

The 2023 Solar PV Status Report for Lebanon

April 2025

Author & Data Collection

Mr. Mohamad El Hajj (Senior Energy Engineer – Project Coordinator)

Mr. Hadi Abou Moussa (Senior Energy Engineer – Project Coordinator)

Ms. Grace Mikhael (Programs Coordinator)

Reviewers

Dr. Sorina Mortada (Technical Consultant)

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The Lebanese Center for Energy Conservation (LCEC) is the national energy agency for Lebanon. LCEC is hosted by the Lebanese Ministry of Energy and Water (MEW) with a financially and administratively independent statute. LCEC acts as the technical arm of the Lebanese Government, specifically of the Ministry of Energy and Water in all issues related to energy efficiency, renewable energy, and green buildings.

For more information:

The Lebanese Center for Energy Conservation, www.lcec.org.lb

Note: The information contained within this document has been developed within a specific scope and might be updated in the future.

ACKNOWLEDGEMENTS

The Lebanese Center for Energy Conservation (LCEC) would like to thank all its partners, specifically the Higher Council of Lebanese Customs, and all renewable energy companies for contributing to the data presented herein and for their support in the preparation of this report.

LCEC would also like to thank the UNDP-DREG Project for the development of the first three versions of the Solar PV Status Report and for enabling the continuation of the fourth, fifth, sixth and the present seventh edition.

EXECUTIVE SUMMARY

This report is prepared annually by the Lebanese Center for Energy Conservation (LCEC) to report on the development of rooftop solar PV applications at the national level. The LCEC is developing the “Annual Solar PV Status Report for Lebanon” by establishing and producing annual market monitoring reports on the installed capacity and electricity produced from decentralized renewable energy across Lebanon.

The objective of this report is to present comprehensive data relevant to the implemented decentralized solar photovoltaic projects in Lebanon, mainly privately owned systems installed with the aim to increase energy security and to reduce the environmental impact of fossil fuels.

The 2023 Solar Photovoltaic (PV) Status Report for Lebanon, developed and published in its seventh edition in 2025, highlights the status and the trends of the solar PV market by presenting and analyzing all its available data.

The Solar PV Status Report for Lebanon has become a yearly collaborative publication reporting on the market’s growth for the previous year. This in turn enables decision-makers and stakeholders to align their efforts to continue supporting the market and sustain its healthy growth.

EXECUTIVE SUMMARY

- 1. The electricity consumption in Lebanon was reduced by 29% between 2021 and 2022, whereas the contribution of renewable energy sources to the electricity generation mix increased from 6.3% in 2021 to 20% in 2022, and remained 20% in 2023 (due to a drop in hydro production).
- 2. The installed solar PV capacity contributed to 2.2%, 12.6%, and 15% of the electricity generation mix for 2021, 2022, and 2023, respectively.
- 3. In 2010, Lebanon’s solar PV installed capacity equaled 0.3 MWp and increased over ten years to reach 92 MWp by the end of 2020. 989 MWp of solar PV capacity were installed in 2021, 2022, and 2023 equivalent to an 845% growth rate of the cumulative installed capacity within two years.
- 4. As of 2010, the year-to-year increase of the cumulative installed capacity was as follows:

+ 43%	to equal	0.5 MWp	in 2011
+ 68%	to equal	0.8 MWp	in 2012
+ 138%	to equal	1.9 MWp	in 2013
+ 139%	to equal	4.5 MWp	in 2014
+ 150%	to equal	11.2 MWp	in 2015
+ 118%	to equal	24.4 MWp	in 2016
+ 52%	to equal	37 MWp	in 2017
+ 52%	to equal	56.2 MWp	in 2018
+ 39%	to equal	78 MWp	in 2019
+ 18%	to equal	92.3 MWp	in 2020
+ 124%	to equal	206.3 MWp	in 2021
+ 321%	to equal	869.3 MWp	in 2022
+ 24%	to equal	1081.3 MWp	In 2023

- 5. This shows an accumulation of 10 times the national target of 100 MWp decentralized solar PV by 2020, as per the National Renewable Energy Action Plan (NREAP 2016-2020).

EXECUTIVE SUMMARY

6. Yearly investment in the solar PV sector increased from \$2.3 Million in 2010 to \$138.8 Million in 2020. The cumulative investments in this sector witnessed a 693% growth rate in the following two years and totaled \$ 1.1 Billion by the end of 2022. In 2023, the total investment reached approximately \$293 million, bringing the cumulative figure to \$1.4 billion, highlighting ongoing strong growth and commitment in the sector.
7. By the end of 2020, 46.7% of investments in installing 92 MW of solar PV came from the NEEREA financing mechanism. Accounting for the cumulative installed solar PV of 989 MW in 2021, 2022, and 2023 none of the investments were through NEEREA.
8. The estimated monetary savings from all solar PV projects in Lebanon grew from USD 0.2 Million per year in 2010 to USD 572.1 Million in 2022. Cumulative savings by the end of 2020 amounted to USD 96.2 Million and totaled around USD 779.2 Million by the end of 2022 showing a 710% growth rate within two years. By the end of 2023, the cumulative monetary savings increased to USD 1.579 billion.
9. The estimated emissions savings from all solar PV projects in Lebanon grew from 377 tCO₂e per year in 2010 to 2,418,435 tCO₂e in 2023. The increase in the implementation of solar PV projects between 2020 and 2023, led to an increase in the cumulative estimated savings by 393%.
10. The average turnkey price for solar PV had been falling steadily year after year from \$7,186 per kWp in 2011 to \$1,003 in 2023. This constitutes a price drop of 86% in a span of eleven years.

TABLE OF CONTENT

LIST OF ACRONYMS	8
LIST OF TERMS	9
REPORT METHODOLOGY	11
LEBANON'S ELECTRICITY SECTOR	12
ELECTRICITY GENERATION MIX	13
SUBSIDIES REMOVAL & PV MARKET BOOM	14
SOLAR PV CAPACITY AND ANNUAL ADDITIONS	15
SOLAR PV CAPACITY AND GENERATION	16
SOLAR PV CAPACITY YEAR-ON-YEAR GROWTH RATE (%)	17
PV INSTALLED CAPACITY WITH AND WITHOUT STORAGE (kWp)	18
SOLAR PV CAPACITY PER GOVERNORATE (MWp ; %)	19
SOLAR PV INVESTMENTS (\$MILLION)	20
ESTIMATED SOLAR PV MONETARY SAVINGS (\$ MILLION)	22
ESTIMATED SOLAR PV EMISSION SAVINGS (tCO ₂ e)	23
YEARLY AVERAGE SOLAR PV TURNKEY PRICE (\$/kWp)	24
TYPES OF PV SYSTEMS USED FOR POWER GENERATION	25
TYPES OF PV SYSTEMS USED FOR SOLAR PUMPING	26
SOLAR PV CAPACITY AND COUNT BY PROJECT SIZE GROUP 2021 & 2022	27
PV UNIT PRICE WITH AND WITHOUT STORAGE (\$/kWp)	28
POWER GENERATION PV SYSTEMS WITHOUT STORAGE: YEARLY AVERAGE PRICE (\$/kWp)	29
POWER GENERATION PV SYSTEMS WITH STORAGE: YEARLY AVERAGE PRICE (\$/kWp)	30
CUMULATIVE INSTALLED CAPACITY BY SECTOR (kWp) – 2021 / 2022	31
SOLAR PV CAPACITY BY SECTOR (%)	32
PV SYSTEM PURPOSE PER GOVERNORATE BY END OF 2020	33
PV SYSTEM PURPOSE PER GOVERNORATE 2021 & 2022	34
PV SYSTEM PURPOSE PER GOVERNORATE 2023	35
PV SYSTEM TYPE PER GOVERNORATE BY END OF 2020	36
PV SYSTEM TYPE PER GOVERNORATE 2021 & 2022	37
PV SYSTEM TYPE PER GOVERNORATE 2023	38
PV SYSTEM TYPES USED FOR POWER GENERATION (%)	39
PV SYSTEM TYPES USED FOR SOLAR PUMPING (%)	40
CLIMATIC ZONES & PV SYSTEM YIELDS	41
MOUNTING SYSTEM TYPES	42
TAKEAWAY POINTS	43
LIST OF PARTICIPATING ACTIVE LEBANESE SOLAR PV COMPANIES	44

LIST OF ACRONYMS

BDL	Banque du Liban
EAC	Energy Attribute Certificates
EDL	Electricité du Liban
IREC	International Renewable Energy Certificate
kW	Kilo-watt
kWh	Kilo-watt-hour
kWp	Kilo-watt-peak
LCEC	Lebanese Center for Energy Conservation
MoE	Ministry of Environment
MEW	Ministry of Energy and Water
MW	Mega-watt
MWh	Mega-watt-hour
MWp	Mega-watt-peak
NEEREA	National Energy Efficiency and Renewable Energy Action
NREAP	National Renewable Energy Action Plan
PV	Photovoltaic
tCO2e	Tons of carbon dioxide equivalent
UNDP-DREG PROJECT	United Nations Development Program-Decentralized Renewable Energy Generation Project

LIST OF TERMS

Decentralized Energy	Decentralized energy is produced close to where it will be used rather than being generated in a large plant and transmitted through the national electrical grid.
Generation Capacity	Generation capacity is the maximum electric output an electricity generator can produce under specific conditions.
Electricity Generation	Electricity generation is the amount of electricity a generator produces over a specific period.
PV projects for Power Generation	Category of solar PV projects serving the purpose of generating and consuming (or storing) electrical power, in order to reduce the consumption from the national grid and/or diesel generators.
PV projects for Solar Pumping	Category of solar PV projects serving the purpose of generating (or storing) electrical power in order to operate DC or AC pumps used for water pumping.
On-grid /Grid-tied /Online	PV systems operating with the national grid only.
On-grid with storage	PV systems operating with the national grid only, and having a storage component (batteries) for backup.
Hybrid/ Multisource (EDL/EDZ+ DGs) with storage	PV systems operating with the national grid and with diesel generator(s), and having a storage component for backup.

LIST OF TERMS

Hybrid/ Multisource (EDL/EDZ+DGs) without storage

PV systems operating with the national grid and with diesel generator(s), without having a storage component for backup.

Off-grid/ Stand-alone /Autonomous with storage

PV systems not connected to the national grid, feeding the local loads and charging the batteries thereby ensuring a fully autonomous operation.

Off-grid /Stand-alone /Autonomous without storage

PV systems not connected to the national grid, feeding the local loads only thereby ensuring a fully autonomous operation.

Off-grid with generator backup with storage

PV systems not connected to the national grid but operating with backup diesel generator(s), feeding the local loads and the batteries, but relying also on backup generator(s) for the same purposes when needed.

Off-grid with generator backup without storage

PV systems not connected to the national grid but operating with backup diesel generator(s), feeding the local loads only, but also relying on backup generator(s) for the same purpose when needed.

REPORT METHODOLOGY

LCEC based its approach to evaluate the solar photovoltaic (PV) installations in Lebanon till the end of 2023 on data collected from solar PV active companies in the Lebanese markets, data provided by the Higher Council of Lebanese Customs, solar PV system components imported during the years of 2021, 2022, and 2023, and information from companies on available stock and percentage of implemented components.

The objective is to evaluate the current status, potential, and impact of solar PV systems in the country. The assessment encompassed a comprehensive analysis of installed capacity, production, distribution on sectors and governorates, savings, market growth and investments, technology used, etc. The assessment includes:

- a. Database Compilation: Development of a comprehensive database of existing solar PV installations in Lebanon based on surveyed data, including their location, capacity, technology used, installation date, etc.
- b. Growth Trends: Analysis of historical data to assess the growth of solar PV installations over the past few years and identify potential growth projections.
- c. Regional Distribution: Evaluation of the geographical distribution of solar PV systems to understand their concentration in different areas of the country.
- d. Carbon Emissions Reduction: Estimation of the reduction in carbon emissions achieved by solar PV installations up to 2023.

115 companies that have been working in the sector for the last 10 years were contacted by the LCEC team, and only 58 companies shared full detailed data regarding their installations of solar PV systems in 2021, 2022, and 2023.

The report is divided into two parts. The first part presents the solar PV data on a national level whereas the second part deals with data collected from surveyed companies.

Based on the findings from the assessment, takeaway points are provided on the status quo and targets to enhance the adoption and impact of solar PV installations in Lebanon.

LEBANON'S ELECTRICITY SECTOR

Background information

Lebanon's electricity sector has been facing long-lasting difficulties for many years, with widespread power shortages and frequent blackouts, and an insufficient supply of electricity to meet the country's demand.

As the demand for electricity in Lebanon has regularly exceeded the supply from the state-owned utility company, Electricité du Liban (EDL), electricity generation capacity has struggled to keep pace with increasing demand from all sectors, especially residential, commercial, and industrial sectors.

In the last quarter of 2019, a severe economic and financial crisis hit Lebanon. The crisis has further intensified the difficulties in the electricity sector, increasing challenges in funding the import of fuel needed for electricity generation and maintaining the existing infrastructure. The country is heavily relying on imported fuel oil and gas to power its electricity generation plants. Fluctuations in international fuel prices and currency exchange rates have contributed to the pressure on the electricity sector.

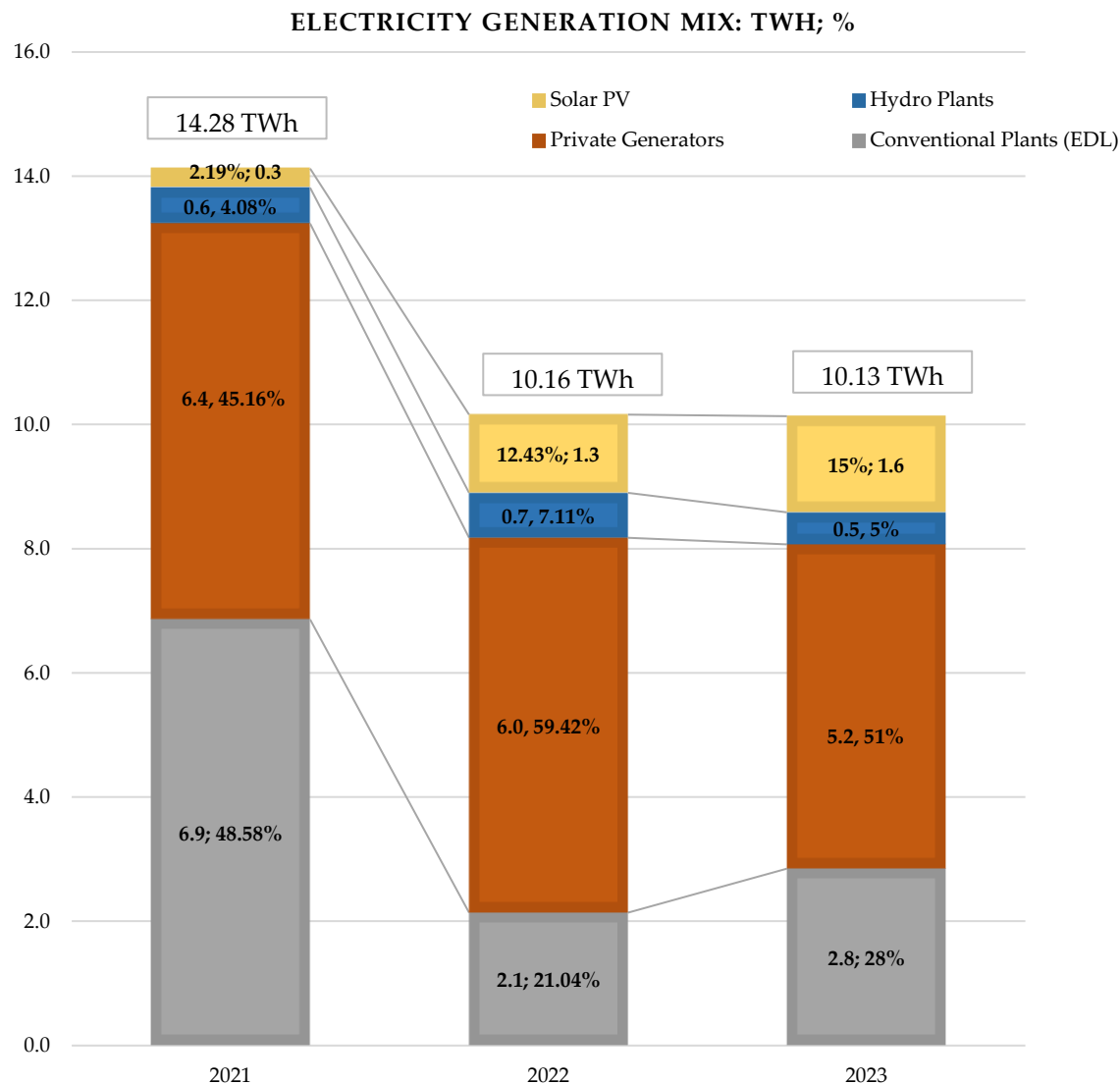
Similar to previous years, in 2021, 2022, and 2023 the actual available capacity regularly fell short of the installed capacity due to various operational and financial issues faced by the Electricité du Liban (EDL).

The contribution of private generators increased to fill the gap left by EDL's decline. Private generators made up 45.16% of electricity in 2021, rising to 59.42% in 2022, before slightly decreasing to 51% in 2023.

Despite the challenges, Lebanon has promising potential for renewable energy sources, such as solar PV. The development of renewable energy projects could diversify the country's energy mix and reduce dependency on costly fuel imports. Solar PV share in the electricity generation mix saw significant growth, rising from 2.19% in 2021 to 12.43% in 2022 and 15% in 2023.

