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ACTORS, GOVERNANCE AND MODALITIES OF ELECTRICITY SUPPLY: THE CASE OF LOW-INCOME NEIGHBERHOODS AND REFUGEE COMPOUNDS IN HALBA

by

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Thank you

Sarah Merhebi.

AN ABSTRACT OF THE THESIS OF

Sarah Abdel Kader El Merhebi for Master of Urban Planning and Policy

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Title: Actors, Governance and modalities of Electricity Supply: the Case of low-Income Neighborhoods and Refugee Compounds in Halba.

This thesis investigates the debates regarding basic service provision in Syrian refugees' compounds, looking at the formal and informal modes of service provision for the acquisition of electricity in Halba after 2011. Studying the actors, governance and outputs of 25 Syrian refugee compounds and one Camp in Cheikh Mhammad village bordering Halba, the thesis unpacks how service provision is the outcome of a hybrid system operated both commercially and by self-help through formal (municipal) and informal actors. While this system responds to the dire needs of refugees in lieu of the ongoing ad-hoc, turn-a-blind-eye strategy adopted by the government, it suffers from many shortcomings, the most prominent of which is dangerous fire hazards that result from an increasing practice of cable hooking. Although the majority of them tap from the grid, they are still very much dependent on the private generators' business during EDL's cut-offs. A considerable sum of the refugees' income go to the private generator owners which make Syrian refugees more vulnerable given they're paying a more expensive bill then the one being paid to the government. . In order to respond to this reality, the thesis argues for the importance of a service provision model that learns from existing hybrid systems and recommends the best model for Halba.

CONTENTS

CHAPTER I

INTRODUCTION

In a world where nearly 20 people are forcibly displaced every minute as a result of conflict, persecution, or natural disasters (UN, 2016) it will be crucial to ensure that **public services** in urban areas are delivered for the refugees/displaced as well as the wider population. Access to basic services such as clean water and sanitation, electricity, transport, health care, and schooling not only increases individual wellbeing but also serves as an input for aggregate production. A lack of access to electricity for example hampers development. It affects everything from people's ability to learn to the creation of enterprises and the provision of public services like health care.

Recently, development professionals have become increasingly aware of the fact that providing better services for the poor is as much about **governance** as it is about solving technical problems. Building power plants, health centers, and water points is all very well, but if teachers and nurses and employees don't turn up to work or perform poorly and if standpipes run dry because of lack of maintenance, development goals remain unfulfilled.

This thesis investigates service provision in Syrian refugees' compounds in Halba after the Syrian war of 2011 by examining the formal and informal modes of electricity acquisition relying on interviews with refugees and service providers of 25 Syrian refugee compounds and one camp in Cheikh Mhammad village. The thesis unpacks how service provision is the outcome of a hybrid system operated

both commercially and by self-help through formal and informal actors. The thesis argues that even though the system responds to the dire needs of refugees in lieu of the ongoing ad-hoc, turn-a-blind-eye strategy adopted by the government, it nevertheless suffers from many shortcomings; the most prominent of which is dangerous fire hazards that result from an increasing practice of cable hooking and environmental costs related to the air pollution caused by generators.

Building on Stel's framework my thesis explores three sets of questions:

i. How does the Syrian displacement impact urban government by adopting the lens of electricity provision in Halba?
ii. How do Syrian refugees access electricity in Halba?
iii. Has this impact made refugees more vulnerable? And if so what can be done on the service provision level to address their vulnerability?

My thesis shows that:

1. Lebanon struggled to adequately meet the population's demand for services way before the Syrian crisis.
2. The growing differentiation in electricity provision by the Lebanese government has led the informal/illegal provision of basic urban services to flourish and expand in many cities and villages I Lebanon Halba being one of them.
3. Syrian refugees are still very much dependent on the private generators' business during EDL's cut-offs even though they hook up illegally to the grid.

4. A considerable sum of the refugees' income goes to the private generator owners which make Syrian refugees more vulnerable given they're paying a more expensive bill then the one being paid to the government.

The thesis' objective is to prioritize interventions and actions required to meet the additional electricity demand in Halba and at the same time to help refugees become less vulnerable by providing adequate, sustainable and affordable power supply for all people residing in Halba. This research will help rethink the aid policy which focuses on the provision of short-term, temporary emergency relief and operates under the premise that forcibly displaced people may eventually return home.

At present, Syrian refugees' operations overwhelmingly rely on diesel for electricity generation, and wood and charcoal for household cooking, which displaced people often buy or collect. Such practices outlast initial emergencies as refugee settlements grow and peacekeeping operations drag on for years with impacts on health, environment and safety. Energy is essential for large populations of refugees and displaced people however it adds more expenses on an already vulnerable population. Also, host countries would rather conserve their own limited resources. This is why the aid and peacekeeping sectors have been leading on delivery of new energies.

According to the above this thesis argues towards **energy democratization** which means a change in energy/environmental politics. As a consequence of this

change, decisions can be decentralized and consumers can have greater input into their energy choices.

A. Framework

In its most abstract sense, **governance** is a theoretical concept referring to the actions and processes by which stable practices and organizations arise and persist (Bevir, Mark 2012 p. 56). These actions and processes may operate in formal and informal organizations of any size; and they may function for any purpose, good or evil, for profit or not. One can apply the concept of governance to states, to corporations, to non-profits, to NGOs, to partnerships and other associations (Bevir, Mark 2012 P.56).

During the 1950s and 1960s, a strong consolidation of state power emphasized public **service delivery**. Governance became a responsibility confined to the state who was the sole provider of urban services. However, the rise of the liberal economic policies coupled with a prevalent cynicism of the role of the state in development eventually impacted developing countries, leading to the progressive withdrawal of the state from the provision of essential services (Simone & Pieterse, 2017 p.120). Marvin and Graham argue that this new market model often favored the provision of infrastructure to specific top quality users leading to increased social distancing of disparate social/racial/economic groups. These dynamics are termed **splintering urbanism** (Marvin & Graham, 2010). Broadly speaking, it

means that a city becomes an assemblage of areas with different social and economic environments.

Twenty years ago, the study of the **governance of service provision** focused on failing public operators. Today, it is focused on the **diversity of actors**, many of whom belong to the informal (resellers, hawkers, dealers) or domestic (semi-wholesalers) sector. These **hybrid** systems have existed for a long time but were ignored or even hunted down in the name of the conventional operating monopoly, they were not considered as resources but as impediments to the "normal" functioning of the operating system (Jaglin, 2006 p.142).

Nonetheless, this hybridity/multiplicity has been recently considered as an opportunity to open up space for cultivating new, hybrid forms of service delivery (Stel, 2012, P.9). This has led to growing trends of initiatives that aim to organize service delivery through mechanisms that involve different actors, often in the context of **decentralization** programmes. These mechanisms are called **multi-stakeholder processes** (MSP) for service delivery (Stel, 2012, P.9). Noor (2010) referred to several definitions for the Multi-stakeholder processes. One of them is the definition of Hemmati (2002) which perceives Multi-stakeholder processes as "processes which aim to bring together all major stakeholders in a new form of communication, decision-finding (and possibly decision-making) on a particular issue (Stel et.al, 2010, p.36). MSPs can be an effective means to tackle service delivery in situations where services are fragmented, state-society interaction is

fragile, and where individual stakeholders, including the state, lack the capacity for service provision.

Based on the above, the theoretical basis for my thesis framework is inspired by key service delivery concepts and features I identified and derived from the MSP framework adopted by Stel (2014). The framework includes three main components of assessment: *actors, governance and deliverables/outputs* of electricity service provision shown below.

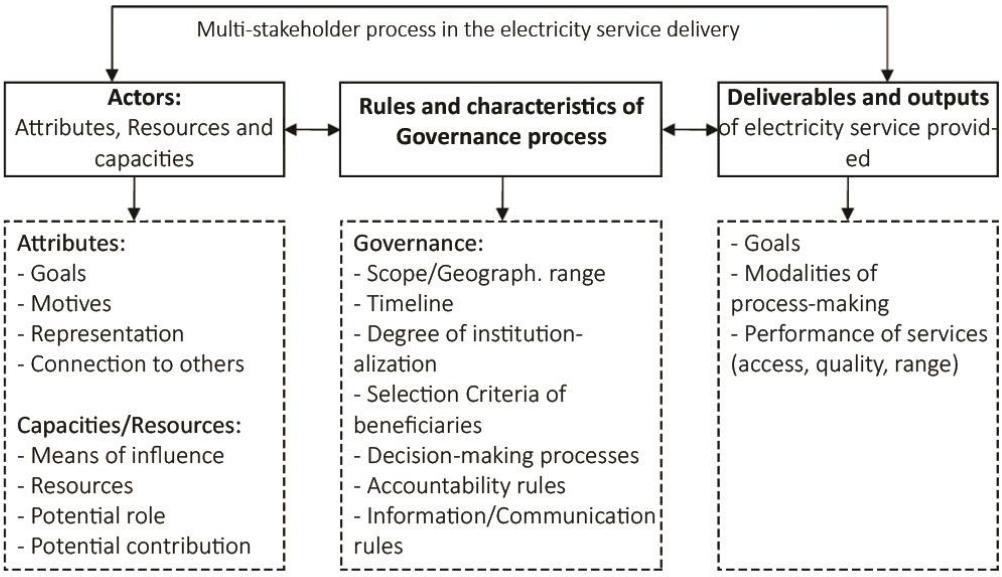


Fig. 1 Study Framework

Source: Nora Stel, Multi-stakeholder Processes, Service delivery and State institutions (2012)

I will be studying the contribution and roles of actors involved in electricity services provision and I will analyze the different resources and capacities (financial, information, and network) that actors use to develop their means of

influence on others. The potential role/contribution factor refers to the distribution of roles between actors, and determine who is dominating the service delivery and who is occasionally steering it. These factors will show the *hybridity* of local institutional arrangements which Franks & Cleaver calls "messiness" (Franks & Cleaver, 2007, p.293).

In determining the rules and characteristics of governance process, I will tackle the scope and geographical range factor to analyze if service delivery is taking place on the local level (level of the locality) or the meso-level (involves other localities). I will study the timeline factor to assess the period that each actor has spent in managing electricity service delivery in each locality and the degree of institutionalization to help identify formal and informal institutions and to analyze the degree of governance structure (existence of executive committees, coordinating groups, etc.). In addition, I will analyze the selection criteria of beneficiaries and the decision-making process to see whether decisions were made by all participating stakeholders or by a leading actor/coalition (Stel & Mandefro Abate, 2014, p. 746). Accountability refers to the "degree to which decision making was transparent and regulated by internal rules and codes of conduct" (Stel & Mandefro Abate, 2014, p. 746). Exchanged information and communication rules addresses the way people get informed about actors involved in electricity service provision (through billboards, phone numbers, word of mouth, etc.) and how they contact them.

Finally, the outputs of service provided will be studied through the analysis of the following deliverables: (1) the goal of studying electricity services delivery (2) modalities of process-making (fossil fuel power plant, illegal hooking, legal electric cables, private providers, etc.); and (3) the performance of electricity services where matters such as access, quality and range are indicative.

B. Methodology

The thesis relies on qualitative methods to unpack the modes of electricity acquisition by Syrian refugees in Halba. It also extensively relies on mapping and data visualization which I used as both analytical and illustrative tools. Qualitative methods stress the socially constructed nature of reality, they highlight the relationship between the researcher and the topic of study, and the situational constraints that shape inquiry (Denzin and Lincoln 2000). I used qualitative semi-structured in-depth interviews as they allow informants the freedom to express their views in their own terms, with minimum control (Bernard, 2002). Snowball sampling was used to identify interlocutors, which is a common method for building a sampling frame for small populations that are difficult to locate, such as undocumented immigrants (Johnson 1990; Bernard 2002).

Since many of Syrians work outside the realm of legality, the recruitment of participants proved to be challenging. Some Syrians were often unwilling to provide information, which could put them under the spotlight or threaten their status. Further, as the topic touches upon illegal access to electricity some refused to engage with a

researcher they do not identify with. To mitigate this, a Syrian resident who's well known and respected among the Syrian community was recruited as a broker. I also privileged the claim that the research aims to document the difficulties to access power and recommend a solution for easier, cheaper and more sustainable power. In addition, I ensured all interviewees anonymity and confidentiality (Farthing 2015).

My interview protocol is organized in three broad categories. I start with inquiring about the resident's origin, family members, employment, paycheck, and monthly expenditures to see if the family has any sort of income and if they have difficulties paying their monthly bills. Then, I move to a discussion on the modes of electricity acquisition and the challenges they face in accessing electricity. Do they have access to electricity in their home? What kind of electricity supply do they have? How much Ampere (Amps) do they receive and how much do they pay for it? What energy sources are used for lighting, heating and cooking in their house? How and from whom is it secured? How much did the family spend on energy last month? This includes expenditures on all energy sources (electricity and other fuels)? How much does the family spend each month on the following sources of energy (paraffin, gas, candle, coal, firewood, solar system, electricity, batteries, car batteries, generators?) Finally, I asked questions concerning their coping strategies and safety: What are the different methods the family uses to save up energy at home? Is the family subject to legalization or cutting off electricity and for how long? What does the family do in this case to secure electricity? Any alternative plans? What does the family do if there is a malfunction? Has there ever been a fire hazard in their home or in their neighborhood?

I interviewed 30 Syrian refugees 17 of whom live in refugee compounds and the rest in Cheikh Mahammad camp, a villge bordering Halba. I also interviewed the generator owners in Halba in the first round of fieldwork in summer 2017, I chose to experiment using a direct approach: walking into the generator owners' facility, introducing the project, and asking if I can interview the owner of the business. Some refused out of concern and fear, others welcomed me with no hesitation. As I built trust with some of these generator owners they started referring me to each other and giving me information about the ones who refused to be interviewed. By the end of the fieldwork I had the names of all the generator owners providing electricity in Halba and a preliminary map of their boundaries. In a next stage of fieldwork, in fall 2017, I asked random Syrians and Lebanese about their private electricity providers so that I can make a more accurate map of the generator owners' boundaries. At the end of fall 2017 I made sure to interview EDL in Halba and the Mayor to evaluate the effectiveness of the governance model concerning the provision of basic services.

C. Thesis Structure

The thesis begins with an overview of the electricity provision system in Lebanon highlighting the inherent weaknesses and inefficiencies of the system present way before the Syrian refugee crisis. These weaknesses were only emphasized after the Syrian refugee influx into Lebanon

Chapter two introduces Halba as the research's case study and gives a context of the electricity service provision and its peculiarity in this locality. This chapter

presents the results of the semi-structured interviews that I conducted with the key stakeholders mentioned earlier. The results are illustrated in “process maps”. The chapter has two main findings: one being that Syrian refugees’ are much dependent on the private generator owners (PGO) in order to access electricity. And two being that this dependency on the PGO not only has a direct financial cost on the Syrian refugees but also an environmental one.

The third chapter presents the energy access strategies of the Syrian refugees in both camps and rented apartments. The chapter also reflects upon the possibility for an energy transition policy.

The fourth chapter provides several cases of electricity provision systems from the local and the African context. Examples are drawn from three successful cases. Before deciding which system to apply in Halba, the chapter examines Halba’s particular context to decide which system works best. This chapter ends with an exercise that shows estimated cost/benefits related to the application of a PV system in Halba.

CHAPTER II

ELECTRICITY PROVISION IN LEBANON: AN OVER VIEW

A. Electricity Provision in Lebanon

The delivery of urban services in Lebanon reflects a similar pattern to countries of the Global South. In 1923 under the French mandate, the expansion of the electricity network was closely linked to the development of local industries. For example, the Qadisha Electricity Company developed a network in Northern Lebanon, including the city of Tripoli, where industrial activity flourished. Several local enterprises were also founded in places like Qadisha, Zahle and Saida (Verdeil 2009, p.420). Such a strategy did not benefit the entire country and is partially responsible for establishing the **roots** of the current regional **inequalities** in electricity provision (Thobie J., 2002 p.540)**.**

In the 1960s, under the rule of Fouad Chehab (1958-1964), the State began to pay increasing attention to socio-economic disparities, and the need to introduce institutional and administrative reforms to contain these inequalities. As a result, the State introduced a number of reforms, some of which fall within the functions of the **welfare state.** This objective was materialized in a unique state-owned electricity company, the Electricité du Liban (EDL) (Abu-Rish, 2015 p.1). It was based on the idea that fragmented and decentralized systems for electricity

distribution did not deliver the expected increased electrification (Sanlaville, 1965 p.372).

Despite considerable efforts to expand generation capacities, in the period preceding the civil war, the electricity supply did not keep up with the strong growth in demand. Electricity outages and local dissatisfaction over the quality of service were already part of everyday life during the period before the war (Verdeil, 2009 p. 424).

The period of the civil war had a dramatic impact on the electricity system in the country. Not only did it cause the physical destruction of the infrastructure, it also undermined the operability and financial capacity of EDL. The lack of control encouraged fraud, theft, and **illegal connections** to the electricity network. These factors undermined the performance of the state-owned EDL. Displaced Lebanese populations during the war had limited means to legally connect to electricity network because official registration required a residency card which was difficult, if not impossible, to obtain amidst the fighting. Today, the underlying patterns of fraud still persist, and the informal links that developed during the civil war period continue to undermine EDL's capacity to respond to practical problems (Thobie J., 2002 p. 542).

At the end of the 1990s, the government attempted to secure additional investment for the electricity sector. EDL was included on the list of public institutions open for **privatization**. Electricity Decree no.462 of 2002 provided a legal basis for this process, outlining conditions for full or partial privatization of

EDL's assets and the creation of an independent electricity regulator. This decree was supposed to kick-start new investment in the county's production, transport, and distribution networks. The decree's implementation was not accomplished due to mounting political tensions and the wave of domestic protests that followed the assassination of former prime minister Rafic Hariri in February 2005 (Thobie J., 2002 p.545).Today, the company retains the status of a public institution despite the fact that Electricity Decree no. 462 of 2002 provided a legal basis for its corporatization into entities that provide electricity production, transmission, and distribution and its consequent privatization (*G. Badelt* and *M. Yehia 2000*).

Recent figures show that electricity consumption per capita has grown at an average rate of 7% per year, whereas electricity generation has always lagged behind (Fardoun, Ibrahim, Younes, and Louahila-Gualous, 2012). A closer look at the electricity supply/demand balance indicates that the electricity demand in Lebanon is exceeding the supply, leading to electricity supply shortages, which in turn cause regular power cuts across all parts of the country. More than 7.5% of electricity demand (1116 GWh) has been imported from Syria and Egypt through the regional interconnection grid. As the Syrian war intensified in 2011, Lebanon became more like an energy island; electricity imports were disrupted and a substantial (new) demand for electricity was induced by the influx of thousands of Syrian refugees to Lebanon, leading to a wider electricity capacity shortage.

