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Enabling PV Afghanistan

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II Acronyms

ACCI	Afghanistan Chamber of Commerce and Industry
ACEP	Afghanistan Clean Energy Project
ACGF	Afghan Credit Guarantee Foundation
ADB	Asian Development Bank
AFN	Afghan Afghani (local currency)
AIB	Afghanistan International Bank
AKAM	Aga Khan Agency for Microfinance
ANSA	Afghan National Standard Authority
ARAZI	Afghanistan Independent Land Authority
AREU	Afghanistan Renewable Energy Union
ASERD	Afghanistan Sustainable Energy for Rural Development
ATVI	Afghanistan Technical Vocational Institute
BMZ	Federal Ministry for Economic Cooperation and Development
BOT	Build-Operate-Transfer
BSW-Solar	German Solar Association
CAPEX	Capital Expenditure
CGFA	Credit Guarantee Facility for Afghanistan
CIT	Communication and Information Technology
CSO	Civil Society Organizations
Ct.	cent
DABS	The Electricity Company of Afghanistan
DF	Distribution Franchisee
DFID	UK Department for International Development
DSO	Distribution System Operator
ESRA	Renewable Energy Supply for Rural Areas of Afghanistan
FiT	Feed in Tariff

FMFB	First MicroFinance Bank
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GW	Gigawatt
ICE	Inter-Ministerial Commission for Energy
IDB	Islamic Development Bank
IPP	Independent Power Producers
IRR	Internal Rate of Return
ISIS	Iraq and the Levant
ITB	Invitation To Bid
KFW	German government-owned development bank
KPU	Kabul Polytechnic University
KUEF	Kandahar University Engineering Faculty
kW	Kilowatt
kWh	Kilowatt-hour
LC	Lease Contract
LCOE	Levelized Cost of Energy
MCI	Ministry of Communications and Information
MDGs	UN-Millennium development Goals
MEW	Ministry of Energy and Water
MMP	Ministry of Mines and Petroleum
MoE	Ministry of Education
MoF	Ministry of Finance
MoFA	Ministry of Foreign Affairs
MRRD	Ministry of Rural Rehabilitation and Development
MUDA	Ministry of Urban Development Affairs
MW	Megawatt
MWh	Megawatt-hour
MWp	Megawatt-peak
NEPA	National Enviromental Protection Agency
NEPS	North East Power System
NGO	Non-governmental Organizations
O&M	Operation and Maintenance
OC	Operating Concession
OPEX	Operation Expenditure
PEC	Provincial Energy Committee
PPA	Power Purchase Agreement
PPP	Public Private Partnerships
PSMP	Power Sector Master Plan
PV	Photovoltaic

RECC	Renewable Energy Coordination Committee
RED	Renewable Energy Department
RENP	Renewable Energy Policy
RER	Renewable Energy Roadmap
RER2032	Renewable Energy Roadmap
RESCO	Renewable Energy Service Company
RFP	Request for Proposals
SECA	South West Energy Corridor of Afghanistan
SEPS	South East Power System
SME	Small and medium enterprises
SPP	Solar Power Park
SY	Solar Year
TAP	Turkmenistan-Afghanistan-Pakistan-Pipeline
TAPI	Turkmenistan–Afghanistan–Pakistan–India Pipeline
TC	Technical Committees
TWG	Technical working Groups
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollar
VAT	value-added tax
WB	World Bank
WTO	World Trade Organization

III Enabling PV Afghanistan

Afghanistan is undergoing a process of re-industrializing its economy and rebuilding its energy infrastructure. This accompanied by an increasing energy demand that cannot be met by conventional energy sources alone. Thus, alternative energy sources have to be explored. Solar photovoltaic has already reached or is about to reach grid parity in most of the sun-belt countries. Solar PV also has a great economic potential in Afghanistan and first efforts to deploy it can be seen. Till 2021, 500 MW of renewable energy will be deployed; of which 200 MW are foreseen for the off grid sector and 300 MW for on grid applications. 1.5 GW of PV are foreseen by 2032. The overall objective of the ENABLING PV study is to contribute to the sustainable development of these PV plans in Afghanistan.

In this study the German Solar Association (BSW-Solar) in cooperation with the Afghan Renewable Energy Union (AREU) and Eclareon GmbH analyze and describe the processes of investments and project development of PV power plants in Afghanistan. This includes the description of the legal and administrative framework and of import, trade and investment conditions, as well as recommendations to enter the Afghan PV market.

The study was developed through desk research and interviews with market experts, legislators and project developers using standardized interview guidelines. Plausibility assumptions and an analysis of barriers helped to formulate recommendations for policy makers and politicians. Sample calculations of typical projects including cash flow modelling and sensitivity analysis provided an outlook for profitability changes related to changes in system prices, energy yield or remuneration and thus a first guideline for investors. The preliminary results were presented at a workshop on the 9th April 2017 in Kabul and discussed with relevant stakeholders in Afghanistan.

1 Summary

Afghanistan is currently facing a challenging energy situation: electricity consumption from the national grid is mainly covered by electricity imports from neighboring countries, such as Uzbekistan and Iran. Additionally, a large share of the Afghan population, especially in rural areas, still has no access to electricity.

To overcome these issues, the government of Afghanistan aims to increase domestic electricity generation by 2032 with a share of 5,000 MW of renewable energy, equivalent to 95% of the electricity supply in that year. According to the governmental "Renewable Energy Roadmap" (RER2032), which specifies the actions needed to reach the renewable energy targets by 2032, the share of solar projects should be 1,500 MW. Nevertheless, according to the Afghanistan Renewable Energy Union (AREU), solar projects could cover 30% of the electricity demand by 2032 with 3,000 MW.

According to the profitability analysis of off-grid, large scale power purchase agreements (PPA) and rooftop net-metering business models which were analyzed in this study, PV projects with a short payback period, are only attractive if they have high investment subsidies and no debt service. However, such investment conditions are unrealistic. Support from the Afghan government in the form of support mechanisms and improved banking conditions are needed to close the viability gap of PV projects. Additionally, the high level of customs tariffs on PV products, affects the profitability of PV projects.

To achieve the established targets, Afghanistan must create and improve the following conditions: the creation of a binding regulatory framework with attractive support mechanisms (incl. FiT and net-metering); the definition of an organizational structure for the implementation of these mechanisms; the reduction of custom tariffs for renewable energy products; the education of investors and financial institutions about solar technology and its profitability. Finally, the government needs to offer security packages in order to lower the security costs of the banks and investors.

2 Key Stakeholders for Sustainable Power Development[1]

The energy sector is one of the main areas in the country´s development and the use of renewable energy sources is already a topic in Afghanistan's energy policy. The Ministry of Energy and Water (MEW), the Ministry of Rural Rehabilitation and Development (MRRD) and the state-owned utility DABS are the three main public organizations involved in the development of Afghanistan's energy sector. MEW is the main organization responsible for the development of the energy sector all over Afghanistan (including both rural and urban areas), whereas MRRD's mandate is limited to the districts and villages. DABS is the only government-owned utility in the country responsible for the distribution of electricity and the operation and maintenance of Afghanistan's power plants.

The description of governmental and private stakeholders currently working in the renewable energy sector in Afghanistan is described in detail below:

2.1 Governmental and Private Stakeholders:

The Ministry of Energy and Water (MEW)

The Ministry of Energy and Water is in charge of shaping all policies and regulations for the country's power sector, including the design of sector plans. MEW is responsible, politically and institutionally for directing the development of the energy and water sectors, and bringing them to decision making processes established on governmental side. Additionally, the ministry seeks to encourage public and private stakeholders to implement these policies and strategies. The power projects implemented by MEW are financed by the national development budget and by international financial institutions and donors. The renewable energy sector is the task of a specific unit within MEW called the Renewable Energy Department (RED).

Renewable Energy Department (RED)

The Renewable Energy Department (RED) of the Ministry of Energy and Water (MEW) promotes the use of renewable energy, increase affordability and access to renewable energy according to the targets set by the government of Afghanistan. It also sets policies and draws up regulations to attract the private sector to engage in the renewable energy market.

Renewable Energy Coordination Committee (RECC)

The Renewable Energy Coordination Committee, which is hosted in the RED, started its operations at the end of 2015 with the aim of supervising the implementation of the Renewable Energy Policy and coordinating the key stakeholders involved in the renewable energy development (incl. non-governmental organizations (NGOs), private sector and governmental stakeholders). The stakeholders work in technical working groups settled by RECC. The Inter-Ministerial Commission for Energy (ICE, see below) and the Provincial Energy Committee (PEC) support RECC in the coordination of MEW and MRRD activities with regard to renewable energy projects.

1 The contact information of the stakeholder is provided in Annex 9.2.

Ministry of Rural Rehabilitation and Development (MRRD)

MRRD´s function is to enhance social and financial growth in rural areas, excluding agricultural activities. This includes the reduction of poverty and the improvement of the living conditions of people in rural areas according to the UN-Millennium Development Goals (MDGs). The Ministry has implemented some programs regarding the electricity supply from renewable energy sources. The last one funded by the UNDP, is the Afghanistan Sustainable Energy for Rural Development (ASERD[2]), which focuses specifically on the development of sustainable energy in rural areas.

Da Afghanistan Breshna Sherkat (DABS)

The name translates as "The Electricity Company of Afghanistan". DABS is the only 100 % government-owned utility in Afghanistan and is in charge of providing electricity, operations and maintenance of the national grid and distribution networks. This includes on-grid, off-grid and mini grid energy power, transmission lines and distribution network. According to the new "Power Services Regulation Act", private companies can invest in the production and distribution of electricity, obtaining the license from MEW. So far – April 2017, eight private companies have obtained the license.

Inter-Ministerial Commission for Energy (ICE)

The government of Afghanistan created the Inter-Ministerial Commission for Energy (ICE) to coordinate the ministries involved in the power sector. The ICE secretariat is currently hosted by the Ministry of Economy. However, the ICE will be moved in 2017 to the Ministry of Energy and Water (MEW) and will change its name and the scope of its activities. ICE has regular meetings and related documents' are available online.[3]

Afghanistan Renewable Energy Union (AREU)

The Afghanistan Renewable Energy Union was established in 2013 with the vision of empowering and promoting renewable energy businesses in Afghanistan. AREU is a non-political organization with its own independent financial sources and legal rights based on the laws of the Islamic Republic of Afghanistan. AREU works in cooperation with the Afghanistan Chamber of Commerce and Industry (ACCI).

Provincial Energy Committee (PEC)

PEC coordinates the provincial governments in the power sector in 5 Northern provinces (Balkh, Kunduz, Takhar, Badakhshan and Samangan) and Herat in the Western part of Afghanistan. The committee, which is supported by GIZ-IDEA, incorporates all key local government departments, universities and representatives of the private sector. Its objective is to identify and analyze the energy needs of the provinces and communicate these to the central government and MEW. PEC plans to extend its activities to more provinces which will be defined in the coming months. AREU takes part in the monthly PEC meetings and makes suggestions for the development of renewable energy projects at local level.

2 More information about ASERD in chapter 3.1.3

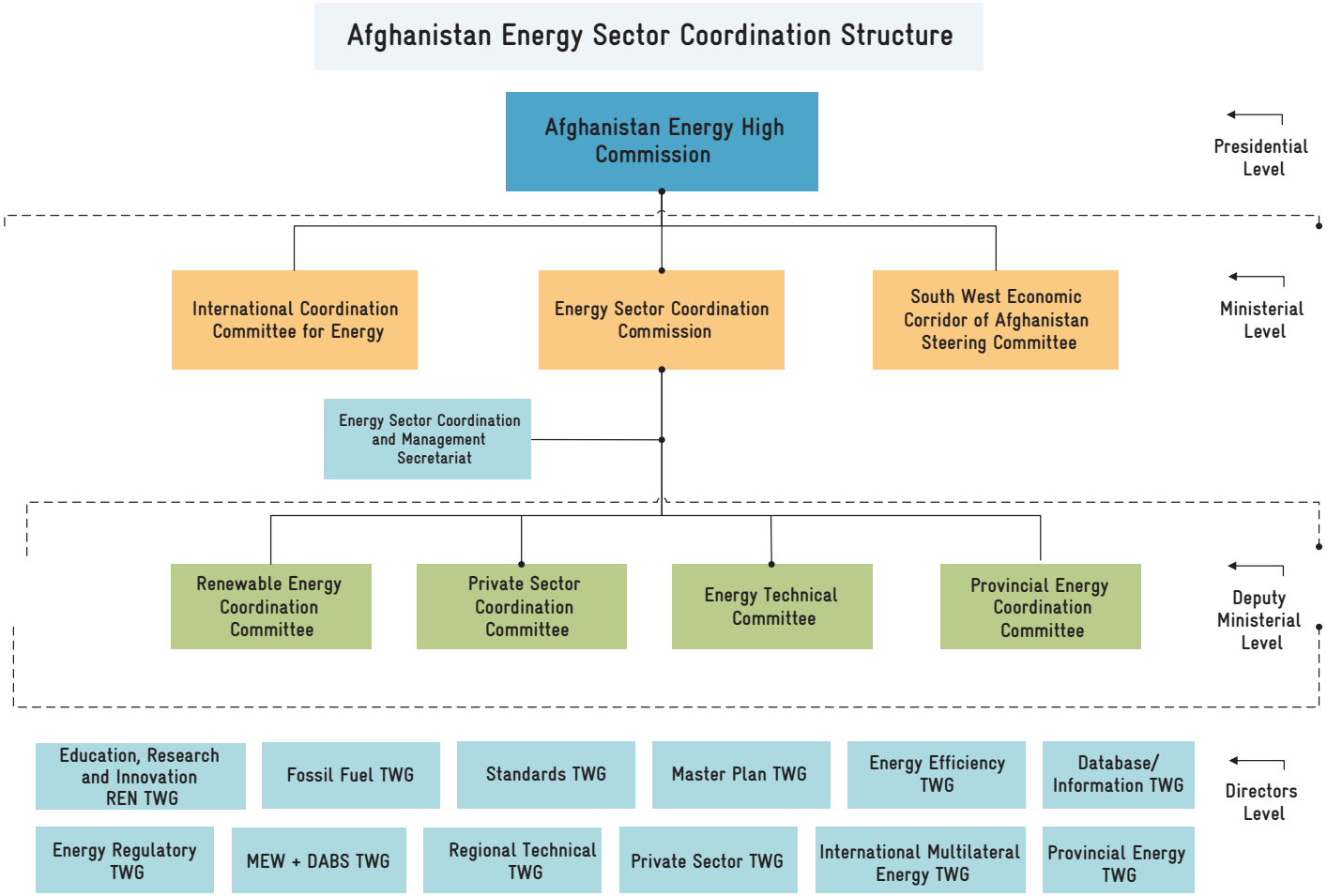
3 Documents available at: https://sites.google.com/site/iceafghanistan/

Afghan National Standard Authority (ANSA)

Since 2007 the Afghan National Standard Authority has been an independent government entity in charge of issuing all norms and standards. ANSA works in Technical Committees (TC) with stakeholders from the energy sector to develop codes and standards for renewable energy in Afghanistan.

Based on the current agreement between MEW and DABS, all energy projects implemented by MEW are handed to DABS for their operations and maintenance (O&M). This includes on-grid, off-grid and mini grid energy power, transmission lines, and distribution network projects. On the other hand, the O&M of the MRRD projects is the responsibility of the local communities where the projects are located. Currently, the Ministry of Energy and Water is working on a new structure to coordinate Afghanistan's energy sector and its stakeholders[4]. This is shown in the figure below.

Figure 1: New Energy Sector Coordination Structure of Afghanistan[5]



4 According to MEW, the new structure will be published in 2017.

5 Afghanistan Energy Sector Coordination Structure.

In this new structure, the following four levels are proposed:

- **The Afghanistan Energy High Commission** will define the strategies and priorities of the national energy sector and ensure coordination between the relevant ministries and international development partners. The key members of the high council are the Ministry of Energy and Water (MEW), the Ministry of Finance (MoF), the Ministry of Education (MoE), the Ministry of Rural Rehabilitation and Development (MRRD), the Ministry of Mines and Petroleum (MMP), the Afghanistan Independent Land Authority (ARAZI) and the utility DABS. The council will be chaired by the President or Vice-President of Afghanistan.
- At the second level is the **Energy Sector Coordination Commission**, which will coordinate and supervise the development and implementation of energy programs, adapt sustainable energy policies and ensure high level coordination among relevant stakeholders in the energy sector. The members of this commission are MEW, the Ministry of Foreign Affairs (MoFA), MRRD, MoE, MMP and the CEO of DABS as permanent members, as well as the Deputy Ministers of MoFA, the Ministry of Communications and Information (MCI), the Communication and Information Technology Center (CIT), ARAZI and donors as representative members.
  - The function of the **South West Energy Corridor of Afghanistan (SECA)** committee is to coordinate the Turkmenistan-Afghanistan-Pakistan-Pipeline (TAP), the Turkmenistan–Afghanistan–Pakistan–India Pipeline (TAPI), the North to South Railway project and the Western Optical Fiber Connectivity Project. The steering committee of SECA is responsible for reviewing to review the work of the technical working groups and making decisions based on the analysis and recommendations provided by the Technical Working Groups (TWG).
  - The **International Coordination Committee for Energy** is in charge of the coordination of all those activities in the energy sector where the international community is involved.
- The stakeholders of the **committees** in the third coordination level are the Deputy Ministers of the MEW (Chairman), MRRD, MMP, MoE, the Afghan National Standard Authority (ANSA), AREU and international organizations. Activities at this level are divided into four committees to coordinate the renewable energy and private sector as well as the topics related to fossil fuels and provincial issues.
- The **Technical working Groups (TWG)** organize forums for the Energy High Council Committees. The TWGs research and discuss technicalities in the energy sector, develop consistent guidelines, manuals on energy, as well as drafts on strategy and policy implementation. The members of the working groups are directors of the relevant energy stakeholders mentioned above.

2.2 International Organizations[6]

The international organizations, financial institutions and donors supporting Afghanistan's energy sector are listed below:

Asian Development Bank (ADB):

The ADB is supporting the Afghan government, financially and technically, in the energy sector, working and supporting the Ministry of Energy, DABS and the Inter-Ministerial Commission for Energy.

Institutional Development for Energy in Afghanistan (IDEA):

IDEA works with the MEW to support and strengthen the implementation of policies and strategies in the energy sector (Component A), to foster and develop the inter-institutional cooperation mechanisms at both national and provincial level (Component B), to amplify the knowledge about renewable energies and energy efficiency and contribute to vocational training for operation and management of power schemes (Component C) and to enable private investment into the Afghan energy sector (Component D). The IDEA programme is the successor of the ESRA programme "Energy Supply for Rural Areas" of the GIZ. ESRA contributed to the development of small renewable energy power schemes that provide electricity to 100,000 people in rural areas of Northern Afghanistan.

United Nations Environment Programme (UNEP):

Since 2002 UNEP has been involved in the sustainable development of Afghanistan. Currently, UNEP focusses on building environmental resilience and sustainability in the country. For this, the programme trains and mentors government counterparts, implements pilot projects and provides technical assistance in the fields of environmental coordination, environmental law and policy and environmental education and awareness, among others. Because energy and environmental issues are closely related, UNEP has been one of the key players in the energy sector in Afghanistan.

The UNEP environment program focuses on risk reduction, preparedness and response, as well as on recovery.

United Nations Development Programme (UNDP):

One of the main UNDP programs is the Afghanistan Sustainable Energy for Rural Development (ASERD), which is implemented through the Ministry of Rural Rehabilitation and Development (MRRD). The main objective of the program is to bring electrification to rural areas through renewable energy technologies including solar, wind and micro hydropower systems.

6 The contact information of the stakeholder is provided in Annex 9.2.

United States Agency for International Development (USAID):

The United States Agency for International Development (USAID) supports Afghanistan's energy sector technically and financially. The first private project of 10MW PV is currently under construction in the Kandahar province with (partial) funding from USAID.

World Bank:

Its main objective is to reduce poverty and accelerate growth. It supports the Afghanistan Government in the energy sector. Examples of projects funded by the World Bank are the Afghanistan Power System Development Project (APSDP), the Naghlu Hydropower Rehabilitation Project (NHRP) and CASA 1000 HVDC transmission line.

3 Power and PV Sector in Afghanistan

3.1 Power Sector Status

Currently, Afghanistan has a total generation capacity of 1.5 GW 60% of its electricity is imported energy from neighboring countries, incl. Uzbekistan, Tajikistan, Turkmenistan and Iran. Local production includes 44 percent of hydropower power plants, 41 percent of thermal power plants and 15 percent of diesel generators.

Nevertheless, the 50 MW of off-grid renewable projects, incl. approx. 37MW of micro hydro power plants and approx. 13 MW of solar are not included in the installed capacity[7] (according to the MEW, Afghanistan has currently 1.8 MW of solar, however, this data hasn´t been updated).

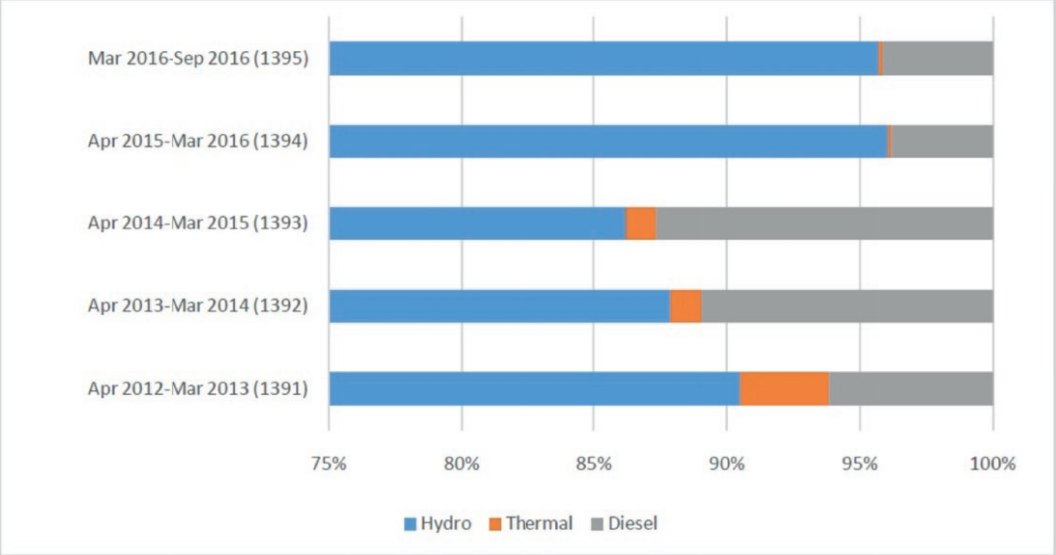
	Installed (MW)	Operational (MW)
Domestic Generation		
Capacity of Hydropower Plants (HPP)	263.4	220.0
Capacity of Diesel Generators (DG)	93.3	79.6
Capacity of Thermal Power Plants (TPP)	247.9	205.0
Subtotal Domestic (HPP, DG, TPP)	**604.6**	**504.6**
Imports		
Uzbekistan	**320.0**	**320.0**
Tajikistan	**350.0**	**350.0**
Turkmenistan	**50.0**	**40.0**
Iran	**180.0**	**140.0**
Subtotal Imports	**900.0**	**850.0**
Total (Domestic + Imports)	**1,504.6**	**1,354.6**

7 ICE; Quarterly Energy Sector Status Summary Report, Q-3 2016.

According to the Inter-Ministerial Commission for Energy (ICE) report, the electricity consumption registered by DABS in the year 1394[8] (2015) was 4,847 MWh. The electricity consumption per capita for the 27.1 million people was approx.178 KWh in the same year[9].

According to ICE, electricity generation in 2016 was approx. 96 % hydro, 3.5 % diesel and 0.5 % thermal[10]. This is shown in the following figure.

Figure 2: Electricity generation by source[11]



3.1.1 Electrification Rate

According to the Ministry of Energy and Water, in 2016, up to 30% of the total population of Afghanistan had access to electricity. However, there are differences in the access to electricity between people living in rural and those in urban areas. The country overview published by the World Bank states that, although about 77% of the Afghan population live in rural areas, only 11% of these have access to grid-connected power. On the other hand, more than 90% of the population living in large urban areas (23% of the total population), including cities like Kabul, Kandahar, Herat, and Mazar-e-Sharif, have access to grid electricity[12].

8 The Afghanistan Solar Calendar is from 21st March until 20th March of the following year.

9 ICE; Quarterly Energy Sector Status Summary Report, Q-3 2016.

10 The reason why power generation from thermal sources is low, despite its high installed capacity, is because of the high fuel price in comparison to the cost of the locally produced (from hydro sources) and imported electricity. Hence, only in emergency situations thermal power plants are utilized.

11 ICE, Quarterly energy sector status summary report. Q3 2016.

12 The World Bank. "Country overview Afghanistan". Web. 25th April 2017.

3.1.2 Power System and Transmission Lines

Afghanistan's current power system is operated by DABS in islanded areas with the current system is made up of approximately nine non-connected networks. The main systems are: the North East Power System (NEPS), the South East Power System (SEPS) and the West Power System Herat.