LEBANON'S ELECTRICITY SECTOR

Electricity Generation Mix (TWh; %)

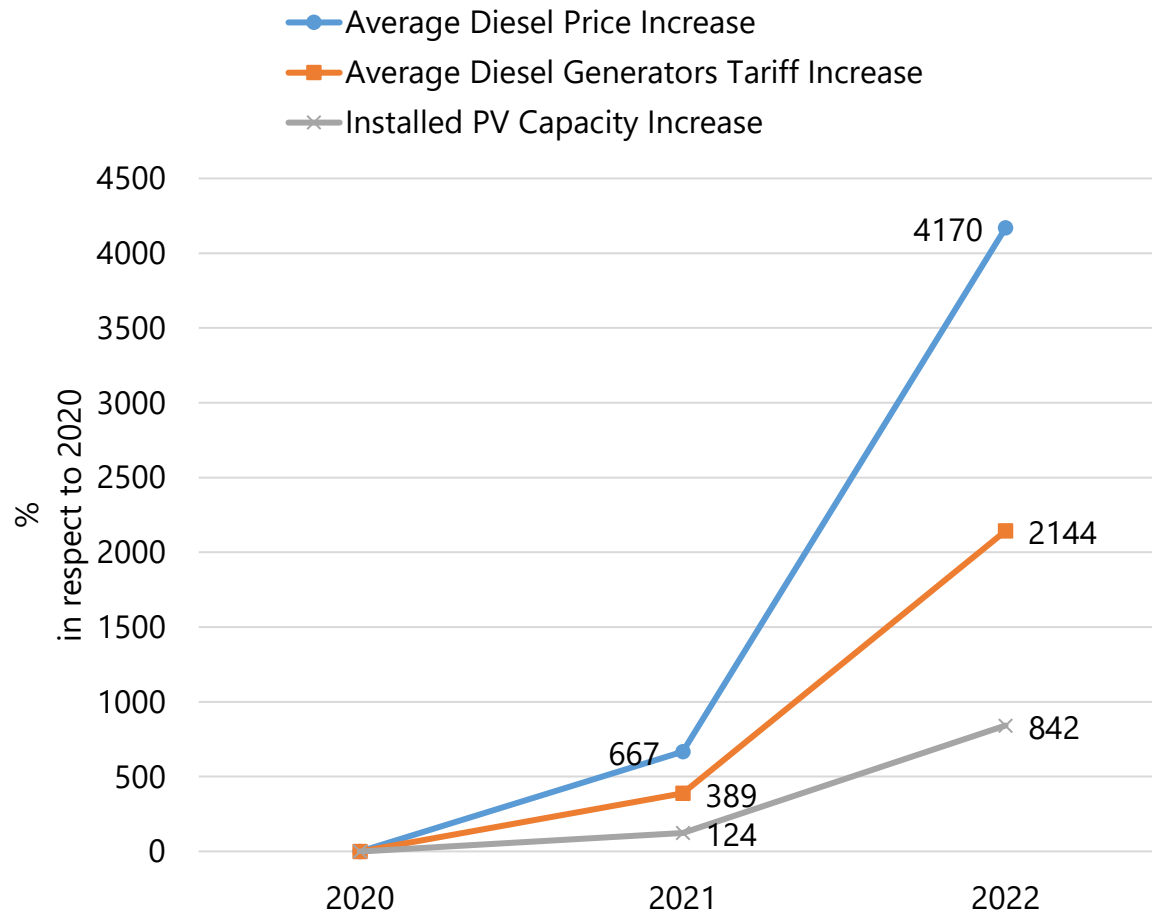


Four main factors contributed to the 29% reduction in electricity consumption:

- Diesel subsidy removal implemented in October 2021
- EDL tariff reform enacted in November 2022
- Consumption behavioral change due to income constraints
- Compounded effect of the financial crisis

The overall contribution of renewable energy has grown, which suggests a transition toward alternative energy sources. This shift is in response to the rising cost of diesel and the removal of subsidies.

SUBSIDIES REMOVAL VS PV MARKET BOOM



Years 2021 and 2022 witnessed an increase in cost of fossil fuels which contributed in a rise of bills of electricity from the parallel market represented by diesel generators in addition to the increase of EDL's tariff which led to a boom in the decentralized solar PV installation that started in 2021 and was amplified in 2022.

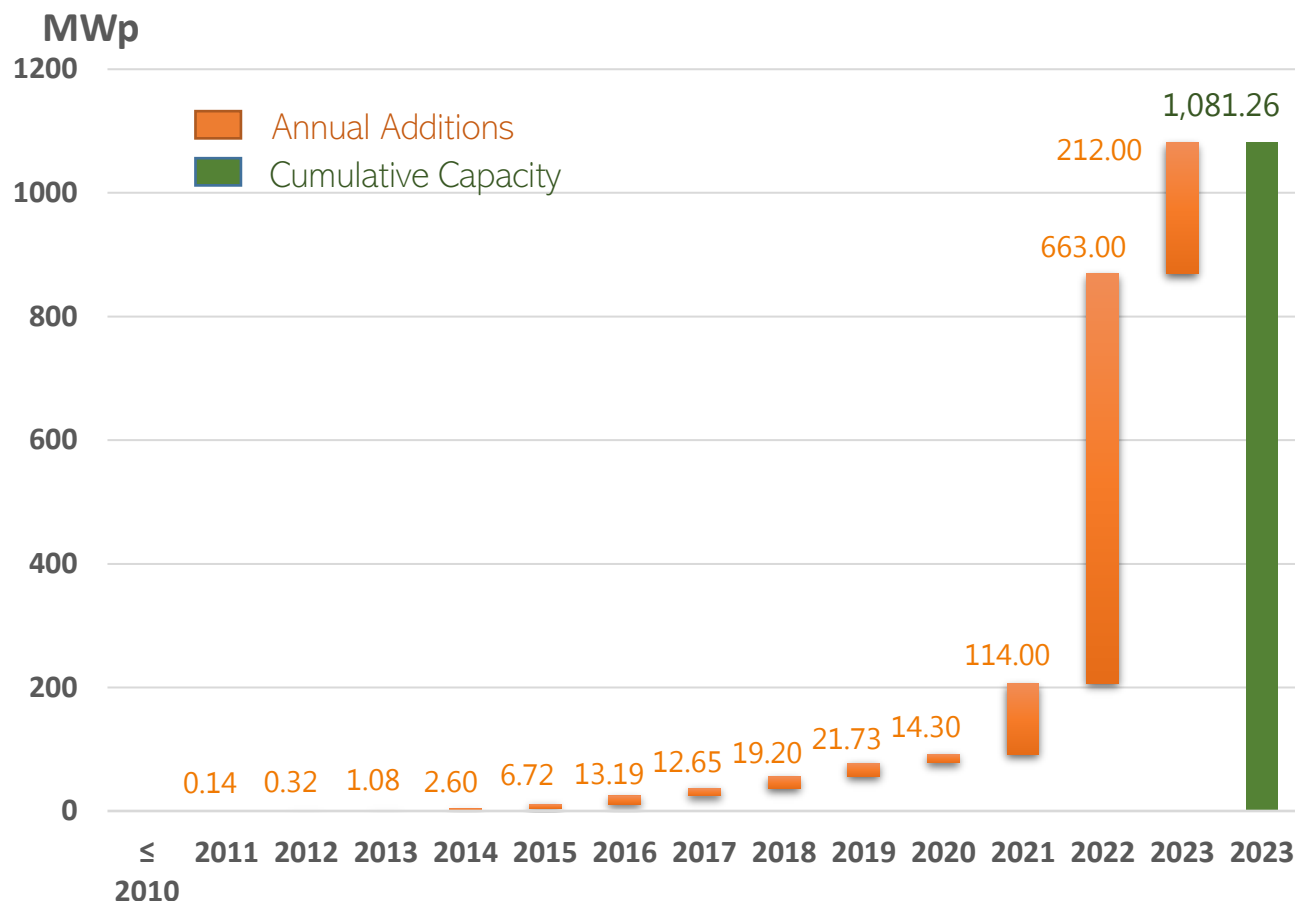
This situation created an intensive need for residents, industrialists, corporate, and healthcare providers to reduce their consumption from conventional power sources, mainly diesel generators, and invest in off-grid or hybrid solar PV systems.

From an end-user point of view, the average price of 1 kWh saved is 0.16\$ in 2021 and 0.6\$ in 2022, considering the generator subscription cost, the EDL supply, and the change in the price of kWh supplied by EDL in 2022.

SOLAR PV CAPACITY AND ANNUAL ADDITIONS

The cumulative installed capacity amounted to 1081.26 MW by the end of 2023

The installed capacity of decentralized solar PV increased from 0.3 MWp in 2010 to 1081.26 MWp in 2023, which surpassed 10 times the NREAP 2016-2020 target for decentralized solar PV installations by 2020.

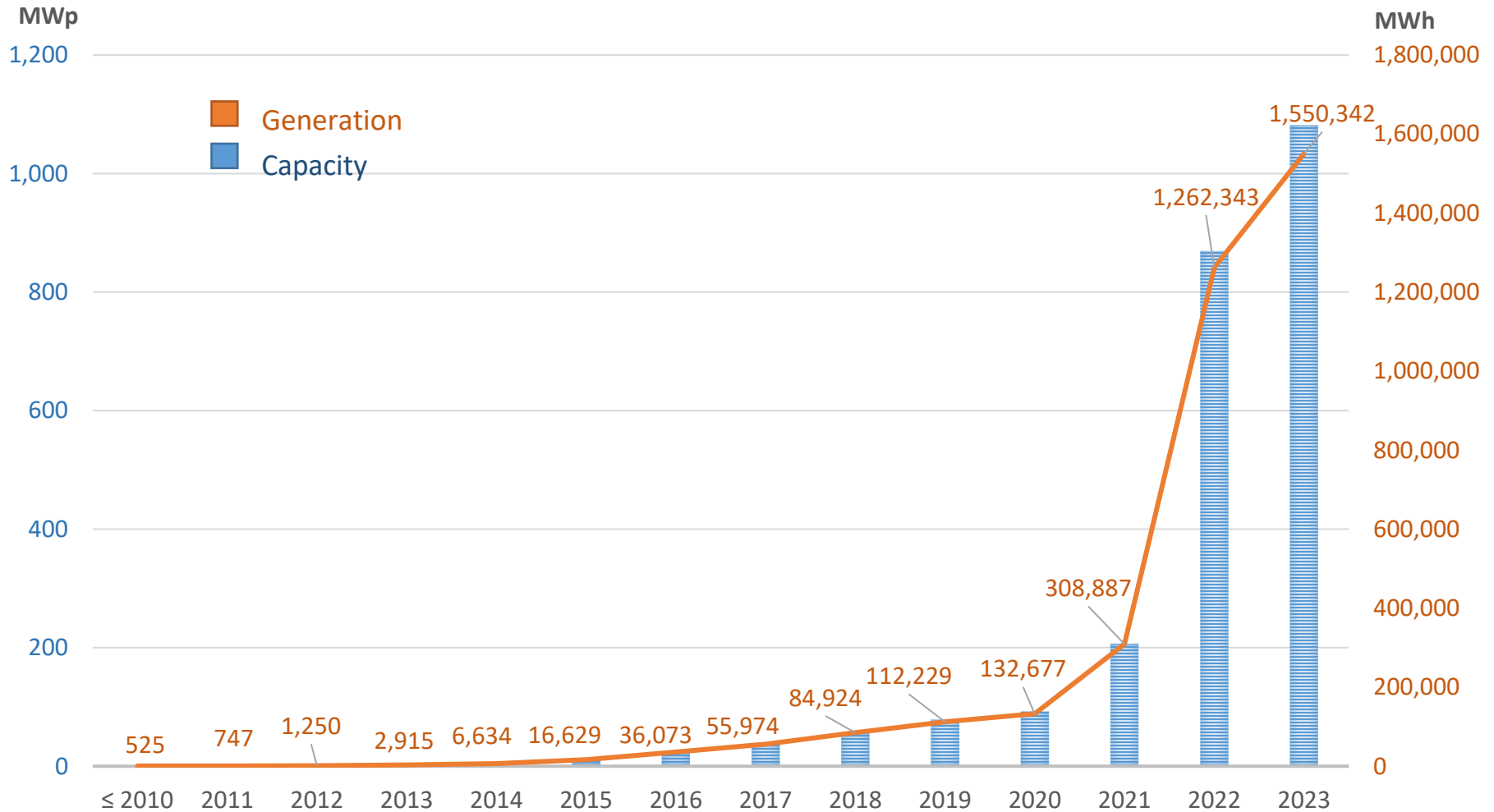


LCEC contacted 115 companies active in the solar PV market, of which 72 responded to the request for participation in the survey. However, 58 companies provided complete information on implemented projects as required by LCEC. The data collected from participating companies shows additional capacities of 16.31 MWp, 75.39 MWp, and 64.97 MWp installed in 2021, 2022, and 2023 respectively.

In reference to import logs provided by the Higher Council of Customs and the percentage of installed components from available stock of active companies in 2021, 2022, and 2023 the additional capacities in 2021, 2022, and 2023 accounted for 114 MWp, 663 MWp, and 212 MWp respectively.

SOLAR PV CAPACITY AND GENERATION

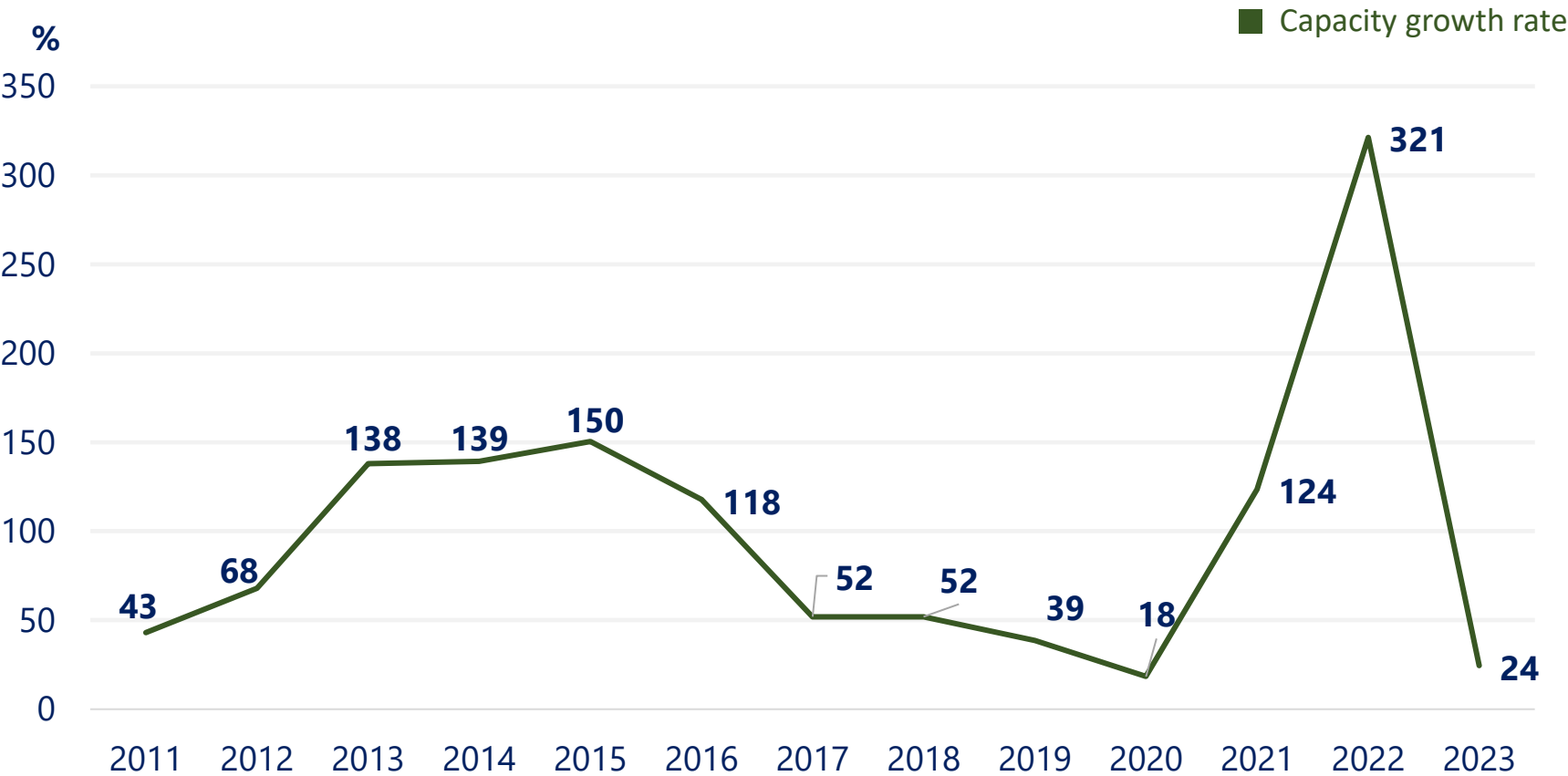
The additional installed capacities of solar PV led to an increase of energy generation increased from 0.1 TWh in 2020 to 1.55 TWh in 2023.



