance the feed-in tariffs for renewable energy. In Germany, as of 2015 - 23% of the total residential spaces in the country were detached single-standing houses – the most likely adopter of PV systems.[17]

As of 2019, Germany had a total installed solar capacity of 45 GWp over 1.8 million systems across the country in PV alone, which on sunny days can account for 50% of demand.[18] Systems of less than 10kWp generation capacity constitute 14.2% of total installed capacity as of 2017.[19] Assuming an average installed capacity of 5kWp per home, this yields a total current installation of approximately 1.4 million small scale power systems or around 14% of total detached houses.[20]

[17] Eurostat, (2018), 'Distribution of population by dwelling type (%)'. https://ec.europa.eu/eurostat/statistics-explained/images/d/da/Distribution_of_population_by_dwelling_type%2C_2018_%28%25%29_SILC20.png (accessed on 18/07/2020)

[18] Fraunhofer ISE, (version of June 10, 2020), 'Recent Facts about Photovoltaics in Germany'. https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/recent-facts-about-photovoltaics-in-germany.pdf (accessed on 15/06/2020)

[19] G. Lettner, H. Auer, A. Fleischhacker, D. Schwabeneder, B. Dallinger & F. Moisl, (2018). 'Existing and future PV prosumers concepts'. *Technische Universitaet Wien* https://www.pvp4grid.eu/wpcontent/uploads/2018/12/D2.1_Existing-future-prosumer-concepts_PVP4G-1.pdf. (accessed on 11/08/2020)

[20] This estimation assumes that the average installation capacity system of the <10kWp category is 5kWp. The total number of installed systems is calculated by multiplying total solar installed capacity (~49GWp) by the percentage of systems under 10kWp and divided by the assumption of the size of the average system (5kWp). The total number of houses is estimated by multiplying the total number of dwellings (42 million - https://www.destatis.de/EN/Themes/Society-Environment/Housing/_node.html) to the number of detached houses (23%, citation below) to obtain a number of

Considering the above information and statistics, our currently applied model of estimation for the total available market in Kosovo based on the NPV approach indicates that the model is reasonable (as will be explained further), when compared to Germany's system. However, other country lessons are important to considering, seeing as Germany's system is highly advanced.

Three current are analyzed in this paper in order to draw potential parallels to Kosovo. These cases were selected based on closeness of overall average incomes to Kosovo, varying level of policies supporting PV installation (good policies, some policies and no policies scenarios) and cultural effects on adoption of PV scenarios.

Primary, the case of Chile is important to consider due to the fact that the country is a developing economy with considerable insolation throughout the year and relatively advanced solar incentive policies. Chile currently has no feed-in tariffs planned to support household installation of PV systems, however, it does apply a net metering concept to aid in the adoption of systems. Chile has also a comparable cost of installation of solar systems when compared to the average wage. Despite the generally favorable conditions for PV solar installations, general adoption of Solar power in the capital, Santiago, remained low.[21] To understand the reasons behind the lag of adoption Walters et.al. (2018) undertook a study of the structural analysis of the reasons that affect PV diffusion in the local Santiago market. According to this research, market maturity – or the capacity to offer special discounts, offers and promotions to finance a PV system is at the center of all other considerations for adoption. However, market maturity is highly dependent on other critical factors, the most critical of which are subsidies available, knowledge of the tech, certainty of the return on investment and understanding of the net-billing concept. These interdependent factors indicate the likelihood that a household will adopt a PV system in a scenario of positive NPV and reasonable break-even point. These findings are also reflected on the studies conducted on the issue in Lahore, Pakistan as well as Saudi Arabia, which were the other cases considered for this study.

These critical points are considered outside of the simple NPV analysis necessary – therefore reflect the experience that other countries have faced challenges in stimulating PV adoption despite positive NPV scenarios. As a result, while the overall NPV approach this paper undertakes can indicate the total potential market for adoption of PV systems as a starting point for strategic decision making for the government and business in the sector, actual penetration will depend on a number of factors unrelated to financial benefit. These factors are discussed at length in the conclusions section of this paper and appropriate recommendations are provided.

approximately 9.8 million houses. This calculation assumes that all installations were made in single detached homes – which has its limitations. (accessed on 24/07/2020)

[21] Walters, J., Kaminsky, J., Gottschamer, L., "A Systems Analysis of Factors Influencing Household Solar PV Adoption in Santiago, Chile", Sustainability – 19 April 2018. https://www.mdpi.com/2071-1050/10/4/1257 (accessed on 29/07/2020)

8. The Net Present Value Approach

The NPV approach utilized in this paper takes into account the total potential savings through the lifetime of a system discounted to the present day and netted from the cost of the installation. The total savings are calculated based on the generation capacity of a system as detailed in this study, at three price scenarios – baseline, 20% price increase and 40% price increase. As such, the total value of the savings for each household energy consumption group and related NPVs are applied to three different scenarios.

