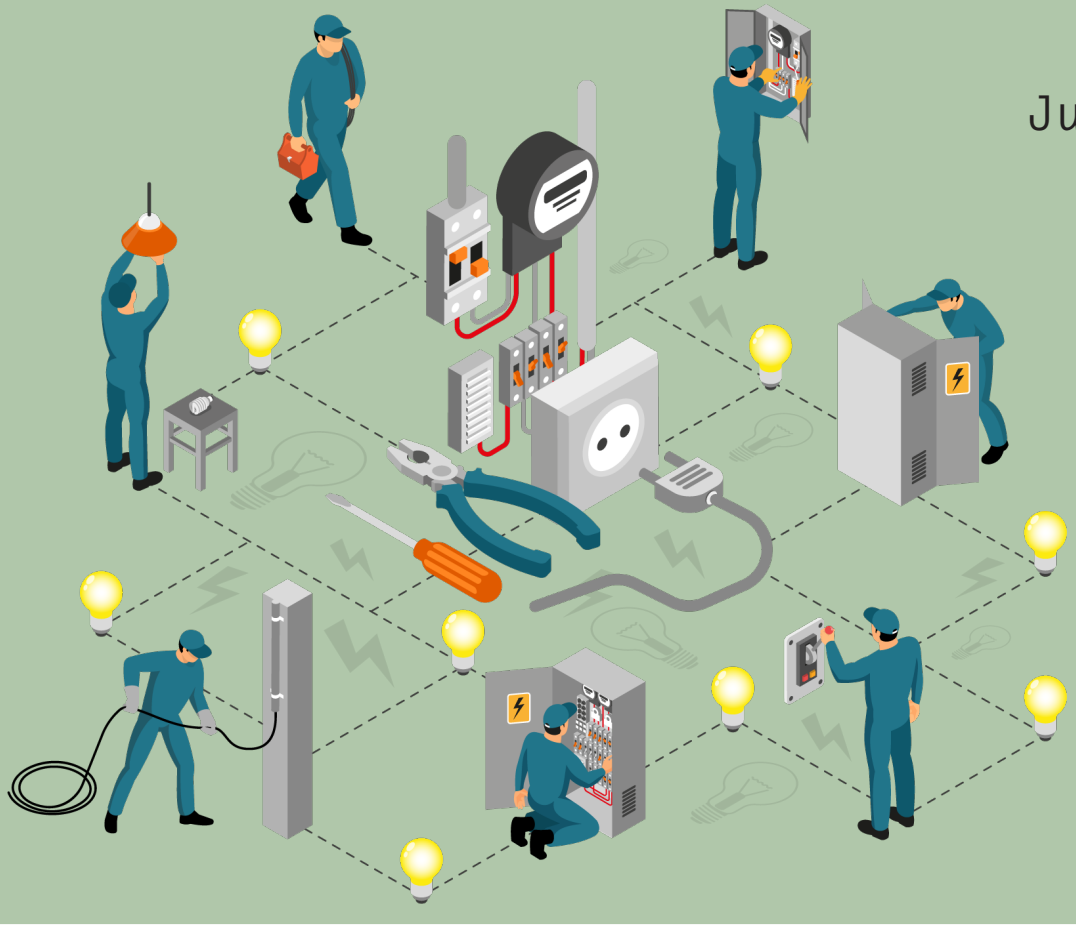
NAO National Audit Office MALTA

High-Level Review: Enemalta's Planning and Investment in the Local Electricity Distribution Network

July 2024



N A O
National Audit Office
MALTA

High-Level Review: Enemalta's Planning and Investment in the Local Electricity Distribution Network

Report by the Auditor General
July 2024

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List of Abbreviations

NAO	National Audit Office
ADPD	ADPD - The Green Party
MEER	Ministry for the Environment, Energy and Regeneration of the Grand Harbour
DSO	Distribution System Operator
HV	High Voltage
LV	Low Voltage
REWS	Regulator for Energy and Water Services
NCR	Network Control Room
NPOS	Network Planning and Operation Section
CEER	The Council of European Energy Regulators
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
kVAh	Kilovolt-Amperes Hours
kVA	Kilovolt-Amperes
METO	Malta International Airport Met Office
GDP	Gross Domestic Product
OECD	The Organisation for Economic Co-operation and Development
NSO	National Statistics Office
IEA	International Energy Agency
NDP	Network Development Plans
NECP	National Energy and Climate Plan
CAPEX	Capital Expenditure
OPEX	Operational Expenditure

Executive Summary

Why this study?

Acknowledging the importance of a reliable electricity distribution network, the events that unfolded during the summer of 2023 give raise to particular concerns. The power outages experienced during July 2023 attracted significant media coverage and were the cause of a public outcry. While, in NAO's own opinion, these occurrences merit a study on the matter, this Office is also in receipt of a request from the "ADPD – The Green Party" (ADPD) for such a review to be carried out.

What NAO Recommends

NAO augurs that Enemalta strengthens its planning function, not only by honouring the associated legal obligations, but also by taking into consideration demographics, climatic trends and associated risks, as well as the lifetime of all assets making up the distribution network, to ensure a more reliable supply of electricity to its consumers.

NAO's Key Observations

This report presents an analysis of the national High Voltage (HV) network's performance between 2014 and 2023. Findings show that the power outages experienced in July 2023 were due to widespread faults throughout the network rather than emanating from a single point of failure. With Enemalta (being Malta's electricity distribution system operator – DSO) citing sustained peak temperatures and an increase in peak demands as the main reasons behind these faults, NAO mapped out the progression of these two cited factors, as well as other indicators such as actual demands and GDP per capita to identify related trends across the scoped ten-year period. While meteorological statistics confirm that the situation which manifested itself last summer during a protracted period of elevated temperature was the highest within the scoped period, this exercise showed that all the analysed factors have been on an upward trajectory throughout the period under review.

On the other hand, capital expenditure invested in the HV network during the scoped period experienced a downward trend. This contrasts with the above-mentioned indicators, as well as with the fact that investment in the low voltage network and the installation of new electricity meters were on the increase. This review also shows that the DSO's annual actual expenditure on the HV network during the scoped period was significantly lower than the annual allocated capital budgets. It is however to be acknowledged that Enemalta experienced significant challenges, hampering it from executing planned projects and works, even if these would have been budgeted for. These issues include contractor availability and the sourcing of materials.

Network development plans reviewed by NAO did not fulfil all the benchmarked criteria, most of which emanate from pertinent legislation and Enemalta's own network code. In addition, this Office observed that reinforcement proposals prepared by the DSO's technical staff are based on what the entity can realistically carry out rather than on what is optimally required. This review further highlighted that Enemalta defaulted on its legal obligation to publish such network development plans and submit them to the regulator (that is the Regulator for Energy and Water Services), with the latter refraining from imposing associated penalties.

The DSO's historic investments in the HV network were, as attested by the prolonged outages experienced in 2023, not sufficient to mitigate the prevailing socio-economic and climatic circumstances. While this Office notes that prior to the summer 2023 occurrences the local distribution network experienced a relatively stable period, the significant capital investment in the electricity distribution network after the summer 2023 occurrences attests that Government acknowledges the strategic importance of addressing the risks of prolonged outages in its infrastructure.

Chapter 1| Introduction

1.1 Why this study?

1.1.1 Acknowledging the importance of a reliable and efficient electricity distribution network for Malta's economic and social well-being , the events that unfolded during the summer of 2023 give rise to certain concerns. The power outages experienced during July 2023 attracted significant media coverage and were the cause of a public outcry. While, in NAO's own opinion, these occurrences merit a study on the matter, this Office is also in receipt of a request from the "ADPD – The Green Party" (ADPD) for such a review to be carried out.

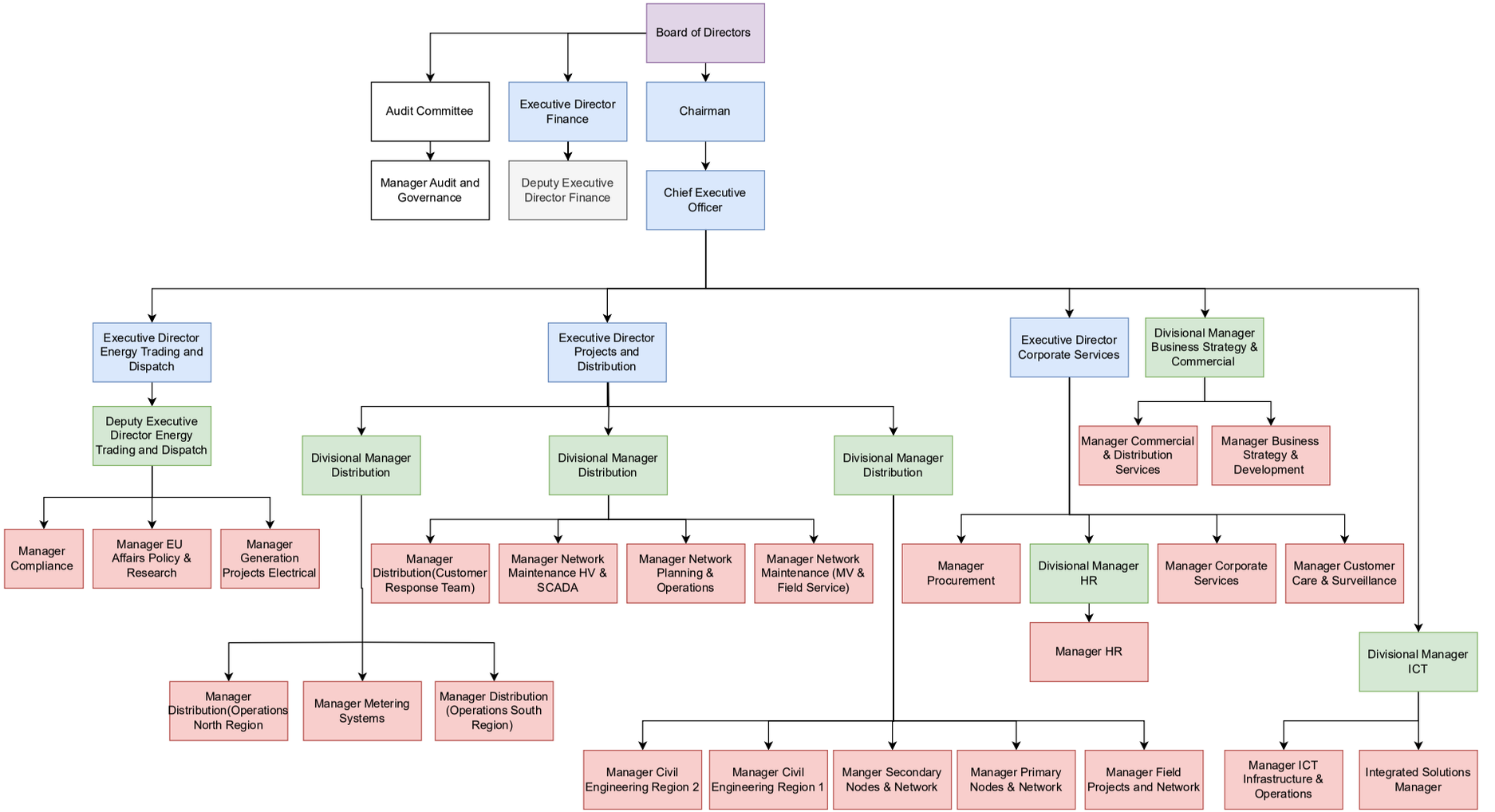
1.2 Background Information

1.2.1 Enemalta plc. is the designated distribution system operator (DSO) and sole supplier of electricity to final customers in Malta. The generation of electricity is open to third party entrants and the existing generation installation are mainly owned by third parties. The residual generation plants owned by Enemalta are used for emergency services and therefore Enemalta is no longer the main player in the generation sector. In its role as the DSO, Enemalta dispatches the local generation plants and manages the flows on the interconnector from Sicily. Enemalta determines whether to dispatch local generating plant or import electricity from the interconnection with Sicilymainly on the basis of economic considerations (including price) and contractual agreements related to gas. Electricity generation plants sell to Enemalta as the sole supplier of electricity to final customers in Malta. To note Malta does not have transmission system and thus no transmission system operator. Enemalta falls under the remit of the Ministry for the Environment, Energy and Regeneration of the Grand Harbour (MEER), and its obligations and responsibilities emanate from the Enemalta (Transfer of Assets, Rights, Liabilities and Obligations) Act (CAP 536), the Electricity Regulations (S.L.545.34), the Electricity Supply Regulations (S.L. 545.01)[1], the Network Code and any other applicable EU legislation.

1.2.2 In addition to being the sole national DSO, Enemalta is understandably a complex organisation. Figure 1 below presents a high-level organisational structure for better contextualisation.

[1] Electrical installations in Malta and Gozo are also regulated by the Electrical Installation Regulations (S.L. 545.24).