In the Lebanese context of weakened state authority, the failings of the electricity system exacerbate the fragmentation along socio-economic, geographical and

sectarian lines, since access to electricity services varies according to one's place of residence and socio-economic status. Furthermore, the level of access to electricity is determined by the schedule of **electricity rationing** in a given area (Verdeil, 2009 p.11). The overall schedule of electricity blackouts is not publicly available. **Beirut** has three hours of blackouts per day. The exact timing is known to the habitants of the concerned neighborhoods. In **rural** and remote areas, the blackouts can last for up to 12 hours a day and are randomly distributed throughout the day (Verdeil, 2009 p.11). The rationing system is thus characterized by great **inequality** between the rural areas and the country's capital echoing the concept of **splintered urbanism.**

Another key issue undermining the effectiveness of EDL's service is the **corruption** that governs the electricity sector. For most of Lebanon's political actors, the electricity sector is a cash cow that gives them unmitigated access to much-needed funds to run their clientelist system (Rabah, 2017). The tale of corruption in the energy sector does not stop with enormous sums of money siphoned from EDL through illegal bribes from such deals; an even bigger problem is that EDL has been used by political elites to distribute free electricity to their constituents but also to industries (Rabah, 2017). According to official sources, around 55% of EDL bills are not collected. Moreover, around 45% of electricity generated by EDL is not even billed - it is estimated that tens of thousands of people get electricity free by illegally tapping into power lines (MoEW, 2017). As Muhammad Qabbani, who heads the parliamentary Energy and Water Committee,

recently observed, many of those who get electricity for free enjoy "political protection"[1]. Those who do not enjoy political protection, on the other hand, are obliged to either pay the highest price for electricity in the Middle East or bribe EDL bill collectors (Qabbani, 2003).

The official power generation in Lebanon is of three types: thermal, hydraulic, and international imports from both Syria and Egypt (El-Khoury, 2015). The greatest variation in the design of thermal power stations is due to the different heat sources; **fossil fuel** dominates in Lebanon, although solar heat energy can also be used. According to Mr. El Khoury[2] (2015) "*Hydropower used to be 70% of Lebanon's electricity production in 1975. Unfortunately, today, only 5% of our electricity comes from renewable energy*" [3] fossil fuel energy consumption (% of total) in Lebanon was reported at 97.62 % in 2014 (Fig.1), according to the World Bank collection of development indicators, compiled from officially recognized sources (El-Khoury, 2015).

Lebanon relies heavily on **energy imports** to meet domestic demand. In 2010, for instance, the country imported 120,000 barrels per day (bbl/d) of refined oil products which accounted for over 90% of total primary energy demand in the country and around $500 million worth of fuel each year to generate electricity.

[1] *The Daily Star* (Beirut), 7 August 2003.
[2] Mr. Pierre Khoury, General Director and President of the Lebanese Center for Energy Conservation (LCEC)
[3] Said by Pierre El Khoury on the 28th june 2018 in a conference concerning a greener Middle East (UOB archived news, 2015).

The cost of production is around $17.14 cents/KWh (10.77 are for fuel and 6.37 for generation, transmission and distribution.)

In 2009, the imports from Syria and Egypt were 589 MWh and 527 MWh respectively, constituting more than 7.5%. Due to regional problems, these imports have not been stable and have encountered several fluctuations during the last years (El Assad, 2014)

Even though the country is dependent on fossil fuel imports for 97% of its energy needs, Renewable energy has not been a priority for the Lebanese Government (El Assad, 2014)

B. The Refugee Crisis

The displacement of a significant Syrian population to Lebanon due to the ongoing war in Syria has placed additional stress on an already weak and inefficient electricity system (LCRP, 2017 p.2).

Even before the eruption of the Syrian conflict in March 2011, and the hundreds of thousands driven across the border by the fighting, Lebanon was grappling with a depleted infrastructure and inadequate public services.

he most immediate impact of this additional refugee population is evident through a significant increase in demand is created by: (1) The connection of improvised accommodation such as informal settlements, collective sites, substandard shelters and unfinished buildings to the electricity grid; (2) Increased

residential load where displaced are being hosted in Lebanese households; (3) Increased residential load where displaced are renting accommodation (LCRP, 2017 p.7)

The increased demand created by an increase in population is either being met through privately operated generators or through illegal connections to the national grid (approximately 45 percent of the displaced Syrians have such connections) (UNDP 2011, p.61)

The illegal connections result in high technical damages to the grid and increased maintenance and reparation costs resulting in additional losses to the energy sector. Illegal electricity connections can also present fire hazards. Children in several communities have voiced fears about electrical explosions caused by faulty wires and electricity theft in their communities (World Vision, 2013).There has been numerous news about fires in camp shelters. A refugee camp in the Bekaa region, built near Qab Elias town has been gutted by fire, with almost all of the tents destroyed and causing the death of one person after the flames broke out. According to the electricity technician, an overload of power caused by illegal connections to the grid was to blame for the blaze which left only the bathrooms at the edge of the settlement still standing.[1]

[1] Read more on http://metro.co.uk/2017/07/02/syrian-refugee-camp-gutted-by-fire-which-destroyed-almost-every-tent-6750451/

There is a common perception in Lebanon and especially from the MoEW that the influx of Syrian refugees to Lebanon, an already weak and vulnerable state, has brought nothing but negative impact into Lebanon by exhausting its social service sectors, not least of which its electricity sector (AEMS, 2017). The MoEW has conducted a study entitled "The Impact of the Syrian Crisis on the Lebanese Power Sector and Priority Recommendations" to obtain clear results and tangible indicators that highlight the areas where urgent action is needed (AEMS, 2017). Overall, the study shows that the displaced Syrians require a power generation of almost 480 MW, exceeding the additional production of 443MW added to the national grid by the Ministry since 2012 (MoWE, 2017). The Minister of Energy Cesar Abi Khalil used the results of this study to announce that "the electricity crisis is caused by several factors; some natural, which is increase in demand, but mostly unnatural, caused by Syrian refugees. Syrian refugees consume almost 480 megawatts, depriving the Lebanese citizens of five hours of electricity on a daily basis, and costing the state more than $333 million."[1] The Minister of Energy hence refrained from naming the original causes that led to the years-long energy shortage in Lebanon, holding instead the Syrian population as the ones exclusively responsible of it.

In fact, the Syrian crisis, in its magnitude, intensity and protracted nature, has fueled a lot of debates over the presence of Syrian refugees not just In

[1] *The Daily Star* (Beirut), 7 August 2003. http://www.cedro-undp.org/Content/uploads/Press/170309054602774~TheDailyStar.pdf

Lebanon but worldwide. This debate has taken a harder edge in recent years. The rising anti-refugee and anti-Syrian sentiments are being frequently fuelled by the use of half-truths and falsehoods to either exaggerate or generalize the impact of the refugees on host societies or the potential consequence of hosting them. Maintaining security, as well as the exaggeration of the economic burden of the presence of refugees, have been the backbone of the prevailing narrative against refugees.

Within such heated debates, the status of the refugee as someone forcibly displaced due to persecution, conflict and fear of harm tends to be forgotten.

It is worth recalling that the protection of humanitarian rights is central practice to the United Nations. According to the Article 14 of the Universal Declaration of Human Rights of 1948 “Everyone has the right to seek and to enjoy in other countries asylum from persecution” (UN, 1948). In this debate some facts remain beyond dispute. No one likes or chooses to be a refugee. A refugee is someone who has been forced to flee his or her country because of persecution, war or violence. Refugees have rights which should be respected prior to, during, and after the process of seeking asylum. According to the United Nations High Commissioner for Refugees, Sadako Ogata, respect for human rights is a necessary condition for both preventing and resolving today's refugee flows. In his words "the refugee issue must be put to all governments and people as a test of their commitment to human rights".

In this thesis we will acknowledge that the impact of the Syrian refugees challenges the already precarious infrastructure and service provision of Lebanon; however we will make sure that the figure of the 'asylum seeker' that has been sullied and defiled recently, will be restored once again as prompting human compassion and spurring an urge to help instead of the current reclassification as a criminal accountability.

In this section we have looked at the case of electricity provision in Lebanon by covering a number of aspects such as: (1) inequalities in electricity provision, (2) Electricity governance in Lebanon, (3) Lebanon's energy resources and (4) the impact of the Syrian refugees on the electricity sector. In conclusion there is no doubt that the weak electricity system coupled with its unequal service provision in Lebanon has emphasized **splintering urbanism.** The refugee crisis has contributed in **highlighting** this urban phenomenon, as overcrowding in areas where both low-income Syrian and Lebanese competing over resources at the local level put pressure on already substandard services. In the next section, we will explore this urban phenomenon on a much more zoomed in level by focusing on Halba as our main case study.

CHAPTER III

HALBA: URBAN ANALYSIS & ELECTRICITY PROVISION SYSTEM

A. Halba's Political and Social Structure

Halba is the administrative division of Akkar governorate Mohafazah.

In the 1960s, IFRED classified Akkar as one of the most deprived regions in Lebanon. Social structure problems and political economy issues experienced in the area today are rooted in structural causes, including a long history of control by feudal families and marginalization in national policies and developmental agendas. Akkar is characterized by a ruling elite (bey or bakawat) who own large estate controlling landless laborers and tenants working as sharecroppers on the feudal estates. The persistence of feudalism into the early 1970s left a major mark on the socio-economic situation in this region (Knudsen, 2006) The tribal system has been replaced by extended families' power structure where the descendants of feudal families became in majority the political representatives of the area and "saw no personal benefit in fighting for the development of the deprived farmers" (Mouchref 2008, P.4)

The main religious groups present in Halba are Sunni, Greek Orthodox, and Maronite (CVE, 2017). In Halba, three large Lebanese families can be

distinguished: al-Halabi, Hammoud and Yaacoub . **Al-Halabi** family along with **Hammouds-** both Sunni - have changed political affiliations in recent years. Before the Syrian war, al-Halabi and their associates were pro-Bashar al-Assad. After the beginning of the conflict, they turned against the Syrians and largely shifted their allegiance to Al-Mustaqbal party (Abdallah, 2017). **Yaacoub** include Catholic and Greek Orthodox families. They are a minority relatively to two other large Sunni families of Halba (Abdallah, 2017, P.1-3). Some are aligned with Tayyar al-Waṭani al-Horr, (Free Patriotic Movement) and others with al-Quwwat al-Libnaniyah, (Lebanese Forces) (CVE, 2017, p.3).

Although under-developed, Halba – Akkar's capital – derives its economic importance from its intermediary position between Homs and Tripoli, and from being the main market for the surrounding villages. Unlike other urban settings that can be discussed in terms of economic 'recovery' after crisis, Halba has never been planned or developed as a city. Infrastructure and services are poor and insufficient. Electricity, when not privately purchased, lasts only four hours per day. People only have access to two hospitals and five schools

Trade in the Akkar region is confined to Al-Abdeh and Halba, and employs 14, 3% of the working population in Akkar (ADELNORD, 2014, P.6). Despite the strategic importance of Northern Akkar, the effect of trade on the region is still very limited. It consists of small local shops and few larger ones in some important locations on international roads and in the Caza centre, i.e., Halba (ADELNORD, 2014, P.7).

The retail and trade sector in Halba specifically is dominated by two major features: the vegetable market and the livestock market. More than **18%** of olive oil production in Lebanon takes place in Akkar mainly in Halba making it a prominent location for agro-food processing (IDAL,2001). The trade sector of Halba but also of other localities in Akkar such as Aayoun Ghozlan, Raouda, Beit el hash, , etc…) is directly linked to neighboring countries like Syria, in both ways, as a selling point for the goods produced in the agricultural plain, and as a provider of necessary materials and equipment to the farmers of the area (Hanafi 2008, p.5). In fact, the economic situation of local populations in Akkar has been drastically affected by the Syrian crisis, due notably to the region's marginalization within the Lebanese economy and its dependence on Syrian markets prior to the crisis. In a interview with ACTED's field teams, farmers in Akkar, indicated a dependence prior to the crisis on price differences between the Syrian and Lebanese markets to sell their agricultural products and buy supplies at cheaper rates, especially livestock. Since the start of the crisis, border incidents and insecurity have significantly affected cross-border trade, resulting in reduced access to key resources and inputs, and destabilizing agricultural and livestock markets (Hanafi, 2008, p.5).

Industry on the other hand is a marginal economic sector in Halba and Akkar and it concerns mostly food industries and car mechanic shops. The recent rehabilitation of the slaughterhouse has significantly improved the situation of slaughtering in the city and the pollution this activity produced

(Hanafi, 2008, p.5). However, the problem of air and noise pollution caused by the car mechanic shops, located in the center of the town along the main road, remains unresolved. Other than these sectors, many of young people work as taxi drivers or in the public sector: school teachers and in the military and internal security forces. In addition to that, many people are daily workers in agriculture and construction (Hanafi, 2008, p.5)

The severe socio-economic structural problems in Akkar are leading to increasing desertification and pollution thus affecting Akkar and Halba's economy significantly (IDAL, 2001). Major threats leading to land degradation - as identified in the National Action Program - include, forest fires, unsustainable charcoal production and excessive fertilizer and pesticide use (IDAL, 2001).

Due to the poor employment opportunities in Akkar and especially in the concerned localities, the majority of the population with higher education levels migrates to Tripoli or Beirut. Consequently, there is a lack of well trained and skilled labour in Akkar (Hanafi, 2008, p.6).

Although Syrian nationals in Halba still provide most of the unskilled labour for gardening, construction, cleaning, and agriculture (Battistin, 2015) the profile of Syrian migrant workers has changed. Those who came to Akkar prior to the Syrian crisis, were mostly young or middle-aged males (Chalcraft, 2009). They worked as seasonal laborers before returning to Syria. When the conflict broke out in Syria in the spring of 2011, some of these migrant workers

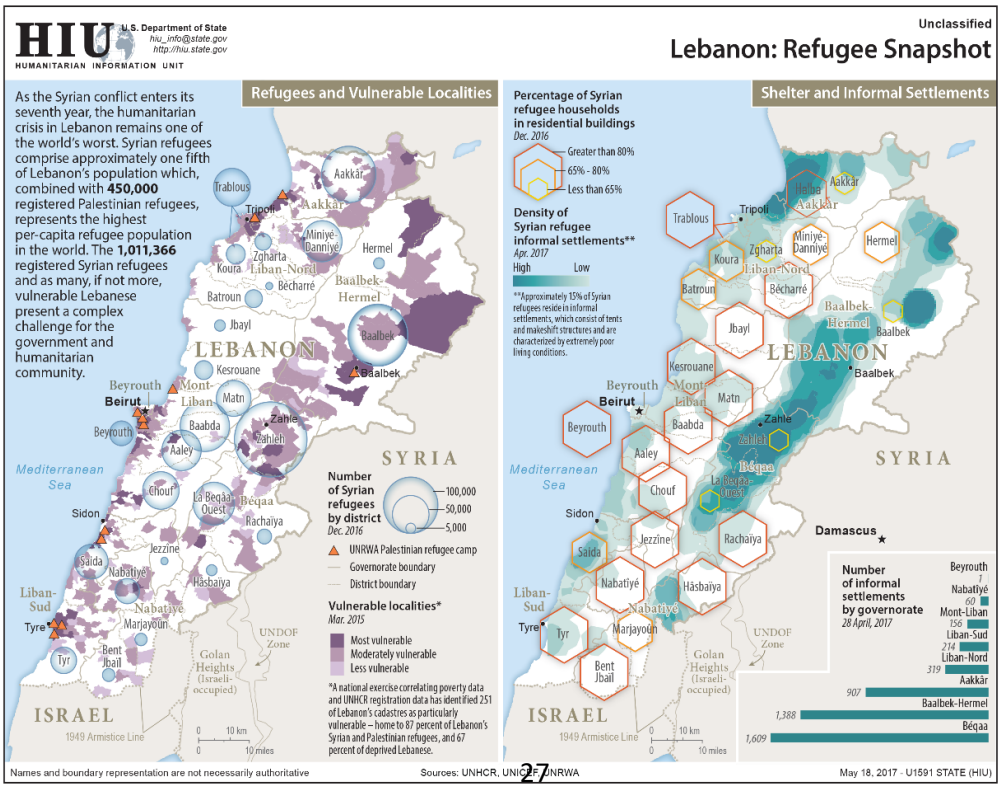
brought their families to Lebanon. The local economy of Akkar, therefore, started to be formed by diverse segments of refugees, including both previous migrant workers and refugee newcomers, including refugee women, youth and children, who provide cheap labor on an irregular basis (Carpi, 2018).

B. Urban Analysis

The war in Syria that began with the Syrian revolution in 2011 has caused the mass displacement of Syrians to Halba, mainly from nearby Syrian cities such as Homs, Al Qousayer, and Hama... According to estimates, there is a 150% increase in population since the beginning of the Syrian conflict with the city of Halba's population now officially 13,333 (UNHCR, 2017). However the real figure of Syrian refugees is undoubtedly larger as there are many more Syrians in the city who have not registered with UNHCR. Syria and northern Lebanon have a long-shared history, strong ties, and extensive trade relations with them (OCHA, 2014). Many Syrians resided there prior to 2011, either because they had family ties or came for work, or because Syrians settled there during the Syrian government's occupation of Lebanon. Many residents therefore empathized with the refugees who fled the Assad regime, and at the onset of the war demonstrated their support by welcoming and protecting them in their neighborhoods. The majority of Syrian refugees in Akkar come from Homs, Idleb, Aleppo, and Hama (OCHA, 2014). Refugees primarily reported going to Akkar because of its low cost of living (74%) and the increased sense

of security (57%). The majority of them arrived during 2012 (45%) and were predominantly living in houses and apartments (49%) at the time of assessment (UNHCR, 2014). Other factors such as proximity (to border areas or presence of Syrian migrant workers) informed the choice of residence of the refugees (UNHCR, 2014). The sectarian background of the Lebanese hosting area also informed the choice of residence of certain families with pro-regime Syrian families more prone to moving to the Hermel or Baalbak regions (Vliet, Hourani, 2014).

According to the map below provided by the HIU, more than 80 % of the Syrian refugees who have resettled in Halba, are living in apartments mostly because these people were living in cities in Syria coming from middle class Syrian families with a fairly good lifestyle before they left, not used to rural conditions (Carpi, 2017).



Also, the bitter memories of the armed presence of Palestinians from the mid-1970s onwards, led the government to forbid the emergence of new camps. Watkins the secretary general of the UN told journalists in Halba, when asked whether new camps might alleviate the refugees' plight. "The policy of the United Nations, and in coordination with the government of Lebanon, is that it is not advisable at this time" (Watkins, 2017).

A very small proportion of the Syrian refugees chose to live in tents at the border of Halba in two nearby village called Cheikh Mhammad and Khouwaikhat (Check Fig.8) these refugees are the ones who used to work in agriculture back in Syria, or who used to live in quite modest conditions (Refugees, personal interview, April 2018).