SOLAR PV CAPACITY YEAR-ON-YEAR GROWTH RATE (%)

Increased By 842% Between 2020 & 2022

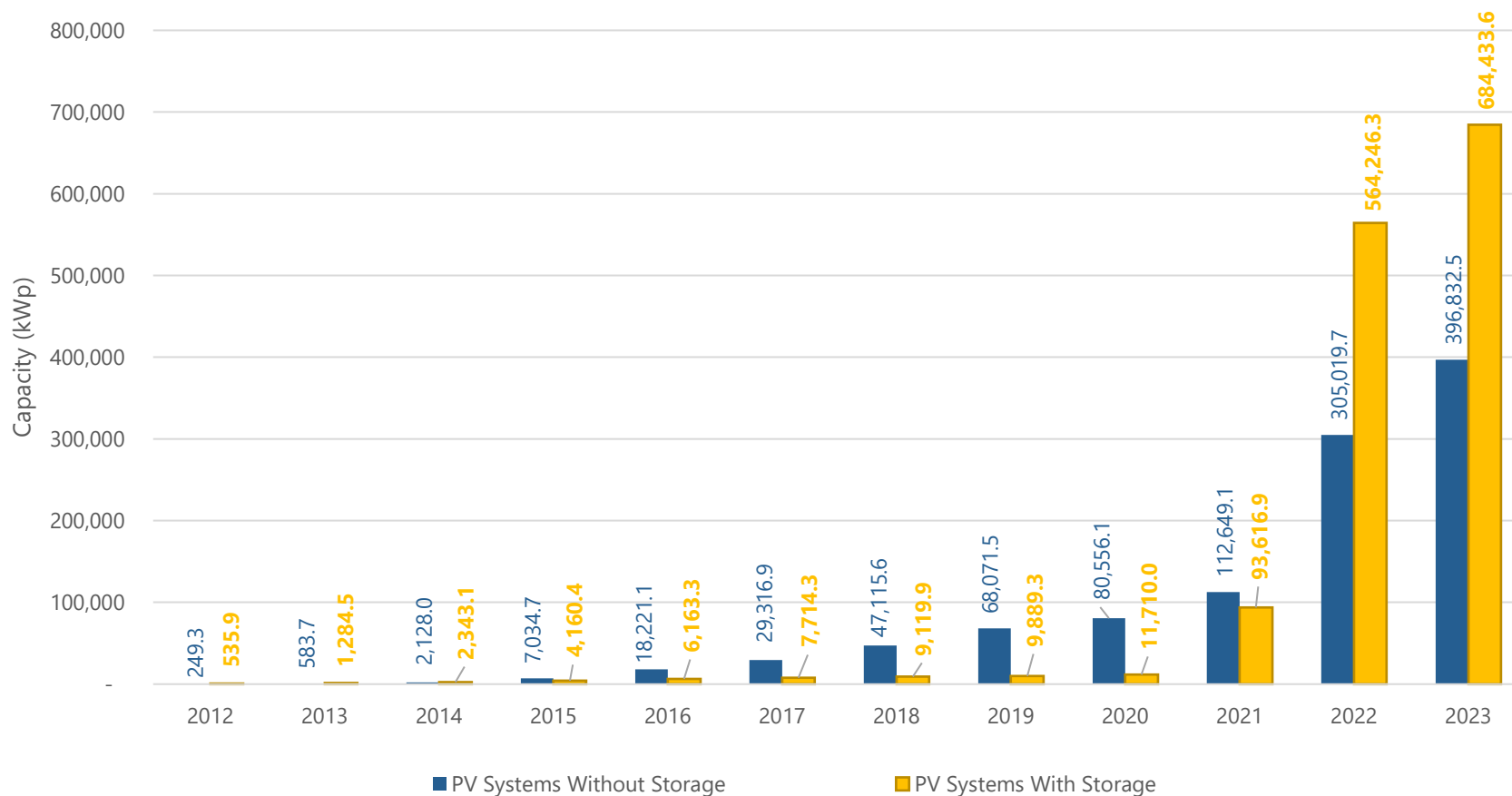
The year-on-year growth rate for 2021 and 2022 can be described as a solar boom. A significant and rapid increase in the adoption and deployment of solar PV occurred. The need and desire for energy independence and security due to the ongoing energy crisis fueled the increase in demand for the implementation of solar PV projects. The sector reported a 124% growth in 2021 while the implementation of solar PV projects expanded significantly to report a growth rate of 321% in 2022. Looking at 2023, the growth rate settled at 24%. While this represents a decrease from the exceptional years of 2021 and 2022, it is important to note that this still reflects significant market growth compared to earlier years, particularly 2020, which saw a growth rate of only 18%.



PV INSTALLED CAPACITY WITH AND WITHOUT STORAGE (kWp)

PV Systems With Storage Represent 63% Of The Market

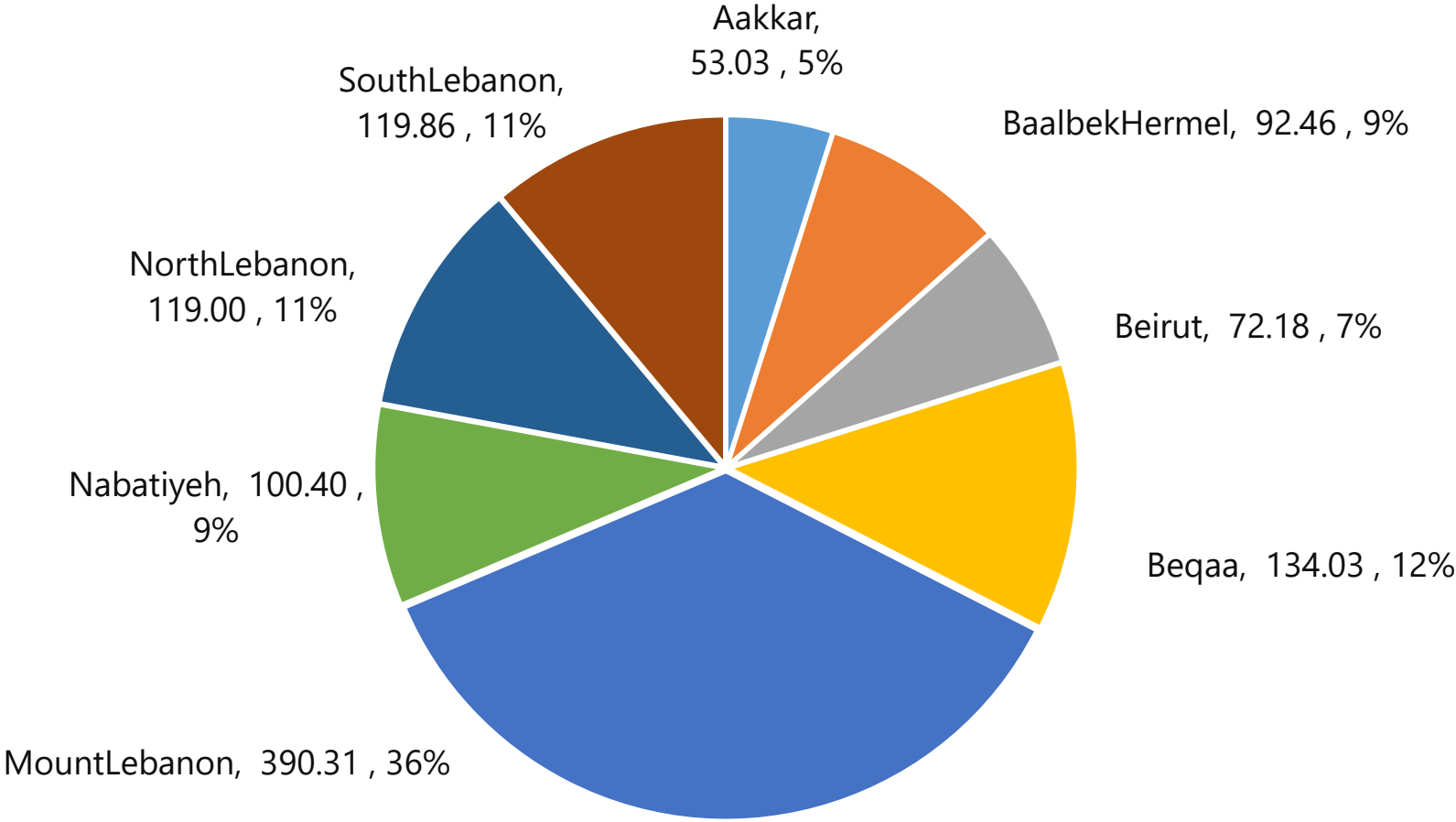
The surveyed data shows that 96% of the capacity installed in the residential sector in 2021, 2022, and 2023 consists of systems with battery storage.



SOLAR PV CAPACITY PER GOVERNORATE (MWp ; %)

36% Of PV Installations Are In Mount Lebanon

By the end of 2023, the top two governorates leading the solar PV market were Mount Lebanon with 390.31 MWp and Beqaa with 134 MWp. South and North governorates surpassed Baalbek-Hermel governorate with installed capacities of 119.86 MWp and 119 MWp, respectively.



SOLAR PV INVESTMENTS (\$MILLION)

Prior to the financial crisis, the Lebanese government had expressed interest in promoting solar power to diversify its energy mix and reduce dependence on imported fossil fuels. Various incentives and policies have been considered to encourage private investment in the renewable energy sector, including tax benefits, feed-in tariffs, and net metering programs.

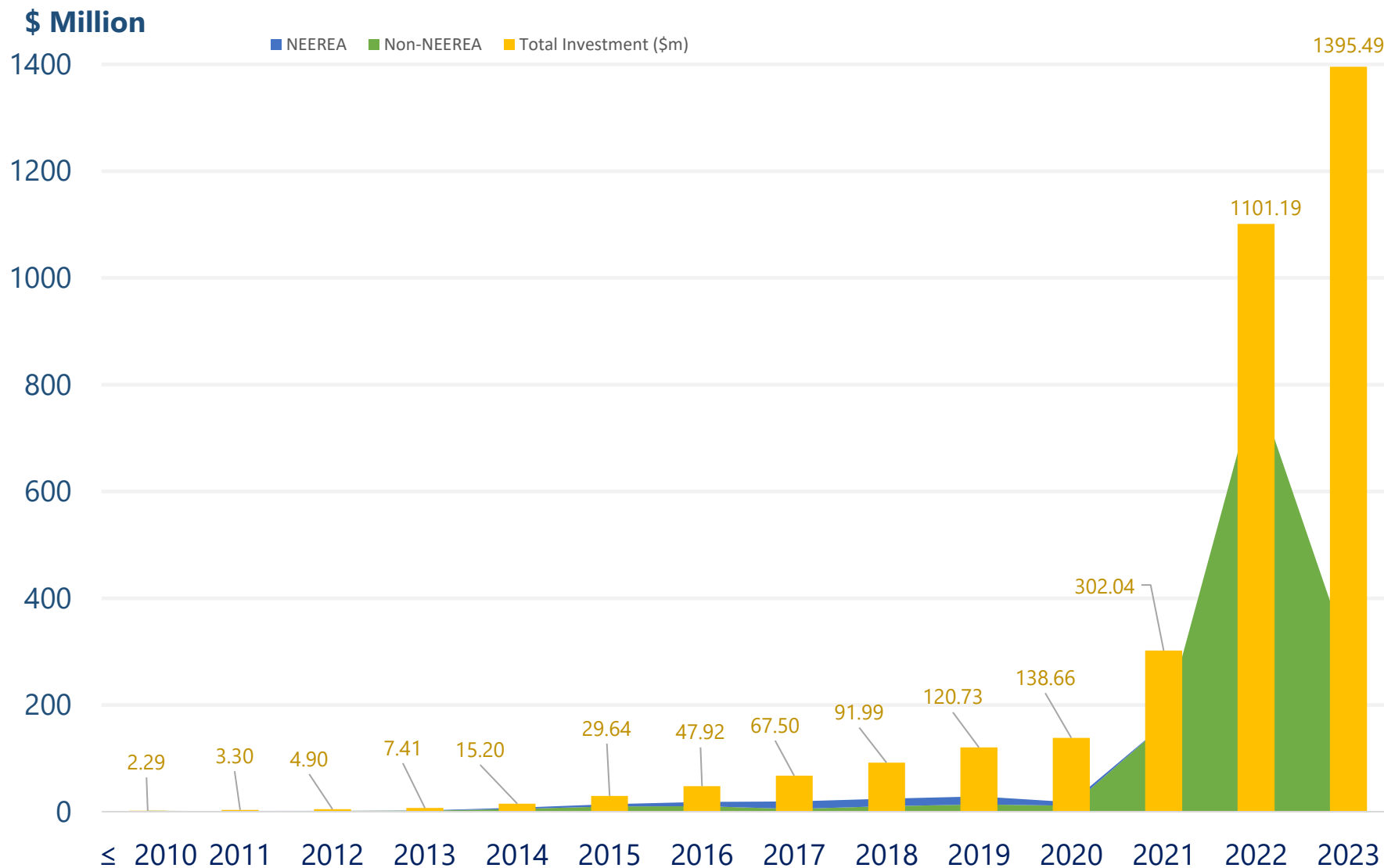
NEEREA-financed projects in 2020 dropped by around 98% compared to 2019. In 2020, around only 1% of the investments had access to the national funding program. Although the absence of funding programs, such as NEEREA, had a negative impact on additional investments in 2020, the need for energy independence and security boosted the solar market in the last two years. In fact, the estimated additional investments reached \$163.38 Million in 2021 and \$799.15 Million in 2022.

In 2023, total investments in the sector reached approximately \$294 million. This indicates continued strong investment and development in the solar PV market in Lebanon, even after the extraordinary peaks of the previous years.

LCEC's estimation for the additional investment was based on the total investments retrieved from surveys conducted on companies. Data analysis shows that around 80% of the installed capacity in 2021, 2022, and 2023 was implemented with storage. Therefore, to assess the total investment in these years, calculating the total cost of systems with and without battery storage was performed using the surveyed capacities. The factors used to estimate the total investments for unsurveyed capacities were the average costs (\$/kWp) and the percentage of systems with and without storage, as retrieved from the surveys.

The cumulative investments recorded till the end of 2022 were \$1,101 Million, and with the additional investments in 2023, this cumulative figure has grown even further to reach \$1,394.6 Million, highlighting the ongoing commitment and growth in the renewable energy sector in Lebanon.

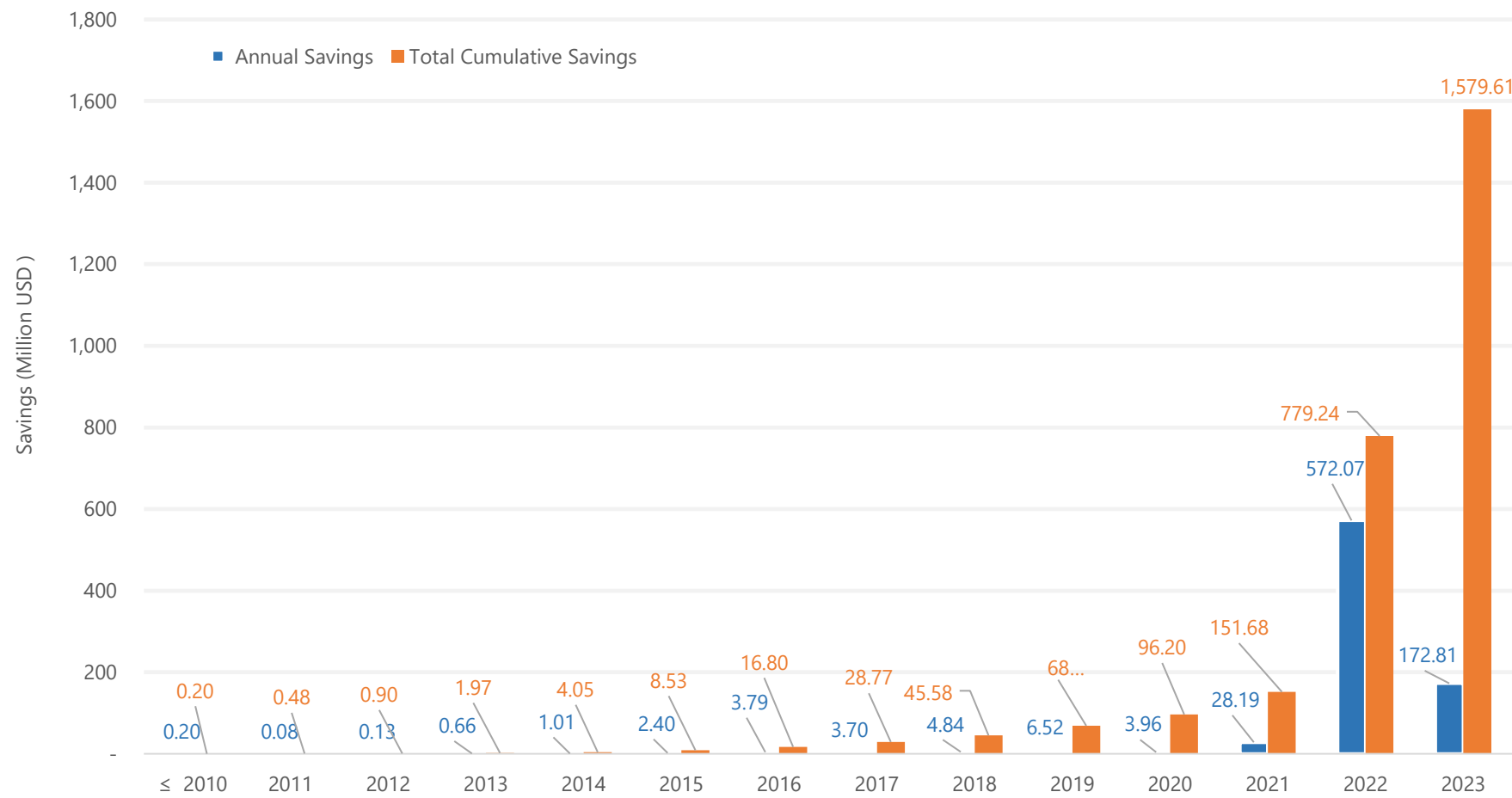
SOLAR PV INVESTMENTS (\$ MILLION)



ESTIMATED SOLAR PV MONETARY SAVINGS (\$ MILLION)