One of the current goals of the Afghanistan government is the development of an effective transmission grid, to provide interconnection between the networks and the neighbouring countries. A major focus is to change the country's electricity grid from isolated islands into a national transmission grid to enable the delivery of power generated in Afghanistan, as well as to ensure that imported electricity can be delivered in the country. Currently Afghanistan has 2,261 kms of transmission lines with a further 6,907 kms under planning.

Figure 3: Current Power System and expansion plans[13]

13 Afghan Energy Information-DABS.

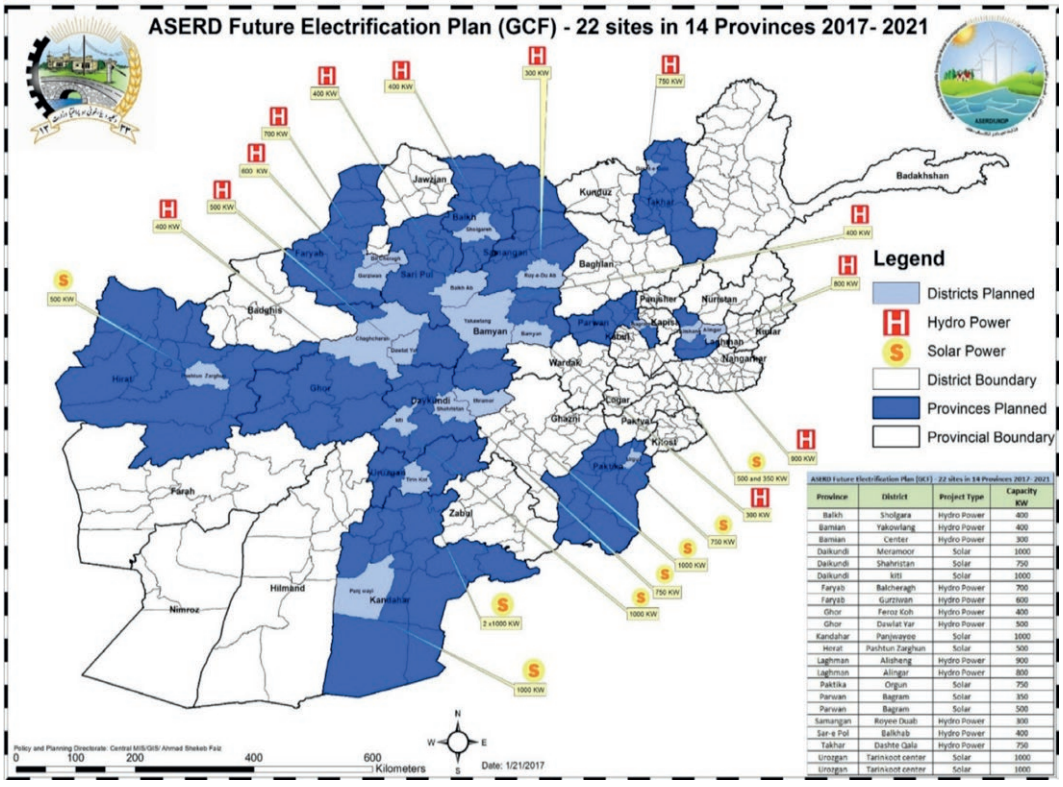
3.1.3 Rural Electrification

Currently Afghanistan has a very low electrification rate in rural areas: according to the World Bank, with fewer than 11% of the rural population having access to grid-connected power although 77% of the Afghan population lives in rural areas[14].

The Afghanistan Sustainable Energy for Rural Development program funded by UNDP with a budget of around US$ 50M, is the only program that works specifically on supplying of sustainable energy in rural areas. The UNDP program aims at providing sustainable energy services for around 200 communities. ASERD considers the use of renewable energy sources not only for electricity, but also for heating. The first phase of the program is from 2017 until 2021.

According to ASERD´s electrification plan, the program aims to implement 22 projects in 14 provinces in Afghanistan, including 10 solar and 12 hydropower projects by 2021. The solar projects with a total capacity of 7,850 kW include: 5 sites with 1,000 kW, 2 sites with 750 kW, 2 sites with 500 kW and one site with 350 kW of installed capacity. ASERD will finance 60% of these projects and 40% will come from investors and consumers. The location of these projects can be seen in the following figure.

Figure 4: ASERD Future Electrification Plan 2017 – 2021[15]



14 The World Bank. "Country overview Afghanistan". Web. 25th April 2017.

15 Afghanistan Sustainable Energy for Rural Development.

The following table summarizes the ASERD electrification plan between 2017- 2021:

No	Province	District	Project type	Capacity (KW)
1	Balkh	Sholgara	Hydro Power	400
2	Bamyan	Yakawlang	Hydro Power	400
3	Bamyan	Center	Hydro Power	300
4	Daikundi	Meramoor	Solar	1,000
5	Daikundi	Shahristan	Solar	750
6	Daikundi	Kiti	Solar	1,000
7	Faryab	Balcheragh	Hydro Power	700
8	Faryab	Gurziwan	Hydro Power	600
9	Ghor	Feroz Koh	Hydro Power	400
10	Ghor	Dawlat Yar	Hydro Power	500
11	Kandahar	Panjwayee	Solar	1,000
12	Herat	Pashtun Zarghun	Solar	500
13	Laghman	Alisgheng	Hydro Power	900
14	Laghman	Alingar	Hydro Power	800
15	Paktika	Orgun	Solar	750
16	Parwan	Bagram	Solar	350
17	Parwan	Bagram	Solar	500
18	Samangan	Royee Duab	Hydro Power	300
19	Sar e Pul	Balkhab	Hydro Power	400
20	Takhar	Dashte Qala	Hydro Power	750
21	Urozgan	Trinkoot Center	Solar	1,000
22	Urozgan	Trinkoot Center	Solar	1,000

3.1.4 Electricity Consumption per Sector

According to the ICE's latest quarterly energy sector status summary, the sector with the highest electricity consumption in the solar year (SY) 1394 (from 21st March 2015 until 21st March 2016) is the household sector with 92 %. Since there is very little commercial activity in Afghanistan, this sector had only a 7 % share. However, this sector increased 6 % in comparison with the previous year[16].

Additionally, DABS registered an 8 % increase in the number of electricity connections in the SY 1394 in comparison with the previous year. Currently, the 90 % of the connections registered by DABS are from the housing sector.

	SY[17] 1392 (2013)	1393 (2014)	1394 (2015)
Household	1,009,445	1,112,833	1,197,388
Commercial	77,980	82,467	87,694
Government	13,999	15,643	17,011
Total (MWh)	1,101,424	1,210,943	1,302,093

3.1.5 Electricity Prices

Electricity prices differ from province to province. This variation depends on the source of electricity and the province where the electricity is sold. While imported power and domestic hydro power energy are the cheapest sources of energy, the electricity from diesel generators is the most expensive, since its price depends on the oil price fluctuation. DABS has a distribution unit in all of Afghanistan's 34 provinces. However, information about the electricity prices in all the sectors, including the residential, commercial and governmental sectors, etc., is only available in the 16 provinces described in the figure below.

In addition to the plants operated by DABS, there are some small scale independent power producers (IPPs) that operate in different parts of the country. However, none of these small IPPS are registered and there is no information available about their electricity prices.

The figure below shows the old and the current electricity tariff structure of the provinces operated by DABS.

16 ICE, Quarterly energy sector status summary report. Q3 2016.

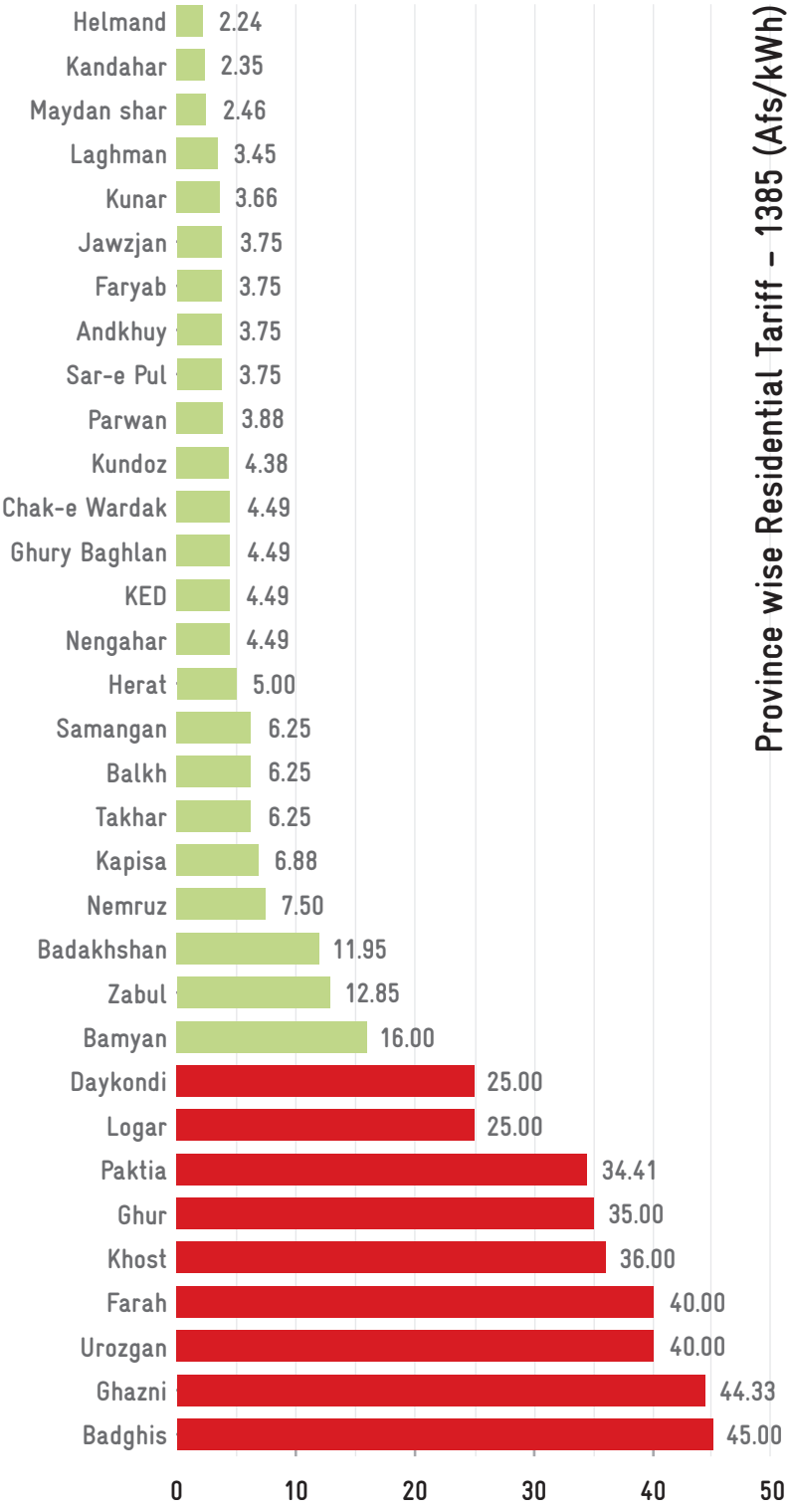
17 The Afghanistan Solar Calendar is from 21st March until 20th March of the following year.

Figure 5: Electricity tariff structure in Afghanistan in Afghani, local currency 1€ equivalent to 82.3 Afghani (August 2017). Comparison between 2015 and 2016

	Category	Schedule	Kabul	Baghlan	Nangarhar	Laghman	Parwan	Kapisa	Samangon	Balkh	Faryab	Andkhoy	Jawzjan	Sarpul	Takhar	Kunduz	Nemroz	Herat
	Category	Schedule	Old Tariff															
Old Tariff	Residential	0-200 Kwh	2.00	2.00	2.00	2.00	1.75	1.75	5.00	5.00	3.00	3.00	3.00	3.00	5.00	3.50	4.50	4.00
		201-400 Kwh	3.00	3.00	3.00	3.00	4.50	4.50	5.00	5.00	3.00	3.00	3.00	3.00	5.00	3.50	5.50	4.00
		401-700 Kwh	5.00	5.00	5.00	5.00	6.50	6.50	5.00	5.00	3.00	3.00	3.00	3.00	5.00	3.50	5.50	4.00
		701-2000 Kwh	7.00	7.00	7.00	7.00	9.00	9.00	5.00	5.00	3.00	3.00	3.00	3.00	5.00	3.50	5.50	4.00
		Above 2000-kwh	8.00	8.00	8.00	8.00	10.00	10.00	5.00	5.00	3.00	3.00	3.00	3.00	5.00	3.50	5.50	4.00
	Worship Places		Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential
	Commerial		10.00	10.00	10.00	10.00	13.00	13.00	13.50	13.50	7.00	7.00	7.00	7.00	13.50	9.00	10.00	10.00
	Government		11.00	11.00	11.00	11.00	13.00	13.00	13.00	13.00	7.00	7.00	7.00	7.00	13.50	9.00	10.00	10.00
	NGO's		10.00	10.00	10.00	10.00	13.00	13.00	13.50	13.50	7.00	7.00	7.00	7.00	13.50	9.00	12.00	10.00
	Registered Industry		6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	Un-registered Industry		10.00	10.00	10.00	10.00	13.00	13.00	13.50	13.50	7.00	7.00	7.00	7.00	13.50	9.00	12.00	10.00
	Category	Schedule	New Tariff for 2016															
New Tariff	Residential	0-200 Kwh	2.50	2.50	2.50	2.50	2.19	2.19	6.25	6.25	3.75	3.75	3.75	3.75	6.25	4.38	5.63	5.00
		201-400 Kwh	3.75	3.75	3.75	3.75	5.63	5.63	6.25	6.25	3.75	3.75	3.75	3.75	6.25	4.38	6.88	5.00
		401-700 Kwh	6.25	6.25	6.25	6.25	8.13	8.13	6.25	6.25	3.75	3.75	3.75	3.75	6.25	4.38	6.88	5.00
		701-2000 Kwh	8.75	8.75	8.75	8.75	11.25	11.25	6.25	6.25	3.75	3.75	3.75	3.75	6.25	4.38	6.88	5.00
		Above 2000-kwh	10.00	10.00	10.00	10.00	12 .50	12.50	6.25	6.25	3.75	3.75	3.75	3.75	6.25	4.38	A	5.00
	Worship Places		Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential	Same as Residential
	Commerial		12.50	12.50	12.50	12.50	16.25	16.25	16.88	16.88	8.75	8.75	8.75	8.75	16.88	11.25	12.50	12.50
	Government		13.75	13.75	13.75	13.75	16.25	16.25	16.88	16.88	8.75	8.75	8.75	8.75	16.88	11.25	12.50	12.50
	NGO's		12.50	12.50	12.50	12.50	16.25	16.25	16.88	16.88	8.75	8.75	8.75	8.75	16.88	11.25	12.50	12.50
	Registered Industry		7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
	Un-registered Industry		12.50	12.50	12.50	12.50	16.25	16.25	16.88	16.88	8.75	8.75	8.75	8.75	16.88	11.25	15.00	12.50

The information of the electricity prices in the residential sector, is available in the 34 provinces of Afghanistan. The following figure describes their ranking by provinces:

Figure 6: Residential tariff in the 34 provinces of Afghanistan[18]



18 ICE, DABS power tariff overview. Analytical report. October 2016.

As seen in the figure, the provinces of Badghiz, Urozgan and Ghazni have the highest tariff in the residential sector, Helmand and Kandahar the lowest. Residential customers and religious places in Kabul, Baghlan, Kapisa, Nangrahar, Parwan and Laghman pay different tariffs depending on their consumption. Industrial, governmental and commercial consumers, as well as NGOs, pay a higher tariff in comparison to the residential consumers, where the electricity is subsidized[19].

To cover its O&M costs, DABS adds around 15 % overhead to the final price of electricity in all the provinces.

Since about 60 % of the electricity in Afghanistan is imported and the payment is in US dollars, the current electricity price of imported energy is 25 % higher than in 2015. This tariff increase occurred in all provinces where the power is imported (incl. Kabul, Mazar, Herat, Kunduz, Baghlan, Parwan, Samangan, Kapisa and Jawzjan). The main reason for this increase has been the inflation of the local currency compared to the dollar.

3.2 Legal Framework for PV Development

At the political level, the renewable energy sector is led by the Renewable Energy Department (RED), which is under the Deputy Minister of Energy and Water (MEW). Since the RED is a newly established department in the structure of MEW, they are still working on creating the legislation and support mechanisms for the development of renewable energy. Several donors have been assisting in drawing up the political framework, including the GIZ, ADB, USAID and the World Bank.

The policy currently regulating Afghanistan's renewable energy sector is listed below:

Power Sector Master Plan (PSMP)

The Power Sector Master Plan was developed with the support of the ADB by the German consulting firm Fichtner GmbH in 2013. The plan is a 20-year demand forecast, where generation and import supply options were analyzed and optimized. Additionally, a transmission network was designed to link supply and demand. The MEW is in charge of its implementation.

Electricity Service Law (formerly: Power Service Regulation Act)

This is the first law for the regulation of power services in Afghanistan. It was issued in 2015 by the President of Afghanistan, Dr. Mohammad Ashraf Ghani. Its main objective is the security of energy supply from local natural resources and imported energy, the improvement of the quality of energy services and the expansion of energy services. The law also establishes the non-discriminatory access to energy. MEW is the implementing agency of this law.

19 Residential users that get their electricity from hydro power plants and with a consumption not higher than 200 kWh every two months (regular billing period of DABS) get a reduced price (subsidy).

National Energy Policy (NEP)

The National Energy Policy is currently being developed by MEW and is in a draft stage. This document will define the rules relating to the efficiency of energy resources and systems and to transparency and financial stability in the energy sector. It will also define the objectives of energy security, renewable energy utilization, rural electrification, industry and agriculture sector development, pricing, funding of projects, incentives, regional cooperation and gender equality. The plan will define the monitoring and evaluation mechanisms.

Five-year Energy Self Sufficiency plan

The five-year plan defines the activities for the development of the energy sector for the years 2016-2020. The main pillars of the plan implemented by the MEW, are energy supply, security and equity, economic, institutional and educational development, and international trade and cooperation.

According to the plan, 2,165 MW will be added to Afghanistan's installed capacity by 2020. According to RED, this includes 100 MW from a gas power plant, 1,565 MW from hydro and 500 MW from renewable energy.

Renewable Energy Policy (RENP)[20]

The MEW is in charge of developing and implementing the RENP. Its goal is to set a framework for the development of renewable energy in the country, including the rural sector. The RENP sets a target for deploying 4500 – 5000 MW of renewable energy capacity by 2032 (according to the Renewable Energy Roadmap 2032, around 1500MW will be for solar[21]). This will constitute 95 % of the total energy needed by 2032. The scope of the policy covers all renewable energy resources and technologies that can be deployed in a techno-economically and environmentally sustainable manner in Afghanistan. The policy will be implemented in two terms – TERM 1 (2015 – 2020) will create and support an atmosphere and activities for the development and growth of the renewable energy sector particularly in the Public Private Partnership (PPP) mode, and TERM 2 (2021-2032) will deploy renewable energy in full commercialization mode.

Renewable Energy Roadmap (RER2032)

The RER2032 specifies the enablers and actions needed to reach the renewable energy target of 5,000 MW by 2032, defined by the Renewable Energy Policy (RENP). Currently only the final draft version of this study is available[22].

20 The RENP is based on the Afghanistan National Development Strategy (ANDS) implemented by the government, which operated from 2007 to 2013 with the goal of improving several sectors, incl. energy, education, health, etc.

21 See chapter 3.4.

22 The final version will be launched within the next months.

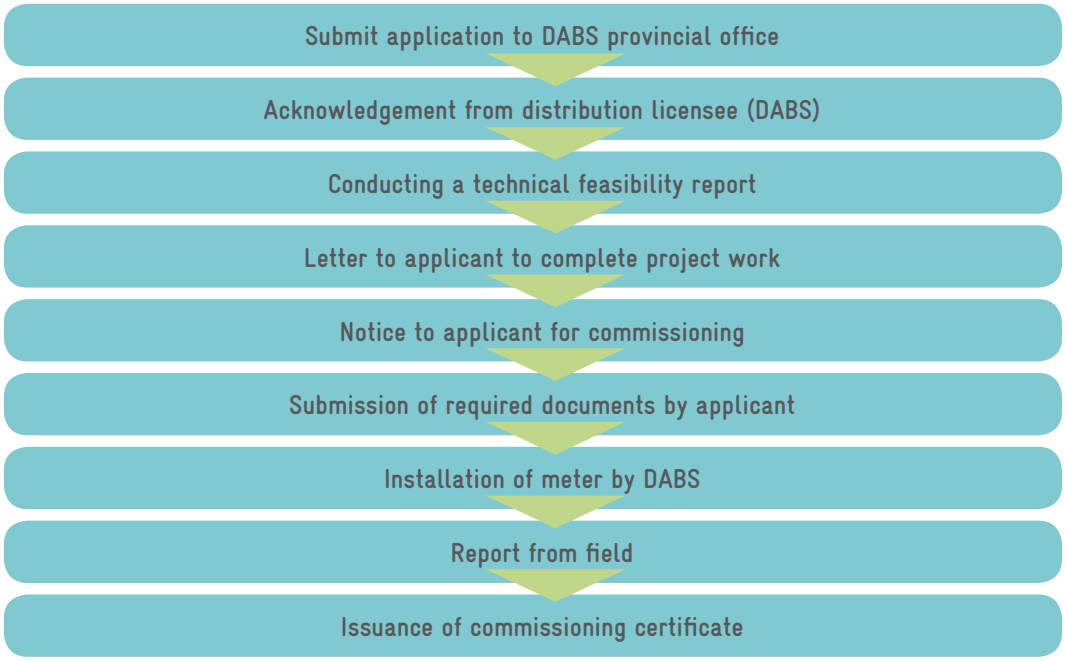
The following three stages, incl. different financing frameworks, are envisioned for this renewable energy roadmap:

1. Market Seeding: This framework is proposed to analyse and evaluate the availability of the natural resources when the market is at the beginning stage. The sources of financing are the grants provided by the government, incl. direct and public grants and the Resource Risk Guarantee. Developing pilot projects to increase the awareness of renewable energy is a common measure at this stage.
2. Market Creation: This stage is entered when the availability of the natural resources and the technical viability have been confirmed, also through pilot projects. This financing framework focuses on continued O&M, cost recovery and covering political and security risks. Subsidies and grants for capital investment, ongoing operation, and tax exemptions are examples of envisioned financial support frameworks. The facilitation of support from international climate fund agencies for investors is also included.
3. Market Expansion: The financing framework at this stage will be focussed on the reduction of the cost of deploying renewable energy in the commercial market. Standardized Feed in Tariffs (FiTs), concessional finance funds, different types of insurances and carbon credits are examples of this kind of support mechanism.

Regulation for Net-metering

The MEW is currently working on the regulations for net-metering. These regulations will describe license and application procedures, as well as the requirements regarding standards, safety and energy accounting of the net metering scheme for Afghanistan. The following figure describes the process for obtaining a license in the net metering model for power selling, which is currently being discussed by the MEW.

Figure 7: Draft of the net-metering process[23]



23 Regulations for Net Metering, Draft March 2017.

The MEW is also working on the development of specific policies and strategies for the development of renewable energy. Some of these documents are listed below:

1. Regulation for grant of license: this regulation will specify the procedures, requirements, terms and conditions for obtaining a generation and distribution license.
2. Tariff Determination: this document will provide standard and specific guidelines on how to determine and modify tariffs in the country.
3. Tariff Policy: the tariff policy will be used to launch subsidy and financial support mechanisms and guidelines.
4. Afghanistan Energy Security Plan's Outline: this plan will ensure energy security.
5. Afghanistan Energy Efficiency Policy: this policy will set targets and guidelines on measures to ensure the efficient use of energy resources.

3.2.1 Support Mechanisms

Currently, there is no approved support mechanism for PV development in Afghanistan. The renewable energy projects developed so far have been financed by international donors. Nevertheless, the government of Afghanistan is currently working on the development of the following support mechanisms:

1. **Feed-in Tariff (FiT):**

   This mechanism is used to encourage owners or investors to invest in PV. The MEW is currently working on the design of a FiT policy for Afghanistan.

2. **Net-metering:**

   According to the most recent draft version of the net-metering policy[24], this could apply to both off-grid and on-grid projects. The capacity of a rooftop PV system to be installed on the premises of a consumer under the net metering regulations should not be less than 500 W nor exceed 1 MW. The maximal capacity to be installed can be up to 100 % of the consumer's connected load.

   The scope of application of the net-metering model is the following: For net-metering arrangements where the focus is primarily on self-consumption. The excess/surplus is either sold to or banked with the local utility.

   According to the draft of the net-metering policy, electricity not consumed will be remunerated with 75 % of the FiT of that financial year. The voltage levels at which the rooftop PV system shall be connected to the grid are as follows:

   - Up to 5 KW – 220 V – Single Phase
   - Upto 100 KW – 400 V – Three Phase
   - Beyond 100 KW – HV Level

24 The last draft version of the net-metering policy is from April 2017.

Additionally, the following charges apply to the connectivity of the following rooftop PV systems:

System Size	Application Fee per connection
1 KW to 10 KW	AFN[25] 200 per KW with minimum of AFN 500
10 KW to 100 KW	AFN 150 per KW with minimum of AFN 2000 and maximum of AFN 100,000
Greater than 100 KW	AFN 100,000

3. Power Purchase Agreement (PPA):

PPAs provide a fixed long-term revenue stream to finance project development, installation and operations of PV systems. This support will be used in the Solar Power Park (SPP), Distribution Franchisee (DF) and the Renewable Energy Service Company (RESCO) models[26].