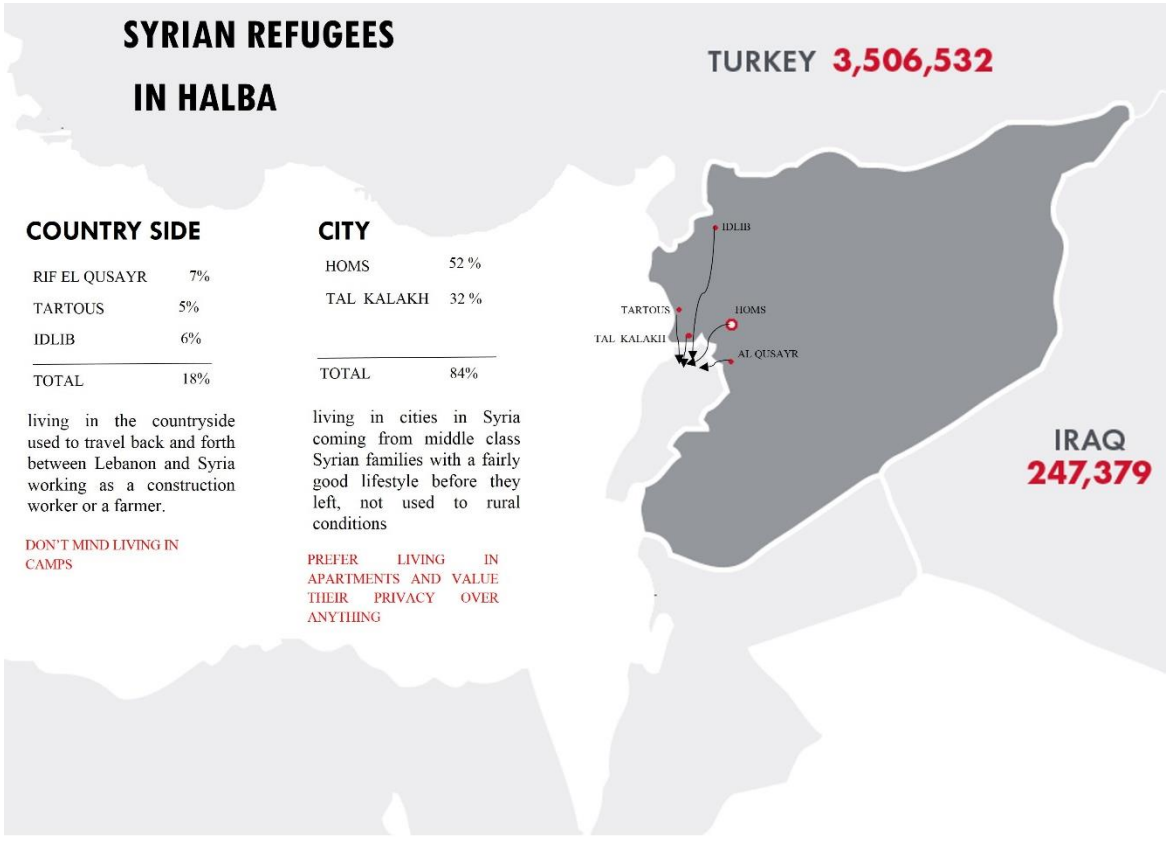


Fig. 2 Origins of the Syrian refugees.
Source: Author

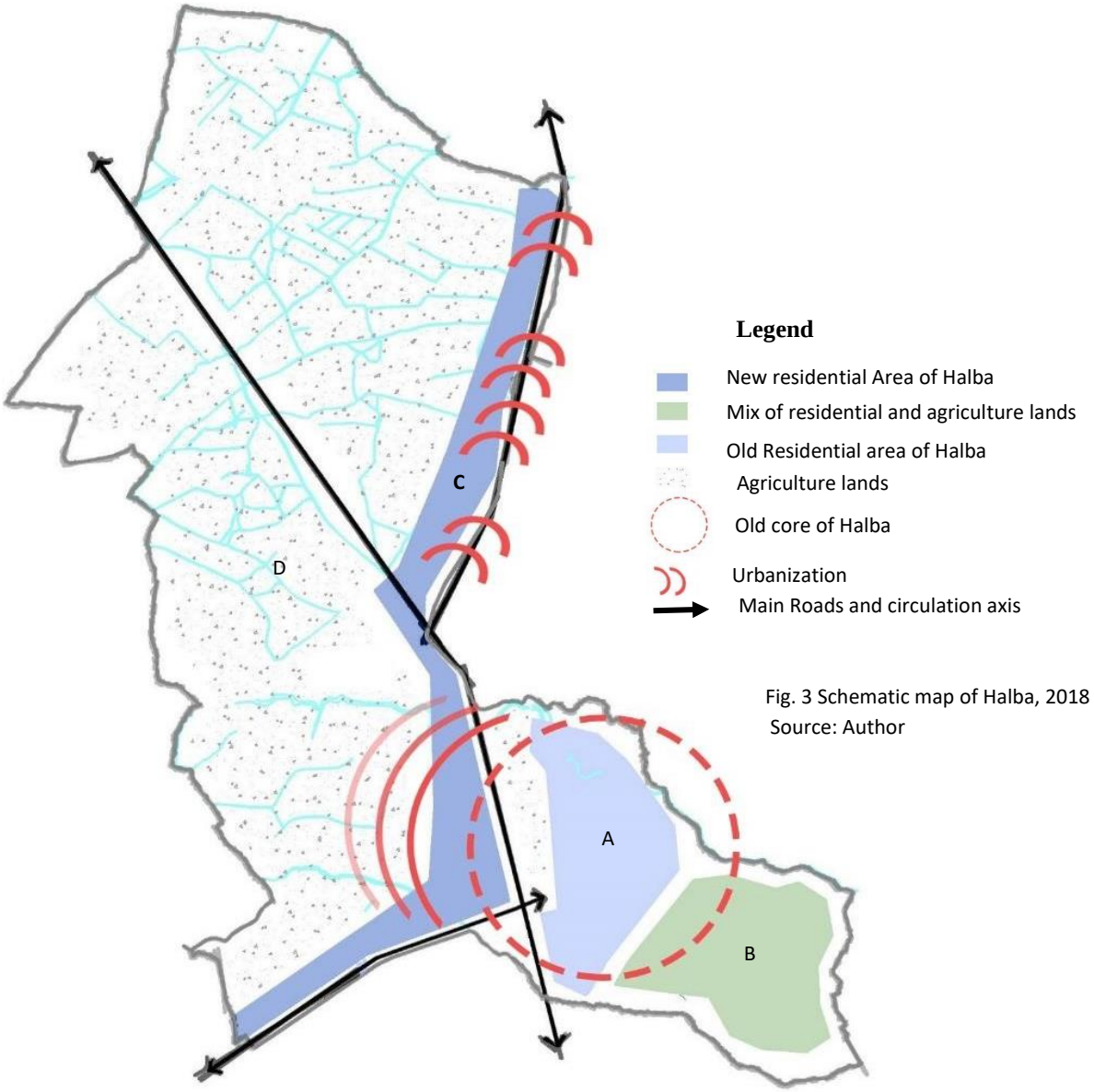


Fig. 3 Schematic map of Halba, 2018
Source: Author

Halba can be divided into 4 main zones:

-Zone A/ Old residential area of Halba: it's the old core of Halba and the only zone where you can spot old historic buildings with red tiles. This zone is the most overcrowded and densely populated area where most of the big families of Halba reside in their villas. No Syrians were seen living in this area. Streets in the old core of Halba are relatively narrow and built on a heavy slope that rages between 12 and 18 degrees.

-Zone B: This zone is a mix of residential and agriculture lands. Most of these buildings are villas. Very few Syrian refugees live in this area in small apartments

-Zone D: Agriculture lands with very few farm houses scattered along the landscape. This area is inhabited by Syrians who were already living in Lebanon before the 2011 war.

-Zone C: This zone has witnessed a construction boom since 2012.

Currently, the built up area makes 18 % of the total area of Halba 13% percent of which are newly built refugee compounds located in this zone, tightly aligned along the main roads. These buildings have the same typology with plain facades and balconies usually painted in red (Fig.4).

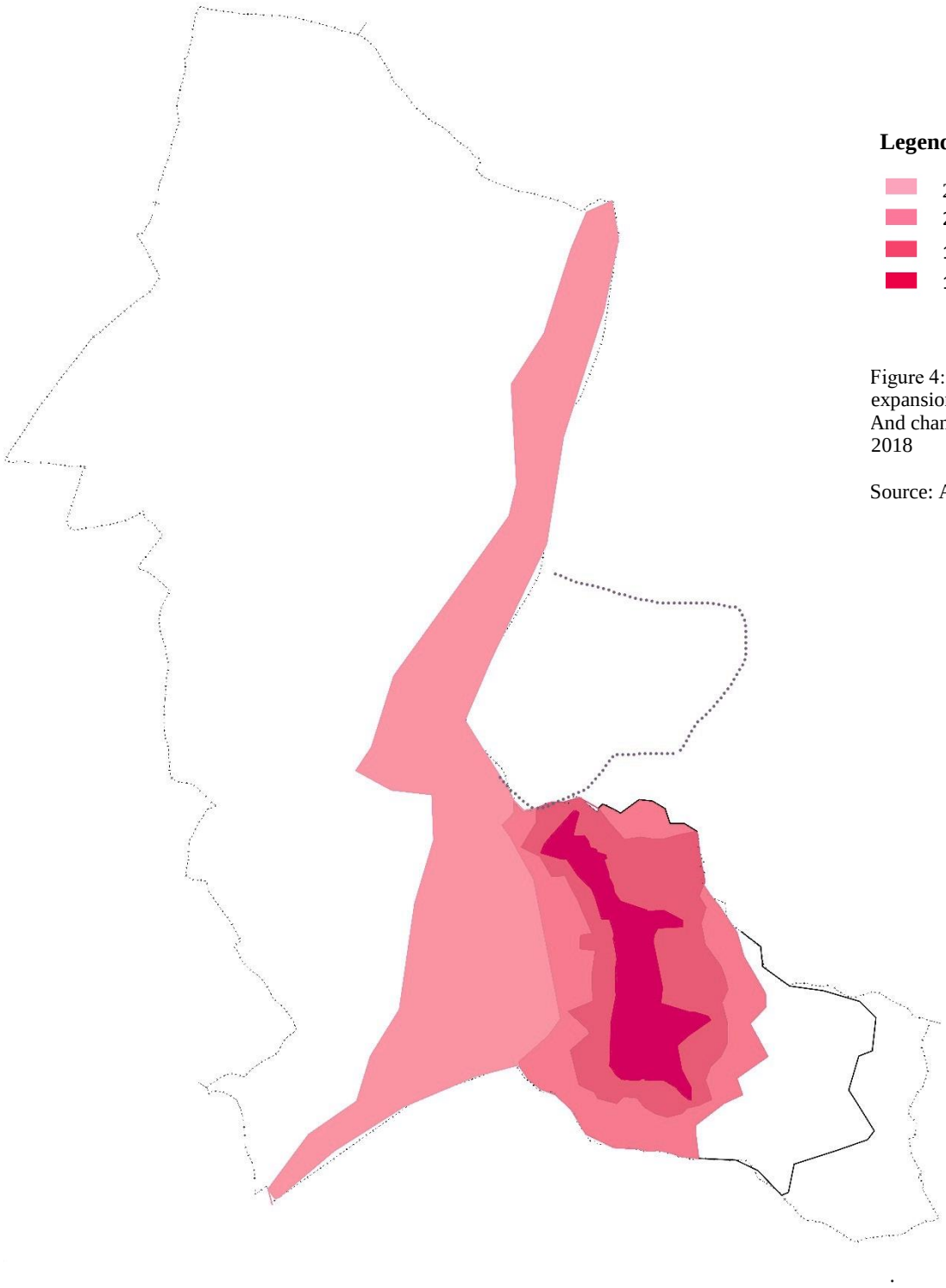


Figure 4: Halba's city expansion
And changing urban form - 2018

Source: Author

Halba's urban form has changed significantly between 1990 and 2018 (Fig.4) There has been a rampant urbanization towards the plains in the West and towards the North since 2014 (Fig.4). This Urbanization is directly linked to the Syrian refugee presence after 2011 and the proliferation of generator owners.

[1]

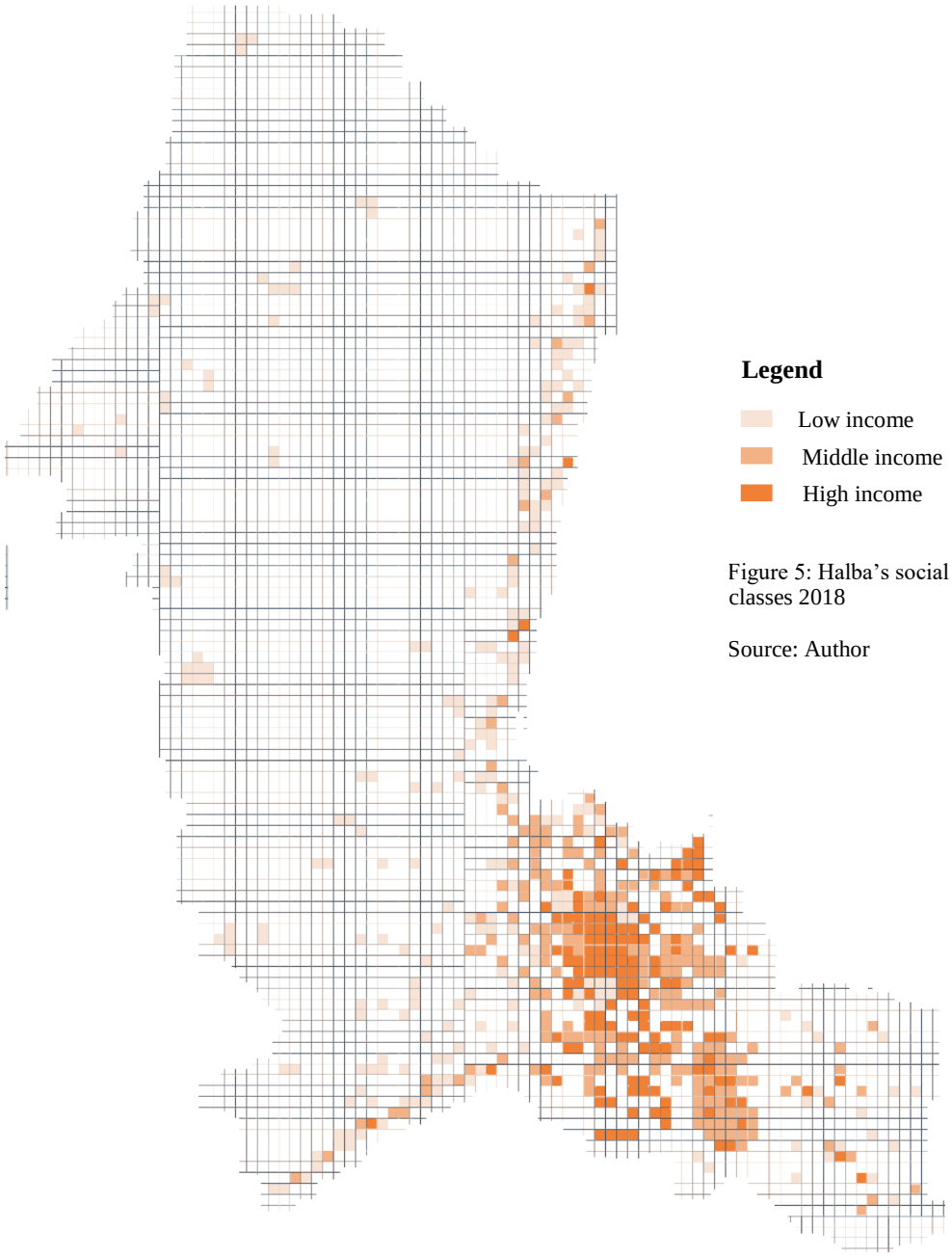


Figure 5: Halba's social classes 2018

Source: Author

There is a large concentration of high and middle income households in the old core of Halba. Moving further from the old core to the west and the North where Syrian refugees reside, middle-income households become fewer, and more low income households appear (fig.5) In this new geography, the 'city' constitutes a spatial continuum with unclearly bounded informal assemblages, where large groups of Syrian refugees reside. This construction boom generated a significant pressure on delivery of services especially on electricity.

[1] The data for this map has been obtained through interviews with the sample of 25 Syrian refugees. Each were classified as low, middle or high according to their income. Given the fact that the chosen sample is relatively small, the interviewees helped me estimate and trace down the social classes' distribution for the rest of Halba. They have been asked to specify landmarks and Known locations in Halba when pin pointing the social classes in order for the map to be representative at best.

The center of Halba consists mostly of multi-story apartment buildings and individual homes ranging between 2-3 floors mainly with some new buildings reaching 4 floors (See Fig.6). Most of the ground floors are either used for commercial activities or rented by Syrians for accommodation purposes. However, as we move outside the center to the east some 1-2 floors homes inhabited by families such as el Halabi and el Rrifaai and other individual houses inhabited by Lebanese are scattered throughout the greener area of Halba.

Figure 6: New building compounds constructed for housing refugees in Halba
Source: Author

During the 1980s, following demographic growth, many illegal houses were built in Halba's former cotton fields (Fig.70). Accordingly, and in line with the Lebanese law, the majority of Syrian residents in Halba are currently not entitled to public services including water and electricity since it is forbidden to connect tenants with water and electricity services if they do not have a residency permit (See more details in Chapter 3). Since many of these dwellers obtain these

services illegally, this process of service provision creates yet another violation