Solar PV Generated USD 1,579.6 Million Of Cumulative Monetary Savings

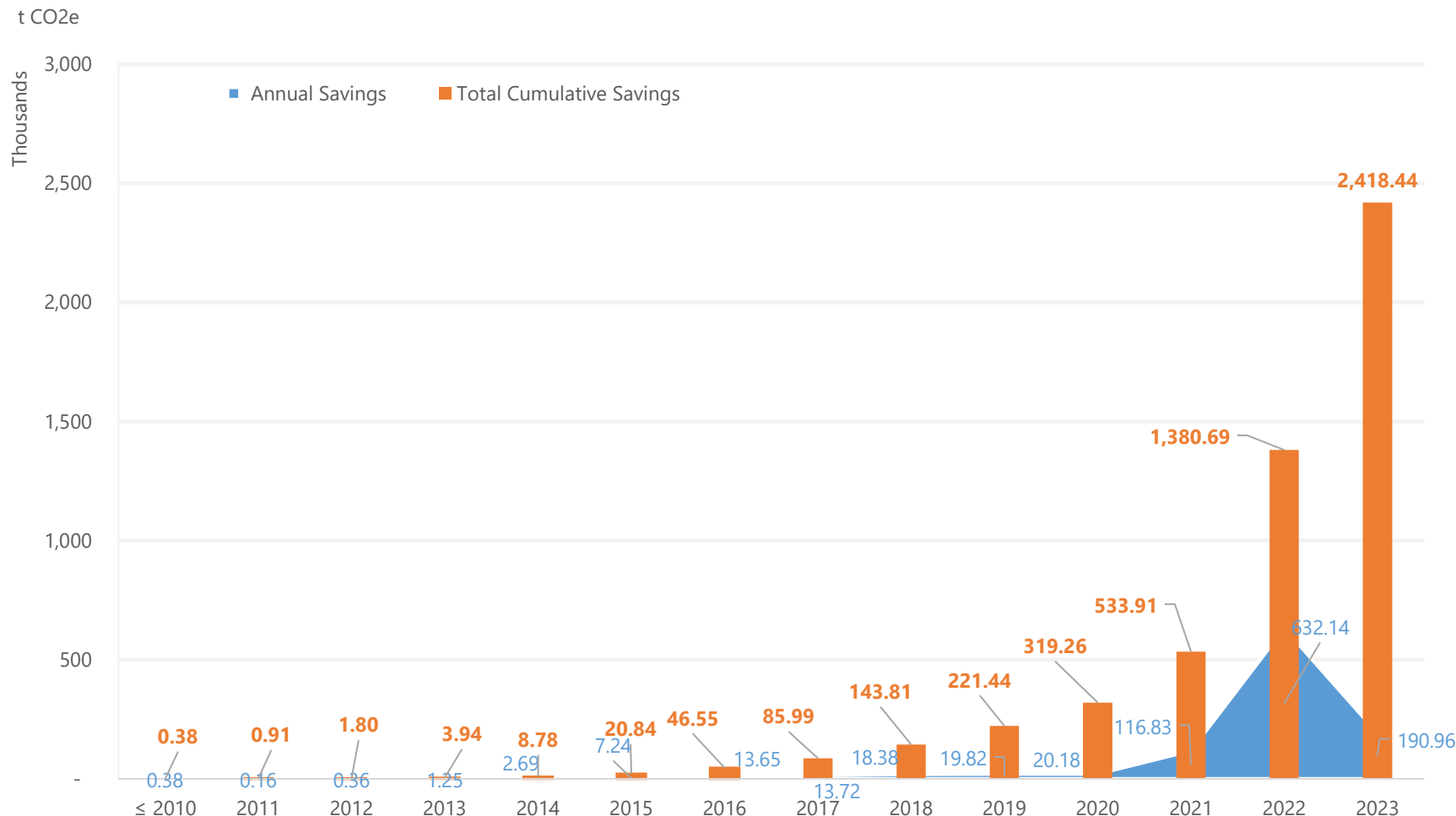
From an end-user point of view, the average saved price of 1 kWh was \$0.16 in 2021 and \$0.6 in 2023, considering the generator subscription, the EDL supply, and the change of the price of kWh supplied by EDL in 2023.



ESTIMATED SOLAR PV EMISSION SAVINGS

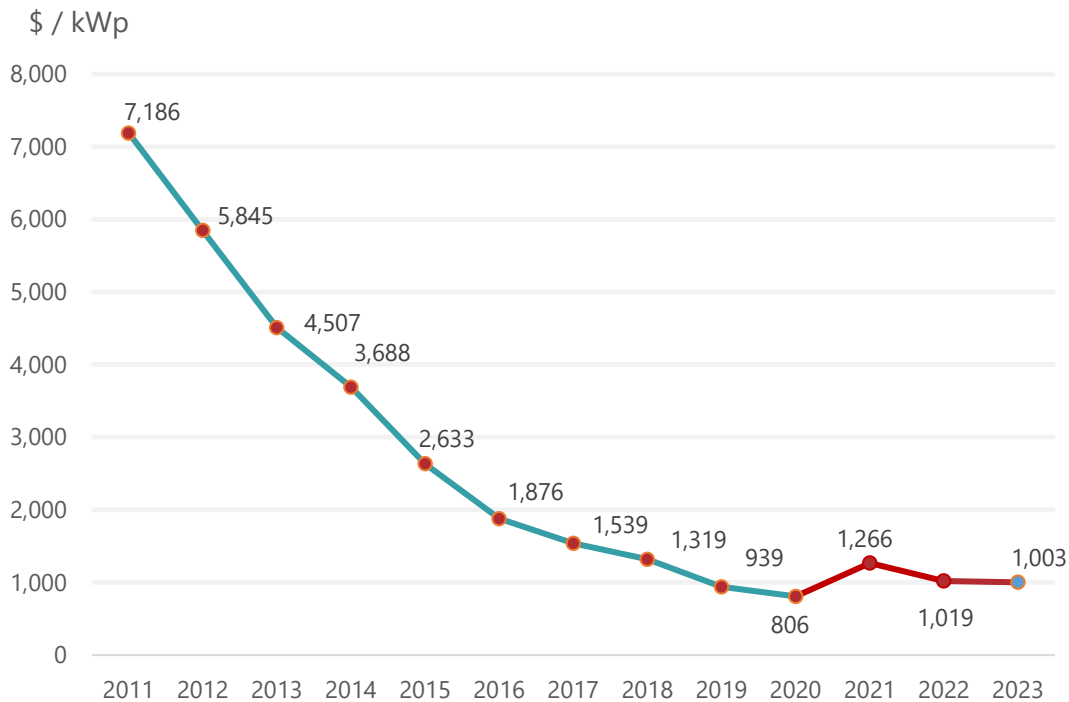
Emission Savings Increased By 393% Between 2020 & 2023

The increase in the implementation of solar PV projects in 2021 and 2022 led to an increase in the estimated savings to 116,827.69 tCO₂e in 2021 and 1,937,182 tCO₂e in 2022. In 2023, the estimated savings reached 190,956 tCO₂e. The estimated cumulative savings by the end of 2023 amounted to 2,418,435 tCO₂e.



YEARLY AVERAGE SOLAR PV TURNKEY PRICE (\$/kWp)

Turnkey Price Decreased By 86% Over 12 Years



The turnkey price for solar PV increased to \$1,266 per kWp in 2021 following a yearly steady fall from \$7,186 per kWp in 2011 to \$806 in 2020.

The main reason behind the price increase is disruptions in the global supply chain due to lockdowns, travel restrictions, and factory closures in early 2021 during and after the global lockdowns imposed by the COVID-19 pandemic.

The increased shipping costs led to a rise in the overall price of solar PV products. Another main factor in the increase of projects' turnkey costs was the shortage of supply caused by the exceptionally high demand the market witnessed in the last couple of years.

Noting that the fluctuation of the exchange rate (LBP/USD) due to the severe economic crisis facing the country has also contributed in the increase of the turnkey cost in 2021.

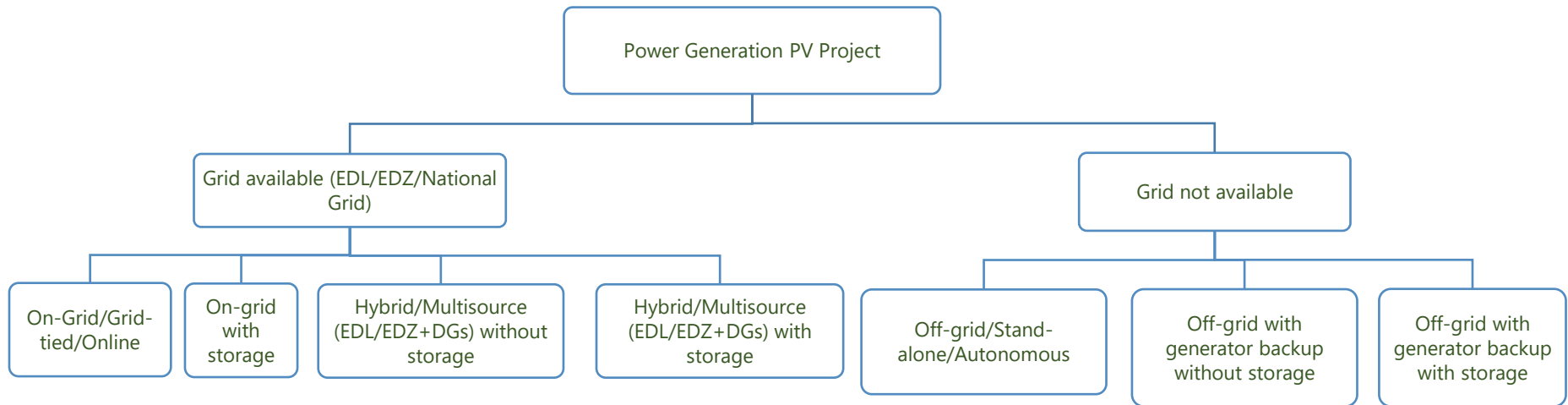
The situation led to delays in the production and delivery of solar PV components, such as solar panels, inverters, and mounting systems. Many solar PV projects experienced delays in construction and commissioning as a result.

As the situation evolved, some of the supply chain challenges and price increases began to alleviate. In fact, the turnkey price decreased to \$1,019 per kWp in 2022. In 2023, the turnkey price for solar PV further decreased to \$1,003 per kWp. This reduction reflects a slight stabilization and adjustment in the market, indicating improvements in the supply chain and balancing of demand and supply.

TYPES OF PV SYSTEMS USED FOR POWER GENERATION

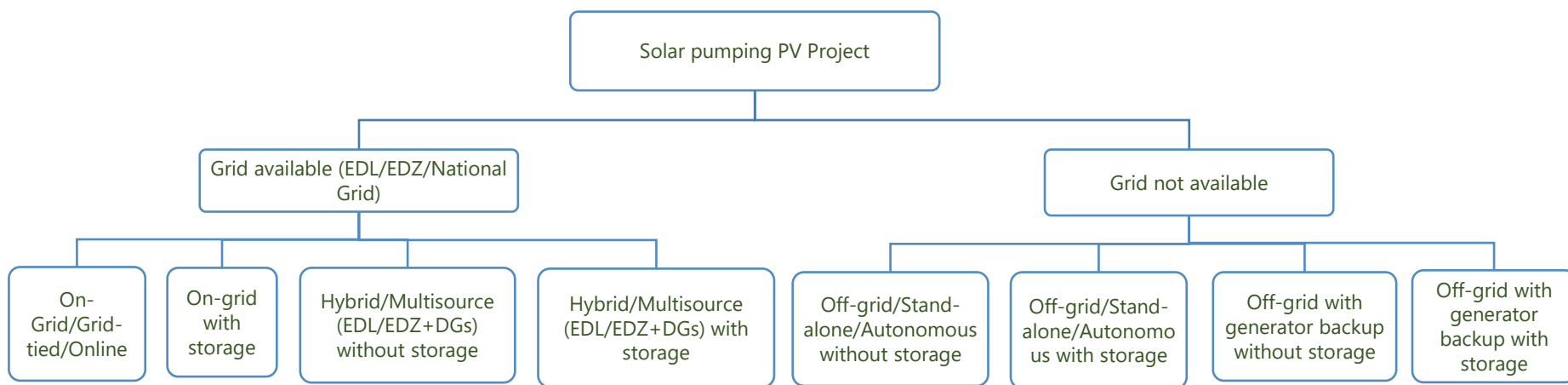
The Off-Grid/Stand-alone/Autonomous type includes by default a storage component which is necessary for the purpose of power generation.

For simplicity purposes, the following graphs might include shorter terms representing the same types of systems. For example, "On-Grid" instead of "On-Grid/Grid-Tied/Online".



TYPES OF PV SYSTEMS USED FOR SOLAR PUMPING

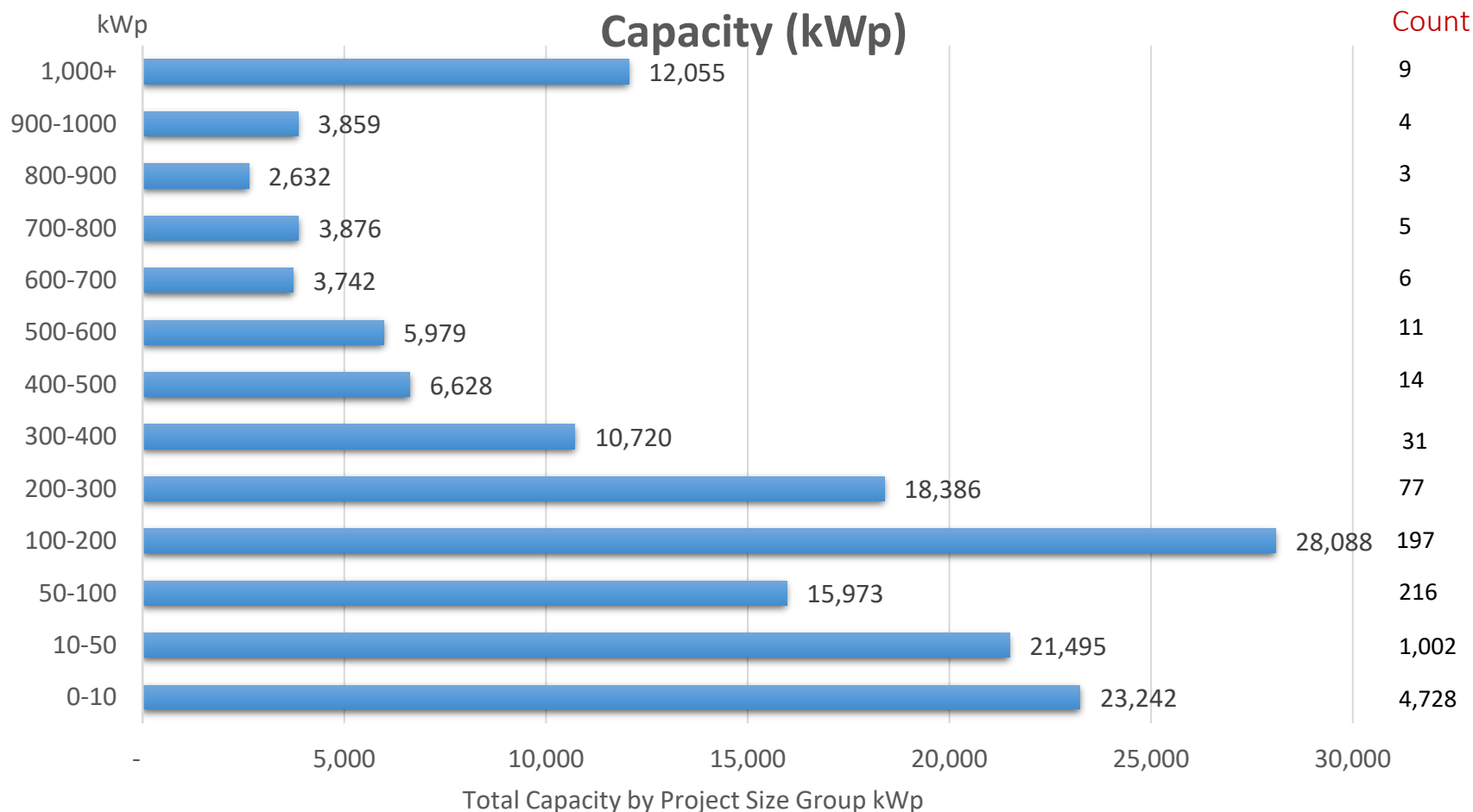
For simplicity purposes, the following graphs might include shorter terms representing the same types of systems. For example, "Hybrid/Multisource with storage" instead of "Hybrid/Multisource (EDL/EDZ+DGs) with storage".