The PPA contract duration for SPPs will be 20-25 years. At the end of the contract, the plant is either transferred to the government, or a new PPA is signed for the further operation of the plant. The duration of the contract for the DF and RESCO models has not yet been specified.

The PPA will be signed between DABS and the investor. Provision of land, extension of transmission line to the plant, paid by DABS, is part of the PPA. Additionally, the tariff for the PPA will be negotiated.

Until now, DABS has signed 4 PPAs with different investors:

I. The Kandahar PV project with 10 MW, has been signed for a period of 15 years;

II. The 100MW hydro project of Kajaki has been signed for a period of 20 years with a tariff of 5.9 US cents;

III. The 600 MW gas project Bayat, with a 5 year contract (extendable for another 10 years) for 8 US cents;

IV. The Ghazanfar project, with a 50 MW gas power plant signed a PPA contract.

In all the PPAs the tariff has been fixed and paid to the seller.

Other instruments currently being discussed by the MEW include the market premium, tax based incentives, grant, loans, rebates and production incentives. The MEW is also discussing the mandatory requirement for selling green power.

25 AFN= Afghani (local currency): 1 € = ~ 82.3 Afghani (August 2017).

26 See description of the business models in chapter 3.2.2.

3.2.2 Business Models

The final draft of the Afghanistan Renewable Energy Roadmap 2032 discusses some models to develop PV projects in Afghanistan. These models are described briefly below.

1. Distribution Franchisee

A Distribution Franchisee (DF) is an entity authorised by the distribution utility (DABS) to distribute electricity on its behalf in a particular area within the utility's area of supply. The distribution franchisee invests in improvements in the existing distribution network to lower technical and commercial losses, improve power quality and enhance overall service delivery. The market segments of this model are clusters of consumers such as industrial parks and municipalities, with DABS as generator and an independent qualified entity, e.g. the DF.

2. Renewable Energy Service Company (RESCO)

The RESCO is an entity which provides energy services to consumers in a particular area by setting up a mini-utility, usually in an off-grid location and combines both generation and distribution functions. This business model is built on enhancing community level incomes through reliable and affordable energy access. These incomes pay for energy consumed, sustaining the micro-utility function. The market segment of this model includes off-grid areas which the national utility (DABS) has difficulties reaching. The segments that could take advantage of this model are agriculture (irrigation), farm-based enterprises (cold storage and drying) as well as services such as telecom, market centres and hospitals.

3. Roof-top Solar PV through Net-metering

The government is currently discussing two models of solar PV for roof-top systems. The first is the Capital Expenditure (CAPEX) and the second one Operation Expenditure (OPEX). In the CAPEX model the owner of the roof purchases all the equipment necessary to generate roof-top PV power and sells it to the distributor through net-metering or a FiT. The roof owner benefits from government tax benefits and incentives available.

In the OPEX model the roof owner rents its roof to a third party to generate electricity from the PV system. The third party sells the power to the distributor and is in charge of the O&M of the PV roof-top system and benefits from the tax and incentives available. For the sustainability of the roof-top PV systems, the distribution companies are encouraged/ required to sign a long term net metering agreement with the owner of the roof-top system. If the roof-top systems are connected to the grid, an FiT applies.

4. Solar Power Park (SPP)

In this model several power producers operate within a single Solar Power Park (SPP) through a Power Purchasing Agreement (PPA). The SPP provides project developers with the necessary conditions for power generation and injection into the grid. Solar Parks also facilitate developers by reducing the number of approvals required. The market segment of this model includes grid connected renewable energy projects. The off taker of the electricity is the utility DABS against long-term PPA (between 20 and 25 years).

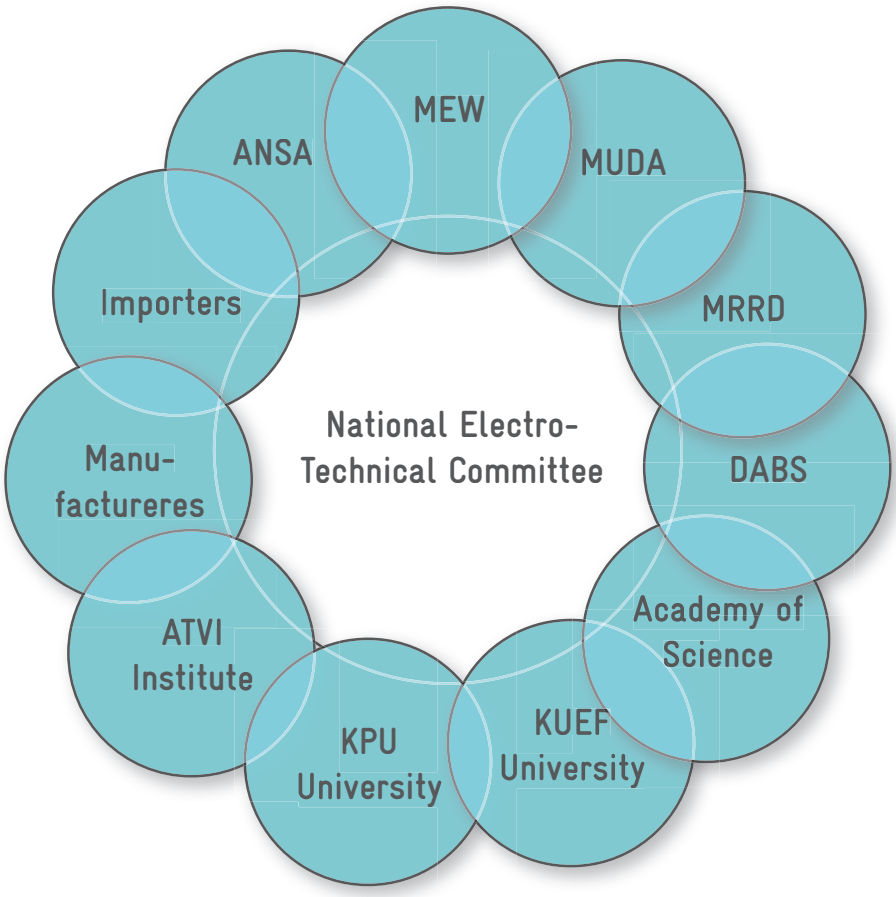
The project Enabling PV analysed the 3 power generation models for the development of PV, these include: the Solar Power Parks (SPP) for large scale, the RESCO model for off-grid areas and the net-metering model for roof-top projects. The framework of these three business models and their profitability were analysed in detail. Their description is included in chapter 4.

3.2.3 Codes and Standards

The Afghan National Standards Authority (ANSA), established in 2004 under the Ministry of Commerce and Industries, is the only agency in the country responsible for of introducing codes and standards in Afghanistan. ANSA has been actively involved in developing and adopting standards and codes for different areas, including the energy sector.

Within ANSA, a group of energy stakeholders work under the "National Electro-Technical Committee" in ANSA. The organizations in this committee are shown in the figure below:

Figure 8: Members of the "National Electro-Technical Committee" for the development of standards in the energy sectors



This committee has adopted around 200 electro technical standards from IEC. The standards packages are listed below:

No	Package	Nr. of Standards
1	Overhead line conductors & live working	16
2	Electrical cables	20
3	Electrical insulators and insulation	19
4	Power transformers	17
5	Electricity metering	4
6	Precast concrete products	1
7	Electrical laboratory safety standards	5
8	Surge arresters	4
9	CFL and LED lamps	4
10	Electrical installation of buildings	3
11	Degree of protection	3
12	Environmental conditions and testing	28
13	Coupling devices	5
14	Circuit breaker / switch gear	2
15	Low voltage fuses	6
16	Renewable energy	43
17	Household electrical appliances/ consumer products	21

ANSA recently approved a list of IEC standards related to renewable energy, including PV. ANSA is still working on the approval of more standards for photovoltaic. The list is shown in the figure below.

Figure 9: List of IEC standards related to renewable energy approved by ANSA

IEC Standard number	Edition	Description
IEC 62257-9-6/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-6: Integrated system – Selection of PV
IEC 62257-9-5/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-5: Integrated system – Selection of portable PV lanterns
IEC 62253	ed1.0	Photovoltaic pumping systems – Design qualification and performance measurements
IEC 62124	ed1.0	Photovoltaic (PV) standalone systems – Design
IEC 62509	ed1.0	Battery charge controllers for photovoltaic systems – Performance and functioning
IEC 61701	ed2.0	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 62257-9-1/TS, 2/TS, 3/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-1, 9-2, 9-3
IEC 62257-4/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 4: System
IEC 62257-6/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 6: Acceptance, operation, maintenance and replacement
IEC 62257-7-1/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 7-1: Generators – Photovoltaic generators
IEC 62257-7/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 7
IEC 62257-8-1/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 8-1: Selection of batteries and battery management systems
IEC 62257-9-4/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-4: Integrated system – user installation
IEC 62257-1/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 1
IEC 62257-2/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 2: From requirements to a range of electrification systems

IEC Standard number	Edition	Description
IEC 62257-3/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 3: Project development and management
IEC 62257-7-3/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 7-3: Generator set – Selection of generator sets
IEC 62257-5/TS	1.0b	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 5: Protection against electrical hazards
61400-2	ed.3.0	Wind turbines – Part 2: Small wind turbines
IEC 61400-24	ed1.0	Wind turbines – Part 24: Lightning protection
IEC 61400-1	ed3.1	Wind turbines – Part 1: Design requirements
IEC 61400-12-2	ed1.0	Wind turbines – Part 12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
IEC 61400-11	ed3.0	Wind turbines – Part 11: Acoustic noise measurement
IEC 62446	Ed1.0	Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning
Hybrid turbine and auxiliaries		
IEC 60308	2.0b	Hydraulic Turbine – Testing of control systems
IEC 60545	ed1.0	Guide for commissioning, operation and maintenance of hydraulic turbines
IEC/TR 61366-2	ed1.0	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 2: Guidelines for technical specifications for Francis turbines
IEC/TR 61366-3	ed1.0	Hydraulic turbines, storage pumps and pump-turbines – Tendering documents – Part 3: Guidelines for technical specifications for Pelton turbines
IEC/TR 61366-4	ed1.0	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 4: Guidelines for technical specifications for Kaplan and propeller turbines
IEC 61116	ed1.0	Electromechanical equipment guide for small hydroelectric installations
IEC 60994	ed1.0	Corrigendum 1 – Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)
IEC 61400-11	Ed3.0	Wind turbines – Part 11: Acoustic noise measurement
IEC 61400-12-2	ed1.0	Electricity producing wind turbines based on nacelle anemometry

3.3 Solar Market Today

According to the MEW, the total capacity of the renewable energy installed in Afghanistan is 55 MW, of which 52.9 MW is hydro and 1.8 MW solar. The projects have been financed by international donors, including USAID, KFW, GIZ, ADB World Bank, Japan, New Zealand and India. According to the Quarterly Energy Sector Status Summary Report Q-3 2016, Afghanistan has 50 MW off-grid renewable projects installed; incl. 37MW of micro hydro power plants and 13 MW of solar[27].

The solar projects implemented include small PV systems for electricity, street lighting, water pumping, solar water heater and solar cookers at small scale.

Some of the large scale PV projects developed so far in Afghanistan are described below[28].

- The first PV off-grid system was commissioned in the Syed Karam district of the Gardez Province in 2010. The project included a 100-kW solar PV and inverter system, with a 250 kW diesel generator backup unit. The project was funded by the American Army Force (Gardez Provincial Reconstruction Team). The project with 20 kV transmission lines supplies electricity to 600 households for lighting and electronic equipment.
- The Chal 244 kW solar PV off-grid project was implemented in the villages Yakatoot and Khanaqa in Chal district of Takhar province in 2013. The project was funded by the GIZ on behalf of the German Ministry for Economic Cooperation and Development (BMZ). There are 923 beneficiaries of the project, including households, shops, schools and mosques.
- The Bamyan 1 MW PV project completed in 2014 is the largest off grid PV/battery/diesel hybrid project installed. The plant supplies 2,500 households, businesses markets and government offices in the Bamyan city with electricity. The project includes around 100 kms of 20 kV transmission line with 0.4 kV distribution system with pre-paid metering system, the plan is operated by DABS. The project was funded by the New Zealand government.

According to the Renewable Energy Department (RED), the following projects are currently, as of April 2017, under construction.

- 10 MW on grid solar PV in Kandahar. The project, partially funded by USAID, was awarded recently to an Indian-Afghan joint venture.
- 2 MW Solar PV + wind hybrid (1.7MW Solar + 300 kW Wind) project in Herat, which is funded by the UNOP (United Nation Operations Program in Afghanistan). The project was recently awarded to a joint venture of Lebanon-Afghan companies.
- The development of a 35 MW solar PV plant for an industrial park and residential area in the Nangarhar province is currently being analysed. The project would be founded by the ADB.
- The feasibility study of a 100 MW PV – Hydro hybrid project in Naghlu is currently under development.
- 12 MW solar PV project in Farah is currently in the bidding process.
- The feasibility study of a 15 MWp rooftop project in Kabul is currently under development.

27 ICE; Quarterly Energy Sector Status Summary Report, Q-3 2016.

28 ICE, Renewable Energy /Solar Energy. Web. 20th March 2017.

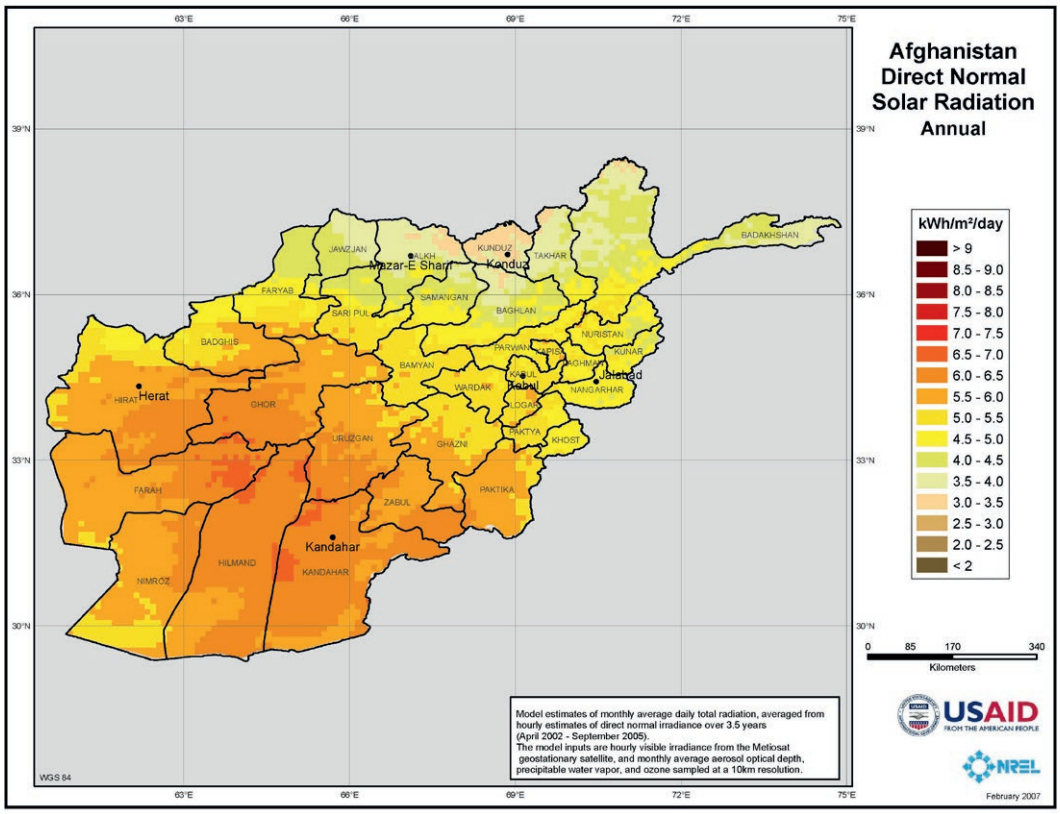
- 30 MW of the 2nd Kandahar PV project: until now, two companies have applied for 15 MW of this tender with one company applying for 5 MW and the other for 10 MW. Currently DABS is negotiating the tariffs of these two projects with the companies.
- The 400 kW off-grid solar PV plant in Bamiyan was commissioned in September 2016.
- 2 MW Solar-Wind Hybrid project was recently awarded. This project will be implemented in the Herat Province.
- The tender of a 35 MW solar power plant in the Nangarhar province is currently being prepared.
- The feasibility study of a 100 MW hybrid project (solar-hydro) is currently under development. The project will be implemented next to the existing Naghlu hydropower facility, which has a 100 MW transmission line to Kabul.
- The feasibility study of a 10 MW hybrid project (solar and wind) is currently under development.
- The development of a 10 MW Solar PV plant with DG Backup for Hisar-e-Shahi Industrial Park, in the Nangarhar province, is currently being analyzed.
- 10 MW Kandahar solar project (partially funded by USAID) has been recently awarded to an Indian-Afghan joint venture. This project will provide 10 MW of solar energy to the Kandahar province.

3.4 Market Potential of Solar PV

Afghanistan has excellent climatic conditions for the development of PV. The country has high irradiation, ranging from 4.5 - 7 kWh/m²/day and approx. 300 days of sun annually[29]. According to the solar irradiation map below, the provinces with the highest potential and with a solar radiation of > 6 kWh/m²/day are Badghis, Bamian, Daikondi, Farah, Ghazni, Ghor, Herat, Hilmand, Kandahar, Nimruz, Paktika, Sar-I Pol, Uruzgan, Wardak and Zabul.

29 MEW. Renewable Energy Policy, 2015.

Figure 10: Afghanistan solar radiation map[30]



According to the MEW, the estimated renewable energy potential is 300 GW, including 222 GW of solar energy[31].

30 NREL.

31 MEW. Renewable Energy Policy, 2015.

The governmental Renewable Energy Roadmap[32] proposes the following distribution per technology to meet the projected 5 GW of renewable energy by 2032.

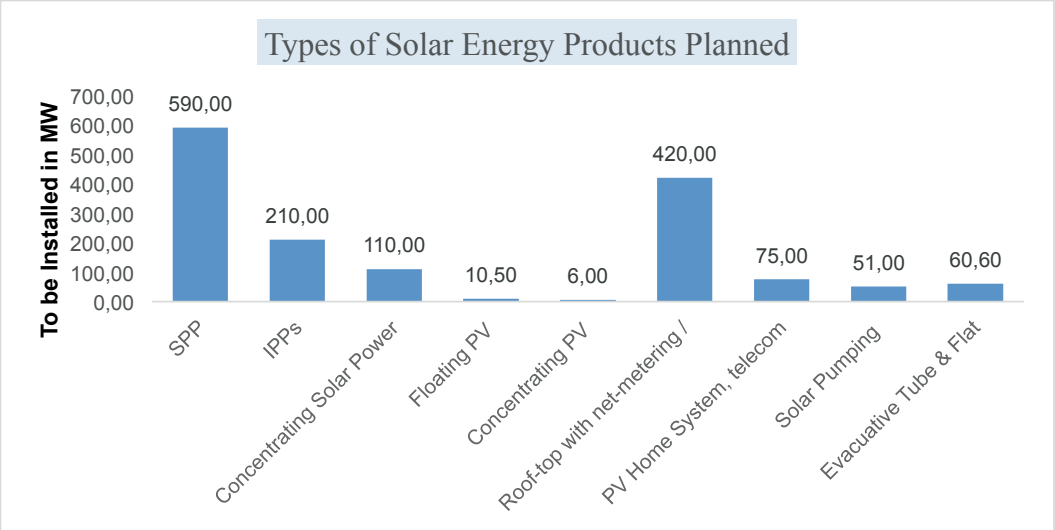
Market	Technology	Type	Target Capacity (MW)
Utility scale	Solar	Solar Power Parks(SPP)	590
	Solar	Solar IPPs	210
	Solar	Concentrating Solar Power	110
	Solar	Floating PV	10.5
	Solar	Concentrating PV	6
	Wind	Wind IPPs	600
	Large hydro	Large Hydro	2,000
	Biomass	Power generation from agri-residues	30
	Biogas	Organic & agri-waste	2
	Waste to energy	Municipal solid waste	56
	Geothermal	Heat pump applications & geothermal energy	55
Mini-grid	Hybrid	Diesel + wind/ solar / mini hydro	300
	MHP & SHP	MHP + SHP	420
Stand alone	Solar	Roof-top with net-metering / FiT	420
	Solar	PV home systems, telecom towers & others	75
	Solar	Solar pumping	51
	Solar	Evacuative tube & flat plate - thermal energy	60.6
	Biogas	Thermal energy	4.1
	Cook stoves	Thermal energy	2.60
		Total	5,002.80

32 The RER2032 is currently under development and only the draft version is available.

According to this breakdown, the renewable energy market is categorized in 3 levels; utility scale, mini grids and standalone system. This includes 3.7 GW on-grid projects and approx. 1.3 GW off-grid projects.

The solar share according to this governmental breakdown is described in the figure below.

Figure 11: Projected solar energy share in Afghanistan by 2032

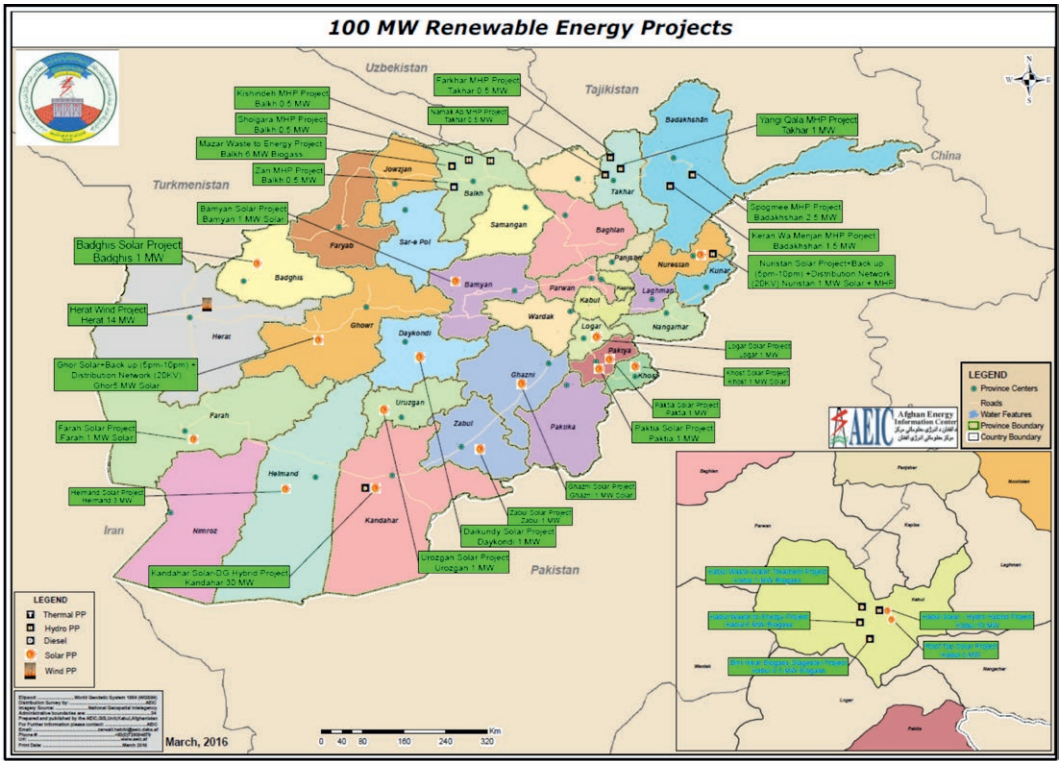


According to this figure, the solar share includes SPP, IPPs, concentrating solar power, floating PV and roof-top PV with a total of 1.5 GW. This includes approx. 900 MW of PV on-grid and 600 MW of off-grid.

The MEW recently announced the tender of 100 MW of renewable energy. The projects will have a PPA for a period of 15 years with a tariff of 16 dollar cents. The share of PV would be 65 MW and should be installed in 15 provinces in Afghanistan.

The map below shows the location and types of the 100 MW RE projects in Afghanistan.

Figure 12: Map with the location and capacity of the 100 MW tender[33]



3.4.1 Solar Potential Estimated by AREU

According to the Afghanistan Renewable Energy Union, rooftop on-grid and off-grid PV systems could be two of the most feasible options to develop PV in Afghanistan, given the country's current situation. Most of the people live in low-rise buildings and the rooftop area available for each building is significant. Most houses are built on 300-350 m² of land. The building footprint is between 100 - 50 m² and the rest is left as the green area/yard for the building. According to AREU, the area available for PV would be around 40 m² per building.