The current value of the installation of the system was obtained from polls with solar installation providers. Currently, the price per kWp installed in Kosovo is € 1,000 including VAT, which brings the current total cost to install a 5kWp system, inclusive of permits, at € 5,000. Two additional scenarios of the present value of the installation are calculated – the first one takes into account a financing system whereby 15% of the value of the installation is obtained as a grant and the rest is paid with a low interest rate (4%) on the outstanding value. This preferential financing system is based on a current offering in the market by the GEFF project by the EBRD in Kosovo.[22] The second financing scenario takes the present value of a 5 year loan on € 5,000 at 6% effective interest rate on the loan (based on Kosovo's individual average interest rate) as the base installation cost.

The NPV analysis is highly dependent on the discount rate applied in order to calculate the present value of the bill savings. The discount rate is effectively the rate that individuals would realistically expect to see on returns on their investment had they invested in another money-making enterprise. For individuals, determining an appropriate discount rate is challenging due to secondary utility considerations rather than simple returns – some individuals would rather buy a slightly newer car than realize a 3% return on their € 5,000 annually. The decision on the exact norm of the discount rate for the bill-savings for the average Kosovo individual is complex. Typically, a discount rate in more advanced economies would consist of the return that an individual would expect from investing the value of the money in a profitable investment with a certain risk profile. This approach significantly simplifies the process of choosing a discount rate for individuals in the market. However, Kosovo has a severely limited infrastructure regarding the opportunities of individuals to invest in global or local equity or debt markets. Commercial bank savings account interest rates for the longest available period of 60 months only yield a 0.9% interest rate – substantially lower than most commercial bank offerings elsewhere. Certain banks in Kosovo also offer the opportunity to purchase global stocks and Kosovo Government bonds, but severe limitations apply – there is 25-euro transaction fee for stock purchases while there is a minimum € 10,000 floor for Kosovo Government bond purchases. As a result, market

[22] Green Economy Financing Facility. https://ebrdgeff.com/kosovo/the-programme/stakeholders/ (accessed on 11/07/2020)

investment vehicle comparable rates are not a strong indicator of real discount factors for individuals in Kosovo.

An alternative method of establishing a baseline for the discount rate for Kosovo would be to evaluate the returns on the Kosovo Pension Fund. From 2002 to 2009, Kosovo's pension fund has exhibited an overall Compound Annual Growth Rate (CAGR) of 2.4%, with an absolute value of share appreciation for people that have been invested since 2002 of 51.6%.[23] While the total overall appreciation value of a share in the pension fund is slightly more promising, the CAGR and average annual growth rate remain too low to be considered appropriate discount rates, particularly when considered against the effective interest rates on loans that citizens are willing to pay for houses and cars.

An additional complication to the establishment of an appropriate individual discount rate is the issue of income. Discount rates for lower- and middle-income individuals tend to be higher than for higher earning individuals due to the cash constriction – lack of availability of cash now and regular cash flows makes cash more valuable.

For the purposes of this paper, therefore, a different approach was required. In order to assign a discount rate, this study uses a compound rate made from the risk-free rate available from commercial banks and the average commercial lending rate for the latest available year. The commercial lending rate was chosen as a proxy of the discount rate since it is a real indicator of the potential future cash flows individuals would be willing to forego to obtain current utility – and due to a lack of better proxies – is the most accurate possible indicator of a discount rate. As discussed above, the risk-free rate for commercial lending account is 0.9%. The effective interest rate for households for 2019 stands at another 6.8%.[24] Together, this yields an individual discount rate of 7.7%. Incidentally, 7.7% is close to the social discount rate of 7.2% for Kosovo according the World Bank, further validating the potential effectiveness of the chosen discount rate.[25]

The calculations depicted in the tables below assume that the lifetime of a PV installation system is 25 years. Three scenarios are presented, and the LTV calculated for the year 2021, with a baseline energy price scenario, 20% price increase scenario and 40% price increase scenario. This study conducts annual forecasts up to 2027.