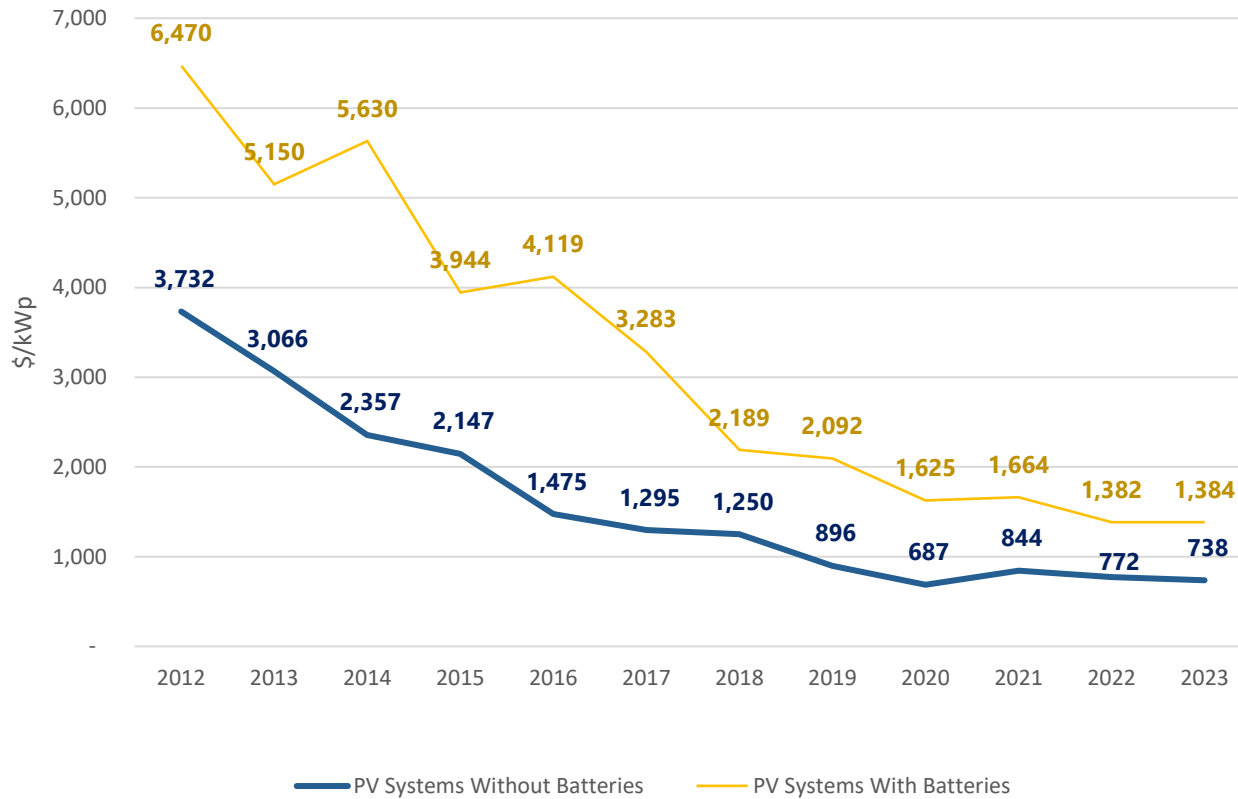
The following sections of this report include data based solely on the replies of the 58 surveyed companies.

SOLAR PV CAPACITY AND COUNT BY PROJECT SIZE GROUP IN 2023

Around 6,303 total projects were installed in 2021, 2022, and 2023 as per the surveyed companies leading to a total of 8,752 projects till the end of 2023. Almost 156.7 kWp were installed in 2021, 2022, and 2023 by the surveyed companies.



PV UNIT PRICE WITH AND WITHOUT STORAGE (\$/kWp)



Based on the surveyed companies, the difference between the cost of PV systems with storage and the cost of PV systems without storage reached around 800\$/kWp in 2021.

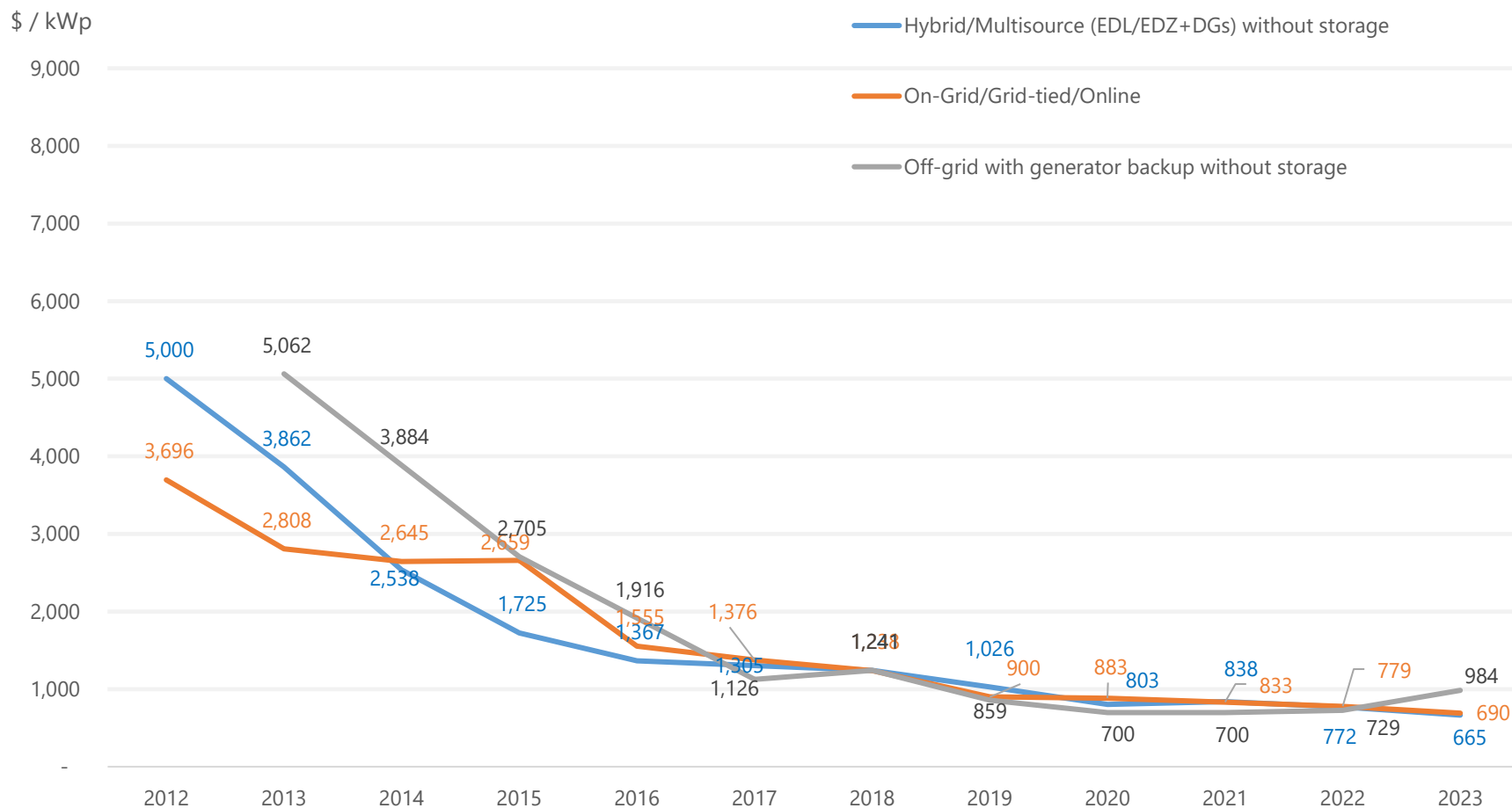
This difference shrunk to become 600\$/kWp in 2023. The drop in the difference in the cost of systems with and without storage is mainly due to the decrease in the cost of batteries.

The drop in the cost of solar batteries can be attributed to several factors including but not limited to technological advancement and market competition, etc.

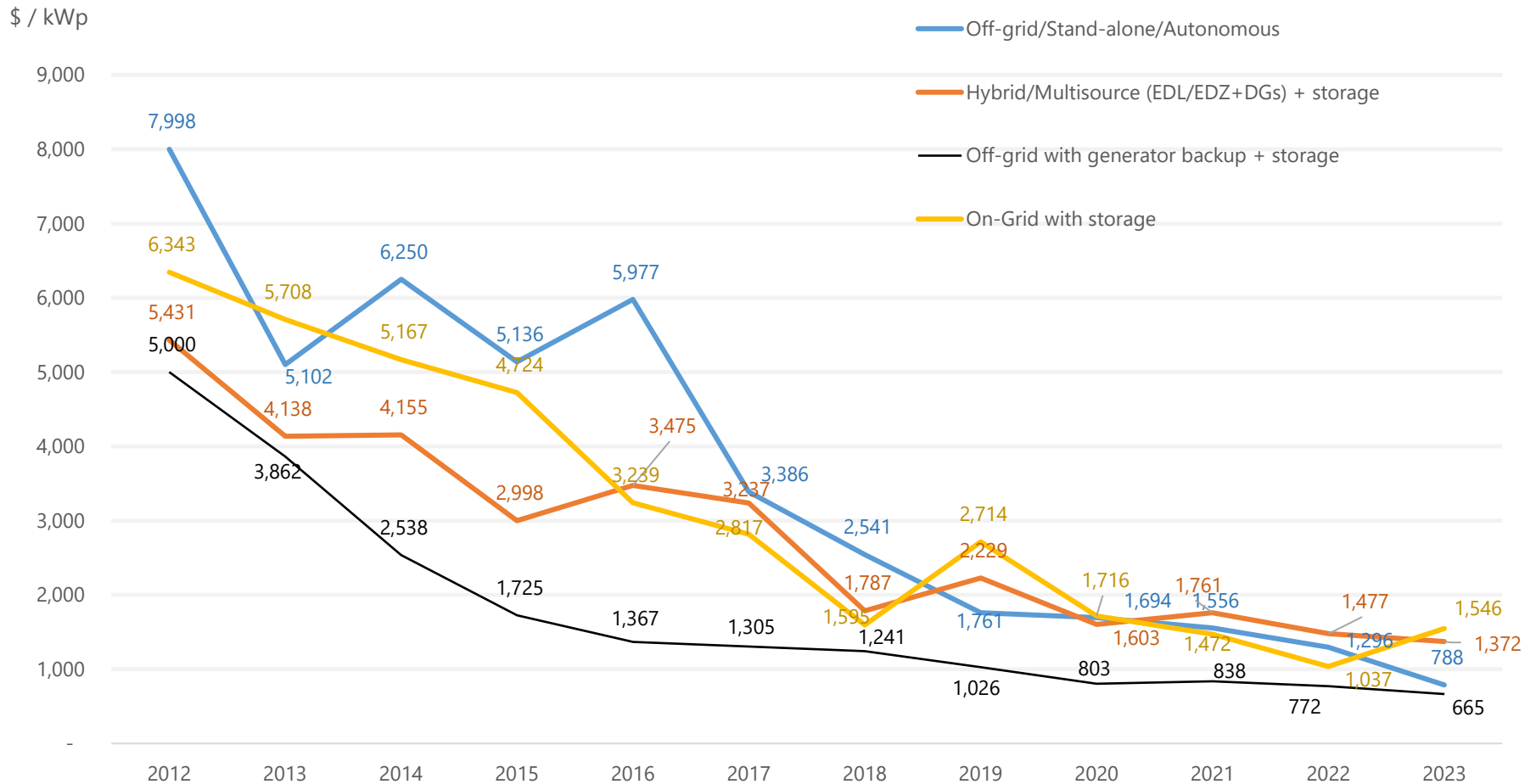
These cost reductions have made solar batteries more accessible to a broader range of consumers and businesses, thus accelerating the adoption of solar-plus-storage systems for residential, commercial, and industrial applications.

POWER GENERATION PV SYSTEMS WITHOUT STORAGE: YEARLY AVERAGE PRICE (\$/kWp)

Surveyed data shows that the average turnkey price of PV systems without storage used for power generation decreased between 80% and 87% between 2012 and 2023.

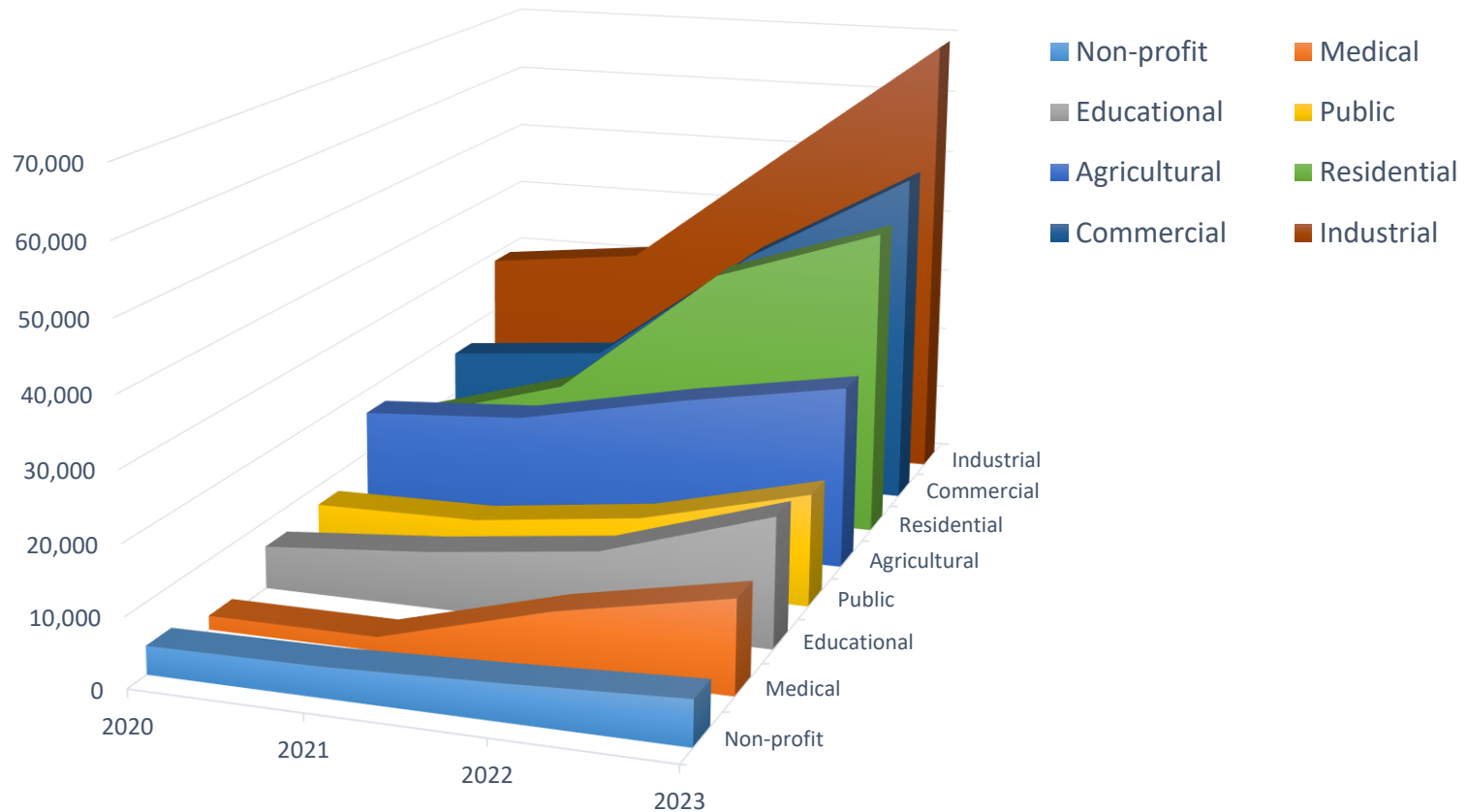


POWER GENERATION PV SYSTEMS WITH STORAGE: YEARLY AVERAGE PRICE (\$/kWp)



Between 2021 and 2023, the solar PV market has seen a general trend of cost reduction, driven by technological advancements and economies of scale. However, certain fluctuations, particularly in hybrid and on-grid systems, indicate that external factors such as market demand, supply chain dynamics, and especially the impact of the pandemic in 2021, which led to the shortage of supply in the local market, also play significant roles in determining the final costs.

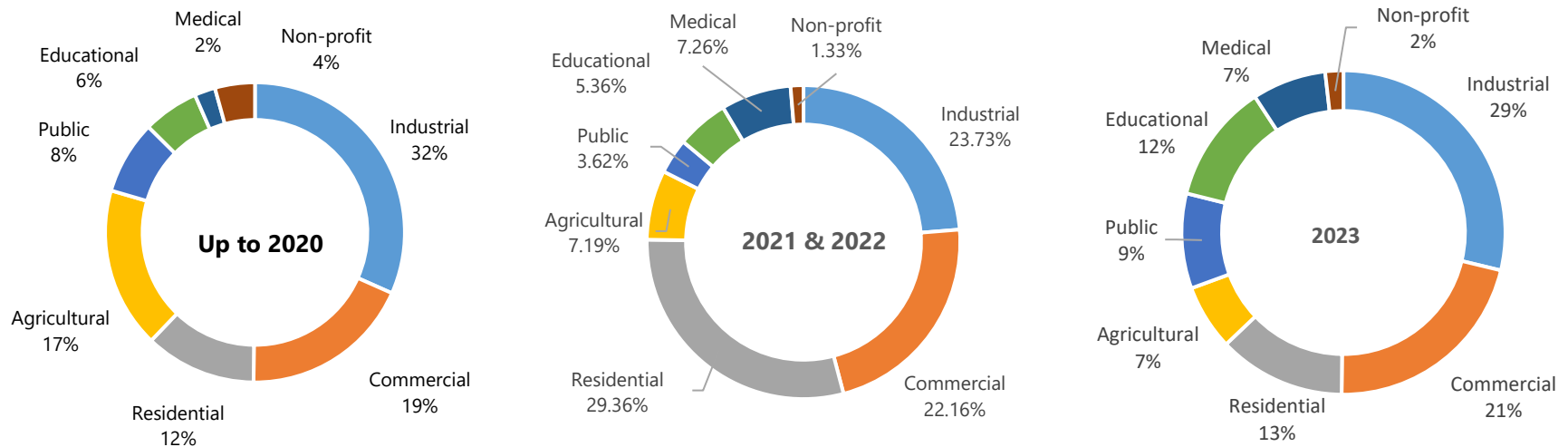
CUMULATIVE INSTALLED CAPACITY BY SECTOR (kWp) – 2023



The surveys show that the residential, commercial, and industrial sectors recorded the highest growth rates in terms of capacity installed, at 64.23%, 13.47%, and 9.71% respectively in 2021 compared to 2020. The top three sectors were the same in 2022, recording growth rates of 109.27%, 94.77%, and 60.47% respectively compared to the year before. Vital sectors kept looking for sustainable options for energy in the last two years, as the economic and energy crises increased the challenges and risks in these sectors. By 2023, while these sectors continued to grow, other sectors also saw notable increases. The educational sector recorded a remarkable growth rate of 69.10%, and the public sector grew by 59.32%. These trends indicate that vital sectors have been increasingly looking for sustainable energy options over the past two years, driven by the economic and energy crises that have heightened challenges and risks in these markets.