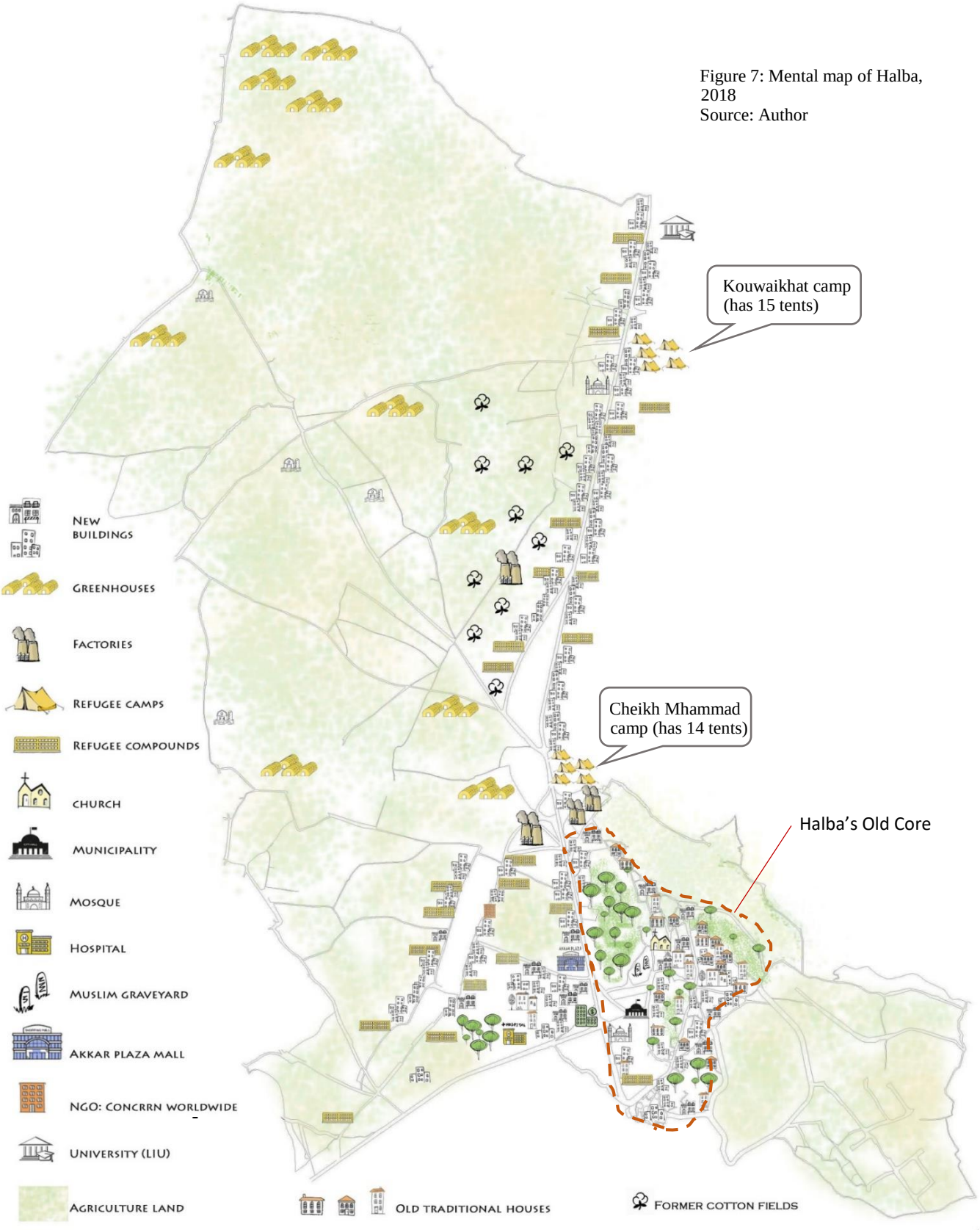


Figure 7: Mental map of Halba, 2018
Source: Author

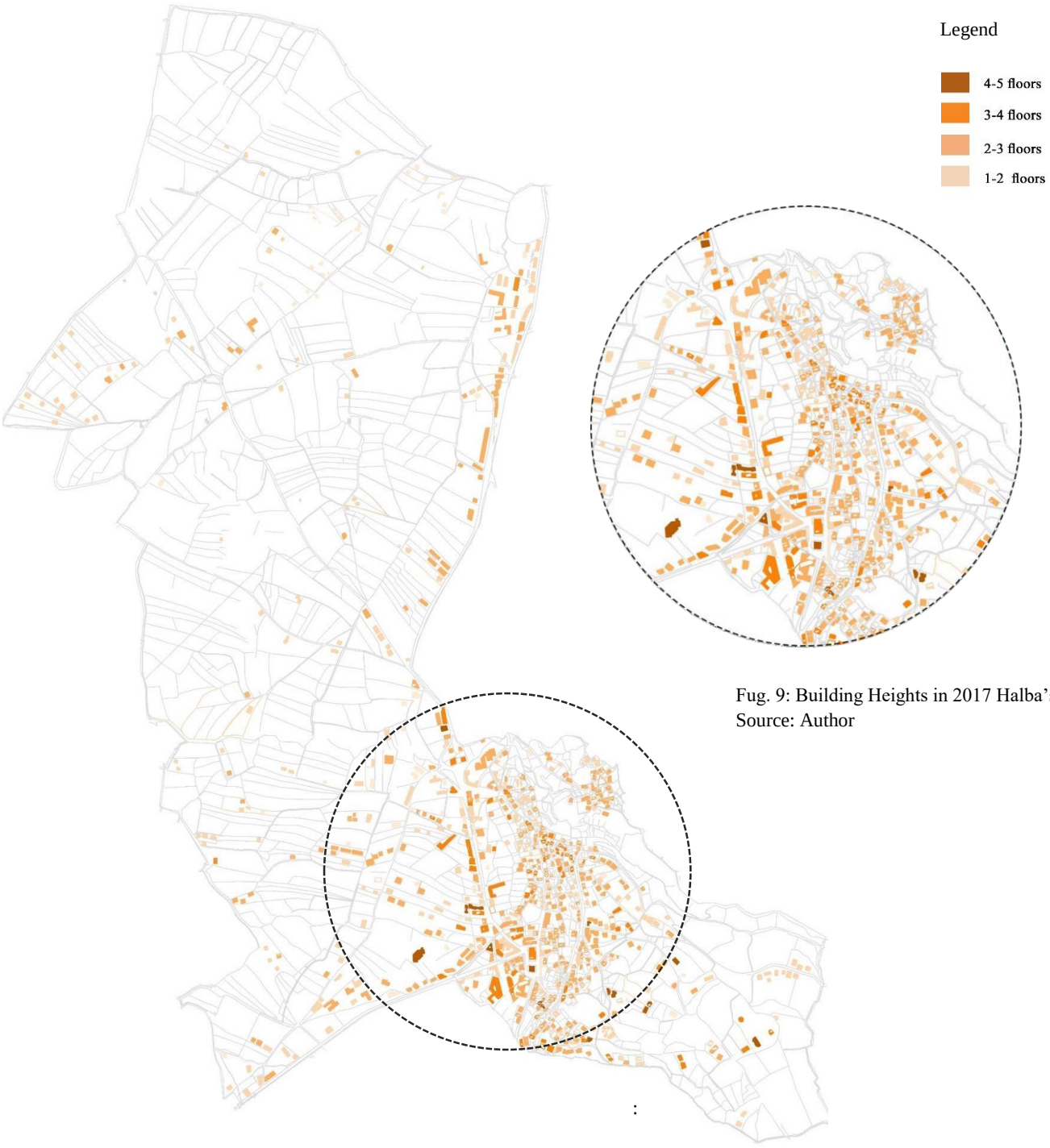


Fig. 9: Building Heights in 2017 Halba's old core
Source: Author :

-

:

Fig.8: Building Heights in 2017Halba's old core
Source: Author

Buildings in the old core of Halba are 1 to 2 floors. Buildings on Halba's main road towards kouwaikhat village are mostly 3 floors with some buildings reaching 4 floors. 5 floor buildings are rare and are limited to hospitals, banks and educational facilities.

Fig. 10: New buildings constructed after 2010
Source: Author

With the influx of Syrian refugees, Halba's housing capacity was soon put under strain. Halba's growing population increased the demand for construction especially in the residential sector. Some real estate developers such as **Al-Rifa'i** who had already started by 2010 to build compounds in Halba for the Lebanese residents took advantage of the Syrian refugee's growing need for housing to expand his real estate business. Consequently, Halba started witnessing a construction boom after 2010 (Fig.10) where most of the newly constructed buildings have been erected by the private real-estate developers from the area in the purpose of housing the Syrian refugees. Most of these buildings take the form of compounds locally known as "moujamaa' al-Sourye" in Halba.

The center of Halba consists mostly of multi-story apartment buildings and individual homes ranging between 2-3 floors mainly with some new buildings reaching 4 floors (See Fig.7). Most of the ground floors are either used for commercial activities or rented by Syrians for accommodation purposes. However, as we move outside the center to the east some 1-2 floors homes inhabited by families such as el Halabi and el Rrifaai and other individual houses inhabited by Lebanese are scattered throughout the greener area of Halba.

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[1] The Lebanese law stipulates that illegally constructed houses are not entitled to receive urban services.

C. Electricity Provision in Halba

The majority of villages in Akkar receive their electricity from EDL, but not all houses are connected to the electricity grid. In Fnaydeq, for example, only 80 percent of the houses are linked to the grid. In many cases the networks are old and lack proper repairs and maintenance (Mouchref, 2014). Transformers are weak and improperly distributed among districts, leaving many towns with a lack of proper street lighting. Significant instabilities and power supply interruptions are common in Akkar. The average number of hours of electricity available per day varies from one village to the next, ranging from 10 to 20 hours per day. Frequent power cuts put an additional burden on an already deprived population, forcing people to buy batteries or generators, with the associated added costs of fuel. In fact, those that can afford to buy private generators are rare. Few villages possess public generators and, when they do exist, only a few residents are able to subscribe to their services (Mouchref, 2014).

Electricity in Halba, when not purchased privately, is provided for only four hours per day by EDL covering most of residential and commercial units (Carpi, 2018). Since refugees are not granted access to the electricity network given their illegal status the percentage of illegal connections to the grid has risen to 36% in the North of Lebanon, these illegal connections lead to a financial burden on the national economy and implies technical losses on the grid (MEOW, 2017).

Informal settlements (IS) sheltering refugees face the same challenges. According to a study conducted by REACH approximately two thirds of IS rely on improvised electricity connections, which are usually hooked on public power lines (REACH, 2014). These improvised connections place considerable burdens on electricity supplies available in Lebanese host communities. REACH found that villages in Akkar hosting IS were almost twice as likely to report that electricity supplies had been adversely affected by the crisis than villages overall. Additionally, IS with improvised connections were reported to be a source of tensions between Syrian and Lebanese populations (REACH, 2014). Dependence on improvised connections appears to be the product of financial constraints rather than other barriers, such as distance. According to the study conducted by REACH, approximately 35% of IS reported access to a generator. Also, 27% of IS with generators rely on improvised connections to public supplies, suggesting that cost of fuel is the limiting factor in making them operational (REACH, 2014).

Although the majority of the displaced Syrians in the Akkar and North regions are living in rented accommodations (non-IS) or hosted within the Lebanese communities; the average power consumption per shelter unit for non-IS turned out to be the lowest among other regions. (DRC, 2012).

There are three sources from which Syrian refugees access energy in Halba. First, they may access electricity from EDL through regular meter (5%). Second, they illegaly hook-ups (95%). and/or third, they purchase electricity from

informal private generator owners through monthly fees known as 'Ishtirak'(100%).

Both Syrian refugees and Lebanese residing in Halba do not really depend on the government for their electricity since it is supplied for only approximately 4 hours/day, as such, they prefer subscribing to the private generator's service which is more expensive, but they pay according to how much ampere they choose to receive (The majority of the Syrian refugees in Halba subscribe to 5 because it's the cheapest). (Stel 2018).

The private generator market is technically illegal. The Lebanese government is aware of the illegality but will not shut it down because it's securing access to electricity, amidst shortages. These different types of providers even though technically illegal yet they do not function in complete isolation of the state apparatus. On the contrary, they generally have strong links with state actors or the state apparatus. As such, they function on the itinerant frontier between the formal and informal.

In fact the government began regulating the cost of private electricity in 2011 by setting limits on the rates that generator owners may charge – currently, about 23 cents per hour for 5 amperes or 45 cents for 10 amperes. But the rules are spottily enforced, and residents say many operators still charge higher rates.

According to EDL's statistics 75% of the Lebanese residents and almost all Syrian refugees residing in Halba resort to various forms of illegal hookups to obtain their electricity when they are not able to pay for the service. Syrian

refugees along with Lebanese residents, cite dire economic conditions as a justification for the illegal hook-up on electric lines. Dwellers maintain that it's a low income area and people cannot afford to pay for many services (Head of Chekka's power plant, personal interview, April 17, 2018).

EDL acknowledges that residents still illegally hook-up to access electricity but EDL and the municipality often turn a blind eye to these informal practices and show even more tolerance towards the Syrian refugees (Head of Chekka's power plant, personal interview, April 17, 2018). One resident claimed that an employee at EDL even went as far as to suggest that he hook up illegally to save up time "they told me in EDL, it was going to take so much time for them to install a circuit breaker that it's easier for me to hook up as it is cheaper and less time consuming". (Resident, personal interview, April 5, 2018).

There are 2 main types of accessing electricity tapping the line and tampering or bypassing the electric meter. This can occur on EDL's power lines but also on the electric lines supplied by the private generator owners (Interview with residents, 2018).

Tapping or hooking is the most used method. 80% of theft occurs by direct tapping from the line. The consumer taps into a power line from a point ahead of the meter. This energy consumption is unmeasured and procured with or without switches. Other methods include a direct hook-up on up on an already illegal hookup line. People resort to this measure to avoid getting a ticket since

it's the primary offender who is likely to be caught; some even go as far as hiding the hookup line in a water hose (Interview with residents, 2018).

EDL conducts field visits every two months to remove illegal hook-ups in Halba and its suburbs, these fieldtrips are randomly conducted except for when neighbors rat on each other (Personal interview, April 17, 2018).

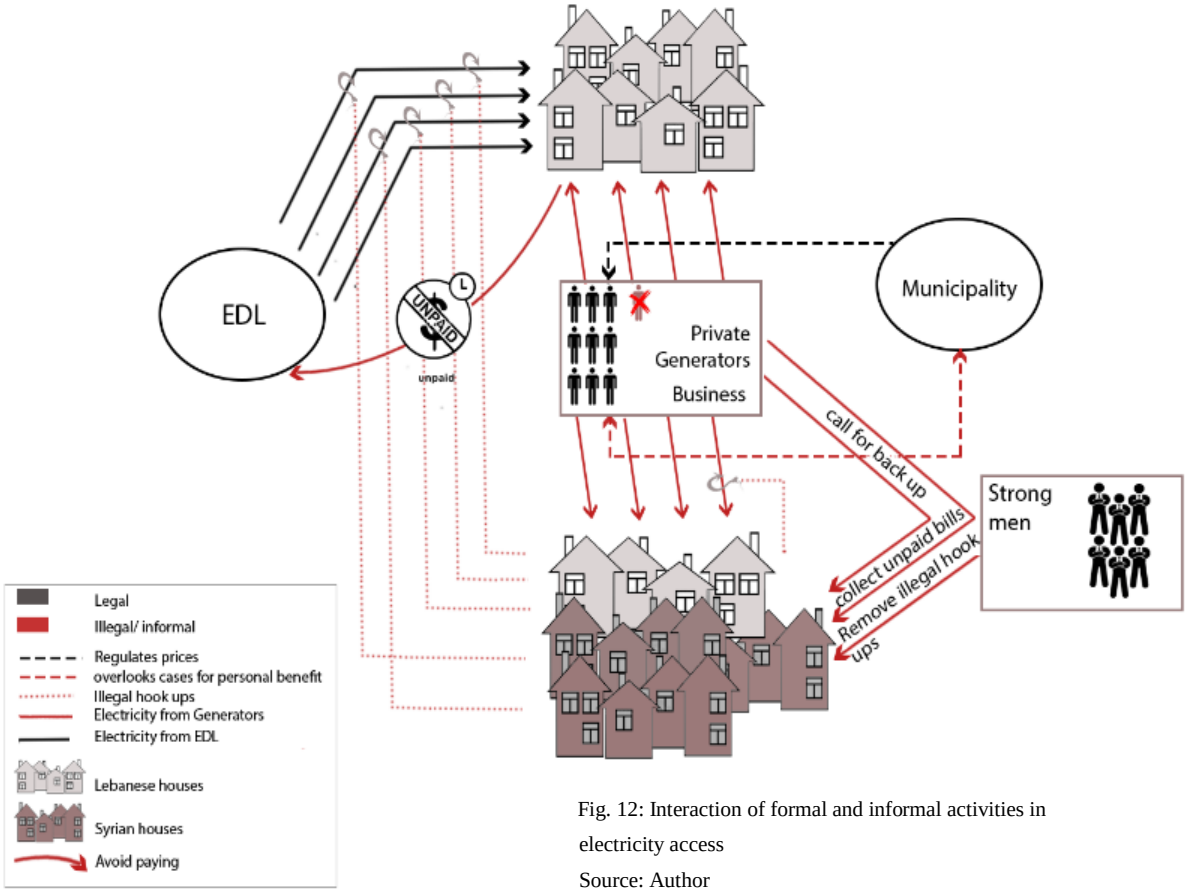

Fig. 12: Interaction of formal and informal activities in electricity access
Source: Author

Disputes often emerge because of illegal hook ups as residents hook up on each other and excessive hookups burn out the transformer. Illegal electric hookups mostly occur during the winter season, when residents operate heaters.

In cases of problems like damaged transformers, electric lines, and circuit breakers, residents resort to EDL or rely on themselves to fix it.

The EDL has been taking a more active role in removing illegalities in the last two years because of the frequent fire hazards and cut offs which EDL assume has increased because of the refugees. Also because of the financial losses, EDL endures from having residents illegally hooking up to the grid. Although aware of this, neighborhood dwellers believe that this poses no serious threats and have hence not changed their practice of illegal hook ups.

Bypassing the energy meter is another method where the input terminal and output terminal of the energy meter is short-circuited, preventing the energy from registering in the energy meter.

Physical obstruction of the meter is a tampering method also used. It is done to electromechanical meters with a rotating element. Foreign material such as magnets are placed inside the meter to obstruct the free movement of the disc. A slower rotating disk signals less energy consumption. Tampering methods are only applied by refugees on the Ishtirak meters. Very few own a meter from EDL given that a refugee should be legal to own a meter.

According to the generator owners, almost 10% of their customers used to steal by tampering with the electric meter. Today the percentage dropped to 2% after private providers took the measure of replacing the old meter boxes with new more secure ones.

Fig. 13- 14: Old meter boxes VS. new meter boxes, 2018 Source: Author

D. Stakeholders and Environmental Impacts

1. Generator Owners and Local Governance

There are 9 electricity providers in Halba who own private generators and provide electricity for neighborhood dwellers. There is a tacit agreement between these suppliers to each provide for a specific geographic area and to stick to the agreed- upon boundaries set for each (Fig.14). El Youssuf, Al Baghdadi and Jacque El-Ashkar were the first to invest in private generators in and near Halba's old core in 2008. These three are well-known families in Halba. Just like in Zahle, generator owners in Halba known as the "generator mafia", are certainly more invested in sustaining the profitability of the private electricity industry than they are in providing affordable resources to citizens. In fact they are against solar energy and will do their entire best to block any project that will threaten their business. These generator owners are a holdover from the country's 1975-90 civil war, when they began to fill the gap left by the destruction of the national grid (Dziadozs, 2018).

These influential men exploit political ties to profit tremendously from supplying private power. In the generator sector, all of these groups are tied to leaders in power (Kodeih, 2015). One study estimates that the private generator industry earns $1.2 billion annually. Those profits come mostly from exorbitant prices maintained by restrictive practices such as informal agreements, price-

fixing and the division of the market into geographic spheres of influence (Kodeih, 2015).

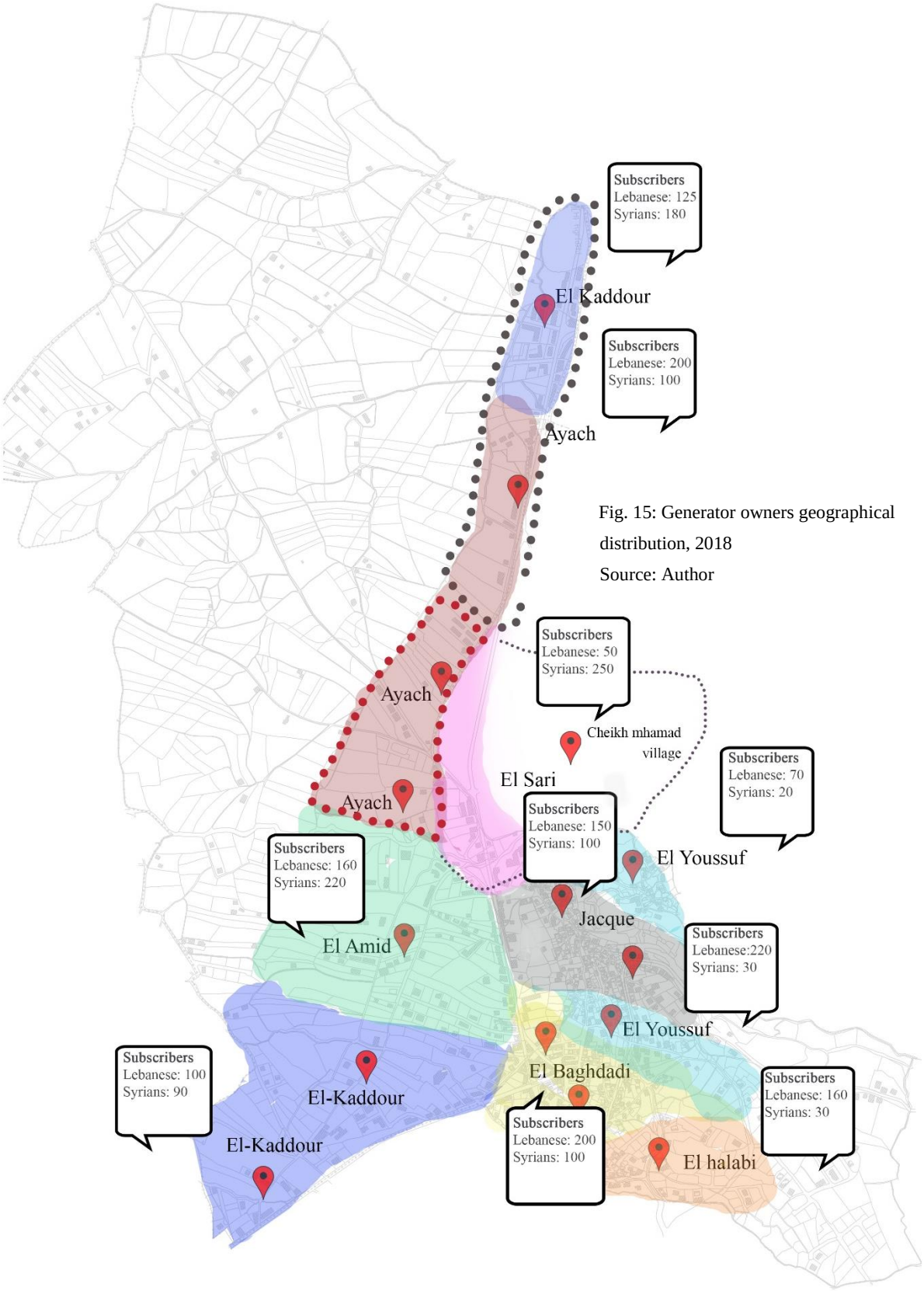

Fig. 15: Generator owners geographical distribution, 2018
Source: Author

With the increase of residents around the core and towards the edges of Halba in recent years, the demand for electricity grew, enticing other providers to join such as El- Kaddour and El-Taleb who started providing electricity through generators 5 to 6 years ago. Additional providers also came in the picture 3 years ago taking advantage of the increasing number of Syrian refugees. Ayach, a supermarket and a dairy factory owner, along with El-Sari who owns a chicken slaughterhouse both decided to invest in the private generator business to diversify their sources of income. Ayach seems to have imposed his business as he took over El-Taleb's private generator by force and put him out of business. The story goes that he sent some of his employees to cut El-Taleb's network of electricity wires. El-Taleb being a Syrian without a residency permit could not report him to the authorities. Ayach is said to have stolen some of El-Kaddour's clients and extended his boundaries towards the North (Fig.15).