[23] Kosovo Pension Savings Trust, (2002-2019), 'Annual returns and cash flow'. http://www.trusti.org/wp-content/uploads/2020/02/FKPK_informatat_vjetore_kryesore_2019shq.pdf (accessed on 15/08/2020)
[24] Central Bank of the Republic of Kosovo, (2018-2020), 'Kosovo economy at a glance'. https://bqk-kos.org/eag/sq/ (accessed on 17/08/2020)
[25] The World Bank, (2018), 'Transport & Digital Development Global Practice Europe and Central Asia Region'. http://documents1.worldbank.org/curated/en/249951531020771941/pdf/Kosovo-KODE-PAD-06132018.pdf (accessed on 21/08/2020)

Table 9: NPV of 5kWp installation in Kosovo by consumption group and price scenario

Consumption Group (2021)	Baseline		20% Price Increase		40 % Price Increase	
	NPV	Break-Even [Years]	NPV	Break-Even [Years]	NPV	Break-Even [Years]
360 kWh/year consumption	€(4,362)	186	€(4,235)	155	€(4,107)	133
860 kWh/year consumption	€(3,477)	78	€(3,172)	65	€(2,867)	56
1360 kWh/year consumption	€(2,591)	49	€(2,109)	41	€(1,627)	35
1860 kWh/year consumption	€(1,705)	36	€(1,046)	30	€(387)	26
2360 kWh/year consumption	€(820)	28	€17	24	€853	20
2860 kWh/year consumption	€45	23	€1,053	19	€2,062	17
3360 kWh/year consumption	€792	20	€1,950	17	€3,108	14
3860 kWh/year consumption	€1,411	17	€2,693	14	€3,976	12
4360 kWh/year consumption	€1,904	15	€3,285	13	€4,666	11
4860 kWh/year consumption	€2,565	12	€4,078	10	€5,591	9
5860 kWh/year consumption	€2,754	11	€4,304	10	€5,855	8
6360 kWh/year consumption	€2,861	11	€4,433	9	€6,006	8
6860 kWh/year consumption	€2,900	10	€4,480	8	€6,060	7
7360 kWh/year consumption	€2,900	10	€4,480	8	€6,060	7
7860 kWh/year consumption	€2,900	10	€4,480	8	€6,060	7
8360 kWh/year consumption	€2,900	10	€4,480	8	€6,060	7
8860 kWh/year consumption	€2,900	10	€4,480	8	€6,060	7
9360 kWh/year consumption	€2,900	10	€4,480	8	€6,060	7

As can be seen from the table above, the NPV for the investment is positive and 10 years or under in the baseline scenario (standard price increase, no stimulation policies) for the higher energy users. These users would constitute immediate likely target adopters of PV systems based on NPV and Break-even point considerations alone – making them a perfect testing ground for awareness raising campaigns. The client groups marked in orange – namely, the groups with a positive NPV but a long break-even point are also likely to adopt PV technology assuming proper stimulation and outreach methods are undertaken to target these groups. For the groups marked in red, however, PV technology is unlikely to be adopted at any point due to the simple unfeasibility of the investment. Additionally, the first three categories (under 1,360 mWh/year consumption) are there to cover partially lived in houses throughout the year.

The table below indicates the total adjusted houses / households (removal of 64% of total houses in Kosovo) that fall within each category after the initial reduction for empty houses, removal of apartment buildings from the dataset and reduction of 40% of the total number to account for unfeasible roof positioning or lack of ground space for installation of the PV solar panels.