SOLAR PV CAPACITY BY SECTOR (%)

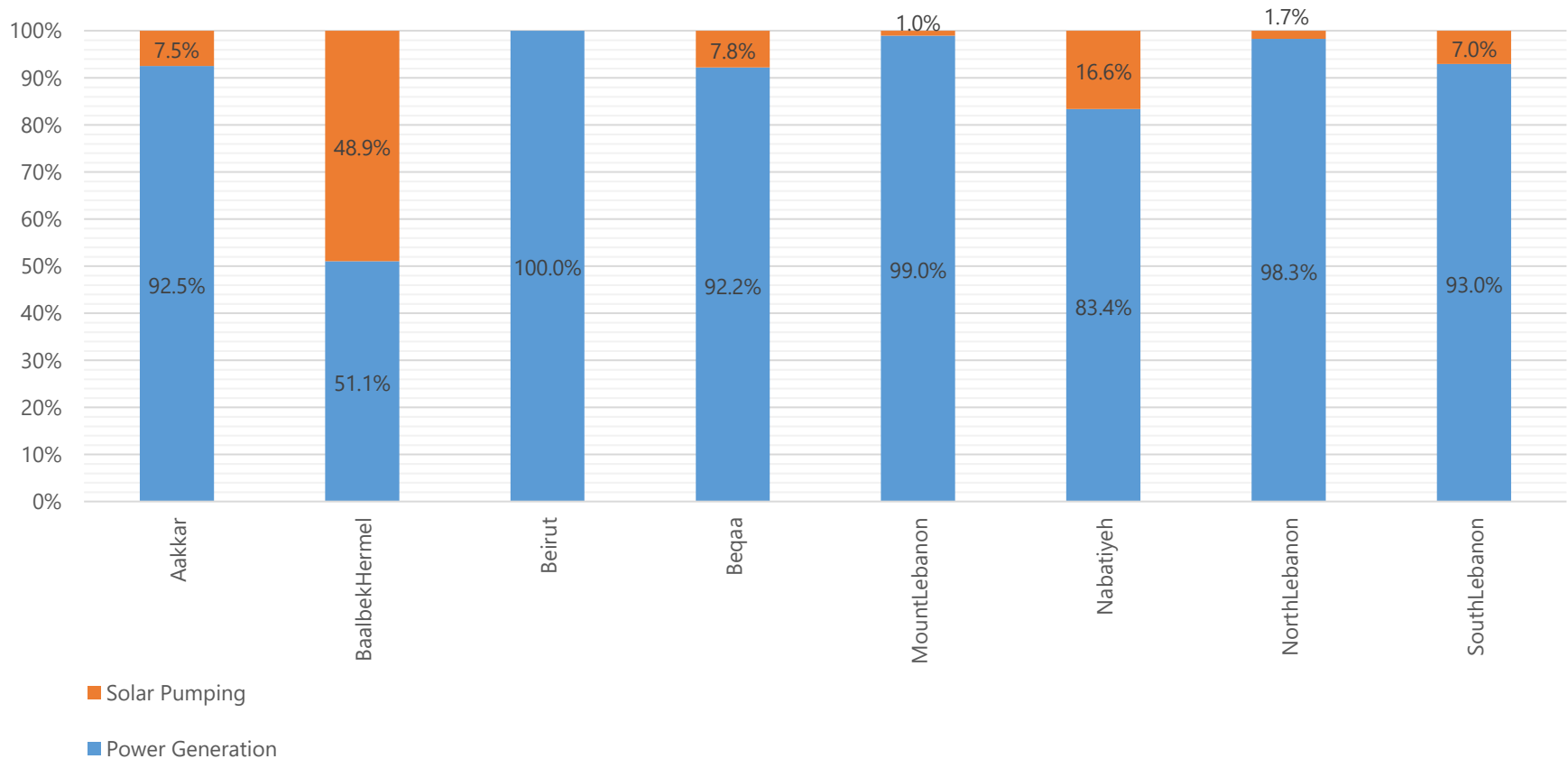
In 2021 and 2022, the residential sector topped the list, in terms of total capacity installed, at 29.36% compared to 12% in 2020. The electricity grid blackouts and the high cost of diesel drove homeowners to more sustainable options as the need for energy independence and security has drastically risen. In 2023, the distribution of installed capacity saw a shift with the industrial sector leading at 29%, followed by the commercial sector at 21%. The residential sector accounted for 13% of the total capacity installed, showing continued but relatively lesser dominance compared to the previous two years. This diversification indicates that while residential demand remains strong, other sectors are increasingly adopting solar solutions, driven by similar needs for energy security and cost savings. The growth in industrial and commercial sectors highlights the broader adoption of solar energy across different segments of the economy, reflecting a more widespread recognition of the benefits of renewable energy.



PV SYSTEM USE PER GOVERNORATE BY END OF 2020

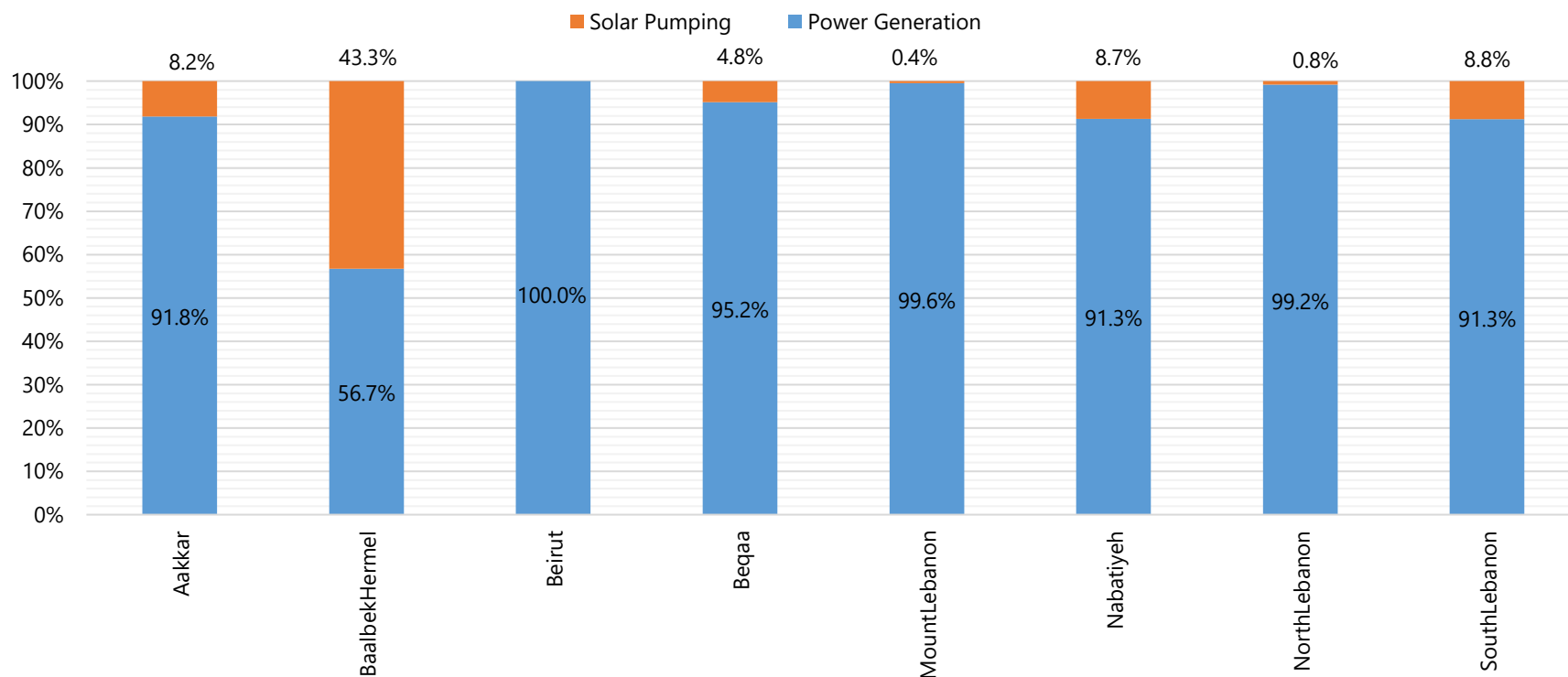
Up to 2020, power generation dominated across most governorates, with only a small percentage (ranging from 0% to 16.4%) allocated for solar pumping. Notably, Baalbek-Hermel had the highest share of solar pumping at 48.9%.

PV System Purpose by Governorate (Up to 2020)



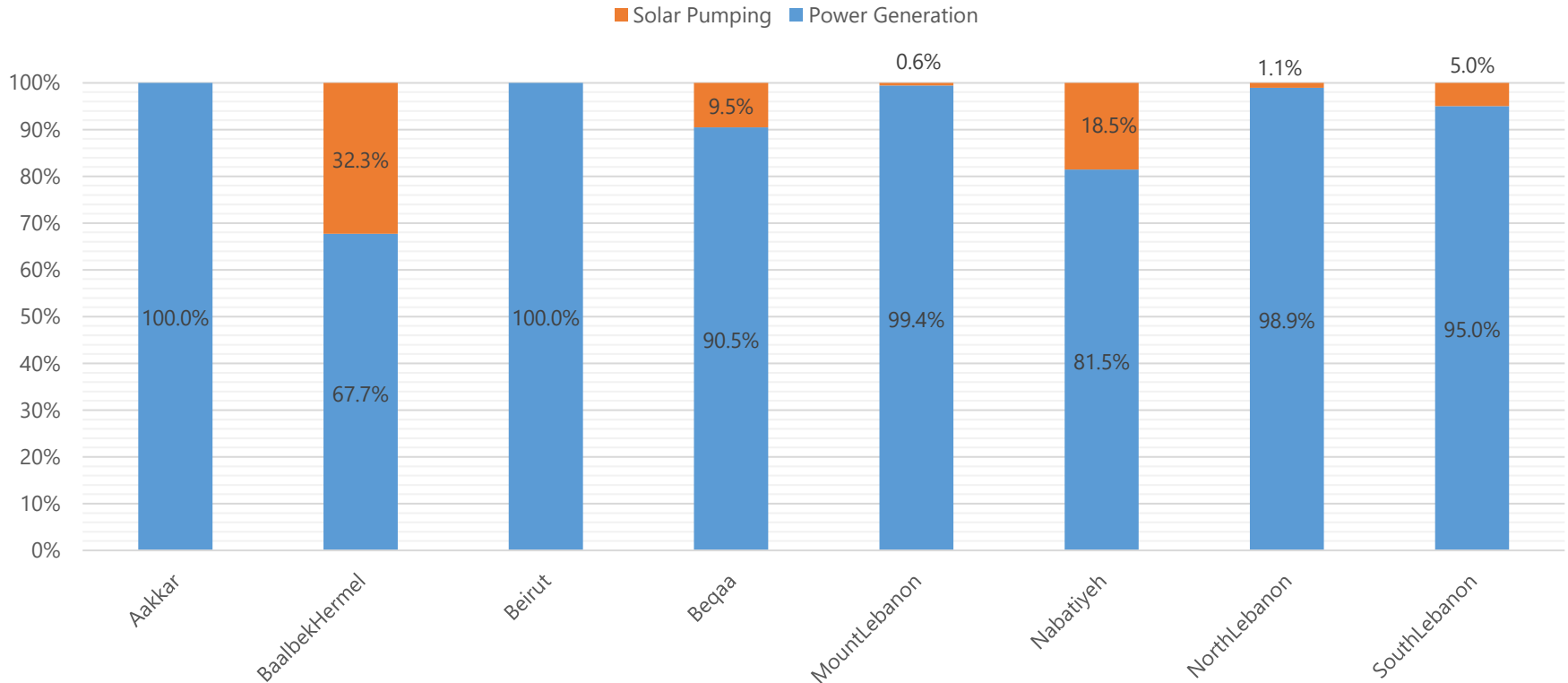
PV SYSTEM USE PER GOVERNORATE 2021 & 2022

As the urge for power generation picked up in 2021 and 2022, especially in the residential sector, power generation remained the dominant purpose. Solar pumping slightly increased in some regions compared to before 2020, The highest solar pumping was seen in Baalbek-Hermel at 43.3%.



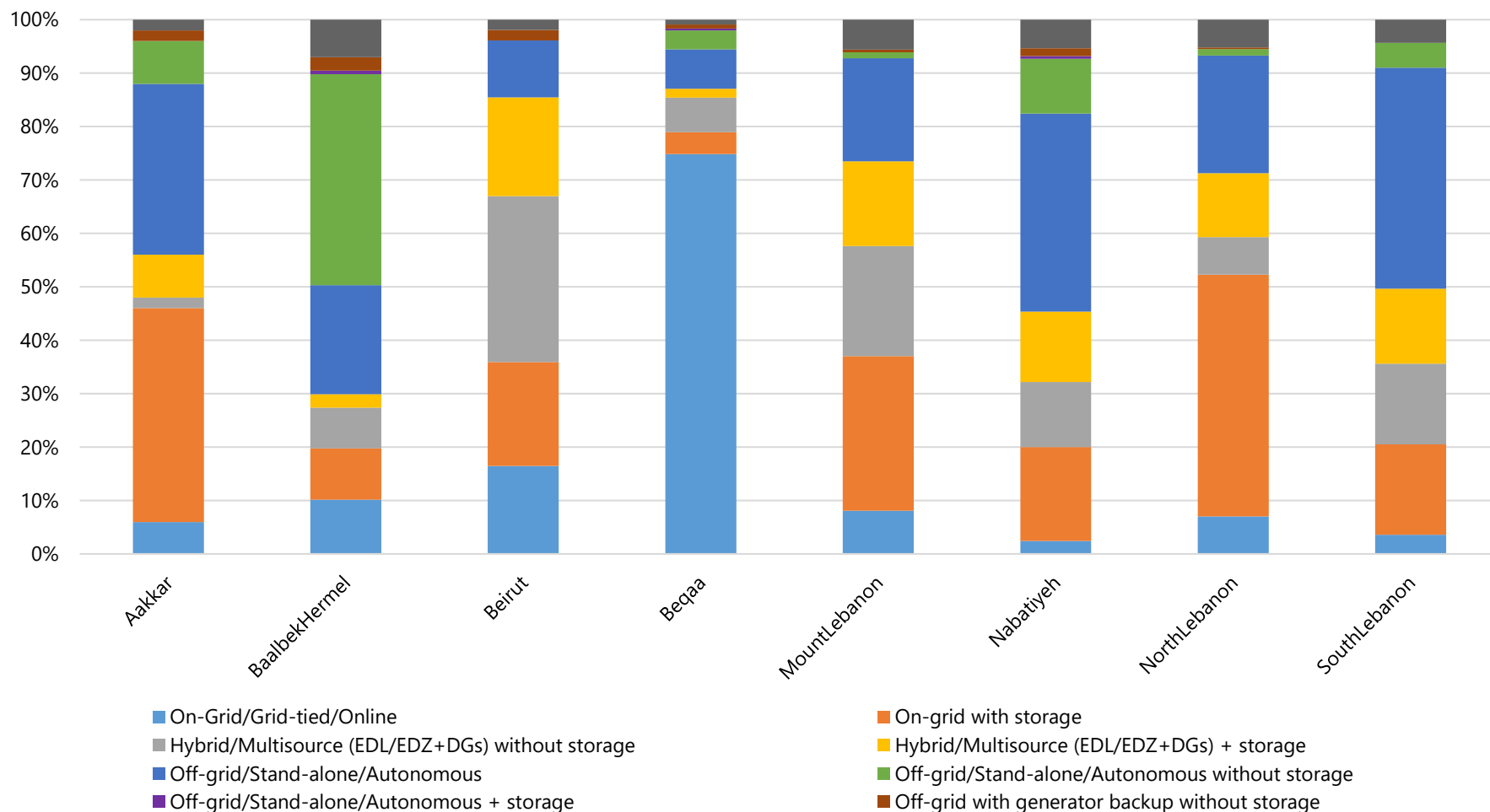
PV SYSTEM USE PER GOVERNORATE 2023

In 2023, this trend continued with power generation remaining the dominant purpose across most governorates. Notably, Baalbek-Hermel still showed a significant portion of projects (32.3%) for solar pumping. Additionally, Nabatiyeh and Beqaa governorates also had notable percentages of solar pumping projects at 18.5% and 9.5%, respectively.