Fig. 16: Generator owners in Halba from 2008 till now.
Source: Author

The number of subscribers to the private generator's service is high seeing that many depend on this service because of frequent power cuts. All of the interviewee whether they were living in camps or in rented apartments/makeshift houses all confirmed being subscribed to the generator service. The following table and graph (Fig.16-17) shows how many subscribers each private generator owner has and the profit they are making. It is quite clear from (fig.16) that the private generator's business derives a great deal of benefit from the Syrian refugees.

Private generator owners	Subscribers		Subscription(L.L.)	Profit (L.L.) From		(%) From total profit		Total profit (L.L.) per Month	Total profit (L.L.) made by generator market in Halba	Profit of each private generator owner in %
	Lebanese	Syrians		Lebanese	Syrians	Lebanese	Syrians			
El-Baghdadi	200	100	50,000	10,000,000	5,000,000	67	33	15,000,000		13.0
El-Kaddour	125	180	50,000	6,250,000	9,000,000	41	59	15,250,000		13.2
El- Sari	50	200	50,000	2,500,000	10,000,000	20	80	12,500,000		10.8
El-Halabi	160	30	50,000	8,000,000	1,500,000	84	16	9,500,000		8.2
El-Youssuf	290	50	50,000	14,500,000	2,500,000	85	15	17,000,000	115,750,000	14.7
Jacque	150	100	50,000	7,500,000	5,000,000	60	40	12,500,000		10.8
El-Amid	160	220	50,000	8,000,000	11,000,000	42	58	19,000,000		16.4
Ayach	200	100	50,000	10,000,000	5,000,000	67	33	15,000,000		13.0

Highest amount/percentage

Fig. 17: Generator owners' subscribers and profit, 2018.
Source: Author

El-Amid and El-Sari are the ones benefitting the most from the Syrian refugees. They provide el Sari with 80 % profit and almost 60 % for el Amid and el Kaddour's. El-Amid's income increased 137 % after the refugees came making him quite dependent on their presence for his income. Even though el Youssef makes a total profit of 17 000 000, he derives most of it from the

Lebanese. His profit only increased by 17 % after the refugees came. Syrians provide Ayach and El Baghdadi with 33% of their total profit and El-Youssef with 40 %.

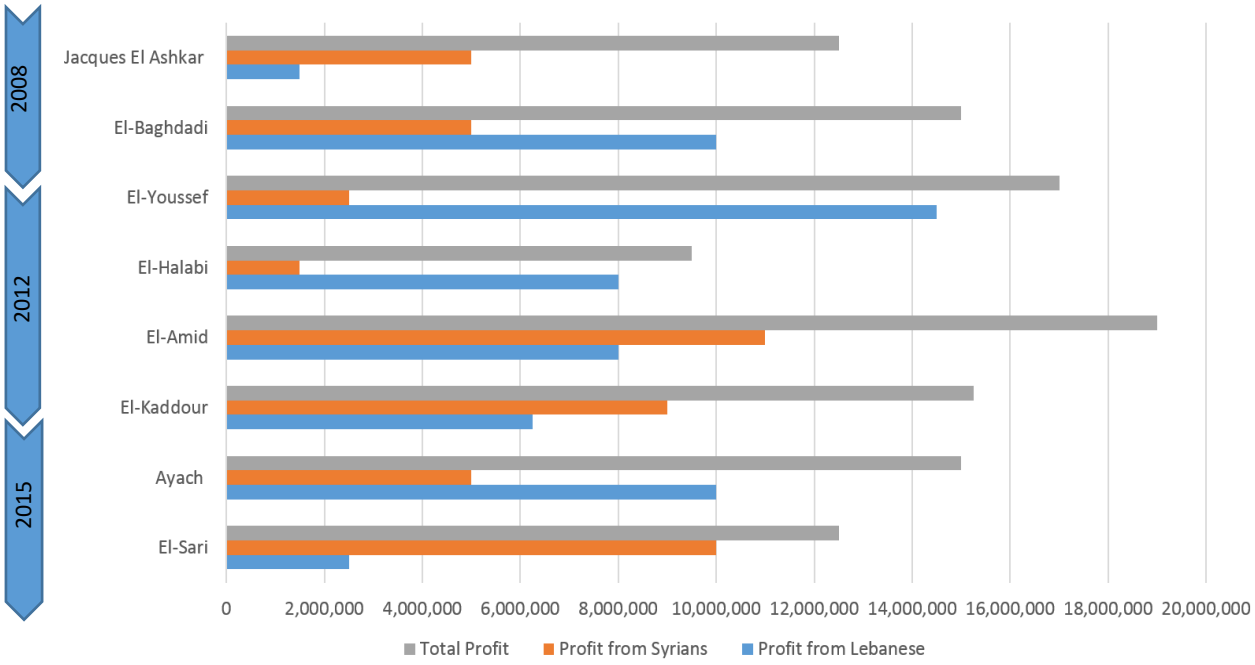

Fig. 18: Generator owners' profits, 2018.
Source: Author

The Ministry of Energy and Water issues tariff guidelines at the end of every month for the pricing of generator ("moteur") services in Lebanon. Subscribers are charged at 680 l.l./ hour as a price ceiling for 10 amps according to the last price imposed by the ministry for the month of January of the year 2018 (MEOW,2018).

The tariff guidelines indicate a fair price for each hour of generator use depending on the level of subscription (5 or 10 amperes) based on the average

price of the red fuel plate for each month after calculating all the expenses and benefits and costs of generators in addition to a good profit margin for their owners. The Ministries of Interior, Energy and Water, and Economy are responsible for enforcing this pricing guideline, according to Decree No. 2 issued by the Council of Ministers on 2011/12/14. Most recently, in January 2018, the Ministry of Economy also called publicly for consumers to report any violations of the generator pricing policy through the Consumer Protection hotline (1739) or mobile application (MEOW, 2018).

In Halba, the municipality makes sure the private generator owners comply with this pricing guideline, if not, the generator owners have to pay a violation fee which is double the sum they earn (Mayor of Halba, Interview, 2018). Still some generator owners such as Ayach do breach the guidelines without the municipality being aware of the violation. (Ayach, Interview, 2018).

While these informal networks of energy provision have helped refugees overcome institutional shortcomings, they are still very much dependent on the private generator's business which derives a great deal of benefit from the Syrian refugees. Even though the municipality enforces some sort of payment guidelines, they are sometimes violated by the generator owners making the subscribers in general and the Syrian refugees more vulnerable by paying to the private generator's service a much more expensive bill then the one being paid to the government.

2. Environmental Impact

The subscribers to the generators' electricity service pay a monthly utility bill which represents the direct cost of fossil fuels; money paid out of pocket for energy from coal, natural gas, and oil. But those expenses don't reflect the total cost of fossil fuels to society as a whole. Known as externalities, the hidden costs of fossil fuels aren't represented in their market price, despite serious impacts to the health and environment. The generators are in fact very pollutant they emit particulate matter containing burnt hydrocarbons and oxides of nitrogen, which add to air pollution. If the generator is not in good condition, it can also emit unburnt hydrocarbons, which are even worse for the environment (Baayoun et al. "Modeling air pollution", forthcoming). They are noisy too. In Halba there are around 15 private electricity generators not all of them necessary seeing there is an overlap of the covered areas. Each generator works for 18 to 20 hours per day. The CO2 emissions are calculated for each with an estimate of CO2 savings in case of a solar energy transition (Calculations on page 83.)

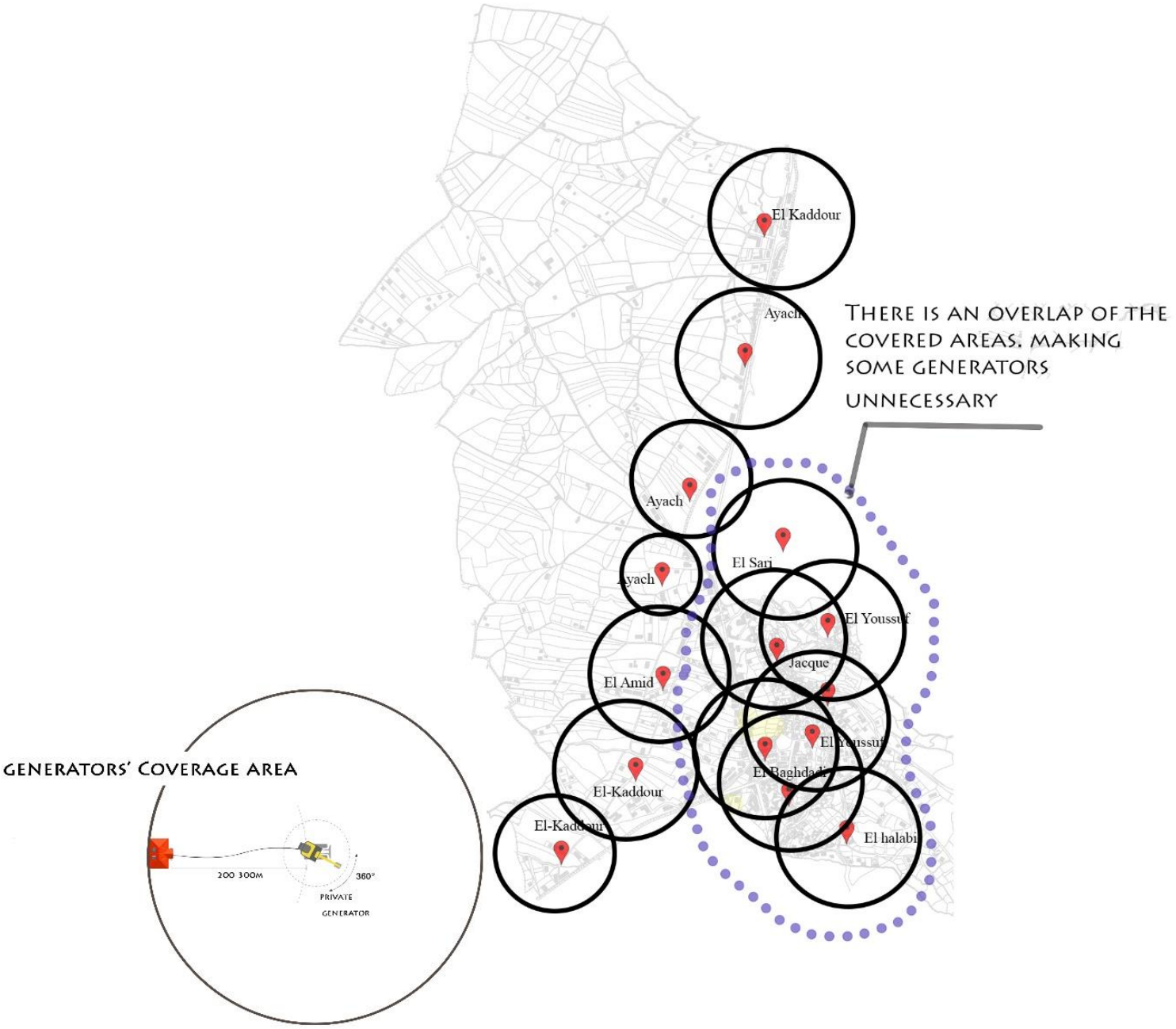

Fig. 19: Generators' coverage area.

Source: Author

E. Refugees' Monthly Expenditures

In order to assess the vulnerability situation of the Syrian refugees in Halba the refugees' monthly expenditures were analyzed in detail below. A sample of 30 Syrian refugees were interviewed: 25 living in apartments and 5 living in camps. Interviewers were asked to breakdown their monthly expenditures, their purchase frequency and the product's price to calculate the household's average monthly bill.

For refugees living in apartments (Table1)

Type	Breakdown of expenditures	Frequency	Price per product in Halba(L.L.)	Total Price per month (L.L.)	Percentage
Power	Gas bottles	once every week	16 000	142 000	28%
	Fuel	once every week	7 000		
	EDL		0		
	Generator's electricity	once every Month	50 000		
Food	Bread	every 2 days	1000	90 000	17%
	Yogurt	every 3 days	3000		
	Vegtables and fruits	every 4 days	5000		
	Rice and cereals	every week	4000		
	Fresh meat	twice a month	10 000		
	Grilled chicken/ Farrouj	Once a week	6000		
Health	Medical products	once a month	20 000	20 000	3%
	Medical services	Depending			
Rent		Once a Month		250 000 -300 000	40%
Total	502 000				

For refugees living in Cheikh Mhammad Camp (Table 2)

Type	Breakdown of expenditures	Frequency	Price per product in Halba(L.L.)	Total Price per month (L.L.)	Percentage
Power	Gas bottles	once every week	16 000	89 000	52%
	Fuel				
	EDL		0		
	Generator's electricity	once every Month	25 000		
Food	Bread	every 2 days	1000	59 000	36%
	Yogurt	every 3 days	3000		
	Vegtables and fruits	every 4 days	5000		
	Rice and cereals	every week	4000		
	Fresh meat	twice a month	10 000		
	Grilled chicken/ Farrouj	Once a week	6000		
Health	Medical products	Once a month	20 000	20 000	12%
	Medical services	Depending			
Rent				0	0%
Total	168 000				

Expenditures covered by NGOs

According to tables (1) and (2) refugees living in apartments pay a higher bill than the ones living in camps, first of all because they have to pay for rent, and second of all because they don't receive monetary assistance from NGOs like refugees in camps do.

As the diagram below shows, power/energy alone takes up almost 32 % of Syrian refugees' monthly expenditures making the cost of energy a significant burden for many households.

The monthly expenditures of the Syrian refugees living in apartments is distributed as following:

Fig.20: Breakdown of refugees' monthly cost

Source: Author

CHAPTER IV

ENERGY ACCESS STRATEGIES OF SYRIAN REFUGEES AND POSSIBILITY FOR AN ENERGY TRANSITION POLICY

In order to cope with the high-priced power bill, the Syrian refugees have adopted diverse set nof energy access strategies. Based on my fieldwork, I found that access to energy sources and the strategies adopted by the refugees to overcome the high cost of energy provision differ from a household to another depending on the refugees' social class (Fig.24).

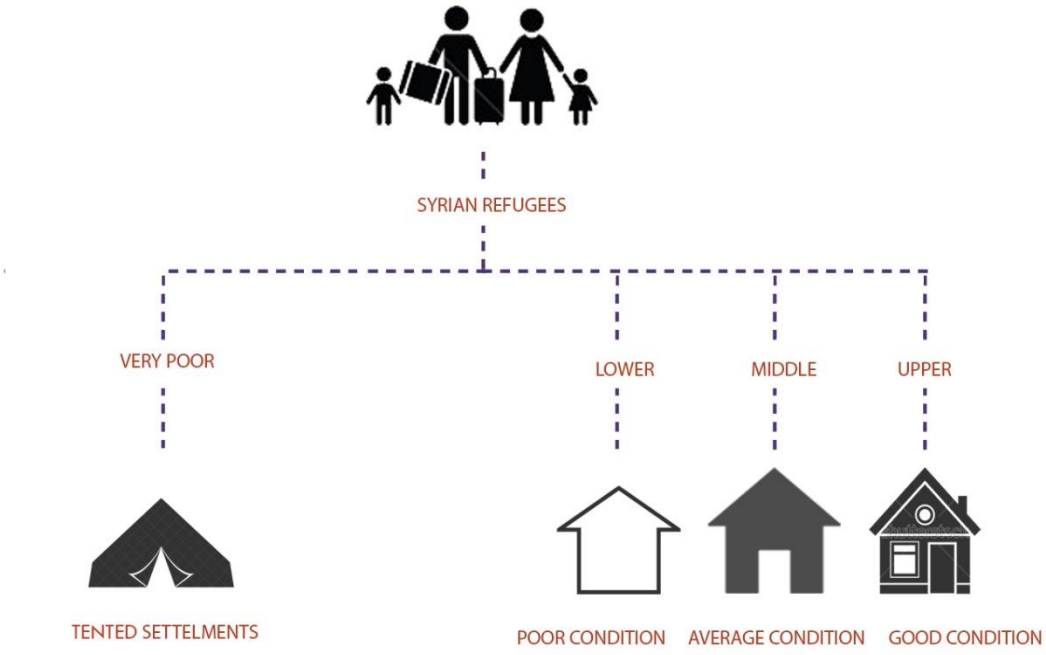

Fig 21: Refugees' type of shelter
Source: Author

In the following section I will be using the "**process mapping**" technique which will be employed as a method that allows a detailed representation and analysis of the series of actions and steps leading up to the provision of electricity service. It documents what

residents actually do to access services as opposed to, or in comparison with, what official policy documents would state on how urban refugees should do to access such services (Smart Pros 2002; NHS 2008). This method highlights the actor involved in the service provision process, the cost of such services and alternatives they may depend on when they face constraints to accessing such services.

