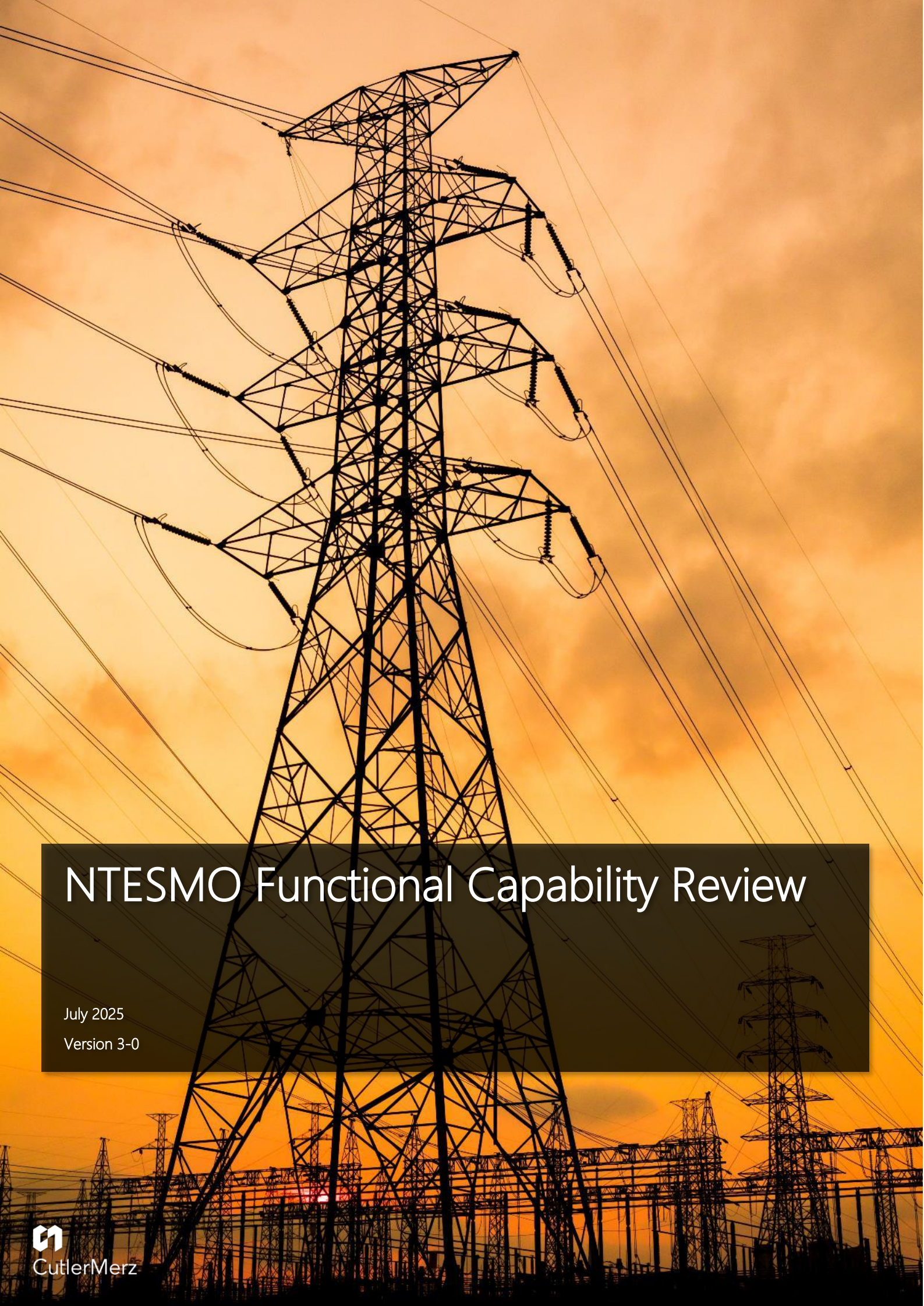

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Document History and Status

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1.0	Working draft for NTESMO review	NB, RD	RD	02/05/2025
2.0	Draft: Added systems capability and revised capability scores and rationale	NB, RD	RD	15/06/2025
3.0	Final: Revised capability scores and capacity numbers	NB, RD	RD	15/07/2025

About this report

The sole purpose of this report and the associated services provided by CutlerMerz is to document the NTESMO's capability review.

In producing this report, we have relied upon and presumed accurate, any information (or confirmation of the absence thereof) provided by NTESMO, and from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We derived the analysis in this report from information sourced from NTESMO, from data and information available in the public domain and from CutlerMerz' industry experience from providing strategic advice to similar industry corporations across Australia, including the Australian Energy Market Operator (AEMO) (NEM and WEM), State and Territory Governments, and electricity utilities. The passage of time, manifestation of latent conditions or impacts of future events may require re-examination, further data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report. We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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Table of Contents

Document Control 2
Table of Contents 4
Acronyms and Abbreviations 6
Figures 8
Tables 9
Executive Summary 10
Capability and capacity summary 10
Recommendations 13
1. Introduction 15
1.1 Purpose 15
1.2 Context 15
1.3 Scope and Objectives 18
1.4 Approach 19
2. The Northern Territory Electricity Market (NTEM) 20
2.1 Stakeholders 20
2.2 History and evolution 21
3. TEM Reform 23
3.1 Centralised system planning 24
3.2 Centralised procurement 25
3.3 NTESMO separation 26
3.4 Reform implications and gaps 27
4. Functional anatomy of the NT power system 28
4.1 The anatomy 28
4.2 Policy layer 28
4.3 Regulatory and legal layer 30
4.4 Planning and investment layer 31
4.5 System implementation and operation layer 32
4.6 Enablers and support system layer 33
5. Functions of a Power System Controller and Market Operator 35
5.1 Comparison of different system and market operators 35
5.2 Overview of functions of a System and Market Operator 36
5.3 Functional Groups 39
5.4 Resourcing methodology 45
6. Functional capability assessment 47
6.1 Framework and methodology 47
6.2 Benchmark, Current and Future State Context 48
6.3 Overview 49
6.4 System Operations 49
6.5 Market Operations 68
6.6 Corporate Services 85
6.7 Capability assessment summary 88
7. Recommendations 90

Appendix A – List of documents reviewed 92
Appendix B – Applicable codes, standards, rules and legislation 95
Appendix C – NTESMO Future fucntional resourcing allocation 97

Acronyms and Abbreviations

Table 1 – Acronyms and Abbreviations

Abbreviation	Definition
AEMO	Australian Energy Market Operator
BESS	Battery Energy Storage Systems
CIS	Capacity Investment Scheme
CLP	Country Liberal Party (NT political party)
CRM	Customer Relationship Management
DER	Distributed Energy Resources
DME	Department of Mining and Energy
DMS	Distribution Management System
EMS	Energy Management System
ERCOT	Electric Reliability Council of Texas
ESS	Essential System Services
FCAS	Frequency Control Ancillary Services
GIS	Geographic Information System
GRC	Governance, Risk, Compliance
I-NTEM	Interim Northern Territory Electricity Market
KPI	Key Performance Indicator
LT PASA	Long-Term Projected Assessment of System Adequacy
MT PASA	Medium-Term Projected Assessment of System Adequacy
NEM	National Electricity Market
NTC	Network Technical Code
NTEM	Northern Territory Electricity Market
NTESMO	Northern Territory Electricity System and Market Operator
OMS	Outage Management System
PASA	Projected Assessment of System Adequacy
PJW	Pennsylvania-New Jersey-Maryland Interconnection (USA)
PMO	Project Management Office
RESIP	Regulated Electricity System Investment Plan
SCADA	Supervisory Control and Data Acquisition
SCTC	System Control Technical Code
SME	Subject Matter Expert
ST PASA	Short-Term Projected Assessment of System Adequacy
TDE	Territory Dispatch Engine

Abbreviation	Definition
TGen	Territory Generation
UC	Utilities Commission
UC Determination	Utilities Commission Determination (financial/regulatory decision)
VPP	Virtual Power Plant
WEM	Wholesale Electricity Market (WA)

Figures

Figure 1 - NTESMO's current v future capability summary 10
Figure 2 - NTESMO's current and required capacity assessment overlaid on the benchmark functional model 12
Figure 3 - NTESMO functions performed by System Control and the Electricity and Market Reform teams 16
Figure 4 – Typical generation profile of a major grid connected solar PV generator demonstrating output volatility 17
Figure 5: Anatomy of the NT power system 28
Figure 6 – Functional model of a system and market operator (Benchmark model) 37
Figure 7 - 1.1 System (future) / Operational (current) Planning and Modelling capability 50
Figure 8 - 1.2 Forecasting capability 53
Figure 9 - 1.3 Connections capability 56
Figure 10 - 1.4 Outage Management capability 59
Figure 11 - 1.5 RT Monitoring and Control capability 61
Figure 12 - 1.6 Performance Reporting capability 64
Figure 13 - 1.7 Network Operator function 66
Figure 14 - 2.1 Participant Support and Market Registration 68
Figure 15 - 2.2 Dispatch Scheduling function capability 71
Figure 16 - 2.3 Market Information function 73
Figure 18 – 2.4 Settlements function current state capability 76
Figure 19 - 2.5, 2.7, and 2.8 capability 80
Figure 20 - 2.6 System Development and Implementation function 82
Figure 21 - Corporate Services function capability 85
Figure 21 - NT Regulatory Framework 95

Tables

Table 1 – Acronyms and Abbreviations 6
Table 2 - Stakeholders involved in the NTEM 20
Table 3 - Comparison of different national and international system and market operators 35
Table 4 - Corporate Service: Description of Level 3 functions 39
Table 5: Description of Power System Operation functions at NTESMO (Level 2 and 3) 40
Table 6 – Description of NTESMO's market operation functions (Level 2 and 3) 43
Table 7 - Benchmark functions of a market operator (not performed by NTESMO currently) 44
Table 8 – Current projects initiated and ongoing at NTESMO relating to developing some future capability 44
Table 9 - People, Process, Technology assessment framework 47
Table 12 - System / Operational Planning skills and capacity 51
Table 13 - Systems requirements for Operational / System Planning function 52
Table 14 – Forecasting function skills and capacity 54
Table 15 - System requirements for Forecasting function 55
Table 16 – Connections function skills and capacity 56
Table 17 - System requirements for Connections function 58
Table 18 – Outage Management function skills and capacity 60
Table 19 - System requirements for Outage Management function 61
Table 20 – RT Monitoring and Control function skills and capacity 62
Table 21 - System requirements for RT Monitoring and Control function 63
Table 22 - Performance Reporting function skills and capacity 64
Table 23 - System requirements for Performance Reporting function 65
Table 24 - Network Operations capacity and skills 67
Table 25 - System requirements for Network Operations function 67
Table 26 - Participant Support and Market Registration skills and capacity 69
Table 27 - Participant Support and Market Registration systems and tools required 70
Table 28 - Dispatch Scheduling skills and capacity 72
Table 29 - Dispatch Scheduling systems required 72
Table 30 - Market Information function skills and capacity 74
Table 31 - Market Information systems required 74
Table 32 - Settlements function skills and capacity 79
Table 33 - Settlement systems required 79
Table - Function 2.5, 2.7, 2.8 skills and capacity required (combined) 81
Table 35 - 2.5, 2.7, 2.8 functions - systems and tools 82
Table 36 - 2.6 System Development and Integration skills and capacity 84
Table 37 - 2.6 System Development and Implementation skills and capacity 84
Table 10 - Corporate Services function capacity assessment 86
Table 11 - Systems requirements summary for Corporate Services function 87

Executive Summary

Capability and capacity summary

The assessment of NTESMO's capability and capacity was conducted across 21 Level 2 functions using a People–Process–Technology (PPT) framework, benchmarking against leading Australian and international operators. This review was carried out in the context of NTESMO's capability to perform its functions now and in the foreseeable future.

The current environment is defined by a power system susceptible to intermittency that is increasingly becoming impacted by DER, variability in demand and supply, reduced system strength, and concerns of not dispatching resources in an economic manner, risking licence compliance breaches. Looking ahead, the future not only amplifies the challenges of the current state but also brings structural and transformative changes to the operational design of the market and power system, driven by reform considerations. The focus was on NTESMO's three core domains:

- System Operations – including forecasting, dispatch, real-time control, outage coordination, and system security
- Market Operations – including registration, market bidding and generator scheduling, settlements, information provision, reform delivery, and rule development
- Corporate Services – management, administrative, and organisational functions in the event that NTESMO separates from Power and Water as part of a reform initiative

For each domain, capability was assessed for current, and future states. Scores were assigned across the PPT dimensions, rated 1 (low), 2 (basic), 3 (mature) or 4 (fully developed). These scores were then visualised through heatmaps and radar plots to capture maturity and risk concentrations.

Figure 1 illustrates NTESMO's current and projected capability across Corporate Services, System Operations, and Market Operations, measured by People, Process, and Technology maturity. Each functional area is assessed against a benchmark of expected capability for operating under the current state I-NTEM and then a reformed NTEM [redacted] in the future.

Figure 1 - NTESMO's current v future capability summary

<1 >2 and <3 >3

		Corporate Functions						System Operations							Market Operations							
		Management	Human Resources & Training	Asset Management, IT and OT Services	Legal and Regulatory	Compliance and Audit	Accounting and Finance	System and Operational Planning	Forecasting	Connections	Outage Management	R-T Monitoring and Control	Performance Reporting	Network Operations	Participant Support and Market Registration	Dispatch Scheduling	Market Information	Settlements	Supply Procurement	System Development and Implementation	Market Rules	Government and Industry Liaison
	F.No.	0.1	0.2	0.3	0.4	0.5	0.6	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
Current	People	0.0	1.0	1.0	0.0	1.0	0.0	2	2.0	2.5	3	3	3	3	3	2.5	2.5	3.5	1.0	2.5	3	2
	Process	0.0	0.0	0.0	0.0	0.0	0.0	2	2.5	2	2.5	2	2.5	3	2.5	2	2	3.5	0.0	1.5	2.5	2.5
	Technology	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	2	1.5	2	2	2	2.5	1.5	2	3	0.0	1.5	2.5	2.5
Future	People	0.0	1.0	1.0	0.0	1.0	0.0	2.5	2	3	2.5	3	2.5	2.5	2.5	2	2	2	2	2	2	2
	Process	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2	1.5	1.5	1.5	1.5
	Technology	0.0	0.0	0.0	0.0	0.0	0.0	2	2	1.5	2	2.5	1.5	2	2	3	2.5	3	1.5	2.5	1.5	1.5

Current state analysis: NTESMO is managing the current system (consider only System and Market Operations in this instance) but capability is stretched, the ability to manage risk is low, and performance depends on individual effort and processes that appear workaround intensive.

- System Operations is operating with relative stability. Capability across all three dimensions is functional, though heavily person-dependent and manually executed.
- Market Operations is fragile but currently delivering core outputs (e.g. dispatch scheduling) with significant manual effort, basic tools, and informal processes with the capability lifted by the settlements function alone.
- Corporate Services is not required as part of NTESMO's regulated function at present. However, it has been reviewed in the context of future addition to provide a holistic assessment. All support functions (HR, finance, legal, IT) are delivered via implicit SLAs with Power and Water. Internal ownership, leadership depth, and digital enablement are minimal to non-existent, owing to limited mapping of implicit requirements.

Future state analysis: NTESMO's current structure and capability are not sufficient to support a reformed electricity market or a separated NTESMO without targeted, staged investment across People, Process, and Technology. In the absence of formalisation of corporate (a consideration if reform agenda to separate NTESMO is adopted) and reform-enabling functions, the organisation will face significant risk to operational integrity and reform execution. This includes the execution of the additional functions outlined in the reform program to be potentially executed by NTESMO.

- Capability either declines or remains stable across most functions when measured against the demands of a reform, including statutory separation, physical market operation, and centralised procurement. Certain functions are required in the future and thus have no or limited current capability to carry those out in the future thus necessitating building that capability through recruitment. Certain capability sees improvement either across People, given the surplus in a certain function where demand is expected to reduce, or Technology aspects given the uplift in certain planned system upgrades that have already been delivered or are underway.
- Corporate Services remains underprepared, with no uplift forecast for necessitating a structural reset and full organisational design, however, only relevant in the event of a full separation
- System Operations faces slight regression due to increased system complexity (DER, ESS and co-optimised dispatch), but a balancing impact from some systemic upgrades including upgraded EMS, introduction of OMS, DMS, and forecasting tools alongside SCADA integration of these modules. Aging workforce is a risk, but with appropriate succession planning and training to exploit decision-support tools that are embedded in the function, this can be addressed.
- Market Operations shows a mix of readiness for the future and a regression in a few areas. Readiness comes from a major overhaul of the systems and tools that have either already been implemented and are future-ready (e.g. Settlements platform) or are planned systemic upgrades (e.g. the TDE suite and packages). Key concern then becomes around the people and processes that need to match the potential which has them leverage the platforms to seamlessly progress into a reform-ready environment.

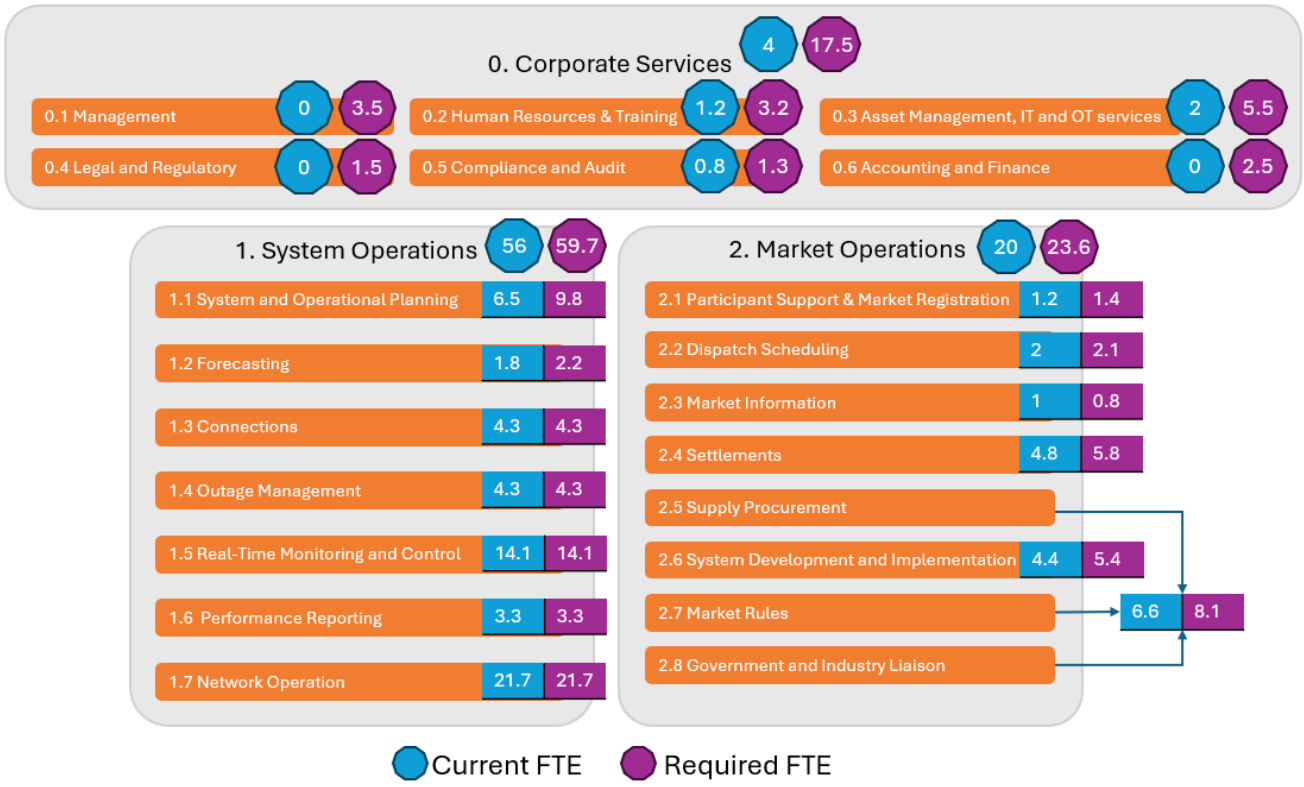
Capacity

Currently NTESMO has two teams – System Control (a significant part of the Power System Control function) and Electricity Market and Reform team (Market Operator function and elements of the Power System Controller function). The functions are split between these two teams. It is important to note that we have assessed the capacity in FTE terms and not headcount, to provide an accurate assessment of resourcing based on workload distribution. Headcount and FTE with reference to resourcing must not be used interchangeably. The review has defined a benchmark functional model that lists the functions of a statutory System and Market Operator organisation, which was used throughout the assessment to keep a consistent narrative between the current and future functions (as the future functions are more aligned to a benchmark operator, relative to how NTESMO is organised currently). Figure 2 below presents the benchmark functional model together with the current and future resources allocated (as assessed by this review) to each function.

The rationale for additional resourcing is that there is clearly a need to add more people and refine the processes and systems to drive the regulated organisational needs including the corporate functions (and other new functions)

required to be performed in the future. Clearly, the capability deficiency in non-existent functions will be made up for by the addition of new resources to perform future functions. Secondly, while the capacity for certain functions has not increased in line with the assessment conclusions, the assumption is that the skill-level that current resourcing is at, needs to be replaced with higher skilled resources. Since capacity is a one-dimensional metric, a different conclusion must not be drawn.

Figure 2 - NTESMO's current and required capacity assessment overlaid on the benchmark functional model



Insights

Several key lessons emerged during the assessment:

1. NTESMO doesn't seem to be a part of the reform – it is being reformed.
   Although now obsolete, the TEM Reform Overview placed a major emphasis on the reform being centred on NTESMO. However, it is in fact the I-NTEM that is required to transform to NTEM and the power system operation that are undergoing reform, where NTESMO is merely an actor that facilitates, enables, implements, operationalises, and operates the system during and beyond the reform period.

   NTESMO has been placed at the centre of the reform narrative without formal mandate, funding, or governance authority. This positioning is misleading and places unrealistic expectations on a team that is still in delivery mode for legacy operations.

2. Capability ≠ Capacity. NTESMO seems to have capacity but limited capability in people.
   Headcount is not a measure of capacity as many resources (including the undergraduate resources) are part-time. The assessment identified multiple areas where individual staff are undergraduate and graduate resources who are led by a handful of senior resources. Very few functions have dedicated senior personnel allocated to it, while other functions are largely served by junior and mid-junior personnel. [redacted]

   Whilst upskilling of undergraduate resources takes place, retention once trained is low. This highlights the need for targeted actions to enable NTESMO to fully capitalise on its existing capacity.

3. Systems maturity is the single greatest constraint on operational uplift.
   While people and process maturity can improve with training and documentation, NTESMO's reliance on manual tools, particularly in scheduling, dispatch, forecasting, and settlements, presents real, operational, compliance, and cost risks. Full deployment of systems such as the Territory Dispatch Engine (TDE), DMS, and financial settlement platforms (for clarity, the settlement platform currently exists with the potential to expand its capability to follow the markets and mechanisms arising out of the reform proposal, however the financial management systems is what is necessary) is non-negotiable for NTESMO's functional evolution.

4. Structural separation cannot succeed without parallel functional uplift.
   Whether, or not NTESMO separates from Power and Water, it must transition from a minimum-viable operator to a fully formed, rules-driven system and market operator. This will require deliberate investment in legal, financial, IT, policy, and communications capabilities, all of which remain outsourced, informal, or unfunded currently.

Recommendations

To ensure NTESMO can deliver on its current obligations and scale to meet future system and market reform requirements, the following strategic priorities are recommended:

1. Increase depth and diversity of staffing across critical functions
   NTESMO's current delivery model is heavily reliant on junior resources across operational and market functions. This creates a skill bottleneck, limits succession planning, and increases operational risk.

2. Embed cross-functional collaboration and knowledge transfer
   Critical operational insights from real-time teams are not systematically shared with Forecasting, Market Reform, or Connections functions. Establish regular knowledge exchange loops across functional boundaries, potentially through a rotating integration role or a cross-functional operations analyst team.

3. Develop a transition roadmap for potential separation from Power and Water
   While separation is not currently mandated, NTESMO should prepare a staged transition plan detailing governance, finance, ICT, legal, and HR capability requirements. This will allow optionality and reduce risk if separation is enacted.

4. Expedite delivery of the TDE and establish an Asset Management function (assumed in corporate functions)
   The manual dispatch scheduling process is unsustainable and exposes the system to cost, compliance, and stability risks. TDE is essential not only for market optimisation but to enable automated merit-order dispatch, spinning reserve co-optimisation, and real-time constraints handling. The lack of a dedicated asset manager to manage the lifecycle from inception to decommissioning of systems and assets that NTESMO has (primarily operational technology systems and tools) creates the issue of piecemeal technology deployment and issues with integration thereby disabling seamless operations / data hand off. An immediate need is to secure an asset management function regardless of the status and pace of the reform. Given that the TDE program may kick off in the immediate term, the time is opportune to add this capability.

5. Invest in supporting operational platforms
   To maintain system security and transparency, NTESMO must move away from spreadsheet-based tracking and toward platform-based operational execution. Priority systems include DMS (for network and outage management), OMS (for integrated outage planning), and EMS/SCADA enhancements (for real-time visibility).

6. Advocate for role clarity and cost-recovery certainty
   The blurring of roles between NT Government and NTESMO in reform design and implementation has created uncertainty and strain. NTESMO should actively seek formal confirmation of its responsibilities under reform and an associated funding model, particularly the new additional functions potentially arising from the reform program. These funding models must be aligned with the revenue models established by the Utilities Commission for the Power System Controller and Market Operator regulatory obligations.

7. Undertake necessary succession and resource planning

NTESMO is subject to significant change to its operating and regulatory environment which will impact the necessary skills mix required to undertake its function. This requirement is compounded by the aging composition of particularly staff undertaking the System Operation function and the expanding reliance of systems to undertake this function.

1. Introduction

1.1 Purpose

This document is intended to inform the NTESMO of the organisation's functional capability and capacity to perform the necessary functions within a transitioning power system and a reforming electricity market.

The proposed reform of the Interim-Northern Territory Electricity Market (I-NTEM) (*hereinafter referred to as the TEM Reform*) impacts NTESMO by:

- fully separating NTESMO from Power and Water Corporation (Power and Water), and
- adding new responsibilities such as centralised planning and centralised procurement of supply and ESS.

Furthermore, the functional capability assessment is to be referenced as an artefact that presents a foundational review of the prudent and efficient resourcing of NTESMO to undertake its functions as prescribed under the regulatory framework defined by the Electricity Reform Act, Electricity Regulations, and the System Control Technical Code (SCTC).