Table 10: Number of households per each NPV level

Consumption Group (2021)	PV Adopter Potential based on NPV analysis		
	Baseline	20% Price Increase	40 % Price Increase
360 kWh/year consumption	1,463	1,463	1,463
860 kWh/year consumption	2,083	2,083	2,083
1360 kWh/year consumption	2,927	2,927	2,927
1860 kWh/year consumption	3,912	3,912	3,912
2360 kWh/year consumption	5,244	5,244	5,244
2860 kWh/year consumption	6,117	6,117	6,117
3360 kWh/year consumption	7,073	7,073	7,073
3860 kWh/year consumption	7,777	7,777	7,777
4360 kWh/year consumption	8,171	8,171	8,171
4860 kWh/year consumption	8,171	8,171	8,171
5860 kWh/year consumption	7,777	7,777	7,777
6360 kWh/year consumption	7,073	7,073	7,073
6860 kWh/year consumption	6,117	6,117	6,117
7360 kWh/year consumption	5,244	5,244	5,244
7860 kWh/year consumption	3,912	3,912	3,912
8360 kWh/year consumption	2,927	2,927	2,927
8860 kWh/year consumption	2,083	2,083	2,083
9360 kWh/year consumption	1,463	1,463	1,463
Positive NPV, <10-year breakeven point clients	**28,819**	**44,767**	**52,938**
Positive NPV, >10-year breakeven point clients	**45,086**	**34,382**	**26,211**
Negative NPV, >10-year breakeven point clients	**15,629**	**10,385**	**10,385**

The table above is a highly conservative estimate. The table above removes 64% of the total houses in Kosovo from consideration for the analysis, and edge cases (bottom and top percentiles) as well as another approximately 5,600 apartment buildings. The remaining houses are further filtered for those that have negative NPV Values. The resulting numbers indicate that under the most conservative, worst case scenario, a total of 28,819 houses exist as potential immediate adopters of PV systems, assuming proper outreach is conducted. If energy prices increase by 20% and 40%, the total highly likely number of adopters climbs to 44,767 and 52,938 potential clients, respectively. For the baseline scenario the total likely adopters of PV systems based on NPV analysis alone constitutes 10.8% of total households of Kosovo, ~3% less than the estimated percentage of detached houses in Germany with installed PV systems as of 2019 which is in line with the expected reduced efficiency of PV diffusion compared to the most successful system.

Based on the analysis above, the potential market for household PV systems, in the most conservative scenario, is a total of € 144 million (assuming 28,819 houses install 5kWp systems at current prices). This means a household generation capacity of 144MWp of solar power in the residential sector alone, without any additional stimulation policies.

9. VAT Removal Impact

Government policies aimed at the stimulation of the adoption of PV systems in the country are one of the key determinants of the sector's likelihood to succeed. In Kosovo's case, the measure of policies that can be enacted has limitations due to the fiscal capacity of the government to enact measures, the population's high sensitivity to energy pricing and the lack of developed market systems for advanced measures. Due to these restrictions, potential government stimulation measures considered in this study fall in the realm of the immediately implementable measures under current conditions.

The first such measure that could drastically affect the balance of the cost of the systems is the removal of VAT from the purchase and installation of PV systems in the country. Currently, Kosovo's VAT is at 18%, with several exceptions to the application of VAT at import for importers and at sale for certain categories of industry. The government also has relatively good access to the measurement and control of VAT measures and excluding certain installation companies from the VAT provision could be done relatively easily without affecting the functioning of the VAT system in the country. Removal of the VAT tax would effectively create an 18% price drop in the overall initial installation cost of the 5kWp sample system undertaken in this paper. The result of this price drop on the aforementioned analysis is shown in the revised NPV table below.

Table 11: NPV of 5kWp installation in Kosovo by consumption group and price level, VAT Removed

Consumption Group (2021)	Baseline		20% Price Increase		40 % Price Increase	
	NPV	Break-Even [Years]	NPV	Break-Even [Years]	NPV	Break-Even [Years]
360 kWh/year consumption	€(3,600)	157	€(3,472)	131	€(3,345)	112
860 kWh/year consumption	€(2,714)	66	€(2,409)	55	€(2,105)	47
1360 kWh/year consumption	€(1,828)	42	€(1,346)	35	€(865)	30
1860 kWh/year consumption	€(943)	30	€(284)	25	€375	22
2360 kWh/year consumption	€(57)	24	€779	20	€1,615	17
2860 kWh/year consumption	€807	20	€1,816	17	€2,825	14
3360 kWh/year consumption	€1,554	17	€2,713	14	€3,871	12
3860 kWh/year consumption	€2,174	15	€3,456	12	€4,738	10
4360 kWh/year consumption	€2,667	13	€4,048	11	€5,429	9
4860 kWh/year consumption	€3,327	11	€4,840	9	€6,353	8
5860 kWh/year consumption	€3,516	10	€5,067	8	€6,618	7
6360 kWh/year consumption	€3,624	9	€5,196	7	€6,768	6
6860 kWh/year consumption	€3,663	8	€5,243	7	€6,823	6
7360 kWh/year consumption	€3,663	8	€5,243	7	€6,823	6
7860 kWh/year consumption	€3,663	8	€5,243	7	€6,823	6
8360 kWh/year consumption	€3,663	8	€5,243	7	€6,823	6