33 Afghanistan Energy Information Center.

The table below shows the population density in the 5 major cities and the total area available for PV in each city:

Province	Kabul	Kandahar	Herat	Mazar-e Sharif	Jalalabad	Afghanistan
Population (Total)	4,523,718	1,252,786	1,928,327	1,353,626	1,545,448	27,657,145
Population (urban)	3,839,580	448,262	561,759	505,070	237,792	6,919,560
Population (rural)	684,138	804,524	1,366,568	848,556	1,307,656	20,737,585
% of Urban Population	85%	36%	29%	37%	15%	25%
% Rural Population	15%	64%	71%	63%	85%	75%
average no. of people per house	10	10	10	10	10	10
Number of houses	452,372	125,279	192,833	135,363	154,545	2,765,715
Average House roof area for PV (m²)	40	40	40	40	40	40
Total available rooftop area for PV (m²)	18,094,872	5,011,144	7,713,308	5,414,504	6,181,792	110,628,580

According to the table, of the 5 cities Kabul has the highest potential for off-grid/on-grid rooftop PV systems, with 18 million square meters available for PV. The main reason is because 85 % of its population live in the urban area. Based on the population statistics, AREU estimates that Afghanistan has more than 110 million of square meters available to install PV systems.

On the other hand, Afghanistan' per capita electricity consumption is one of the lowest in the world, at 178 KWh. One of the reasons for this is the relatively small number of consumers connected to the grid. Hence, on-grid and off-grid rooftop´ options for large cities, where the availability of energy is a challenge, are suitable solutions for urban areas to start with.

According to AREU, the goal of installing 1.5 GW PV by 2032 is not very ambitious, since by 2020 Afghanistan will have increased its per capita consumption by at least a factor of 3. The electrification rate is also expected to increase to 20 % by 2020, which widens the demand for power capacity even more.

According to the table below, the necessary capacity growth by 2020 is approx. 5 GW; by 2032, the additional required capacity will amount to 9 GW. Due to its efficiency and distributed nature, PV can contribute a significant share of this growth. Looking at the growth of global power capacity, PV had a share of 18% in 2014 (40 GW of 220 GW), 20% in 2015 (51 GW of 251 GW) and finally 31% in 2016 (75 GW of 239 GW) [34]. Even if the Afghan PV deployment contributes only 20% of the future

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capacity growth till 2020, the total share can be 15% (972 MW of 6480 MW). By 2032, the global PV share of power capacity expansion will probably be far beyond 35%, in which case a PV share of 30% seems a realistic objective. Taking this into account, the Afghan PV growth scenario for 2032 described by AREU results in 3.3 GW.

The figures are presented in the following table:

PV Installed Capacity needed by 2020		
Current consumption per capita (kWh)	178	KWh
Expected per capita consumption by 2020 (kWh)	500	KWh
Current installed capacity	1500	MW
Electrification rate escalation	1.2	20%
Population growth	1.2	20%
Per capita consumption (kWh) increased 3 times	3	
Total demand by 2020	6,480	MW
Share of PV	**15**	**%**
Total of PV installed capacity needed by 2020	**972**	**MW**

And if the electrification rate increases to 20 % by 2020 the demand by 2032 would be:

PV installed capacity need by 2032		
Current consumption per capita (kWh)	178	KWh
Expected per capita consumption by 2032 (kWh)	650	KWh
Current installed capacity	1500	MW
Electrification rate escalation	1.5	20%
Population growth	1.4	20%
Per capita consumption (kWh) increased 3 times	3.5	
Total demand by 2032	11,025	MW
Share of PV	**30**	**%**
Total of PV installed capacity needed by 2032	**3.3**	**GW**

4 Suitable Business Models in Afghanistan

This chapter focuses on the issues from the perspective of a PV developer. The first part will present the existing business cases, introduce the stakeholders which must be involved, describe the existing framework and give an overview of the specific process steps that developers and investors have to undergo in the current legal framework. Following this, the main barriers identified will be described and the impact of the barriers on business cases will be explained through quantitative and sensitivity analysis. In a last step, the main conclusion and decisive factors for the development of PV power plants in Afghanistan from the perspective of a developer or an investor will be summarized and discussed.

Due to the nascent state of the Afghan PV sector it is not entirely clear which type of PV projects will become predominant in the future. Enabling PV Afghanistan analyses the three different business models for power generation currently being discussed by the MEW. These models will address the challenges currently faced by project developers in Afghanistan. These business models are not in use yet. Thus, for the analysis of their development and profitability the following business models will be examined:

- PV projects that produce and distribute renewable energy through a mini-utility in off-grid areas (RESCO model)
- Solar Power Parks (SPP) for grid connected renewable energy projects generating power for sale to the grid against a long-term PPA
- Roof-top projects based on net-metering.

The analysis of the process of project development and profitability of these business models was carried out on the basis of information gathered through interviews with stakeholders in the PV sector in Afghanistan, including the Ministry of Energy and Water, banks as well as local and international project developers. They were further verified in two national workshops with national and local stakeholders.

4.1 RESCO Model for Off-grid Projects

4.1.1 Business Model Description

Most of the large-scale PV projects currently implemented in Afghanistan are off-grid projects developed on donation basis either through foreign government development agencies or third party development organisations (mainly NGOs). The entity responsible of the off-grid mini-utilities has both, generation and distribution functions. Such projects can be found mainly in areas not connected to the national grid. The operator of such plants generates the electricity in ground-mounted PV projects, operates a mini-grid and sells the electricity produced to consumers through prepaid meters at a price ensuring their viability. Currently, the operators of most of the projects are either DABS, already from the beginning of the project, donors or project developers which intend to transfer the project to DABS in due course.

The process depends mainly on the conditions of the tendering contract. In the case of invitations to bid (ITB), the administrative steps – e.g. applying for licenses, identifying and obtaining the site - are taken care of by the donor whereas Requests for Proposals (RFP), are the responsibility of the applicant.

The Afghan government foresees in the RER2032 that in the future, off-grid projects will be operated by a Renewable Energy Service Company (RESCO). In the Roadmap, RESCO projects are defined as projects realised in an off-grid location and providing both generation and distribution of electricity on a mini-utility scale. This model is proposed mostly for areas where DABS has difficulties extending the national grid. RESCOs would be particularly suitable for irrigation, farm-based enterprises, telecom, business centres, hospitals, schools and remote populated areas. It is foreseen that such off-grid projects will be in the range of 500 to 1.000 kWp and have the capacity to supply 3 to 7 villages with electricity, corresponding to 1.000 to 2.000 households in total.

As defined in the RER2032, RESCO projects will be required to conduct a number of pre- activities such as site selection, load analysis, feasibility study and design. Local Civil Society Organizations (CSOs) or other local entities are likely to assist RESCO project developers with these pre-project activities. These CSOs also play an important role in building bridges between the RESCO project and the local population. The implementation of off-grid PV projects under the RESCO business model is also an opportunity to establish Public Private Partnerships (PPPs) between DABS and the company acting as a mini-utility.

4.1.2 Stakeholders Involved

The stakeholders involved in off-grid PV installations are:

- **Donor:** The donor puts a PV project out to tender, either through an Invitation to Bid (ITB) or a Request for Proposals (RFP). Donors are generally foreign development aid agencies (e.g. GIZ, USAID and the UK Department for International Development (DFID) or international NGOs.)
- **Applicant:** The applicant bids for the tender opened by the donor. The complexity of the application depends to a great extent on the details of the tender, as outlined above. In practice, applications are often submitted by an Afghan company and a foreign company in the form of a joint venture.
- **Da Afghanistan Breshna Sherkat (DABS):** DABS is the national utility company, operating a number of mini-utilities in Afghanistan. The applicant is advised to inform DABS about his project, even if the project is not part of a DABS operated mini-utility.
- **Transport Companies:** Transport companies play an essential and specific role in Afghan PV projects as the applicant has to rely on transport companies for the import of the required materials. Logistics are handled by international as well as Afghan companies. Donor organisations may have prearranged agreements with certain transportation companies.
- **Customs Authorities:** Customs authorities are also influential factors in the PV process because, since there are no PV production facilities in Afghanistan. PV equipment must be imported through a land border. The applicant therefore has to interact with custom authorities to receive clearance of the imported goods.
- **Ministry of Trade & Industry:** The Ministry of Trade & Industry issues the business licence for a company to operate in Afghanistan.
- **Ministry of Energy & Water:** The Ministry of Energy & Water issues the licence for a company to generate and sell energy to consumers.

- **Banks and other third party investors:** For RESCO projects, which are not fully or only partially funded by donor agencies or NGOs, the project developer will have to raise (additional) funds through banks or third party investors. Currently, the financing through public banks is not a common practice; not at least due to the high country risk level of Afghanistan. It is however to expect that this situation might change over time, making banks and third party investors regular stakeholders for PV projects in Afghanistan.
- **Consumers:** Under the RESCO model, it is foreseen that projects are implemented through PPAs. This means that the developer needs to enter into an agreement with consumers on the use and purchase of electricity. Currently, the electricity from off-grid PV projects is sold to local consumers through pre-paid meters.

4.1.3 Legal Framework

For RESCO projects, PPAs between the RESCO and DABS constitute the main legal framework with a proposed operation period of 20-25 years. Several PPA models are available and subject to agreement between the parties:

- Firstly, the BOT (Build-Operate-Transfer) option: The initial capital is provided by both the public and private sector, with construction is carried out by the private sector. The private sector also operates the installation until the initial investment is paid back, after which the installation is transferred to DABS (the public sector).
- Secondly, OC (Operating Concession), which is used for installations built without private investment in the initial phase. The public sector concedes the revenues of the project to the private sector which is responsible for the collection of fees, as well as the operation and maintenance of the project during the term of the contract.
- Thirdly, the LC (Lease Contract) model for projects for lighting purposes and projects below 100 kWp, offering a delayed financial return. The private sector leases the installation from the public sector, and based on the contract, is responsible for the collection of revenues, while the public sector remains responsible for the maintenance.

Agreements between RESCOs and the electricity consumers also form part of the legal framework. These agreements are not regulated yet, and in practice take the form of the obligation for the consumer to purchase a prepaid meter. One can envisage a different contract between the consumer and RESCOs in the future, however, without prepaid meters.

The project developer needs the following licences from the Ministry of Energy & Water:

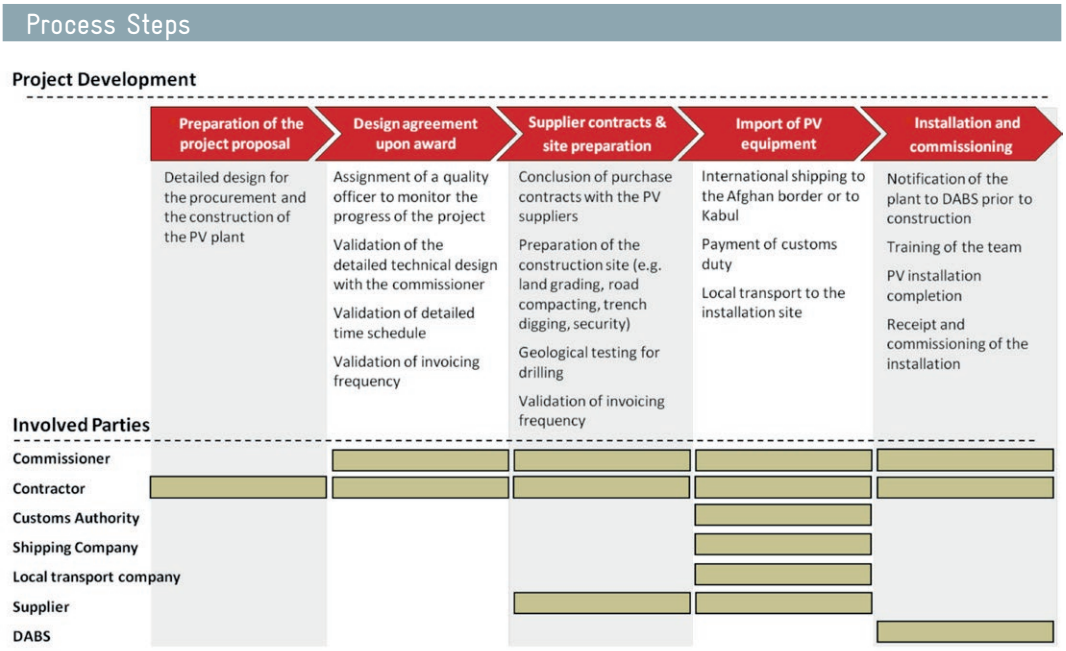
1. Electricity Generation License, which is valid for a maximum of 25 years.
2. Electricity Transmission License which is valid for a maximum of 25 years.
3. Electricity Distribution License which is valid for a maximum of 20 years.
4. Electrical Energy Import License which is valid for a maximum of 15 years.
5. Electrical Energy Export License which is valid for a maximum of 15 years.

4.1.4 Process of Project Development

The first project example (of 400 kW) analysed in this study was fully financed by the Aga Khan Foundation. The project partners did not have to carry out any administrative procedures to obtain the required permits, which significantly accelerated its realisation and under these circumstances, the project was realized within 8 months. Another off-grid project (1 MW) funded by the New Zealand Ministry of Defence, for which the administrative procedures were also taken care of, was realised within 18 months.

The steps of the process of project development are not defined or standardized and therefore can vary significantly between projects. It should be noted that the steps described here are only taken following tendering.

Process Steps



Barriers

Barrier	Process Step Affected	Description
Very high import tax	Importing of equipment	The import duty for imported PV plants is determined by the custom tariff applied on the value of the imported PV system. The value of the PV system is listed in the customs database. Due to outdated referencing of the PV equipment in the customs database cost reductions of PV technology have not been taken into account. As a consequence, the import tax is much higher than expected which significantly increases the price of PV systems.
Overall security situation	Installation and commissioning	Due to the ongoing multi-layered conflicts in some regions in Afghanistan, many foreign project developers and investors consider PV project activities too dangerous. This additional risk is also reflected in high risk premiums and staggering interest rates.
Lack of asphalted roads between cities in Afghanistan	Transport of equipment within Afghanistan	Due to the road conditions in many areas of Afghanistan, delays in transportation of the equipment may occur, especially from Kabul to the installation sites.
High interest rates	Planning and financing	The interest rates for PV investment are currently a staggering 15 % (in comparison to less than 5 % in many European markets). As a consequence, banks cannot be used to leverage equity investments thus significantly increasing the overall investment costs.
Off-grid electricity tariff is too high for the local population (off-taker risk)	Transfer to DABS and operation thereafter	Consumers expect off-grid electricity to be similarly priced to on-grid electricity, e.g. in Kabul. However, DABS charges about 4 times more for electricity produced through PV off-grid plants, due to the higher total costs of generation. This leads to reluctant use of off-grid electricity produced by PV. Nor is there a legal obligation to purchase the electricity. As a consequence, the risk of selling the electricity lies solely with the investor.

4.1.5 Financing Schemes

As the projects discussed in the interviews were fully donor funded, the sources of finance at this stage are limited to donors in the form of foreign development agencies and NGOs.

The RESCO model as defined in the 2032 Roadmap does not prescribe a specific financing scheme. Public-Private Partnerships (PPP), however, are considered a kind of public support. In fact, it is envisaged that renewable energy projects may be financed to 60 % from public funds, a further 20 % coming from private investments (equity) and the final 20 % provided through bank loans. It should be noted that the interest rates for loans are currently 15 % in Afghanistan, which is too high for developers to consider a loan. As long as the interest rate remains so high, the funds will have to come from the equity investor.

For both, current off-grid projects and future projects under the RESCO model, pre-paid meters are an integral part of the business model. The electricity produced by the PV plant can thus be consumed by the local inhabitants on the basis of a prepaid meter system. Once a project is finalized, people are encouraged to purchase and install a meter in their homes, which costs approximately 100 USD. All costs have to be covered by the meter buyer. Once the meter is installed, people have the possibility to buy their electricity with a prepaid card.

4.2 Large Scale PPA projects via Solar Power Parks

4.2.1 Business Model Description

In the interviews conducted for this report, one large scale PPA project was evaluated. This 10 MW project in the Kandahar province is the outcome of a USAID tender for the installation, operation and maintenance of the installation. The aim of the project is to replace the use of diesel generators in Kandahar through electricity production from PV. This project is only in the initial phase as the PPA must still be signed, and the contract for import was only signed very recently.

In general, current large scale PPA projects are very similar to off-grid projects, as they are not yet connected to the national grid and are often also donor-funded projects. Therefore, the process steps are almost identical.

However, the Afghan government envisions that these large-scale projects will be connected to the national grid immediately, and that these projects will be implemented under a PPA regime. The BOT (Build-Operate-Transfer) method will most likely be used for project delivery, after which the PPA will either be extended or the project will be transferred to DABS through a sale or other means of transferring to be agreed upon on a project basis. Other methods are however not excluded.

A government entity will be formed to provide and develop the land for these large-scale projects. This land will then be leased by this entity for the duration of the PPA to the project developer. The government entity will be responsible for the clearances and approvals to prepare the land for the project, as well as for the development of the necessary infrastructure, e.g. access roads and water supply. It will also be in charge of extending and creating the power transmission grid within the Solar Power Park as well as maintaining the grid.

It should be noted that this model can also be replicated for wind power parks/farms.

4.2.2 Stakeholders Involved

- **Donor:** If a donor is involved, they will open a tender for Afghan project developers to bid to and provide (partial) funding for the project. Donors are generally foreign development aid agencies (e.g. GIZ, USAID or DFID) or international NGOs.
- **Applicant:** The applicant bids for the tender opened by the donor. The role of the applicant depends to a great extent on the details of the tender, as outlined above. In practice the applicant is often an Afghan company that has formed a joint venture with a foreign company.
- **The Electricity Company of Afghanistan (DABS):** DABS is the national utility company that purchases the electricity and is actively involved in the process of connecting the installation to the national grid.
- **Transport Companies:** the applicant has to rely on transport companies for the import of the required materials. Logistics are handled by both international as well as Afghan companies. Donor organisations may have prearranged agreements with certain transportation companies.
- **Customs Authorities:** The PV equipment has to enter Afghanistan via a land border and therefore the applicant will interact with custom authorities to receive clearance of the imported goods.
- **Ministry of Trade & Industry:** The Ministry of Trade & Industry issues the business licence for a company to operate in Afghanistan.
- **Ministry of Energy & Water:** The Ministry of Energy & Water issues the licence for a company to generate and sell energy to consumers.
- **Banks and other third party investors:** For projects, which are not projects fully or only partially funded by donor agencies or NGOs, the project developer will have to raise (additional) funds through banks and other third party investors. Currently, financing through public banks is not common practice; mainly due to Afghanistan's high-country risk level. However this situation may change over time, making banks and third party investors regular stakeholders for PV projects in Afghanistan.

4.2.3 Legal Framework

For the large scale PPA model, PPAs provide the main legal framework with a proposed operation period of 20-25 years. Several PPA models are available and subject to agreement between the parties:

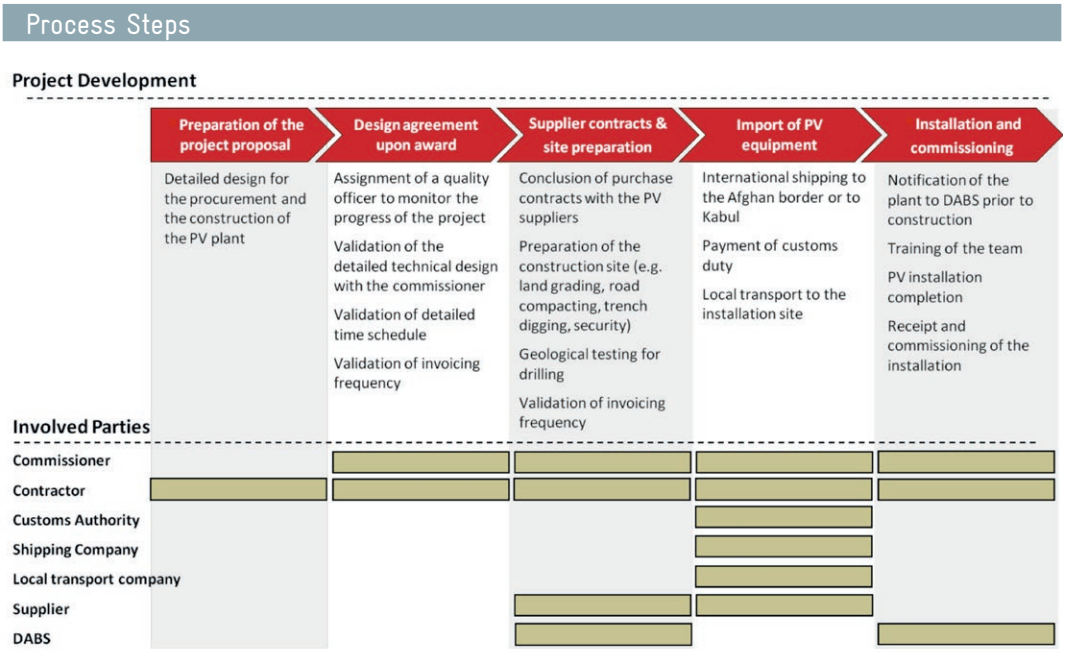
- Firstly, the BOT (Build-Operate-Transfer) option: The initial capital is provided by both the public and private sector, and the construction is carried out by the private sector. The private sector also operates the installation until the return period of the initial investment, after which the installation is transferred to DABS (the public sector).
- Secondly, OC (Operating Concession), which will be used for installations that are built without private investment in the initial phase. The public sector concedes the revenue of the project to the private sector which is responsible for the collection of fees, as well as the operation and maintenance of the project during the term of the contract.
- Thirdly, the LC (Lease Contract) model for projects for lighting purposes and projects below 100kWs, offering a delayed financial return. The private sector leases the installation from the public sector, and based on the contract, is responsible for the collection of revenues, while the public sector remains responsible for the maintenance.

4.2.4 Process of Project Development

At this stage, the development of large scale projects is still in an early phase, which means that there is a lack of experience and therefore also a lack of information about process steps. Nor are the steps defined or standardized which means that they can vary significantly between projects.

The information as described in this paragraph was gathered through an interview about a 10 MW project funded partially by USAID. As discussed above, the information provided is similar to an off-grid project, because current large scale PPA projects have not been yet connected to the national grid.

Process Steps



Barriers

Barrier	Affected Step	Description
Very high import tax	Importing of equipment.	Due to outdated referencing of the PV equipment in the customs database, the import tax is much higher than expected.
Lack of asphalted roads between cities in Afghanistan	Transport of equipment within Afghanistan.	Due to the Afghan road conditions, delays in transporting on of the equipment may occur, especially from Kabul to the installation sites.

4.2.5 Financing Schemes

The government does not prescribe a specific financing scheme for large scale PPA projects, so arrangements are likely to be made on an ad hoc basis.

In the 10 MW project that was taken as base case for the analysis of large PPA projects, the PPA foresees that the electricity produced will be bought by DABS for 7.3 US cents per kWh for a guaranteed period of 15 years. In addition, USAID provides financial support in the amount of $ 10 million in order to ensure the profitability of the project. According to further interviews, DABS is willing to purchase PV electricity to a price up to 8,5 US cents per kWh, which corresponds to the highest import price of electricity from Uzbekistan.

4.3 Rooftop Net-metering Projects

4.3.1 Business Model Description

Currently, the development of rooftop projects is still in its infancy and therefore there are no projects that can be used as an example of this type of installation. However, the Draft Regulation of Net Metering (as of March 2017) allows for the formulation of assumptions on how this technology will be developed in the Afghan context.

Due to the high level of solar radiation and available roof-top spaces in urban areas, two models of solar PV roof-top systems are proposed:

- Firstly, the CAPEX (Capital Expenditure) model, under which the owner of the rooftop purchases all the equipment necessary to generate rooftop PV electricity and sells the electricity to the distributor through a net-metering agreement.
- Secondly, the OPEX (Operation Expenditure) model, where the rooftop is rented by a third party to generate electricity. The third party is responsible for the installation and maintenance of the PV plant, and can therefore also enjoy the tax credits and incentives available. For the sustainability of roof-top solar PV systems, distribution companies will be encouraged to sign long-term net-metering agreements with the owner of the roof-top system.

4.3.2 Stakeholders Involved

- **Applicant:** the applicant is the entity submitting an application to DABS for the usage of a roof to generate solar electricity. This can either be the owner of the roof, or a third party leasing the roof for electricity generation purposes.
- **DABS provincial office:** the DABS provincial office is the point of contact for the applicant. It is responsible for confirming receipt of the application, signing the connection agreement, installing of the meter and commissioning the certificate.
- **DABS field office:** the DABS field office is responsible for the technical feasibility study of the project, as well as jointly responsible for the installation of the meter.
- **Customs Authorities:** as the PV equipment has to enter Afghanistan via a land border, the applicant will interact with custom authorities to receive clearance of the imported goods.

- **PV installer:** the PV installer will be commissioned by the owner to install the roof-top and also possibly at later stages for maintenance of the installation.
- **Bank or third party investor:** the bank or third party investor will be able to provide a loan for the roof-top installation developer should they not have sufficient private equity to finance the project.