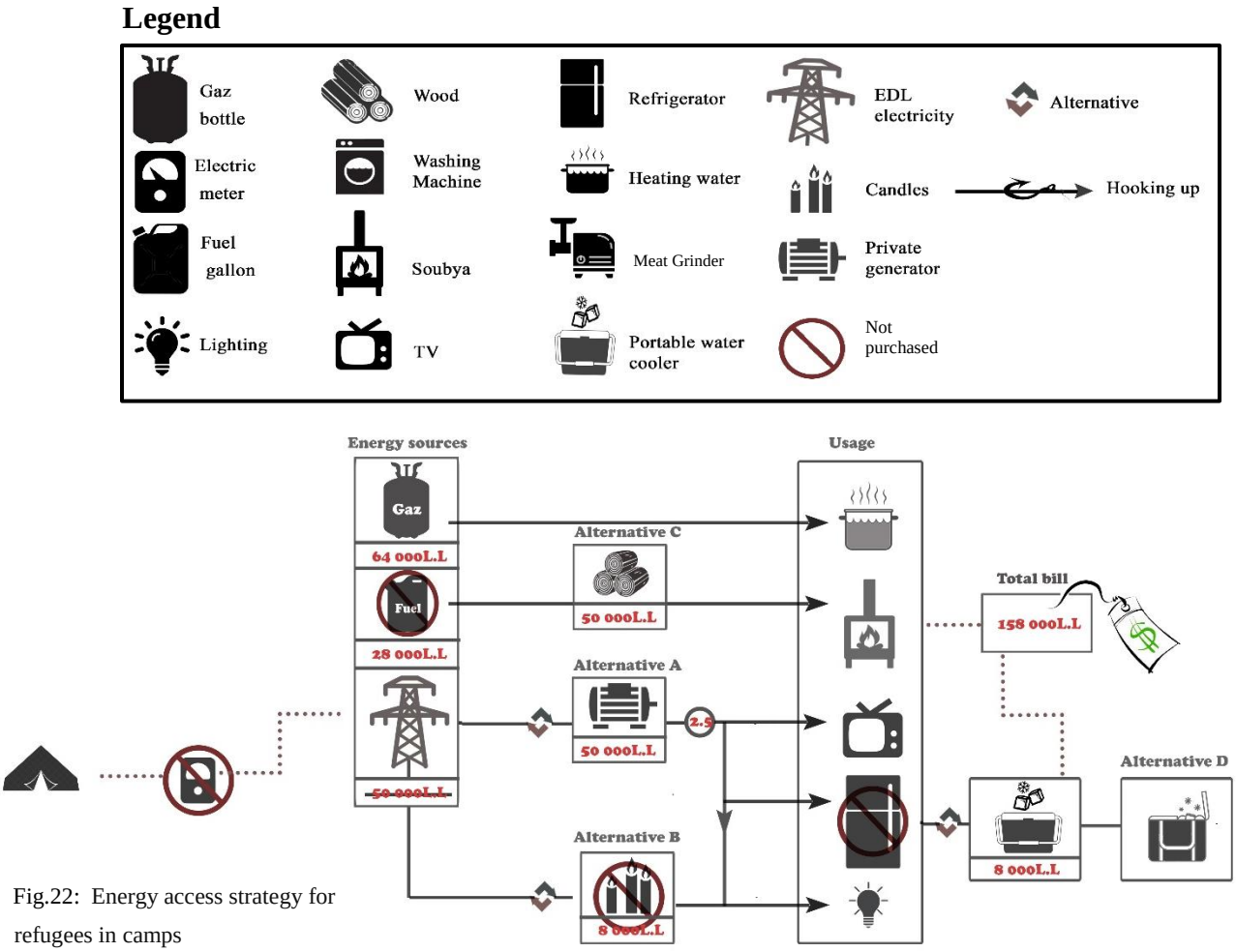

Fig.22: Energy access strategy for refugees in camps
Source: Author

Refugees living in tents don't own electric meters at all. They get electricity illegally by hooking up to the government's electricity grid. Electricity is used for TV and light bulbs. When EDL cuts off electricity, refugees get power from private generator owners. They pay a flat fee of (70 000L.L./month). Refugees living in tents don't use candles for safety reasons. They also don't

use fuel for heating because it is much more expensive; they use wood instead even though it is much more pollutant than fuel (Annex 01). The basic energy source they pay for is gas (64 000L.L/month.) which they use to cook and heat water. Refrigerators are too expensive to buy for refugees living in camps so they buy portable coolers instead, and pay 8000L.L each time they buy ice to store meat (which is once every week according to my interviews with them). Their monthly total bill reaches 150 000 L.L. / month

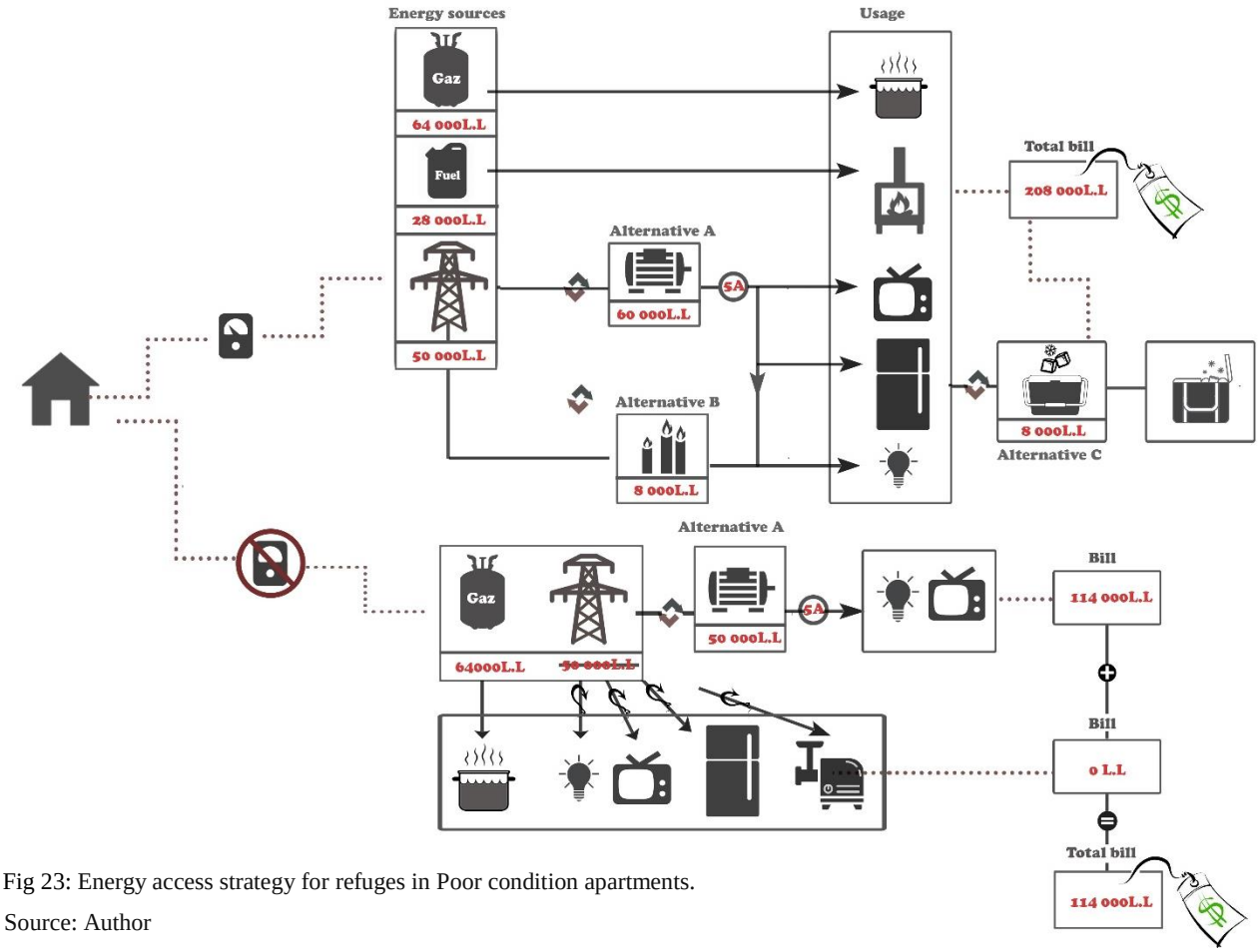

Fig 23: Energy access strategy for refuges in Poor condition apartments.
Source: Author

Refugees from the lower class living in apartments and who don't own electric meters (Minority

of 4% based on my sample) get their electricity illegally by hooking up to the government's electricity grid. Electricity is used for TV and light bulbs. When EDL cuts off electricity, refugees get power from private generator owners. They pay a flat fee (70 000L.L./month). They use candles for lighting as an alternative when the private generator service is down. Candles cost them almost 8000L.L./month. They use fuel in "sobyas"[1] instead of wood for heating because it is too pollutant. The basic energy source they pay for is gas (64 000l.l/month.) which they use to cook and heat water. The majority of them own refrigerators and they only operate them on the government's electric grid which they hook on. During cut offs the generator service is an alternative (50 000L.L./month)

Their monthly bill reaches 114 000 L.L. / month. When it comes to the refugees from the same social class but who are legally connected to the grid (Minority of 6% that own an electric meter), the difference in the energy access strategy lies in not being able to buy a refrigerator because of its high cost especially that they are paying an extra 50 000 for the electricity they receive from EDL because they are legally connected to the grid. They buy portable coolers instead and pay 8000L.L each time they buy ice to store meat.). Their monthly bill reaches 208 000 L.L. / month.

[1] Fuel burning stoves

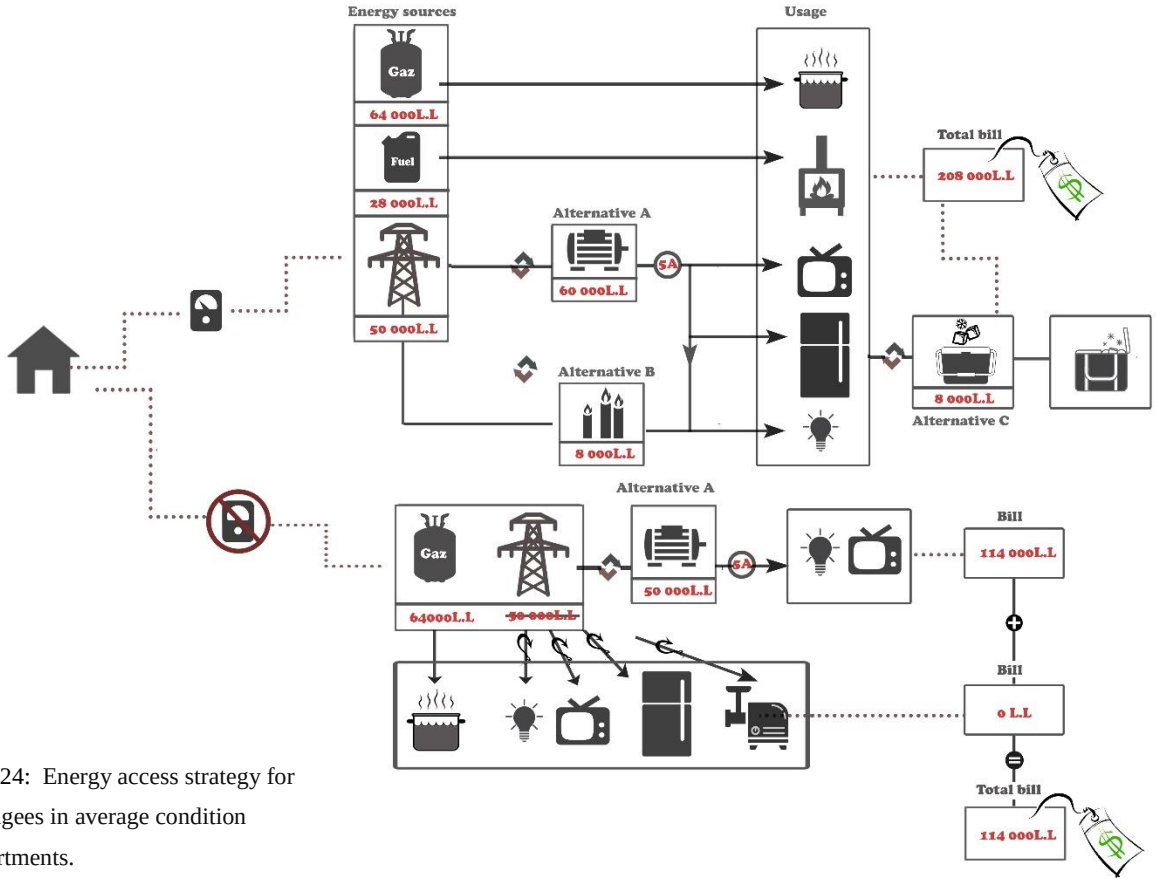

Fig 24: Energy access strategy for refugees in average condition apartments.
Source: Author

The difference in the energy access strategy between refugees from the middle class and refugees from the lower class living in apartments and who own electric meters (minority of 3%) is that even though they are paying a 50 000 L.L. to EDL, they afford buying a refrigerator to store food.

Their monthly bill reaches 114 000 L.L. / month. Refugees from the same social class but who are illegally connected to the grid (majority of 92%), afford buying more kitchen appliances which they use only when they are connected illegally to the grid. Their monthly bill reaches 114 000 L.L. / month.

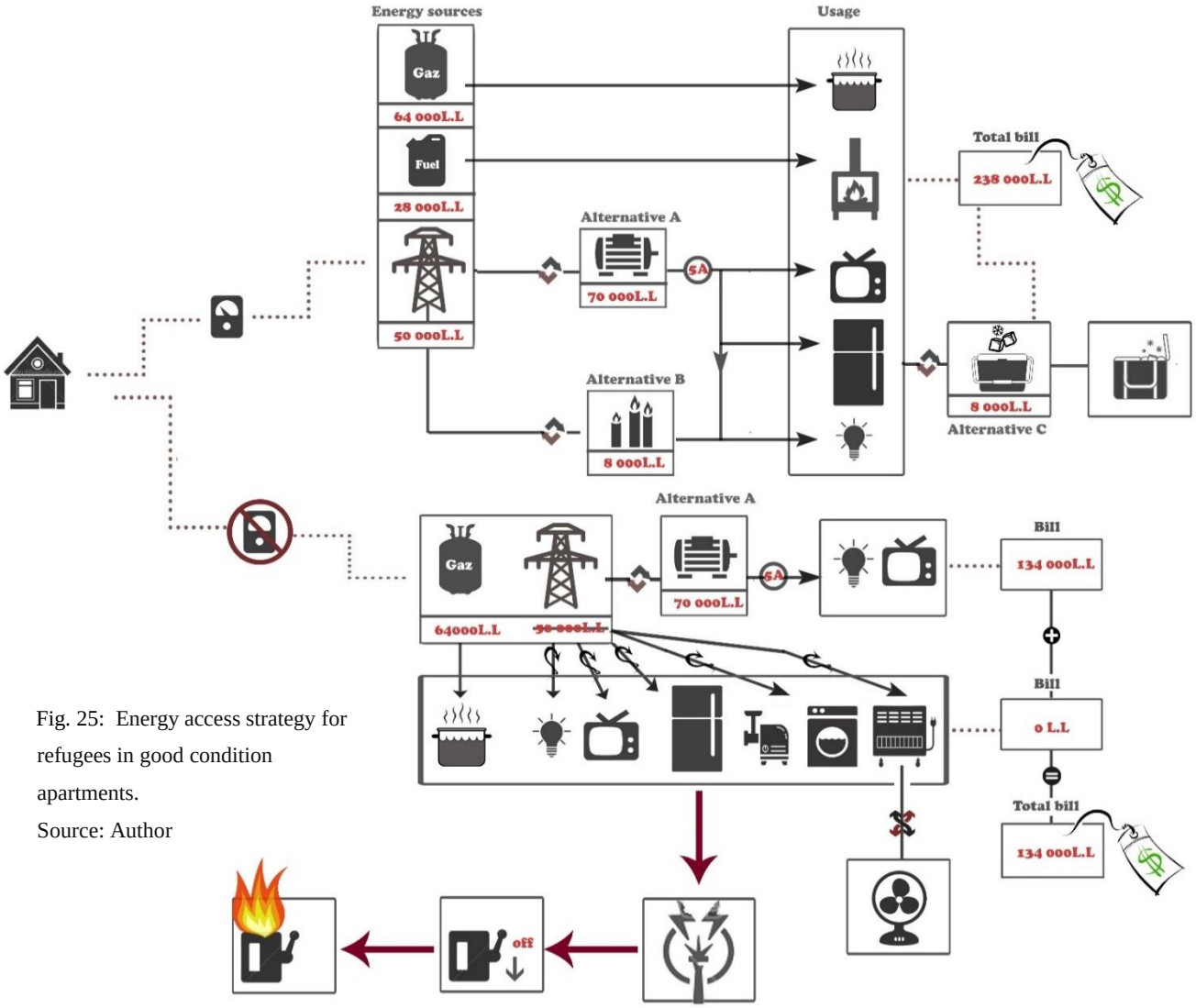

Fig. 25: Energy access strategy for refugees in good condition apartments.
Source: Author

As for the upper class refugees who own electric meters (Minority of 1%) they adopt the same energy access strategy as the middle class (who own electric meters). Their bill reaches 238 000 L.L. The only difference in energy consumption is that upper class refugees who are illegally connected to the grid buy more appliances such as a washing machine and an AC or an electric heater and a fan in the summer that they use only when they are connected to EDL's electricity. Sometimes the line gets so overloaded that the breaker might catch fire. During cut offs when

the generator is running, they use power only for lighting and for turning the TV. Their monthly bill reaches 134 000 L.L. / month.

According to the previous diagrams we can summarize the coping strategies as follows.

A. Refugees in Camps

Refugees living in camps consider their shelters as temporary, because the hope is that at some point they will be able to return to their homes. Therefore, long term investments, such as connecting the camps to the grid or providing them with expensive energy solutions are often discouraged by the government and municipality. However nearly all tents in "Mafrak Cheikh Mhammad" camp have electricity connections, although all electrical connections are illegally wired, bypassing owning an electric meter. In the "Cheikh Mhammad" camp, a Syrian who used to work as an automobile technician volunteered to connect the camp illegally to the grid.

Other than the electric power stolen from the main grid, refugees depend on other energy sources especially that the electricity supplied by the government is only provided for 4 hours per day in Halba. The camps are subscribed to the service of a private generator owner named El-Sari that covers essentially the camp of Cheikh Mhammad and extends to parts of Halba.

The camp gets 2.5 amps from the private generator owner (Alternative A/Fig.25) which only allows the operation of light bulbs and a TV (Alternative B/Fig.25). Candles are not considered as an alternative for lighting in case of power cuts because refugees fear the risk of plastic tents catching fire. Refugees in camps do not own refrigerators because the latter will overload the 2.5 amp circuit causing the circuit breaker to trip. This usually happens when a greater demand for

electricity is being placed on the circuit. Operating a fridge needs a minimum of 5 amps but given that refugees living in camps do not have the ability to pay for this service they have found alternatives to cope and overcome the high cost of energy provision such as owning a portable cooler (Alternative D/Fig.25). Syrian refugees only use it when they want to store food they intend to cook the next day. It costs them 2000 L.L. for a pack of ice per week.

For cooking and heating water, refugees in camps usually depend on gaz bottles, as for warmth they use wood as an alternative to fuel in order to light fire in stoves or "Soubyas" because wood is way cheaper even though fuel burns much more cleanly than wood, and fire is a hazard.

B. Refugees in Apartments

❖ Owning an Electric Meter/ being legally connected

Refugees living in apartments who are legally connected to the grid and own electric meters constitute a very small percentage of my sample (8%), all of whom use an electric meter already installed by the landlord and registered in his name. All of them use fuel to light fire in stoves or "Soubyas" because they can't afford to get an electric heater that will run up the electricity bill. If they are from the lower class, they can't afford owning a fridge and hence owning a portable cooler is the best alternative (Alternative B/Fig.26). Middle class refugees can afford owning a fridge but they would only operate it when it's necessary in the hot months of summer or when they purchase food that needs cooling. Upper class refugees can afford owning a fridge and they operate it much frequently then middle class refugees. However in both cases the portable cooler is still an option when users choose not to operate the fridge. Refugees from all social classes pay around 70 000 L.L. to the private generator per month. They all get 5 amps from the private generator owner (Alternative A/Fig.26-27-28) to operate light bulbs and TVs. Candles

(Alternative B/ Fig 26-27-28) are considered as an alternative for lighting in case of power cuts. For cooking and heating water, refugees in apartments usually depend on gaz bottles, as for warmth they use fuel gallons to light fire in stoves or “Soubyas”.

- Not Owning an Electric Meter / being illegally connected.