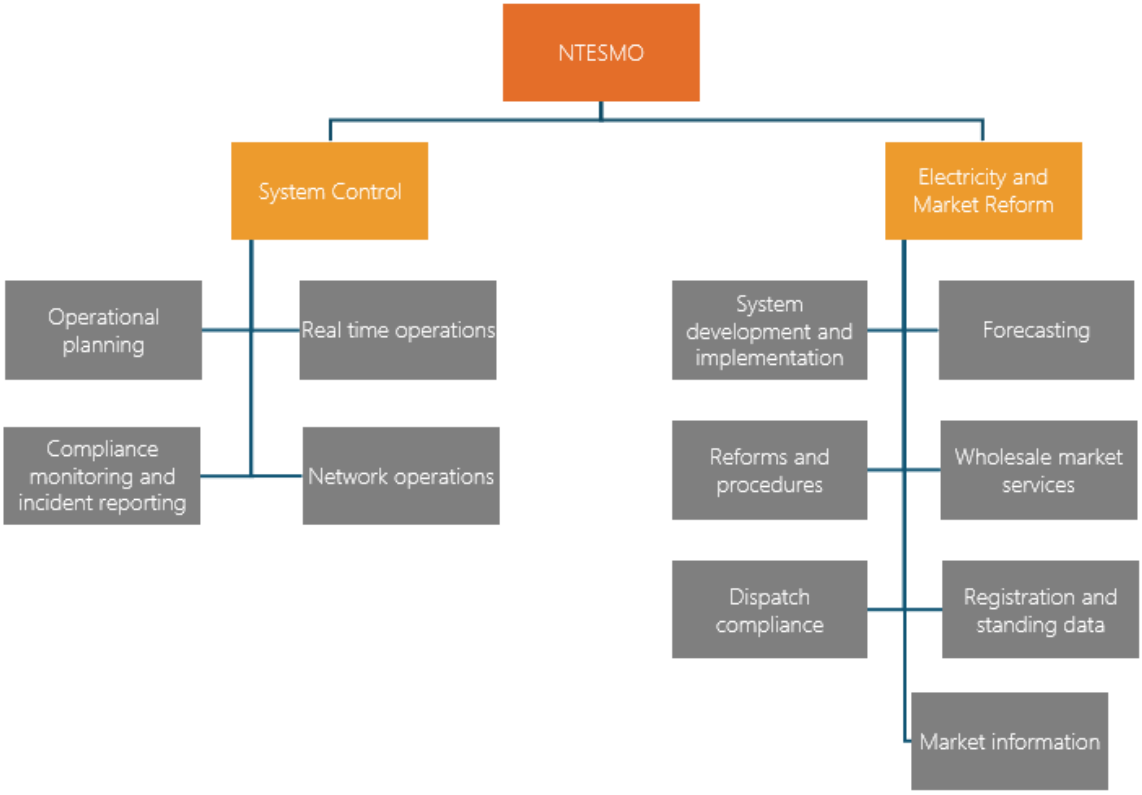
1.2 Context

Power and Water is currently responsible for undertaking power system control and market operator functions in the Northern Territory's (NT's) distinct electricity systems, in accordance with Section 38 of the Electricity Reform Act 2000[1] (NT) and the SCTC[2]. These functions are performed under the System Control Licence granted to Power and Water and undertaken by a ring-fenced business unit. Under the National Electricity Rules applicable in the NT (NER[NT]), the power system control and market operator functions are referred to as the Northern Territory Electricity System and Market Operator (NTESMO)[3]. Central to the Power System Controller's functions is ensuring the reliability, stability and security of the power system(s), with reliability focusing on uninterrupted power supply; stability to ensure balanced and steady operation; and security safeguarding the power system from physical and cyber threats. Central to the Market Operator's functions is facilitating the efficient operation of the I-NTEM[4].

NTESMO reports into Power and Water for executive management and other corporate functions and is thus organised in a manner that enables effective delivery of the two core functions, Market Operations and System Control. Figure 3 shows the organisational structure of the NTESMO function, that sit within the Power and Water organisation.

1 Northern Territory Legislation, Electricity Reform Act 2000 (in force as at 1 July 2024)
2 Power and Water. System Control Technical Code (SCTC) v7.0. 14 February 2024
3 The National Electricity Rules (NT) refers to the Northern Territory Electricity System and Market Operator (NTESMO) as a collective term for the entity that either controls the operation of the power system or administers the market arrangements. The term 'NTESMO' is used in this report to refer to the system controller and market operator functions that Power and Water is licenced to perform under its System Control Licence, treating it as a business unit.
4 NTESMO. Consultation Paper – NTESMO Revenue Proposal 2024-2027

Figure 3 - NTESMO functions performed by System Control and the Electricity and Market Reform teams



Reform of the NT Electricity Market

Proposals to reform the NT Electricity Market have been taking place since 2014-15 – when the I-NTEM was established with the goal to reform the market in 18 months and transition to a NTEM. Several iterations of reform proposals have been tabled over the years since, but a firm policy and reform agenda have not yet been confirmed or legislated. Section 2.2 covers this history in further detail.

When this functional review commenced in February 2025, the Northern Territory Government (NT Government) was understood to be progressing to adopt new wholesale electricity market arrangements that incentivise investment in renewable generation technologies within the NT's regulated electricity system through the detailed design and implementation of the Territory Electricity Market (TEM) Reform[5]. The reform objectives were set to *promote efficient investment and efficient operation and use of electricity services for the long-term interests of consumers of electricity.* The TEM Reform was introduced in July 2023 by the then NT Government. There was a change of government in September 2024, which subsequently lead to the abolition of the renewable energy target, set by the previous government, in March 2025[6]. [redacted]

The TEM Reform paper set out the market design framework for the Darwin-Katherine Power System (DKPS), termed as a "public procurement model", [redacted] Under this model and reform arrangements it is proposed that:

NTESMO shall:

[5] Territory Electricity Market – Overview Paper, Department of Industry, Tourism, and Trade, Northern Territory Government. February 2024

[6] Maley, G (Deputy Chief Minister, Minister for Renewables). March 2025. *CLP scraps Labor's failed 50% renewables by 2030 target.* Media Release createsend.com/t/t-5EF46B3A75144DB22540EF23F30FEDED [redacted]

a. **conduct centralised planning.** Periodically develop a Regulated Electricity System Investment Plan (RESIP) that will determine the investments required to meet the needs of the three regulated power systems and the Government's renewable energy policy.

b. **undertake centralised procurement**. This process will procure the electricity services as outlined in the RESIP and mandated by Government in alignment with the Market (TEM) Rules. A planning and investment review panel comprising of Northern Territory Government, NTESMO, Power and Water, and an independent expert will govern the procurement process that extends to evaluation of tenders and award of contracts based on value for money and the Territory. Centralised procurement to be undertaken on a least-cost, least regret basis. Territory Generation would be obligated to procure for the Alice Springs and Tennant Creek regulated power systems.

c. **operate the power system** to securely supply electricity at lowest cost.

d. **be separated from Power Water** and be re-established as a new entity.

The proposed Reform measures have an impact on how NTESMO operates currently. Given the stark differences between current ways of operation and the changes, either in function-as-a-whole or newer responsibilities-in-part to perform expanded functions, a review of NTESMO's capability is warranted. This is critical to understand NTESMO's current and required (future) capability to deliver on any new or modified functions of a System Controller and Market Operator as-a-result of reform, if any.

Legislative and Regulatory setting in a transitioning power system

The NT Government has incentivised the uptake of behind the meter renewable energy technologies (such as solar PV and battery energy storage systems [BESS]) and the connection of large-scale renewable generation to the Northern Territory power system[redacted] This increase in solar generation has significantly increased power system volatility (transmission and distribution) to the order of between 60-80% over a 5-minute period, as shown in Figure 4 below. This shows an increasing need to actively manage power system reliability more accurately and securely through operationalising real-time supply and demand equilibrium.

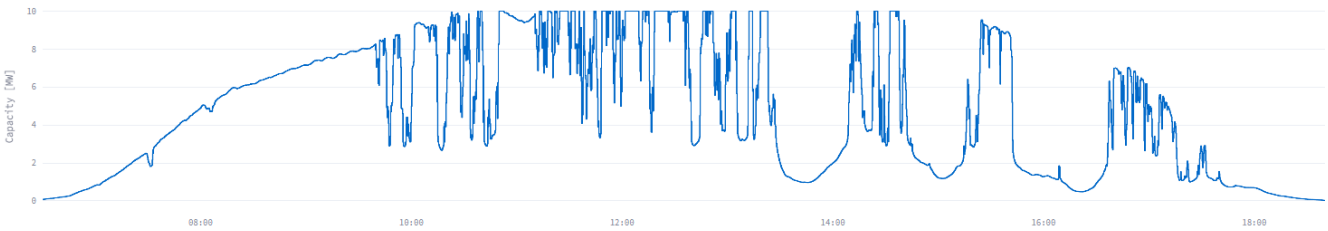


Figure 4 – Typical generation profile of a major grid connected solar PV generator demonstrating output volatility[9]

The obligations on Power and Water as the System Control licence holder per the *Electricity Reform Act 2000* (NT)[10], are that it is required to develop a System Control Technical Code[11] (SCTC) and have it approved by the Utilities Commission (UC), before distributing it to an *electricity entity* (as defined in the *Electricity Reform Act 2000)*. An electricity entity (including Power and Water) is obligated to adhere to the requirements of the SCTC as set out in the Act. Clause 4.3(a)(6) of the SCTC states that the *Dispatch Principles include security constrained economic dispatch (for the Darwin-Katherine power system)*.

Power and Water has assessed that in the absence of appropriate uplift of its systems and transformation of its functional operating model it is likely that NTESMO will not comply with the technical code by requiring consistent enforcement of renewable generation constraints and overcommitment of spinning reserve and may experience load shedding events[redacted] ll of this is due to NTESMO's increasing inability to adequately manage increased power system volatility caused by a high penetration of intermittent renewable generation and rapidly changing weather conditions.

[redacted]

[9] NTESMO (2025). 2025.02.14 – NTESMO Work Program briefing.

[10] *Electricity Reform Act 2000* (NT). Part 3, Div 3, Cl 38. (Reprint: REPE027). In force 1 July 2024.

[11] Power and Water. 14 February 2024. System Control Technical Code. *Version 7*

[redacted]

Therefore, NTESMO engaged CutlerMerz – a specialist management, engineering, regulatory, and economic consulting firm – to conduct an independent functional review of NTESMO's capability and capacity. The review involved and relied on inputs from NTESMO and an understanding of the power system and energy market nuances from our previous experience providing strategic advice and functional design for jurisdictional authorities in the National Electricity Market (NEM) and the Wholesale Electricity Market, WA (WEM). This guided the independent thinking based on benchmarking equivalent functions, capability, and capacity in the NEM and the WEM, but normalised to the unique characteristics of the NTEM.

1.3 Scope and Objectives

Scope

The overarching scope of this review is to carry out an independent review and assessment of NTESMO's functions to determine:

- its capability (including personnel headcount, skills, systems, and operating environment) to meet the requirements of the current and emerging state of the DKPS,
- its capability to implement changes to its functions that arise out of reform proposals, if any
- if the functions are correctly positioned for a changing future in the context of a reformed market and increasing power system operational complexity.

Objectively, the scope of this review focuses on conducting a functional review of NTESMO's capability and capacity with regard to:

- reform proposal [redacted] reform objectives, and the NT Government Policies,
- requirement that the conduct of the work program satisfies prudency and efficiency in accordance with the regulated revenue process that NTESMO subject to,
- the distinction of roles and responsibilities of the key stakeholders in designing, implementing, and operationalising reform,
- the changing energy mix in the power system, its implications on system and market operations, and the increasing need to proactively manage power system security, reliability, and safety, and
- the potential separation from Power and Water to operate as an entity in its own right.

For clarity, the scope of this review includes only a review of the NTESMO, and its functions, capability and capacity. Commentary on the wider reform and policies being proposed by the NT Government is provided only to the extent that it relates to and has the potential to cause any impact on NTESMO's functions. NTESMO's broader role includes the operation of the water system, which is outside the scope of this review as it focuses purely on the electricity market reform and implications on the related operational functions.

Objectives

The objectives of this review have been derived from extensive engagement with the project sponsor and team. These are to:

- inform NTESMO of their capability and capacity to perform its functions (and those associated with the reform) in the future
- enable, through the review, an advocacy communique to the NT Government by defining, distinguishing, and demarcating the roles and responsibilities of the stakeholders (NT Government and NTESMO in particular) toward a reform of the NTEM, and
- review the functional capability and capacity and provide an independent justification for resourcing – personnel and/or systems.

1.4 Approach

The specifics of the methodology used to carry out the capability and capacity assessment have been described in detail in section 6.1 of this document. The project was carried out in a four-step process. The steps were:

1. Review

CutlerMerz received inputs and documentation listing the organisational structure, functions, and other operations-related documentation from NTESMO. The documentation was reviewed to form a baseline view of NTESMO's current and changing functions. The list of documentation provided by NTESMO is shown in Appendix A – List of documents reviewed. This review also involved benchmarking NTEM's operation and functions to those of the NEM and the WEM including a thorough review of the applicable market rules. Furthermore, the review formed the basis for the next step of the process, i.e., to engage with personnel from NTESMO to get a deeper understanding of the functions.

2. Engage

The engagement with NTESMO took place by functions and sub-functions, meeting with the senior management, management, and team lead-levels. The outputs from this engagement were then captured in a common assessment framework, described in detail in section 6.1, being the People, Process, Technology (PPT) framework, where each leg of the framework called a Theme. For example, when considering People, the Theme disaggregated into four (4) Dimensions – individual, team, management, and leadership, which then splits further into 11 distinct capability Areas.

Ranking or maturity descriptions were then developed to score capabilities against, enabling a comprehensive assessment of the capability across each function.

3. Assess

The assessment was conducted in two stages: top down and bottom up. Top-down, where critical capability elements were compared against the NEM and WEM benchmarks. Bottom up, where each of the PPT Themes were investigated to ascertain the capability maturity was appropriately reflected in the maturity descriptions and the scoring.

4. Recommend

Based on the assessment, analysis was performed to recommend suitable, immediate steps that NTESMO can take to both prepare for and be proactive in shaping of the reform implementation

2. The Northern Territory Electricity Market (NTEM)

This section outlines the evolution of the Northern Territory Electricity Market (NTEM), providing an overview of its historical developments since the early 2000s. It also outlines the current interim NTEM framework and the planned NTEM reforms. In the context of the planned market reforms, the roles and responsibilities of various stakeholders were also examined.

2.1 Stakeholders

The roles of the stakeholders involved in the NTEM are described in Table 2.

Table 2 - Stakeholders involved in the NTEM

Stakeholder	Role in the NTEM	Role Description
NT Government	Sets the policy and informs regulatory environment	The Northern Territory Government is responsible for setting the overall policy and regulatory framework for the electricity market, which includes formulating and implementing policies to promote a secure, reliable, and sustainable electricity supply; establishing legislation and regulations to define roles and heads-of-power; designing inaugural rules to be implemented that ensure market integrity and consumer protection; establishment of the regulatory authority (Utilities Commission) to oversee the rules, sub-ordinate instruments and the incremental amendment thereof; and leading initiatives for market reforms to facilitate the transition to renewable energy and improve market efficiency.
NTESMO	System Operator and Market Operator; central implementer of rules to give effect to policy	NTESMO is responsible for operating the NT's electricity market and power systems, including: System Operator functions that oversee the safe, secure and reliable operation of the power system; through the I-NTEM as the Market Operator; Registration of all market participants (retailers and generators) operating in the I-NTEM; virtual market settlements that involve the calculation and issue of settlement statements to retailers and generators; and daily publication of market prices and other wholesale market data. NTESMO facilitates the review and amendment of the SCTC and all subordinate procedures as per the prescriptions that are regulated by the Utilities Commission.
Power and Water	Licensed network service provider / operator; Governs NSP and NTESMO	Power and Water is responsible for managing and maintaining the electricity network infrastructure, operating and maintaining the transmission and distribution networks; planning and implementing network expansions and upgrades to ensure capacity and reliability; and managing field operations and maintenance activities associated with transmission substations. Power and Water reviews and facilitates amendments to the Network Technical Code (NTC). Note that the network operator function that is the responsibility of Power and Water is conducted by NTESMO under a Service Level Agreement. Power and Water also oversees and governs NTESMO within its Core Operations Division.
Licensed Generators	Energy generation and provision of ancillary services (T-Gen)	Generators are responsible for providing, operating and maintaining power generation facilities to supply electricity to the market; ensuring sufficient generation capacity to meet demand and support system reliability; and integrating renewable energy sources into the generation mix. Currently, Territory Generation is remunerated to provide all ancillary services (termed interchangeably as ESS).
Licensed Retailers / Market Customers	End-use electricity retailer	Retailers are responsible for providing electricity to residential and business customers; managing customer accounts, billing, and support services; and engaging in the wholesale electricity market to procure electricity for retail customers.

Stakeholder	Role in the NTEM	Role Description
Australian Energy Regulator (AER)	Network regulator	The AER is responsible for regulating energy networks and compliance with national energy legislation; and taking enforcement action when there is potential or actual harm to consumers arising from licensed network provision.
Utilities Commission (UC)	Jurisdictional electricity regulator	The Utilities Commission is responsible for promoting competition and fair market conduct and preventing the misuse of monopoly power; setting and monitoring prices for electricity, water, and sewerage services; and issuing licenses to market participants and ensuring compliance with regulatory prescriptions that includes both market and technical power system requirements.

2.2 History and evolution

The NTEM was formally established in 2000 with the introduction of The Electricity Reform Act 2000[13]. This legislation outlines the framework for the electricity supply industry in the Northern Territory, aiming to promote efficiency and competition, ensure safe and efficient operations, maintain financial viability, and protect consumer interests. The NTEM is designed to centralise the approach for determining and procuring generation resources at the lowest cost, while ensuring system security and reliability are not compromised.

The reform undertaken in 2000 additionally provided third-party access (as opposed to being restricted to Territory Generation) to the Power and Water's three regulated electricity networks, Darwin-Katherine, Alice Springs, and Tenant Creek. This was a key enabler of competitive generation and retail sectors and of improving efficiency, together with arrangements to facilitate buying and selling of electricity between generators and retailers[14].

In 2014, the contestable retail and generation businesses of Power and Water were separated to create two new government owned corporations: Jacana Energy, responsible for retail functions, and Territory Generation, responsible for generation. Power and Water retained responsibility for system control. This separation required coordination arrangements for electricity generation dispatch, financial settlements between retailers and generators, and equitable sharing of power system security service costs[4].

In May 2015, the I-NTEM was established in the DKPS. The I-NTEM was the first step towards implementing long-term market arrangements to reduce barriers to entry and improve the efficiency of the generation and retail sectors. It provided arrangements for buying and selling electricity, enhanced cost transparency, and maintained reliability and security. The I-NTEM was intentionally developed and implemented to provide an 18-month interim market arrangement prior to the implementation of the Northern Territory Electricity Market (NTEM), a functional wholesale electricity market similar to the NEM.

The NTEM did not materialise and in 2017, the NT Government introduced its Roadmap to Renewables Report[15], committing to a target of producing 50 percent of the NT's energy across the three regulated power systems from renewable resources by 2030.

The Northern Territory Government's renewable energy target of 50% by 2030 presented significant challenges in maintaining affordable, secure, and reliable energy within the existing I-NTEM framework. The primary challenge was to develop a market-based framework suitable for the relatively small size of the Territory's power systems. A new market design was required that supports efficient renewable energy investments, streamlines disparate governance roles within each regulated power system, and enhances transparency in generation dispatch and power system operations.[16]

[13] *Electricity Reform Act 2000* (NT).
[14] NT Government. 2020. Northern Territory Electricity Market Priority Reform Program: Introductory notes on scope and work program
[15] Roadmap to renewables report
[16] Territory Electricity Market – Overview Paper, Department of Industry, Tourism, and Trade, Northern Territory Government. February 2024, p.4 [Archived]

To address these challenges, the NT Government introduced I-NTEM 2.0 in 2018 and subsequently evolved into the NTEM Priority Reform in 2020. This Reform aimed to provide a high-level pathway for integrating renewable energy resources across the three regulated power systems, while ensuring a balance between security, reliability, and affordability. The reforms have since been reviewed and refined to better align with the evolving electricity objective of the NT Government, leading to the transition to the reform program that was released in 2024 called the TEM Reform. [redacted]

As discussed in section 1.2, the 2024 elections in the NT resulted in a change of government and subsequent abolition of the 50 percent renewables by 2030 target set by its predecessor. This was followed by the TEM Reform Overview paper being archived (not forming a part of the current NT Government's formal position on reform). [redacted]

The cyclic review and amendment of the reforms of the NTEM over the past decade are driven by the NT Government's continually evolving policy objective. However, the changing complexities of power system operation in high CER penetration future, even in the absence of a reform loom over NTESMO's ability to perform its functions in a compliant and efficient manner.

Given that the TEM Reform was still in force at the commencement of this review, the next section discusses its overarching framework and objectives which, [redacted] still provides sufficient ground to consider the proposed changes to form a part of the changing future that NTESMO needs to prepare for.

[redacted]

3. TEM Reform

The TEM Reform was initiated in early 2023 [redacted] and introduced in 2024 under the auspices of the previous NT Government. The TEM reform was designed to support an orderly and efficient transition to renewable energy while ensuring a secure, reliable and affordable energy system. The reform included significant changes to the NT power system market arrangements, by establishing a new Territory Electricity Market for the Darwin-Katherine, Alice Springs, and Tennant Creek power systems.

As proposed in the TEM Reform, DKPS will incorporate a centralised planning and public procurement model, while Alice Springs and Tennant Creek will have a sole supplier arrangement provided by Territory Generation (TGen). As noted in section 1.3, Power and Water holds the System Control license (operated by NTESMO as per footnote 3) for Alice Springs and Tennant Creek power systems and delegates certain functions to TGen.

Implementation of the public procurement model in DKPS will require supporting governance arrangements to establish and clarify the roles and responsibilities of different entities required for the TEM. This distinction of roles and responsibilities is further described in section 4 of this document. These roles and responsibilities will follow a similar trajectory for the Alice Springs and Tennant Creek power systems to the extent that they do not breach the reform mandate (to continue with a sole electricity supplier arrangement) of public procurement.

The TEM Reform aims to improve the efficacy of the NT electricity systems while accommodating the increase in renewable energy. The key priority areas emphasised by the NT government include:

- the primary objective for the electricity sector is to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to:
    - price, quality, safety and reliability and security of supply of electricity;
    - the reliability, safety and security of the Northern Territory's local electricity systems; and
    - the achievement of targets set by the Northern Territory Government, in particular, the target of 50% renewable energy by 2030 (noting this target has now been revoked).

Based on the overarching objectives outlined in the TEM Reform paper, the following have been derived as the key areas of functional relevance to meet the NT Government's objectives as a priority:

- System Security and Reliability: Implementing a reliability standard and framework for the DKPS. The NT Government (via the Utilities Commission) should be responsible for establishing this standard.
- Real-time Market Operations: Introducing inter-temporal requirements and a centralised unit commitment and dispatch process.
- Settlements: Moving from virtual to physical financial settlements and ensuring flexible out-of-balance arrangements. This will imply additional responsibilities for NTESMO as the Market Operator, as they will have to act as a clearing house, manage prudential financial and credit risks, collect payments from market participants, and issue payments to generators.

The fundamental changes to the electricity market arrangements in the TEM Reform include:

- centralised whole-of-system planning for capacity, energy and ESS to meet the Electricity Sector Objective,
- establishment of a centralised procurement model for all supply-side resources,
- cost-based scheduling and dispatch of resources coupled with whole-of-market rules-based settlement across retailers and market customers,

- separating NTESMO from Power and Water and establishing it as a statutory entity, and
- establishing Territory Generation as the sole electricity supplier for Alice Springs and Tennant Creek.

Each of these changes, and the impact on NTESMO are described in the following sections.

3.1 Centralised system planning

The main objective of the TEM Reform is to achieve a new generation mix that balances cost-effectiveness, system security, and reliability.

To accomplish this, the NT Government is expected to introduce a central system planning framework, which would define a comprehensive plan for the development of the NTEM. NTESMO would assume the role of System Planner and would be responsible for developing a 10-year system investment plan for all regulated power systems in the NT.

The outcome of the centralised system planning is to[18]:

- determine the optimal level of generation capacity and timing of investment necessary to meet energy demand and ESS to achieve a reliability standard as set by the NT Government, and
- determine the required network investments necessary to meet the ongoing development of the power system.

Note: The NT Government has announced in March 2025, the abandonment of the 50 percent renewables by 2030 target, citing the lack of affordability to achieve the target in a compressed timeframe. They argue that pursing this target would impose a financial burden for households and business and lead to greater grid instability. The NT Government's plan will still focus on security and reliability, but with a stronger emphasis on affordability and investment in energy infrastructure.

[redacted]

RESIP Progress

The RESIP has successfully completed Stage 1, which focused on developing the delivery methodology. The outcome of Stage 1 was a draft Inputs, Assumptions, and Scenario Report (IASR), along with appendix datasheets. This draft resulted from extensive engagements with system participants throughout 2023 and recent data collection from stakeholders.

Stage 2 is currently underway. This stage involves finalising the IASR, as well as conducting demand forecasts and techno-economic and technical system modelling for the RESIP. The purpose of Stage 2 is to consolidate and document the data that will serve as inputs for the RESIP modelling, determining the necessary investments in the NT regulated power systems to meet capacity, system security, and reliability requirements. Stage 2 has been significantly delayed through substantial and frequent changes required by NT Government over the past 8 months related to

[redacted]

changing policy and targets subsequent to the change in Government in September 2024. The completion of the RESIP, for which the heavily revised IASR is a critical input, is scheduled for late 2025[20].

3.2 Centralised procurement

Another central aspect of the TEM Market Reform is the establishment of a public procurement model. It is important to note that the public procurement model and NTESMO's role within are yet to be determined by Government through resolution of policy. Therefore, the details surrounding procurement are limited in nature and, to an extent, outside the scope of this review. Consequently, this section will provide a high-level description of the centralised procurement model foreshadowed, pending Government policy direction, and its high-level implications on NTESMO's internal capacity and capability requirements.

The public procurement model was intended to harmonise the diverse aspects of DKPS, from strategic planning of generation, supply-side and network infrastructure investments to maintaining a secure and reliable electricity system. This approach bridges the gap between rapidly dwindling capacity due to end-of-life retirement and integrating higher levels of renewable energy combined with sufficient storage and non-energy supply side technology, ensuring grid security and reliability. This market design intended to centralise the planning and procurement of wholesale electricity services within the DKPS, coordinating generation and supply-side investment through a centralised process.

Thus, the public procurement model presented a pragmatic pathway to NT Government meeting its 2030 Renewable Target and provided a high level of central control to facilitate the electricity market transition. Notwithstanding the recent abolition of the 50% renewable energy target, the public procurement model remains a preferred market model for the DKPS due to its size and the nature of the supply-side investment required. At the same time, the model will provide higher levels of transparency of the energy dispatch and settlement process and will better support the orchestration of private sector investment. However, the enhanced role of NTESMO as the System Procurer [redacted] will not only require legislative changes but will also arguably warrant full separation from Power and Water[21]. The capacity and capability implications of this change are described in Section 0.