4.3.3 Legal Framework

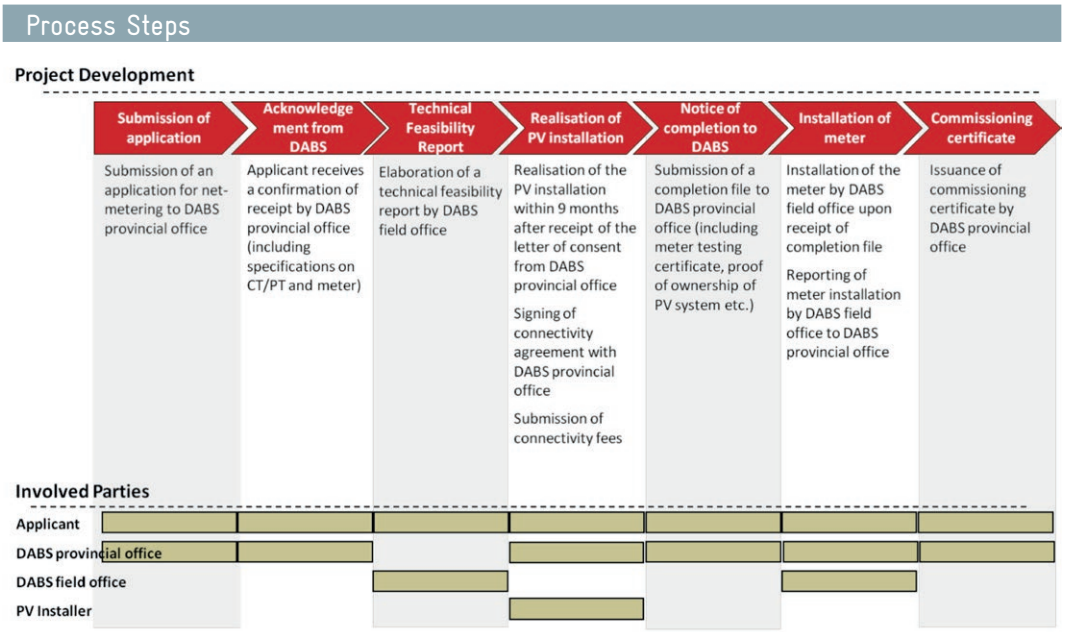
If the roof to be used for the project is not owned by the project developer, the rooftop owner and the installation developer will have to enter into an agreement for the generation of electricity by the PV installation. This agreement can take the form of a lease agreement, and will transfer ownership of the installation to the project developer and exclude the owner of the roof from owning the installation, unless agreed upon differently by the Parties.

Further, the owner of the roof-top installation will need to enter into an agreement with DABS regarding the net-metering. At this stage, these agreements are not standardized and therefore need to be agreed upon on an ad-hoc basis.

4.3.4 Process of Project Development

The development of rooftop installations is still in its infancy. The steps described below are taken from the Draft Net-Metering Agreement (as of March 2017) and thus are based on assumptions. In practice, the steps might differ slightly from those described.

Process steps



Barriers

Barrier	Steps Affected	Description
Broad role of DABS which might lead to application bottlenecks.	All steps	In the official draft agreement, the role of DABS is very broad as they are involved in every step of the process. This can become a large burden on DABS and could create bottlenecks they receive too many applications at once.

4.3.5 Financing Schemes

No specific financing scheme is prescribed for roof-top installation. Furthermore, the interest rate of bank loans is currently 15 % which is too high for developers to take out a loan. Therefore, projects, at this stage, will have to be funded from 100 % own equity.

4.4 Profitability Analysis

4.4.1 Off-grid Projects

The following case study is based on a real project which was implemented in the Bamyan province in order to ensure the electricity supply of the Bamyan Provincial Hospital. The project has a capacity of 400 kWp and was fully supported on the basis of donations from the Aga Khan Foundation Pakistan, upon the publication of a tender for the delivery of the equipment, the installation, technical support on site and commissioning of the plant. This project can be considered a flagship project, aiming at highlighting the possibility of implementing solar energy plants in the country. It was not intended to be profitable from a commercial perspective and can thus not be considered a viable business model as such. However, its implementation has set the path for future off-grid projects. Based on benchmark parameters and implementation processes gathered through this project, the ideal conditions ensuring the profitability of off-grid projects in Afghanistan were determined.

In order to assess the viability of off-grid projects implemented without 100 % donations, the profitability of such projects was calculated based on realistic assumptions. These assumptions will be varied in the sensitivity analysis in chapter 4.3.4.

Figure 13 provides an overview of the parameters taken into account to calculate the profitability of a 400 kWp off-grid PV installation, implemented on the basis of a 60 % investment subsidy and 40 % private equity. This financing structure is based on assumptions of the Afghanistan Sustainable Energy for Rural Development (ASERD) program, that the country's present bank situation in the country does not allow for bank loans financing such projects.

Figure 13: Overview of input parameters for 400 kWp off-grid plant

PV Project			
PV System Size		kWp	400
Specific System Cost		AFN/kWp	267.000
Additional CapEx (e.g. Batterie)		AFN	-
Investment Subsidy	60%	AFN	64.080.000
Total System Cost		AFN	42.720.000
Fixed Operation Costs		AFN p.a.	450.700
Variable Operation Costs		AFN/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	2.000
Performance Factor		%	80%
Specific System Performance		kWh/kWp/a	1.600
Degradation		% p.a.	0,70%

Investment			
Project Duration		Years	20
Equity		AFN	34.176.000
Debt (Gearing)	-	AFN	-
Loan Tenor		Years	-
Interest Rate		%	-
Inflation Rate		%	4,5%

The specific system costs of 267.000 AFN per kWp (~3,949.49 USD) correspond to real figures, which are quite high compared to international market prices, mainly due to high import taxes and transport costs. Apart from this, the system costs also include the cost of solar PV panels and batteries. The operation and maintenance costs amounting to 450.700 AFN per year correspond to 1 % of the total system costs per year. This share is relatively low due to the comparatively high turnkey costs.

In this calculation, the operation costs are composed of the following expense items:

- The exchange of 2 converters (there are 2 converters in the setup of this mini-grid/ off-grid),
- The maintenance of the diesel PV hybrid installation
- The costs for 2 employees ensuring the installation safety, maintenance and regular cleaning of the PV panels to maintain their maximum efficiency

Afghanistan benefits from a high solar irradiation ranging from 1600 to 2500 kWh/m²/year. As around 2000 kWh/m² can be achieved, this value was used for the profitability analysis. The performance factor of the PV plant was set at 80 % to allow for performance decreases caused by the dusty and dry climate and the resulting low self-cleaning effect of the modules. For the degradation a very common assumption of 0.7 % per year was used due to the lack of experience with operational systems in this emerging market.

The profitability of the project was calculated over a project lifetime of 20 years, with an equity amounting to over 34 million AFN. The inflation rate was set at 4.5 % per year, which corresponds to the average value for the Afghan currency in 2016. Bank loans were deliberately not considered at all, in order to reflect the current situation in Afghanistan, where the 15 % interest rate of banks makes it unrealistic to take out loans. Moreover, the high risk factor and off-taker risk of off-grid projects in Afghanistan makes it highly unlikely for foreign banks to provide financing loans.

Figure 14: Purchase tariff for a 400 kWp off-grid plant

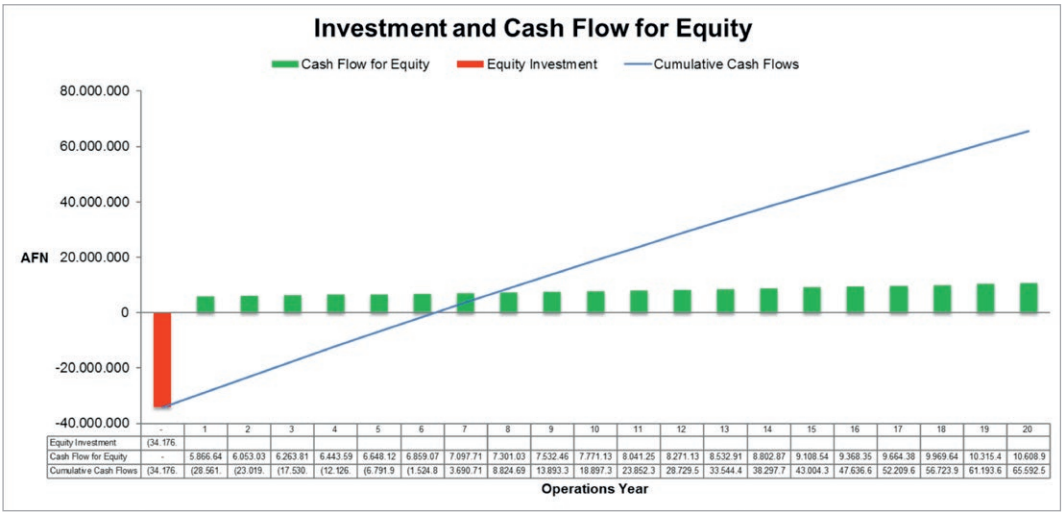
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	AFN/kWh	-
Self-consumption	-	AFN/kWh	-
Fees		AFN/kWh	-
Net-metering	-	AFN/kWh	-
Fees		AFN/kWh	-
Excess Electricty		AFN/kWh	-
PPA Tariff	95%	AFN/kWh	10,00
Fees		AFN/kWh	-
Overysupply Price		AFN/kWh	-
Undersupply Penalty		AFN/kWh	-

Under current circumstances, PV projects in Afghanistan are able to acquire very large number of donations for the realization of off-grid projects, making it a very specific business model under the status quo conditions. Assuming that in the future, a decrease in donations can be expected in the country, the viability of the business model would need to be reassessed.

In the present business case, it is assumed that the electricity produced by the off-grid PV plant is sold to local consumers at the price of 10 AFN per kWh (through prepaid-meters), as displayed in figure 14.

This tariff assumption is a more affordable tariff than the current off-grid consumer tariffs, but is still higher than the average residential tariffs for grid electricity. The share of 95 % for the price of electricity sold, takes into account the electricity losses for battery storage and distribution in the local grid. In these conditions, the payback of equity investment is achieved after only 6 years, as illustrated by the blue curve in figure 15, showing the yearly equity cash flows of the project from the investor perspective. This short payback period is also possible thanks to the high investment subsidy amounting to 60 % of the total costs. Moreover, the absence of debt service in this business model also contributes strongly to a quick return on investment.

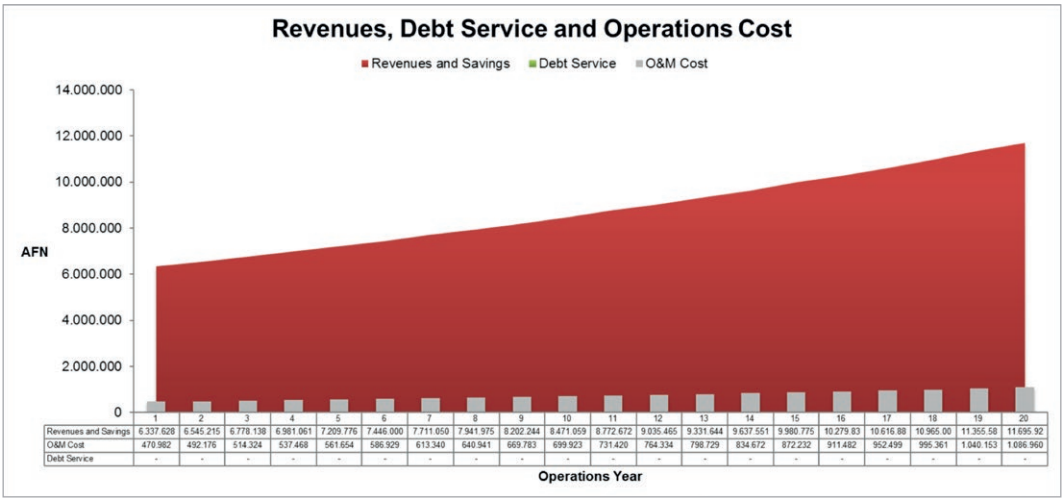
Figure 15: Equity Investment and Cashflow for a 400 kWp off-grid plant



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(34.176.																				
Cash Flow for Equity	-	5.866.64	6.053.03	6.263.81	6.443.59	6.648.12	6.859.07	7.097.71	7.301.03	7.532.46	7.771.13	8.041.25	8.271.13	8.532.91	8.802.87	9.108.54	9.368.35	9.664.38	9.969.64	10.315.4	10.608.9
Cumulative Cash Flows	(34.176.	(28.561.	(23.019.	(17.530.	(12.126.	(6.791.9	(1.524.8	3.690.71	8.824.69	13.893.3	18.897.3	23.852.3	28.729.5	33.544.4	38.297.7	43.004.3	47.636.6	52.209.6	56.723.9	61.193.6	65.592.5

Figure 16 illustrates the project cash flows of the off-grid project during its 20 years of operation. The red area indicates the revenues, which increase over 20 years due to the inflation adjustment of the electricity purchase price. As mentioned above, the amount of revenues available for the equity investor is even higher due to the absence of a debt service. The only remaining costs are for the operation and maintenance, which also increase due to inflation. The operation and maintenance costs are mainly the recruitment of 2 people for the surveillance of the site and the maintenance of the PV plant over its lifetime.

Figure 16: Revenues and operation costs for a 400 kWp off-grid plant



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	6.337.628	6.545.215	6.778.138	6.981.061	7.209.776	7.446.000	7.711.050	7.941.975	8.202.244	8.471.059	8.772.672	9.035.465	9.331.644	9.637.551	9.980.775	10.279.83	10.616.88	10.965.00	11.355.58	11.695.92
O&M Cost	470.982	492.176	514.324	537.468	561.654	586.929	613.340	640.941	669.783	699.923	731.420	764.334	798.729	834.672	872.232	911.482	952.499	995.361	1.040.153	1.086.960
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

When looking at the specific results in figure 17, the high Internal rate of return (IRR) and the Net-Present Value underline the high profitability of the investment. However, these attractive results can only be achieved provided that the project receives a high subsidy share. Without such financial support, the electricity produced by the PV plant would have to be sold at a price above 13,71 AFN/kWh in order to be profitable, as demonstrated by the value of LCOE without subsidy. With a subsidy amounting to 60 % of the total project costs, the project starts to be profitable during its 6th year of operation, which represents an attractive financial investment.

Figure 17: Profitability assessment for a 400 kWp off-grid plant

Results		
Net-Present Value	AFN	64.964.014
Project IRR	%	19,13%
Equity IRR	%	19,13%
Payback Period	Years	6,29
LCOE* (w/o subsidy)	AFN/kWh	13,71
LCOE (w subsidy)	AFN/kWh	5,52
Min DSCR**	x	-
Min LLCR***	x	-

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

4.4.2 Large Scale PPA

The profitability of large scale PPA projects in Afghanistan was calculated based on a 5 MW on-grid PV project for a total cost of 420 million AFN (~6,2 million USD). This includes operation and maintenance costs amounting to 1.5 % of the total system costs per year. The profitability was calculated in Afghani, since a large part of the financing sources stem from local banks, as explained in the paragraph below.

Figure 18: Overview of input parameters for 5 MWp on-grid plant

PV Project			
PV System Size		kWp	5.000
Specific System Cost		AFN/kWp	84.000
Additional CapEx (e.g. Batterie)		AFN	-
Investment Subsidy		AFN	-
Total System Cost		AFN	420.000.000
Fixed Operation Costs		AFN p.a.	6.323.500
Variable Operation Costs		AFN/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	2.000
Performance Factor		%	80%
Specific System Performance		kWh/kWp/a	1.600
Degradation		% p.a.	0,70%

Investment			
Project Duration		Years	20
Equity		AFN	164.379.490
Debt (Gearing)	70%	AFN	294.000.000
Loan Tenor		Years	15
Interest Rate		%	13,5%
Inflation Rate		%	4,5%

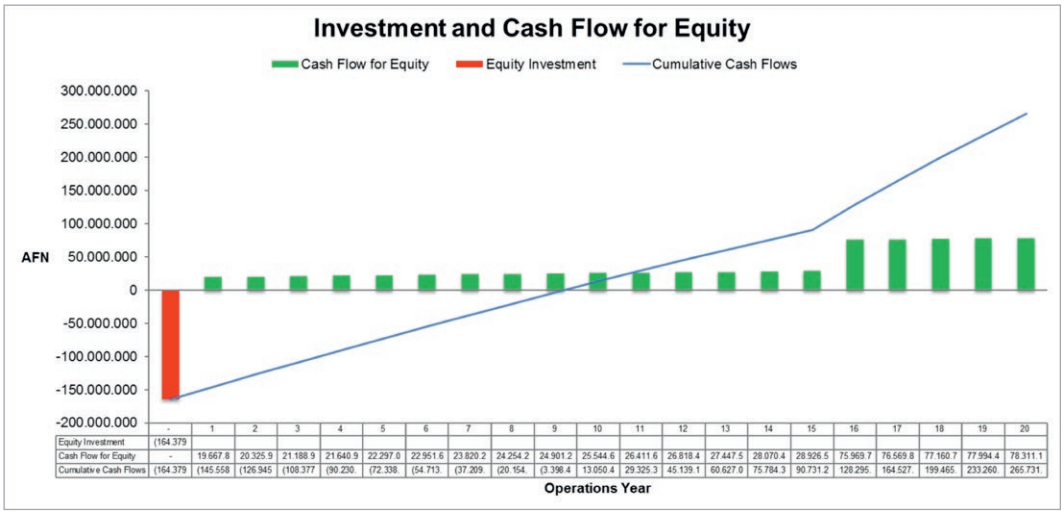
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	AFN/kWh	-
Self-consumption	-	AFN/kWh	-
Fees		AFN/kWh	-
Net-metering	-	AFN/kWh	-
Fees		AFN/kWh	-
Excess Electricty		AFN/kWh	-
PPA Tariff	100%	USD/kWh	0,085
USD Inflation Rate		%	2%
Viability Gap		USD/kWh	0,047

The specific yield of 2000 kWh/m²/year applied for the calculation of the PV electricity generation corresponds to the high average of solar radiation in Afghanistan. In fact, it is highly probable that such large projects will rather be built in areas with a high solar radiation, in order to ensure the best solar conditions for the project. As with the other business models in this report, the performance factor of the PV plant was set at 80%, considering the performance loss due to the dusty and dry climate in the country. For the degradation a very common assumption of 0.7 % per year was applied due to the lack of experience with operational systems in this emerging market.

Regarding the investment parameters, the business case was calculated for a project duration of 20 years. The financing structure of the project involves a 70 % debt share amounting of 294 million AFN (~4,4 million USD) over a period of 15 years, which is relatively common for this kind of project on the international market. So far, the banking structure in Afghanistan has not financed such large PV projects in the country. However, since donation-based projects do not constitute a sustainable business model on the long-term, the present calculation is intended to show the realistic circumstances under which the project would be viable. Hence the banking loan with an interest rest of 13,5 percentage, which is slightly under the rates currently offered by local banks but still extremely high in comparison to European levels.

The PPA tariff of 8,5 USD cents per kWh corresponds to the highest price at which DABS is willing to purchase the PV electricity of such projects. In fact, it is the highest tariff of imported electricity from Uzbekistan, which serves as a benchmark price for PPAs concluded between DABS and the PV project operator. Since in Afghanistan, PPAs are usually concluded in US dollars, the corresponding average USD inflation rate of 2 % was taken into account over the duration of the contract.

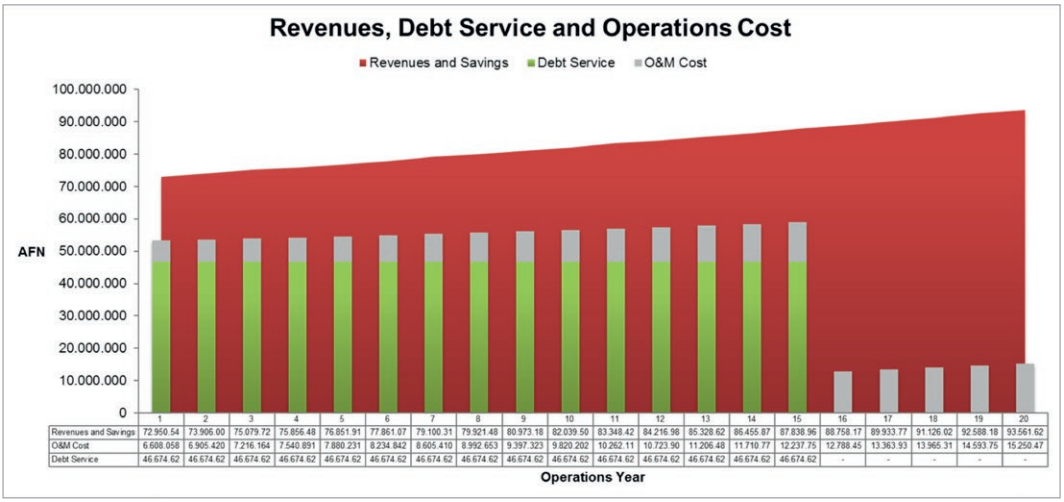
Figure 19: Equity Investment and Cash Flow for a 5 MWp on-grid plant



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(164.379																				
Cash Flow for Equity	-	19.667.8	20.325.9	21.188.9	21.640.9	22.297.0	22.951.6	23.820.2	24.254.2	24.901.2	25.544.6	26.411.6	26.818.4	27.447.5	28.070.4	28.926.5	75.969.7	76.569.8	77.160.7	77.994.4	78.311.1
Cumulative Cash Flows	(164.379	(145.558	(126.945	(108.377	(90.230.	(72.338.	(54.713.	(37.209.	(20.154.	(3.398.4	13.050.4	29.325.3	45.139.1	60.627.0	75.784.3	90.731.2	128.295.	164.527.	199.465.	233.260.	265.731.

With a PPA tariff of 8,5 USDcents per kWh, the Afghan government would need to provide a support amounting to 4,7 USDcents in order to close the viability gap of the project and ensure a payback time for the investor under 10 years, as illustrated with the blue curve in figure 19.

Figure 20: Revenues, Debt Service and Operation costs for a 5MWp on-grid plant



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	72.950.54	73.906.00	75.079.72	75.856.48	76.851.91	77.861.07	79.100.31	79.921.48	80.973.18	82.039.50	83.348.42	84.216.98	85.328.62	86.455.87	87.838.96	88.758.17	89.933.77	91.126.02	92.588.18	93.561.62
O&M Cost	6.608.058	6.905.420	7.216.164	7.540.891	7.880.231	8.234.842	8.605.410	8.992.653	9.397.323	9.820.202	10.262.11	10.723.90	11.206.48	11.710.77	12.237.75	12.788.45	13.363.93	13.965.31	14.593.75	15.250.47
Debt Service	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	46.674.62	-	-	-	-	-

As far as the project cash flows are concerned, the remaining revenues represented by the red area in figure 20 increases after the debt service is paid in the first 15 years. Additionally, the project revenues slightly increase over time due to the 2 % inflation adjustment of the USD-based PPA price.

Figure 21: Profitability results for a 5 MWp on-grid plant

Results		
Net-Present Value	AFN	248.522.325
Project IRR	%	12,55%
Equity IRR	%	13,61%
Payback Period	Years	9,21
LCOE* (w/o subsidy)	AFN/kWh	8,40
LCOE (w subsidy)	AFN/kWh	8,40
Min DSCR**	x	1,42 x
Min LLCR***	x	1,49 x

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

The project IRR and the equity IRR for this business case have nearly the same value (figure 21), which means that the cost of debt is roughly as high as the project revenues without debt capital. Under these conditions, the attractiveness of such a project for investors would mainly depend on his investment alternatives. Nevertheless, the profitability of this business model can definitely be improved by modifying some key parameters, as shown in the sensitivities analysed in the section below.

4.4.3 Rooftop Net-Metering

As of April 2017, there are no roof-top PV installations working on the basis of a net-metering scheme in Afghanistan. However, the Afghan government is currently establishing a legal framework for net-metering, so that such projects can be developed in the near future. In this context, the Enabling PV study presents first calculations demonstrating the profitability of net-metering projects, using the example of a PV system with a capacity of 100 kWp, which corresponds to a middle-sized commercial PV plant.