Lower class refugees are illegally connected to the grid all use fuel to light fire in stoves or “Soubyas”. Upper class refugees use electric heaters instead because they can afford them. All of them own refrigerators which they operate only on the stolen electricity line because it is stolen and hence don’t have to pay for the energy they consume (Alternative D/Fig.26-27-28) As refugees become better-off more appliances are bought and operated on the stolen electricity line causing eventually a power point overload. This occurs when a user exceeds the maximum amperage of the electrical circuit he/she is using. This can be caused by plugging too many appliances into the one power point or running appliances that draw high amps at the same time. The result of an overload can be a short circuit and quite possibly a fire. They all get 5 amps from the private generator owner (Alternative A/Fig.26-27-28) to operate light bulbs and TVs. Candles (Alternative A/Fig.26-27-28) are considered as an alternative for lighting in case of power cuts. For cooking and heating water, refugees in apartments also depend on gas bottles.

The following table synthesizes the cost of each category and percentages in relation to income/ type of shelter.

Shelter	Connected	Avg.Income/Month	Minimum costs/Month	Cost of electricity /Month	% of electricity in relation

					to income
Camp	Illegally	100$	111$	100$	100%
Poor condition	Illegally	250$	335$	88$	35.2%
	Legally			151$	60.4%
Average condition	Illegally	350$	335$	88$	25 %
	Legally			151$	43%
Good condition	Illegally	400$	335$	151$	37.75%
	Legally			88$	22%

In conclusion refugees who are illegally connected to the grid pay much less than those who are legally connected to the grid and get to operate more appliances as they get richer without paying for the extra consumption making the whole situation quite unfair for the most vulnerable Syrians among them who are trying their best to be legal.

CHAPTER V

PROCESS FOR HALBA'S ENERGY TRANSITION POLICY

Over 90% of Syrian refugees interviewed pay upwards of 50 000L.L./month to be hooked up to a generator in a patchy, low-quality micro-grid sometimes held together with duct tape (fig. 25).

Fig. 26: Intertwined cables held together with a duct tape.
Source: Author

Each "block" of 50–100 houses generally has someone who is operating a generator business, presumably grossing >US$4500/month. It is clear that Syrian refugees are extremely dependent on the private generator service to receive electricity since government is still unable to provide 24/7 electricity and are willing to pay a higher bill compared to the one they could pay to EDL to access electricity.

In conclusion, even though the informal sector's successes are celebrated as an evidence of people' capacity to overcome inadequacies in resource provision, it still suffers from many shortcomings the most prominent of which is that Syrian refugees are still very much dependent on the private generator's business which derives a great deal of benefit from the subscriber. In order to respond to this reality, the thesis suggests an energy transition policy in Halba by which the Syrian refugees and other vulnerable dwellers will be made less dependent on the private electricity suppliers all the while acknowledging the potentials of the existing hybrid system and integrating it into policy making.

Based on the former I propose below a process by which I investigate the possibility of an energy transition policy in order to improve the social, economic and environmental impacts on Halba.

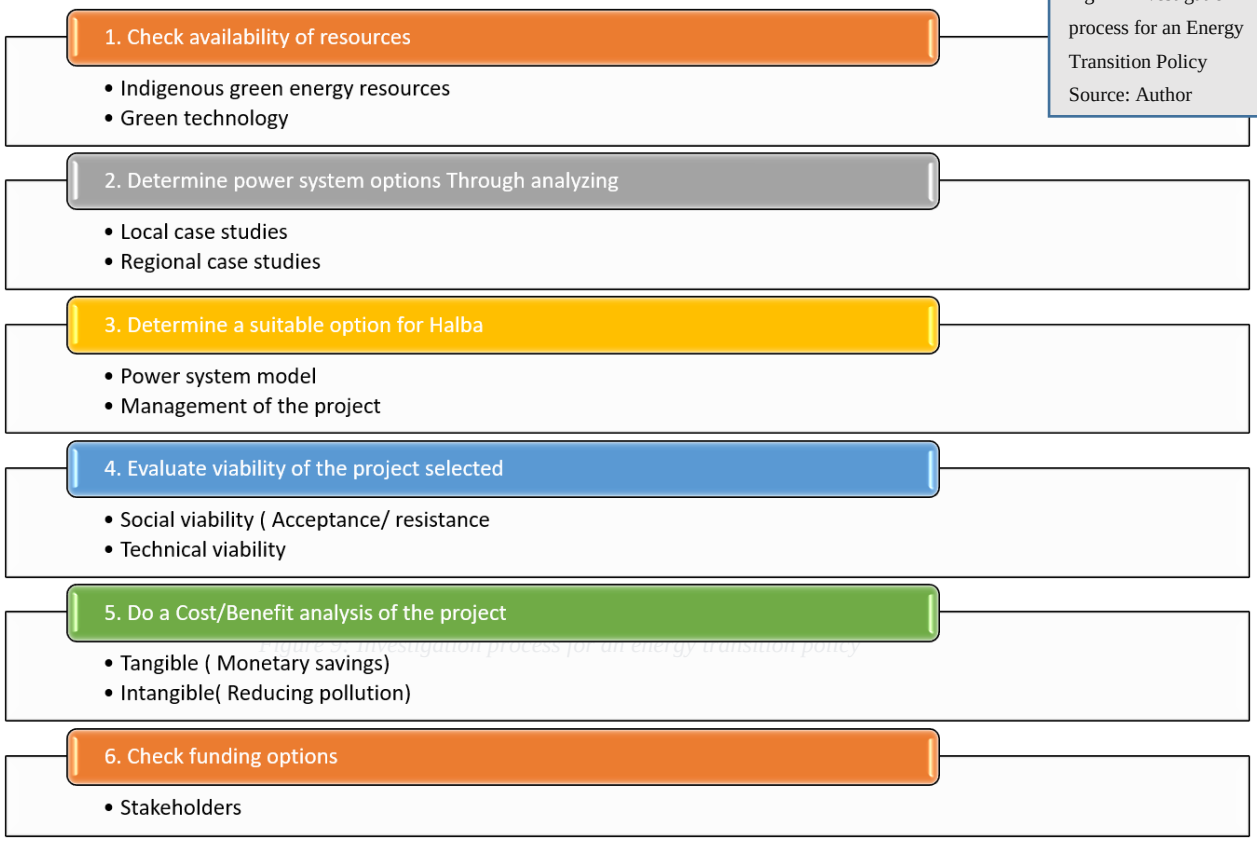

Fig 27 Investigation process for an Energy Transition Policy
Source: Author

Based on the process suggested above, the following section starts by identifying available green energy resources in Lebanon and shows that the solar energy is the most interesting resource to explore in Halba according to the "MEOW Solar Energy Study for Potential PV farms in Lebanon". It also identifies available green technology and shows that Lebanon has seen a lot of progress in designing, manufacturing and selling renewable energy solutions such as solar panels. Onwards, we will determine power system options by drawing on a couple of successful case studies in Lebanon and in the African context in order to analyze if there is a potential to implement similar ones in Halba, and if they can complement traditional power generation models. After identifying the potential options, I will check its technical feasibility by examining building heights, solar radiation and buildings' drop shadows. It is also important to see if it would be accepted socially and if it may get the support of key stakeholders. The tangible and intangible cost-benefits analysis will also be conducted to determine economic viability. Last but not least, I will identify the potential parties that might be willing to fund the project.

A. Availability of Resources

- **Wind** is generally considered the most feasible energy resource for Lebanon. In many wide-ranging areas, average wind speeds are in excess of 9-10 meters per second per year and, in many other areas, average wind speeds are in excess of 6.5 to 7 meters per second, the speed at which wind farms are known to be economically viable (Houri, 2005).
- **Water:** Globally, most of the renewable energy is generated from water. Also in Lebanon it is the most common "clean" energy resource. In 2004, 283 MW were

produced by installed hydro power plants. According to a study by researchers from the American University of Beirut, there is a potential for 533 MW (Houri, 2005).

- **Sun:** Lebanon has around 300 sunny days in a year with over 8-9 hours of daily sunshine and an average yearly insolation of 5.4 Kwh /m²/day at 35 degrees inclination direction south. Sun can be used as energy resource for either photovoltaic or for solar water heating systems. Although prices have decreased during the past years, photovoltaic panels are still comparatively expensive to install. They have been promoted in Lebanon on a local level especially by international initiatives, particularly after the 2006 war on Lebanon (Houri, 2005).

  Fig. 27 shows the areas with the best technical and economic viability, and the least environmental and social drawbacks. The total suitable area is around 148 km2 of Lebanon's total area (10,452 km2), with 61 km2 having the highest irradiation levels (2265 kWh/ m2). As shown in the map, **Halba** is located in an area with a global horizontal solar irradiation of more than 1800 kilowatt-hours (kWh) per square meter per year (kWh/m2/year) (NREL, 2015) which makes it a good place to invest in solar panels.

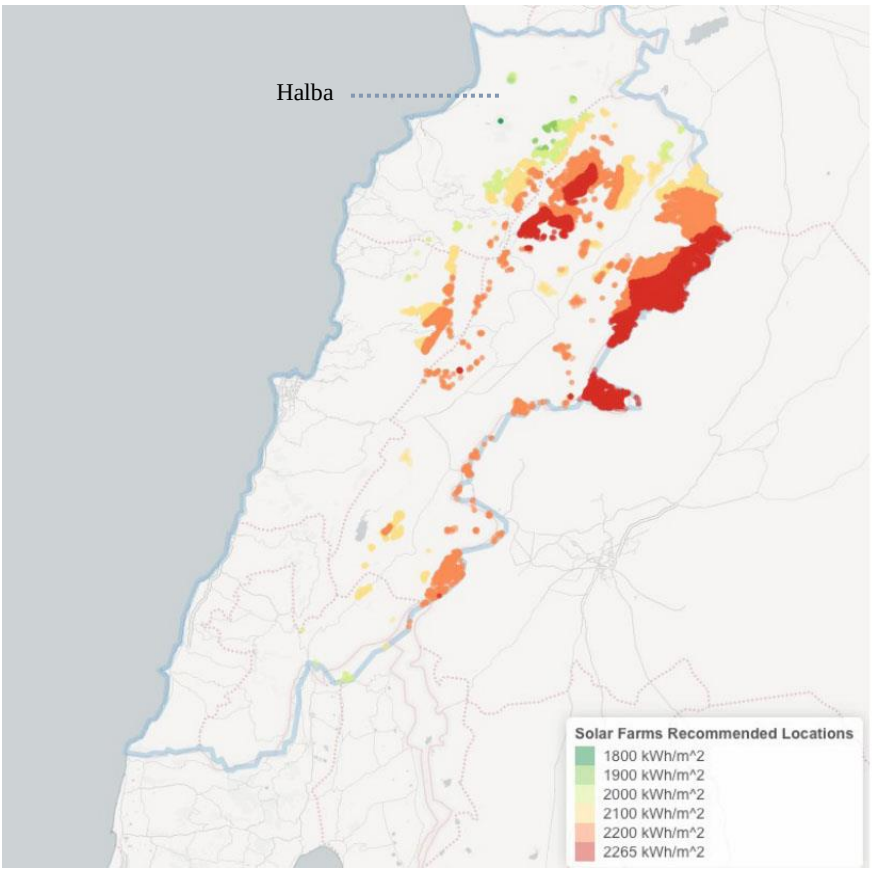

Fig 28: Solar farms recommended locations in Lebanon 2017
Source: Pressreader.com

However dependency on fossil fuel cannot be a 100% eradicated especially in winter when there is less solar irradiation. This is why a hybrid model of fossil-solar power generation system is a better option in Halba.

B. Local and Regional Case Studies

A detailed review of the recent literature shows that numerous studies attempted to deal with the electricity problem in Lebanon. Some of these studies proposed reform plans and useful insights for the **sustainability** of the electric sector, while others included

recommendations and policy suggestions for the usage of renewable energy sources. Chedid and Ghajar (2004) examined the merits of implementing energy efficiency policies in the building sector in Lebanon and provided recommendations to remove the major barriers hindering the penetration of energy efficiency options in the Lebanese market. El-Fadel, et al. focused on the evaluation of the local electricity sector in terms of its sustainability. Dagher and Ruble (2010) constructed scenarios for Lebanon's electricity sector. The authors examined the shift toward natural gas in one scenario and toward renewable energy sources in another scenario. Kinad and Elkhoury (2012) presented an overview of the current renewable energy status in Lebanon. The authors focused on barriers hindering improvements and proposed relevant solutions. Najjar, Ghoulam, and Fares (2012) assessed the feasibility and reliability of implementing hybrid-renewable distributed energy systems. Ibrahim et al. (2013) presented a review of the energy status, conventional and renewable, and illustrated their problems with the suggested recommendations.

These studies show that the solar energy is the most interesting resource to explore. Three official reform plans have been developed by the Ministry of Energy and Water since 2006 to integrate renewable energy resources in the power production process, but due to political reasons[1], none were properly implemented (ESCWA, 2018).

[1] Concerning international financing, both the political instability and the problem of EDL bankability are bound to increase the financial risk of the investment. In fact, when it comes to any investor or lender, EDL is a company in deficit which will be the main customer for all large-scale renewable energy projects. This represents an added factor to be included in the risk study of the whole investment that will affect the final price.

Solar power can also be used for water heating purposes, but despite the successful installations of solar water heaters in Lebanon, their installation rate remains considerably low, reaching only 3% of the overall water heaters in the country in 2009 (World Bank, 2009). Furthermore, a PV grid backup system appears to be an acceptable solution worthy of studying (Khoury, 2015).

Even though Lebanon has gotten off to a modest start with its implementation of relatively small utility-scale solar power projects, the country has seen a lot of progress in designing, manufacturing and selling renewable energy solutions ever since the DREG[1] project was initiated in 2014. In fact, the number of new solar PV projects increased from 18 in 2011 to 259 in 2015. The year-on-year growth rate of the solar PV capacity increased to 149 percent in 2015. Khoury argues that there is still room for much more improvement.

The Beirut Solar Snake, which spans the length of the Beirut River and the Zahrani Power Plant (fig.28) have an operating capacity of 1 megawatt each. Although small compared with some of the projects in neighboring countries, the implementation of these two projects shows that there is the potential for similar ones, and that they can complement traditional power (Anderson, 2017). At this point, a more noteworthy sign of viability of solar power in Lebanon is in the private sector, through the financing scheme National Energy Efficiency and Renewable Energy Action NEERA

[1] The Small Decentralized Renewable Energy Power Generation Project, also known as DREG, is funded by the Global Environment Facility (GEF), is to be nationally executed by the Ministry of Energy and Water (MoEW) of the Government of Lebanon in coordination with the Lebanese Center for Energy Conservation (LCEC), and is to be implemented by the United Nations Development Programme (UNDP).

implemented by the Central Bank in 2010, which has taken 464 loans totaling $322 million. Through this program, 338 solar PV projects were installed with a capacity of 13.5 megawatts. (Anderson, 2017).

Fig 29: Zahrani power plant
Source:Anderson 2017

In recent years, the role of the UN refugee agency UNHCR and other humanitarian agencies has changed significantly. Originally, these institutions were focusing on the provision of short-term, temporary emergency relief and operated under the premise that forcibly displaced people may eventually return home. However, statistics show that forcibly displaced people who find refuge in a camp remain there for an average of 17 years, which means that managing the corresponding settlements is a medium to long-term obligation that requires a dedicated strategy and novel operational competences (Jeffries, 2017; Lahn et al., 2015). In light of these developments, the topic of energy demand and supply for refugees has gained increasing attention in recent years. Starting from the observation that "the costs of energy access and provision are unnecessarily high, whether measured in terms of finance, the environment, health or security" (Lahn et al., 2015, p. viii), UNHCR and other actors have launched initiatives such as the Global Strategy for Safe Access to Fuel and Energy, or the Moving Energy Initiative (Lahn et al., 2015; UNHCR, 2014). At the same time, a variety of different pilot projects started

to bring clean energy technologies–such as solar photovoltaic (PV)–to the field and to position the humanitarian sector as a launch pad for sustainable development. Examples include: the recent inauguration of two megawatt-scale photovoltaic (PV) power plants near the refugee settlements of **Azraq and Mafraq Za'atari** in Jordan, which demonstrate that **solar PV systems** can be used to power vital infrastructure of entire camps (Hashem, 2017; Pyper, 2015). Jordan, which imports 98 percent of its energy needs, has struggled to manage the cost of the country's 1.3 million Syrian refugees until it turned to solar energy to relieve stress of refugee crisis (Luck, 2017).

However, even though solar PV provides a promising alternative to conventional forms of electricity generation, so far there has been no study that assesses to which degree the Jordan case is transferrable to other contexts, This assessment seems highly worthwhile since 70% of the largest refugee camps under UNHCR authority are located in areas with a global horizontal solar irradiation of more than 2000 kilowatt-hours (kWh) per square meter per year and in host countries with relatively high electricity prices.

As already mentioned Halba is located in an area with a global horizontal solar irradiation of more than 1800 kilowatt-hours (kWh) per square meter per year (kWh/m2/year) (NREL, 2015) which makes it a good place to invest in solar panels. However Halba's case is quite different then the Jordanian one seeing that 90 % of the Syrian refugees in Halba reside in compounds and apartments and the rest in camps making the installation of residential solar panels on rooftops a better option than a PV power plant (Mayor of Halba, personal interview, 2018). These solar panels can be aggregated into a virtual power plant.

Zahle's case is interesting to mention. Electricite de Zahle (EDZ) was founded in the 1920's to produce and distribute electricity way before EDL was established (Sakr, 2015). A few years after its establishment, EDL monopolized power generation in Lebanon and gave EDZ rights for distribution. These partnerships became known as **concessions** (Sakr, 2015). But at that time Lebanon was producing energy at a surplus jeraissati explains that the agreement guarantees EDL's monopoly over production as long as it ensures uninterrupted power supply and since this hasn't been the case, Nakkad took advantage of the failure of EDL to take full responsibility of producing and distributing electricity to Zahle through EDZ citing the 1920s concession agreement with the Lebanese government (Sakr, 2015). EDZ leased diesel generators from a Britain-based firm named **Aggreko**[1]and pumped the energy into the local grid. By covering the power gap left by the state utility and offering a single, cheaper bill, rather than the two bills residents had been paying (one to the state utility, another for their local private generator), EDZ was able to push hundreds of smaller generators out of business (Dziadozs, 2018).

The mafias fought back by burning tires and blocking streets. They also shot at transformers and threatened its chief executive. In the end, the protests died down and the generator owners moved on thanks to substantial support from the public for its effort (Saba, 2015).

[1] EDZ partnered up with Aggreko, a British company that specializes in temporary power supply with a 2-year lease to supply Zahle with the rest of the power it needs.

So, basically EDZ buys energy from EDL that is fed into the EDZ grid, and the second EDL stops supplying every day, EDZ maintains the power supply constant with its own generators for most of the hours in a day. This means that for a customer, the electricity never cuts and more importantly, they pay one bill that is 35–40% cheaper overall (Saba, 2015). That's because EDZ's tariff is based on how many hours EDL fails to provide electricity and the price of diesel oil, unlike the "moteurs" local generators that have refused to lower prices even though diesel is down more than 60% from its peak when their tariffs were set (Dziadozs, 2018).

Few private companies have implemented energy efficiency and *renewable energy* projects; **EDZ** is one of these few**.** 24-hour power has made Zahle the only town in Lebanon where there's a national law allowing **net metering** (Fig.33) (Carpi, 2018). The latter is a billing mechanism that credits renewable energy owners for the electricity they inject on the distribution grid, one example is the installation of photo-voltaic panels on rooftops or available areas; the system allows individual solar panel owners to sell power back to the grid (Carpi, 2018).