Procurement process

Under the public procurement model, NTESMO will have the responsibility to procure all new generation capacity through a competitive tender process. A Planning and Investment Review Panel comprising of NT Government, NTESMO, Power and Water, and an independent expert will oversee centralised system planning, investment, and procurement. The procurement process would flow through the following steps[22]:

1. System and investment plan to determine system requirements followed by structuring of an investment portfolio to satisfy system requirements. NTESMO as the System Planner (and Reliability Manager) will develop a RESIP that determines power system requirements (including capacity to meet Reliability standards) at a minimum of two years in advance, taking the Government's mandated criteria into account as a guiding input. The RESIP will consider the signals and indicators in the energy market that will determine the need for, and timing of, new capacity coupled with the mix of technology requirements.

2. Procure required services through tender process: All bidders will bid their proposed services through a tender process. NTESMO as the System Procurer will determine the successful provider(s) based on long-term least-regret cost evaluation.

3. NTESMO to contract service provider(s): Once the successful tender has been determined, NTESMO will bilaterally contract with the provider and will be the off-market counterparty. NTESMO will be fully accountable for the administration and management of all public procurement model supply arrangements under the contracted services to be scheduled and dispatched to meet power system requirements.

[20] Notice of consultation – RESIP – Draft Inputs, Assumptions and Scenario Report | NTESMO

[redacted]

4. NTESMO to aggregate the fixed and variable costs associated to the contracts executed to provide the services required to enable the reliable and secure function of the power system.

5. Retailers are charged through a rules-based gross settlement for the proportion of the contracted services they account for that is likely to be based upon a combination of contribution to maximum demand and energy consumed – i.e. fixed costs settled against contribution to maximum demand and variable costs settled against energy consumed. ESS revenue is to be settled in a similar manner, although Government is yet to formally consult over the model design.

The Alice Springs and Tennant Creek Systems are likely to be operated in a similar manner, except that Territory Generation would be procuring the services required by the RESIP and NTESMO would merely be providing settlement statements to retailers and Territory Generation that enable settlement of revenue for services procured by Territory Generation. NTESMO would remain accountable for the scheduling and dispatch of the services and may delegate the performance of these function to Territory Generation to the extent necessary.

3.3 NTESMO separation

A key aspect of the TEM Reform is the consideration of separating NTESMO from Power and Water and establishing NTESMO as a statutory entity. With NTESMO's role expanding due to the introduction of the public procurement model and centralised system planning, the basis of NTESMO's establishment will no longer align with Power and Water's establishment as a Government Owned Corporation (GOC)for the following reason [redacted]

- NTESMO cannot operate on a profit basis – it must remain commercially neutral to the market as a statutory entity,
- NTESMO's expanded role will require a Board with skills that differ significantly from those needed for the network business, and
- NTESMO will be passing its direct costs to market participants, necessitating clear cost separation from Power and Water

As a consequence, for NTESMO to deliver on their functions, the NT Government has proposed that NTESMO operate as an independent entity, however, the detail has yet to be fleshed out.

The separation from Power and Water will require NTESMO to obtain additional capacity and capabilities beyond what is required to perform its current roles as the system and market operator within Power and Water. These implications are further detailed in section 6.2.

While the objective to separate NTESMO stems from creating transparency in a market environment, separation might not be the best and only solution to achieve this. Notwithstanding the additional administrative burden and likely duplication of costs that the separation would entail, the same objective can be met with stringent ring-fencing and regulatory oversight while NTESMO remains a part of Power and Water. The expectations from a statutory entity can still be applied to NTESMO with such oversight and allocation of dedicated resourcing arrangements.

If, however, the intent to separate NTESMO from Power Water remains, it should be considered once the reform is set in motion with clear policy objectives, defined roles, accountabilities, and responsibilities, clear understanding of market design and arrangements, robust legislative, governance, and regulatory framework, and an operationalised reform program. Contemplating the two to occur concurrently could pose a high risk of failure due to extreme ambiguity in the two processes and shifting priorities of the stakeholders to keep a system and market operational, a reform ongoing, and a separation in the midst.

[redacted]

3.4 Reform implications and gaps

While the TEM Reform Overview provides an out-of-date and possibly obsolete framework for how the Reform will be developed further, it is limited in terms of the roles and responsibilities of the stakeholders associated with the development and implementation of the Reform. Specific information such as the cost models, revenue recovery mechanisms, the way of unbundling of energy and ancillary services will occur in the future – to name a few – is also limited to infer from the, now out-of-date, overview paper. These, along with a clear and defined policy, are a precursor to the development of a robust set of Market Rules (which NTESMO could base / premise its functions on) that will form a strong basis for the specifics of market design and associated functions of all stakeholders including the market participants. The market design influences the functions that the stakeholders, NTESMO in particular, will be responsible to perform going forward and thus is the cornerstone of an effective reform program.

This review interprets the available information on the Reform that is considered to remain to be the Government intent and builds on it to derive the functions that NTESMO is likely to take on. The key themes of the proposed Reform – centralised planning, procurement, scheduling, dispatch and likely NTESMO separation from Power and Water – have substantial implications on NTESMO's functions overall. NTESMO's current capability was developed to suitably perform the functions that currently sit within its obligations for operating the system and market. However, the additional accountabilities being considered as part of the Reform and establishing NTESMO as a separate entity will require an uplift in the capability, skills, and capacity to effectively perform, what are likely to be, its functions in the future.

To adequately assess NTESMO's capability, a holistic set of functions needs to be defined. While our review has attempted to be comprehensive to the extent permissible with the information available, there is a broader need to demarcate what constitutes functions that are required to be performed as part of reform implementation and those that are to be continued as an ongoing function.

In addition to that, the line between NTESMO's roles and responsibilities and those of the NT Government (and other stakeholders) in the power system reform appears to be blurred. **The TEM Reform Overview places a major emphasis on the reform being centred around NTESMO. However, it is in fact the NTEM and the power system operation that are undergoing reform, where NTESMO is merely an actor that facilitates, enables, implements, operationalises, and operates the system during and beyond the reform period.**

Good market reform[24] focuses on the why, what, and how rather than who. The need for clarity on policy objectives and identifying ways in which to meet those are the foundations of any good reform[25]. Therefore, the next section aims to provide some structure to the functional anatomy of the power system – which also helps establish the conventional roles and responsibilities of stakeholders involved in an electricity market reform.

[24] International Energy Agency (IEA). (1999). Electricity Market Reform. An IEA Handbook

[25] Blueprint Institute. (2022) Untangling the NEM. A policymaker's guide to the National Electricity Market

4. Functional anatomy of the NT power system

This section sets out market reform principles using the functional anatomy of a power system. This is intended to inform the process of reforming an electricity market and power system by delineating the different roles and responsibilities that stakeholders are required to fulfil within a reforming system.

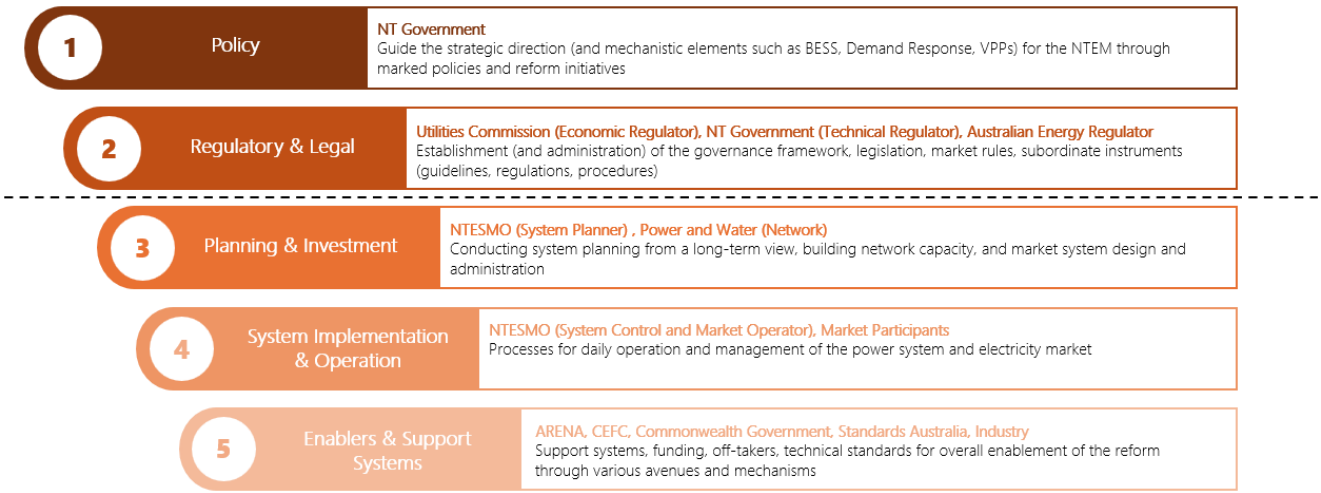
4.1 The anatomy

The structure of the NT power system can be understood through five key layers that encompass strategic policy making, legislation and regulation, planning, operation and system support. Each layer involves different stakeholders and mechanisms working together to ensure the electricity system is secure, reliable and transitions towards a more sustainable future.

The first layer of the anatomy is policy. The policy layer sets a strategic direction to realise a specific goal or meet certain objectives. Conventionally, it features a policy position paper, policy objectives, and the initiative(s) that enable realisation of policy goals. Following policymaking comes the regulatory and legal layer. This effectively aims to formalise the policy and initiatives by divvying up obligations among stakeholders through regulation and legislation. The next step is to plan for implementation and the investment needed for it and is usually done at system-level. It leads to the implementation and operationalisation layer, where the systems, processes, and procedures across different stakeholders in the power system come together for streamlined operations. Lastly, there are the support systems and enablers which assist in operationalising the activities emerging from the system plan and policy initiatives through enabling aspects such as provision of operational technology, grant funding, and other forms of capital. This is depicted visually in

Figure 5.

Figure 5: Anatomy of the NT power system



4.2 Policy layer

At the top of the functional anatomy is the policy layer that sets the strategic basis for all other layers to emerge from. The policy layer speaks to setting of the objectives that the power system is required to meet and those aspects with which it is going to be able to meet. Through policies such as renewable targets, attracting private investment in energy infrastructure, integration of demand-side flexibility into power system operations, and identifying ways to achieve these policy outcomes through specific initiatives is how the policy layer best delivers its role in the power system.

The policy layer is primarily concerned with high-level objectives such as the transition to renewable energy, external investment in capacity for the NT power system, improving energy security, reliability, and affordability and the various

ways in which these can be achieved including technology consideration, distribution incentives, allowing distributed aggregations to participate in the wholesale market to name a few. It provides the foundation upon which regulatory, operational, and investment decisions in the NT electricity sector are built.

Example: The Australian Government has a policy designed to encourage new investment in renewable energy generation and dispatchable storage, aiming to help the country reach its 82% renewable electricity target by 2030. The approach proposed to achieve this policy objective is via the implementation of the Capacity Investment Scheme (CIS). The scheme has a defined basis of setting a price floor and ceiling that provides revenue certainty for the investors building new capacity. The broader implementation of this policy is performed by the stakeholders that can implement it effectively (such as AEMO Services Limited running the tender process, evaluating bids for technical and commercial viability, and recommending projects to award to the Commonwealth Government).

The main stakeholders in the Policy layer include:

- The NT Government Defines the strategic priorities and policies for the NT electricity sector,[26]), energy security and affordability. The NT Government also drives reform initiatives for the electricity system to modernise market arrangements and support decarbonisation efforts.

- Department of Mining and Energy (DME): Responsible for shaping the overall policy framework in the NT electricity market. DME leads energy policy implantation to promote secure, reliable and sustainable energy supply, and additional lead initiatives for market reforms to facilitate the renewable energy transition and improve marked efficiency in the NT. The CEO of the DME oversees the Electricity Market Reform Program as chair of the Electricity Reform Taskforce.

- Department of Treasury and Finance: Shareholding ministry for Power and Water (including NTESMO).

- Minister for Essential Services: Portfolio Minister.

It is imperative that the strategic decision-making and policy direction are set out clearly by the NT Government to guide all successive actions to follow, as articulated in section 4.1. While various stakeholders, such as the NTESMO and Power and Water, may inform the policymaking process, they do not hold authority to shape or implement policy themselves.

The key components of a good policy design include having a clear intent and purpose, being evidence-based and well-informed, being practical and implementable, being cognisant of stakeholder engagement, having accountability and oversight, having flexibility and adaptability in design, addressing the entirety of the policy's lifecycle, and bearing supporting documentation[27,28]. As the TEM Reform currently stands, there seem to be key elements missing.

The roles and responsibilities that have been derived from the TEM Reform paper are listed below but have been substantially amended following a reconstitution of the Government Departments providing reform direction. However, these appear to be high-level in nature creating ambiguity around specific aspects of accountability.

- Electricity Reform Taskforce (ERT): ERT has been tasked with carrying out the TEM Reform implementation with support from DME to develop detailed implementation plan and undertake industry consultation. ERT will also be advised by the DME project team on the development of RESIP, formulating the necessary legislation to give effect to the features of the TEM, and establishing an initial set of Market Rules. These rules will apply to the DKPS (and the other two regulated power systems as well), outlining the functions of different entities and consolidating the operations of the system and market into a single set of rules. This will ensure a unified framework governing market functions and power system operations and will enable the regulatory bodies to formulate legislation that govern how the policy outcomes should be achieved[29].
- NTESMO: Will be tasked with developing and implementing the necessary tools, systems, and procedures to actualise the new market arrangements. It will be re-established as a separate entity from PWC, conduct

[26] Maley, G (Deputy Chief Minister, Minister for Renewables). March 2025. *CLP scraps Labor's failed 50% renewables by 2030 target.* Media Release createsend.com/t/t-5EF46B3A75144DB22540EF23F30FEDED

[27] Productivity Commission. 2010. Theme chapter - Chapter 1: Good public policy - why evidence and process matter - Productivity Commission Annual Report 2009-10

[28] Althaus. C et al. 2023. Australian policy handbook: a practical guide to the policy-making process, 7th edn, Routledge, Sydney. p 87

[29] Territory Electricity Market – Overview Paper, Department of Industry, Tourism, and Trade, Northern Territory Government. February 2024

procurement activities for the DKPS upon initial RESIP finalisation, and maintain its current role as the System and Market Operator.

- Licensed Market Participants: Will be responsible for actively participating in the consultation and engagement through industry reference groups to provide inputs into the execution of the market design. The stakeholder inputs will provide important feedback on the development of detailed rules and procedures that give effect to the new market framework.

NTESMO plays a critical role in the day-to-day management of the NT regulated power systems. The operational responsibilities of NTESMO defined in the SCTC and the NTC gives NTESMO deep insight into the practical functioning of the NT power system and NTEM, including the technical, logistical, and economic realities of energy system operations.

However, NTESMO does not have the mandate nor legislative authority to develop or set Market Rules—this remains a core function of the NT Government (or ERT). As such, while NTESMO can provide valuable operational knowledge that helps develop a robust set of Market Rules, perhaps even the minimum technical requirements for the ESS and detailed requirements for unbundling of energy and ESS (ancillary services) in a generator offer, they cannot independently shape the strategic direction or policy outcomes of the TEM. Furthermore, NTESMO's current capability and capacity (as discussed in section 0) restrict it to take on additional responsibilities without additional resourcing and funding in accordance with the prevailing regulatory determination process applied by the Utilities Commission.

A collaborative approach between the NT Government and NTESMO is therefore essential. NTESMO's real-time system knowledge can help ensure that Market Rules and policy settings are fit for purpose, practically implementable, and aligned with the long-term operational requirements of the TEM. However, for this to be effective and sustainable, the NT Government must establish clear mechanisms for cost recovery, enabling NTESMO to support the policy development process without assuming unfunded responsibilities outside its core mandate. Additional temporary resourcing can be allocated within NTESMO to act as a dedicated TEM Reform team from NTESMO – carrying out the necessary functions in supporting the NT Government, ERT, and the DME in refining the Reform implementation plan and system and market technicalities. This would, however, require a formal mandate from the NT Government.

This delineation of roles ensures that strategic authority remains with government, while the expertise of operational entities like NTESMO is appropriately harnessed to inform and support sound, practical policy design.

4.3 Regulatory and legal layer

The Regulatory and legal layer forms the second-highest tier of the Northern Territory's power system framework, providing the foundation for governance, legislation, and market rules. This layer establishes the statutory and institutional architecture that governs how the electricity sector operates.

The I-NTEM operates under a legal framework set out in the Electricity Reform Act 2000[30], the National Electricity (Northern Territory) (National Uniform Legislation) Act 2015[31] and the Utilities Commission Act 2000[32]. Together, these Acts underpin the Territory's electricity regulatory regime and form the basis for the Northern Territory National Electricity Rules (NT NER)[33], which are tailored to the Territory's unique market structure and system characteristics.

Under the Electricity Reform Act, the Utilities Commission (UC) has been appointed as the economic regulator for the NT. The UC is responsible for administering the licensing framework for electricity market participants, overseeing compliance with industry codes and guidelines, and regulating key pricing mechanisms. In addition, the UC publishes annual reports on the performance of the NT's electricity sector, monitors market conduct, and investigates complaints involving licensed entities. Through these functions, the UC plays a vital role in ensuring transparency, accountability, and economic efficiency within the NT power system.

[30] Northern Territory Legislation, Electricity Reform Act 2000
[31] National Electricity (Northern Territory) (National Uniform Legislation) Act 2015
[32] Northern Territory Legislation, Utilities Commission Act 2000
[33] NTNER Version 123 Summary - AEMC Energy Rules

Case in Point: Presently, the UC is both the economic and technical regulator for the Power System Controller and Market Operator, irrespective of its limited capacity and capability to effectively regulate technical matters.

Part of the ERT and DME's intent is to establish Government as the technical regulator and owner of the rules, whilst preserving the UC as an economic regulator only. This may result in greater complexity for the management of the rules for the regulated power systems going forward. It necessitates a robust legislative and regulatory framework that delineates the roles, responsibilities, and accountabilities clearly.

Crucially, without amendments to existing legislation, such as the Electricity Reform Act 2000, NTESMO would not have sufficient head-of-power and obligation, and cannot recover the costs associated with undertaking functions that differ from those currently legislated and subsequently defined in regulatory obligations within the technical codes. To enable NTESMO to fully perform its expanded role in the future, including acting as the System Planner and System Procurer, the legislative head-of-power requires further definition in an unequivocal manner with the subsequent rules and cost-recovery mechanisms being established and set in place. These rules must clearly define the scope of these functions and the financial arrangements that allow NTESMO to sustainably carry them out.

4.4 Planning and investment layer

The Planning and investment layer of the NT power system plays a foundational role in shaping the future of electricity supply. This layer focuses on ensuring that the NT power system is capable of meeting evolving energy and ESS demands through long-term infrastructure development, system planning, and the integration of renewable and distributed energy resources. This layer serves as the bridge between long-term strategic policy goals and the physical and operational realities of the NT regulated power systems. Through coordination between government, regulators, system operators, licensed participants, and investors, this layer ensures that the Territory's electricity infrastructure is prepared to meet future challenges—supporting the orderly transition in a sustainable manner to clean energy while maintaining system security, affordability, and reliability.

The following stakeholders are involved in the planning and investment for regulated power systems in the NT:

- Power and Water: As both the Transmission and Distribution Network Service Provider (TNSP/DNSP) in the NT's regulated networks, Power and Water is responsible for maintaining and upgrading electricity infrastructure. This includes long-term network planning to ensure that generation and demand remain balanced and that the grid can support new technologies like solar PV, batteries, and electric vehicles. Power and Water also works closely with other market participants to assess the need for new infrastructure and system capabilities.

- NTESMO (as a Division of Power and Water): Subject to implementation of TEM reforms, NTESMO will play an important role in centralised planning of all regulated power systems and centralised investment in the DKPS. For the function of centrally planning for the power systems by means of the RESIP development, NTESMO provides critical technical expertise, market data, and operational insight to inform infrastructure planning and guide investment decision-making. Through its roles as the System and Market Operator, NTESMO identifies emerging operational challenges and system constraints, provides advice on generation and storage adequacy, supports technical planning for system upgrades and offers system modelling, operational forecasting and performance analysis.

  NTESMO's input is essential to ensuring that planning decisions and infrastructure investments are fit for purpose, technically feasible, and aligned with future market functionality under the TEM. If formally assigned the System Planner role in the future, NTESMO would require enabling legislative and regulatory mechanisms to recover costs associated with fulfilling those functions, as described in the prior section.

The RESIP draft Report is expected to be provided to the ERT in October 2025 and will provide a comprehensive 10-year investment plan for the NT's regulated electricity systems, which will outline the necessary investments to meet future capacity, system security and reliability requirements[34]. RESIP is expected to:

- balance cost-effectiveness by ensuring that investments are economically viable,
- provide better system security and reliability, and
- provide a plan for achieving the NT Government's renewable energy targets.

The plan involves extensive consultation with stakeholders and is based on detailed inputs, assumptions and scenario reports. While the ultimate policy and investment direction is guided by the NT Government and supported through initiatives such as the RESIP, the development of the RESIP is facilitated and primarily overseen by NTESMO. NTESMO is responsible for coordinating the various stages of the RESIP, including consultation with stakeholders, the finalisation of the inputs, assumptions and scenario reports, the planning activities, and culminating in the development of an investment plan that seeks Government mandate prior to procurement thereof.

4.5 System implementation and operation layer

The System implementation and operations layer is where strategic plans and policies are translated into real-time actions. This layer is responsible for the day-to-day operation of the NT electricity system, ensuring that electricity supply and demand are balanced, system security is maintained, and market processes are administered efficiently and transparently.

This layer involves close coordination between operational agencies, market participants, and government bodies to ensure that the Territory Electricity Market (TEM) functions reliably and in accordance with the policies, regulations, rules, and subordinate instruments established through higher-level governance layers.

The following stakeholders are involved in the layer:

- NTESMO delivers the core operational functions of the NT power system through its responsibilities as both the:
    - Power System Controller overseeing real-time power system security, frequency control, and generator dispatch across the Darwin–Katherine, Alice Springs, and Tennant Creek power systems.
    - Market Operator administering the I-NTEM including the subsequent implementation of the TEM, including market dispatch, settlements, participant registration, and publishing operational and market data.

NTESMO ensures operational compliance with the I-NTEM (and subsequently TEM) rules, but it does not have authority to change or define those rules. Any expansion of its responsibilities (e.g. as System Planner or System Procurer under the future TEM framework) will require legislative change, establishment of commercial head-of-power for market operation and mechanisms for cost recovery.

- The NT Government, through DME, enables system implementation by:
    - defining market structure and policy intent,
    - reviewing, amending and developing rules to give effect to the policy across the existing instruments being the SCTC and the NTC,
    - approving the Market Rules and regulatory framework under temporary Ministerial Code Change powers established in 2021, and
    - ensuring operational entities like NTESMO are appropriately empowered and funded.

[34] Notice of Stage 2 of the Regulated Electricity System Investment Plan | NTESMO

The NT Government also plays a key role in managing the transition to new market arrangements under TEM, including oversight of roles, responsibilities, and accountability frameworks as well as establishing transitional arrangements to give effect to the reforms in a pragmatic and timely manner.

- Other key stakeholders include:
  - PWC: maintains transmission and distribution assets, supports outage response, and coordinates with NTESMO.
  - Licensed market participants:
    - Generator Participants: including Territory Generation, MC Power and private renewable providers, which deliver energy into the market
    - Retailers and Market Customers: such as Jacana Energy and Rimfire Energy, which manage customer relationships and energy procurement.
  - The Utilities Commission as jurisdictional regulator.
  - The AER as the economic regulator for the network.

As the TEM reform progresses, roles and functions will be developed, become more formalised and consolidated under a single set of Market Rules (TEM Rules), which must include future considerations to:

- clarifying and potentially expanding NTESMO's functional obligations, including planning and procurement roles
- amending and expanding the obligations of licensed participants of the regulated power systems
- establishing funding and cost-recovery mechanisms for new NTESMO responsibilities
- enhancing real-time integration of renewables and DERs while maintaining system security
- ensuring operational readiness and alignment across all three regulated power systems
- specifying licensed participant obligations
- delineating amended market rules from the technical rules for operation of the regulated power systems
- establishing head-of-power and prescribing a more comprehensive array of sub-ordinate instruments that define the operational arrangements of the regulated power systems in more detail (for example, the secure system guidelines that define technical parameters for the maintenance of power system security).

The TEM Rules will identify an array of subordinate instruments that define the operational approach to development and maintenance of the regulated power systems and wholesale electricity market to a level of prescriptive detail that sufficiently articulates the way it is operated in the best interest of the consumers taking account of multiple licensed participants. These instruments are overseen by NTESMO and serve to:

- more comprehensively define power system and wholesale market operation in a centralised manner,
- prescribe specific technical and economic parameters, technical envelopes and boundaries to the extent necessary,
- describe consistent methodologies for system and market operations,
- proceduralise activities that are routinely repeated in the operation of the power systems and market, and
- easily amendable through formalised consultation processes that invite the input of licensed participants in an equitable manner.

4.6 Enablers and support system layer

The Enablers and support system layer provides the essential tools, frameworks, and standards that support the effective functioning of all other layers in the NT power system. This includes initiatives such as the NT Distributed Energy Resources (DER) Roadmap, which guides the integration of rooftop solar, batteries, and other consumer technologies, and the development of reliability standards to ensure secure and consistent power delivery. These

cross-cutting elements enable innovation, support regulatory and market compliance, and ensure the system remains adaptable and resilient as the NT transitions toward a cleaner, more decentralised energy future.

Stakeholders such as the Australian Renewable Energy Agency (ARENA) and Clean Energy Finance Corporation (CEFC) have supported numerous clean energy initiatives across the NT. Their funding and investment help enabled large-scale solar projects, hybrid microgrids, and battery storage systems—particularly in remote and off-grid communities.

5. Functions of a Power System Controller and Market Operator

This section provides an overview of the core functions and capabilities typically required of a system and market operator (the general terminology used to refer to an entity performing the functions that NTESMO performs), drawing on established practices from national and international counterparts. These benchmarked functions serve as a reference point for assessing NTESMO's current functions, capabilities, and capacity. By comparing NTESMO's existing functions and capabilities with those of other operators, the analysis identifies areas of alignment, gaps, and opportunities for development to support the effective implementation and operation of the future NTEM.

For clarity, this section will only compare the relative differences between the functions that are typical of a system and market operator and those that NTESMO is currently legislated to perform. This analysis facilitates an understanding of whether any new functions are needed to be added to NTESMO's remit.

NOTE: A reference to system and market operator in the text that follows is to refer to any entity that is responsible for operating the power system and the electricity market in a jurisdiction.