8860 kWh/year consumption	€3,663	8	€5,243	7	€6,823	6
9360 kWh/year consumption	€3,663	8	€5,243	7	€6,823	6

The NPV analysis with the drop of the 18% VAT rule indicates an immediate expansion of the expense groups, as well as a reduction in the break-even point for two additional consumption groups. This further expands the market for potential household PV installations in Kosovo, enabling business to better market their PV solutions. In total the new market is estimated according to the table below:

Table 12: Number of households per each NPV level, no VAT scenario

Number of Houses with potential to install PV based on NPV analysis (No VAT)			
Consumption Group (2021)	**Baseline**	**20% Price Increase**	**40 % Price Increase**
360 kWh/year consumption	1,463	1,463	1,463
860 kWh/year consumption	2,083	2,083	2,083
1360 kWh/year consumption	2,927	2,927	2,927
1860 kWh/year consumption	3,912	3,912	3,912
2360 kWh/year consumption	5,244	5,244	5,244
2860 kWh/year consumption	6,117	6,117	6,117
3360 kWh/year consumption	7,073	7,073	7,073
3860 kWh/year consumption	7,777	7,777	7,777
4360 kWh/year consumption	8,171	8,171	8,171
4860 kWh/year consumption	8,171	8,171	8,171
5860 kWh/year consumption	7,777	7,777	7,777
6360 kWh/year consumption	7,073	7,073	7,073
6860 kWh/year consumption	6,117	6,117	6,117
7360 kWh/year consumption	5,244	5,244	5,244
7860 kWh/year consumption	3,912	3,912	3,912
8360 kWh/year consumption	2,927	2,927	2,927
8860 kWh/year consumption	2,083	2,083	2,083
9360 kWh/year consumption	1,463	1,463	1,463
Positive NPV, <10-year breakeven point clients	**44,767**	**52,938**	**60,715**
Positive NPV, >10-year breakeven point clients	**29,138**	**26,211**	**22,346**
Negative NPV, >10-year breakeven point clients	**15,629**	**10,385**	**6,473**

Effectively, the removal of the VAT from the sale and installation of PV systems effectively nearly doubles the potential market of adopters in the baseline scenario alone. The number of clients that based on an NPV and break-event point basis of decision making would potentially adopt PV systems jumps from 28,819 in the VAT included scenario to 44,767 in the no VAT scenario. This expands the market by 89.7% in total, jumping the value of the total potential transactions from to €144. million to € 223.8 million – a substantial increase. More importantly, at the very worst case scenario, removal of the VAT would drastically increase the likelihood that the previous 23,594 clients in the VAT-included scenario would adopt PV energy.

10. Kosovo Budget Impact of VAT removal scenarios

The removal of VAT from companies that install PV systems, specifically for installations for the residential sector, is expected to have a negative impact in Kosovo government revenues. The exact impact that this policy will have on the revenues is a factor of both the total potential market for installation of PV systems, as well as the exact diffusion of PV systems. The diffusion of PV systems is a function of government and company efforts to educate the public on the benefits of PV systems. In order to quantify the exact possible impact on revenues, as well as the boost to a potential installer company, this study forecasted a sample business that exclusively installs equipment under both scenarios.

Several assumptions constitute the core of the forecasted scenarios below. The first assumption diverges from the commonly held belief of current installers in the market regarding the potential client base. This assumption is based on the fact that dedicated advertising and client acquisition costs for residential clients at current PV installation companies are very low. By comparison, client acquisition costs in western companies equate come to between 11 and 15% of the total cost of sale for a client (5.7kWp system).[26] [27] [28] Due to these considerations, INDEP estimates that PV diffusion rates among households in Kosovo would be substantially higher if higher investment into customer acquisition was pursued.