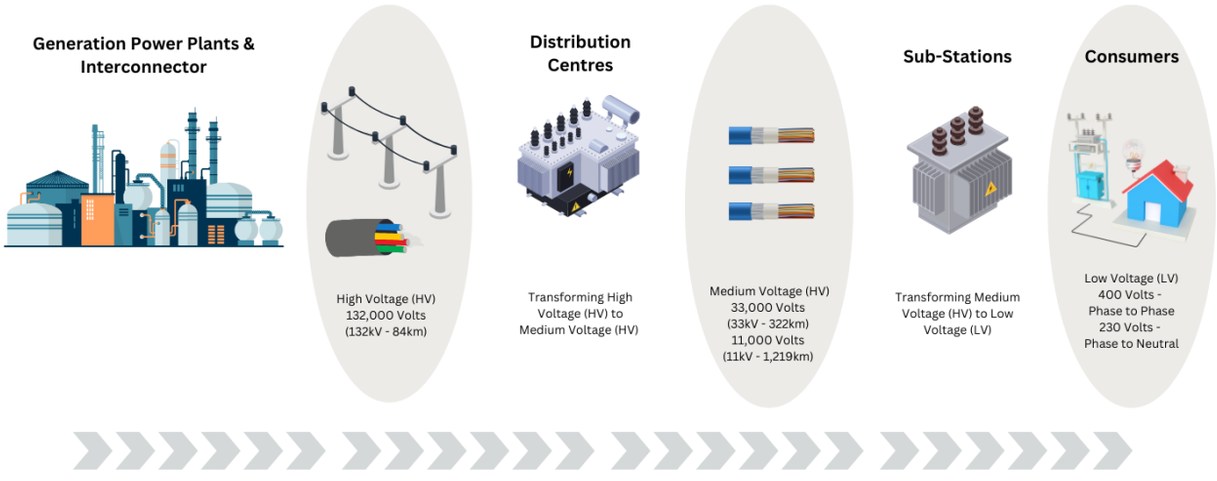
Figure 1: Enemalta's high-level organisational structure



Adapted from information forwarded by Enemalta as October 2023

1.2.3 The local electricity distribution network is categorised into three main components, that is; the high (HV), medium[2] and the low voltage (LV) systems. The higher voltage cables are mainly used to transport electricity from the local generation plants and the import from the interconnector, with the voltage level decreasing as the network approaches the final consumer. Apart from the main generation plants there are also a number of small renewable energy plants distributed along the low and medium voltage network. Figure 2 presents some further detail on these categorisations.

Figure 2: Voltage categories and length of related cables in the national distribution network



1.3 Audit Objectives and Scope

1.3.1 This publication is intended to provide a high-level overview of the area at hand and not an in-depth analysis. In due course, NAO may consider whether it will pursue this subject, or otherwise, in greater detail in subsequent publications.

1.3.2 This review seeks to determine the extent to which Enemalta's management of the electricity distribution network was conducive to a robust system that can meet the current as well as future demand for electricity in Malta. Specifically, it aims to determine whether:

a. Enemalta's planning appropriately covers the main elements necessary to sustain a robust electricity distribution network.

b. Capital funds earmarked for upgrading the distribution network were actually utilised.

c. Investments made in the distribution network constituted value for money in terms of improving security of supply of electricity.

[2] For practicality's sake, the term high voltage throughout this report is to be interpreted as high and medium voltage. This was discussed and agreed with Enemalta plc.

1.3.3 This review will cover a ten-year period, namely between 2014 to 2023. This period will ensure that any planning (or shortcomings thereof) that may have potentially contributed to the summer 2023 events, is included in this audit's scope.

1.3.4 This audit will only focus on Enemalta's planning function, its budgeting and investments, as well as evaluate results vis-a-vis network performance. In depth analysis on this entity's operational processes and its procurement function do not fall within the scope of this review.

1.3.5 As already mentioned, Enemalta is responsible for the distribution of electricity supply in Malta and the dispatch of local generation plants and management of flows on the interconnector. For the purpose of this review however, only the distribution aspect will be analysed, as the faults occurring during the 2023 summer were essentially related to this function (issue to be discussed in greater detail throughout the report).

1.3.6 This review will focus on the HV system and omit the LV, with the former being the main arteries of the distribution network and the primary origin of the summer 2023 faults.

1.3.7 It must also be noted that the entity's finances will be analysed solely from a high-level performance and value for money perspective. The compliance aspect of this area will therefore not be examined.

1.4 Methodology

1.4.1 Following a review of Enemalta's operations and industry best practices, the audit team convened an opening meeting with the entity's management. This discussion served NAO to gather in-depth understanding of the company's structure and key areas of operation. Information obtained from this meeting was used to support the audit team's ideas in its compilation of the issue analysis and audit design matrix. Through this process, audit questions were identified, as were relevant evaluation criteria and appropriate methodologies for conducting this audit.

1.4.2 A series of semi-structured interviews were then held with Enemalta officials, at various levels of management, in order to address the set audit questions. Meetings were also held with the Regulator for Energy and Water Services (REWS) on the subject matter. In tandem with these meetings, the audit team also meticulously reviewed all documentation that was requested from, and subsequently submitted by Enemalta, particularly, plans, downtime data and minutes. Analysis as required was carried out to address the audit's predetermined objectives.

1.4.3 The audit team also visited Enemalta's Network Control Room (NCR) and attended a walkthrough to grasp a working understanding of how this entity monitors the local distribution network, and how it responds to occurring faults. Furthermore, the audit team also conducted a meeting intended to better understand the formulation and summation of indices and metrics needed to classify outages and faults occurring in the distribution network.

1.4.4 Once all required information was gathered, analyses carried out, and observations secured, the audit team proceeded to produce a first draft of the report which was then presented to the auditee for its final feedback before publication. While general feedback was discussed during a meeting shortly prior to publication, comments in writing were received later by the auditee.

1.4.5 NAO conducted this performance review during the period between January and June 2024 and in line with the Standard for Performance Auditing ISSAI 3000.

1.5 Report Structure

1.5.1 Following this introductory chapter, this report adopts the following structure:

1.5.2 **Chapter 2** – This chapter reviews the performance of the HV network during the scoped period, based on the interruption data provided by the DSO. These results are then studied in parallel with trends in those factors which, according to Enemalta, contributed to the widespread outages experienced in summer 2023.

1.5.3 **Chapter 3** – NAO here presents a review of Enemalta's plans for the development of its HV network together with the legal obligations surrounding these documents. In addition, this chapter also presents the results from a benchmarking exercise in which the reviewed plans were assessed against set criteria.

1.5.4 **Chapter 4** – This last chapter presents the audit team's review of the financial elements that effect the planning of the HV distribution network. Specifically, this part of the report reviews the financial resources allocation during the planning stage, the annual budget allocation as well as their actual expenditure. In addition, this section also presents the trends of Enemalta's actual financial expenditure in the development of the network during the scoped period.

1.5.5 **Concluding Remark** – This report closes off with a concluding remark which sums up NAO's overall opinion on the subject matter.

1.5.6 **Auditee Comments** – This chapter presents MEER's and Enemalta's feedback on this report. These comments are referenced to the report sections that each relate to. The NAO had already considered auditee feedback throughout the conduct of this performance audit (and which was reflected in the text of this report that is in Chapters 1 to 4). Notwithstanding, at a later stage, the auditee referred written feedback, which the NAO opted to reproduce *verbatim*.

Chapter 2| High-Voltage Distribution Network Performance between 2014-2023

This chapter reviews the performance of the HV network during the scoped period based on the interruption data provided by the DSO. These results are then studied in parallel with trends in those factors which, according to Enemalta, contributed to the widespread outages experienced in summer 2023.

2.1 Data forwarded to NAO by Enemalta is primarily generated through its Network Control Room

2.1.1 During its fieldwork, the audit team held discussions with Enemalta's Network Planning and Operation Section (NPOS), being the section in charge to monitor the performance of the distribution network. Amongst other responsibilities, this Unit mans Enemalta's Network Control Room (NCR), which the audit team visited as part of its fieldwork to gather a better understanding of its operations.

2.1.2 From the NCR, NPOS monitors the local HV distribution network through two main software systems. These lay out a schematic of the main network components, namely distribution centres and substations, as well as the connections between them, on screens at the NCR. Through this setup, NPOS is able to monitor the operationality of these assets and is alerted with any fault which may occur in the national network.

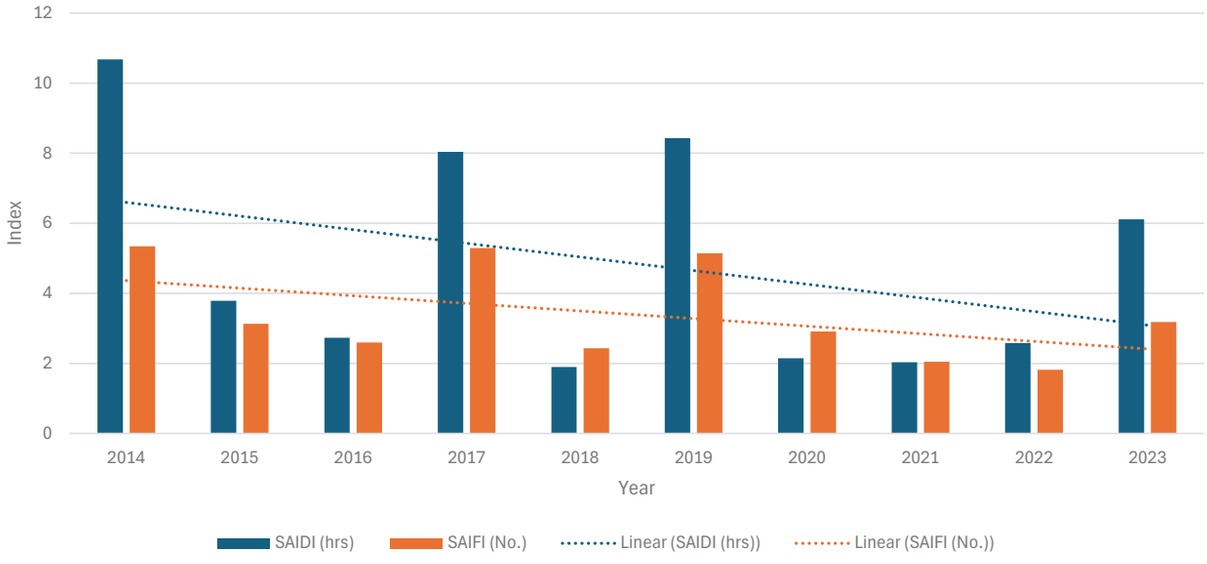
2.1.3 Apart from this monitoring function, this system keeps record of the overall distribution system performance and any occurring faults. NPOS officials are therefore in a position to extract data accordingly and use this to compile reports and statistics as would be needed by the DSO. In compiling this performance review, the audit team requested that a copy of this generated data (pertaining to this study's scoped period), is forwarded so that it could better contextualise the area at hand. Relevant representations of this information are presented throughout this report.

2.2 Summer 2023 downtime due to widespread faults in distribution network – a first time and highest occurrence within the scoped period.

2.2.1 Downtime in electricity supply and distribution is measured by electricity system reliability metrics. The Council of European Energy Regulators (CEER) states that "*the two main groups of indicators are those that deal with duration and those that deal with the frequency of interruptions. SAIDI and SAIFI (duration and frequency, respectively) are the basic indicators reported in almost all countries, sometimes under different names and with different methods of weighting the interruptions*." The "Distribution System Operator Observatory 2022", published by the European Commission's Joint Research Centre, defines SAIDI as the System Average Interruption Duration Index, measured in

the number of interruption minutes per customer per year for all customers. On the other hand, it defines SAIFI as the System Average Interruption Frequency Index, measured in the number of interruptions per customer per year for all customers. Figure 3 presents these metrics (per annum and including both generation as well as distribution related downtime) for the local scenario over the scoped period, based on interruption data forwarded to the NAO by Enemalta.

Figure 3: SAIDI and SAIFI over the scoped period



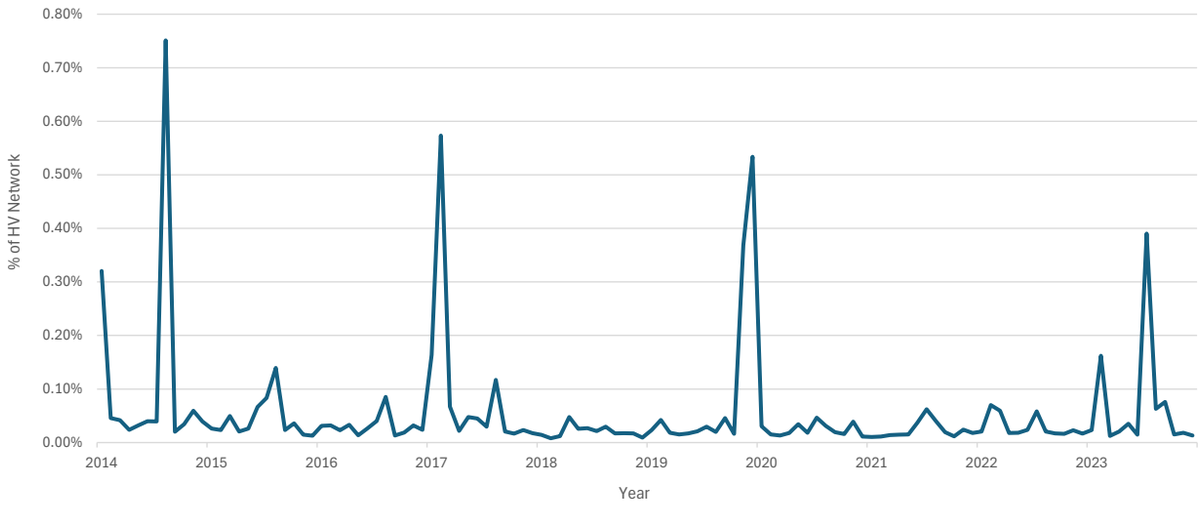
Adapted from information forwarded by Enemalta

2.2.2 In view of the fact that elevated SAIDI and SAIFI indices indicate poor network performance, Figure 3 shows that, while through the scoped period these indices show a downward trend (meaning that overall power interruptions through these years averaged lower frequencies and durations), the electricity network (including generation plants) registered significantly low performance during 2014, 2017, 2019 and 2023.