5.1 Comparison of different system and market operators

In order to benchmark the different functions and capabilities of system and market operators, five (5) jurisdictional operators were studied inclusive of NTESMO. These include a mix of energy only and energy and capacity markets to capture a holistic view of the functions across both market structures. The NT market and power system was found to be the closest to the WEM, despite being approximately 10 times smaller in size (400 MW vs. 4,000 MW maximum demand). A summary of the key differences between operators in different jurisdictions is shown below in Table 3.

Table 3 - Comparison of different national and international system and market operators

Entity	Region	Max Demand	Generators / Generation capacity	Market Structure	Key Functions
NTESMO	Northern Territory	287 MW (2022-23)[35]	~11 licensed generators[36] / c.434 MW[37]	– Capacity procurement model (proposed NTEM) – No formal wholesale market (I-NTEM facilitates settlement of bilateral contracts) – Central dispatch and outage coordination	Manages the wholesale exchange of electricity between generators and retailers by scheduling generation dispatch and providing settlement statement for generators and retailers to settle between themselves Ensures safe, secure, and reliable power system operation, including network operation (switching) by forecasting demand, real-time monitoring and control
AEMO (WEM)	Western Australia	4175 MW (2023-24)[38]	- 5,859 MW of registered generation capacity	**Energy + Capacity** – Reserve Capacity Mechanism (RCM) + Short-Term Energy Market (STEM) – Energy and ESS – 5-min Real-Time (balancing) Market (RTM)	– Operates WEM market and dispatch – Procures and certifies reserve capacity – Ancillary services and ESS co-optimisation – Transmission planning and forecast reporting
AEMO (NEM)	QLD, NSW, ACT, VIC, SA, TAS	33,716 MW (2024)[39]	- Over 600 registered participants - Approx. 65,000 MW of	**Energy-only** – Real-time gross pool – 5-min dispatch and 30-min settlements – 8 FCAS markets	– Operates NEM wholesale spot market – Dispatch and system security – Demand forecasting and reliability assessments – Power system planning

[35] Utilities Commission. 2023. Northern Territory Electricity Outlook Report, p.11
[36] Utilities Commission. Register of electricity licences, exemptions and dedicated connection assets, p.11
[37] NTESMO (2025). 2025.02.14 – NTESMO Work Program briefing.
[38] Ampere Labs. April 2024. WEM Quarterly Market Review:Q1 2024, p.4. [updated July 2024]
[39] AEMO. 30 January 2025. *National Electricity Market hits new demand and renewable energy records in December quarter*. [Media Release]

Entity	Region	Max Demand	Generators / Generation capacity	Market Structure	Key Functions
			registered capacity	– Capacity mechanism under policy review	
ERCOT	Texas, USA	85,199 MW (2024)[40]	- More than 1,800 active market participants	Energy-only – Real-Time and Day-Ahead Markets – Ancillary Services market – No central capacity market	– Manages real-time grid reliability – Market clearing and dispatch – Forecasts supply adequacy – Transmission planning and reliability standards
PJM	Northeastern USA	152,666 MW (2024)[41]	- 144,644 MW of registered generating capacity	Energy + Capacity – Locational Marginal Pricing – Capacity via Reliability Pricing Model (RPM) – Ancillary Services (regulation, reserves	– Operates energy, capacity, and ancillary markets – Conducts transmission and reliability planning – System balancing and reserve management – Market monitoring and compliance enforcement

Based on the conclusion from the analysis above, AEMO's (WEM) functional model was chosen to be the template to model a benchmark. The section that follows establishes the benchmark functional model which was then utilised to compare NTESMO's situation against.

5.2 Overview of functions of a System and Market Operator

Following from the section above, we have developed a functional model that not only reflects the required functions for an entity to operate a power system and market but is also cognisant of the unique nature of the NT electricity market and power system, NTESMO's unique positioning, and regulatory and legislative barriers. Instead of choosing AEMO's (either in the NEM or the WEM) functional model as-is to use as a benchmark, we have adjusted the functional model template that respects the scale, size, legacy, and legislative and regulatory history of the I-NTEM relative to NEM, WEM, and other international counterparts. What follows is a description and depiction of the model we have utilised as the benchmark for this review.

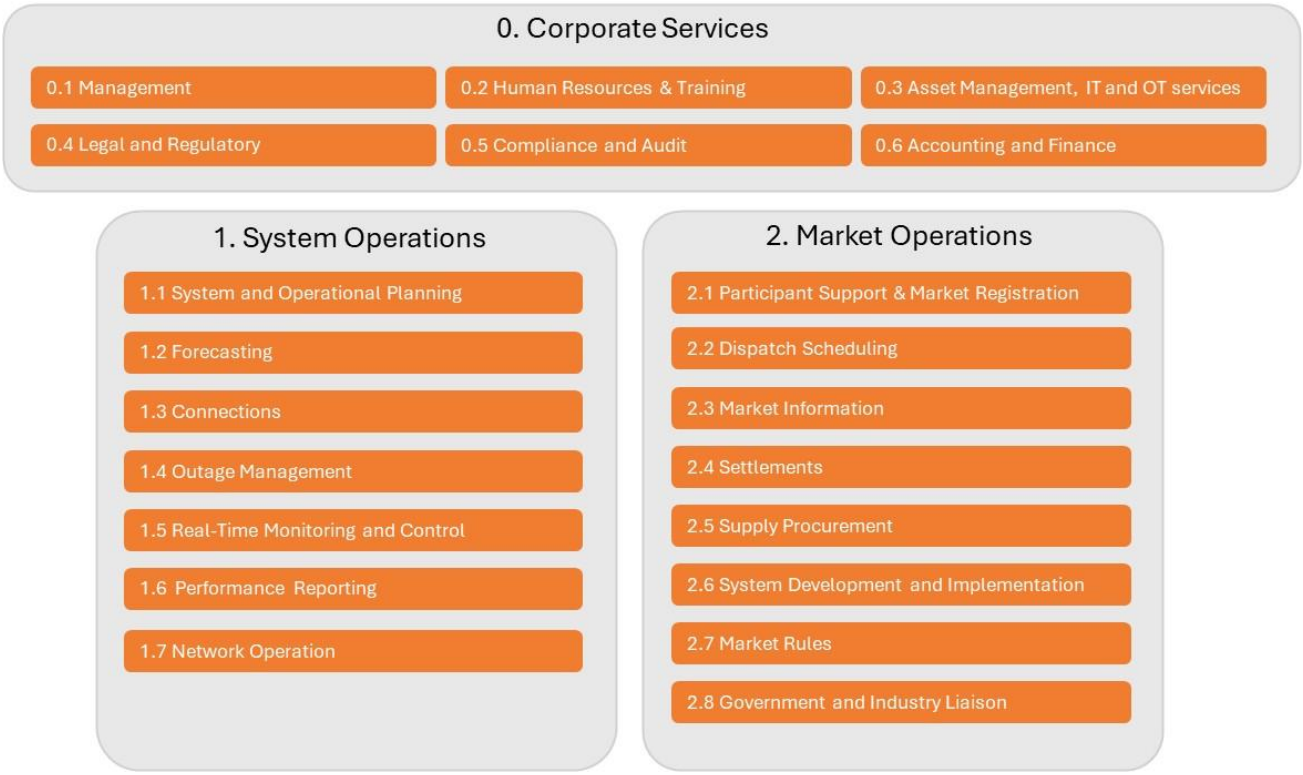
The model defines three primary functional groups that represent the core responsibilities required for the effective operation of the Northern Territory's power system and electricity market. The functional groups are:

- Corporate Services – encompassing management, legal, regulatory, compliance, audit, finance, human resources, and enabling technologies, including information and operational technology (IT OT) functions
- System Operations – covering real-time system control, outage coordination, system security, and operational planning to ensure power system reliability and security
- Market Operations – including market scheduling, dispatch, pricing, settlements, and supply procurement processes to support efficient market functioning, market rules (implementation through procedures development), control/market systems development and implementation, and government and industry liaison

Together, these three functional groups comprise 24 individual competencies as shown in Figure 6.

[40] ERCOT. 17 September 2024. ERCOT Monthly Operational Review (August 2024).
[41] PJM. 2 January 2025. 2024 in Review: PJM Operations Maintained Reliability. [Media Release]

Figure 6 – Functional model of a system and market operator (Benchmark model)



5.2.1 Comparison to NTESMO's functional model

Consistent similarities were found between the benchmarked model and the NTESMO functional model that depicts its current state functions. However, the depiction of NTESMO's model does not cover certain key functions related to electricity market reform and transition (including supporting the NT Government with the inaugural RESIP development and implementation) and systems and tools development (discussed in section 0 in depth).

Under System Operation

- NTESMO's *Real-Time Monitoring and Control function* (1.5) includes *Network Operation* function from the benchmark model
- NTESMO's *Maintain Operational Systems* function (1.8) is included within System Operations, whereas in the benchmark model this function has been aggregated into *Asset Management* (0.3) function (under corporate services function) in order to drive organisation wide visibility over systems, tools, and assets (operational technology)
- NTESMO's *Compliance Monitoring (1.7*) *Operational Reporting (1.7)* functions have been aggregated into and combined with the benchmark model within the *Compliance and Audit (0.5)* function.
- NTESMO's *Operational Training (1.9)* and *Participant Training (2.1)* have been rolled in with the corporate function of training, that sits within *Human Resources and Training* (0.2) function

Under Market Operation

- NTESMO's *Participant Support and Training* has been split to separate out the training component. The *Market Registration and Standing Data* function has been rolled into *2.1 Participant Support and Market Registration* in the benchmark model
- NTESMO's function *Pre-Dispatch Scheduling (Day Ahead)* is specific to its case where a merit order and dispatch schedule are determined one day before dispatch; whereas the benchmark model notes it as *Dispatch Scheduling* assuming that it can be performed at any time including same-day and in real-time (the assumption here is

devoid of a particular market structure, i.e., energy only or capacity and energy market, however, WEM too features a day-ahead (pre-dispatch scheduling) and STEM [same-day scheduling])

- A regulated NTESMO function, (*Control*) *System Development and Implementation*, currently does not feature in the NTESMO function model whereas is a core component in the benchmark model
- Other functions from the benchmark model that the NTESMO's model is missing are *Supply Procurement, Market Rules, Government and Industry Liaison* owing to the fact that these are not currently regulated functions that NTESMO is permitted to perform – however, our review observed that resources within NTESMO are involved in carrying out tasks that relate to these functions in order to support the reform initiatives and manage impacts, though not formally accounted for.

5.3 Functional Groups

5.3.1 Corporate Services

Benchmark

There are operational aspects of an organisation that are required for the smooth and efficient functioning of an organisation. Though they do not form part of the core functions, they are enabling and administrative functions that facilitate the core functions. These include, but are not limited to, corporate functions, Executive Management, Human Resources, Payroll, Financial Accounting, Assets, Information and Operational Technology (IT OT) Services, Legal, Compliance, and Audit.

NTESMO

NTESMO, still being a part of Power and Water, leverages the corporate and administrative functions through resources available at Power and Water. Several of these functions are delivered through implicit Service Level Agreements (SLAs) between NTESMO and Power and Water. Structurally this means that the highest level of management function at NTESMO – Senior Manager Electricity and Market Reform (functionally responsible for both the market reform and market operations functions) and Senior Manager System Control – report to executive management at Power and Water and NTESMO is headed by the Chief Executive Officer (CEO) at Power and Water.

Table 4 below follows the same headings, to the extent that there is evidence of such functions being performed within NTESMO currently, listing the Level 3 functions that fall under the competencies including how they are currently delivered. Where there are differences between the two model, adjustments have been made and incorporated in the text in the table below.

Table 4 - Corporate Service: Description of Level 3 functions

Level 2 Functions	Level 3 Functions	Current FTE to deliver
0.1 Management	0.1.1 Strategic Planning 0.1.2 Business Performance Management 0.1.3 Organisational Governance / Risk Management	Delivered via an implicit SLA
0.2 Human Resources and Training (System and Market Operator functions assumed to be here)	0.2.1 Planning, Recruitment, Remuneration 0.2.2 Employee relations, Training and Development, HR Operations and Systems 0.2.3 Operational training to System Operators / controllers 0.2.4 Market Participant training	Delivered via an implicit SLA * 1.2 FTE from System Control w.r.t. training to be assumed here
0.3 Asset Management, IT and OT Services (this is the function which assumes resourcing from *Maintain Operational Systems function in NTESMO's mode)*	0.3.1 IT Strategy, Governance, Architecture 0.3.2 DevOps and Maintenance 0.3.3 Cybersecurity and Infrastructure 0.3.4 Service support and Data Management 0.3.5 Manage SaaS platforms support and performance levels 0.3.6 Provide system maintenance and outage support via OT and ICT ticketing and service level agreement 0.3.7 Continuous improvement and change management	To be delivered via an explicit SLA (currently under development) *2 FTEs from System Control w.r.t. OT services to be assumed here.
0.4 Legal and Regulatory	0.4.1 Legal services and Contract Management 0.4.2 Regulatory Affairs	Delivered via an implicit SLA *0. FTE resourcing from Market Operations currently assume to perform the Regulatory function
0.5 Reporting, Compliance and Audit (this function assumes Compliance Monitoring function from System Operations)	0.5.1 Internal audit 0.5.2 Regulatory compliance 0.5.3 Compliance monitoring of power system operations	Delivered via an implicit SLA *0.8 FTE from System Control to be assumed here

Level 2 Functions	Level 3 Functions	Current FTE to deliver
0.6 Accounting and Finance	0.6.1 Financial planning and Analysis 0.6.2 Taxation and Financial reporting 0.6.3 Accounts and Payroll 0.6.4 Asset and Capital management	Delivered via an implicit SLA

5.3.2 Power System Operations

Benchmark

The Power System Operator function comprises of:

- System Planning and Modelling (Medium to long-term power system planning) function that focuses on generation and network capacity planning over a long-term horizon
- Operational Planning and Modelling (short-term operational planning) function responsible for the day-to-day system requirements and modelling the power system to operate securely, reliably, and safely
- Forecasting – which looks at demand and generation forecasts based on weather monitoring, receiving inputs from networks, generator participants, and other sources
- Catering to large connections (such as generators) into the power system, modelling their contributions, harmonics, and imbalances into the power system to determine connection standards and maintain system security
- Managing outage – generators and network (in some cases)
- Real-time monitoring and control of the power system to respond to changing supply and demand equation on a real-time basis (excl. network operations)
- Report the performance of the power system including security constraints, curtailment, outage durations.

NOTE: In some peculiar cases, where the utilities operate in a vertically integrated setup or as GOCs, the power system operator also performs network operator functions including switching and real-time monitoring of the network.

NTESMO

At present, of the benchmark functions, NTESMO performs almost all the functions, except for the *System Planning* function. While most of the functions listed are also the legislated functions of the System Controller in the NT, *System Planning* is not, yet. It is important to note that in our review it was observed that System Planning is currently being facilitated as an inaugural unregulated function within NTESMO funded by the NT Government for the specific purpose of delivering the inaugural RESIP.

In addition, NTESMO performs the Network Operator role on behalf of Power and Water under a SLA. This arrangement enables Power and Water to meet its legislated obligations as the Network Operator by leveraging NTESMO's existing control room infrastructure, systems, and personnel through regulated ring-fencing arrangements. The control room provides round-the-clock (24/7) monitoring and operational management of the NT's power system operations whilst observing the wholesale market prescriptions.

A summary of the current resourcing of the function is shown below. Refer to Appendix C for a detailed list. For clarity and simplicity of the NTESMO functional capability model, the network operator responsibilities have been separated into a distinct level 2 capability as shown in Table 5. NTESMO currently does not perform System Planning or Medium-Long Term Projected Assessment of System Adequacy (MT/LT PASA) as a regulated function and only performs Operational Planning or Short Term PASA (ST PASA). This has been reflected accordingly in the table below.

Table 5: Description of Power System Operation functions at NTESMO (Level 2 and 3)

Level 2 Functions	Level 3 Functions
1.1 System and Operational Planning	1.1.1 Receive information from participants (OTR's, operational data, performance issues) 1.1.2 Assess generator capacity and availability

	1.1.3 Assess ancillary services 1.1.4 Establish security and reliability requirements for operation 1.1.5 Issue system constraints (Risk Notices, Long Term advice) 1.1.6 Integrated System Planning 1.1.7 Power System Modelling 1.1.8 Update UFLS Scheme 1.1.9 Update Procedures (Black start, market related procedures)
1.2 Forecasting	1.2.1 Receive 3rd Party/In-house Real-Time System Load Forecasts 1.2.2 Assess accuracy of forecast (Not in Real-Time) 1.2.3 Adjust Forecasting Model (if required) 1.2.4 (Real-Time) - Publish Forecast information on Dashboard 1.2.5 (96 Hour) - Issue Notification to Generator Participants 1.2.6 (14 days) - provide access to relevant platforms and manage credentials 1.2.7 (1 year) forecast- outlook report (Integrated System Planning)
1.3 Connections	1.3.1 Receive New Connection Application 1.3.2 Contribute to Connection Studies and Assessment (Provide Dispatch Scenarios) 1.3.3 Assess suitability of requested negotiated access standards 1.3.4 Contribute to Functional Specification Assessment 1.3.5 Review and Approve Operating Protocol 1.3.6 Review Commissioning Compliance and Test Plan 1.3.7 Perform Dispatch Testing 1.3.8 Assess Test Results 1.3.9 Complete Reliability Run
1.4 Outage Management	1.4.1 Process incoming plant outage requests (OTR/Preliminary/Annual Forecast) 1.4.2 Perform security assessment and risk analysis 1.4.3 Establish risk mitigation measures and constraints 1.4.4 Issue Risk Notification to relevant stakeholders (including concurrent Generator/ Transmission outages/ Restrictions) 1.4.5 Issue non-reliable notices to relevant stakeholders 1.4.6 Maintain outage records
1.5 Real-Time Monitoring and Control	1.5.1 Review various inputs (e.g. pre-dispatch, dashboard info, risk notification) 1.5.2 Perform Real-Time monitoring of power system (SCADA - capacity, system load rate of change, contingency sizes) 1.5.3 Assess system operating state (satisfactory, secure, and reliable) 1.5.4 Assess required actions to optimise system performance 1.5.5 Perform generating unit commitment or dispatch adjustment 1.5.8 Log decisions and actions (Grad 2 log)
1.6 Compliance monitoring (moved to Corporate Services to aggregate the function – in the benchmark model)	1.6.1 Review various inputs (events, incident reports, operational reports, performance issues) 1.6.2 Produce annual audit schedule 1.6.3 Audit System Participants 1.6.4 Identify Participant non-compliance actions
1.7 Performance Reporting	1.7.1 Review data (Maximo, SCADA data, controller logs) 1.7.2 Assess and classify events or anomalies 1.7.3 Consult with System Participants (RFQ, investigation, corrective action if applicable) 1.7.4 Issue operational reports (internal operational parameters, monthly KPIs) 1.7.5 Issue Incident Reports to UC and System Participants 1.7.6 Issue 6 monthly Performance Reports (UC) 1.7.7 Monitor and report on progress against recommendations
1.8 Operational Training (moved to Corporate Services to aggregate the function – in the benchmark model)	1.8.1 Operational training
1.9 Network Operation (This has been changed from NTESMO's model's *Real-Time Monitoring and* Control to align with benchmark) (SLA within ring-fencing guidelines to provide these services to Power and Water)	1.9.1 Perform network switching or adjustment 1.9.2 Process Outage/Testing Request and Return to Service paperwork (Planned and Unplanned)

5.3.3 Market Operations

Benchmark

A typical market operator's functions vary slightly with the market structure – whether energy-only (like NEM or ERCOT in Texas USA) or capacity markets (like the WEM or PJM in Pennsylvania in USA). The benchmark functions we have chosen for this functional group are as follow:

- Participant Support and Market Registration: A market operator is required to onboard a participant with suitable training that enables them to comply with any dispatch notice or other notices (risk notices, Lack of Reserve notices, Underfrequency Load Shedding notices, Emergency Backstop Mechanism notices) in order to run the market (and power system) effectively. It also has the market operator receive, review, register, and approve all technical, identification, commercial, and parametric data such as commissioning and testing data for participants, compliance and test results, and market registration data.
- Dispatch Scheduling: A market operator coordinates electricity dispatch by optimising bids, balancing supply and demand (forecast or real-time), and ensuring system reliability. They use economic dispatch processes to select cost-effective generation while maintaining transparency and security.
- Market Information function provision of market information by collecting, analysing, and disseminating data on market conditions, prices, and system performance. This ensures transparency, helps participants make informed decisions, and supports efficient market operations.
- Settlement function involves calculating financial charges and credits based on market participation. It ensures accurate payments for energy transactions, ancillary services, and other market activities, maintaining transparency and fairness in the financial aspects of the electricity.
- Supply Procurement – how electricity is brought to meet demand – is shaped by who is responsible for ensuring enough supply (obligation) and by jurisdictional policies. The way obligations are assigned to different players, such as retailers, generators, or a central body (like NTESMO), determines how supply is secured.
    - If retailers are responsible for capacity obligation, then a system is needed to check if they are meeting that obligation, to handle shortfalls in supply and to recover costs.
    - If a central authority (generally linked closely to the system operator) handles supply, they can also manage other services like ESS more efficiently.
    - If a generator, especially a Government Owned Corporation (GOC), which is the current model in the NT, hold this responsibility, then retailers do not have to ensure supply however making it harder to connect supply responsibility to retail electricity prices.

  For the benchmark and the purposes of this review we will consider the case where the central authority is responsible for this function. [redacted]
- System Development and Implementation function looks after the business need to continually evolve and improve the systems and tools that the market operator uses to run the dispatch process efficiently, economically, and in a coordinated manner including being cognisant of system security and power system considerations.
- Market Rules function within a market operator is responsible for supporting the governing body responsible for establishing these rules in developing, refining, reviewing, and evolving the Rules in alignment with evolving market conditions. This function also sets out the market procedures based on Rules and administer the Rules and procedures ensuring participants follow these.
- Government and Industry Liaison function serves the purpose of stakeholder management and consultation. This engagement is with government and regulators in relation to the matters of power system and market operation for any policies, reforms, regulations, and impacts. Engagement with the industry including market participants (new and existing) to facilitate smooth, transparent operations, and consult on changes to market rules and procedures that are required for ease of market operations.

NTESMO

As discussed in Section 2.1, NTESMO is the Market Operator in the I-NTEM and is responsible for facilitating the market operation of the NT electricity market. However, an electricity market in its conventional sense does not exist in the NT. Rather, generators and retailers have existing bilateral off-market contracts which NTESMO does not have visibility of.

Generators submit their capacities for a 30-minute time interval for the day-ahead based on their generation output forecasts and any scheduled plant outages. NTESMO receives these generator offers and runs it within a constraints equation formed by the inputs from demand forecasts, network and plant outages, known network constraints, and other power system requirements, largely on MS Excel spreadsheets. Manually performed optimisation and system balancing yield a merit order stack that contains a list of generators and associated capacity that those generators are then scheduled for. The generators are then notified of this schedule to allow them to prepare and be called upon for dispatch at their scheduled slot the following day.

The benchmark model notes a major function of the market operator being *Supply Procurement* in one or other forms noted and highly dependent on the clarity of policy settings. However, the chosen model, i.e., centralised model, is a function that NTESMO is currently not required to perform. The proposed reform[42], [redacted] as considering Centralised Procurement of supply. In addition, the *Market Rules and Government and Industry Liaison* functions are also not prescribed functions as part of NTESMO's remit at present and are contingent on the reform initiatives by the Government. Thus, these functions have been excluded from the table below that describes NTESMO's current functions.

Table 6 below shows a summary of the current functions that NTESMO performs and associated resourcing. Refer to Appendix C for a detailed list.

Table 6 – Description of NTESMO's market operation functions (Level 2 and 3)

Level 2 Functions	Level 3 Functions
2.1 Participant Support and Training (changed in the benchmark model)	2.1.1. Receive Participant queries 2.1.2 Respond to Participant queries 2.1.3 Procedural Consultations
2.2 Market Registration and Standing Data (changed in the benchmark model)	2.2.1 Receive Preliminary Market Registration and Standing Data 2.2.2 Review and approve for Preliminary Registration (Commissioning and Compliance Testing) 2.2.3 Receive Final Market Registration and Standing Data and Compliance Testing results 2.2.4 Review and approve Market Registration (commercial operation) 2.2.5 Receive updated data 2.2.6 Review and approve Market Standing data
2.3 Pre-Dispatch Scheduling (changed from *Dispatch Scheduling* in the benchmark model)	2.4.1 Receive Offers from registered Generator Participants 2.4.2 Process offers in Dispatch Pricing Tool 2.4.3 Produce the Pre-Dispatch schedule 2.4.4 Issue pre-dispatch schedule to Generator Participants and Control Room
2.4 Market Information	2.4.1 Receive previous trading day data (generator output files, Grade 2 log, OTR and RTS) 2.4.2 Receive Actual Constraints 2.4.3 Review and resolve security constraints 2.4.4 Issue market information to stakeholders 2.4.5 Investigate operational errors 2.4.6 Complete identified corrective actions
2.5 Settlements	2.5.1 Receive data inputs (e.g. MDE files) 2.5.2 Check for missing data 2.5.3 Manage customer churns 2.5.4 Liaise with Network Operator to rectify missing data 2.5.5 Run market settlements 2.5.6 Issue market settlements (Preliminary, Final, 13-week, ad-hoc) 2.5.7 Liaise with Participants to resolve data discrepancies
2.7 System Development and Implementation	Refer section 5.3.4

As part of the reform proposed in the NT electricity market (introduced in May 2015 with the I-NTEM, subsequently evolving to I-NTEM 2.0, then replaced by the NTEM Priority Reform Program in June 2020, which was then replaced by the TEM Reform in 2024 – currently being reviewed and possibly amended), NTESMO has had resourcing provisioned

[42] Territory Electricity Market – Overview Paper, Department of Industry, Tourism, and Trade, Northern Territory Government. February 2024 [redacted]

within to manage, coordinate, plan, implement, and operationalise reform initiatives as well as deliver regulatory amendments to the existing technical codes and sub-ordinate procedures. These resources comprise of experienced senior-management with direct background in power systems engineering, electricity market regulatory affairs, reform programs across the NEM and WEM, and experience in system and market operations organisational development complimented by mid-junior level resources with a technical and project coordination background.

The Regulatory and Market Reform Team within NTESMO has been temporarily re-purposed and deployed to facilitate NT Government's direction to develop and expedite the inaugural RESIP over a two (2)-year period from 2023 to 2025 and foreshadow the establishment of a regulated function to undertake whole-of-system planning and centralised investment development for the regulated power systems.

We note that the current NTESMO functions do not include three functions from the benchmark model. However, certain functions within the Market Rules function have been given effect from within NTESMO at present that covers rules, procedures, and guidelines. These functions are central to a market operator's role and are likely to form a part of NTESMO's future [redacted] We have expanded on these functions in Table 7 .