The relationship between the increased client acquisition costs forecasted for this scenario and the actual market penetration rate were also tested. PV installation companies indicated that they would be able to do 200 installations per year if the VAT was removed from similar installations. Considering that VAT is at 18% in Kosovo and the forecasted customer acquisition costs as a percentage of sale for this model stand at 11%, and company customer acquisition costs are usually more effective than policy measures, we assumed that a baseline 200 customer per years starting in year 1 of the forecast was acceptable. As such, in the baseline scenario for the calculation of the market penetration rate we assumed 236 clients which translates to a total baseline market penetration of 1% (not of total potential clients, exclusively the high spending clientele). This scenario, therefore, is unrealistically conservative – however, for the purposes of proving the worse case scenario the study started with this scenario.

The rest of the components of the expenses of a company doing installations of equipment were obtained by analyzing the expense structure of a U.S. company in the same industry.[29] The reason

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[26] R. Fu, D. Feldman, R. Margolis, M. Woodhouse, and K. Ardani, (2017), 'U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017'. *National Renewable Energy Laboratory*. https://www.nrel.gov/docs/fy17osti/68925.pdf (accessed on 13/08/2020)

[27] Cost of Solar Panels (Complete Guide to Financing Solar Panels), (2017). *SUNMetrix* https://sunmetrix.com/cost-of-solar-panels/ (accessed on 24/07/2020)

[28] Wesoff, E., (2017). 'Costs to Acquire US Residential Solar Customers Are High and Rising'. *GreenTechMedia*. https://www.greentechmedia.com/articles/read/costs-to-acquire-us-residential-solar-customers-are-high-and-rising (accessed on 19/08/2020)

[29] R. Fu, D. Feldman, R. Margolis, M. Woodhouse, and K. Ardani, (2017), 'U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017', *National Renewable Energy Laboratory*. https://www.nrel.gov/docs/fy17osti/68925.pdf (accessed on 16/07/2020)

for the necessity to use a foreign company as a model is due to the lack of readiness of Kosovo PV installers to share their internal cost structures. However, Kosovo PV companies did share several assumptions – such as the number, profile and costs of employees necessary to install 200 systems per year. Based on those shared assumptions, we calculated that the percentage of labor as a share of revenue for Kosovo business is the same as US businesses in the same industry. Additionally, the Material Cost of Goods Sold for the industry is also the same based on the information shared with INDEP, when adjusted for import and VAT fees on products. Therefore, the forecasts of the expense accounts of the example firm created for this scenario is generally accurate to within 15% of what we would see in the real market. Considering all the above, as well as the total market potential and market penetration rates explained in this study the Income Statement of the baseline scenario of a firm is as follows:

Table 13: Forecast of VAT revenues for a PV installation business in a VAT applied scenario

VAT SCENARIO	2021	2022	2023	2024	2025	2026	2027
Number of Clients [5kWp]	**288**	**307**	**327**	**349**	**372**	**397**	**423**
Assumed growth rate		*6.5%*	*6.5%*	*6.5%*	*6.5%*	*6.5%*	*6.5%*
Implied Gross Revenue	**1,440,000**	**1,535,000**	**1,635,000**	**1,745,000**	**1,860,000**	**1,985,000**	**2,115,000**
[VAT]	*219,661*	*234,153*	*249,407*	*266,186*	*283,729*	*302,797*	*322,627*
Revenue [Net of VAT]	**1,220,339**	**1,300,847**	**1,385,593**	**1,478,814**	**1,576,271**	**1,682,203**	**1,792,373**
Costs of Goods Sold							
Hardware [net of VAT]	615,858	656,487	699,255	746,300	795,483	848,942	904,541
Labor	130,332	138,931	147,981	157,937	168,346	179,659	191,425
(of which, PIT)	*6,733*	*7,178*	*7,645*	*8,160*	*8,697*	*9,282*	*9,890*
General and Administrative Costs							
Overhead	148,184	157,960	168,251	179,570	191,404	204,268	217,645
Customer Acquisition Costs	135,109	144,022	153,405	163,726	174,516	186,244	198,441
Pre-Tax Profit	**190,856**	**203,448**	**216,701**	**231,281**	**246,523**	**263,090**	**280,320**
Tax	*19,086*	*20,345*	*21,670*	*23,128*	*24,652*	*26,309*	*28,032*
Net Profit	**171,771**	**183,103**	**195,031**	**208,153**	**221,870**	**236,781**	**252,288**

In this scenario, the baseline price is unchanged from current market prices, baseline demand is increased by nominal amounts, market penetration rate is 1%, VAT is present, and the firm requires approximately 20 direct laborers for every 200 clients. Under this scenario total Kosovo government tax revenues in 2021 would be € 245,480.