2.2.3 The NAO also endeavoured to determine the number of customers who were affected by each individual interruption. During meetings with Enemalta however, the audit team was informed that this latter information is not recorded, but that figures showing Kilovolt-Amperes Hours (kVAh) lost per interruption are kept by the DSO. Specifically, Enemalta explained that kVA is a unit used to measure the transformer rating of substations (which assets turn HV electricity to LV and feeds LV cables out to the final consumers). Generally, sub-stations are rated according to the expected demand and, as a consequence, this rating can be used as a proportion of the number of customers being served. However, to determine the magnitude of the interruption, the duration of each event also has to be considered. When this duration is factored in together with the kVA rating, the kVAh lost metric is achieved. During meetings with Enemalta it was confirmed that, with the available information, this is the more consumer-centric measure used to gauge each interruption event.

2.2.4 By using the kVAh lost metric, NAO was able to produce Figure 4, which shows monthly interruptions within the scoped period. It is important to note that for this representation, the audit team also factored in the total network's kVA capacity as at end of each respective year (that is, kVA lost over total network kVA capacity), thereby ensuring a fairer ratio throughout. Enemalta further confirmed this method, referring to it as 'Network Unavailability'.

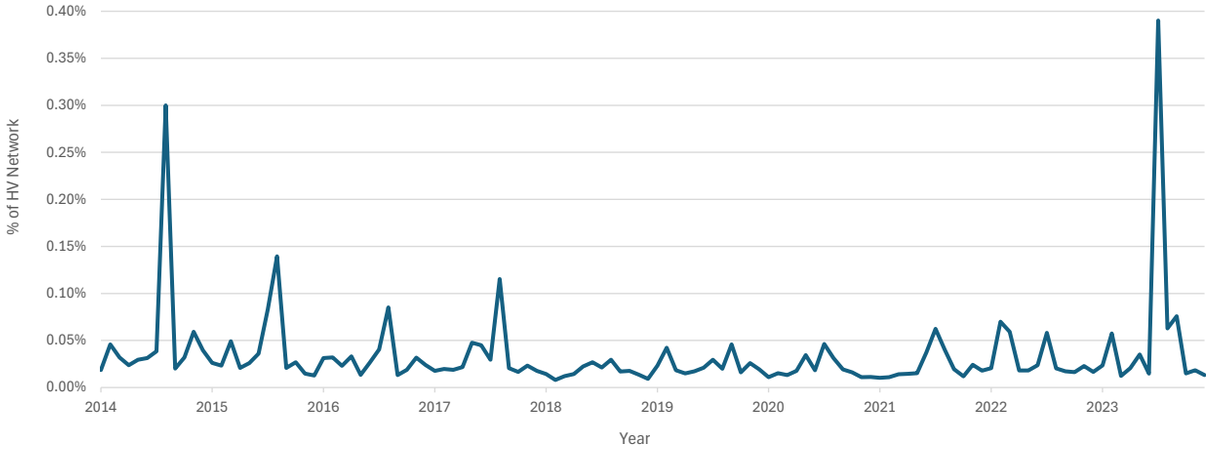
Figure 4: Overall network unavailability 2014-2023



Adapted from information forwarded by Enemalta

2.2.5 While Figure 4 shows that the magnitude of overall downtime peaks (that is, generation and distribution related) decreased over time, it is important to note that this audit is scoped to cover the distribution network, and omits the generation aspect. Consequently, the forwarded data was filtered accordingly to reflect network unavailability which occurred due to faults in the distribution system only. Figure 5 presents this filtered ratio throughout the scoped period.

Figure 5: Network unavailability 2014-2023 due to distribution related faults

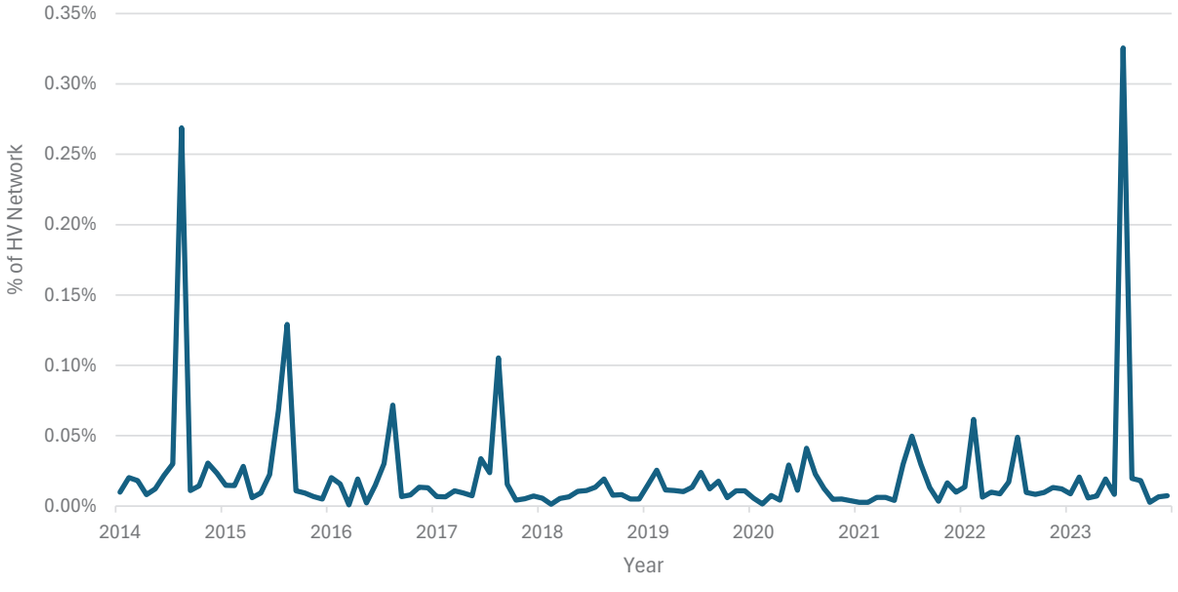


Adapted from information forwarded by Enemalta

2.2.6 In understanding better what were the causes of these registered interruptions, the audit team analysed the forwarded data and compiled Table 1 accordingly. As can be seen from this table, apart from scheduled interruptions (which were filtered out from this review – section 2.2.7 refers), HV joints are the primary contributors, by a considerable margin, to registered downtime in the national distribution network.

2.2.7 As this review seeks to assess Enemalta's planning and budgeting, this Office acknowledges that faults occurring through third party interventions (such as cables being damaged during works, vandalism etc) are largely out of the DSO's control. The audit team therefore filtered such related downtime out of its analysis. This Office also filtered out downtime resulting from interventions by Enemalta such as works, load shedding or switching. While NAO understands that these should be supported by the N-1 principle (that is, electricity supply would not be interrupted due to a contingency – discussed further in subsequent parts of this report), it adopted this prudent approach given that an in-depth and technical analysis on this issue was beyond this study's scope. Figure 6 shows the residual downtime throughout the scoped period.

Figure 6: Network unavailability 2014-2023 due to distribution related faults, excluding third party and DSO interventions



Adapted from information forwarded by Enemalta

Table 1: Causes of power interruptions by category and magnitude

Fault Category	2014 KVAh Lost	2015 KVAh Lost	2016 KVAh Lost	2017 KVAh Lost	2018 KVAh Lost	2019 KVAh Lost	2020 KVAh Lost	2021 KVAh Lost	2022 KVAh Lost	2023 KVAh Lost	Grand Total KVAh Lost	% of Total KVAh Lost
Scheduled Interruptions	1,928,080	1,396,198	1,610,221	1,746,557	1,283,181	1,276,441	952,046	1,010,471	1,370,114	2,411,752	14,985,061	30.16%
H.V. Joints	893,765	981,471	576,058	1,592,323	443,382	855,341	865,760	1,209,606	1,643,926	4,009,239	13,070,871	26.31%
Electrical Fault	540,603	1,825,302	1,126,135	510,433	423,080	349,633	326,974	389,833	602,273	693,064	6,787,330	13.66%
Third Parties	204,550	290,233	90,023	202,609	184,714	304,282	323,685	432,067	656,429	1,790,136	4,478,728	9.01%
Mechanical Fault	2,727,874	358,427	175,464	7,666	1,742	28,960	8,933	65,659	13,255	110,291	3,498,271	7.04%
Settings	168,272	40,910	211,635	19,651	5,892	74,496	348,865	7,970	76,418	97,113	1,051,222	2.12%
Untraced	0	0	0	146,592	63,390	195,065	43,788	118,471	104,527	263,480	935,313	1.88%
Insulator	46,862	67,035	46,105	142,183	53,512	54,415	23,427	129,528	87,893	170,293	821,253	1.65%
Broken Line	199,030	10,797	61,960	32,158	51,722	123,015	55,561	59,048	38,858	175,157	807,306	1.62%
Outdoor Box	76,588	43,754	21,150	73,357	38,433	57,840	40,758	55,140	107,003	26,726	540,749	1.09%
Ventilation	0	0	0	15,424	0	33,289	6,475	8,693	5,674	403,465	473,020	0.95%
Indoor Box	38,946	0	21,744	0	5,096	21,564	21,516	82,465	22,952	129,829	344,112	0.69%
Surge Divertor	98,580	38,807	25,506	22,361	31,731	15,616	13,648	24,489	24,901	22,170	317,809	0.64%
Overload	11,030	40,892	29,919	27,098	7,646	4,320	38,976	13,857	8,721	115,521	297,980	0.60%
Broken Jumper	6,100	2,309	10,963	13,180	0	72,980	17,966	17,642	57,291	6,113	204,544	0.41%
Touching Lines	0	0	0	14,707	19,106	37,067	17,330	24,933	55,036	18,952	187,131	0.38%
Oil Leak	21,551	7,139	9,357	21,561	14,513	17,710	10,882	25,885	11,975	31,908	172,481	0.35%
Untraced – Lightning	0	0	0	13,193	27,478	12,817	12,354	39,634	11,391	34,637	151,504	0.30%
Others	14,198	10,863	3,118	8,731	28,484	33,452	6,070	0	1,191	4,245	110,352	0.22%
Faulty Battery	6,774	0	1,756	7,248	528	10,386	18,901	16,829	18,939	17,487	98,848	0.20%
Link Strainer	33,828	14,124	0	4,014	0	5,594	28,481	2,325	2,516	4,272	95,154	0.19%
Fuse Carrier	12,543	1,407	3,722	841	1,728	10,882	375	7,319	8,496	20,450	67,763	0.14%
Oil Level Variation	0	0	7,295	18,547	2,316	2,300	6,293	8,501	8,789	1,360	55,401	0.11%
Gassing	0	14,959	4,106	1,375	0	6,584	6,445	883	1,633	15,648	51,633	0.10%
Damaged Pole	0	0	0	0	0	38,223	0	8,274	4,998	0	51,495	0.10%
SF6 Leak	0	0	0	0	0	0	0	0	19,312	0	19,312	0.04%
Outdoor Termination	0	0	0	0	0	6,319	0	0	0	0	6,319	0.01%
Faulty E/F Indicator	0	1,434	3,504	222	198	0	27	0	496	36	5,917	0.01%
Maintenance	0	0	0	0	0	0	1,126	0	0	0	1,126	0.002%
	7,029,174	**5,146,061**	**4,039,741**	**4,642,031**	**2,687,872**	**3,648,591**	**3,196,662**	**3,759,522**	**4,965,007**	**10,573,344**	**49,688,005**	

Adapted from information forwarded by Enemalta

2.2.8 Figure 6 shows that, throughout the scoped period, registered downtime was relatively constant, with the exception of two major spikes (with one occurring in August 2014 and the other in July 2023). Enemalta contends that improvements in connectivity (that is, consumers being connected to more than one sub-station as contingency in the case of a default in one of them) and increased automation (which enables remote switching with the aim of restoring energy supply at substation level by the DSO once a fault has been addressed) are two main contributors to this result. Insofar as the two major spikes in distribution related faults are concerned, it must however be noted that, data forwarded by Enemalta shows that the 2014 spike occurred due to a single incident which affected the Marsa Distribution Centre. Therefore, while a major occurrence, this happened due to a fault at a single point of failure. In contrast however, the spike in faults during July 2023 occurred due to widespread occurrences throughout the network which, as the graph illustrates, was the only one of its kind (and the most significant) during the scoped period. From data forwarded by Enemalta, and as already stated in section 2.2.6, it is apparent that the primary cause of these faults were HV joints, occurring through 83 incidents and resulting in 3,315,842kVAh lost in just one month.