Table 7 - Benchmark functions of a market operator (not performed by NTESMO currently)

Level 2 Functions	Level 3 Functions
2.6 Supply Procurement	2.6.1 Capacity tenders and auctions 2.6.2 Contract management 2.6.3 Supplier qualification, bid evaluation, and selection 2.6.4 Supporting settlement of procurement agreements
2.8 Market Rules	2.8.1 Draft and implement market procedures 2.8.2 Review efficiency and efficacy of TEM Rules and propose amendments 2.8.3 Supervise participant compliance with Market Rules 2.8.4 Develop market participation guidelines
2.9 Government and Industry Liaison	2.9.1 Engage with Government agencies 2.9.2 Coordinate policy development 2.9.3 Conduct industry consultation and forum 2.9.4 Provide regulatory updates / monitor legislative changes

5.3.4 Control system development projects

There are several projects and initiatives underway within NTESMO, all of which form part of its core operations – either in enhancing current functionality and capability or in adding new capability in response to the changing nature of the business owing to an increasing share of Distributed Energy Resources (DER) in the power system coupled with substantial uptake of grid-connected inverter based resources such as BESS and utility-scale solar PV generators. These project and initiatives are listed in Table 8 below identifying the projects related to the Reform agenda and those that are enabling.

Table 8 – Current projects initiated and ongoing at NTESMO relating to developing some future capability

Package	Project	Description	Related to reform / Enabling	Revenue Source
Territory Dispatch Engine (TDE)		Market Management System (MMS) to determine and implement an integrated and systematised technology solution to modernise the antiquated tools and systems on which NTESMO relies (primarily MS Office spreadsheets and templates) to: • Enable scalable scheduling and dispatch of renewable generation • Manage increasing power system instability (capacity volatility resulting from the connection of renewable generation and demand volatility resulting from uptake of behind the meter solar) • Establish new electricity market management capabilities that	Extremely related, given the MMS allows the dynamic and optimal management and enhances responsiveness of the Market Operator function by relying less on manual processes and using a machine-learning optimisation platform (like NEMDE that AEMO use in the NEM) for market operations. This will allow meeting the Reform objectives to allow a secure, safe, reliable power system operations.	Derived solely from UC determination (and confirmed by NT Government approval of the Statement of Corporate Intent and related approval processes)

Package	Project	Description	Related to reform / Enabling	Revenue Source
		operationalise progressing NTEM reform outcomes		
Transitional Tools	C-FCAS	This tool is to sensitise the contingency reserve requirement to the operating circumstances of the power system as opposed to a static requirement	Enabling	Derived solely from the UC determination (and confirmed by the Power and Water delegated financial authority approval process)
	Real Time System Security Monitoring Tool (RTSSMT)	This tool allows real-time system security monitoring to ensure that system control and dispatch functions are suitably adjusted in practice to maintain real-time power system balance	Related	
	DKIS BTM Forecasting	Enhance the functional capability of the forecasting processes	Related	
	Regulation Reserve for Large Solar	Enable quantification of the additional reserve requirement to ensure a firm contribution of solar to the dispatch solution with a probabilistically determined limit	Related	
	Proportional Energy Dispatch (PED, RT1)	Enhance existing dispatch process to proportionally allocate the dispatch quantifies across solar facilities that are represented equivalently in the merit order i.e. a tie break process. Primarily applied for security constrained dispatch	Related	
	Outage Planning Module		Enabling	
	DER Backstop Mechanism (AS/TC)	This is an emergency response triggered when DER is seen to service close to 50% of the underlying demand, i.e., during minimum system load (MSL) events in order to protect the power system from collapsing due to any sudden shifts in uncontrolled solar generation and manage reverse flows by curtailing DER	Enabling	
Energy Management System (EMS)		EMS is a set of tools combining software and hardware that is used to monitor, control, and optimise energy flow including real-time monitoring to track power flow and system status continuously, optimisation algorithms to enhance energy efficiency, and integrated seamlessly with SCADA and ADMS	Enabling	Hybrid between AER and UC determination - AER approves the bulk of this revenue; with UC determining revenue for EMS aspects that relate to power system control
Distribution Management System (DMS)		DMS is a software platform that will help NTESMO-operated network manage and optimise their distribution networks. It is used for real-time monitoring, control, network analysis, and outage management, enabling reliability and efficiency improvement	Enabling	

5.4 Resourcing methodology

Resourcing can be expressed in one of two ways – headcount or FTE (Full-Time Equivalent). Headcount means the total number of individuals employed or contracted, regardless of whether they work full-time or part-time. Each person counts as one, no matter their hours. An FTE on the other hand is a unit that represents the workload of an employee in terms of a full-time schedule. For example, 1 full-time employee will be counted as 1 FTE, 2 half-time employees will equate to 1 FTE, and an employee working 80% of full-time hours will equate to 0.8 FTE.

A functional review, which assesses staffing levels, efficiency, and resource allocation, must be based on FTE, not headcount. This is because FTE reflects actual capacity accounting for how much work is being done / is required to be done, not just how many people are employed. Headcount can be misleading in this respect as a team of 10 part-time staff may only equate to 5 FTEs, which is a very different resourcing picture.

Headcount and FTE should not be confused or used interchangeably. Capacity based conclusions must only be drawn based on the FTE requirement ensure accuracy.

6. Functional capability assessment

This section focuses on reviewing NTESMO's capability (skills and systems) and capacity (resourcing and headcount) for the functions presented in Section 5 using the benchmark model as the basis to guide the functions required of a system and market operator. We have split the functions into current state functions (those functions that NTESMO currently performs) and future state functions (those that are likely to become part of NTESMO's remit) through reform or by natural evolution of power system and market operation.

The capability assessment evaluates NTESMO's readiness to deliver each Level 3 function holistically, incorporating contributions from all relevant teams, and identifies areas where enhanced capacity or development may be required to meet future operational and strategic demands.

6.1 Framework and methodology

This review assessed NTESMO's ability to perform its operational and market functions across both current and future states by applying a bespoke functional capability framework. The framework is designed to evaluate the readiness of NTESMO to meet increasing system complexity and reform demands through a multi-dimensional lens: People, Process, and Technology (PPT).

- People: Assesses individual job design, effectiveness, skills, experience, training, staffing levels, management and leadership, ensuring NTESMO's capability to manage operations effectively and adapt to evolving demands, enhancing overall capacity and performance.
- Process: Evaluates operational efficiency, compliance, and continuous improvement in the context of available systems and tools and how they are developed, implemented, and utilised ensuring systems, tools and processes can be used and developed efficiently with clear communication pathways between functions.
- Technology: Assesses systems and infrastructure availability, robustness, relevance in meeting organisational requirements, and innovation, ensuring NTESMO's capability to leverage advanced systems and protect data, enhancing overall market reliability and efficiency. As the mix of generation and technology evolves, and as operation and dispatch of the market systems changes accordingly, adaptable systems will be needed.

These three themes are disaggregated into fourteen (14) dimensions which are in turn made up of twenty-eight (28) capability areas. A summary of the assessment framework is listed in Table 9 below.

Table 9 - People, Process, Technology assessment framework

Theme	Dimension	Area
People	Individual	Individual job design
		Personal effectiveness
		Analytical and problem solving
		Experience and standing
		Influencing and advocacy
		Commitment and passion
	Team	Staffing level
		Team members
	Leadership	Leadership effectiveness
	Management	Management
		Senior management team
Process	Strategic / Growth	Monitoring of external environment
		Strategic planning
	Resource Management	Human resources planning
		Personnel development and retention

Theme	Dimension	Area
		Performance analysis and adjustment
		Use of organisational processes
		Knowledge management
	Financial	Financial planning and budgeting
	Operational	Operational planning
		Decision making framework
		Organisational structure
Technology	Functional Tools	Systems/software used to deliver the function
	Data Management	Availability, structure, and usage of data
	System Integration	Linkages across internal platforms
	User Support and Accessibility	Usability, access, training
	Security and Resilience	Cyber, continuity, reliability
	Analytics and Intelligence	Insights, forecasting, metrics

Our approach involved applying a structured set of questions and an associated scoring system across these three themes. The scoring system ranks NTESMO's functional capabilities on a scale from 1 to 4, based on our assessment of the following levels of maturity:

1. Need for increased capability
2. Basic level of capability
3. Mature level of capability
4. Full capability

Given the challenges in precisely quantifying capability, the scoring system is designed to identify areas for additional focus and potential improvement along with recommendations. Capacity assessment has been performed in a qualitative manner, given the absence of specific resourcing information at the benchmark organisation (AEMO – WEM). A critical mass of capacity required by function, based on the complexities involved in meeting regulatory obligations currently and the evolving needs of the future (both from a transitioning system and market reform perspectives) were assessed. Furthermore, our engagement with key personnel at NTESMO during the course of this review has added to shaping the capacity assessment.

Our evaluation was informed by in-depth interviews with accountable personnel for each function. The comprehensive nature of these interviews allowed us to cross-check and validate the statements made by personnel regarding their functions. Through this approach, we have developed an overall assessment of capability within each function and formulated recommendations based on NTESMO's current stage of development.

6.2 Benchmark, Current and Future State Context

To support the assessment of NTESMO's functional capability, we have examined the current and future state of each function in comparison to industry benchmarks. The analysis provides insight into how NTESMO's capabilities align with peers and the evolving expectations within the sector. The assessment is presented across three key lenses: benchmark, current state, and future state, as outlined below.

- **Benchmark** includes commentary around what scoring levels of capability (need for more / basic / mature / full) exists across benchmark organisation(s).
- **Current state** includes NTESMO's current state description vis-à-vis a function being assessed, challenges, and relevance of current scoring in a holistic manner with narrative for where anomalies (higher or lower than benchmark) exist. This assessment puts the current capabilities (skills and skill-level, processes, systems) and capacity (resource allocation, headcount) to perform the function today in today's context and environment that

faces NTESMO's operations every day, where DER penetration and utility-scale inverter-based resources are increasing, power system security is threatened, generation capacity is depleting, reliability is uncertain beyond 2028[44], and an uncertain reform is pending.

- Future state includes an assessment of NTESMO's future, in the context of what the future looks like with even increased DER penetration (constrained network, frequent minimum system load events, intermittent generation impacting forecasting accuracy) and a reforming market (separation, centralised supply procurement, central system planning, transition from virtual to physical settlements). The assessment then captures NTESMO's capability to effectively perform each function in the future state

6.3 Overview

Currently, NTESMO is a part of Power and Water. This means NTESMO does not have a separate corporate, administrative, and technology functions as part of its organisational team. It operates as a ring-fenced business unit of Power and Water, on the basis that respective functions from Power and Water are also responsible for corresponding NTESMO's functions. As part of, now obsolete, TEM Reform initiatives, NTESMO was being considered to separate from Power and Water and operate as a statutory entity. To do so, NTESMO will require a suite of corporate, administrative, and technology / systemic functions to be added to its operations.

While NTESMO seems to currently be performing its functions, it is susceptible to breaching its regulatory obligations and hitting the performance metrics with regard to compliance. [redacted] uring engagement with several NTESMO personnel it was found that power system security is increasingly becoming difficult to maintain without breaching the SCTC requirement to operate in *security constrained economic dispatch* basis. NTESMO's current capability is limited to power system control and virtual market operation (of the DKPS). The nature of operation can't be fully equated to that of a typical system and market operator; it is rather a subset. Consequently, the capability and capacity within NTESMO today are reflective of the minimum viable capacity and skillset required to get by.

The need to uplift capabilities and capacity has drivers that are either the reform program or the changing operating environment in which NTESMO operates. An example of an instance of a reform driver is the potential evolution of the settlement framework such as the transition from a virtual settlement market to financial cash settlement market effectively rendering NTESMO to become a clearing house. This would necessitate the passage of enabling head of power in legislation. Any capability uplift of NTESMO would only be required in proportion to the timing of when the head of power would come into effect and also the revised draft of the updated version of the SCTC (that are expected to be referred to the TEM Rules in the future).

Another area of required capability uplift is the ability to effectively run a constraint co-optimised dispatch solution (as inferred from the Territory Dispatch Engine Business Case). This is a consequence of the evolving operating environment in which NTESMO operates and the present systemic inadequacy. Deductive logic dictates that this may be a major reason that is adding to NT's system costs (by being unable to schedule the most economically optimal generator to maintain power system security) and increasing consumer bills.

6.4 System Operations

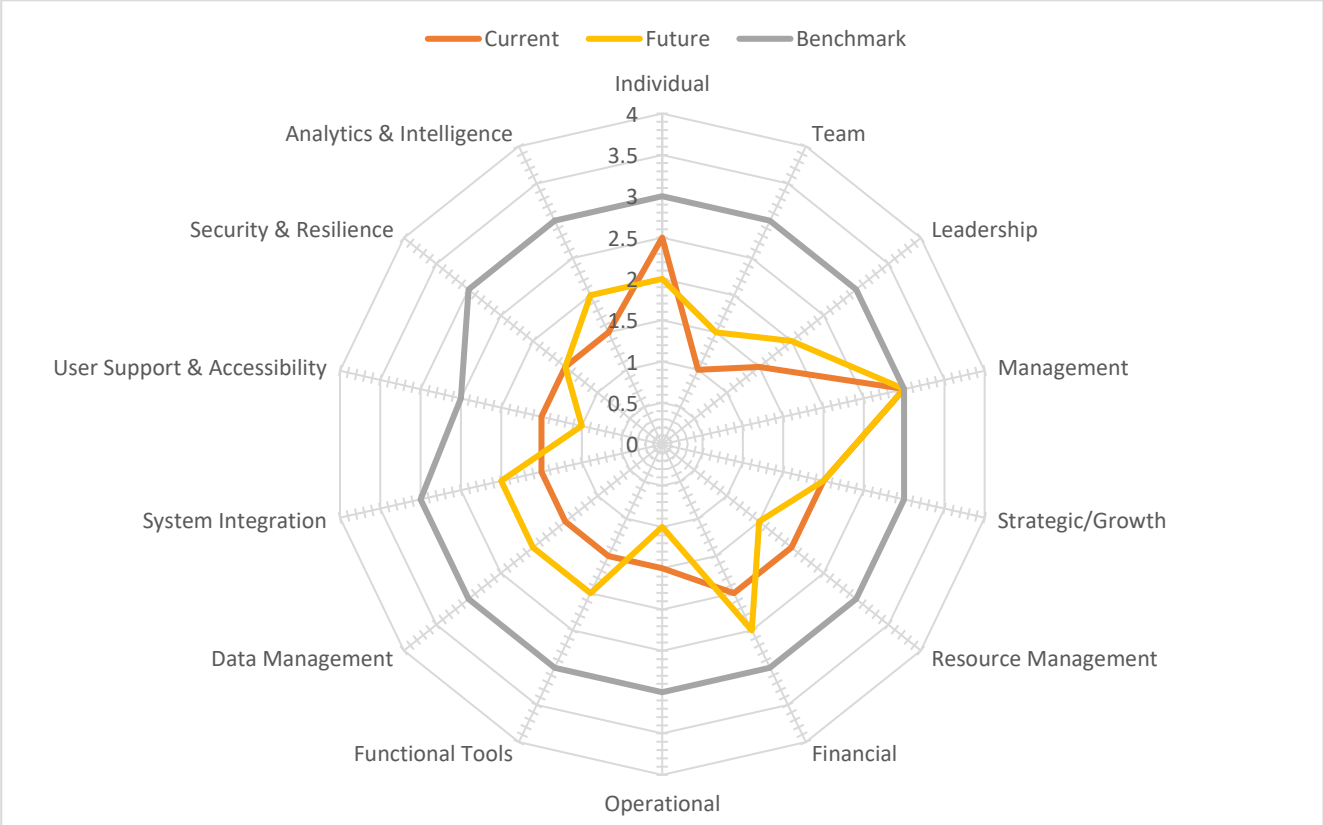
NOTE 1: As discussed in depth in section 5.3.2, NTESMO doesn't currently perform *System Planning* (MT-LT PASA) rather, only performs *Operational Planning and Modelling* (ST PASA). MT-LT PASA focuses on the medium-term horizon, typically covering a period of two (2) to ten (10)-year horizon whereas ST PASA focuses on the short-term horizon, typically covering a period of up to 6 days and uses more granular, real-time data. Based on the indication from latest reform initiatives [redacted] it is expected that NTESMO will likely be required to expand their function to include MT-LT PASA. Therefore, the current state assessment for function 1.1 was performed for *Operational Planning and Modelling* and *System Planning and Modelling* for the future state assessment. For clarity, the benchmark includes System Planning.

[redacted]

NOTE 2: As discussed in section 5.3.2, NTESMO also performs a network operator function under an SLA with Power and Water. This function has been split out from NTESMO's functional model and assessed separately as a distinct function. Similarly, *Connections* function is a licensed network operator function which NTESMO performs under an SLA.

6.4.1 Operational/System Planning and Modelling

Figure 7 - 1.1 System (future) / Operational (current) Planning and Modelling capability



6.4.1.1 People

NTESMO's current People capability in System / Operational Planning and Modelling is supported by technically skilled individuals, but its maturity is impacted by relatively junior resourcing (contracted undergraduate resource), high attrition risk (a trained power systems engineer departing), and a structural vacancy in team leadership (Team Lead – Modelling). Individual and management dimensions score higher in the current state owing to a robust job design and seniority in management that makes up for the lack in leadership within the team. Consequently, team and leadership are rated low owing to vacancies. .

Leading operators such as AEMO (WEM/NEM) operate distinct operational and system planning streams, each with dedicated senior engineers, long-term scenario modellers, and defined roles in PASA cycles. Job clarity, cross-training, and resourcing continuity are embedded.

As for the future state scores, the assessment assumes that the System Planning function (once formally adopted by NTESMO as a result of reform implementation) will be a part of NTESMO's remit. NTESMO scores lower than current state in most areas except management. Individual scores lower given a lack of capability required for carrying out MT/LT PASA modelling for the system planning function, as it would be the first time NTESMO would be performing this function. The team, however, scores slightly better than current state as overall resourcing increase will occur within this function owing to an expanded function of system planning. Subject to the complexities of how frequently system planning will be required to be updated and to what extent, it is expected that the modelling and power systems engineering resources will have capacity peaks and troughs through a given period of time. This means the MT/LT PASA specific resources might be flexibly deployed for operational planning requirements as an ongoing

requirement during low demand periods of the system planning aspect of this function. Manager Electricity Reform and Implementation joins this team for the System Planning aspect of this function, effectively maintaining scores in the management leg. Leadership scores have been assessed to improve based on the assumption that the current management provides team leadership capability as well or one of the senior resources is developed into taking a leadership position.

Table 10 - System / Operational Planning skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
6.5 FTE	9.8 FTE (see Appendix C for detailed allocation)	Given the function is likely to expand from Operational to System Planning additional resourcing is required to perform that function. Additional resourcing required for this function is in terms of the following capability: **Senior Power System Engineer** (LT PASA) background to support with RESIP (or System Plan) development **Senior Analyst/Modeller** with an economics background, capability to perform/interpret forecasting, data analysis, techno-economic modelling, and interpret/understand long-term system planning	**Power Systems Engineering** incl. software tools (for grid modelling), **data analysis, forecasting, and techno-economic modelling =** including specialised planning tools (for scenario planning), **energy markets knowledge** (for supply and demand modelling), **regulatory compliance** understanding

6.4.1.2 Process

NTESMO's current operational planning processes are moderately effective for short-term planning, but lack structural maturity for long-term reliability modelling, formal consultation, and cross-functional coordination.

Benchmark operators (e.g. AEMO WEM) operate documented, scenario-driven PASA cycles linked to forecasting, generator availability, and planning timelines. These are supported by structured outage integration, investment plan alignment, and internal QA processes.

In the current state, NTESMO's scores vary widely. Strategic planning capability remains basic owing to a hung policy environment for over a decade now since the I-NTEM was initially established. There seem to be no internal feedback loops from forecasting, dispatch, or performance monitoring outputs that can be fed back to improve the outputs from this function as indicated by the operational dimension. Financial planning and resource management score similar given reactive responses to both in the current state.

In future, structurally, an elevation is expected (as System Planner role formalises). However, scores remain low capability wise because of the lack of defined end-state PASA process or procedural roadmap, there is no automated coordination between outage scheduling, system adequacy forecasting, and procurement signal generation (if and when Supply Procurement also becomes a function), and performance monitoring and feedback loops (for example, forecast deviation tracking, constraint learning) remain theoretical. The only uplift in capability comes from financial planning owing to the assumption that the addition of system planning function will come with additional budget allocation toward this function. However, this requires a change in the regulated function to reflect this change and the UC approving an increased cost recovery

6.4.1.3 Technology

Technology is a critical weakness in this function currently but expects some improvement in the future owing to TDE deployment, when it occurs.

Mature operators deploy integrated PASA platforms, with linkages to real-time SCADA, outage management, TNSP models, and dispatch engines. These systems enable constraint-aware simulation, long-horizon forecasting, and automated documentation.

In the current state scores are low across all dimensions reflecting heavy reliance on spreadsheets and unconnected modelling tools, no automated data integration with forecasting, dispatch, or RESIP tools, and manual data cleaning, validation, and event logging.

As for the future there is modest uplift expected, driven primarily by assumed TDE, EMS upgrade, and transitional tools' deployments (e.g. RTSSMT, PED). However, first-time deployment risks and limited internal configuration capability limit the pace and effectiveness of system adoption. Proposed integrations and technology / tool deployments provide knock-on effects on this function in future with regard to the systems capability. This is reflected in higher than current scores in the capability.

Systems

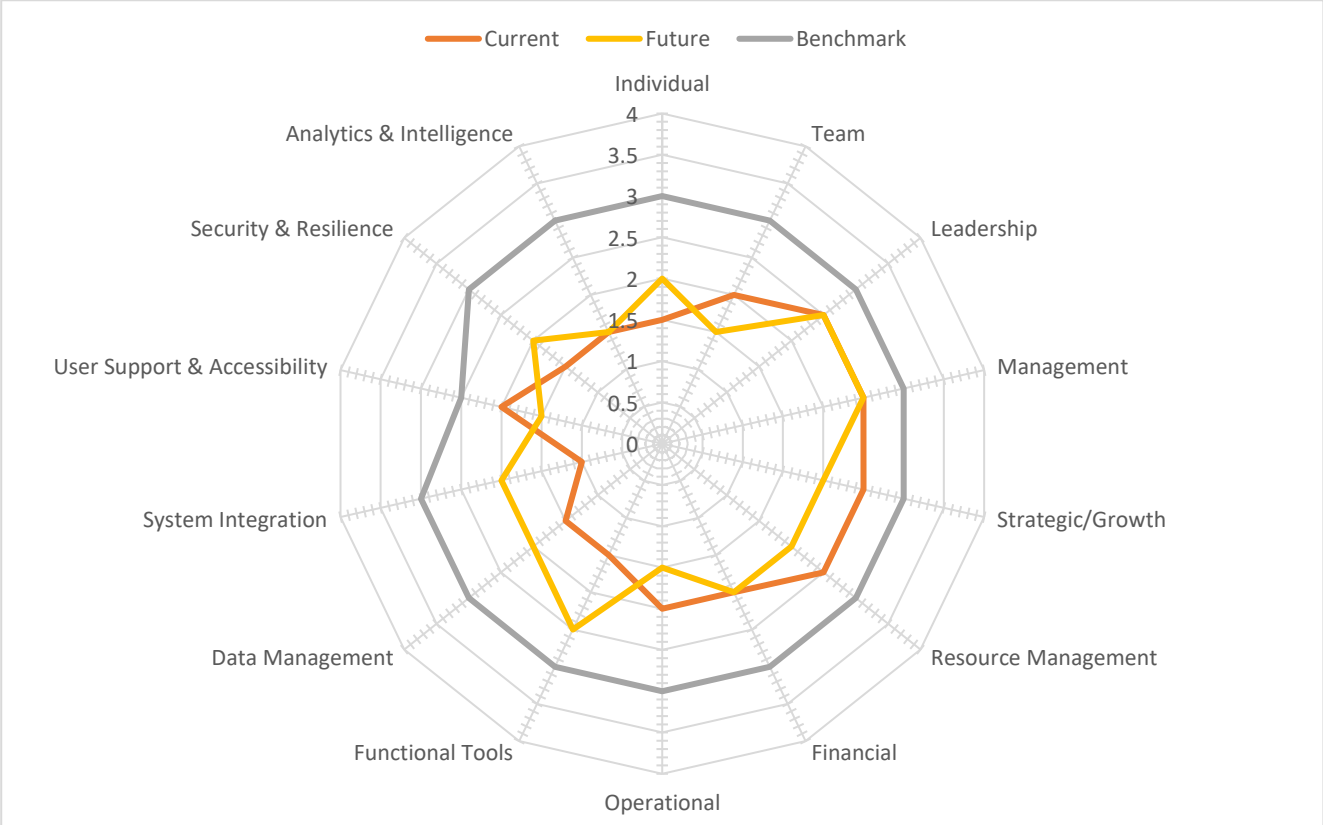
Operational and System Planning is one of the most systems-dependent functions in a maturing power system and market operator. The future state of this function, particularly if NTESMO is to take on statutory System Planner responsibilities, requires a significant uplift in both planning-grade tools and integrated system architecture. This is proposed as part of the wider TDE project which is subject to final approval at present. If approved, it has the ability to provide systemisation of operational planning allowing transitioning away from processes that are largely manual managed from within using folder structures and emails.

Table 11 - Systems requirements for Operational / System Planning function

System	Purpose
System Planning and Simulation Platform	Enables deterministic and stochastic modelling of the power system under multiple demand, generation, and policy scenarios. Supports the development of 10-year RESIP and reliability adequacy assessments.
Scenario Engine / PASA Workflow Tool	Allows the creation, scheduling, and tracking of ST/MT/LT PASA simulations. Facilitates the integration of constraints, outage forecasts, generator availability, and reserve adequacy across varying time horizons.
Forecast–Planning–Dispatch Integration Layer	Links planning outputs to demand forecasts, dispatch constraints, outage schedules, and procurement triggers. Enables real-time feedback loop into planning models and analytics dashboards.
Geospatial System Map with Asset Layering	Visual platform to overlay network assets, generation plant, outage zones, and DER regions. Enhances outage impact analysis, constraint forecasting, and scenario visualisation.
System Constraint Builder and Validator	Tool that auto-generates technical constraint equations (thermal, voltage, ramp rate) based on real-time inputs and RESIP scenario assumptions. Can be integrated into TDE or outage planning module.
Data Lake and Analytics Platform	Central data repository that consolidates SCADA, forecast, dispatch, planning, and event datasets. Enables multi-year scenario analysis, historical performance benchmarking, and risk profiling.

6.4.2 Forecasting

Figure 8 - 1.2 Forecasting capability



6.4.2.1 People

In mature operators like AEMO or PJM, forecasting teams consist of dedicated meteorologists, data scientists, and energy modellers who collaborate across forecasting horizons. Staffing levels are well-structured, with clear roles for short-term, medium-term, and long-term forecast windows. Teams benefit from diversity in expertise—spanning electrical engineering, statistics, and climatology—with senior roles offering technical leadership and mentoring pathways. Cross-skilling between forecasting and dispatch or planning functions is actively fostered.