According to the model for this study, removal of VAT from the sale and installation of residential PV systems would increase the NPV and reduce the break-even point of a few of the customer consumption groups. This would mean that an increased number of clients would see a positive NPV on the investment as well as break-event points under 11 years. As such the total client base for the businesses would increase.

Therefore, the forecast of the potential business impact of the removal of the VAT is reflected in the model by increasing the total potential client base and maintaining all other assumptions constant. This approach ensures that the potential error leans toward the conservative side in order to provide a worse-case-scenario to stress-test the assumptions. As can be seen from the table below, total annual tax revenue losses for the Kosovo government under the baseline scenario would be in the low hundreds of thousands, with total 6-year losses amounting to € 1.7 million. This tax loss would result in the virtual doubling of households with installed PV systems and the inclusion of an additional 19MW of solar generation or the generation of 26.6GWh of renewable energy in a six-year period.

Table 14: Forecast of VAT revenues for a PV installation business in a no VAT scenario

No - VAT SCENARIO							
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Number of Clients [5kWp]	448	478	510	544	580	618	659
Assumed growth rate		*7%*	*7%*	*7%*	*7%*	*7%*	*7%*
Revenue	**1,898,305**	**2,025,424**	**2,161,017**	**2,305,085**	**2,457,627**	**2,618,644**	**2,792,373**
Costs of Goods Sold							
Hardware [Net of VAT]	958,001	1,022,152	1,090,581	1,163,286	1,240,269	1,321,528	1,409,202
Labor	202,739	216,315	230,797	246,183	262,475	279,671	298,225
(of which, PIT)	*10,474*	*11,175*	*11,924*	*12,719*	*13,560*	*14,449*	*15,407*
General and Administrative Costs							
Overhead	230,508	245,944	262,409	279,903	298,426	317,978	339,074
Customer Acquisition Costs	210,169	224,243	239,255	255,206	272,094	289,921	309,156
Pre-Tax Profit	296,888	316,768	337,975	360,506	384,363	409,546	436,716
Tax	*29,689*	*31,677*	*33,797*	*36,051*	*38,436*	*40,955*	*43,672*
Net Profit	**267,199**	**285,092**	**304,177**	**324,456**	**345,927**	**368,591**	**393,045**
Net Tax Revenue losses	**(205,317)**	**(218,823)**	**(233,001)**	**(248,705)**	**(265,082)**	**(282,984)**	**(301,470)**

As can be seen from the model assumptions above, even in the baseline case of business as usual, with no price increases, and only 1% market penetration rate, the removal of the VAT would have a substantial effect in the improvement of diffusion of PV systems in Kosovo. The tax losses stemming from this stimulation method would be low, amounting to less than 0.5% of the total annual budget of the country. Additionally, the measure would create a total of approximately 45 new jobs immediately, at an assumed tax-loss based cost per new job of €37,000. These jobs would be stable and expected to continue for the forecasted period of 92 years (assuming a yearly market penetration rate of 1% and no growth of interest for PV other than the current clientele of approximately 28 thousand houses).

11. Conclusions

Kosovo's current rate of adoption of PV systems in homes is low to non-existent. Despite this, Kosovo has relatively permissive PV diffusion policies, with a net metering law in effect that is functional, a competitive price environment in the market for PV systems and solar radiation that enables positive cost savings. As a result of the difference between the policies and capabilities of PV systems in the local market, and actual adoption rates, this study analyzed total potential, barriers to adoption and potential policy impacts.