2.3 Sustained peak temperatures and associated demand cited as the primary causes of the summer 2023 events

2.3.1 During meetings with Enemalta's management, the audit team enquired about what, in the former's opinion, was the primary cause of the 2023 events. In response, the DSO stated that the sustained high temperatures during the summer in question inevitably brought with them an increase in demand from consumers. This was causing significantly higher loads on the local distribution network, which led to failures[3]. While the DSO would switch consumers on alternate distribution pathways after such failures, it was further explained that the extended duration of peak temperatures did not allow enough time for Enemalta to carry out repairs on primary faults before the contingencies themselves also started to fail.

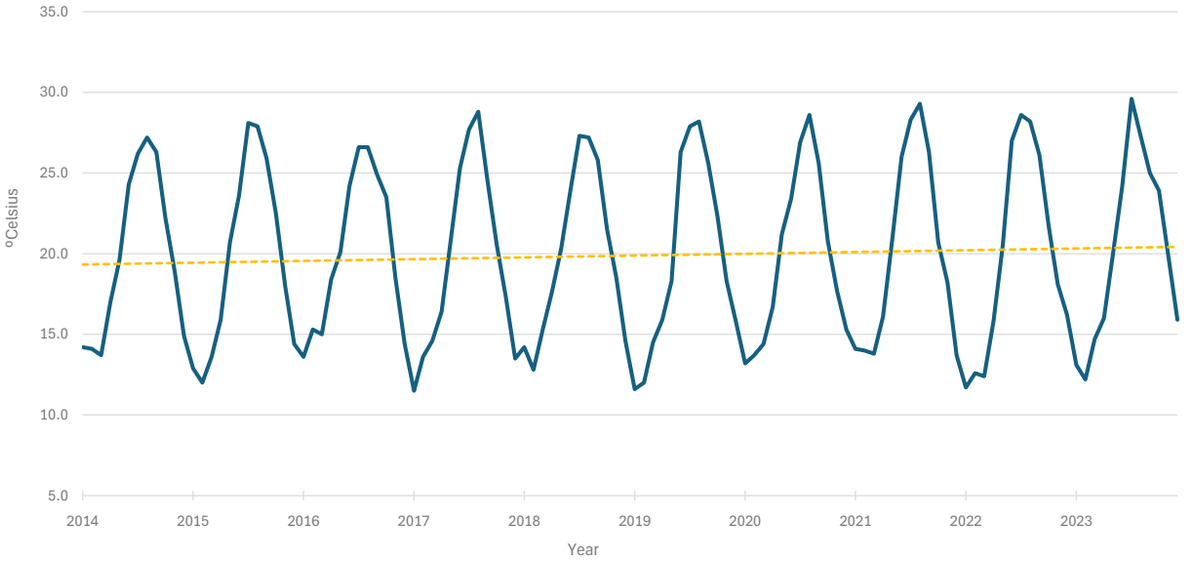
2.3.2 In addition to this, Enemalta explained that the demand for electricity is on the increase. Specifically, it highlighted that businesses and households are increasingly investing in appliances and electrical equipment which all put pressure on the local supply and distribution systems. The DSO further informed the audit team that it generally plans for a 3 per cent increase in load from one year to the next which, in 2023, resulted as insufficient – particularly as Enemalta estimates that the 2023 occurrence resulted in an increased electricity demand from consumers of around 14per cent.

2.3.3 In order to verify these claims, NAO sought to map out the progression of these two cited factors, namely increasing temperature and demand throughout the scoped period, so that trends can be identified. Starting with temperature, NAO submitted a request to the Malta International Airport Met Office (METO) so that the latter would provide it with relevant data for the scoped period. Once this information was in hand, the audit team was able to determine two main trends, namely that showing the average monthly temperature (Figure 7 refers) as well as that related to

[3] Even when assuming that the network is in an optimal state of maintenance and operation, it is to be noted that it would be able to operate beyond the maximum designed capacity only for a limited time.

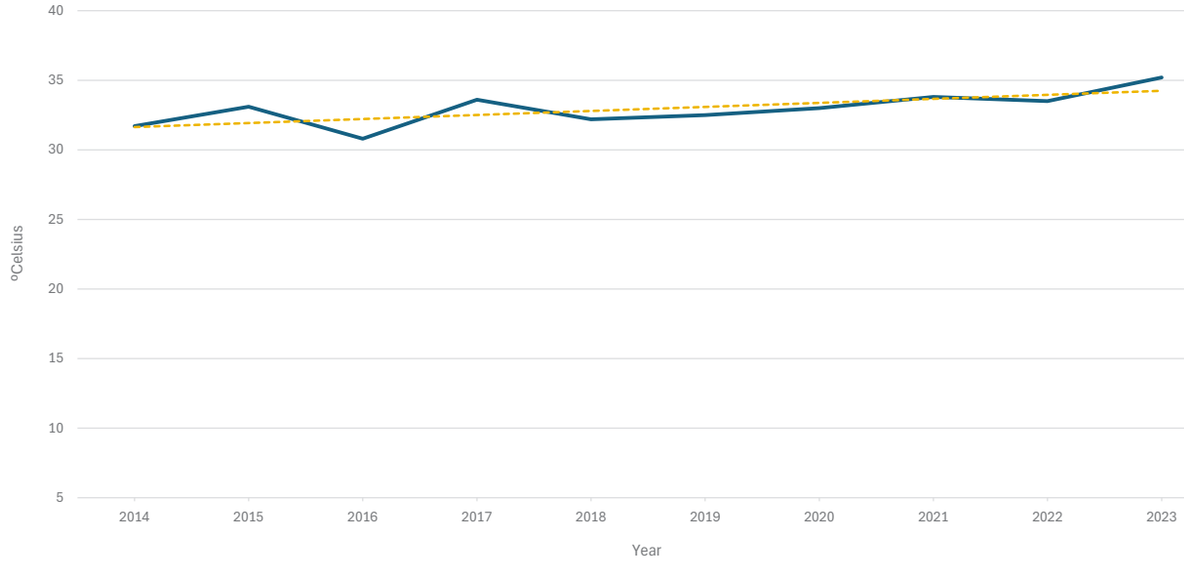
peak temperatures throughout the period under review (Figure 8 refers). It is important to note that for the latter consideration, the audit team selected the warmest month of every year and averaged its daily peak temperatures to arrive at the value. In so doing, this average takes into account the actual registered peak temperatures as well as the relevant duration.

Figure 7: Monthly average temperatures



Adapted from information forwarded by METO

Figure 8: Average peak temperatures (of warmest month each year)



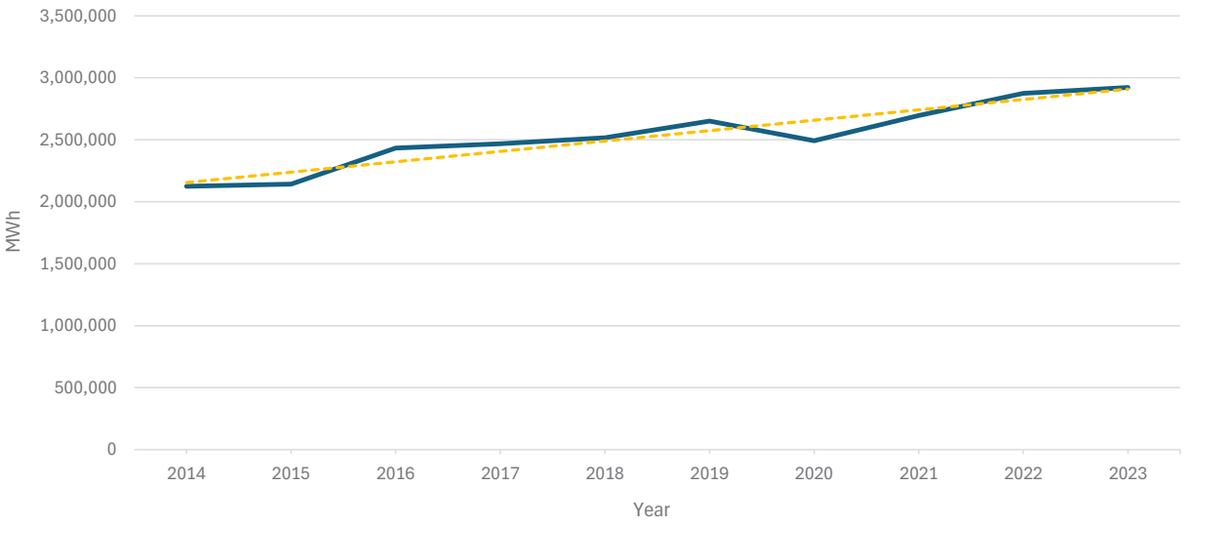
Adapted from information forwarded by METO

2.3.4 As can be seen from Figures 7 and 8, both the monthly average temperatures as well as average peak temperatures have been on an upward trajectory since the start of the scoped period. It is important however to note that the trend line through the average peak temperatures has a steeper gradient than the monthly average temperatures, specifically 0.29 against 0.01 respectively. This means that sudden spikes in peak temperatures have been increasing at a more significant

rate when compared to upward fluctuations in the average temperature itself. In fact, a close review of temperature statistics shows that during July 2023 daily peak temperatures in excess of 39 degrees Celsius were sustained for eight consecutive days, which occurrence was the most significant throughout the period under review.

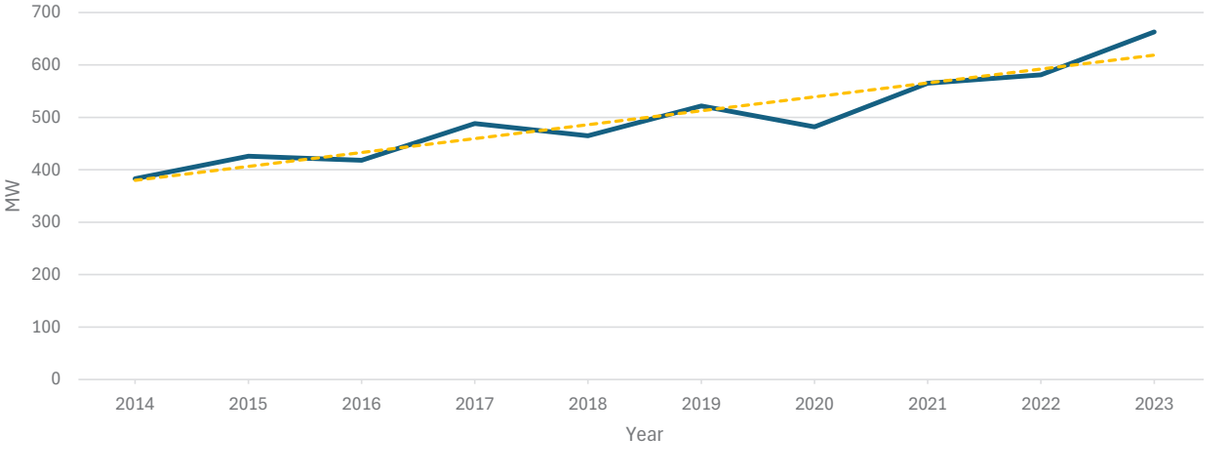
2.3.5 This supports the argument that demand for electricity would invariably increase, and register higher peaks, during such instances, with consumers utilising domestic appliances to regulate the temperature. In fact, Figures 9 and 10 below show that demand for electricity as well as related peaks throughout the scoped period were predictably also on an upward trajectory.

Figure 9: Annual demand in MWh



Adapted from information forwarded by Enemalta

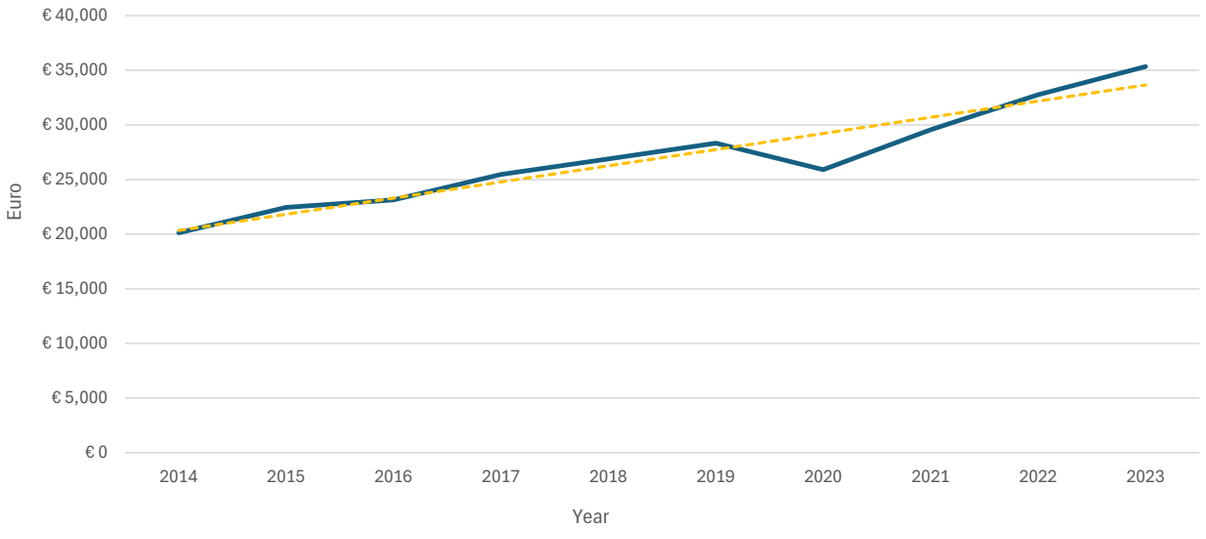
Figure 10: Annual peak demand in MW



Adapted from information forwarded by Enemalta

2.3.6 Considering Enemalta's statement that businesses and households are becoming increasingly dependent on electrical appliances and equipment, the audit team opted to refer to the Gross Domestic Product (GDP) per capita metric as an indicator of this. The Organisation for Economic Co-operation and Development (OECD) indicates that GDP per capita is a core indicator of economic performance and is commonly used as a broad measure of average living standards or economic wellbeing, despite some recognised shortcomings. In view of this, NAO requested the annual local GDP per capita figures for the period under review from the National Statistics Office (NSO). Figure 11 shows that this is also on a pronounced upward trajectory, which further supports the occurrence of increased annual and peak demand for electricity.