NTESMO's forecasting team has successfully delivered a significant uplift in the underlying methodology and system to deliver NTESMO's Forecasting function albeit that the forecasting team comprises junior engineers. While there is strong commitment and day-to-day delivery, capability is concentrated in a small number of individuals with little depth or succession planning. Forecasting performance is a critical issue in a small, high-variability system like DKPS. Despite solid individual performance, the overall team capability sits at a basic level, constrained by junior resourcing and absence of senior analytics oversight. The senior resource available to this function is spread too thin across multiple operational facets.

In the future, assuming NTESMO will be required to adopt a more integrated system forecasting role under reform and increasing DER penetration, capability is expected to improve modestly across the individual and team legs given the reduction in manual processes, rather the skills required to be applied being informed decision-making. Although new systems may automate some tasks, the core skill gaps, are not automatically resolved by tools alone. Without targeted recruitment of data science, climate modelling, and energy analytics specialists, people capability will remain limited to basic operational forecasting rather than predictive or strategic analysis. The core requirement is a different set of skills and capabilities within this team.

Table 12 – Forecasting function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
1.8 FTE	2.2 FTE (see Appendix C for detailed allocation)	Current team within Electricity Market and Reform performs this function and will benefit from the increased automation and sophistication of the forecasting framework with the introduction of TDE. This will assist the capability of the team to expand forecasting activities to encompass harmonising forecasting to be used by the Utilities Commission, Power Services and NTESMO. However, additional capacity with data science and analysis skills would be useful to ensure effective functioning and catering for any future additions such as the R-FCAS function which is likely to be a part of this function's remit. Current team's skill-level is relatively junior and would need to be supplemented/replaced with senior, experienced resources for this function. Further clarity is needed on the associated processes, and the potential impacts on resourcing and technology requirements.	**Data analysis** (ability to analyse large datasets and econometrics), **statistical modelling** (familiarity with machine learning algorithms for forecasting), **software proficiency** (Python, R, specialised forecasting tools)

6.4.2.2 Process

Best-practice forecasting functions operate under formal forecast cycles, with structured review points, performance monitoring dashboards, and procedural coordination across generation, market operations, and system control. Error tracking, forecast bias review, and exception handling are routine. Forecasts are scenario-based and version-controlled, and internal processes include regular coordination with dispatch, compliance, and system planning.

Process maturity in NTESMO's forecasting function is limited. While operational timelines are met, there is a requirement for more formal processes for quality control, error tracking, or performance benchmarking. Coordination with dispatch and operational planning is informal and occurs via embedded knowledge (given the same team performs both Forecasting and Dispatch scheduling functions) or ad hoc exchanges (if perhaps a System Controller happens to communicate variations/fluctuations back to the team). There are no processes in place to assess the effectiveness of adjustments or to calibrate forecast models against performance outcomes.

Under a reform-aligned operating model, it is assumed that NTESMO will operate within a more formal forecasting framework, potentially as part of its System Planner obligations. In this environment, forecast process maturity is required to improve, particularly if a single system forecast (shared across NTESMO, UC, and Power and Water) is adopted. However, uplift will still depend on institutionalising forecast error tracking, automating workflows, and integrating DER generation visibility into forecast models. Process maturity will remain incomplete without deliberate design and resourcing of an interdepartmental forecasting function. New systems planned for deployment that would assist in carrying out this function would require robust processes and workflows to be implemented and that is when the capability would improve.

6.4.2.3 Technology

At benchmark operators, forecasting is underpinned by integrated platforms that include real-time weather feeds, DER telemetry, probabilistic forecast engines, and automated report generation. Tools like AEMO's Forecasting Models (5-Minute Settlements, ST PASA) operate through secure APIs, and are tightly integrated with SCADA, dispatch, and planning systems.

Currently, NTESMO relies on a mix of third-party tools and internally maintained spreadsheets to generate forecasts. There is little automation, no systemised error correction, and no integration with SCADA or real-time visibility of DER output. The technology environment lacks the robustness and repeatability required for high-accuracy prediction. Support for forecasting systems is externally sourced and issue response times vary.

In the future, technology capability is expected to improve with the rollout of functional package upstream of TDE that enables generation forecasting, system demand, behind-the-meter solar generation forecasting, and weather

forecasting. Forecast accuracy may benefit from these interweaved modules of the package that process data to forecast within reasonable limits and the integration of forecasting into dispatch tools will improve responsiveness.

A slightly different approach that could be considered to source short-term forecasts (hourly to weekly time horizon) could be via a software-as-a-service (SaaS) solution. This method is both scalable and efficient that provides a reasonable level of forecasting, especially for systems that are similar in size and context as that of the NT power system. If this solution is found to be fit for purpose, broader integration of the service into say Power and Water and the UC may also assist with a unified view of the forecasts, enabling a cohesive decision-making in the matters of the NT power system.

Systems

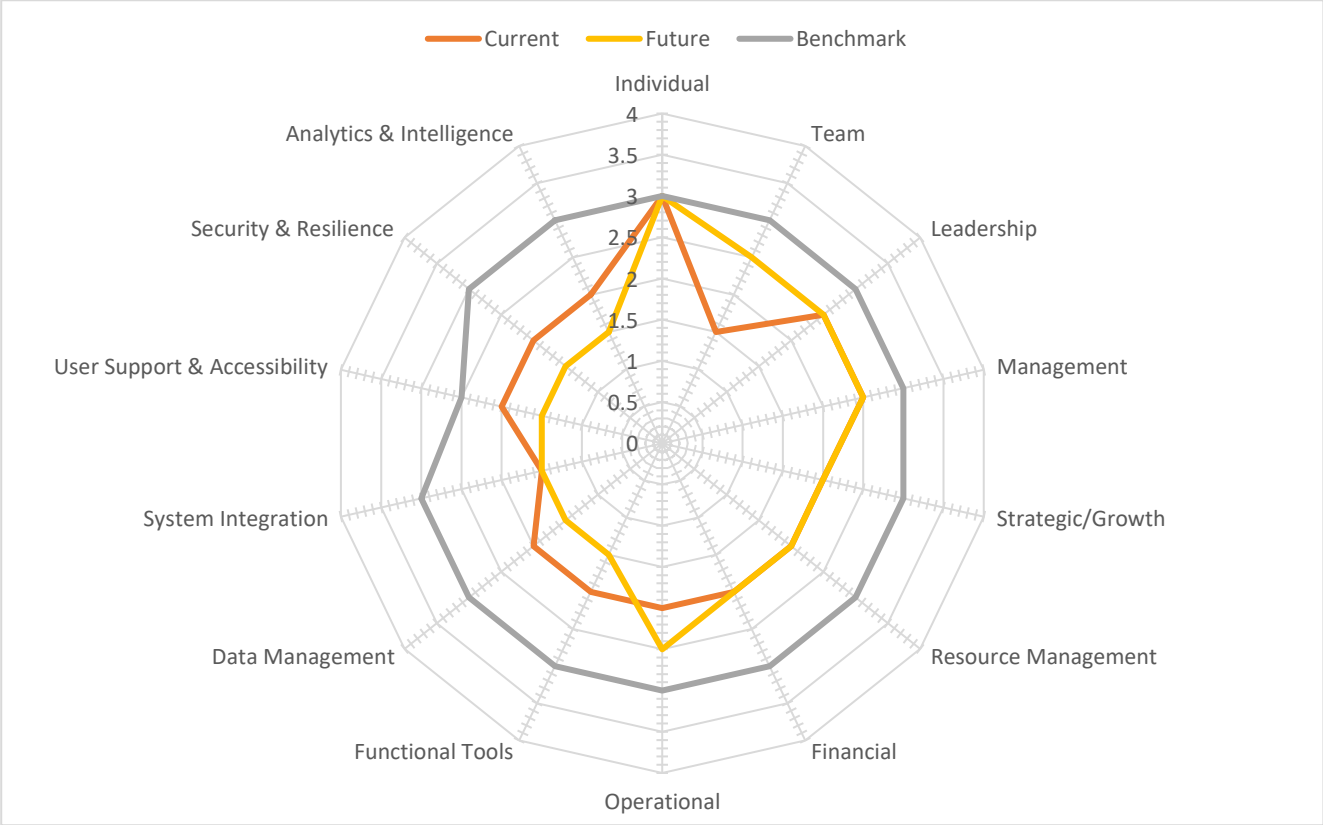
The Forecasting function at NTESMO is a critical enabler of system reliability, dispatch optimisation, and planning coordination—particularly under high DER penetration and real-time volatility. As NTESMO transitions toward a more formalised System Planner role, the need for platform-based forecasting infrastructure becomes foundational.

Table 13 - System requirements for Forecasting function

Systems and tools	Purpose
Integrated Forecast Engine	Core system to produce short-term, medium-term, and long-term (LT) forecasts across load, solar PV, and DER generation. Supports both deterministic and probabilistic forecasting methods.
Weather and DER Input Layer	Real-time integration of BOM data, satellite imagery, and rooftop PV telemetry. Informs load shape, cloud cover impacts, and minimum system load projections
Forecast Data Management System	Central repository for forecast inputs, versions, assumptions, and outputs. Supports version control, model tuning, and traceability across shared users (UC, Power and Water).
Integration to TDE, SCADA, RESIP	Ensures forecast outputs feed into dispatch merit order optimisation, real-time system security assessments, and planning adequacy assessments

6.4.3 Connections

Figure 9 - 1.3 Connections capability



6.4.3.1 People

In mature network or system operator environments, the Connections function is delivered by multi-disciplinary teams of power systems engineers, compliance officers, and regulatory advisors. Roles are clearly defined across the lifecycle—from application review, modelling, negotiation of access standards, to commissioning and performance sign-off. Benchmark operators maintain deep technical capability such as GPS compliance, harmonic analysis, often supported by project engineers and regulatory liaisons, with structured succession planning.

NTESMO's People capability for the Connections function is strong, especially with senior personnel in the team hitting the benchmarks scores with experience. However, resourcing is thin and fragile as, two of five positions are vacant, thus scoring low on the team front. This creates exposure to knowledge concentration and processing delays.

As the future state introduces reform-related change (e.g., potential increase in generator connections from centralised procurement or fewer generator connection given removal of renewable targets), People capability increases above the current state given lower resourcing requirement in the function but additional capability available. There is no indication of pipeline development or redeployment strategies to adapt to changes in workload. This could result in staff mismatch—either underutilisation if renewable targets fall, or workload saturation if procurement drives new GPS compliance and commissioning demands. Without structured upskilling or flexible reallocation planning (a viable solution could be to redeploy the resources into Supply Procurement function to enable technically sound procurement planning), the team risks under-delivering or being misaligned with reform-driven needs.

Table 14 – Connections function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required

4.3 FTE	4.3 FTE* (see Appendix C for detailed allocation) 2 FTE**,^ (2 FTE Sr. Connections Engineer)	Senior Power Systems Engineers are required for this function given the complexity of activities involved. *With scrapped renewable targets, the possibility of a large number of generators seeking to connect seems low warranting redeployment of resources. However, these could be redeployed into supply procurement – in the event of a reform that retains centralised procurement model.	Power Systems Design (ETAP, MATLAB, Python proficiency) Electrical Engineering (design and implement protective relays), regulatory compliance

*Assuming the vacant roles in the current state are filled this makes the resourcing at 4.3 FTE for this function. However, in the event of a reduced connections inquiries, subject to reform agenda implications, this function could do with a 2.3 FTE resourcing.

**In the event that policies are directed such that continued amount of connection applications are expected then the function would need to certainly fill the two vacant roles with same/equivalent skill levels as that of a Senior Connections Engineer bringing the resourcing to the original 4.3 FTE.

^In the event that resourcing is brought up to 4.3 FTE and then the workload reduces owing to external / policy-based factors, then the 2 resources could be re-deployed to another function, such as 2.6 Supply Procurement and 1.1 System and Operational Planning and Modelling.

6.4.3.2 Process

Leading operators (generally network operators, not system operators like those benchmarked for this review) manage Connections via mature, standardised processes that include detailed workflows, documented technical standards, interface with system planning and compliance teams, and regular reporting. Process maturity includes version-controlled documentation, automated compliance checklists, and integration with GIS/asset tools. Continuous improvement mechanisms are also present, informed by connection queue metrics, technical audits, and participant feedback.

NTESMO's process maturity is reasonably solid in procedural documentation and technical handling. The function is well-structured for day-to-day operational execution, but broader process areas such as strategic planning, risk management, and knowledge sharing remain limited. Processes are not deeply integrated with adjacent functions like forecasting or procurement. Most application workflows are semi-manual and vary by engineer or application type. There is no structured use of performance analytics or internal feedback loops. The current process score reflects basic but stable procedural execution.

In the future, process maturity improves marginally, not because of any specific improvements targeted within this function but by extension to all the associated systems and tools that are likely to be implemented across the organisation that would enable better, integrated workflows – thereby improving the operational aspect. As for this particular function, the assumption is that continued use of existing templates, with reliance on external resources for bulky power system modelling and simulations required for processing generator connection applications, is continued. If connection volumes reduce due to policy shifts (e.g. abandoned renewable targets), the function risks stagnation. Conversely, if connection processes evolve to include procurement-linked technical advisory or GPS evaluation, existing processes may need to be redesigned or augmented. No evidence currently exists for this evolution.

6.4.3.3 Technology

Benchmark operators maintain system integration between application portals, constraint models, planning tools (e.g. PSSE, DigSILENT), and commissioning databases. Connections are tracked through CRM or workflow management systems, often integrated with GIS and real-time system models. Commissioning and GPS compliance tools are standardised and interoperable with system planning and dispatch platforms.

Technology scores for the Connections function in the current state are stable and basic, purely owing to the relatively low volume of connection applications and the capability of existing systems to service the volume and complexity. While engineers use specialised platforms and other tools individually (in tandem with external contractor and

consultant support), there is no centralised application tracking system, no workflow automation, and no integration between modelling tools and dispatch or planning platforms. Application processing, document handling, and compliance verification are conducted manually or via disparate file shares. Technical modelling capability exists, but system maturity is weak.

Despite potential overlaps with new procurement roles, the new type of connections requests, such as BESS and other invert-based resource, are now starting to flow in larger numbers necessitating a shift in how connections modelling is carried out. Since there is no preparation for this change systems-wise, the technology scores remain modest in the future. There is no plan for integrated connections systems, nor any effort to standardise or digitise the commissioning process. Even in a reduced workload scenario, technical process efficiency and transparency will remain limited unless proactive system planning, integration, and workflow automation are addressed.

Systems

In the future, the role of the Connections function at NTESMO may evolve in one of two directions:

- Stagnation, if connection activity drops due to lower renewable targets and fewer new projects; or
- Functional realignment, where the technical expertise of the connections team is leveraged to support procurement functions, particularly generator performance standard (GPS) compliance, power system studies, and technical evaluation during tender processes.

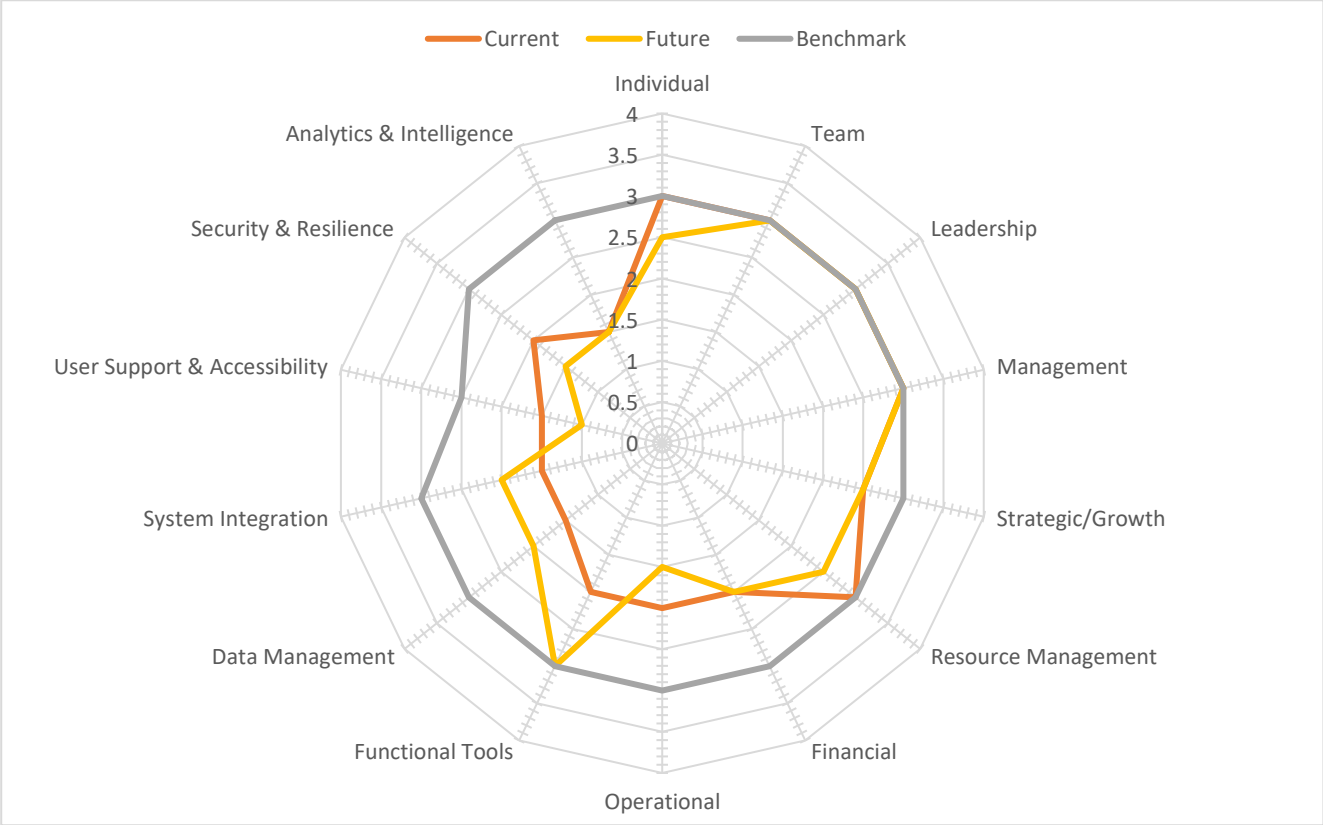
Regardless of direction, future functionality depends on implementing standardised, interoperable systems that support flexibility, transparency, and knowledge retention.

Table 15 - System requirements for Connections function

Systems and tools	Purpose
Connection Application Management Platform (internal CRM extension)	Enables intake, status tracking, document handling, and milestone monitoring of connection applications. Supports automated notifications, version control, and role-based access. Reduces reliance on person-specific knowledge.
Integrated Power System Modelling Environment	Allows engineers to run consistent GPS and connection studies using shared datasets and model templates. Enables standardised workflows and peer review across applications. Required regardless of whether work relates to new connections or procurement scenarios.
Scenario Management Tool (shared with planning/modelling functions)	Allows simulation of system impact from new connections (or procurement bids) under varying system configurations. Useful if the team supports capacity modelling in parallel with RESIP or LT PASA processes.
Compliance Verification Tracker	Ensures consistent application of connection standards, including negotiated access criteria, commissioning checklists, and procedural adherence. Functions as a compliance log for regulator and audit reference

6.4.4 Outage Management

Figure 10 - 1.4 Outage Management capability



6.4.4.1 People

In benchmarked system operators (e.g. AEMO, ERCOT), outage management is delivered by dedicated teams with a clear split between outage planning, risk coordination, and system modelling. Staff possess mid-to-senior engineering expertise, strong cross-functional awareness, and embedded decision-making authority. Role clarity, technical experience, and resilience against staffing changes are defining features.

NTESMO's People capability for this function is relatively well-developed, with an experienced team lead and manager and a mid-senior level team member. Scores across individual dimension are lower than benchmark owing to a lacking senior team member, however team, leadership, and management dimensions score at benchmark levels. Staff are technically competent, operate with clear delegation lines, and demonstrate commitment and ownership of planned and unplanned outage processes. However, qualitatively, the capability is limited by a narrow resourcing base with limited rotation, pipeline development, or depth across specialised roles (e.g. concurrent outage analysis or grid contingency planning). Succession planning and diversity of skills remain moderate. This has not been reflected in the capability scores, per se.

In the future, People capability is expected to slightly reduce in the individual dimension given the lack of a senior team member with experience in concurrent outage or scenario analysis. This is quite likely a feature of the future of NT power system given an aging generation fleet and if more generators are expected to connect to the power system, the likelihood of concurrent outages increases significantly, at least for modelling purposes. However, the team meets the benchmark given reduced manual input once advanced systems including TDE are deployed. This means that the overall capacity could be reduced in this function. Alternatively, the capability could be improved with a different skill set considered. Unless NTESMO designs a deliberate skills development framework to uplift roles into scenario planning, system risk quantification, and digital outage coordination, this function risks remaining tactically capable but not strategically aligned. Higher DER volatility and increasing frequency of dynamic constraint events will place additional strain on even relatively experienced teams without deeper modelling and communication capabilities.

Table 16 – Outage Management function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
4.3 FTE	4.3 FTE (see Appendix C for detailed allocation)	More resources might be required if number of generators increase due to any reason. The relative experience level of this team seems to be mid-junior level and Power Systems Engineering focused. It would benefit from redistribution of resources to include **Planner/Scheduler** coupled risk assessment skillset to round out the capability.	**Planning and scheduling** (develop, maintain coordinate outage plans), **risk assessment** (of outages and mitigation strategies implementation), **technical support** and **communication**

6.4.4.2 Process

High-performing operators implement formal outage planning processes integrated with constraint modelling, resilience testing, and real-time system impact forecasting. These processes are automated where possible, version-controlled, and linked to adjacent functions like dispatch and planning. Regular simulations and outage coordination committees with external parties (e.g. TNSPs, generators) are standard.

Process capability for outage management at NTESMO is relatively mature, with standardised internal workflows and clear coordination paths with real-time operations and control room functions. However, external integration (e.g. with generator outage data or network maintenance plans) remains manual. Scenario testing and cross-function coordination (e.g. with forecasting or connections) are not institutionalised and occur only as needed. There is limited performance tracking (e.g. forecasted vs. actual outage durations or risk notice effectiveness), and no structured reporting of systemic outage trends or resolution insights.

Process capability remains stable and worsens slightly from an operational perspective. This is due to the need for an evolution of processes and workflows to exploit the full functionality of the new tools (such as the RTSSMT deployment and the EMS 3.4 upgrade) present. They will enable enhanced scenario-based outage planning and contingency management and documented robust processes are required to make best use of the same.

6.4.4.3 Technology

Leading operators utilise Outage Management Systems (OMS) integrated with EMS, SCADA, and planning tools. These systems include outage calendars, approval workflows, real-time network overlays, risk scenario engines, and digital dashboards accessible to internal and external users. GIS-layered outage visualisation and auto-triggered risk notices are increasingly common.

NTESMO's technology score for outage management is currently modest. While data capture and notification templates exist, most coordination remains spreadsheet-based, with key decisions managed through email or manual tagging systems. There is no centralised OMS, no integration with real-time network data, and no visualisation or simulation capability, however, an OMS upgrade is due with the TDE work program and thus this capability could be redeemed in future. Outage Risk Notification may be generated and issued but remain manually populated and isolated from upstream constraints or dispatch tools.

Technology capability is expected to improve due to direct and indirect reasons. The direct reason is the deployment of an outage planning module (refer Table 8 for details), while the indirect reason being the implementation of adjacent tools such as the RTSSMT and EMS upgrade..

Systems

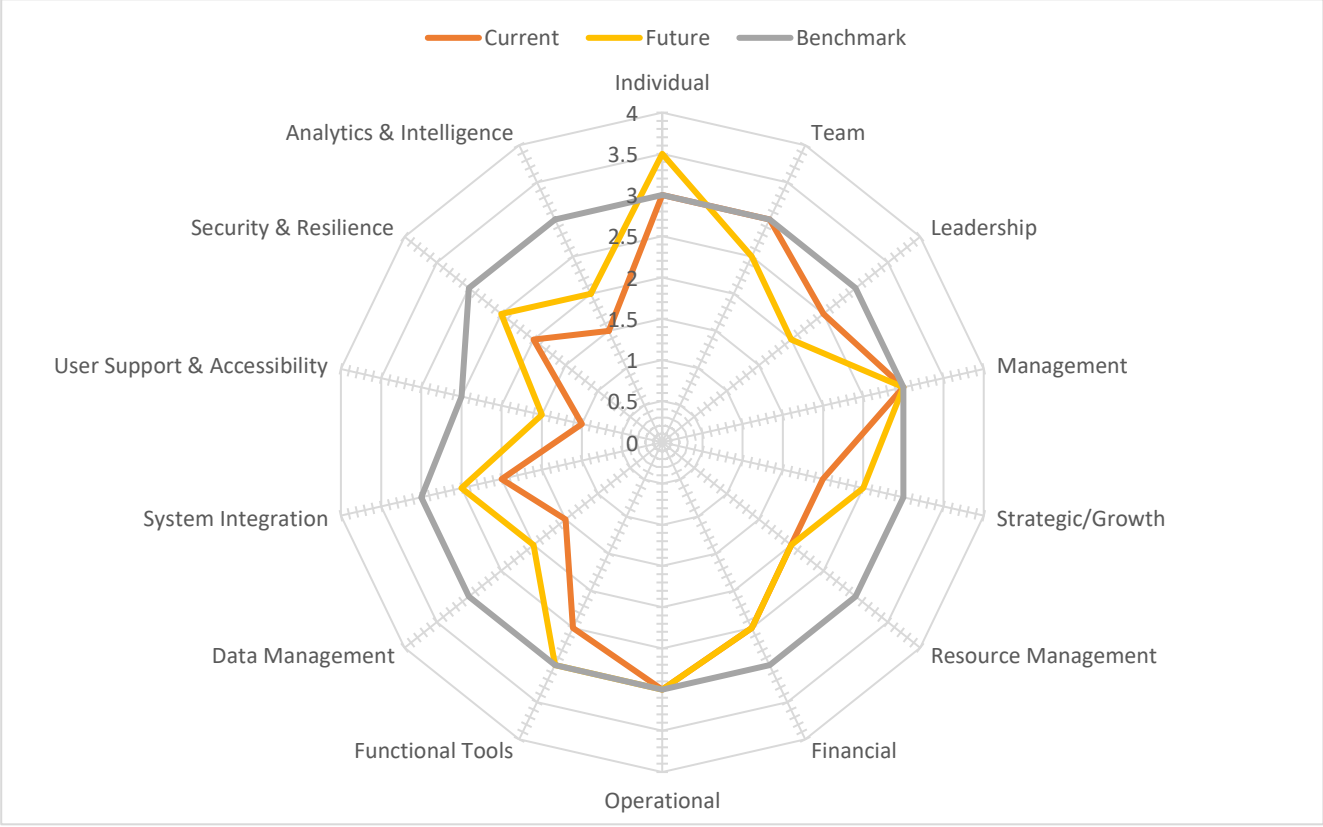
To manage high DER, maturing market with more participants, real-time coordination need with network operation and dispatch, and increased grid-scale inverter-based resources, NTESMO will require a suite of interoperable tools that support automated outage coordination, dynamic risk assessment, and scenario-based decision-making.