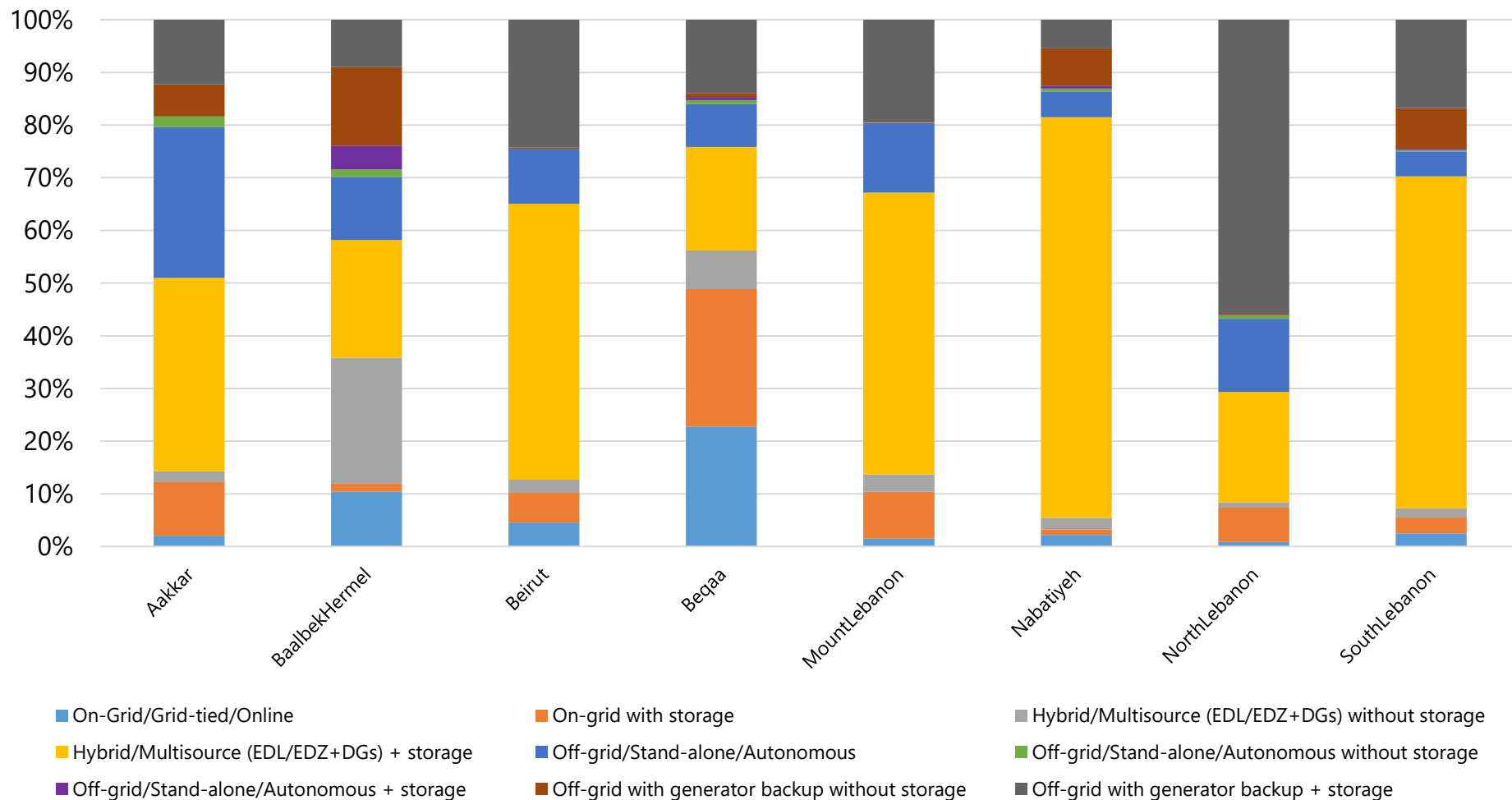
PV SYSTEM TYPE PER GOVERNORATE BY END OF 2020

In 2020, electricity supply in Beirut and Beqaa, and Zahleh area specifically, was reflected by the large number of On-Grid PV systems implemented compared to other system types in these regions. Poor supply in other governorates led to the use of other configurations with backup storage.



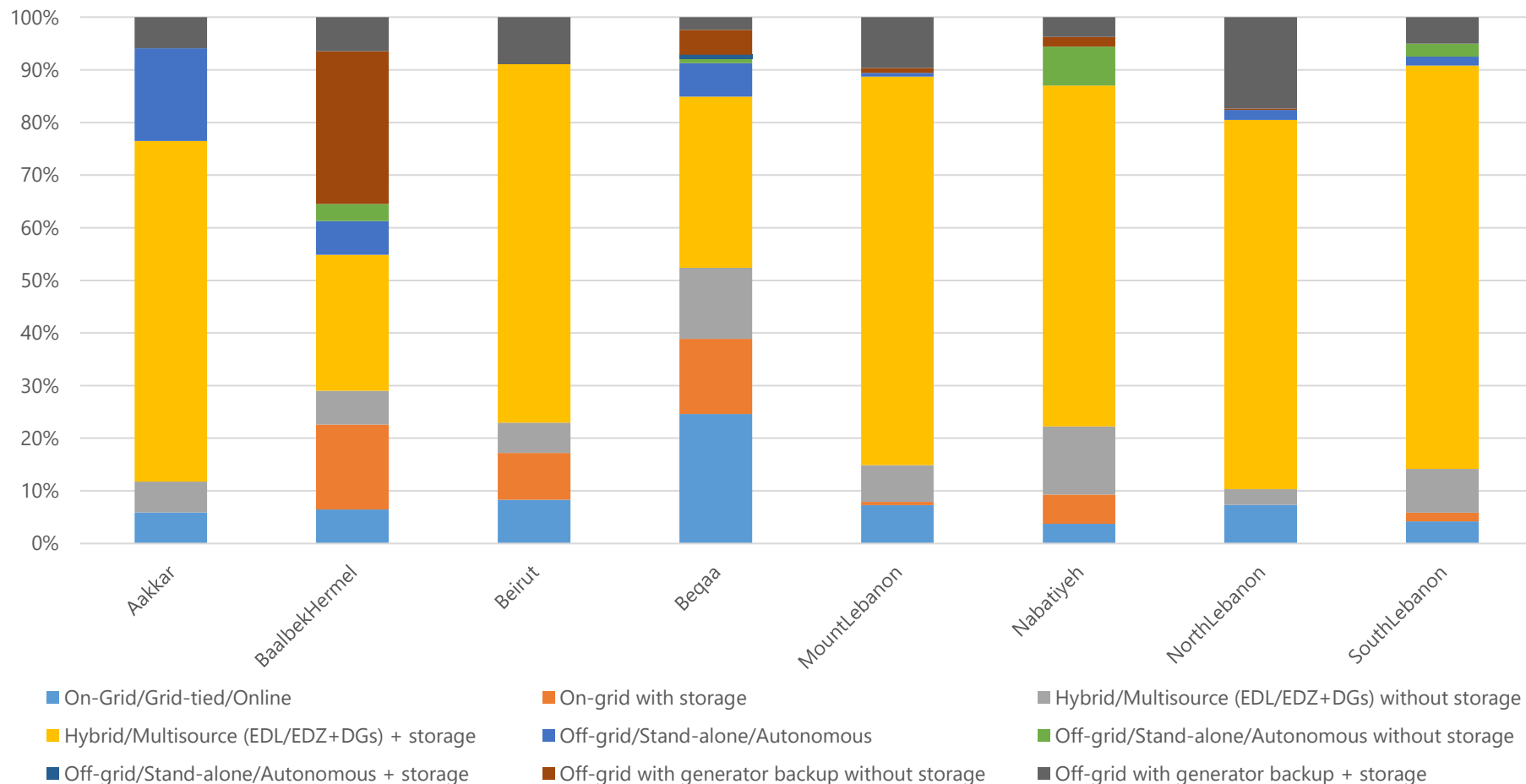
PV SYSTEM TYPE PER GOVERNORATE 2021 & 2022

The energy crisis consequences affected Beirut and Beqaa regions as well as other governorates. Surveyed data shows that the percentage of system types with backup storage became the highest in 2021 and 2022 in these regions, where the grid-tied solution was the major configuration implemented in 2020.



PV SYSTEM TYPE PER GOVERNORATE 2023

In 2023, the trend continued with hybrid/multisource systems with storage dominating in most governorates. Baalbek-Hermel displayed significant diversity in system types, including off-grid systems both with and without storage. The shift towards systems with storage indicates a growing focus on energy reliability and resilience in response to ongoing energy crises.



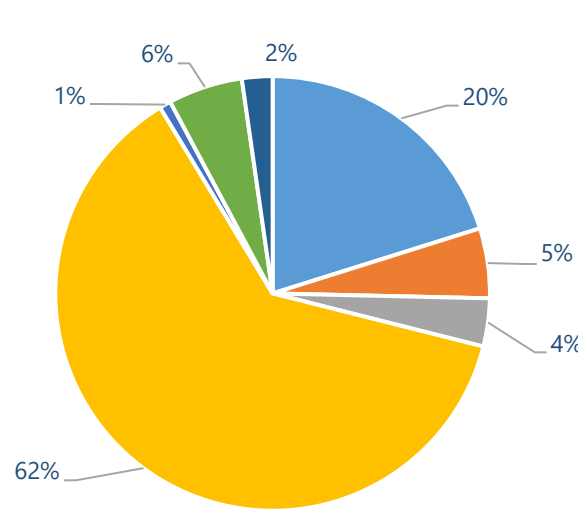
PV SYSTEM TYPES USED FOR POWER GENERATION (%)

As in previous years, surveys showed that the top two predominant system types used for power generation remained hybrid without storage and on-grid systems. However, the percentages of these types in terms of installed capacities decreased by 15% and 1% respectively. The total percentage of projects with storage in 2021 and 2022 combined was 36% showing an increase of 15% as compared to 2020.

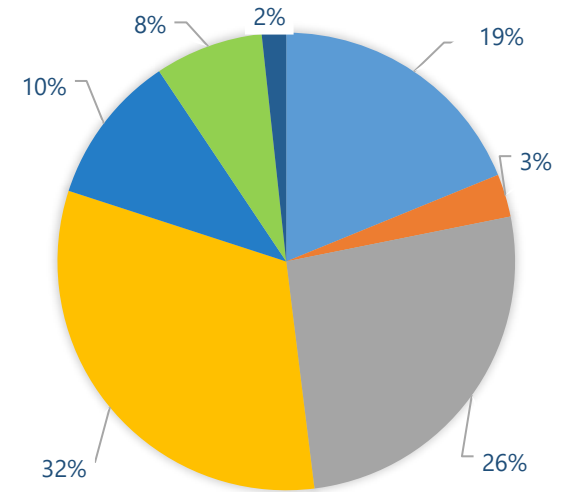
In 2023, there was a notable shift in the distribution of system types:

- Hybrid/Multisource without storage significantly decreased to 23.62%, indicating a substantial reduction from previous years.
- On-grid/Grid-tied systems increased to 30.52%, reflecting a higher adoption rate compared to prior years.
- Hybrid/Multisource with storage saw a noteworthy rise to 39.49%, emphasizing the growing importance of storage in PV systems.
- On-grid with storage decreased further to 0.45%, suggesting a decline in this configuration.

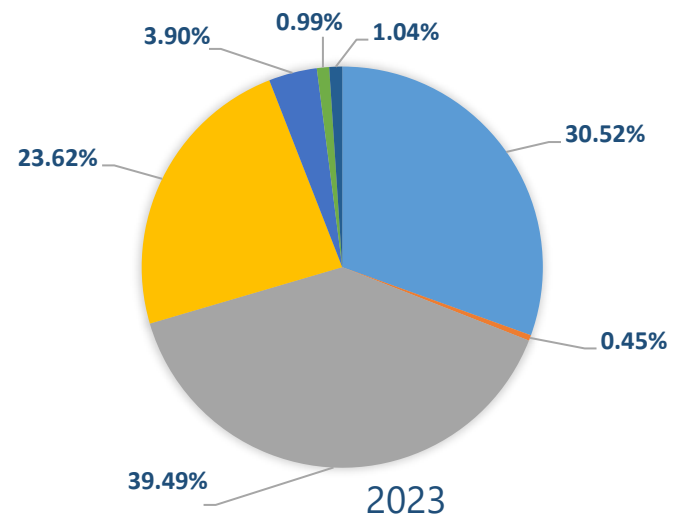
Overall, the trend in 2023 highlights a significant shift towards integrating storage with hybrid/multisource systems.



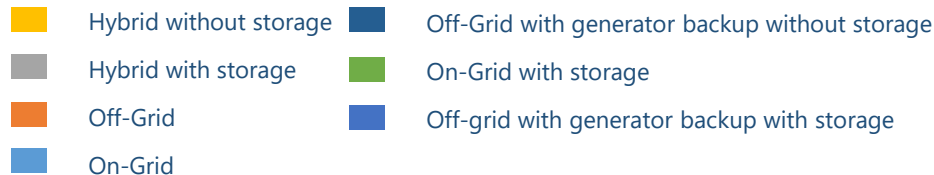
By End of 2020



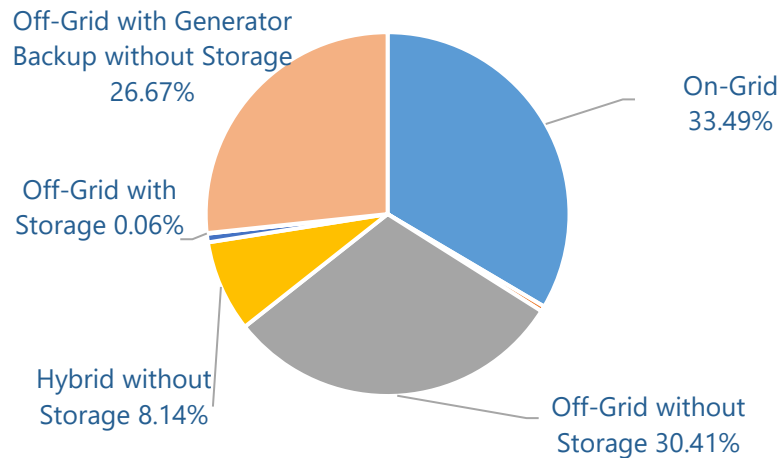
2021 & 2022



2023



PV SYSTEM TYPES USED FOR SOLAR PUMPING (%)



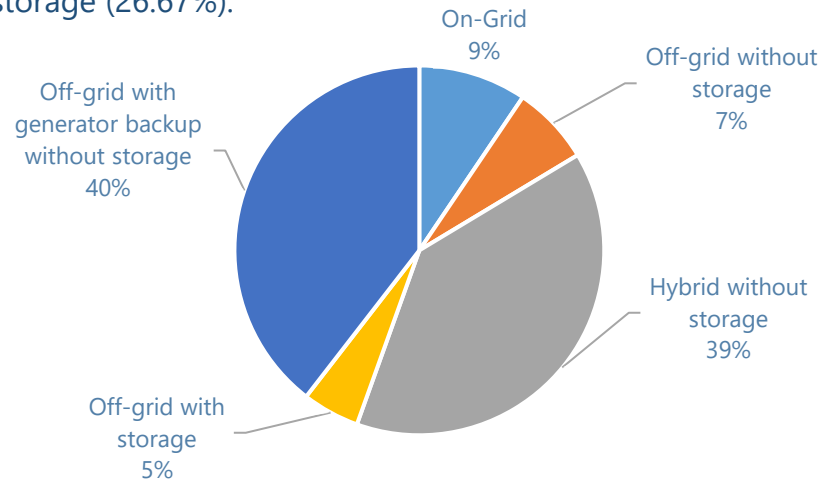
By End of 2020

In 2021 and 2022, surveys show that the top three types used for solar pumping have changed to become respectively: Off-grid with generator backup without storage (40%), and Hybrid without storage (39%).

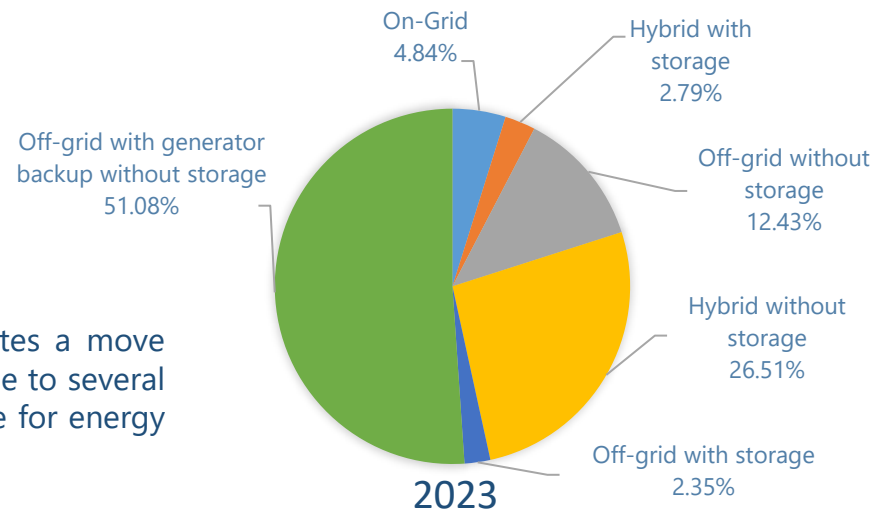
In 2023, the top three types used for solar pumping further evolved to become respectively: Off-grid with generator backup without storage (51.08%), Hybrid without storage (26.51%), and Off-grid without storage (12.43%).

The steady decline in the share of on-grid systems indicates a move away from dependence on the public grid. This could be due to several factors, including grid instability, increased costs or a desire for energy independence.

In 2020, The PV system types used for solar pumping were installed respectively as follows: On-grid (33.49%), Off-grid (30.41%), and Off-grid with generator backup without storage (26.67%).