Figure 11: GDP per capita 2014-2023



Adapted from information forwarded by NSO

Chapter 3| Enemalta's Network Development Planning

NAO here presents a review of Enemalta's plans for the development of its HV network together with the legal obligations surrounding these documents. In addition, this chapter also presents the results from a benchmarking exercise in which the reviewed plans were assessed against set criteria.

3.1 Network reinforcement proposals generated by Enemalta are based on what the entity can realistically carry out, rather than on what is optimally required

3.1.1 This audit found that NPOS prepares periodic reports (and submits them to Enemalta management) in which proposed reinforcements of the local distribution network are collated. NPOS officials explained that these reports contain a detailed scenario analysis of the network, primarily identifying which feeders are heavily loaded during the summer and winter peak load periods, with particular attention being given to those registering higher peak loads when compared to previous years. These identified feeders are then earmarked for reinforcement projects, while keeping in view whether they are already part of previously committed broader improvement projects. It is important to highlight that any projects and reinforcement initiatives are planned with what is referred to as the "N-1" principle in mind. By way of information, the International Energy Agency (IEA) states that a power system can be described as being "N-1" secure when it is capable of maintaining normal operations in the event of a single contingency event, such as the unplanned loss of a transmission line, generator or transformer.

3.1.2 During discussions with NPOS, the audit team was informed that these documents are prepared every six months. Having requested copies of a sample of these, this Office is in receipt of six such reports, which cover periods ranging from 2018 to 2023. While the audit team did not assess these documents on their technical qualities, it did note that the proposals within are presented in substantial detail. It must also be noted that, for this high-level review, the audit team sought to assess the extent to which the proposals in these documents featured in Enemalta's final official plans (discussed in more detail in the next part of this Chapter). To do this, the audit team requested and reviewed the Board of Management's and Board of Directors' minutes of meetings in which the distribution network was discussed. Enemalta made available to the audit team extracts of these minutes but these generally dealt with separate projects and initiatives. The audit team therefore could not knit a continuous trail leading to the corporation's final planning.

3.1.3 In view of the above, the audit team enquired with NPOS on whether these proposals are generated according to the actual needs of the local distribution network, or whether the quantity and depth of these proposals are limited by what Enemalta's position to actuate such proposals would be at each particular instance. In reply, NPOS explained that it normally determines the network reinforcement works required and only formally submits to management the priority proposals

that could be realistically undertaken with Enemalta's resources at the time (that is, funds, time, manpower, and the availability of third-party contractors). NAO was however further informed that following the failures that developed in July 2023, an additional list of interventions that were deemed required (apart from the abovementioned usual report). The first phase of the implementation of the precautionary reinforcements identified by Enemalta was completed in June 2024. When queried about the status of the works which were earmarked as part of the normal procedure, Enemalta confirmed that these are planned to be undertaken after Summer 2024 and that the required cables and accessories have been procured and delivered.

3.2 Enemalta defaulted on its legal requirements to publish network development plans and submit them to the regulator

3.2.1 The 2014-2023 scoped period spans over two primary governing legislations when it comes to the local DSO's reporting obligations. Specifically, LN 166 of 2011 was in vigore till end of May 2021, with SL 545.34 superseding it at the start of June 2021.

3.2.2 Starting with considerations on SL 545.34, Article 30 (4) states that Enemalta needs to produce Network Development Plans (NDP), which plans are intended to "*provide transparency on the medium and long-term flexibility services needed, and shall set out the planned investments for the next five-to-ten years, with particular emphasis on the main distribution infrastructure which is required in order to connect new generation capacity and new loads, including recharging points for electric vehicles. The network development plan shall also include the use of demand response, energy efficiency, energy storage facilities or other resources that the distribution system operator is to use as an alternative to system expansion*". This legislation further requires Enemalta to publish this plan on its website and submit it to the national regulator (that is the Regulator for Energy and Water Services (REWS)) at least once every two years. Table 2 cites these obligations accordingly.

Table 2: NDP submission and publication obligations cited in SL 545.34

Legislation	Submission to Authority and Publishing of Network Development Plan
SL 545.34	30 (4)(a) development of a distribution system shall be based on a transparent network development plan that the distribution system operator shall publish at least every two (2) years and shall submit to the Regulator. 30 (5) (b) the distribution system operator shall publish the results of the consultation process along with the network development plan and submit the results of the consultation and the network development plan to the Regulator. The Regulator may request for amendments to be made to the plan. 40 (1) at least every two (2) years, transmission system operators shall submit to the Regulator a ten-year network development plan based on existing and forecast supply and demand after having consulted all the relevant stakeholders. That network development plan shall contain efficient measures in order to guarantee the adequacy of the system and the security of supply. The transmission system operator shall publish the ten-year network development plan on its website.

3.2.3 In assessing whether Enemalta complied with these legal requirements, NAO requested copies of such plans which were generated during the effective period of SL 545.34. In response, the audit team was forwarded with two plans covering periods 2022-2027 and 2024-2031. It must be noted that while the plan 2024-2031 was quite extensive, the 2022-2027 one was an undated four-page document which, upon review, appeared to cover the mentioned period (considerations on the actual details of these plans are presented in subsequent parts of this Chapter).

3.2.4 The audit team proceeded to enquire with REWS whether it is in receipt of these two plans, as a means to ascertain whether Enemalta complied with its legal obligation to produce and submit them to the former accordingly. As a reply, REWS informed the audit team that for the period 2021 to date (that is, during the effective period of SL 545.34) it has only been officially forwarded with one NDP by the DSO, that is, the one covering the period 2024-2031. However, REWS stated (and forwarded supporting documentation accordingly) that this plan was only submitted to it in April 2024. NAO notes that, since the introduction of SL 545.34 in June 2021, almost three years had elapsed till the April 2024 date of submission. As the DSO's current legal obligation is to submit an NDP to the regulator at least every two years, this means that the DSO has defaulted on this requirement during the effective period of SL 545.34. This observation was confirmed by REWS.

3.2.5 Additionally, the audit team also observed that, between June 2021 to date, Enemalta did not publish any network development plans on its website. This was confirmed by the DSO itself. NAO therefore notes that this puts Enemalta in further non-compliance to SL 545.34.

3.2.6 Insofar as LN 166 of 2011 is concerned, which covered the scoped period from its start till May 2021, the audit team noted that this law does not make specific reference to the obligation of a formulation, submission and publication of an NDP by the DSO. NAO however notes that this law obliged Enemalta to draw up, and keep updated, a Network Code. Specifically, Article 10 states that: "*Within such time and following such consultation as the Authority may direct, the distribution system operator shall prepare, keep updated and publish a "network code", subject to the approval of the Authority, defining the technical safety criteria and the technical rules establishing the minimum technical design and operational requirements for the connection to the system of installations, distribution systems, directly connected consumers' equipment, interconnector circuits and direct lines and set the minimum operational rules and obligations on network security and foreseeable circumstances in which security shall be maintained*."[4]

3.2.7 A search of Enemalta's website showed that a version of this Network Code is published therein. NAO notes that this version is dated October 2013, which corresponds comfortably to the part of the scoped period in which LN 166 of 2011 was in vigore. A review of this document showed that the concept of an NDP (though referred to as a 'distribution system planning report'), and the need for its regular submission to the regulator, were already recognised (and cited as requirements)

[4] SL 545.34 through Article 29 also calls for the DSO to draw up, and keep maintained, a Network Code.

by Enemalta at that time. Specifically, the network code stated that: "*every two years Enemalta must submit to the MRA a report called the distribution system planning report detailing how it plans over the following 5 calendar years to:*

a. Meet predicted demand for electricity supplied through the distribution network.
b. Improve supply reliability to its customers.

....

.... the report must include the following information

a. Existing generation and network capacity.
b. The historical and forecast overall system actual and peak demand and peak seasonal demand at the primary substations in the distribution system.
c. A description of flexible options for meeting forecast demand.
d. Where a preferred option for meeting forecast demand has been identified a reasonable detailed description of that option, including estimated cost.
e. A description of the nature, timing, cost and expected performance of the distribution system reliability improvement programs.
f. An evaluation of the supply reliability improvement programs undertaken in the preceding years."

3.2.8 Enemalta's recognised need of an NDP at that time is further confirmed with its compilation of the report titled "High Voltage Network Plan", which covered the period 2013-2020. This Office can also confirm the DSO's recognised need to submit this plan to the regulator at the time, as a copy of this was forwarded to the audit team by REWS, implying that it was in receipt of this document.

3.2.9 It must however be noted that Enemalta did not forward to NAO other such plans for the period in which LN 166 of 2011 was in effect[5]. As the network code calls for a submission of this plan to the regulator every two years, and the NAO is not in possession of any other documents, the latter could not confirm the DSO's fulfilment of this requirement during this period.

3.2.10 This Office acknowledges that, as opposed to SL 545.34, LN 166 of 2011 did not explicitly oblige the DSO to prepare an NDP. However, the fact that Enemalta's network code is enacted in this legislation, and that this requirement is clearly cited within this code, gives rise to doubts on whether the compilation of such plans was a legal requirement, or otherwise, between 2014 and May 2021.

[5] It must be noted that another report covering the period 2006-2015 was also forwarded to NAO. Being dated October 2006 however, this plan inevitably reflects planning which occurred well before this study's scoped period. In addition, this plan was compiled before the coming into effect of LN 166 of 2011. To this end, even if this plan comprised two years from the 2014-2023 audit period, it will not be included in NAO's considerations.

3.3 Regulator did not impose penalties for Enemalta's defaults on legal obligations

3.3.1 This Office makes reference to Articles 59 and 60 of SL 545.34 in which applicable penalties and administrative fines are quoted for applicable defaults[6]. These provisions are reproduced in Table 3 for ease of reference.

Table 3: Penalties and administrative fines cited in SL 545.34

Article	Provision
59	(1) Any person who contravenes any of the provisions of these regulations or of a licence condition or of an authorisation or approval issued thereunder, shall be guilty of an offence, and shall, on conviction, be liable to a fine (multa) of not more than sixty-nine thousand euro (€69,000) or for one thousand and three hundred euro (€1,300) for each day during which the offence persists.
	(2) Any person who, when information with respect to these regulations is requested or required by the Regulator, knowingly or negligently . . . (c) fails, without reasonable cause, to supply information requested within the time given . . . shall be guilty of an offence, and shall, on conviction, be liable to a fine (multa) of not less than one thousand euro (€1,000) and of not more than sixty thousand euro (€60,000) for each day during which the failure to comply subsists.
	(3) Notwithstanding any other provision of these regulations, where any person fails to comply with the provisions of these regulations or of a licence or authorisation condition for a period not exceeding three (3) months, the Regulator may revoke such licence or authorisation.
60	(1) The Regulator may impose an administrative fine upon any person who infringes any provision of these regulations or who fails to comply with any directive or decision given by the Regulator in ensuring compliance with these regulations.
	(2) An administrative fine imposed under sub-regulation (1) shall not exceed one hundred thousand euro (€100,000) for each contravention and, or six hundred euro (€600) for each day of non-compliance, from the date of the decision given by the Regulator: Provided that, in the case of undertakings (including vertically integrated undertakings) or a body corporate, a fine of up to ten per cent (10%) of the total turnover concerned in the preceding business year may be imposed even if such fine results in an amount which exceeds the threshold provided in this sub-regulation.

Note: Article 59 lays out applicable penalties if defaulter is found guilty through a judicial process. On the other hand, Article 60 cites applicable fines in instances in which a defaulter would opt to settle the matter without the need of judicial proceedings.

[6] As compliance or otherwise to LN 166 of 2011 during its effective period could not be confirmed at this stage (section 3.2 refers), considerations on penalties and administrative fines will only be discussed with respect to SL 545.34.

3.3.2 In view of the defaults from Enemalta's part to adhere to the above legislation (section 3.2 refers), the audit team enquired with REWS whether any penalties, as cited by the abovementioned law, have been imposed on the DSO. In reply, REWS management confirmed that it never imposed such penalties on Enemalta and that it rather prefers to attempt to convince the DSO to abide to such regulations. Specifically, REWS explained that, in its view, imposing penalties may divert effort and resources, from both the regulator and the DSO, towards lengthy judicial proceedings rather than employing these to complete and fulfil the submission of the plans in question.