Table 17 - System requirements for Outage Management function

Systems and tools	Purpose
Outage Management System (OMS)	As planned for deployment. Core platform for managing planned and unplanned outages. Tracks lifecycle from request to restoration, maintains calendar views, supports approvals, and documents outage reasons and resolution. Should allow tagging by asset, region, or function
DMS Integration Layer	Enables real-time view of network and asset status, enabling NTESMO to visualise and schedule outages with live system information. Supports constraint-aware scheduling.
Dispatch and Forecast Coordination Interface	As planned for deployment within the TDE package / as modules. Links the OMS with dispatch tools (e.g. TDE) and forecast systems to ensure outage plans reflect expected load, generation availability, and constraint windows. Enables smarter scheduling that anticipates volatility.
Compliance Tracker / Audit Module	Ensures outages are assessed and recorded in accordance with SCTC requirements. Provides audit trail for regulatory compliance and post-incident reviews.

6.4.5 Real-Time Monitoring and Control

Figure 11 - 1.5 RT Monitoring and Control capability



6.4.5.1 People

Benchmark operators operate dedicated, 24/7 control rooms with system operators, supported by specialists in contingency management, DER monitoring, and SCADA/EMS operations. The staff are accredited, undergo continuous scenario training, and operate with clear escalation hierarchies. Capability includes technical decision-making, stress management, and automated system oversight.

NTESMO's real-time operations team scores relatively well on People capability, particularly in individual, team, and management dimensions. The Grade 2 desk responsible for real-time system security is staffed by mid-senior level

experienced operators who demonstrate high levels of commitment, situational awareness, and problem-solving. However, key limitations persist such as the team is stretched thin during system stress events, there is limited internal rotation or redundancy planning, tacit knowledge transfer between generations of operators is not systematically captured, and interaction with forecasting and operational planning teams is informal, limiting cross-functional learning – leading to reduced leadership scoring.

People capability improves with the implementation of real-time optimisation tools such as TDE, DMS, and EMS upgrade. As manual decision-making is increasingly augmented by automated alerts and scenario engines, the skills required shift from reactive intervention to systems oversight and optimisation tuning. NTESMO is expected to retain its experienced operator base, and their adaptability and learning mindset provide a strong foundation for transition. However, the risk remains that without structured re-skilling programs, operators may underutilise the new systems or be unable to interpret advanced analytics.

Table 18 – RT Monitoring and Control function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
14.1 FTE	14.1 FTE (see detailed allocation in Appendix C)	No reduction in headcount. However, it could be considered due to the introduction of advanced monitoring and control tools alongside an optimisation engine TDE reducing manual reliance. However, the skillset required would differ quite significantly from current state. Skills that impart **Machine learning and AI**-integrated tool operations and decision support capability would become critical.	**Data analysis** (processing, visualisation, statistical modelling), **technical proficiency** (SCADA, EMS, ADMS, machine-learning and AI for predictive monitoring), **communication** (technical communication to non-technical stakeholder)

6.4.5.2 Process

Mature system operators run formalised shift handovers, real-time data analysis protocols, dynamic constraint management procedures, and active contingency plans. Real-time operations are supported by structured knowledge management, incident learning loops, and coordination playbooks. Interfaces with dispatch, forecasting, and compliance are formalised and documented.

NTESMO's process maturity in this function is stable and semi-formalised. Control room procedures for real-time security, frequency control, and system stability are clear, and compliance with SCTC is strong under normal operating conditions. However, handover processes vary in quality and detail, lessons learned from near-miss events, or major contingencies are not always systemised into training materials, real-time operators lack visibility into upstream decisions (e.g. scheduling, forecasting assumptions), there is no real-time integration with market systems to reflect constraint pricing, reserve availability, or DER variability.

Process capability remains the same, which is fairly high, with the expectation that NTESMO develops real-time contingency protocols (for ESS procurement), simulation exercises, and automated alert-handling. Deployment of EMS/DMS platforms is likely to streamline outage response, DER integration, and control decision transparency. These tools will enable new operating envelopes to be developed around predictive risk flags and security assessments. However, these improvements depend on robust change management and formal training investment to translate process intent into practice.

6.4.5.3 Technology

Benchmark operators operate an integrated SCADA/EMS/DMS architecture, with real-time visualisation, constraint analytics, grid health indicators, and automated fault detection. Control rooms use smart dashboards and contingency algorithms to anticipate and respond to system instability. These systems integrate tightly with outage management, dispatch, and DER forecasting layers.

NTESMO's technological capability currently reflects an operational reliance on SCADA, with information sourced from the existing EMS (upgrade due) or the DMS (currently under development), along with SCADA-based custom calculations. The existing operations lack predictive alerting tools, automated constraint visualisation, and digital twin capabilities or fast frequency response (FFR) simulation capabilities that are present in more advanced markets such as the NEM, but not yet available in the NT. Real-time system operation is heavily reliant on operator intuition and interpretation of SCADA data. It has been observed that approximately 25% of the load is carried as spinning reserve. This is primarily to maintain system security in response to high levels of behind-the-meter solar generation (for a system as small as that in the NT), small individual generation unit, aging fleet, and network constraints south of Darwin. Maintaining this level of spinning reserve will be optimised through the implementation of Contingency Frequency Control Ancillary Services (C-FCAS) tool (currently under development). The C-FCAS application would provide operators with predictive alerts related to system security, thereby enabling a reduction in the size of the spinning reserve required.

Technology capability improves significantly in the future as EMS, ADMS, and the TDE are fully implemented. These tools will provide real-time decision support, load-shedding automation, DER visibility, and proactive contingency warnings. Integration with SCADA and dispatch will enhance coordination. However, the effectiveness of these systems will depend on user adoption, local configurability, and seamless real-time interoperability—especially during high-risk conditions such as low load, DER reversals, or islanding events.

Systems

At present, system operations rely heavily on SCADA and manual operator interventions, with minimal support from predictive or integrated digital tools. However, in the future, real-time system control must be capable of anticipating and responding dynamically to high-frequency disturbances, DER variability, and constraint violations, while also co-optimising with dispatch and market operations. To bridge the gap between the current and future state, NTESMO is enhancing its operational capabilities through the Transitional Tools Program by implementing several interim solutions.

One such solution is the automated Proportional Energy Dispatch (PED), which enables more efficient management of energy ties. In parallel, a real-time system security monitoring tool (RTSSMT) is being deployed to address contingencies and transmission line violations in real time. These tools support operational optimisation and facilitate the modernisation of system operations in advance of the full implementation of the Territory Dispatch Engine (TDE). In addition, NTESMO is progressing the development of the Contingency Frequency Control Ancillary Services (C-FCAS) tool within the EMS to enable predictive monitoring and strengthen system security outcomes.

To meet this need, NTESMO requires a modern, interoperable control environment with embedded intelligence, automation, and visibility across the entire power system.

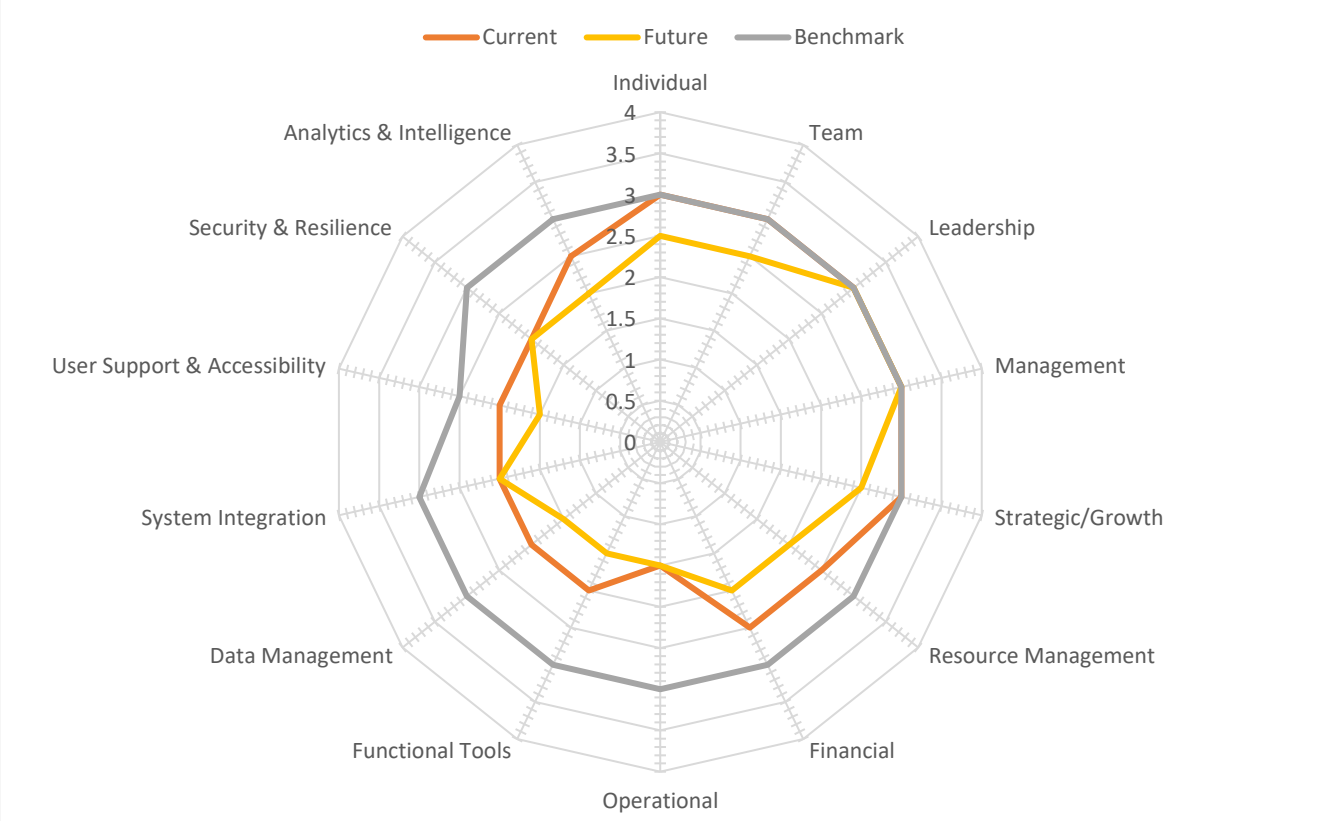
Table 19 - System requirements for RT Monitoring and Control function

Systems and tools	Purpose
SCADA interface	Core real-time monitoring tool for system parameters (frequency, voltage, load, contingency size). Must be retained and integrated with EMS/ADMS to support event flagging, alarms, and auto-control.
Energy Management System (EMS)	Supports advanced control room functionality — including economic dispatch integration, load forecast visibility, real-time generation tracking, and operator alerts. Enables dynamic state estimation and security assessment.
Distribution Management System (DMS)	Provides a layered view of distribution assets and DER behaviour. Supports feeder-level voltage visibility, reverse flow tracking, and DER coordination with dispatch/security objectives.
Proportional Energy Dispatch (PED) tool	The Proportional Energy Dispatch (PED) tool is being developed to manage energy ties within the DKPS and to optimise the Capacity Forecast Dispatch System (CFDS) application on the EMS. It evaluates system constraints and calculates energy maxima to allocate dispatch proportionally across generators with identical price offers.

Territory Dispatch Engine (TDE) – Real-Time Interface	Ensures dispatch orders and system constraint decisions are visible in real-time. Enables feedback loop between control room, dispatch schedule, and actual generator performance.
Real-Time Security Monitoring Tool (RTSSMT	The Real-Time System Security Monitoring Tool (RTSSMT) uses contingency and short circuit analysis to simulate near-term events, such as feeder loss or sudden PV drop, and recommends pre-contingency corrective actions. This enables quicker system restoration and more accurate spinning reserve allocation. It also monitors stability margins, DER penetration, and other key metrics, alerting operators when thresholds are exceeded.

6.4.6 Performance Reporting

Figure 12 - 1.6 Performance Reporting capability



6.4.6.1 People

NTESMO's current team has a solid foundation of experience, particularly in technical reporting. Scores for individual, team, leadership, and management rate at benchmark levels, owing to meeting the reporting requirements as specified by the regulator. In the future, unless roles evolve to include analytics and strategic insight generation, capability is expected to weaken, especially as reporting becomes more complex under a reformed market. However, the reporting complications are partly a systems issue and partly people. Therefore, the future state scores are slightly lower than current state.

Table 20 - Performance Reporting function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
3.3 FTE	3.3 FTE (see detailed allocation in Appendix C)	More resources might be required if number of generators increase due to any reason. The relative experience level of this team seems to be mid-junior level and Power Systems Engineering focused. It would benefit from redistribution of	**Planning and scheduling** (develop, maintain coordinate outage plans), **risk assessment** (of outages and mitigation strategies implementation), **technical support** and **communication**

		resources to include **Planner/Scheduler** coupled risk assessment skillset to round out the capability.	

6.4.6.2 Process

The team executes prescribed tasks (e.g. operational reports, incident logs, monthly KPIs) reliably but process maturity is static. There is little automation, minimal strategic use of performance data, and no structured improvement loop. Current process scores are mid-range; future scores drop slightly due to greater volume, stakeholder scrutiny, and regulatory complexity. Without process reform, the function risks becoming a compliance checkbox rather than a performance insight engine. An observation, for example, is that there is no formal methodology for incident investigation and recommendation development - application of industry practice such as ICAM or other similar methodologies would serve to streamline and improve incident investigation efficacy.

6.4.6.3 Technology

Current tools are basic: performance reporting relies heavily on Excel, SCADA logs, and manual controller inputs. There's no integration with dashboards, analytics layers, or auto-ingest from EMS/SCADA . Technology scores are low. Future tools (e.g. an EAP or event loggers) may improve data capture, given recent support from IT teams at Power and Water in order to uplift the capability through the deployment of a Government approved Python toolbox – that will assist in improved analysis and reporting automation. Without investment in visualisation, exception detection, or predictive metrics, this function will struggle to generate forward-looking operational insights thereby keeping overall scores in the future lower than current state.

Systems

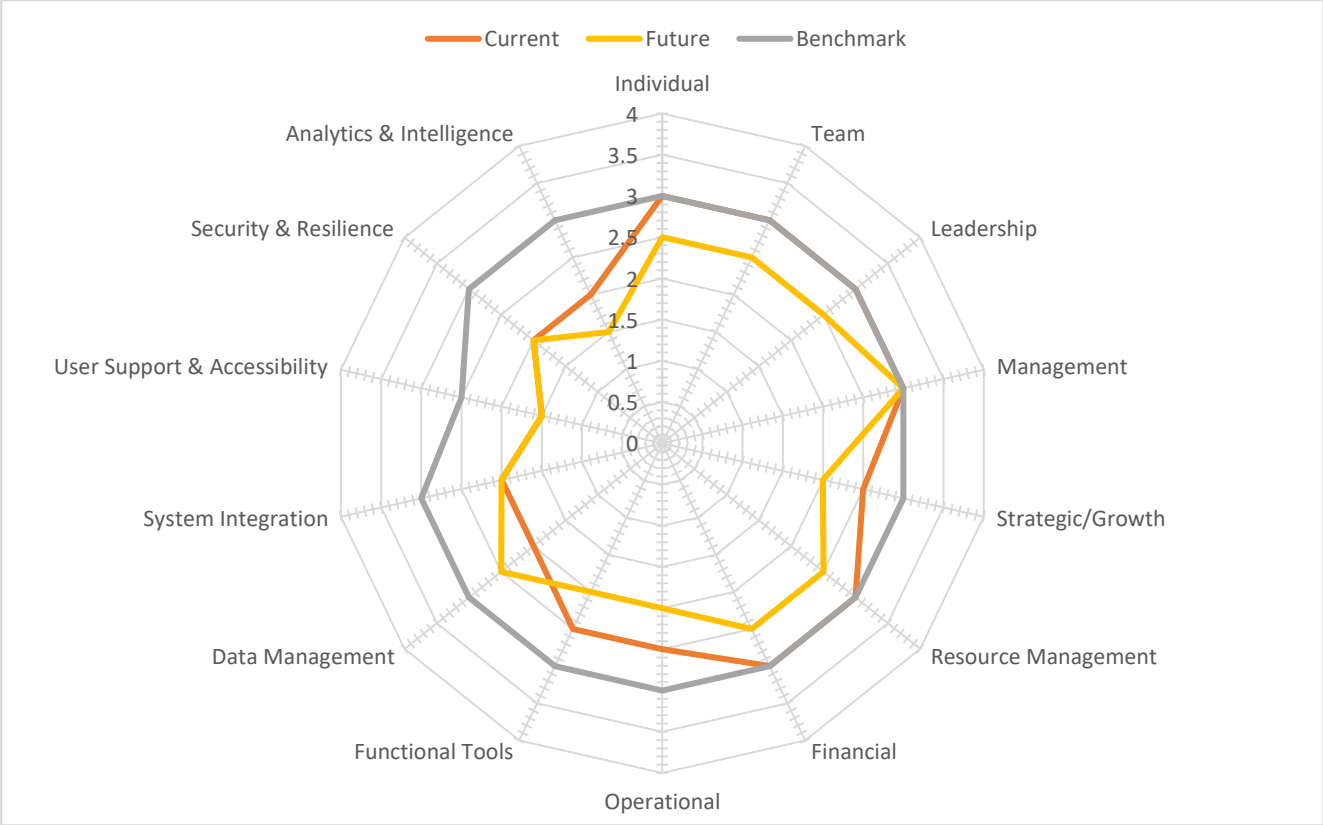
Performance Monitoring at NTESMO must evolve from manual, incident-by-incident reporting toward an integrated data intelligence function. Performance reporting is key to demonstrate transparency of the system performance to the market participants, which would strengthen confidence in the operations. While this is currently happening, reporting can be improved with increased data capture from the additional and wider systemic uplift that is anticipated to take place at NTESMO in the coming future. This overall technological shift can be leveraged to become more data-driven both internally and externally – through reporting – supporting and enhancing informed decision-making. It would need cross-platform integration to create data lakes to deep-dive on specific performance aspects that allow for a data-driven approach to continuous improvement (of the market, of procedures, of participation, of endemic kinks embedded by virtue of market design). Another core need is high-speed data capability from events for reporting and power system modelling, as the foundational component of such analysis and reporting. In a reform-aligned and DER-driven system, NTESMO's ability to detect trends, report accurately, will be essential for overall operational excellence.

Table 21 - System requirements for Performance Reporting function

Systems and tools	Purpose
Operational Data Warehouse / Central Data Lake	Aggregates SCADA, EMS, dispatch, outage, and log data into a structured repository. Enables consistent, reliable data extraction for reporting and trend analysis
Performance Analytics and Visualisation Tool (e.g. Power BI, Tableau)	Automates generation of dashboards for KPIs, trends, incident classifications, and system availability. Enables interactive reporting for internal ops and external stakeholders (e.g. UC, government).
Integration Layer with Compliance Tools	Shares relevant event summaries and audit trails with compliance monitoring tools (especially useful if compliance is now consolidated under corporate functions)
Automated Reporting Engine	Generates scheduled reports (e.g. monthly, 6-monthly performance reports for UC) with templated outputs. Reduces manual effort and improves consistency in metrics and formatting.

6.4.7 Network Operations

Figure 13 - 1.7 Network Operator function



6.4.7.1 People

Comparable network operators (generic DNSP/TNSP, not the benchmarked entities like AEMO – as they don't perform a network operator function in the NEM/WEM) maintain distinct network operator roles with strong coordination protocols, power systems expertise, and 24/7 situational coverage. Current NTESMO personnel are highly capable at the individual levels given the spectrum of experience – seasoned senior professionals at Grade 3 desk coupled with fresh, young, digitally-adept talent on Grade 1 desks. Together, the team demonstrates strong system awareness, discipline, and risk management in the DKPS.

As the future moves toward more complex DER impact on voltage, flow reversals, and protection schemes, People capability scores are expected to decline without active skill diversification and workforce strengthening. The criticality here in upskilling is becoming digital savvy with the inherent power system operations experience. Robust embedded knowledge flow management is required to transfer the intel that senior and experienced professional hold to the graduate pool of Grade 1 resources, while being upskilled to handle technically mature integrated interfaces like the DMS, EMS, and SCADA with wider power system applications including the OMS, constraint interface of the TDE, and forecasting tools.

One of the most significant challenges is the aging real time operations workforce with a high proportion of the workforce approaching retirement age or eligible for long service leave given their term of employment. This requires sophisticated resource planning that also encompasses the evolutionary mapping of the required skills mix. This is reflected in the people scores for the future state.

(This function has been changed from NTESMO's model's *Real-Time Monitoring and* Control to align with benchmark and carried through an SLA within ring-fencing guidelines to provide these services to Power and Water).

Table 22 - Network Operations capacity and skills

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
21.7 FTE	21.7 FTE (see detailed allocation in Appendix C)	Same resourcing levels as current state. However, slightly reduced level of resourcing could be considered given the introduction of DMS, EMS, SCADA integration. However, the skillset required would differ quite significantly from current state. Skills that impart **Machine learning and AI**-integrated tool operations and decision support would become critical.	**Technical expertise** (HV switching, knowledge of network hardware and software, proficiency in network protocols), **problem-solving** (root-cause analysis and resolution, troubleshooting), **communication** (effective communication with technical and non-technical stakeholders), **project management** (coordination of network upgrades and maintenance)

6.4.7.2 Process

Process maturity is reasonable, with effective daily coordination and compliance with SCTC obligations. However, there is no scenario-driven contingency modelling or network behaviour analysis beyond day-ahead operational windows. Clearly, this depends on the requirements that Power and Water have set as per the performance metrics as part of their SLAs – therefore NTESMO is bound by limitations that the SLA (and ring-fencing) imposes. Real-time learnings and procedural updates are informal, and there's no evidence of a systematic engagement with Power and Water on network model calibration, evolving protection settings, or long-term constraints.

In the future, without a clear uplift pathway or integration into system planning and DER coordination protocols, process capability will likely remain static or decline in relative effectiveness.

6.4.7.3 Technology

Current tooling is SCADA-centric and the DMS is in works to be implemented. For clarity, this is an unregulated function of the NTESMO and not necessarily required to be reviewed through the same level of critique as its other functions.

Technology scores reflect dependence on legacy tools, lack of real-time network state estimation, and no integration with DER telemetry. Future improvements may raise capability modestly, but will require integration with outage planning module, forecasting, and dispatch systems. Without full SCADA-DMS-EMS linkage and internal capacity to configure network observability tools, this function will remain behind benchmark peers, particularly as DER complexity increases.

The Network Operator function must evolve from a SCADA-observer role into a more proactive distribution-level risk manager, particularly as reverse flows, voltage violations, and DER clustering introduce new system security threats. NTESMO's future systems must support real-time visibility, automated risk alerts, and data-sharing with Power and Water and DER aggregators (if a future policy and market design allows for a VPP-styled deployment in the NT).

Table 23 - System requirements for Network Operations function

Systems and tools	Purpose
Distribution Management System (DMS)	Core platform for distribution network visualisation and control. Enables live monitoring of feeder performance, voltage conditions, DER output, and power quality. Should integrate with EMS/SCADA for system-level situational awareness.
DER Visibility Layer (e.g. DERMS or SCADA integration with inverter telemetry)	(Ideally a Power and Water function / requirement – which can then be integrated to the SCADA at NTESMO) Enables real-time and forecast-based awareness of rooftop PV, battery discharges, and load shifting. Needed to anticipate local system limits, manage Minimum System Load conditions, and coordinate with forecasting.
Voltage and Flow Monitoring Module	Monitors threshold violations and triggers alerts based on distribution constraints. Supports pre-contingency analysis and fast-frequency response actions. May be embedded in DMS or a standalone module.

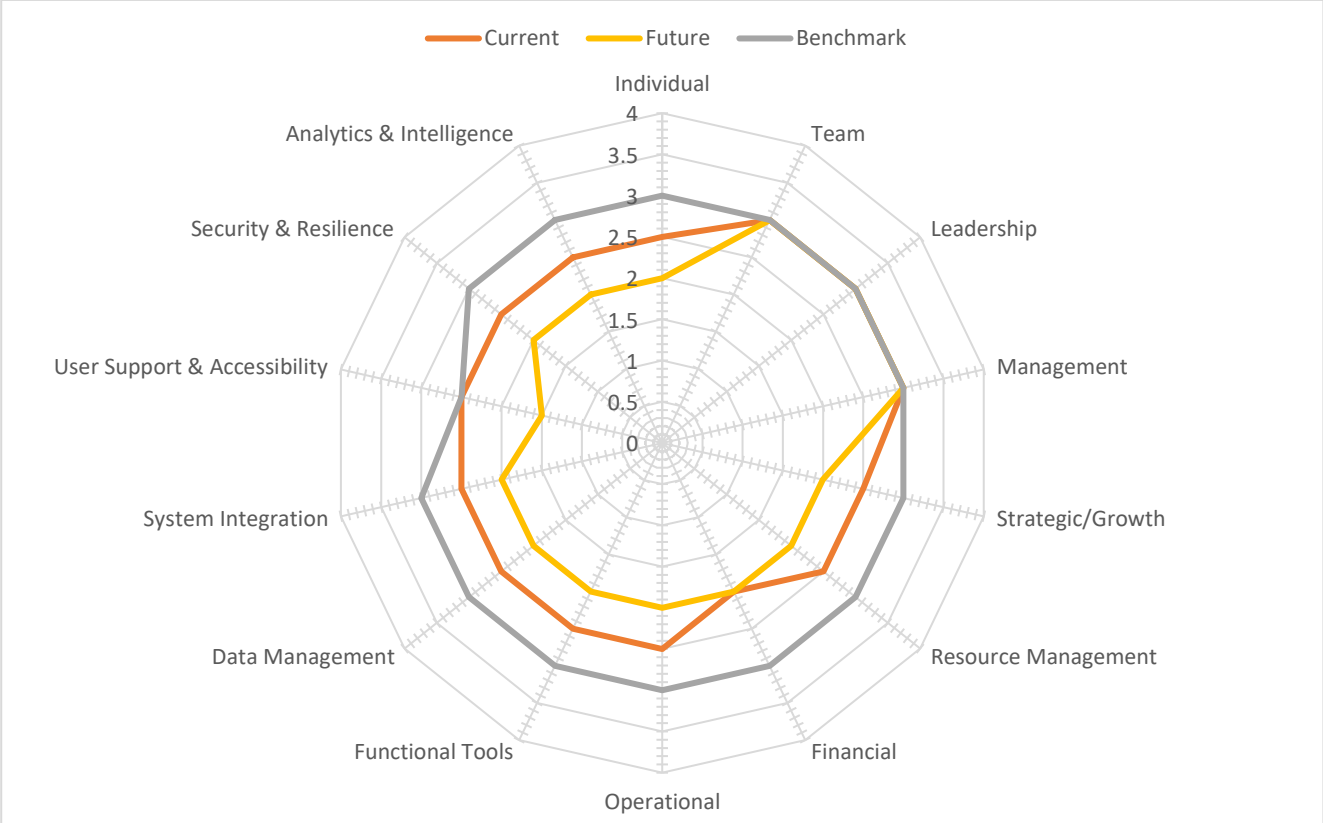
EMS Integration	Provides network operators with system-wide awareness—linking generation, load, dispatch constraints, and grid health indicators across voltage levels.