Kosovo's overall housing market, ownership structure and vacancy rates indicate that there is a substantial single, detached homeowner population with potential to adopt PV in terms of surface land available and positioning of rooftops. The energy consumption patterns of households also indicate, assuming normal distribution, that there are several residential high energy users in the market which make for ideal PV installation targets. Applying a net-present-value valuation of the energy bill savings of a 5kWp system indicated that the total potential market of adopters is substantial. To do so this study considered people who would see a positive NPV within a 25-year window and a break-even points of less than 10 years as potential adopters. This study finds that in the business as usual scenario the total potential market is 28,819 systems to be installed, or € 144 million. The implied total residential solar generation capacity would be 144MWp, or an average of reduction of demand from the grid of 212GWh if everyone adopted the PV system in the first year.

When accounting for other potentially influencing factors, such as realistic expectations of price inflation due to carbon taxes and the uncompetitive energy production industry in Kosovo, these statistics improve. In a scenario with 20% price increase, the total market of potential adopters climbs to 44,767, up 88% from the baseline scenario. This is equivalent to a total local target market of € 223 million, 223 MWp or an equivalent of 302GWh reduction of grid demand. These numbers are even more substantial in a 40% energy price increase scenario.

Appropriate governmental market stimulation would also substantially serve to further jump start the sector without substantial revenue losses to the government. Removal of the VAT from the sale and installation of PV equipment from residences would manifest in the same way as the 20% energy price increase but serve as a positive signal instead of a negative signal. Under this scenario, assuming a 1% annual market penetration rate of businesses, the government will lose approximately € 1.7 in total revenue over a six-year period – a negligible decline. However, in doing so, the government would create approximately 45 new stable jobs in the sector immediately with the benefit of added renewable energy generation capacities locally and further grid independence.

While the financial analysis of the benefits of PV systems in Kosovo indicates the potential for a healthy market, the non-financial aspects of the lack of diffusion remain. Several critical points must be addressed by industry, government and non-governmental organizations in order to stimulate the sector. Both the government and businesses need to engage in substantial outreach and advertising efforts to promote residential PV systems. Based on the experiences of other countries like Kosovo, lack of understanding of NPV, break-even point, net metering law and other considerations play a substantially important role in the prevention of PV diffusion. Bridging these knowledge gaps is essential in ensuring adoption of PV systems in households. Additionally, local companies lack appropriately scaled advertising and customer acquisition budgets that would appropriately target residential clients. The reasons for the lack of appropriate budgeting is unclear – however it is at least a substantial cause of the lack of PV adoption.

Another important aspect of PV adoption is financing. The up-front cost of the systems currently varies between € 4,200 / 5kWp in a no-VAT scenario to € 5,200 / 5kWp as one of the most expensive systems in the market. The price of these systems is substantial for most Kosovo citizens. As a result, affordable and well-advertised financing schemes should be made available to citizens, possibly nested under installers that make the sales, in order to increase interest for PV diffusion. Currently, some efforts by the European Bank for Reconstruction and Development (EBRD) and the Millennium Foundation Kosovo (MFK) are underway to stimulate the sector through credit guarantees to financial institutions. However, these efforts should also include provisions requiring banks and installers to properly advertise and outreach for PV adoption.

Financially, the adoption of PV systems is profitable for up to 14% of households in Kosovo. However, the information environment around PV inclusion in the country is lacking, as are the incentive systems for adoption. In order to better capture the target market, substantial financial credit measures with a developed market system as well as effective information sharing and customer capture strategies are required.

12. Recommendations

1. **1.** The Ministry of Finance of Kosovo should consider the removal of VAT for the purchase and installation of PV systems of 10kWp or less (residential sector). This measure would serve to stimulate the market and secure a minimum of 40 stable jobs in the industry in the immediate future. Additionally, the measure would serve to pre-cede potential energy price increase scenarios by providing incentives to lower the consumption of grid energy.
2. **2.** PV installers in Kosovo should proportionately increase their customer acquisition expense and sophistication in targeting the residential sector. Appropriate market targeting and education would substantially increase the number of PV adopters seeing as it is financially suitable for approximately 23 thousand houses to do so immediately.
3. **3.** Commercial Banks and other lending institutions should consider the further development of financial products aimed at residential clients for the adoption of PV systems. Working together with IFIs currently in the market, the Kosovo Government and installers, they should also explore advertising avenues for these loans.
4. **4.** The Kosovo Government, in collaboration with PV installation businesses as well as NGOs should increase focus in the education of the public regarding the benefits of PV systems and modern, real, financial benefits, This could potential create a reduction of as much as 400GWh of demand in the next 40 years.

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