3.4 Analysed plans featured shortcomings when benchmarked against criteria established by NAO

3.4.1 In order to form an opinion on the comprehensiveness of the three forwarded plans (referred to earlier in 3.2.3 and 3.2.8), NAO compiled a set of criteria which it deemed as being necessary components in an NDP. In order to compile these benchmarks, the audit team made reference to governing legislation, Enemalta's Network Code as well as to the National Energy and Climate Plan (NECP). These criteria are listed in Table 4 together with NAO's assessments on whether each of these was adequately satisfied in the above-mentioned plans or otherwise.

3.4.2 It is important to note that NAO's analysis on these plans did not extend into the related technical quality but was primarily targeted to assess whether relevant aspects were duly included. This Office further highlights that the main focus of all three submitted plans mostly relates to the HV system of the distribution network.

3.4.3 By way of explanation, Table 4 uses a traffic-light system to present the results of NAO's assessment of each plan vis-à-vis these criteria. Namely, a green designation was used to signify adequate adherence, amber indicating limited compliance and red signalling default. Additionally, remarks are presented throughout the checklist where deemed applicable by the audit team.

Table 4: Enemalta's NDPs benchmarked against identified good practice criteria

Element of Plan	High Voltage Network Plan 2013-2020	Distribution Network Reinforcement Plan 2022-2027	Network Development Plan 2024-2031
Existing generation and network capacity			
Historical and forecasted actual and peak demands as well as peak seasonal demands on the distribution network's sub-stations	While covering the impact on the generation capacity, the growth forecast presented in this plan does not stipulate the effect that such a forecast would have on the distribution network's load		This document only presents the monthly peak demands for 2022 and an aggregated annual peak demand figure for the whole network in 2023. The plan also presents a forecast on the effect that the introduction of Electric Vehicles would have on the distribution network
Description of flexible options on how to meet the forecasted demands	Only one option is presented, being the implementation of all projects listed in the plan	Only one option is presented, being the implementation of all projects listed in the plan	Only one option is presented, being the implementation of all projects listed in the plan
A detailed description of how the DSO intends to meet the forecasted demand including the estimation of costs in taking such an option	The plan lists the annual cost of implementing the mentioned projects collectively but does not provide individual costings for each project.	This document only includes an undetailed list of initiatives to be undertaken by the DSO in order to reinforce the network	This document lists a number of projects that need to be implemented however these are only costed collectively (just one figure for all the projects) for the duration of eight years
A list of system reliability improvement programs for the distribution network including a description of the nature, timing, cost and expected improvements	Projects were listed however these were not costed individually	Description of projects is not comprehensive despite including cost and timing	No indication on the costings of each individual project

Element of Plan	High Voltage Network Plan 2013-2020	Distribution Network Reinforcement Plan 2022-2027	Network Development Plan 2024-2031
A list of system reliability improvement programs for the distribution network undertaken in previous years	The plan does provide a number of initiatives undertaken in the past however, the description of such projects is not comprehensive		
Elements of real-time monitoring and automation procedures		Network monitoring is only mentioned briefly in this document	
Engagement/Involvment of stakeholders outside Enemalta			
Prioritisation of the programmes highlighted in the network plan		Scheduling of projects is being considered as a strong indication of prioritisation	Scheduling of projects is being considered as a strong indication of prioritisation
The inclusion of renewables and energy efficiency measures			While containing a detailed analysis on the uses of EVs, this report only mentions other measures very briefly

3.4.4 As can be observed from Table 4, the three plans under review all featured certain weaknesses when benchmarked against the above set criteria. While this Office cannot ascertain that identified missing elements are not provided for in other planning documents within Enemalta, it is pertinent to note that the criteria set by this Office for these plans emanate, amongst others, from relevant legislation and the entity's own network code. In light of this, the NAO believes that regardless of whether these aspects are addressed in other documents, their absence from these plans is considered a deficiency.

Chapter 4| Capital Investment in the High-Voltage Distribution Network

This last chapter presents the audit team's review of the financial elements that affect the planning of the HV distribution network. Specifically, this part of the report reviews the financial resources allocation during the planning stage, the annual budget allocation as well as their actual expenditure. In addition, this section also presents the trends of Enemalta's actual financial expenditure in the development of the network during the scoped period.

4.1 NAO could not correlate the majority of annual projected costs in forwarded plans with eventual annual budgets

4.1.1 The audit team sought to assess the extent to which funds projected in Enemalta's network plans (Chapter 3 refers) materialised into annual budget allocations. In doing so however it became immediately evident that, for the period between 2014 and 2021, this exercise could not be undertaken at this stage. Specifically, when reviewing the plan covering 2013-2020, the audit team noted that cited projected costs therein did not include all components of the high-voltage network (namely omitting those related to the 11kV infrastructure) and therefore these could not be compared to eventual actual budgets. Insofar as the year 2021 is concerned, the audit team noted that none of the three forwarded plans covered this period, rendering any comparison impossible.

4.1.2 The last two years of the scoped period, that is 2022 and 2023, were covered by the four-page plan submitted to NAO, which spanned between 2022-2031. Through its review, the audit team noted that this plan included costings for both HV and LV infrastructure and, after communication with Enemalta, LV components were filtered out to arrive at figures relating solely to the HV system. As can be seen in Table 5, the actual allocated budgets for both these years were higher (112% and 116% respectively) than what was cited in the 2022-2027 plan.

Table 5: Financial allocations as per 2022-2027 plan and actual annual allocations[7]

	2022 (€)	2023 (€)
Investments on HV Network as per **Network Development Plan**	10,000,000	9,500,000
Investment on HV Network Allocated in **Annual Budget**	11,150,000	11,000,000
Variance	1,150,000	1,500,000

Adapted from information forwarded by Enemalta

[7] A review of the plan in question showed that any cited estimates refer to projects, which are classified as capital expenditure. To this end, NAO compared this to allocated capital expenditure figures only, therefore omitting operational budgets.

4.1.3 It must also be noted that, while reviewing the 2024-2031 plan, the audit team observed that this document does not lay out planned annual budgets for the years it encompasses. Rather, it only states that the foreseeable initial cost of investment amounts to €150 million.

4.2 Enemalta's annual actual expenditure on the HV network during the scoped period, was significantly lower than the allocated capital budgets

4.2.1 In order to assess whether Enemalta utilised all allocated funds throughout the scoped period, the audit team requested the former to indicate this allocation, as well as the actual expenditure on an annual basis, both filtered to feature amounts only relating to the HV system. In reply however, Enemalta stated that, while this filtering could be carried out for capital expenditure (CAPEX), HV and LV operational costs (OPEX) are recorded collectively, and extracting the seperate costs was deemed an impractical task by the DSO. To this end, figures forwarded to this Office by the DSO and which featured in the former's analysis, focus on CAPEX[8].

4.2.2 Upon receipt of this information, the audit team proceeded to set off the allocated expenditure against the actual. The related figures are presented in Table 6 below for ease of reference. As is evident, for the period between 2014 and 2023, Enemalta underspent considerably insofar as the HV network is concerned from what was allocated.

Table 6: Annual allocated capital funds against actual CAPEX on HV network

	Annual Allocated capital funds	CAPEX	Variance
	€	€	€
2014	13,587,100	14,550,671	963,571
2015	22,906,554	12,726,436	-10,180,118
2016	23,758,332	17,624,663	-6,133,669
2017	28,484,957	19,826,601	-8,658,356
2018	22,981,387	13,571,944	-9,409,443
2019	15,102,999	7,872,024	-7,230,975
2020	17,742,037	8,489,056	-9,252,981
2021	10,876,000	4,780,423	-6,095,577
2022	11,150,000	6,232,954	-4,917,046
2023	11,000,000	5,736,684	-5,263,316

Adapted from information forwarded by Enemalta

[8] As per this study's scope (Chapter 1 refers) NAO did not review Enemalta's accounts for this study, but relied on information forwarded in aggregate by the auditee's finance department.

4.2.3 While Table 6 presents variances between the annual allocated funds and actual capital expenditure, Enemalta contends that during the period under review, there might have been instances where unexpended funds were allocated again in the subsequent year. Nonetheless, Table 6 shows that over time Enemalta did not manage to expend allocated funds on the distribution network as anticipated. In view of the above, NAO enquired with the DSO on the reasons for this significant under expenditure. In reply, Enemalta management highlighted that the amount of work that can realistically be carried out in any given year, is subject to a number of factors and limitations, Among others, Enemalta highlighted that the pool and capacity of contractors who are able to carry out the required works, may not always be sufficient to cater for all the projects that are earmarked by the DSO. In addition, one also needs to consider that the service of this same pool of contractors would also be required by other entities, putting further strain on their availability. The audit team was also informed that the procurement of materials (such as HV cables) can be problematic, particularly in view of current uncertainties on an international level. Enemalta additionally highlighted that internal human resource limitations can also play a part in the amount of work the entity can commission and manage.

4.3 Actual annual CAPEX on the HV distribution network system experienced a downward trend, while average temperatures and demand for electricity were on the increase

4.3.1 Table 7 below presents annual figures of Enemalta's actual CAPEX on the national HV and LV networks as well as funds for projects which originated from third parties[9].

Table 7: Actual annual CAPEX on the distribution network throughout the scoped period

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	€	€	€	€	€	€	€	€	€	€
Low Voltage	4,808,216	4,076,243	3,928,510	4,574,038	5,750,527	6,863,185	7,372,786	8,678,033	11,634,837	10,925,070
High Voltage	14,550,671	12,726,436	17,624,663	19,826,601	13,571,944	7,872,024	8,489,056	4,780,423	6,232,954	5,736,684
3rd Party	1,968,977	2,759,475	4,290,335	7,065,438	5,711,497	2,799,261	4,440,089	4,703,998	2,960,414	3,585,616
	21,327,864	**19,562,154**	**25,843,508**	**31,466,076**	**25,033,968**	**17,514,470**	**20,301,931**	**18,162,454**	**20,828,205**	**20,247,370**

Adapted from information forwarded by Enemalta

4.3.2 As can be seen from Table 7, the annual capital investment in HV distribution network has been on the decrease throughout the scoped period. This contrasts with investment in the LV network which absorbed increasing expenditure throughout these years. In addition, information forwarded by the DSO shows that the number of active meters has also been on a relatively constant upward trajectory, starting at 291,426 in 2014 and reaching 377,311 in 2023 (Table 8 refers).

[9] Investments by third parties are mainly comprised of sub-stations that have been financed by consumers (typically in the case of bulk supplies) completely or in part. While the ownership of the sub-stations remains with Enemalta, this figure cannot be considered as an investment in the HV network as, should the DSO decide to utilise the sub-station to supply other consumers, it would have to fork out additional fees to the consumers financing the sub-station (SL 545.01 Article 15-b iv).

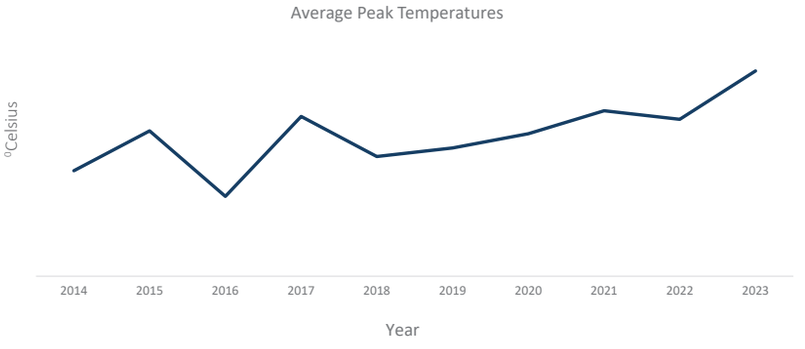
4.3.3 In view of the above, together with the factors discussed in Chapter 2, namely increases in average and peak temperatures, as well as the registered increases in peak and actual demand (brought about by an increasing GDP per capita), NAO questions the decrease in capital investment in the HV distribution system, particularly as this is the area in which the faults of summer 2023 occurred. Figure 12 brings all these factors together in one visual representation.

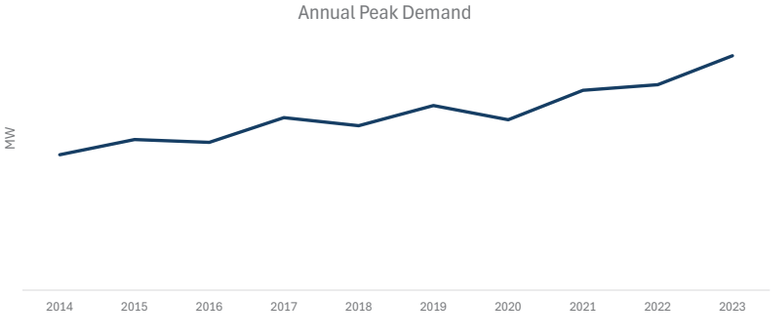
Table 8: Number of installed meters (as end of each respective year) throughout the scoped period[10]

Year	Number of Meters Installed
2023	377,311
2022	367,195
2021	356,646
2020	344,232
2019	336,254
2018	325,639
2017	317,747
2016	307,893
2015	300,749
2014	291,426

Adapted from information forwarded by Enemalta

[10] The 2014 figure presented in Table 8 actually corresponds to January 2015.