Figure 22: Input parameters for a 100 kWp rooftop plant

PV Project		
PV System Size	kWp	100
Specific System Cost	AFN/kWp	100.000
Additional CapEx (e.g. Batterie)	AFN	-
Investment Subsidy	AFN	-
Total System Cost	AFN	10.000.000
Fixed Operation Costs	AFN p.a.	150.000
Variable Operation Costs	AFN/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1.800
Performance Factor	%	80%
Specific System Performance	kWh/kWp/a	1.440
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	20
Equity		AFN	10.000.000
Debt (Gearing)	-	AFN	-
Loan Tenor		Years	-
Interest Rate		%	-
Inflation Rate		%	4,5%

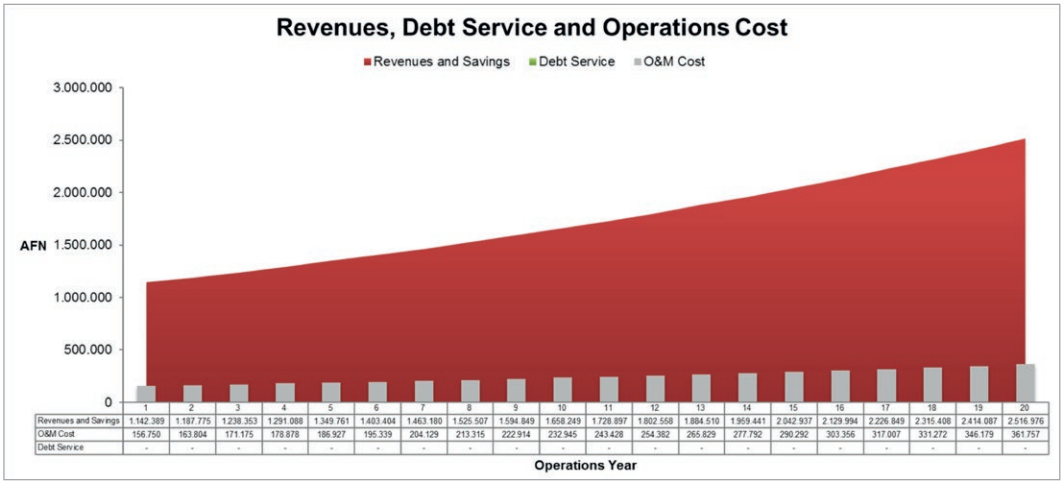
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	AFN/kWh	-
Self-consumption	-	AFN/kWh	-
Fees		AFN/kWh	-
Net-metering	60%	AFN/kWh	12,50
Fees		AFN/kWh	-
Excess El.	40%	AFN/kWh	-

Most of the input parameters applied for this business case were determined on the basis of expert interviews with local and international stakeholders.

The calculations were made in Afghani, since this business model particularly addresses local commercial investors, so they can reduce their electricity bill through the self-consumption of their PV electricity. Consequently, the calculation takes into consideration the average inflation rate of Afghani over the year 2016, corresponding to 4.5 %.

As shown in figure 22, the specific system cost considered for the calculation amounts to 100.000 AFN per kWp (~1480 USD/kWp). With regards to the high interest rates currently offered by local banks, investors are unlikely to take out a loan for their PV project. Therefore, the present business case was calculated with 100 % equity capital, with a total project duration of 20 years. The figure 23 illustrates the revenues in red and the operation and maintenance costs in grey over the lifetime of the project. The revenues increase over time due to adjustments of electricity prices in accordance with the high inflation rate of the Afghan currency.

Figure 23: Revenues and operation costs for a 100 kWp rooftop plant



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	1.142.389	1.187.775	1.238.353	1.291.088	1.349.761	1.403.404	1.463.180	1.525.507	1.594.849	1.658.249	1.728.897	1.802.558	1.884.510	1.969.441	2.042.937	2.129.994	2.226.849	2.315.408	2.414.087	2.516.976
O&M Cost	156.750	163.804	171.175	178.878	186.927	195.339	204.129	213.315	222.914	232.945	243.428	254.382	265.829	277.792	290.292	303.356	317.007	331.272	346.179	361.757
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

As far as the parameters for PV generation are concerned, the specific yield of 1800 kWh/m²/year corresponds approximately to the value for the capital city Kabul, where such commercial rooftop projects are likely to be developed. As for all the business models in this report, the performance factor of the PV plant was set at 80 % to account for performance decreases caused by the dusty and dry climate and the resulting low self-cleaning effect of the modules. For the degradation an assumption of 0.7 % per year was applied due to the lack of experience with operational systems in this emerging market.

Finally, this business case was calculated on the basis of 60 % self-consumption, with an avoided electricity tariff amounting to 12.5 AFN per kWh. This tariff is the average electricity tariff for commercial consumers, ranging between 8.75 and 16.88 AFN per kWh, depending on the province.

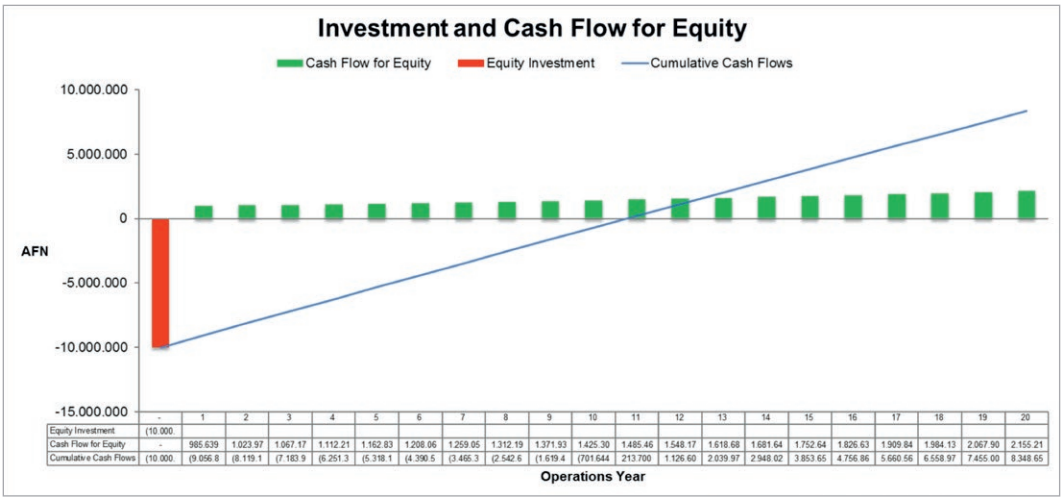
Figure 24: Profitability results for a 100 kWp rooftop plant

Results		
Net-Present Value	AFN	8.192.594
Project IRR	%	11,31%
Equity IRR	%	11,31%
Payback Period	Years	10,77
LCOE* (w/o subsidy)	AFN/kWh	7,38
LCOE (w subsidy)	AFN/kWh	7,38
Min DSCR**	x	-
Min LLCR***	x	-

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

The results in figure 24 and the blue curve in figure 25 show that the project is profitable after 10 years of operation, which may represent a relatively long payback period for commercial projects. Nevertheless, the attractiveness of such an investment for commercial investors can only be assessed when compared to alternative investment opportunities. Moreover, the payback period of 10 years can be reduced by modifying several parameters, as shown in the sensitivity analysis below.

Figure 25: Equity Investment and Cash Flow for a 100 kWp rooftop plant



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(10.000																				
Cash Flow for Equity	-	985.639	1.023.97	1.067.17	1.112.21	1.162.83	1.208.06	1.259.05	1.312.19	1.371.93	1.425.30	1.485.46	1.548.17	1.618.68	1.681.64	1.752.64	1.826.63	1.909.84	1.984.13	2.067.90	2.155.21
Cumulative Cash Flows	(10.000	(9.056.8	(8.119.1	(7.183.9	(6.251.3	(5.318.1	(4.390.5	(3.465.3	(2.542.6	(1.619.4	(701.644	213.700	1.126.60	2.039.97	2.948.02	3.853.65	4.756.86	5.660.56	6.558.97	7.455.00	8.348.65

4.4.4 Sensitivity Analysis

As observed in the previous chapter, the economic viability of business models for PV in Afghanistan strongly depends on the value of certain key geographic and financial parameters, which can be influenced in order to provide the project with the best possible conditions. This is the case for the specific yield of the PV plant, but also for the electricity purchase price, the customs tariff or the interest rate of banks. The following section aims at demonstrating the effect on the project's profitability when modifying these input parameters.

1. Specific yield sensitivity

Figure 26: Yield Sensitivity (400 kWp, Off-grid)

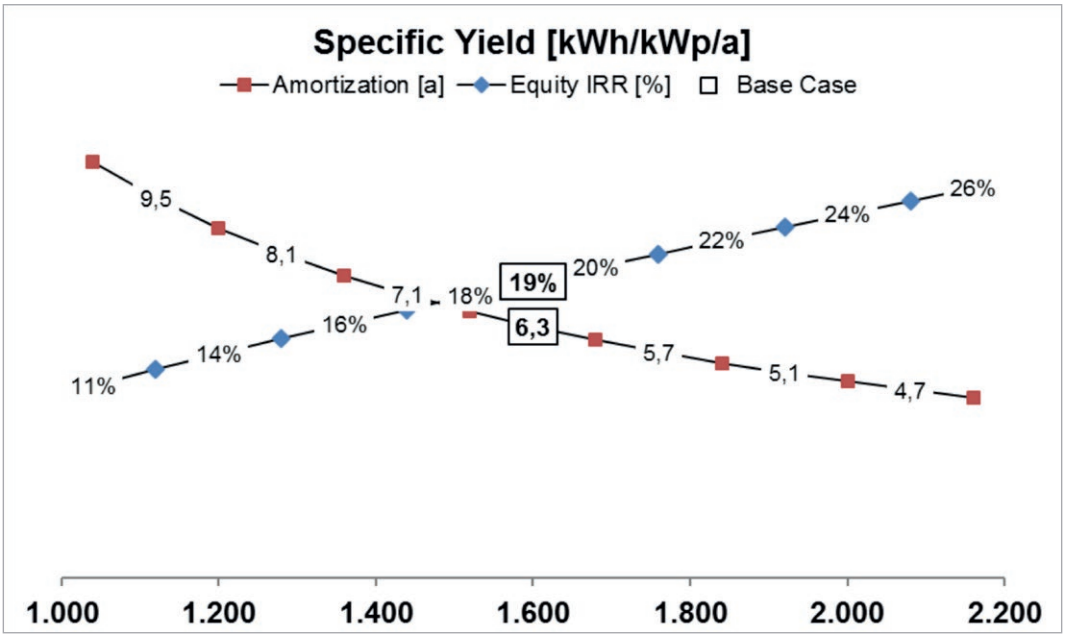


Figure 27: Yield Sensitivity (5 MWp, PPA)

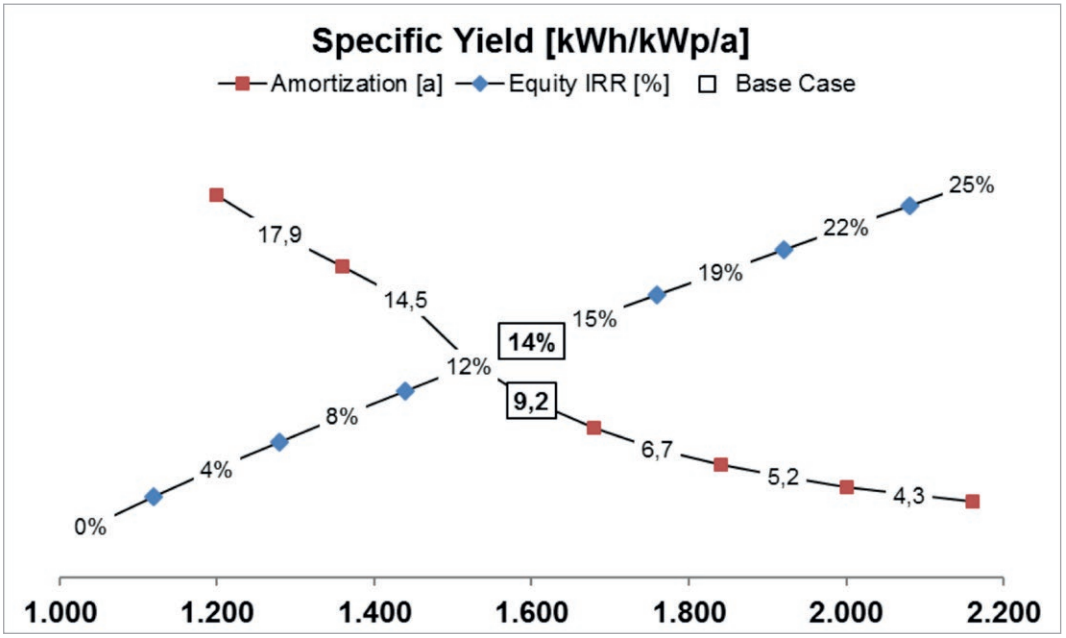
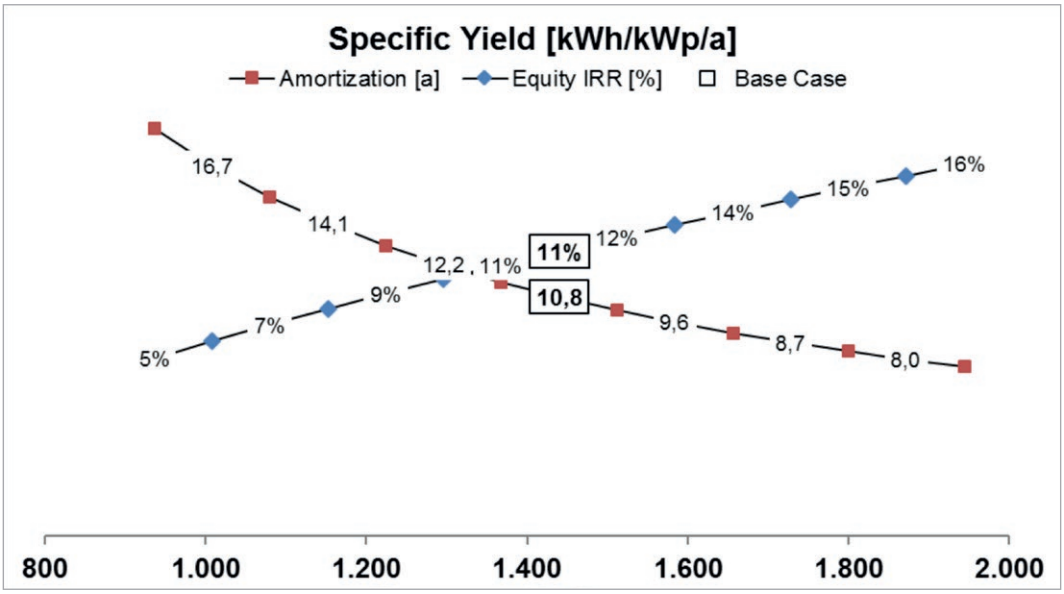


Figure 28: Yield Sensitivity (100 kWp, Net-Metering)



The yield sensitivity allows the visualization of the impact of solar radiation on the performance of the PV plant. In all three business cases, the amortization curve reacts non-linear to changes in the specific yield, whereas the curve of the equity IRR remains linear. This is explained by the fact that during the first years, the payback time is strongly influenced by the debt service. Therefore, every change in revenue caused by a lower/higher yield affects the payback period disproportionately. For its part, the equity IRR is calculated based on the whole operations period and thus reacts proportionate to changes in the specific yield.

As illustrated in figures 26 to 28, the level of specific system performance has a strong impact on the amortization period and the equity IRR. In fact, an increase of 200 kWh/kWp/year alone reduces the payback time by more than 1 year and increases the equity IRR by approximately 3 % points. Hence, Afghanistan's extraordinary natural resources are so positive that all regions are suitable for profitable PV investments.

2. Customs tariff sensitivity

One important issue impeding the development of PV projects in Afghanistan is the high level of customs tariffs. Within this context, the sensitivity provided in the adjacent figures 29 to 31 aims at demonstrating the effect of lower customs tariffs on the profitability of PV projects.

Figure 29: Customs Tariff Sensitivity (400 kWp, Off-grid)

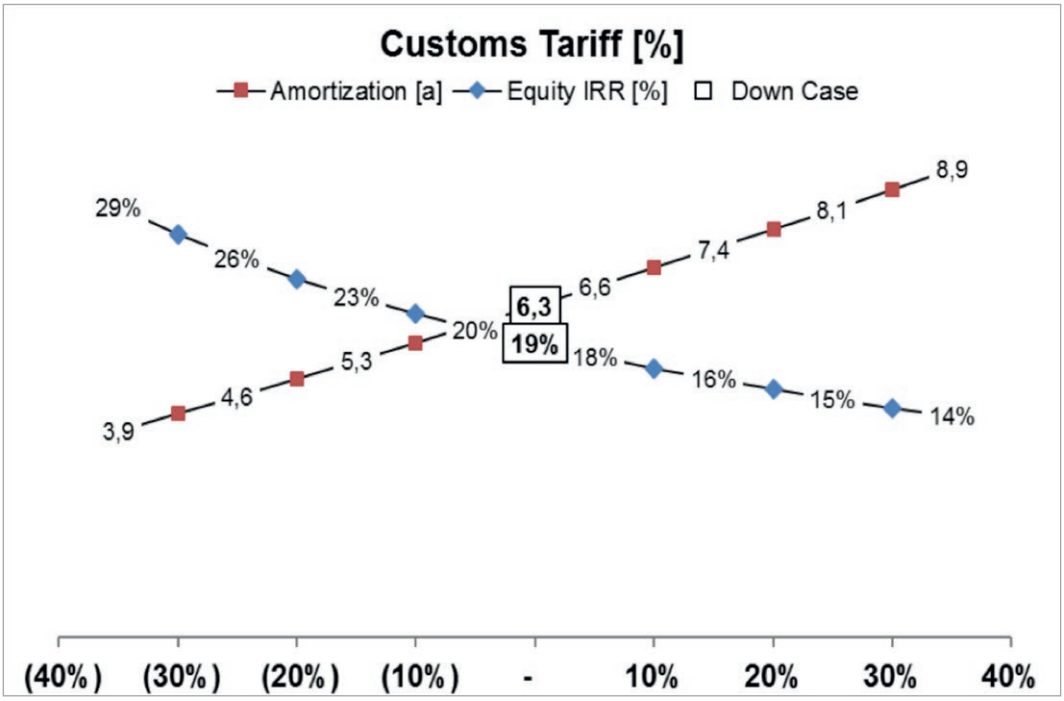


Figure 30: Customs Tariff Sensitivity (5 MWp, PPA)

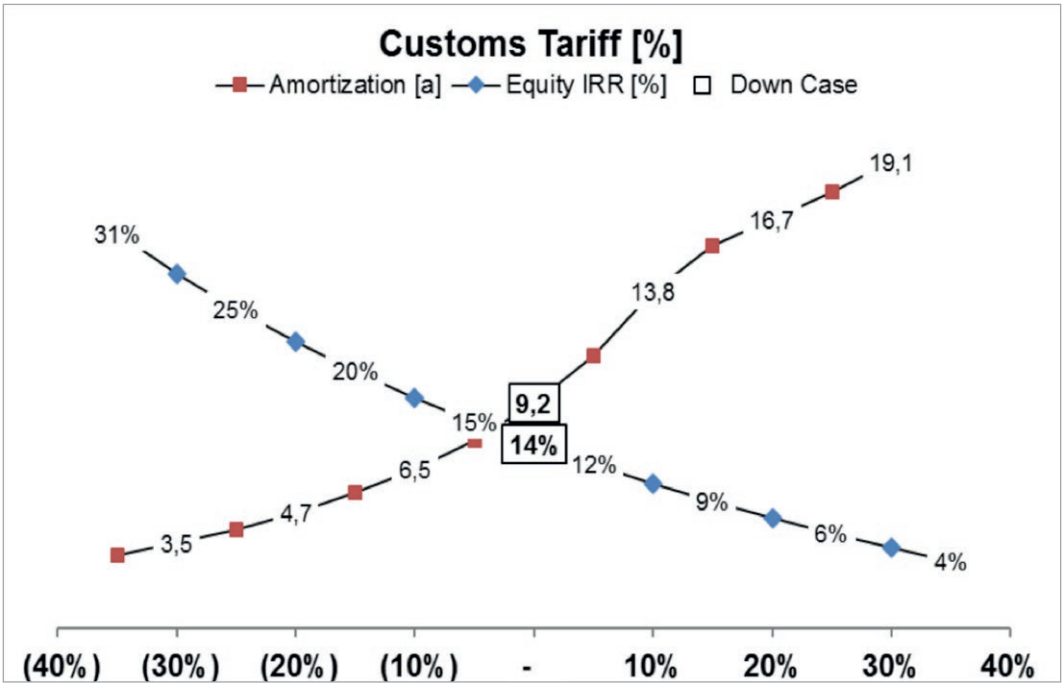
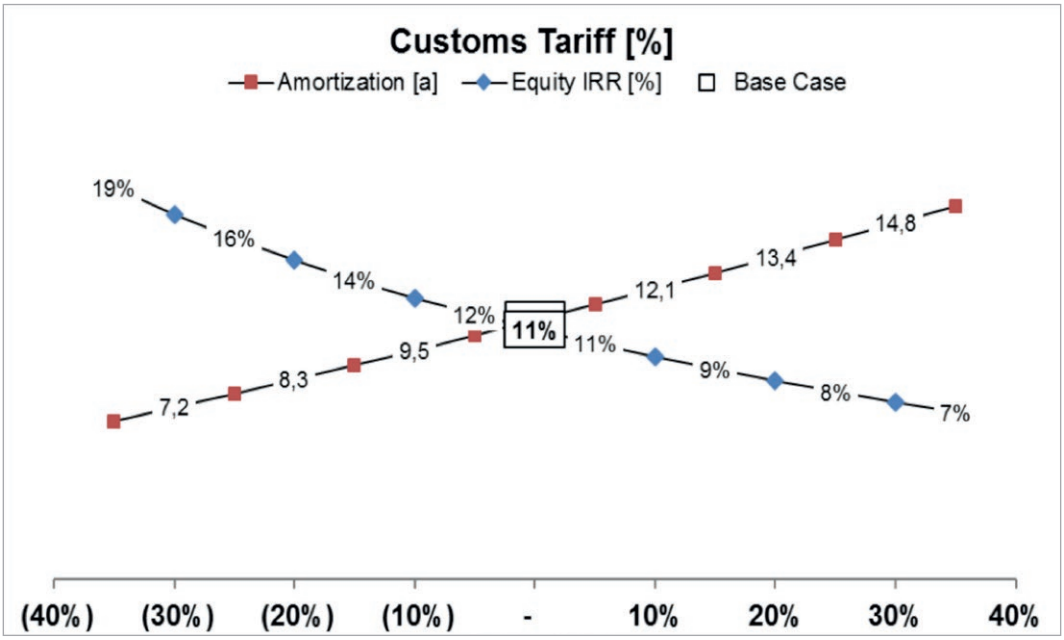


Figure 31: Customs Tariff Sensitivity (100 kWp, Net-Metering)



In the three figures, the base case takes into consideration an average customs tariff amounting to 12 %. Reducing this customs tariff by 40 %, which means that the customs tariff would be approx. 7 %, would allow the payback period to be reduced by 2 to 6 years, depending on the business case. Moreover, a customs tariff of 7 % would increase the equity IRR by between 8 up to 17 % points, depending on the project.

Hence, the level of customs tariff has a significant impact of the profitability of PV projects as well as the cost reduction potential if relatively easy mitigation measures were undertaken.