C. Proposed governance Model in Halba

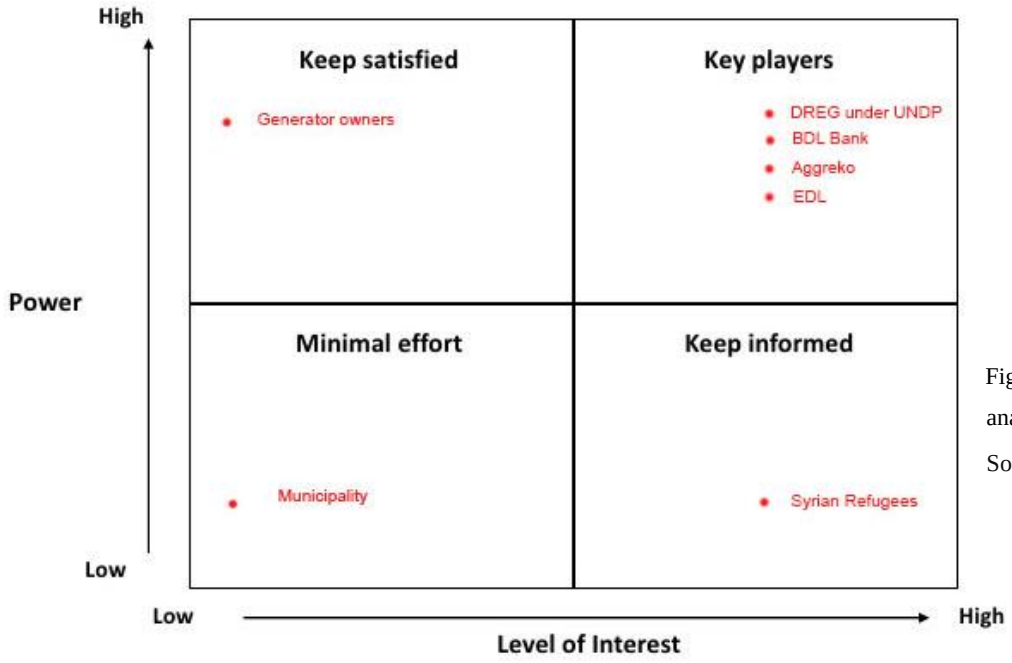

Fig 30: Stakeholder analysis

Source: Author

- **DREG under the UNDP, BDL Bank, Aggreko and EDL:** Can be involved in the governance/ decision making and funding bodies.
- **Generator owners:** They are the least interested in providing affordable resources to citizens and more invested in sustaining the profitability of the private electricity. Engage and consult with them to find a suitable setup.
- **Municipality:** Incompetent Mayor and unqualified to take responsibility. Try to increase level of interest and engagement.
- **Syrian refugees:** Keep informed and consult on interest areas

Drawing from the success of Zahle, I propose replicating the same model in Halba through the construction of EDH (Electricité de Halba) a sister company of EDZ. EDH will be a hybrid model incorporating both solar and fossil fuel -based generation

technologies in the same facility. The private company will begin by consolidating the ownership of the public generators through buying the generators from them from their owners.

Since, most of Lebanon's electrical infrastructure (poles, lines, transformers, etc.) are owned by EDL, the latter will allow EDH the use of the existent infrastructure under a **concession**[1] that gives it the right to produce electricity. When the concession expires EDH will have over the network to EDL and it will dissemble its power only in the case where EDL id able to provide electricity 24/7 to its citizens given that the original contract with EDZ stipulates EDL has to meet electricity needs of the region.

Many of the proposed benefits of decentralization are based on the premise that it brings local decision makers closer to the constituencies they serve. Implicit in this are assumptions about the nature of information available to local decision makers and the presence of effective channels for the public to express wants and preferences. The resulting argument is compelling: local decision makers have access to better information on local circumstances than central authorities, and they use this to tailor services for local needs and preferences; the public provides input to local decision-making processes and holds local decision makers accountable for their actions. Classical descriptions of the benefits of decentralization typically follow one or more of these strands (see, for example, Tiebout 1956 and Musgrave 1959).

[1] Concession contracts provide a mechanism for transferring the traditional public sector client roles of market research, project appraisal, project financing, operation and maintenance, and revenue generation associated with power station projects from the government to the private sector organizations (Antony Merna, Nigel j. Smith , 1994).

But decentralization is not a risk-free endeavor. In a society like Lebanon's with entrenched traditions of patronage, the danger is that decentralization simply shifts rather than eradicates the locus of corruption (O'Sullivan, 2014). Worse, the creation of new levels of government and the overloading of incapable local institutions could even exacerbate the problem. The 2006 World Bank paper which inscribed the long-term virtues of decentralization cautioned against the short-term risk of "capture" by local elites; if not done properly, "localization may increase the opportunities for corruption," it warned (O'Sullivan, 2014)..

Halba's municipality has been internally divided, led by one family (Halabi) for decades, and, as an institution, has been serving the mainstream political patrons and clientelist networks who use it to expand their power. It seems that trusting the municipality to play a developmental and impartial role in electricity provision is a long shot. However a comparison between the 2010 and the 2016 municipal elections in Halba shows that while in 2010 competition was limited to the Halabi family, the 2016 included three opposition lists. Two were headed by Halabi family members, and the third by Mohammad Zoghbi[1] named "Halba el Ghad". Even though the "Halba's Development" headed by Abdul Hamid el Halabi won with 41.4% of the total vote, the new list "Halba Al-Ghad" which has no ties to political parties shows that the residents of Halba are discontent with the situation and are yearning for a political change (The Monthly, 2016).

[1] Chairman of the board of directors of a Local Civil Society Organization in Halba called "Al Hamidya Charitable Association"

Recently, the Ministry of Interior and Municipalities decidedto dissolve the municipality of Halba after the resignation of half of the members of its municipal council, and the assignment of the governor of Akkar, Emad el Labaki, to run its business until the election of a new municipal council (The Monthly, 2018).

A council member explained that the mayor and his deputy are not qualified to take responsibility, and that they were unable, with their team, to be in harmony with the citizen, the administration and the state institutions. The mayor and his deputy were asked to resign and appoint two other people from the same team, but they refused, which made things difficult and complicated and led 10 members to resign (The Monthly, 2018).

The dissolution of the current municipality reveals that the community of Halba is aware of the corruption and incompetence within the municipal council and are holding them accountable, and that the re-elections are a great opportunity for municipal reform.

I will assume that the transition to solar energy will occur gradually through deliberation between the newly elected municipality, EDL, and generator owners. I'm assuming the municipality will lead the policy and work towards the setup of a partnership that may translate into a concession and the establishment of an electricité de Halba (EDH), funded similarly to EDZ whereby a setup with generator owners can be negotiated.

D. Social and Technical Viability of the project

Tall buildings have great mass, they reduce the solar access of their surrounding environment by overshadowing adjacent properties. In Halba most buildings are 2 to 3 floors which makes them potential locations for the installation of PV panels. Most Syrian refugees reside in apartments and not in camps. Also most empty plots are agricultural ones therefore it is not desirable to use up the lands for PV installation and ruin the landscape. Interconnected rooftop solar and battery storage systems distributed across households is found to be a better option than an actual solar power plant.

Fig 31: Virtual PV power plant

Source: www.nersa.org.za

Fig 32: Conventional PV power plant

Source: www.nersa.org.za

When we think about power plants, we tend to visualize large facilities that produce an output in the scale of megawatts. This power is then delivered to consumers through high-voltage transmission lines, transformers, and distribution lines. It is now possible to link a network of decentralized, small scale **power** generating units installed on rooftops, operating them in coordination like a utility-scale power station - this concept is called a virtual power plant (VPP) (Fig.30).

Virtual power plants have many operating advantages over conventional PV power plants. A conventional power plant can be brought offline if a key component suffers a fault, but a VPP does not have this weakness. If a fault affects one of the generation systems connected to the VPP, there is only a very small loss of capacity. Also virtual power plants don't ruin the landscapes as they are installed on rooftops whereas a conventional PV power plant (FIig.31) takes up huge surfaces.

E. Cost/benefit analysis of the project

Taking into consideration that in Halba a building of 120 m2 houses on average 3 households all of whom decided to install the roof top solar panel around the 120 square meter area of the roof, the amount of energy generation from installed roof top solar panel and the corresponding monetary savings can be calculated to evaluate the cost-benefit analysis of such an option. For this thesis an exercise has be done with the help of an Engineer to come up with an approximation of the values. The end results appear positive and enabling for saving on electricity bills. The Exercise will be shown below in case of further interest in the details of the calculations.

The purpose is to study the potential benefits, both tangible and intangible, that might be brought forth by the energy transition policy which is elucidated in the following cost-benefit analysis. Nonetheless, the figures and indicators even though they reflect realistic scenarios, need to be treated with some caution seeing that Arithmetic averages have been used for both area value and number of Syrian refugees. Inaccuracies in calculating the annual solar energy are hence possible. The table below shows some data gathered from interviews with the generator owners.

Avg. Monthly consumption/ household	1500 watt
Avg. Monthly Bill/ household	60 000 L.L.
Avg. Yearly consumption/Family	18 000 Watt
Avg. Yearly Bill/ Family	840 000 L.L.

Fig 35 /Table: Monthly energy consumption

Source: Author

To calculate the annual solar energy output of a photovoltaic system the global formula to estimate the electricity generated in output of a photovoltaic system is

$E = A * r * H * PR$ E = Energy (kWh)

A = Total solar panel Area (m2)

r = solar panel yield or efficiency (%) given by the ratio: electrical power (in kW) of one solar panel divided by the area of one panel.

H = Annual average solar radiation on tilted panels.

PR = Performance ratio, coefficient for losses (range between 0.8 and 0.9, default value = 0.85)

The solar panel yields or efficiency factor in this study is taken to be 15 percent as the average value of commercial crystalline solar panels, which have the highest global market share with around 90 percent (IEA, 2014). According to IEA (2014), a well-designed PV plant can achieve a yearly average performance ratio, coefficient for losses (PR) of 80 to 90 percent. Therefore, we will assume a yearly average of 85 percent.

The values of the annual average solar radiation on tilted panels are taken from the graph below.

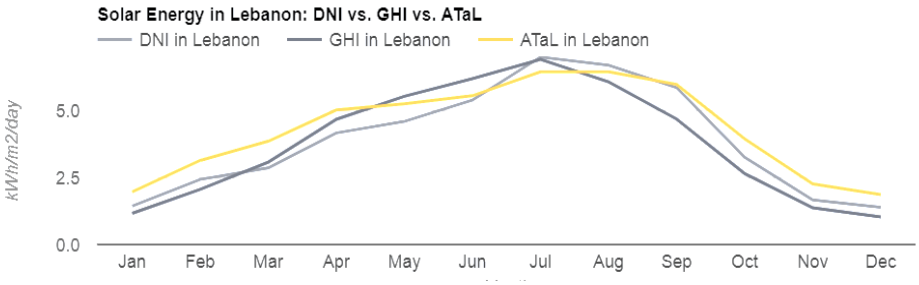

Fig 33: Solar energy in Lebanon
Source: https://solarenergylocal.com/

Taking into consideration that in Halba a typical refugee compound has an area of 120 m2 and houses on average 3 households all of whom decided to install the roof top solar panel around the 120 square meter area of the roof, the amount of energy generation from installed roof top solar panel and the corresponding monetary savings are shown in the table below. Our calculations are based on the assumption that the cost of 1 kWh is 118.32 LBP/$0.08 USD (LCEC 2012)

Month	Area (Sq.m)	Solar Panel Yields (%)	Annual Avg. irridiation (KW/M2/Day)	Performance losses and coeff. Of losses	Energy/Day	Monthly energy generation	Avg. Monthly electricity consumption from generators	Generationn - Consumption =	Monthly generation cost (USD)	Monthly total consumption cost (USD)	Monthly profit(USD)	Monthly Monetary saving (%)	Monthly profit (%)
January	120	0.15	2.5	0.85	38.25	1147.5	4500	-3352.5	91.8	120	-28.2	76.50	0
February	120	0.15	3	0.85	45.9	1377	4500	-3123	110.16	120	-9.84	91.80	0
March	120	0.15	3.8	0.85	58.14	1744.2	4500	-2755.8	139.536	120	19.536	100.00	16%
April	120	0.15	5.5	0.85	84.15	2524.5	4500	-1975.5	201.96	120	81.96	100.00	43.23%
May	120	0.15	6.5	0.85	99.45	2983.5	4500	-1516.5	238.68	120	118.68	100.00	69.28%
June	120	0.15	7	0.85	107.1	3213	4500	-1287	257.04	120	137.04	100.00	82.30%
July	120	0.15	6.8	0.85	104.04	3121.2	4500	-1378.8	249.696	120	129.696	100.00	77.09
August	120	0.15	5.5	0.85	84.15	2524.5	4500	-1975.5	201.96	120	81.96	100.00	43.23
September	120	0.15	5	0.85	76.5	2295	4500	-2205	183.6	120	63.6	100.00	30
October	120	0.15	3	0.85	45.9	1377	4500	-3123	110.16	120	-9.84	91.80	0
November	120	0.15	2.5	0.85	38.25	1147.5	4500	-3352.5	91.8	120	-28.2	76.50	0
December	120	0.15	2.3	0.85	35.19	1055.7	4500	-3444.3	84.456	120	-35.544	70.38	0
Avg. yearly profit													51.59
Yearly savings												74.22	

Fig 34/Table: Profit and monetary savings from PV energy generation
Source: Author

Calculations:

- Energy/Day = A (Area) * r (Solar panel yields) * H (Annual average irradiation) * PR (Performance losses).
- Monthly Energy Generation = Energy/Day * days of the month.
- Avg. monthly electricity consumption from generators (Calculated in Annex 02).
- Monthly generation cost = E*0.08 USD.
- Monthly total consumption cost ranges between 50-70 for a household according to the type of subscription. We are going to use 60$ as a default value hence the monthly total consumption for the entire building is 120$
- Monthly profit= Monthly generation cost - Monthly total consumption cost.
- Monthly monetary saving (%) = (Monthly generation cost/ Monthly consumption cost) *100
- Monthly profit (%)= monthly monetary saving- 100
- Avg. yearly profit = ∑ (Monthly profit) /7
- Avg. yearly savings = ∑ (Monthly monetary saving) /6

According to the results above, installing solar panels will help an apartment building that accommodates on average 3 households to save up a total of 74% of money on energy bills during autumn and winter and to make a total profit of 51.6% % during the hotter months of the year when there is an excess of production. **Net-metering** is a great technique that permits a PV user to take advantage of his excess of production. Net-metering allows the flow of electricity in two directions: from the grid to the customer in case energy demand exceeds production, and from the customer's facility to the wider common grid in case of excess production, using a bi-directional meter. Its advantages include legal and technical simplicity. The bill at the end of the month will be the difference between the electrical energy consumed from the grid and the energy injected into the grid. Any surplus will be carried to the next month and subtracted from the consequent bill.

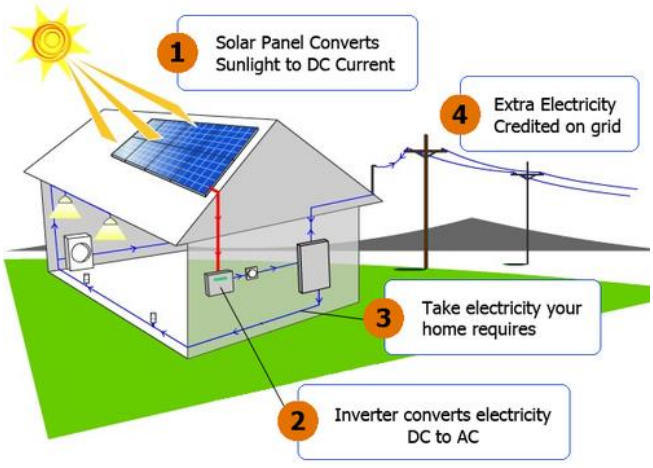

Fig 35: Net-metering operation Source: www.cleantechnica.com

Table 2 shows the savings in terms of CO2 emissions, considering an emission factor of 0.65 tCO2 /MWh (LCEC 2012). The highest saving is in the month of June reaching 71%. The lowest percentage is during the winter in the month of December where solar irradiation is at its minimum, 33.4 % is still somehow acceptable considering a yearly average savings of 45.39% in CO2 emissions.

Month	Energy generated from from solar energy for one building (watt)	Energy generated from fossil fuel for one building (watt)	Co2 emissions(t)from fossil fuel	CO2 emissions (t0 if solar energy is used an an alternative	saving in terms of CO2 emisions (%)
January	1148	4500	0.002925	0.0021788	25.51
February	1377	4500	0.002925	0.00202995	30.60
March	1744	4500	0.002925	0.0017914	38.76
April	2525	4500	0.002925	0.00128375	56.11
May	2984	4500	0.002925	0.0009854	66.31
June	3213	4500	0.002925	0.00083655	71.40
July	3121	4500	0.002925	0.00089635	69.36
August	2525	4500	0.002925	0.00128375	56.11
September	2295	4500	0.002925	0.00143325	51.00
October	1377	4500	0.002925	0.00202995	30.60
November	1148	4500	0.002925	0.0021788	25.51
December	1056	4500	0.002925	0.0022386	23.47
Average yearly savings in terms of CO2 emissions					45.39

Fig 36 /Table: Savings in terms of CO2

Source: Author

Calculations:

- Co2 emissions (t) from fossil fuel= 4500*110^-6 *0.65
- Co2 emissions (t) from fossil fuel if solar energy is used as an alternative=.(Energy generated from fossil fuel foe one building –Energy generated from solar panels for one building) * 10^-6 *0.65
- Savings in terms of CO2 emissions = (CO2 emissions if solar energy is used as an alternative-CO2 emissions (t) from fossil fuel) / CO2 emissions from fossil fuel * 100
- Average yearly savings in terms of CO2 emissions = ∑ (Monthly savings in terms of CO2 emissions) /12

F. Funding Options

For the suggested virtual PV power plant EDH can benefit from the Small Decentralized Renewable Energy Power Generation Project (DREG) which also associates banks to the funding of such projects.

CHAPTER V

CONCLUSION

This thesis has investigated service provision in Syrian refugees' compounds in Halba after the Syrian war of 2011 by examining the formal and informal modes of electricity acquisition relying on interviews with refugees and service providers of 25 Syrian refugee compounds and one camp in Cheikh Mhammad village, the thesis unpacked how service provision is the outcome of a hybrid system operated both commercially and by self-help through formal (municipal) and informal actors. The study shows that even though the system responds to the dire needs of refugees in lieu of the ongoing ad-hoc, turn-a-blind-eye strategy adopted by the government, it nevertheless suffers from many shortcomings, the most prominent of which is dangerous fire hazards that result from an increasing practice of cable hooking and environmental costs related to the air pollution caused by generators.

Although the majority of the Syrian refugees tap from the grid, they are still very much dependent on the private generators' business during EDL's cut-offs. A considerable sum of the refugees' income go to the private generator owners which make Syrian refugees more vulnerable given they're paying a more expensive bill then the one being paid to the government. In order to respond to this reality, the thesis argued for the importance of a service provision model that learns from existing hybrid systems. It recommended an energy transition policy by which the Syrian refugees and other vulnerable dwellers be

made less dependent on the private electricity suppliers, while providing them with less costly and more sustainable energy services than the ones they are currently paying for.

Putting aside the question of power access, I would like to draw the attention to the housing issue in Halba which I found to be very interesting for a future research. Indeed the urbanization growth in Halba raises questions related to the patterns of spatial production and roles of land developers in this process, as well as financialization schemes they rely on.

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