Average Peak Temperatures
°Celsius
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year


Annual Peak Demand
MW
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023

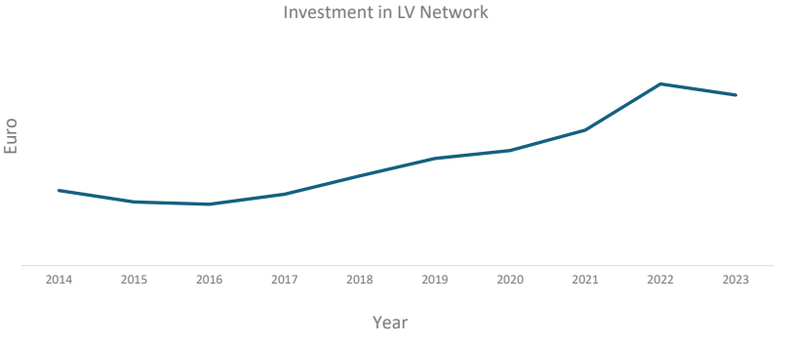
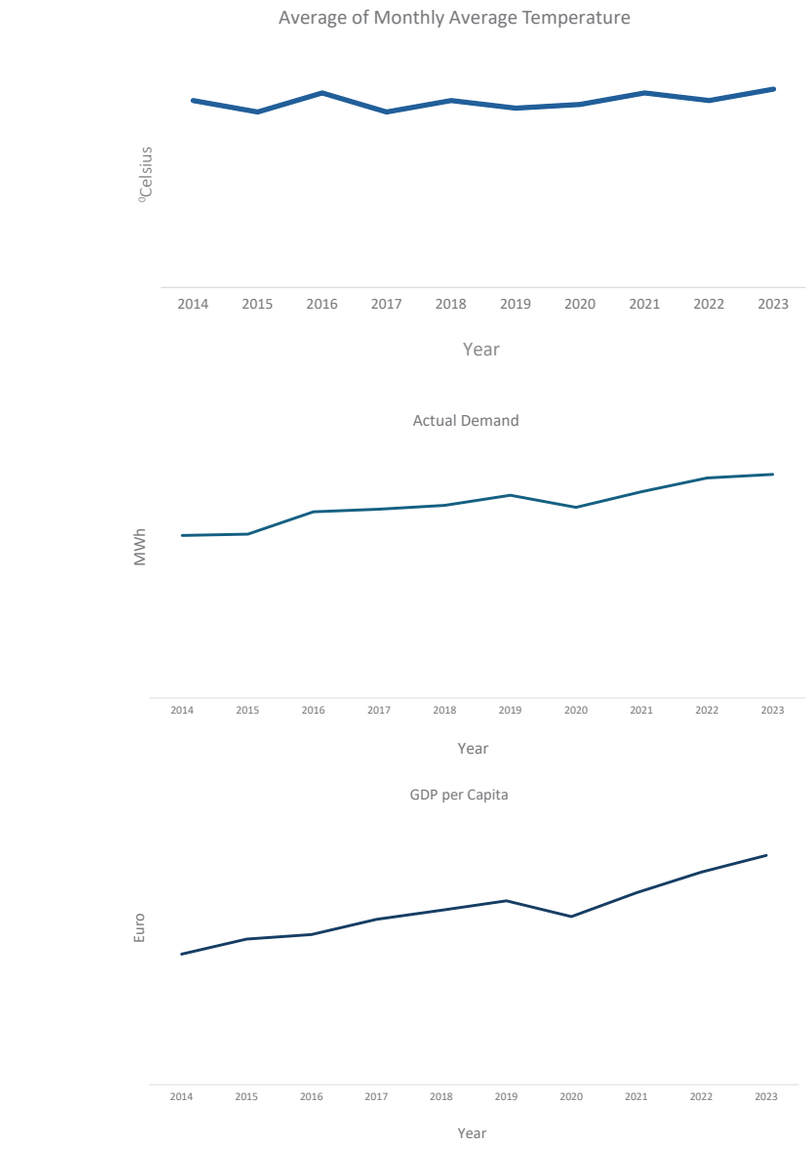
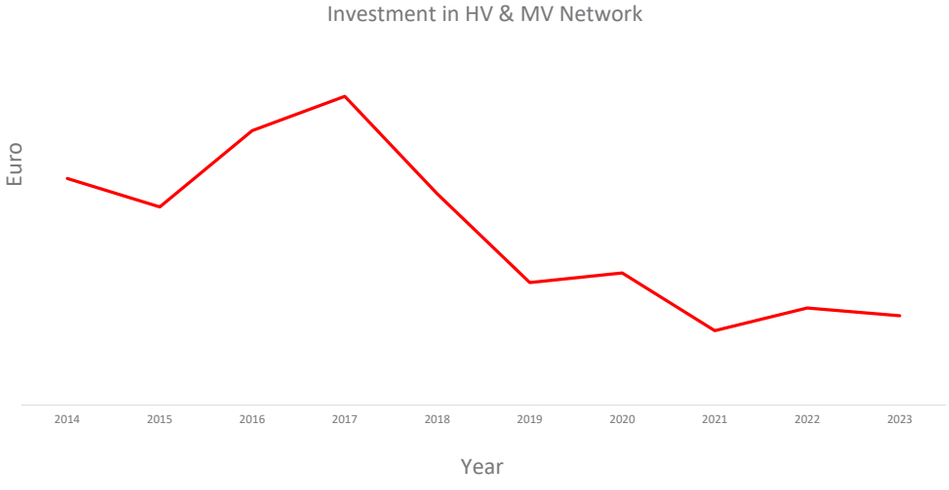

Investment in LV Network
Euro
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

Figure 12: Investment in HV network compared to other factors





Adapted from information forwarded by Enemalta, METO and NSO

Concluding Remark

This review showed that, even through a high-level analysis, it is apparent that deficiencies in Enemalta's planning and capital investment in the HV distribution network during the scoped period, negatively impacted its operational performance. While meteorological statistics confirm that the situation which manifested itself last summer during a protracted period of elevated temperature was the highest within the scoped period, NAO concludes that shortcomings in the planning and investment noted in this report, to varying degrees, contributed to the prolonged power outages experienced in some localities.

While this audit did not delve deeply on the technical merits of the DSO's plans and actual projects carried out, the summer 2023 occurrences clearly signify that Enemalta's related expenditure throughout the scoped period was not well targeted, and/or not efficiently utilised and/or too low, particularly in view of the ever-increasing demands for electricity. Even if the SAIFI and SAIDI indices show an average decline in the frequency and duration of power supply interruptions, NAO feels that, as would be the case in any other industry, shortcomings in the planning function and investment shortfalls detract from the value for money of the services provided. Apart from the apparent inconvenience to consumers, the negative effect on value for money is also attested to by the payment of compensation to clients by the DSO for prolonged outages or damages caused, as well as by the economic impact emanating from risks associated with security of supply. NAO also considers the shortcomings identified in Enemalta's NDPs, as well as the non-conformities to legal obligations for the compilation, publication and submission to the regulator of such plans, as concerning indicators on the level of priority that Enemalta invests in the cohesive planning of the national distribution network.

NAO acknowledges and reported on the significant challenges experienced by Enemalta which invariably hamper the execution of planned projects and works (even if these would have been budgeted for). This Office is also aware that substantial funds have been channeled towards the repair and upgrading of parts of the electricity distribution network. In part, this reaction is due to the increasing demand and to cater for the expected increase in frequency and intensity of higher temperatures as a result of climate change. Within this context, the NAO augurs that Enemalta strengthens its planning function by taking into consideration demographics, climatic trends and associated risks, as well as the lifetime of all assets making up the distribution network, to ensure a more reliable supply of electricity to its consumers.

Auditee Comments

This chapter presents MEER's and Enemalta's feedback on this report. These comments are referenced to the report sections that each relate to. The NAO had already considered auditee feedback throughout the conduct of this performance audit (and which was reflected in the text of this report that is in Chapters 1 to 4). Notwithstanding, at a later stage, the auditee referred written feedback, which the NAO opted to reproduce *verbatim*.

In reaction to Section 1.1.1

The summer of 2023 was the hottest on record worldwide. The Mediterranean was one of the areas affected, with dramatic consequences. This unprecedent weather caused several distribution network faults in Mediterranean countries. DSOs in neighbouring countries struggled to keep up with the number of faults in a short duration. Enemalta affirms that the distribution network in Malta was not an exception, and that the rapid rise in faults due to this exceptional and extreme weather followed the same pattern as that experienced by other DSOs in the Mediterranean[11].

In reaction to Section 2.2.1

Enemalta affirms that the abnormally high SAIDI and SAIFI values observed do not necessarily reflect inherent poor network performance. Rather, they underscore the impact of interruptions caused by abnormal or extreme circumstances, such as severe weather events or other extraordinary situations that fall outside the scope of normal operations. For example, the high incidence of SAIDI and SAIFI in 2017, evidenced in Figure 3, was the consequence of three separate and unrelated Interconnector failures- one of which precipitated a total shutdown- and one Delimara Gas Facilities failure resulting in the tripping of local generation plant. Similarly, the high incidence of SAIDI and SAIFI in 2019 was a consequence of two total shutdowns, the first on 26 November 2019 originating from a severe 220kV system fault in Ragusa that caused local generation plant and the Interconnector to trip, and the second on 23 December 2019 originating from the severing of the Interconnector cable by a marine vessel's anchor.

In reaction to Section 2.2.4

Enemalta contends that Figure 5 indicates that there were no progressively increasing spikes during the scoped period and that the 2014 spike was the result of a failure of the Marsa Distribution Centre, whilst the spike of 2023 was the result of the severe 9-day heatwave in July. Following this heatwave, Enemalta embarked on a 6-month HV network reinforcement programme where more than 80kms of cable were laid and connected. In the meantime, network reinforcement plans will continue, with the installation of additional HV cables, the building and commissioning of Distribution Centres, the building of new 11kV substations within new developments, and the upgrading of existing 11kV substations and additional LV feeders.

[11] https://www.helmholtz-klima.de/en/aktuelles/dramatic-weather-records-mediterranean
https://climate.copernicus.eu/european-summer-2023-season-contrasting-extremes
https://earthsky.org/earth/european-heatwave-mediterranean-july-2023/

In reaction to Section 2.2.5

Enemalta maintains that Figure 5 confirms that, apart from spikes that occurred due to extraordinary circumstances that are explainable, the distribution network has proved to be reliable- otherwise, progressively increasing spikes would have been experienced. The 2023 spike in Figure 5 equates to around 0.38% of the network's kVA capacity.

In reaction to Table 1

Enemalta maintains that, as shown in Table 1, the failure of HV joints in July 2023 alone contributed to 25% of all the kVAh lost from failed HV joints during the whole 10-year period from 2014 to 2023. This again illustrates the extraordinary nature of the extreme weather event of July 2023.

In reaction to Section 2.2.8

Enemalta points out that the total number of joints that failed during the heatwave in July 2023 was 83 out of a total of approximately 14,000.

In reaction to Section 2.3.1

Enemalta affirms that the abrupt and abnormally high increase in temperature, starting from 17 July 2023, resulted in a substantial number of network failures, mainly joints, as indicated, that normally would occur over a period of time that would allow remedial action with minimal disturbance to consumers. However, in this instance, the period of time was unusually short.

The N-1 principle adopted by Enemalta allows for the changeover, often done remotely and within a very short time, of the provision of supply to consumers from alternative feeders. However, due to the abnormal severity in terms of abruptness, temperature, and duration of this particular heatwave, a number of feeders involved in these changeovers eventually failed, generally not due to overload, but rather due to cable load profile shock, abruptness of load increase (peak load increased from 469MW on 17 July 2023 to 569MW on 18 July 2023 to 600MW on 19 July 2023, and from 563MW on 23 July 2023 to 649MW on 24 July 2023 to 663MW on 25 July 2023), very high and sustained temperatures, and the extended duration of the heatwave.

In reaction to Section 2.3.2

Enemalta indicates that while it generally plans for a 3 per cent average year-on-year increase in load, this does necessarily mean that the network will fail if the actual increase in load is well above 3 percent. The biannual studies carried by the Enemalta NPOS ensure that feeders throughout the network have sufficient headroom well above the 3 per cent average year-on-year increase in load projection. This is further reinforced by application of the N-1 principle. The faults that the network sustained in July 2023 largely did not originate from overload, but rather from physical failure of elements of the network precipitated by the unusually prolonged severe weather conditions.

In reaction to Section 2.3.3

Enemalta emphasises the fact that ground surface temperature will be approximately 10°C higher than air temperature. Subsurface temperature at 1.0m depth will be approximately 5°C cooler than the surface temperature, but still 5°C higher than air temperature. This attests that cables and cable joints were exposed to abnormally temperatures during the heatwave of July 2023. These exceptionally severe temperatures contributed to an abnormal rate of failures[12].