3. Electricity purchase price sensitivity (for off-grid and large scale projects)

Figure 32: PPA Price Sensitivity (400 kWp, Off-grid)

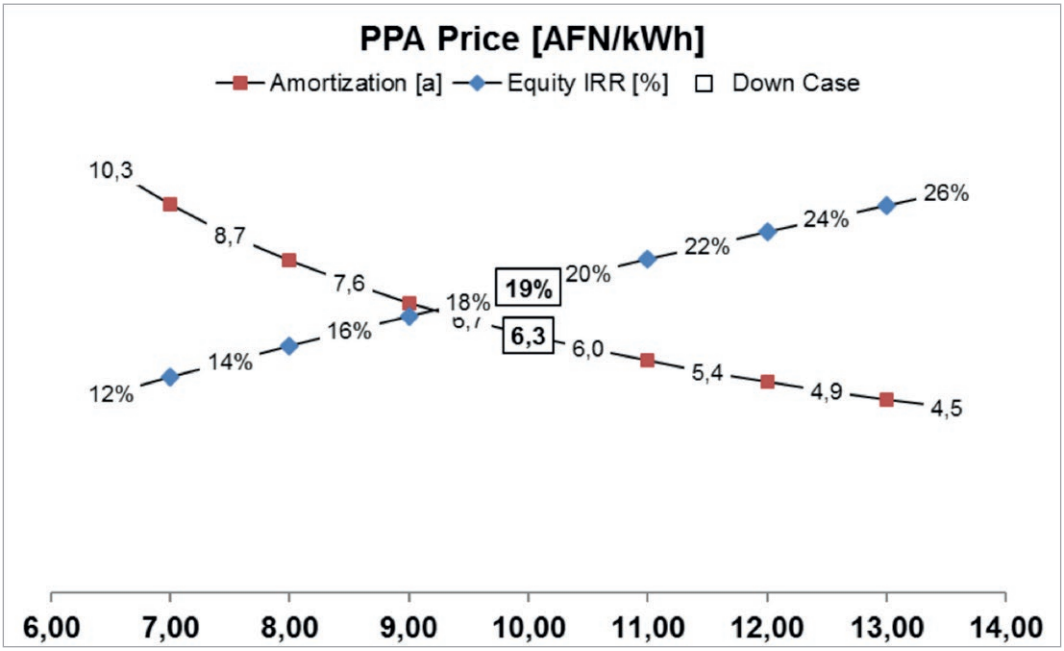
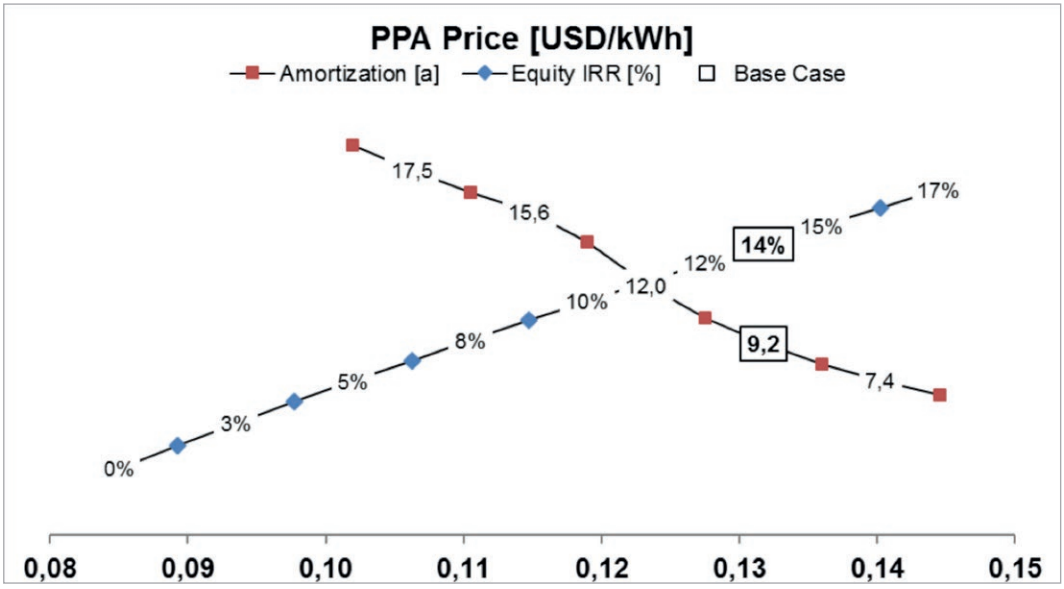


Figure 33: PPA Price Sensitivity (5 MWp, PPA)

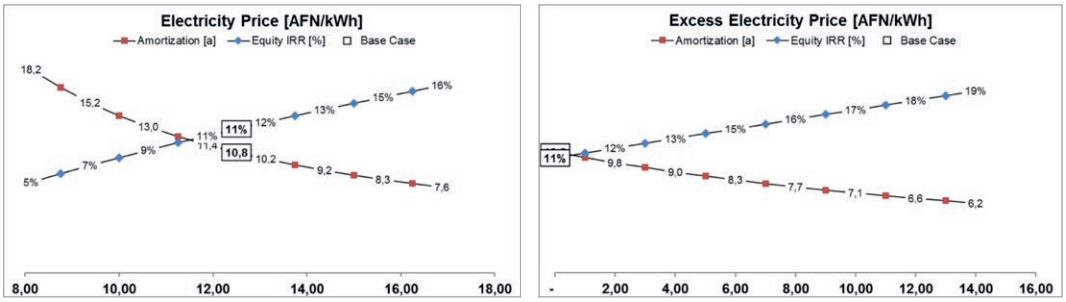


For the base case, the electricity price purchased by consumers was set at 10 AFN per kWh, a more affordable tariff than the current off-grid consumer tariffs, but still higher than the average residential tariffs for grid electricity. As illustrated in figure 32, increasing the purchase price to 14 AFN per kWh would theoretically improve the profitability of the project. However, this would also reduce the operator's chances to find off-takers for the electricity produced, unless the increased price was paid in the form of a support scheme. In fact, consumers located around off-grid PV plants in Afghanistan usually cannot afford to pay a high price for their electricity. In the absence of an additional support scheme, the investor would need to strike a balance between affordable tariffs and sufficient profitability.

For large scale PV projects, the PPA price taken into account for the base case was of 8,5 USDct purchase price from DABS and 4,7 USDct additional support from the government to close the viability gap of the project. This underlying support underlines the need for additional support, in particular as long as the interest rates remain high.

4. Self-consumption sensitivity (for rooftop net-metering projects)

Figure 34: Avoided and Excess electricity price with 60% self-consumption



The legal framework defining the implementation details of the net-metering scheme for PV systems in Afghanistan is currently under preparation. Within this context, the sensitivity scenarios above (figures 34 to 36) aim at illustrating the effect of different net-metering alternatives for investors, assuming that the grid tariff (tariff and inflation adjustments) remains fixed for the whole project lifetime. The figures take into consideration an avoided electricity tariff from the grid amounting to 12,5 AFN per kWh, which is the average electricity tariff for commercial consumers, ranging between 8,75 and 16,88 AFN per kWh, depending on the province. Residential customers purchase electricity at a significantly lower price which makes net-metering less profitable for them. This would change however, if the currently existing subsidies of electricity consumption were carefully adapted which would result in a modest increase in the artificially low electricity prices.

Figure 35: Avoided and Excess electricity price with 80% self-consumption

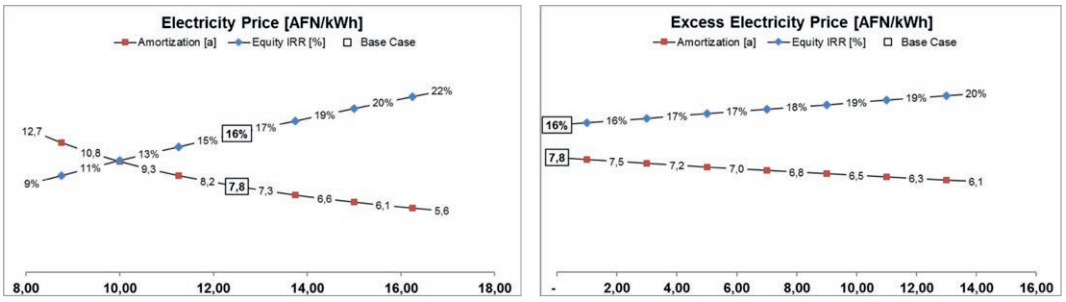
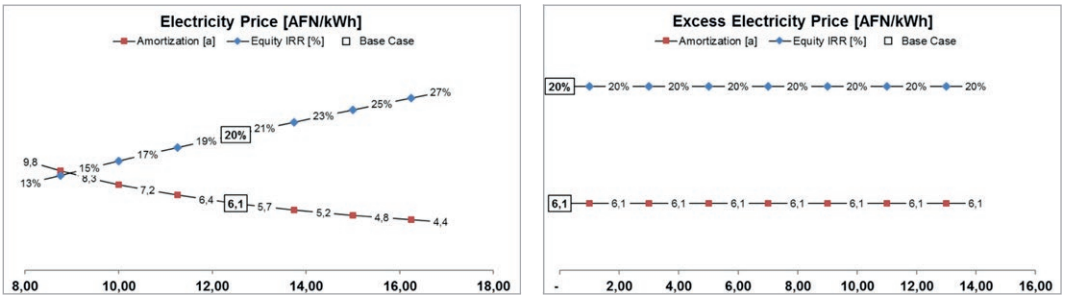


Figure 36: Avoided and excess electricity price with 100% self-consumption



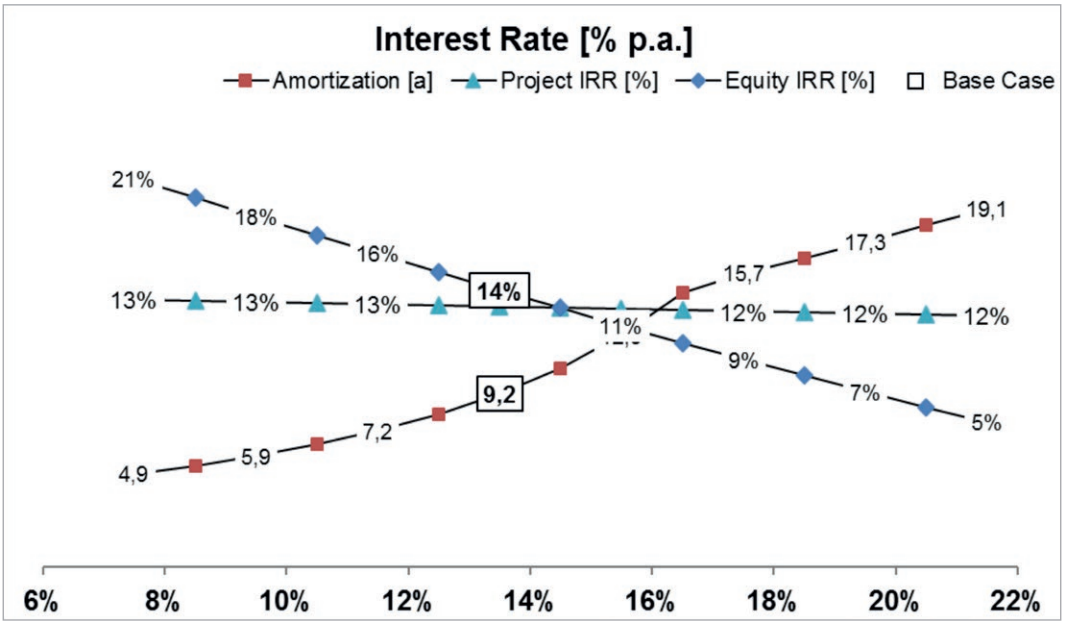
The figures 34 to 36 illustrate the impact of the sale of excess electricity on the amortisation period and equity IRR of the project, provided the electricity is sold at the same price as the average tariff for commercial consumers mentioned above. When systems are designed to barely cover the electricity demand of the consumer in a billing period, profitability is only marginal.

The lower the share of self-consumed electricity, the higher the impact of excess electricity sale on the project's profitability. Considering the relatively high tariff of grid electricity for commercial consumers, it appears most profitable for PV projects to consume the totality of their electricity they produce.

5. Interest rate sensitivity (large scale PPA)

The interest rate sensitivity was applied in order to analyse the impact of lower interest rates on the profitability of large scale PPA projects. As observed in the business case analysis in the previous section, the 13.5 % interest rate makes the project unattractive, since the amount of debt service is as high as the revenue. The figure 37 shows that only an interest rate significantly below the applied debt interest rate of 13.5 % would have a stronger leverage effect on the equity IRR. Lowering the interest rate of banks to European levels of 4 % or 6 %, would increase the equity IRR to very attractive levels of 18 to 21 %.

Figure 37: Interest rate sensitivity (5 MW plant)



Conclusion of the sensitivity analysis:

The profitability calculations show that the Afghan market has a significant PV potential. However, serious roadblocks currently make external donations and subsidies necessary for the development of PV projects. If these barriers are removed, Afghanistan will be able to realize its full potential for PV.

As far as positive aspects are concerned, Afghanistan benefits from excellent solar conditions which allow for a very good performance of PV modules. The existing administrative procedures for PV projects are currently time-efficient (although it remains unclear whether they would remain as effective with an increased number of PV projects to be developed). Moreover, the presence of skilled and highly-motivated manpower is a positive prerequisite for an attractive investment climate in the country. Additionally, Afghanistan's current reliance on imported electricity even increases the government's determination to encourage the development of indigenous PV energy production.

Within this context, the calculations showed that under current conditions, PV projects are only financially attractive with a short payback period if they enjoy high investment subsidies and no debt service. Such investment conditions are quite unrealistic and thus constitute very specific business models. In the real world, PV projects developed in Afghanistan need some form of support in order to achieve healthy profitability. This is currently the case for several off-grid projects developed with the donations from foreign government or private development agencies. For projects without donations, a financial support from the Afghan government is still needed to close the viability gap of PV projects.

Such support schemes are necessary in order to overcome the challenging investment situation Afghanistan currently faces. In fact, the relatively high interest rates presently offered by Afghan banks hardly contribute to increasing the profitability of PV projects. In this regard, calculations showed that in certain cases, the cost of debt is roughly as high as the project revenues without debt capital. In the absence of a financial support scheme such as donations or viability gap financing, the profitability of PV projects strongly depends on the tariff of the avoided electricity (from the grid or from other off-grid generation sources) allowed through the PV plant. This is particularly the case for rooftop PV projects working on the basis of net-metering, which are more profitable for commercial or un-registered industrial electricity customers, since they are subject to the highest electricity tariffs from DABS. Finally, the high level of customs tariff applied to PV equipment also breaks the profitability of PV projects.

The sensitivity analysis shows that the profitability of business models for PV can definitely be improved by modifying some key parameters. For example, reducing the customs tariff by 40-50% would have a significant impact on the payback period. Lowering the interest rate of banks to European levels of 4 % or 6 % could contribute to increasing the equity IRR to very attractive levels. Modification of these key parameters could be achieved through relatively simple mitigation measures, such as updating the price for PV systems on the custom tariff database. Other instruments such as introducing programmes to reduce interest rates artificially (e.g. through guarantees or debts with low interest rates), or providing training for banks, administrative institutions and utilities to increase their knowledge on PV will take more time and effort but will prove to be effective in mitigating existing risks in the future.

4.5 Success Factors for Developing PV Power Plants

The critical success factors for the development of a PV power plant, which any investor should consider before pursuing a particular opportunity, are the following:

- Distinguish between the specific security situations in the different regions of Afghanistan to allow for more differentiated security assessments and possible investment options in more stable regions;
- In the upstream financial feasibility study for off-grid PV projects, make sure to be able to sell the electricity produced at an affordable price for local consumers. Striking a balance between affordable electricity tariffs and satisfactory profitability is crucial for the long-term viability of the project, especially in rural areas with low purchasing power
- With regards to the current lack of existing Afghan technical standards and administrative procedures for PV plants, it is important that the consortium and the commissioner agree beforehand both on the standard requirements for the PV equipment and the process steps to be applied for the implementation of PV project.

5 Financial Options and Guarantees

To date, the development of solar PV projects in Afghanistan has been financed by international donations. The major donors have been USAID, the World Bank, the Asian Development Bank, the GIZ and the KfW group. Although there are many state-owned, private and international banks active in Afghanistan.[35] The financial options granted by international financial institutions are very limited and the financing offered by local banks for the development of PV is non-existing. On the other hand, mitigation financial mechanisms such as guarantees have not yet been used in the renewable energy sector in Afghanistan, but in the power generation by natural gas.

5.1 National Funding

Da Afghanistan Bank is in charge of the regulation of all banking and money handling operations in Afghanistan. Currently, there are no specific financial instruments or experience financing renewable energy projects in the country.

The financial conditions for regular financing by local banks in Afghanistan are:

- 13 to 18 % interest rate
- 120 % collateral guarantee

5.2 International Funding

Afghan Credit Guarantee Foundation (ACGF)

The Afghan Credit Guarantee Foundation is a risk mitigating instrument used to address non-commercial risk that prevents private sector investment. This kind of risk mitigation mechanism is usually provided by public funds.

This instrument, which started its activities in 2005 as the Credit Guarantee Facility for Afghanistan (CGFA), was implemented by the Deutsche Investitions- und Entwicklungsgesellschaft mbH (DEG) and funded by the German Ministry for Economic Cooperation and Development (BMZ) and USAID, with the aim to support the development of the private sector by improving access to finance for Afghan small and medium enterprises (SMEs). In 2015 the CGFA became an independent entity with an own management board and changed its name to the Afghan Credit Guarantee Foundation.

The business model of the ACGF includes the integration of partial credit guarantees and technical assistance in Afghan banks. The ACGF offers individual letters of guarantee for loans ranging between USD 10k – USD 1million extended to Afghan SME, covering up to 72 % of the loan. Fixed assets and working capital are available for all sectors. However, until now the ACGF has not covered any renewable or solar energy project.

Until the end of 2016 the foundation has covered 4,687 loans with a value of USD 168 million. The ACGF currently cooperates with the Afghanistan International Bank (AIB) and the First MicroFinance Bank.[36]

35 The list of active banks in Afghanistan provided in Annex 9.4.

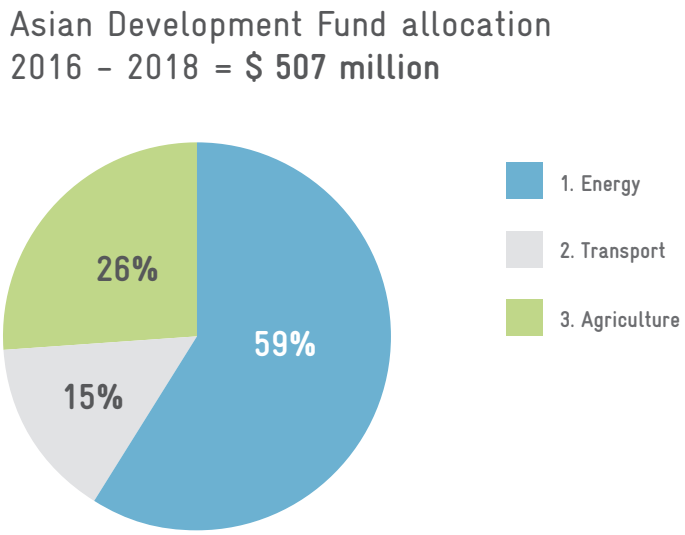
36 ACGF. Web. 30th March 2017.

Asian Development Bank (ADB)

Afghanistan is only eligible for the Asian Development Fund (ADF) grants from the ADB, since the country is considered as a high risk market. The Asia Development Fund provides grants to ADB's lower-income developing member countries and supports poverty reduction and improvements in the quality of life in the low-income countries of Asia and the Pacific. ADF resources come mainly from contributions from ADB's member countries[37].

Currently, the ADB finances renewable energy projects in Afghanistan in the framework of its "Country Business Plan 2016-2018". The grant allocation for 2016–2018 is $507 million for three main areas of assistance: 1) transport; 2) agriculture and natural resources and 3) energy. The share for energy projects is $301 million (59.4 % of the funds).[38]

Figure 38: ADF allocation for Afghanistan in the period 2016-2018[39]



The focus of the energy projects financed by the ADF is to improve the access to affordable and reliable energy for households. Within the energy budget, the key areas of assistance include renewable energy generation, including solar.

37 ADB. Asian Development Fund. Web. 29th March 2017.

38 ADB. Country Operations Business Plan, Afghanistan 2016–2018. November 2015.

39 Ibid.

Hermes cover: Export credit guarantees from the German government[40]

The Hermes cover protects German exporters against debt losses for commercial or political reasons. Usually, this is a prerequisite to getting funding from a bank.

Since Afghanistan´s country risk category by Hermes is 7 of 7, the export credit guarantee available is only for transactions with the private sector with contract values up to EUR 100,000. The guarantee is only short-term, for a maximum of 1 year. German export companies that sell their products to several countries and need the Hermes cover, can apply to a "collective cover" (Sammeldeckungen), where the amount is limited to EUR 500,000. Investment guarantees is only for special interest projects. To define this, an individual evaluation is necessary.

The Environment Protection Fund

Currently is being discussed the possibility of creating an "Environment Protection Fund", financed by international donors and international organizations related to climate change funds. Afghanistan has a national organization the NEPA (Afghanistan Environmental Protection Agency)[41], who could receive and manage the fund to support renewable energy projects.

5.2.1 Microcredits

Currently few international financial institutions offer micro-credits for the development of solar applications in Afghanistan. These institutions cooperate with the Afghan Credit Guarantee Foundation.

FINCA-Afghanistan[42]

FINCA-Afghanistan is a Kabul-based Micro Finance Institution founded in 2003 by FINCA International that offers financial products, mainly financing working capital and short-term assets. The aim of the institution is to alleviate poverty through solutions that help people to build assets, create jobs and raise their standard of living. Currently FINCA Afghanistan had more than 25.000 clients, a loan portfolio of 16.7 Mio US dollars in 21 branches, with an average loan of 1,000 US dollars. The products and services include individual loans, small group loans, SME loans as well as rural and agriculture loans.

Currently FINCA Afghanistan is implementing a pilot loan program that offers loans that support the acquisition of solar products of the "European Technology Company" (ETC)[43], located in Afghanistan. The loan offers up to AFN100,000[44], a loan tenor of 12 months and an annual interest rate of 21%. The pilot project, which is being supported by the IFC, will finish in June 2017. FINCA Afghanistan plans to implement the credit line officially at the end of 2017 and to extend it for the purchase of quality products of other companies (not for a specific company).

40 Euler Hermes Aktiengesellschaft -AGA Portal. Web.

41 National Environmental Protection Agency. Web. 4th May 2017.

42 FINCA-Afghanistan. Web. 29th March 2017.

43 ETC Power is a joint co-operation of four enterprises, three German and one Polish. Website: http://www.etc-power.de/en/home

44 AFN= Afghani (local currency): 1 € = ~ 82.3 Afghani (August 2017).

The First MicroFinance Bank Afghanistan (FMFB-A)[45]

The First MicroFinance Bank is part of the Aga Khan Agency for Microfinance (AKAM), which has programmes in over 15 developing countries. FMFB´s main objective in Afghanistan is to contribute to poverty alleviation and economic development though the provision of sustainable financial services for people with limited resources. FMFB-A systematically submits guarantee applications for a wide range of business sectors to ACGF, for loans from different regions of Afghanistan.

In the last few years, FMFB-A has explored the possibility of pilot-testing different models of solar products. As a result, it has identified an IFC-approved vendor for solar-powered home solutions namely ETC (European Technology Company), who provides solutions to supply power, water and heating through technologies based on renewable energy.

Through this collaboration, FMFB-A's will offer financial facilities to support the acquisition of solar home solutions. These include solar lights, cell phone chargers, TVs and DC fans. FMFB-A Solar products will target lower and middle-income segments who suffer long electricity cuts, as well as households located in off-grid locations. FMFB-A is in the final stage of negotiations regarding the loan conditions with its partner and expects to launch the loan in the coming months[46].

45 FMFB. Loans. Web. 30th March 2017.

46 Telephone interview with FMFB-A.

6 Business Conditions for PV Development

6.1 German-Afghanistan Relations[47]

Germany and Afghanistan have a long history of relations and in 2015-2016, the two countries celebrated 100 years of diplomatic relations. In the economic field, the Federal Ministry for Economic Cooperation and Development (BMZ) works in long-term programmes in the following five areas of development cooperation, included in the "Country Strategy for Afghanistan 2014 - 2017[48]": water, energy, good governance, education and promoting business and employment. Currently, Afghanistan is the biggest recipient of Germany's Official Development Assistance (ODA).

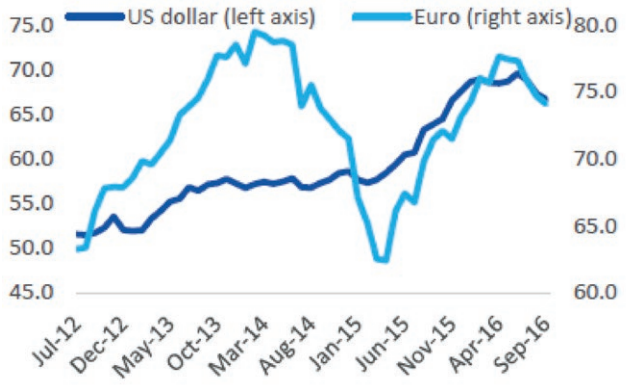
6.2 Afghanistan Economy Status

Currently, the private sector is one of the key drivers of the country's economy and growth. In this sector SMEs make up about 80 percent of Afghan businesses, half the country's Gross Domestic Product (GDP), and employ more than 1/3 of the labor force[49].

According to the World Bank, the main sectors that contributing to the GDP in 2015 were: agriculture, incl. cereals and fruits with 21,7 percentage; industry, incl. manufacturing, mining and construction, with 23,3 percentage; and services, incl. wholesale and retail trade, transport, communications, financial services and government services, with 55 percentage[50].

The local currency, the Afghani, has depreciated steadily against the US$ since 2012 (see figure below). The main reasons for this include: a) the decline of foreign exchange (reduction of foreign aid); b) the decline of foreign direct investment; c) an increased tendency for households to hold their savings in US$, and d) capital outflow due to increased migration and security issues.

Figure 39: Afghani exchange rate against US dollar and euro



47 German Federal Foreign Office. Bilateral relations: Afghanistan. Web. 2nd April 2017.

48 A revamping of the Country Strategy for Afghanistan is planned for 2017.

49 Islamic Development Bank.

50 World Bank. Afghanistan Development Update, October 2016.

Afghanistan trade and industrial pools are mainly located in Kabul, Kandahar, Herat, Jalalabad and Mazar-e Sharif.

Kabul, hosts almost all the main branches of major businesses. Kandahar, Herat, Jalalabad and Mazar-e Sharif are the 4 major provinces which represent the 4 zones of the country (North, South, East and West). Excluding Kabul, all of these major cities are located in border areas and their main economic activity is agriculture.

6.3 Export Status and Trade Partners

The main exports in 2015 were agricultural products with 30 %, including dried fruits and nuts, and medicinal plants with 19 %. The handcraft sector also occupies also an important position in the economic structure with 19 % of the export share in the same year.

Since 2002, export from Afghanistan has increased significantly. In 2002 Afghanistan's total exports were an estimated $100 million, which increased to $470 million in 2012. However, the contribution of "smuggled goods" is an estimated $2.6 billion[51]. Afghanistan's´ main trade partners are Uzbekistan, Pakistan and China. The trade with Uzbekistan was mostly the import of power.

In 2016 German exports to Afghanistan amounted to 50 million € and from Afghanistan to Germany 12 million €. However, there is no participation in the energy sector[52].

Afghanistan's formal admittance to the World Trade Organization (WTO) in July 2016 brought a large number of benefits, including: access to global markets, facilitation of transit and the resolution of trade disputes[53]. Regarding the ease of doing business, in 2016 the country ranked 182 of 190 countries. Afghanistan had a good ranking (38th of 190) in the activity "starting a business" in 2016[54].