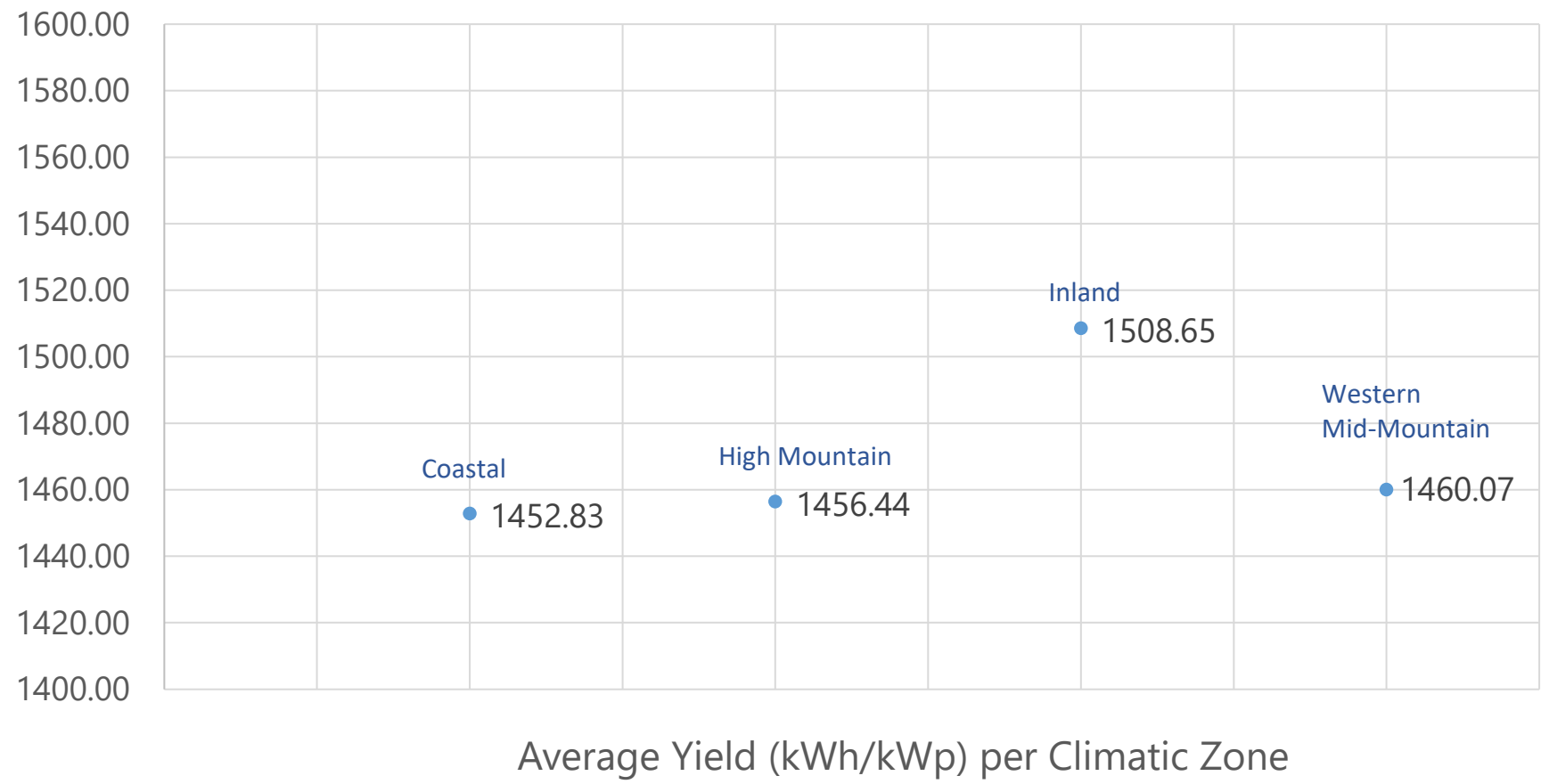
2021 & 2022



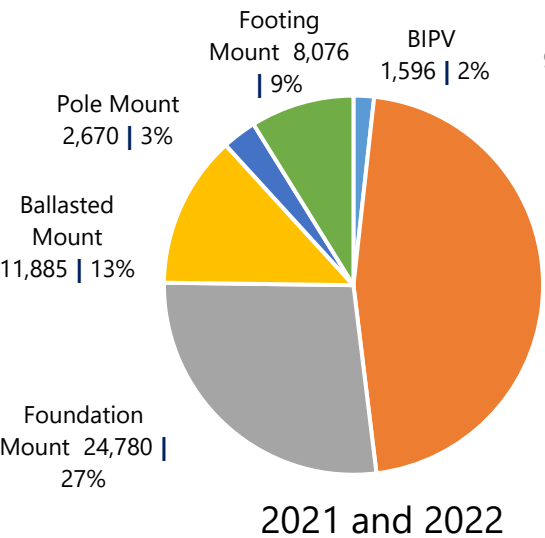
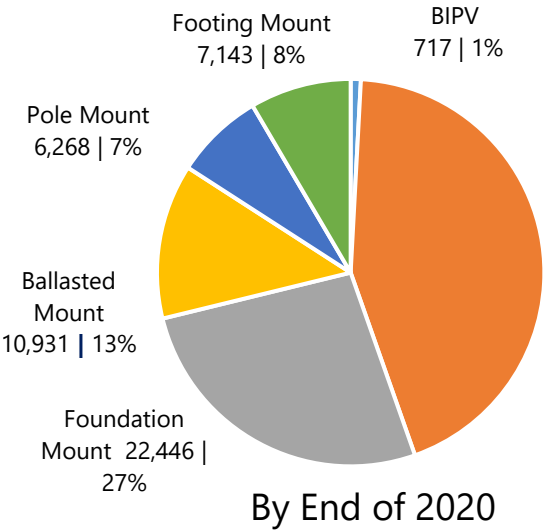
2023

CLIMATIC ZONES & PV SYSTEM YIELDS

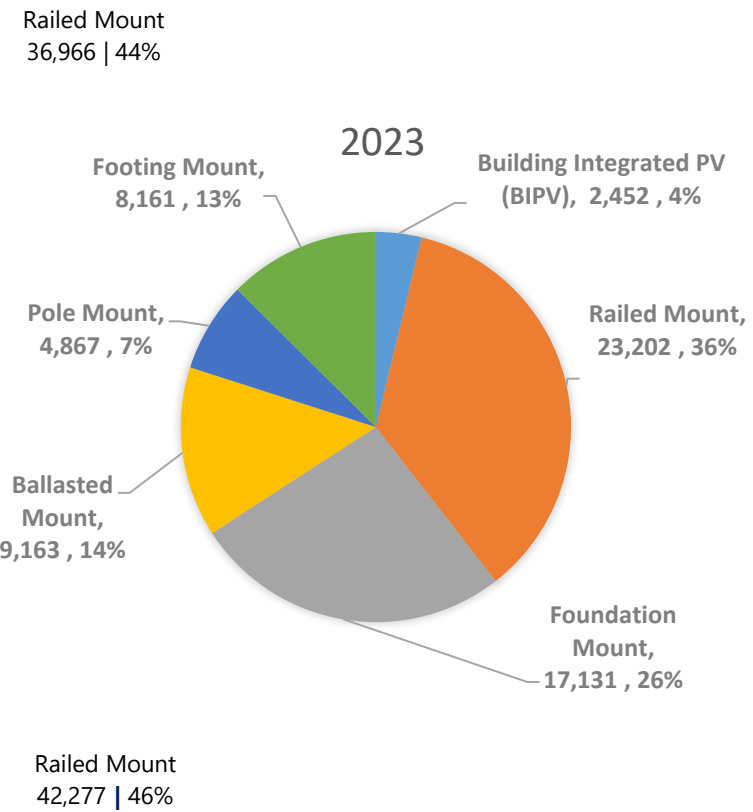
The average yield of installed PV systems was calculated excluding all misleading values below 1,000 kWh/kWp and above 2,000 kWh/kWp.



MOUNTING SYSTEM TYPES: kWp|%



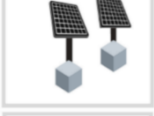
Based on the surveys, and similar to previous years, in 2021 and 2022, the three mounting system types used most were the Railed Mount (46%), Foundation Mount (27%), and Ballasted Mount (13%).



**FOUNDATION MOUNT**

**POLE MOUNT**

**RAILED MOUNT**

**FOOTING MOUNT**

**BALLASTED MOUNT**

**BIPV**

In 2023, railed mounts led at 36%, showing increased preference over previous years. BIPV systems, at 4%, reflect a growing interest in integrated solutions. These shifts indicate evolving installation preferences and diverse project needs compared to prior years.

TAKEAWAY POINTS

Decentralized solar PV is evolving as a practical option in Lebanon, primarily driven by the need to address the country's long-lasting power shortages and reduce dependence on imported fossil fuels. Lebanon's recent financial and economic crisis led to a shortage of foreign currency reserves and difficulties in importing fuel. This situation caused frequent power outages and increased reliance on alternative energy sources like solar power.

The Lebanese government is playing a crucial role in promoting renewable energy adoption by implementing new policies. The ratification of the Decentralized Renewable Energy (DRE) law as Law 318/2023 on December 28, 2023, developed with the support of the European Bank for Reconstruction & Development (EBRD) and in partnership with EDL and LCEC, marks a significant milestone towards creating a sustainable energy future for Lebanon.

Solar energy can provide energy independence, especially in regions with limited access to conventional energy sources. With ongoing challenges in Lebanon, individuals and businesses may have seen solar power as a way to mitigate their dependence on imported energy sources.

As the solar PV market in Lebanon heavily depends on the global supply chain for raw materials, components, and manufacturing, the turnkey cost stopped declining in 2021 due to the troubles that faced supply chains following the outbreak of COVID-19. Factory closures, labor shortages, and logistic challenges affected prices. Although the purchasing power in Lebanon dropped considerably after the economic crisis in 2020, the high demand for solar PV, due to the need for energy security, also contributed to the increase in prices in 2021. The turnkey costs showed a decrease in 2022 after a slight steadiness that occurred in supply chains.

In 2023, the market saw further improvements in the supply chain, leading to a continued reduction in turnkey prices, reaching \$1003 per kWp. This reduction reflects increased market stability and the benefits of technological advancements.

Regardless of all the challenges, Lebanon managed to achieve a solar boom in 2022, when the adoption and implementation of solar energy technologies reached their peak in the last ten years. This is due to a combination of factors led by the urge for energy security and independence in times of crisis.

In 2023, the Solar PV market in Lebanon sustained robust growth compared to 2020, the year preceding the remarkable boom in 2021 and 2022. This growth was characterized by important investments and increased installed capacity, underscoring the market's ongoing expansion.

The introduction of Energy Attribute Certificates (EACs) through the International Renewable Energy Certificates (IREC) scheme in Lebanon is set to significantly enhance the solar PV market. This initiative will play a vigorous role in advancing the market by facilitating investment, ensuring transparency, and supporting the growth of renewable energy capacity. With LCEC's recent approval of the first device for IREC issuance in Lebanon, the supply of these certificates will soon be available, providing a robust framework for tracking and trading renewable energy attributes. IRECs shall contribute to the overall transition to a cleaner and more sustainable energy future in Lebanon.

LIST OF PARTICIPATING ACTIVE LEBANESE SOLAR PV COMPANIES

#	Company Name	Address and Email Address
1	AEMS	Achrafieh, Adlieh Street, Olivetti Building, info@aems-lb.com
2	AL DIYAR	Beirut, Lebanon awada1958@yahoo.com
3	ALBINA	Verdun, Vienna Street, Chatila Building, r.balesh@albinagroup.com
4	Alkhawarizmi Group	Tyre -Alabbasiyyeh Highway (Near Horsh Al-Aabbasiyyeh) m.danash@alkhawarizmi-group.com
5	Alternative Energy Group	Beirut, Makdessi Street, Matta Building, kelsolh@ae-mena.com
6	Apex Energy	Zahle, Industrial Zone, said@apexmechatronics.com
7	Arina Energy	Sin El Fil, Kore Center, 2nd Floor info@arinaenergy.com
8	ASES	Al Hassan Center, Bloc A, 3rd Floor, Corniche El Mazraa, Beirut, Lebanon mr@asesgrp.com
9	Clean Energy Solution	Kartaba Main Road, Halat - P.O. Box 98 Jbeil, Lebanon rabih.hayek@spp-power.com
10	CoEnergy	Jabbour bldg-36, 1st Floor, Aatchane-Bikfaya,Lebanon n.jabbour@coenergy.me
11	Computel sal	Jdeideh-Street_Pierre A. Gemayel street -Bldg._St Antoine Center info@computel.com.lb
12	CTI	Jal-El-Dib, Main road, Yachoui Building, marc.yachoui@cti-businesses.com

LIST OF PARTICIPATING ACTIVE LEBANESE SOLAR PV COMPANIES

#	Company Name	Address and Email Address
13	Dawtec	Furn El Chebbak, LEMEC Building, dawtec@dawtec.com
14	Earth Technologies	Antelias, Sawma Jaber Street, CCI Building, gabboud@earthtechnologies.com
15	EAS Green	Jnah, United Nation Street, Assaf Building, barakat@eas-lb.com
16	ECOsyst	Beirut Corniche Al Nahr, Holcom Building, g.geha@ecosys.com.lb
17	Elements Sun&Wind	Dbayeh, Ziad Bou Dagher Building, elias@elementssw.com
18	EMTC	Baabda-Hadath, Ramadan Building, fuadosseily@hotmail.com
19	Energies-Sport-Sante ESS	Kornet Chehwan, Batir Building, 7th Floor, info@energies-sport-sante.com
20	Free SAL	Aintoura, Emile Wheibeh Building, toni.skayem@gmail.com
21	GP Stellar	Hamra, Broadway Center, 10th Floor, ali@gpstellar.com
22	Green Essence	Zahle, St Elie Street, Jean Zaatar Building, francois@greenessencelebanon.com
23	Green Power Generation	Zalka, Main Street, 4th floor, white building sabdo@gpglb.com
24	Green Power Tech	Chtaura, Jdita Mansour Building, dayehmohammad@yahoo.com

LIST OF PARTICIPATING ACTIVE LEBANESE SOLAR PV COMPANIES

#	Company Name	Address and Email Address
25	Green Wise energy	Van dyke 713, Van Dyck Street Ain Mreisse, Beirut , Lebanon sallyhraibe@greenwise.me
26	Hourie Energy Solutions SAL & Smart Energy Solutions LB	1 st Floor Sequoia Building, Sami-Solh Street Facing Adlieh, Beirut info@hourie-energy.com
27	Jubaili Bros	Jubaili Building, Maarouf Saad Boulevard, Saida ibrahim.serhan@jubailibros.com
28	Kypros	Dora, Cebaco Building, Block A, info@kyrossolar.com
29	Lebanon Power System sal Manalco group	Gemayel Bldg Financial Bank Mar Youssef Street Dora, Lebanon roger.teddy@Manalco.com
30	MASS	Mass Electro Mechanical Contracting, Beirut, Lebanon mc@mass-mep.com
31	Matrix	Matrix Power Network SAL, Boulevard Heights, Sin El Fil, Lebanon tendering@matrixpowerlb.com
32	ME Green	Byblos Street 13, Khoury Business Center, info@me-green.net
33	MEDCO	Saifi 311, 5th fl. Tabaris Sq Beirut, Lebanon robert.balech@medco.com.lb
34	Metasol	Beirut, Jnah, Al Yassmine Building, h.shawa@metasol.me
35	Narinco Micro	Dora Highway Dedeyan Center Block A, Gnd floor, Beirut Lebanon narinco.micro@gmail.com
36	Nova Energia	Jal El Dib, Lebanon 1st Floor, Bloc C, Laplaza Center, Bsalim Rd. joe.hawi@novaenergia-me.com

LIST OF PARTICIPATING ACTIVE LEBANESE SOLAR PV COMPANIES

#	Company Name	Address and Email Address
37	Phoenix	Safra, Hawa Chicken Street, energy@phoenixlb.com
38	Power & Green	Beirut-Lebanon nhakim@powerandgreen.me
39	Renewable MED Energy	Zouk El Khrab, Dbayeh Main Street, ziad.doumit@rmenergies.com
40	RJR Trading & Contracting	Sin El Fil, Ghazal Street, Matta Building, rony.rihany@rjrtrading.com
41	SAAB RDS	UG1,LaRoche bldg,Ferdaws st energy@saabrds.com
42	SERTA CHANNELS S.A.L	Resource Group, Mathaf 2058 6007, Beirut, Lebanon ghinwa.elsabeh@sertatelecom.com
43	SHIFT Group	Safra, Keserwan, Lebanon, P.O. Box 11 – 2354 Beirut mario@shift-group.co
44	SIG	SIG Showground, Monsef Highway, bassemale@yahoo.com
45	Smart Age	Zalka, Cité Moussa Center, Block C, elie.khoury@smartageeng.com
46	Solaris	Dbayeh Highway, Dbayeh Lebanon pj@solaris.green
47	Solarnet	Mansourieh Old Road, Yazbeck Building, info@solarnet-online.com
48	SolarWind	Sin El Fil, Horsh Tabet, Symposium Tower, solarwindme@solarwindme.com

LIST OF PARTICIPATING ACTIVE LEBANESE SOLAR PV COMPANIES

#	Company Name	Address and Email Address
49	Sun for Free	Zahle, Highway, Hrawi 1597, bldgtonynkara@gmail.com
50	Sustainable Energy Partners	Sustainable Energy Partners LLC – Center Rached, Jounieh - Lebanon r.sahyoun@sep-power.com
51	T.G.M. electronics	Zahle, Moualaka, Adel Khoury Building, tony-g-maalouf@hotmail.com
52	TAKOM Energy	Ghazieh Main Road, Khalifeh Center, b.taki@takomenergy.com
53	Talia Electronics / Yellow Eco Energy	Beirut, Lebanon y.malek@yellowecoenergy.com
54	Yazbek Solar	Al Nakhle, Koura, Lebanon mikaelyazbek@hotmail.com
55	YEKA Partners	Fouad Chehab Street-Byblos Bank Bldg-6th floor info@yekapartners.com
56	Yelloblue	Berytech T&H, Damascus Rd, Beirut-Lebanon tony.kaldany@yelloblue.com
57	YY-Regen	Jeanne D'Arc Street - Hamra Beirut info@yy-regen.com
58	Zmerly & CO SARL	Tripoli, Bahsas, Facing Tripoli Square info@zmerly.com