In reaction to Section 2.3.4

Enemalta remarks that the average temperatures trendline in Figure 7 indicates a 1.5°C change from 2014 to 2023 (19.0°C to 20.5°C), whilst that for average peak temperature shows a change of 2.0°C (from 32.0°C to 34.0°C) over the whole period. This is nowhere near the actual temperatures registered in July 2023. Indeed, the average peak temperature for the period 17 to 25 July 2023 was 39.4°C, and the average peak temperature for the period 22 to 25 July 2023 was 40.6°C, with the peak temperature reaching 41.7°C recorded on 24 July 2023. This is illustrative of the difficulty to project the extent and effects of climate induced heatwaves even when adopting industry standard techniques practiced around the world. Moreover, studies indicate that in the Mediterranean region a 1.0°C increase in temperature may lead to a 2.5% to 4.0% rise in electricity demand[13]. This supports the incidence of sharp increases in electricity demand in Malta as a result of abnormally high temperatures.

In reaction to Section 2.3.5

Enemalta remarks that, as shown in Figure 8, the actual peak temperatures registered in 2023 was around 14.0 per cent higher than that predicted (with hindsight) by the trajectory projected by the NAO.

In reaction to Section 2.3.6

Enemalta points out that, according to the peak demand forecast modelled by the Energy & Water Agency (EWA) in 2019, the high growth scenario for the worst climatic year projected that the peak demand of 663MW recorded in July 2023 would not be reached before 2029.

Enemalta maintains that it undertakes continuous network reinforcement works that allow the network to cope reliably and continuously with the trended year-on-year increase in demand. Otherwise, Summer outage spikes of progressively increasing magnitude would have occurred well before 2023, which was not the case.

[12] https://caas.usu.edu/weather/graphical-data/surface-temperature#:~:text=Ground%20surface%20temperature%20has%20become,cold%20infinity%20of%20outer%20space

[13] "The Impact of Climate Change on Electricity Demand: Evidence from Italy" by De Cian and Lanzi (2013)

In reaction to Heading 3.1

Enemalta contends that the sub-title is incorrect. The Enemalta NPOS determines and prioritises the network reinforcement works required, and the sections responsible for the development of primary- and secondary-nodes undertake reinforcement projects accordingly, within the constraints prevailing at the time of execution.

In reaction to Section 3.1.1

Enemalta affirms that, similar to other DSOs and as commented earlier, Enemalta adopts the N-1 principle that allows for the changeover- often done remotely and within a very short time- of the provision of supply to consumers from alternative feeders, in case of a localised failure. However, due to the abnormal severity in terms of abruptness, temperature, and duration of this particular heatwave, a number of feeders involved in these changeovers eventually failed, generally not due to overload, but rather due to cable load profile shock, abruptness of load increase, very high and sustained temperatures, and an extended heatwave.

In reaction to Section 3.1.2

Enemalta remarks that the first part of this section attests to the fact that Enemalta NPOS undertakes and carries out appropriate and timely planning.

In reaction to Section 3.1.3

Reacting to the NAO observation that "NPOS explained that it normally only formally submits to management proposals that could be realistically undertaken with Enemalta's resources at the time", Enemalta maintains that this does not mean that essential reinforcements are not undertaken in a timely manner. The Enemalta NPOS determines and prioritises the network reinforcement works required, and the sections responsible for the development of primary- and secondary-nodes undertake reinforcement projects accordingly, within the constraints prevailing at the time of execution.

Enemalta clarifies that following the failures that developed in July 2023, an additional list of interventions was included as precautionary reinforcement over-and-above what would normally have been considered as reasonably required and what is proposed in the biannual NPOS report. The failures that occurred in July 2023 developed as a consequence of extraordinary stress on the distribution network infrastructure. It would have been extremely difficult to forecast the failures that occurred in July 2023. Enemalta maintains that these failures identified areas that required precautionary reinforcement over-and-above what is reasonably required. The first phase of the implementation of these precautionary reinforcements identified by Enemalta was completed in June 2024. Enemalta confirms that works which were earmarked as proposed by the latest NDOS biannual study are planned to be undertaken after Summer 2024, and that the required cables and accessories have been procured and delivered.

Enemalta highlights that as part of ongoing reinforcement works, during 2022 it reinforced areas in Rabat, Naxxar, Burmarrad, Lija, Mellieha and Sliema, whilst in 2023 it reinforced areas in Naxxar, Mellieħa, Balzan, Żurrieq and Mosta. During 2024, so far, Enemalta has energised reinforcements in Siġġiewi and reinforced works in Mġarr and Żebbuġ which are ongoing. These do not relate with the new reinforcements list drawn following the interruptions that occurred in July 2023, but were already ongoing reinforcement works.

In reaction to Section 3.4.4

Enemalta contends that one should not arrive to the conclusion that any shortcomings related to the NDP documentation and publication equates with inadequate network development planning. As indicated in this report, apart from the fact that the 2024-2031 NDP document reviewed by the NAO was considered to be quite extensive, the Enemalta NPOS prepares an updated network reinforcement plan every six months respectively after the Winter peak and after the Summer peak. The reinforcement projects recommended by the NPOS plan are subsequently undertaken by the primary- and secondary-nodes sections. The manifest reliability of the distribution network throughout the years prior to July 2023 attests to the fact that Enemalta planning and execution of network reinforcement works are commensurate. Enemalta indicates that the NAO's remarks related to network development planning documentation and publication have been well noted, and that it shall be taking all necessary steps to adopt the NAO's recommendations and to abide by its legal obligations.

In reaction to Table 5

Enemalta clarifies that budgeted amounts would typically include a 10% to 15% contingency for the possibility of actual costs that are higher than estimated. If higher costs do not actually materialise, a shortfall in expenditure would result.

In reaction to Section 4.2.2

Enemalta contends that the tabulated figures are construed in a negative manner, since the full extent of the details related to distribution CAPEX has not been considered. Whilst 63% of HV CAPEX allocated was utilised, 146% of the LV CAPEX allocated was utilised, resulting in a total of 80% of the total Distribution CAPEX allocated being utilised. HV investment should not be considered in isolation, as HV and LV networks are complementary to one another. Therefore, to provide a realistic view of works carried out by Enemalta to reinforce the network, both LV and HV reinforcement works must be referenced. Moreover, an adjustment for 10% contingency would raise the utilisation percentage to 70% HV and 163% LV, resulting in a total 89% of allocated funds that were effectively utilised.

In reaction to Section 4.2.3

Enemalta contends that, in actual fact and as already highlighted, during the past few years there has been an intended strategic shift in investment emphasis from the HV/MV to the LV network, where the allocated capital CAPEX budget was actually exceeded by 46%. This implies that, in actual fact, 80% of the total Distribution CAPEX budget was actually utilised. When adjusting for the inbuilt and unrealised budget contingency, the actual utilisation of the total CAPEX budget rises to 89%.

In reaction to Heading 4.3

Enemalta does not agree with the heading of this section, reiterating that the company does not allocate and spend CAPEX on the HV distribution network system according to average temperature and electricity demand trends, but rather according to the biannual network reinforcement recommendations prepared and submitted by the Enemalta NPOS.

In reaction to Table 7

Enemalta clarifies that the reinforcement of the Distribution network must be assessed in terms of cumulative investments taken over the years to strengthen the whole network (and not just the HV network), together with the incremental benefit this engenders. Enemalta reaffirms that these investments are largely based on recommendations made by the Enemalta NPOS, which determines needs and requirements on the basis of observed network demand as well as of specific issues, and therefore effectively also incorporates customer response to temperature.

In reaction to Section 4.3.3

Enemalta contends that a reliable distribution network requires investment in both the HV and LV network, and that, indeed, investments on the LV network increased in the period under consideration. As a matter of fact, total yearly network investment remained approximately at the same level for the period in consideration. The reinforcement of the network depends on the cumulative investments over the years, and not on singular annual investments per se.

Enemalta further contends that, as of July 2023, the network had sufficient redundancy to continue operating reliably throughout Summer, even within the heatwave circumstances of the past Summer. The N-1 principle allows for minimal outage durations when faults do occur. However, the heatwave of July 2023 was extraordinarily severe in terms of abruptness, high temperatures, and duration. The severity of the heatwave and the consequent high demand resulted in cascading failures, particularly of cable joints, that overwhelmed the N-1 provision in a manner that had never happened before. Some areas even had provisions for N-2 and N-3, but these too were overwhelmed.

In reaction to the Concluding Remark

Enemalta contends that the conclusion that "shortcomings in the planning and investment noted in this report, to varying degrees, contributed to the prolonged power outages experienced in some localities" should be considered to be an opinion emanating from a high-level analysis.

Enemalta similarly contends that the conclusions that "the summer 2023 occurrences clearly signify that Enemalta's related expenditure throughout the scoped period was not well targeted, and/or not efficiently utilised and/or too low, particularly in view of the ever-increasing demands for electricity" and the reference to "concerning indicators on the level of priority that Enemalta invests in the cohesive planning of the national distribution network" should be considered to be opinions emanating from a high-level analysis.

Enemalta affirms that investment planning in the distribution network has always included both the HV and LV network as this provides the highest chances for robustness and reliability, and this is why it has invested in both of these networks. In addition, future investment planning is typically based on future projections that are made at a point in time, such that planning for 2023 would be undertaken a number of years beforehand without the benefit of hindsight as to what actually would occur in 2023 in terms of extreme temperatures. Enemalta further affirms that most of the works planned since 2014 have been undertaken and completed, even if in some cases completion did not occur within the year of the original allocation of respective budget (and which might lead one to erroneously conclude that the budget allocation was not spent). Discrepancies between planned and actual expenditure are not

uncommon in infrastructure projects, in view of the multitude of dependencies impacting the flow of work. Enemalta contends that using the model used in Figures 7 and 8, and the linear trends depicted therein, as translated into yearly temperature increases, the model shows that only marginal yearly increases in peak temperature would have been forecastable, but not the unprecedented prolonged extreme temperatures experienced in July 2023 both in Malta and around the Mediterranean, where similar and worse outages than in Malta were experienced. The prolonged period of extraordinary temperature led to failures at N-2, N-3 and N-4 levels, and this is what caused the outages experienced in Malta. Industry practices demand a DSO to be prepared for N-1 incidents, which would be enough for expectable heat deviations experienced during peak demand periods. Enemalta could not be prepared for such an unforeseen rise in temperatures that has been recognised worldwide as unprecedented. In the final analysis, the outages across Malta in July 2023 resulted from the failure of 83 joints from a total of over 14,000. This means that, in spite of the excessive heatwave, less than 0.6% of the network joints failed. Indeed, the percentage of faults occurring in 2023 was below 0.05% of the whole HV network.
Enemalta highlights that it relies on the peak demand projections modelled by the Energy and Water Agency through the assistance of international experts and using industry projection techniques. Under demand projections made in 2019, the high growth scenario for the worst climatic year had projected a peak demand of 663MW to occur not before 2029. The unprecedented heatwave of 2023 anticipated all this, and what was forecasted to happen in 2029 in fact happened in 2023.

Enemalta emphasises that it reinforces the Distribution network on an ongoing basis- reinforcement is incremental and continuous. If this were not the case, failures similar to those that occurred in July 2023 would have happened every year with the onset of every heatwave, which is not the case as attested by Figure 6 of this report. Enemalta opined that the incremental effect of cumulative investments on the distribution network should not be ignored.

Enemalta indicates that it remains committed to continue to plan and undertake whatever needs to be done to ensure security of electricity supply to its customers. Heatwaves similar to the one that affected the Maltese islands in July 2023 are an emerging and new phenomenon, which affected the local distribution network in ways that could not be anticipated, and which have been affecting other networks abroad in similar ways, but which would be expected to happen again in the future.

While noting the NAO's appeal towards heightened persistence and renewed vigour in the quest for finding solutions to the unrelenting and developing challenges affecting the Distribution network, Enemalta expresses its appreciation to the NAO's audit, analysis, and conclusions, and affirmed that it shall endeavour to undertake the requisite measures that are essential to ensure, as much as is reasonably possible, the security and reliability of electricity supply to consumers.

2023-2024 (to date) Reports issued by NAO

NAO Annual Report and Financial Statements

July 2024	National Audit Office Annual Report and Financial Statements 2023

NAO Audit Reports

June 2023	Follow-up Audits Report by the National Audit Office Volume I 2023
June 2023	IT Audit: Malta Food Agency
July 2023	A review of the implementation of Sustainable Development Goal 2: Addressing pre-obesity and obesity
October 2023	Review by the Auditor General on Fixed Assets and Stocks
November 2023	Follow-up Audits Report by the National Audit Office Volume II 2023
November 2023	Report by the Auditor General on the Workings of Local Government for the year 2022
November 2023	A review of the employment agreement of the Consultant to the Chief Executive Officer, Institute of Tourism Studies
December 2023	IT Audit: A Follow-up on the 2020 IT Audit – ICT Across Local Councils
December 2023	Report by the Auditor General 2022
January 2024	An audit of the contract for the provision of food and beverage services at the Malta Life Sciences Park
January 2024	Performance Audit on the Operations of Jobsplus' Law Compliance Unit
February 2024	Performance Audit: Preliminary Review: Leasing of Private Property by Government
June 2024	Follow-up Audits Report by the National Audit Office Volume I 2024