6.4 Trade Conditions and Restrictions[55]

Currently, there are no deductions, legal or otherwise, including tax, value-added tax (VAT) for solar products in Afghanistan. According to the "Tariff Schedule, import & export" issued by the Afghan Customs Department, the following import taxes apply to imported photovoltaic products.

- Photovoltaic cells whether or not assembled in modules or made up into panels: 2,5 percentage
- For batteries: 5 percentage
- For inverters: 5 percentage

51 Afghanistan Export Promotion Agency.

52 Federal Statistical Office (Destatis). Atlas, Afghanistan. Web. 2nd April 2017.

53 World Bank. Afghanistan Development Update, October 2016.

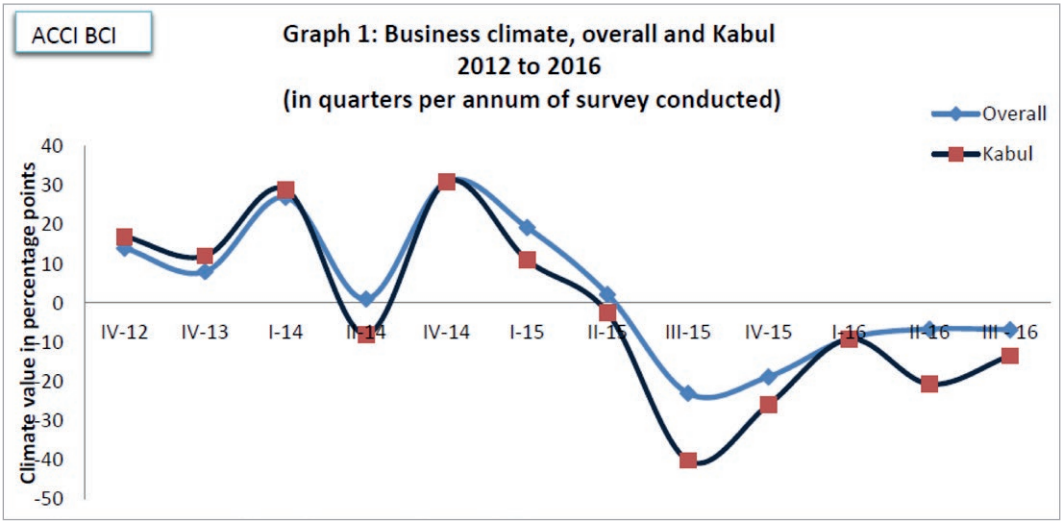
54 World Bank. Doing Business: Afghanistan. 2017. Web. 2nd April 2017.

55 Afghanistan Custom Department. Tariff Schedule 2014.

6.5 Security and Business Climate

According to the Afghanistan Chamber of Commerce & Industries (ACCI) Business Tendency Survey Report, although the business climate in Afghanistan witnessed a huge decline from 2014 to 2016, it has been slowly improving since the 4th quarter of 2015.

Figure 40: Business climate, overall and Kabul, 2012 to 2016[56]



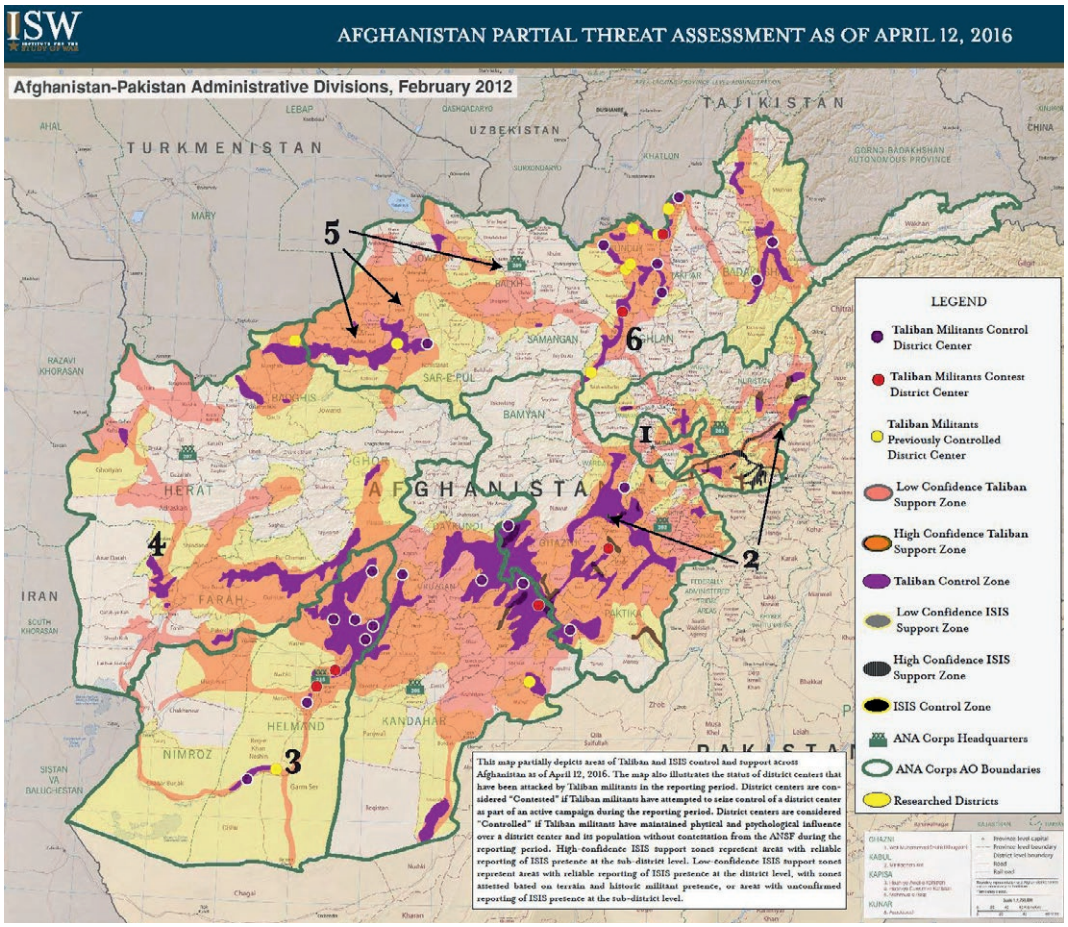
According to the survey, the most important factor for business development is security, followed by administrative reforms, infrastructural improvement and access to finance. The provinces of Kandahar and Nangarhar have the best business conditions[57].

The security situation in Afghanistan has been fluctuating unpredictably. The map below is an assessment of threat in different parts of Afghanistan.

56 ACCI Business Tendency Survey Report. October 2016.

57 Ibid.

Figure 41: Afghanistan threat assessment – 2016[58]



As shown in this map, central Afghanistan is the most secure place in the country. Eastern places have been safe in the last decade, but the presence of the Islamic State of Iraq and the Levant (ISIS) and Taliban armed forces has aggravated the security situation in this area in the last 2 years. Herat, Farah, Nimroz and Ghor provinces are relatively safer provinces. However, some areas in these provinces have also experienced a number of casualties in the past 15 years.

Parwan, Kapisa, Panjshir, Bamyan, Daikundi, and Samangan are among the safest places with minimum casualty rates in the past 15 years. The central provinces and districts and their closer surroundings are also considered safe areas. These are the most populated areas of the country and have the potential for PV integration.

Since the security risks and costs are an important issue for investors, these risks and costs need to be identified and covered. One way to cover these costs would be to include them in the bid of tenders, which would increase the tariff offered by the company. The other option would be if the government of Afghanistan were to offer security packages to cover these costs.

58 ISW – Institute for the Study of War.

7 Policy Recommendations

Afghanistan is taking big steps towards an energy transition with high shares of solar energy. Through these efforts, the Afghan society will benefit from cheap, reliable and clean energy. In particular solar rooftop PV provides several advantages for the Afghan case: By enabling a self-sustained business model via Feed-in-Tariffs and a Net-Metering scheme, the private capital of non-professional investors will be mobilized that would otherwise go into the financing of central fossil power sources. Projects can be implemented much more quickly than in the traditional energy sector with the result that the electrification and the stabilization of the existing power supply will progress at a higher pace. Distributed solar PV, especially if combined with storages, reduces power outages on individual consumer level. Thus, commercial activity can better flourish because it relies on a more stable power supply. On a macro-economic level, the cost of added power capacity is lower when solar PV and wind energy are deployed. Already today, the results of PV tenders around the world have undermatched the price of fossil energy sources significantly as the cases of the UAE or Mexico (both 2016) show with less than 40 US $ /MWh. As a consequence of this price path, the world installed approx. 75 GW of solar PV in 2016 alone, compared to 64 GW of other renewables and 100 GW of non-renewables, which results in a PV share of 31% of all newly installed power capacity in 2016. Afghanistan can benefit from this development and harvest the outcomes of further cost reductions in the future.

To initiate this opportunity, the Afghan government has to set up an appropriate framework. This report shall outline the fields of action, which can generate the highest impact on the development of solar PV and tackle the most urgent challenges in the market. Amongst others, these are:

- The lack of an accessible, profitable and reliable support scheme for everybody. A scheme that sets itself apart from individual negotiations with the government but establishes a resilient standard.
- The unpredictability of applied taxes: Which taxes have to be paid for which service, is extremely unclear and partly uncertain.
- Access to Finance: One of the greatest obstacles to doing business in Afghanistan is scarce access to finance.
- Manpower: Technical and engineering knowledge is low; skilled labor is scarce, the literacy of Afghans is also low only 28 %.
- Corruption and regulation: The lack of institutional capacity and binding regulation create corruption and anti-trust between government and business interested people.
- Security Challenges: World Bank claims crime and security as the number one constraint for doing business in Afghanistan.

How can the Afghan government tackle these challenges?

Feed-in-tariff / PPA tariffs and Net-Metering

The existing attempt to reach a binding framework for kwh-based remuneration of solar PV should be finalized properly in order to create investor confidence. Within the Feed-in-tariff policy, it is necessary to guarantee a fix tariff for every PV-kwh and for a certain time period. In most FiT-countries, this time span is 15 or 20 years, incentivizing system quality and durability. It is possible to slice the FiTs into periods of 3 to 5 years, giving the opportunity to re-assess and modify components of the FiT which do not determining the production cost of the system (e.g. security cost). The total duration of a PPA- / FiT-contract shall not be affected. Secondly, the right to access to the grid for injecting the PV electricity without paying for unreasonable grid expansion, should also be guaranteed. The Distribution System Operator (DSO) must be obliged to offtake the electricity and to authorize the installations within short deadlines and with financial penalties when deadlines are exceeded. Most customer groups should be eligible for the FiT. Curtailment should be reimbursed by the DSO for not disincentivizing grid expansion. In the case of disputes between private investor and DSO, the burden of proof should lie with the DSO, to protect the weaker role of the (private) investor. In addition to these criteria, net metering requires clear and reliable compensation of excess energy, generous balancing periods and common standards for the installation of meters which should not be prohibitive financially or technically.

Organizational structure

In many documents, DABS is assigned as the implementing body of PPAs and net-metering. Since DABS is a legal entity with certain business interests touching the expansion of renewable capacity, it is hard for them to remain completely neutral. This applies in particular to the preferred grid zones and the allocation of grid expansion costs. As in many other countries, a neutral third party could take over the responsibility for the necessary transactions, just as the SUNA agency is doing in Iran. This third party could define standardized and reliable procedures for the project development, including binding application forms and approval deadlines.

Information hub

PV technology is new on the Afghan energy market. Since the market uptake depends on the comprehension and willingness of investors, dedicated institutions should try to educate the market stakeholders about the technology, its profitability, the administrative processes and the related norms and quality standards. The MEW or other regulatory bodies should have clear information freely available on their websites or via printed publications. The MEW should also assign responsibility for market information campaigns and for training standards to an institute or a department so that (any) material must not be developed twice and is of an acceptable quality.

Customs

Customs tariffs for imported PV products delay business activities in the solar sector. The reason is that the tariff schedule of the Afghan Customs Department applies import taxes for photovoltaic cells (2.5 percentage), batteries (5 percentage) and inverters (5 percentage). In addition, the reference prices for these tariffs are outdated and far too high. If customs tariffs cannot be abolished, at least the reference prices should be updated to today's global prices level. This would decrease the absolute tariffs immediately and make Solar PV more economical.

Financing

Financing apart from donations is still rarely available in Afghanistan. Interest rates are high, the public default risk significant and no solar specific financing scheme is available yet. The government can tackle these deficits indirectly by educating the banking sector to better assess solar technology and by introducing special security packages in order to lower security-driven cost on the bank side and on the investor side.

Moreover, to reduce the default risk of FiT payments, the government should offer public guarantees and securities, signed by the Ministry of Finance, for insuring the offtaker-risk, at least for the larger installations.

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9 Annex

9.1 Annex 1: Template of Interviews

Research template for the analysis of the current framework for solar photovoltaics in Afghanistan

Interviewee Profile				
Name				
Position				
Name of the company or institution				
1.	Business model	What is the name of the business model applied for PV (e.g. self-consumption, net-metering, direct line PPA, micro-grid etc.)?		
2.	Size and Voltage of the PV System	Which types of PV installations are concerned by this business model?		
3.	Irradiation in kwh/m2/a	What is the irradiation range of the PV system according to the geographical site?		
4.	Type of grid connection	Is the PV system off-grid or grid-connected (in which case, what is the voltage level of the grid the installation is connected to?)		
5.	Customer group	To which customer group is the PV system addressed (private households, commercial, industrial customers)?		
6.	Support scheme	Programme	- Does the business model benefit from financial support (e.g. grants, loans, FIT)? - If yes, what is the name and nature of the support program (investment subsidy, loan with preferential interest etc.)?	
		Eligibility criteria	What are the conditions for support?	
		Amount of support	- How is the amount of support defined (in AFN or in % of the investment price)? - Is the support limited over time?	
7.	Project flow description	Please describe in the correct sequential order each step that has to be undertaken by the project developer in order to accomplish the project. Such steps can include for example: 1. Site selection 2. Electricity production 3. Administrative process 4. Grid connection permit 5. Support scheme 6. PV system construction 7. Financing 8. PV system operation		
		Step 1	Description	
			Relevant actors	
			Duration	

	Project flow description	Step 2	Description	
			Relevant actors	
			Duration	
		Step 3	Description	
			Relevant actors	
			Duration	
8.	Project development duration	How much time is spent carrying out the project and how much of this time is spent just waiting for an authority to respond?		
		Overall Duration	Average time spent starting from first official administrative process step to final commissioning of the plant.	
		Waiting Time	For how long does the project developer have to wait for an answer from authorities, administrations or grid operators, which delays the PV project development process?	
9.	Retail price of the PV plant	Overall system price	What is the overall system price of the PV plant in AFN/kWp?	
		Installation costs	How much are the installation costs of the PV plant (in % of the overall costs)? Excluding soft costs, hardware and financing costs.	
		Soft costs	Please estimate the share of soft costs of the PV plant (e.g. administrative costs) in %. Such costs may relate to: - Applications fees for necessary licenses and certifications - Fees for inspections or audits if required by legal-administrative regulations - Costs due to subcontracting	
		Hardware costs	- What is the share of hardware costs in % (for PV panels, inverter, cables etc.)? - How are the VAT costs calculated?	
		Financing costs	In case of liabilities, what is the share of financing costs (including interest rate and borrowing conditions)?	
10.	Project revenues (according to the activity of the interviewee)	Payback time	After how many years is the investment amortised?	
		Direct revenues	What are the direct revenues allowed with this business model? For example, can the electricity produced be sold to a third party (e.g. grid operator)? How is the sales price of the produced electricity defined? Is there any feed-in tariff, or does the electricity producer has to negotiate a supply price?	
		Indirect revenues	Such as electricity savings or green certificates.	
		Customer's expectations	What are the revenue expectations of the customer, in terms of amortisation and expected return on investment?	

11.	Profitability factors of the business model	Electricity purchase	– To which price can the electricity of the PV producer be sold to the grid operator? – Is there a difference between electricity tariffs of the grid operator and the purchase price of PV electricity?
		Components of the electricity price	
		Direct electricity supply	Is it possible to directly supply the electricity produced? E.g. to a neighbour via a direct line or via the grid to any consumer?
		Conditions of electricity supply	Can the produced electricity be supplied through the national electricity grid, or can it only be supplied through own grids?
		Avoided taxes and duties	Are there costs due to taxes and duties which can be saved?
		Electricity supply quotas	In case of self-consumption, which share of electricity production can be sold to the grid operator?
		Electricity consumption quotas	In case of self-consumption, which share of electricity production will typically be consumed on site?
		Yearly electricity consumption and load profile of the consumer	Total consumption over a year with monthly distribution and typical daily profile for the different seasons.
		Increase rate of electricity tariffs for the consumer	Increase of electricity tariffs in %/p.a. for the past 5 years and forecast for next 5 years if available.
12.	Practical Barriers	Please describe all possible barriers and unnecessary obstacles which may occur during this process.	
		Barrier 1	
		Barrier 2	
		Barrier 3	
13.	Relevant legal sources	List of relevant legal sources used in the document	

9.2 Annex 2: Relevant Contacts

	Name of Stakeholders	Contact information
1	Ministry of Energy and Water (MEW)	www.mew.gov.af/
2	The Renewable Energy Department (RED) of MEW	www.red-mew.gov.af/ RED@mew.gov.af
3	Ministry of Rural Rehabilitation and Development (MRRD)	www.mrrd.gov.af/
4	Da Afghanistan BRESHNA SHERKAT(DABS)	main.dabs.af/
5	Afghanistan Renewable Energy Union (AREU)	www.areu.com.af
6	Afghan National Standard Authority (ANSA)	www.ansa.gov.af
7	Inter-Ministerial Commission for Energy (ICE)	https://sites.google.com/site/iceafghanistan/
8	World Bank /Afghanistan	http://www.worldbank.org/en/country/afghanistan
9	Asian Development Bank /Afghanistan	https://www.adb.org/countries/afghanistan/main
10	GIZ/Afghanistan	https://www.giz.de/en/worldwide/358.html
11	USAID	https://www.usaid.gov/afghanistan
12	ASERD (Afghanistan Sustainable Energy for Rural Development)	http://mrrd.gov.af/en/page/69/430
13	United Nations Development Program (UNDP)	http://www.af.undp.org/content/afghanistan/en/home/operations/projects/poverty_reduction/ASERD.html

9.3 Annex 3: Company Members of AREU

No.	Company Name
1	Bakhtar Bastan.com
2	European Technology Company
3	Farhad Technic Company
4	Kabul Rohani Company
5	Qaderdan Rural Technology and Development Workshop
6	Zaib Pamir Elect Engineering Company
7	Clean Solar Energy Production Company
8	Afghan Effective Marketing Services
9	Ikhlas Sultani . Ltd
10	Afghan Sun Energy for today
11	Zularistan Ltd
12	Farah Gostar Co.ltd
13	Zasu Arrow Ltd
14	Brag Engineering & Consulting Co
15	Integration Group
16	Sustainable Engergy Services International
17	Rana Afghan Micro Hydro Power And ACSR Conductor
18	Paikar Renewable Energy
19	Stroke Renewable Energy
20	MiDS
21	Towfiq Amini Solar Company
22	Afghan Wind Solar Company
23	Bashiri Machinery Ltd
24	Qasemi Group of Companies
25	Moon Style Construction.Co
26	Global Infrastructure Consultant
27	RGM International Group
28	Infoexpress Solar Power
29	NovinSimia production company
30	Dewa Solar Company
31	Paneltech Company
32	Vista Solar Company
33	Rahkar Renewable Energy Consulting
34	Alef Technology
35	Zwakman Afghan
36	Sahami Shinwari Engineering
37	Kohsar Pamir
38	Omid Khurshid Noor solar company
39	Destiny Consultancy Service
40	Naser limited Company
41	Alokozia limited company
42	MHP limited company

9.4 Annex 4: Contact Information of the Banks in Afghanistan

a) Government Banks:

Bank-e-Millie Afghan	
Type of bank	State Owned Commercial Bank
Telephone	+93 20 2102 221
Fax	+93 20 2101 801
P.O. box	522 Kabul Afghanistan
Telex	31 Bankmili AF
Email	info@bma.com.af
Website	www.bma.com.af
Swift	BMAFAFKA
Address	Ibne Sina Watt, beside the Da Afghanista

New Kabul Bank	
Type of bank	State Owned Commissarial Bank
Telephone	+93 791 600- 700 / 800
P.O. box	260
Email	info@newkabulbank.af
Website	www.newkabulbank.af, www.newkabulbank.com
Swift	KABUAFKA
Address	10- 42 Turbazkhan Share-e- Now, Kabul Afghanistan

Pashtany Bank	
Type of bank	State Owned Commercial Bank
Telephone	+93 202 1038- 63 / 65 / 72
Fax	+93 210 29 05
Email	info@pashtanybank.com
Website	www.pashtanybank.com
Swift	PIBA AF KA
Address	Ghazi Mohammad Jan Khan Watt, Kabul, Afghanistan

b) Private Banks

Afghanistan Commercial Bank	
Type of bank	Full - Fledged commercial bank
Telephone	+93 202 2038- 71 / 72
Fax	+93 202 2038 70
Website	www.acbank.com.af
Swift	--
Address	Shar-e-Naw Tura Baz Khan Street Kabul Afghanistan.

Afghanistan International Bank	
Type of bank	Full - Fledged Commercial Bank
Year established	March 22, 2004
Telephone	+93 20 2550 256 and +93 799 0898 98
Fax	+93 20 2550 256
Email	info@aib.af
Website	www.aib.af
Swift	AFIB AF KA
Address	Shahr-e-Naw Haji Yaqoob Square, next to butcher street, Kabul, Afghanistan

Afghan United Bank	
Type of bank	Full - Fledged Commercial Bank
Telephone	+93 202 2038- 36 / 37
Fax	+93 202 2038 38
Email	aubkbl@gmail.com, info@aub.af
Website	www.aub.af
Swift	BMAFAFKA
Address	Turabaz Khan road, Shahr-e-Naw, Kabul, Afghanistan

Arian Bank	
Type of bank	Full – Fledged Commercial Bank
Telephone	+93 202 2039 67
Fax	+93 202 2040 10
P.O. box	5810
Email	info@arian-bank.com.af
Website	www.arian-bank.com.af
Swift	AFABAFKA
Address	Opposite Of Attorney General, Hanzala Masque Road, Shahre Now, Kabul Afg.

Azizi Bank	
Type of bank	Full – Fledged Commercial Bank
Telephone	+93 202 104 470, +93 752 023 975
Fax	+93 202 1044 71, +93 752 0239 75
P.O. box	221 Kabul Afghanistan
Email	mainbranch@azizibank.af, info@azizibank.com
Website	www.azizibank.com
Swift	AZBAAFKA
Address	Zanbaq square, main road, opposite of Turkish embassy, Kabul, Afghanistan

Ghazanfar Bank	
Type of bank	Full – Fledged Commercial Bank
Telephone	+93 202 1011 11, +93 797 8600 01
Email	info@ghazanfarbank.com
Website	www.ghazanfarbank.com
Swift	--
Address	Sher Pur Road, Kabul, Afghanistan

Maiwand Bank	
Type of bank	State Owned Commercial Bank
Telephone	+93 202 1038- 63 / 65 / 72
Fax	+93 210 29 05
Email	info@pashtanybank.com
Website	www.pashtanybank.com
Swift	PIBA AF KA
Address	Ghazi Mohammad Jan Khan Watt, Kabul, Afghanistan

The First Micro Finance Bank	
Type of bank	Full - Fledged Commercial Bank
Telephone	+93 202 2017 33, +93 798 3632 23
Email	info@fmfb.com.af
Website	www.fmfb.com.af
Swift	--
Address	Street west of Park Shahr-e-Naw, Charahi Ansari Kabul, Afghanistan

c) Foreign Commercial Banks

Bank Alfalah Ltd	
Type of bank	Foreign Commercial Bank
Telephone	+93 202 203- 363 / 860
Fax	+93 202 203- 362 / 861
Email	kabul@bankalfalah.com
Website	www.bankalfalah.com
Swift	ALFH AF KI
Address head branch	410 Char Rahi-e-Sadarat Shahr-e-naw, Kabul, Afghanistan

Habib Bank Ltd	
Type of bank	Foreign Commercial Bank
Telephone	+93 202 2001 47, +93 202 2034 49
Fax	+93 202 2001 48
Email	cmhbl.afg@hotmail.com
Website	www.habibbankltd.com
Swift	HABB AF KA
Address head branch	First Floor, Park Plaza, Torabaz Khan Road Shahr-e Now, Kabul, Afghanistan

National Bank of Pakistan	
Type of bank	Foreign Commercial Bank
Year established	October 1, 2003 (Afghanistan)
Telephone	+93 20 2302 729
Fax	+93 20 2301 659
Email	nbpkbl@hotmail.com, nbpkbl@yahoo.com
Website	www.nbp.com.pk
Swift	NBPA AF KA
Address head branch	House No:2, Street No:10, Wazir Akbar khan, Kabul, Afghanistan

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E: info@bsw-solar.de | T: + 49 30 2977788-0 | F: + 49 30 2977788-99 | I: www.solarwirtschaft.de

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