6.5 Market Operations

As discussed in depth in section 5.3.3, NTESMO doesn't currently perform *Supply Procurement*, *Market Rules*, *or the Government and Industry Liaison* functions. However, based on the indication from previous reform initiatives [redacted] it is expected that NTESMO will likely be required to expand their function to include these three functions.

6.5.1 Participant Support and Market Registration

Figure 14 - 2.1 Participant Support and Market Registration



6.5.1.1 People

Benchmark operators deliver this function through structured onboarding teams, helpdesk systems, and compliance officers with clear regulatory and technical accountabilities. There is clear role separation between participant support, standing data validation, and technical interface.

Current state capability notes a benchmark capability, particularly across team, management, and leadership dimensions. The team demonstrates commitment, technical understanding, and strong interpersonal rapport with participants. However, skill base is junior and role clarity between participant-facing support and registration administration is blurred from the perspective that the same set of people perform both functions. Onboarding processes still depend on interpersonal knowledge, and leadership is stretched across broader market operations responsibilities.

Future state capability declines due to expected increase in participant types, data complexity, and regulatory scrutiny as I-NTEM evolves under a reform initiative and implements the public procurement model, effectively increasing the quantum of participants being dealt with. Without greater functional separation, standardised induction processes, and senior coordination roles, this function will struggle to scale. As the market expands, participant data compliance and responsiveness to audits will demand more specialised skills and resourcing. Realistically, what this means in the context of the NT is not a significant change in terms of number of participants that would warrant additional resourcing. Therefore, the capacity remains same regardless of some deficits in the future.

As the NTEM evolves, NTESMO will need to support a more diverse participant base—including new entrant generators, DER aggregators, energy service providers, and potentially community energy projects. This will increase the complexity of participant onboarding, standing data management, and support requirements. NTESMO will also be expected to maintain a clean and auditable registration database, comply with market rules, respond to participant queries efficiently, and support compliance investigations involving standing data.

The role of this function will no longer be limited to basic data handling or interpersonal support, it will evolve into a key gatekeeping and assurance function in a maturing market.

Table 24 - Participant Support and Market Registration skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
1.2 FTE	1.4 FTE (see Appendix C for detailed allocation)	This uplift reflects not just increased volume but also the **increased regulatory risk**, need for **traceable and standardised workflows**, and importance of data integrity across market functions.	Regulatory interpretation Participant lifecycle management Data governance and integrity Stakeholder engagement Issue triage and support

6.5.1.2 Process

Benchmark operators have documented onboarding, registration, and standing data update workflows aligned with market rules. Participant lifecycle is tracked, and support services follow structured SLAs, with handover processes between registration, technical onboarding, and settlements/dispatch.

Current processes are stable but above basic capability. Registration forms and standing data management are administered manually or via semi-standardised emails, and exception handling varies across staff. Support is responsive but not governed by process-based performance measures (e.g. issue resolution times, audit trail compliance). Participant feedback loops are ad hoc.

Future state process capability remains moderate, assuming greater participant diversity, more granular standing data (e.g. DER aggregators – if any, VPPs – if any), and stricter regulatory compliance. The ease of implementation of automated workflows and digitisation together with a data governance framework are promising of a relatively capable future. The scores are lower than the current state, only due to the lack of these workflows today, but the relative ease of implementation promises a capable future.

6.5.1.3 Technology

Benchmark tools include secure participant portals, standing data APIs, identity verification modules, and registration systems integrated with dispatch, settlements, and compliance platforms. CRM-style ticketing tools support ongoing participant engagement.

Current technology capability scores are basic in terms of scoring of the capability. This is broadly consistent with most of the organisation. Market registration and participant support functions are executed using email, spreadsheets, and shared folders. There is limited structured participant database, low to no audit trail, and minimal integration with systems such as dispatch, settlements, or compliance – given they are scattered in existence, if they exist.

However, there is a key consideration that the market is so small at present that there are four (4) generators and two (2) retailers in the whole I-NTEM. This low volume of participants does not warrant a fully deployed technology suite. Thus, they have been scored keeping this context intact.

On that basis, the future state technology capability is expected to worsen modestly. However, system ownership, support, and configuration capability will need to mature to prevent a scenario where tools exist but are underutilised or misaligned with workflow needs.

Systems

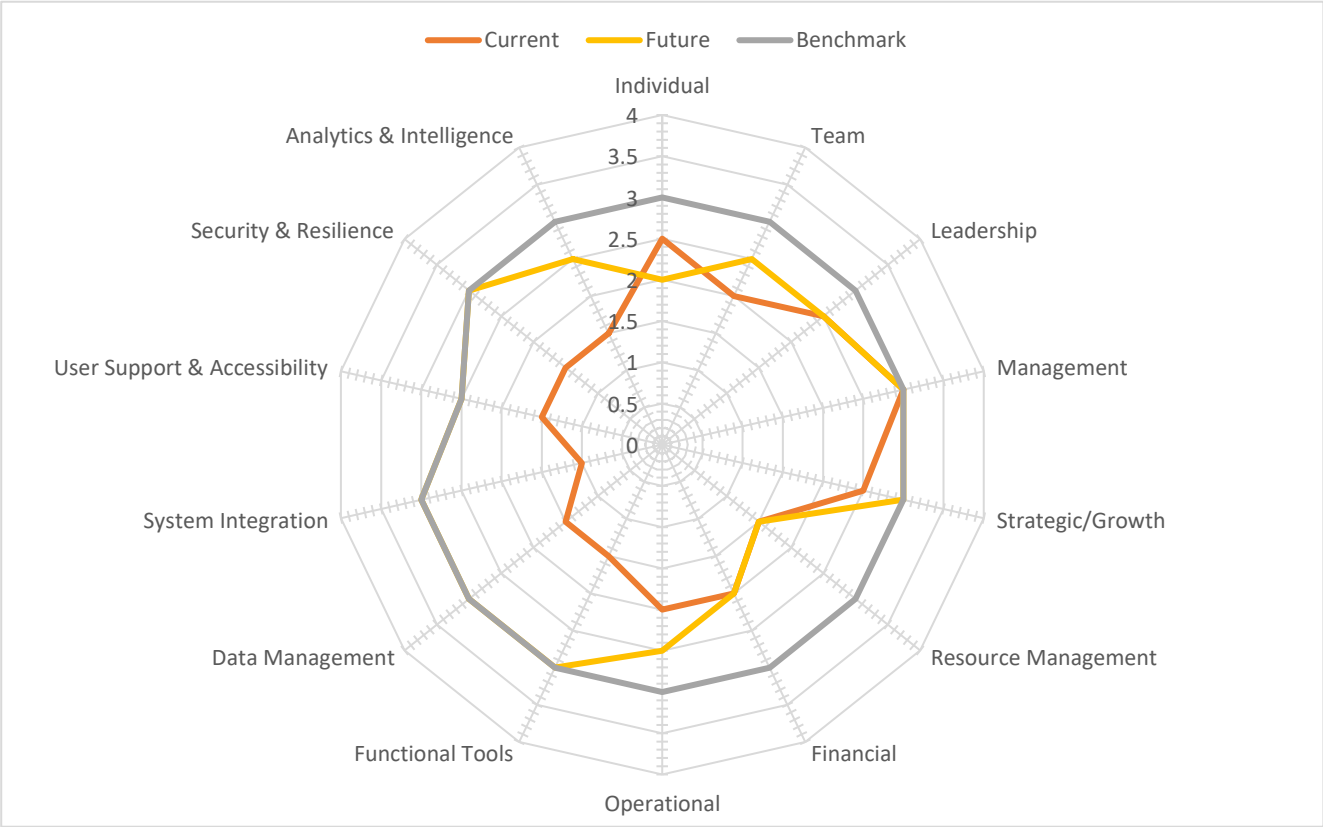
As NTESMO transitions into a more mature market operator role, this function will require digitisation, auditability, and participant-facing automation. The systems below are essential for shifting from email-based support and spreadsheet-driven registration to a secure, responsive, and rules-aligned platform.

Table 25 - Participant Support and Market Registration systems and tools required

Systems and tools	Purpose
Market Participant Portal	A secure, self-service portal where participants can register, update standing data, upload documentation, track submissions, and view system notices. Should support two-factor authentication and identity management.
Participant Registration System	A structured backend database and workflow engine that manages participant lifecycle (onboarding, changes, offboarding). Includes validation logic, role-based access, and audit trail for compliance and UC review.
Standing Data Management Module	Ensures accurate storage and management of generator attributes, trader details, contact info, and obligations. Includes version control, validation alerts, and integration with dispatch and settlements systems.
CRM / Support Ticketing System	Enables NTESMO to triage participant queries, track resolution times, and generate issue logs. Should support tagging by topic (e.g. registration, settlement, compliance), and escalation routing.

6.5.2 Dispatch Scheduling

Figure 15 - 2.2 Dispatch Scheduling function capability



6.5.2.1 People

Benchmark operators run dedicated scheduling desks staffed by dispatch engineers with strong optimisation and market design knowledge. Skillsets span dispatch logic, constraint formulation, and system balancing, with well-resourced coverage during critical intervals.

NTESMO's current capability is anchored in individual intent and problem-solving, but constrained by manual processes, limited handover documentation, and high operational risk. Only a small number of staff are trained in the dispatch process, with most of the effort concentrated in a pre-dispatch window using Excel-based logic. While this works at present, it is not a sustainable, economic, prudent, and efficient way of market operations, especially with the previously proposed reform measures.

Future state capability is expected to drop under reform, but only in terms of individual as job design and training requirements would widely change from what the role currently looks like versus what it would in future, owing to TDE deployment – which would not only automate the optimisation, scheduling, and dispatch function but have other additional features and modules upstream and downstream to support with decision-making. This would see the resources freed up for other tasks, however, the skill-level for the resources needs to be improved to ensure they are capable of operating the TDE platform. Without strong investment in upskilling staff in constraint modelling, offer validation, merit-order formation, and contingency scenarios, the function will struggle to adapt to automated and more complex scheduling environments. Overall capability outlook is quite positive, given the leadership and management would have additional time to focus on strategic problem-solving and ensuring development and training programs are instated for the junior resources to upskill on operating the new tools.

Table 26 - Dispatch Scheduling skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
2 FTE	2.1 FTE (see Appendix C for detailed allocation)	The current dispatch scheduling function at NTESMO is manually intensive, relying on a combination of Excel-based dispatch formulation, offer validation, and constraint tracking. This has necessitated a 1.1 FTE resourcing to reliably perform pre-dispatch tasks, troubleshoot scheduling outcomes, and manage scheduling risk manually. With TDE implementation this is expected to drop with oversight, validation, anomaly management-based requirement for manual attention.	Regulatory awareness Scenario simulation Exception handling Constraint reasoning TDE Operation (training and skills)

6.5.2.2 Process

Benchmark scheduling functions operate automated dispatch engines with embedded constraint solvers, supported by structured workflows for offer validation, contingency management, and scheduling publication. Procedures are version-controlled, audit-compliant, and tested regularly under rule changes.

Current process capability is basic. While the current daily dispatch process is completed reliably, it is manually executed via Excel, prone to user error, and lacks process integration with forecasting, network availability, or contingency planning. Offer validations, while technically performed, rely on individual judgment and past precedent.

Future state processes will need to absorb the complexity of constraint-aware scheduling, interaction with a real-time dispatch engine, and potentially new market rule-driven protocols. Without a structured procedural uplift, particularly in pre-dispatch diagnostics, risk flagging, and merit order logic, the risk of poor dispatch outcomes will increase despite system investment.

6.5.2.3 Technology

Benchmark operators use co-optimised dispatch engines (e.g. NEMDE), real-time forecast integration, constraint and offer validation tools, and simulation environments. Outputs are published via participant-facing APIs and dashboards.

NTESMO's current technology capability reflects heavy reliance on spreadsheet-based dispatch workflows. There is no fully operational market engine, no dynamic merit order co-optimisation with constraints and forecasts, and no automated constraint handling. Visibility across input data, scheduling logic, and dispatch output is limited to a few users.

Future technology capability assumes deployment of TDE and transitional tools (e.g. Proportional Energy Dispatch tool), enabling automated scheduling and dispatch formulation. However, initial implementation will be limited by staff familiarity, lack of configuration control, and no integration with compliance or performance tracking tools. There's no user interface layer planned to make the system more accessible or transparent to operators during early use.

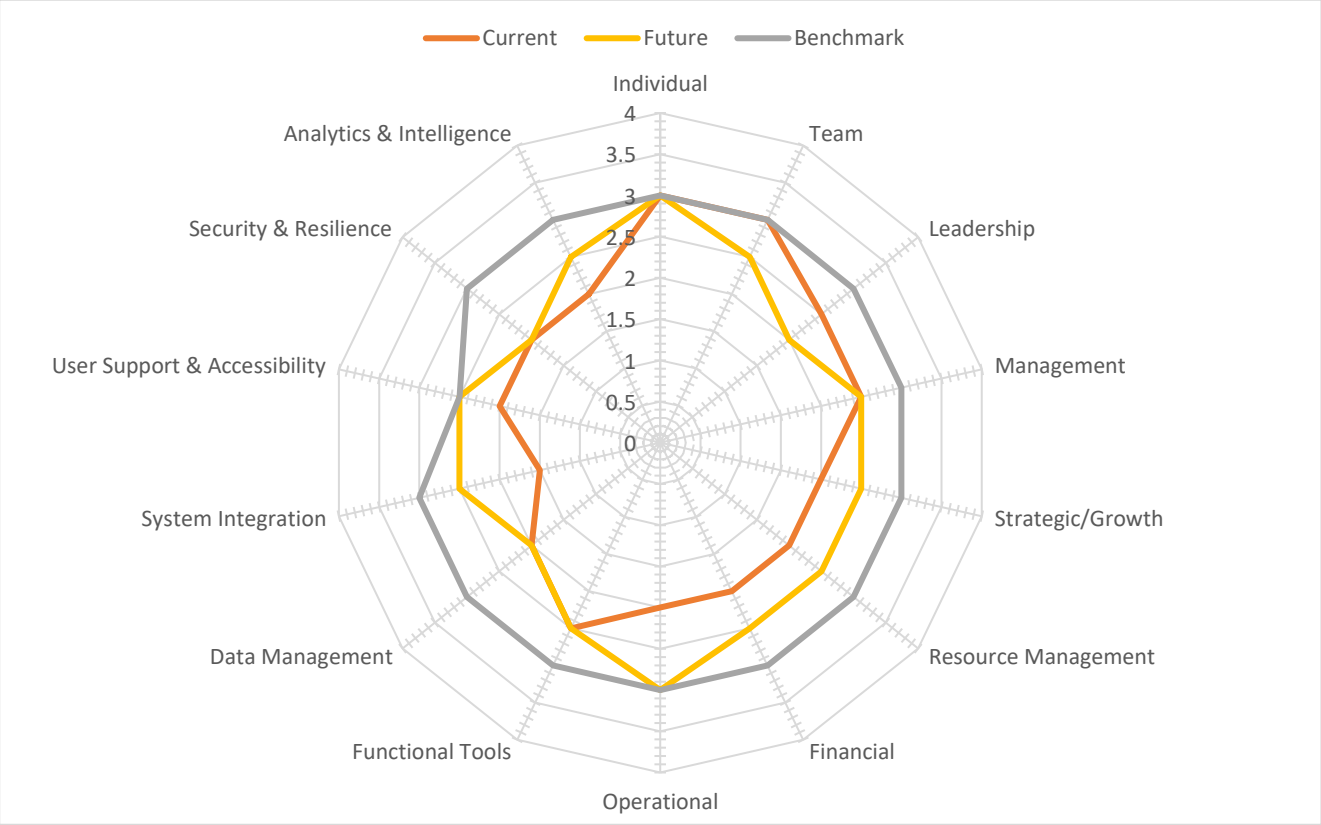
Table 27 - Dispatch Scheduling systems required

Systems and tools required	Purpose
Territory Dispatch Engine (TDE)	Core scheduling platform that automates merit-order generation based on submitted offers, constraints, and system conditions. Must support co-optimised scheduling for multiple services (e.g. energy, FCAS, ESS).
Offer Validation Module	Automates checking of generator offers against market rules and dispatch parameters. Flags infeasible or rule-breaching bids prior to scheduling. May be embedded within or linked to TDE.

Systems and tools required	Purpose
Constraint Management Interface	Allows authorised users to define, upload, and manage system constraints (thermal, voltage, ramping). Should support constraint equations and real-time validation.
Schedule Publication Tool	Generates and distributes daily schedules, reports, and market notices to participants. Supports standardised template generation and version control
Scenario Testing / Simulation Environment	Enables NTESMO to test scheduling under different scenarios (e.g. outage conditions, bid changes, DER injections). Useful for reform implementation and UC transparency.

6.5.3 Market Information

Figure 16 - 2.3 Market Information function



6.5.3.1 People

Benchmark operators manage this function through a combination of technical analysts and communications officers who can transform real-time system and market data into meaningful participant-facing insights. Skills span operational analytics, rule interpretation, stakeholder engagement, and media protocols.

NTESMO's current capability is driven by a small, technically capable team that produces core market reports but lacks dedicated market communications or data analytics resources. Tasks such as issuing market notices, post-dispatch data publication, or reporting constraint events are performed manually and depend on a few knowledgeable staff. There is no function-level role separation between operational data management and outward-facing communications.

Future state capability is expected to remain stable, in fact would require fewer resourcing given the data integration from wider systems deployment. As transparency and compliance expectations grow under a more rules-based NTEM, NTESMO will need clearer accountability and skills in structured data reporting, audit traceability, and participant

engagement. Without targeted investment in the skills upliftment or acquisition with data analysis and visualisation and automating web data stream interface handling, the function risks becoming a bottleneck for market trust and clarity.

Both the current and future state scores are reflective of a capable set of people currently but changing requirements in the future demanding a more robust skillset within the team therefore bringing future capability down.

Table 28 - Market Information function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
1 FTE	0.8 FTE (see detailed allocation in Appendix C)	Market information is manually compiled and published based on operational judgment and informal expectations. As NTEM evolves, the volume, frequency, and regulatory importance of market data will increase. Market Information must shift from being a by-product of operations to a deliberate, rules-aligned communications function – needing skilled resources rather than high numbers	Operational data literacy Market reporting Analytics and reports/summarisation Stakeholder communication Report automation and tool creation

6.5.3.2 Process

Benchmark market information processes are automated, templated, and rules-aligned. They include real-time and end-of-day publication of dispatch outcomes, pricing data, constraint notices, and system events. Data formatting, timing, and accessibility are governed by procedure and linked to compliance frameworks.

Current processes rely on formal expectations and compliance requirements of reporting. Reports are prepared manually and published on the webpage. There is a basic level of publication standard expected that is aligned to the regulatory requirements. Clearly, this needs to evolve in the future, subject to how complex the overall market becomes in the future.

Process wise the future state scores favourably for NTESMO as there are newer systems being procured that will enable documentation, automated workflows, and data hooks through wider systemic deployment and integration enabling processes to be automatically set in to a large extent. This capability is reflected in the future scores.

6.5.3.3 Technology

Benchmark operators deploy data portals, automated report generators, and live dashboards to provide consistent, real-time, and historical market data. These tools are tightly integrated with dispatch engines, forecast systems, and public reporting platforms.

Current technology capability is from an integration standpoint. The full extent of automated data flows is yet to be achieved and is not far, having procured AEMO's market interactions enablement system and almost complete in rolling it out.

Future technology capability assumes continuum of the current upgrades, refining of workflows into the program, and the deep and wide links from TDE and other Transitional Tools, which would unlock the next and final level or systemic capability for this function. Accordingly, the function rates highly in the future from a technology standpoint..

Table 29 - Market Information systems required

Systems and tools required	Purpose
Market Data Publishing Platform	A dedicated system or module that collects, formats, and publishes market data (dispatch, prices, constraints, outages) to participants and the public. Should support secure and version-controlled publication.
Data Visualisation and Analytics Layer (e.g. Power BI, Tableau)	(can be coupled with Performance Reporting function) Provides internal dashboards for trend detection, summary statistics, and insight generation. Supports transparency and internal review before publication.

Systems and tools required	Purpose
Integration with TDE	Automatically pulls dispatch schedules, prices, and merit order outputs for packaging into published reports. Ensures consistency across systems

6.5.4 Settlements

The Settlements function is expected to change significantly in future if the reform, [redacted] progresses to implementation.

The I-NTEM, is not a market in the conventional sense of an electricity market. It is a **virtual market**, where generators and retailers have pre-existing off-market bilateral contracts in place and NTESMO provides settlement statements to them at the end of a settlement period. The settlement statements are a compiled aggregation of the meter data records that shows the total quantity of energy consumed within that settlement period during each 30-min interval. The generator and retailer, based on these statements and their agreement, settle the payments among themselves. NTESMO does not have a role to play in the actual transactional settlement, or put better, in a physical settlement.

If the reform measures, as proposed previously, come into force, the NT market would shift from a virtual settlements market to that of a **physical settlement market**. This would effectively mean that NTESMO would become a clearing house, settling transactions between entities, collecting payments from buyers and making payments to sellers of the electricity commodity and ESS (should the reform proposal introduce that a separate market for ESS procurement is to be created). We note that the proposals in the past have introduced that the future NTEM would be a capacity-market and not an energy-only market. Regardless of which type of market it ends up being, if the market is to move from that of a virtual settlement to a physical one, the Settlements function within NTESMO will look entirely different to what it is like today and will have different requirements in terms of the capability and capacity going forward.

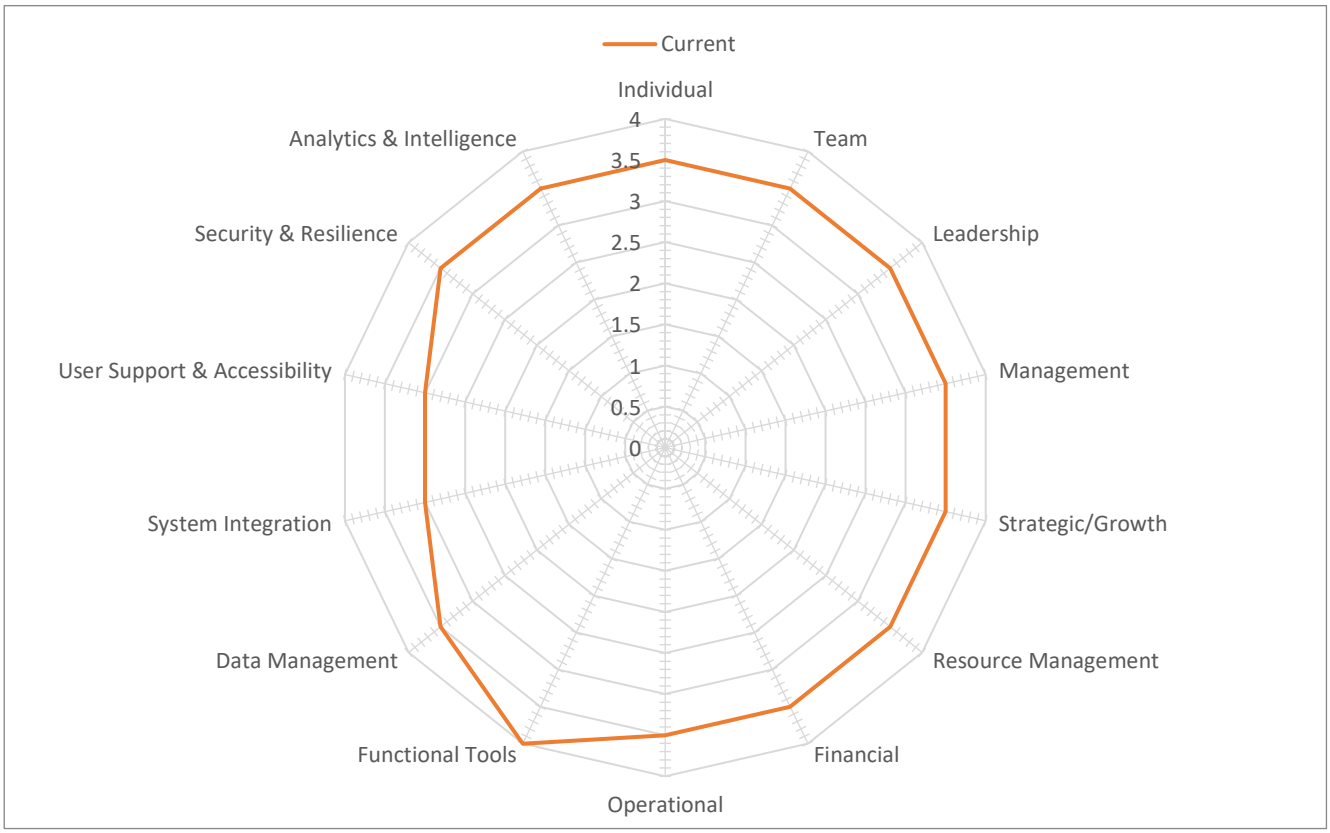
Since it is a significant change that is anticipated for the Settlements function in the future, regardless of if it occurs or not, considering it within this review is warranted to be holistic in conducting the capability review for NTESMO's future. Therefore, it is important to note that the current and future state capability assessments for this function must be considered independently and a conclusion comparing the two must not be drawn. The reason for this distinction is that the contexts of current and future states in this function are entirely different and a comparison of the two will not be appropriate and result in drawing incorrect conclusions.

For the avoidance of doubt the respective contexts for current and future states are as follow:

- Settlements function current state context: The I-NTEM, as it currently stands and operates, is a virtual settlement market as described above.
- Settlements function future state context: The NTEM, as it may evolve into and stand to operate as in the future, will be a physical settlement market as described above.

6.5.4.1 Current state capability: People, Process, Technology

Figure 17 – 2.4 Settlements function current state capability



No benchmark has been utilised to assess NTESMO's current state capability for the Settlements function, given that in Australia, the NT market is unique in the way that it is set up and operates and would not allow for a like for like comparison should an equivalent benchmark in the Australian context is utilised. As for an international benchmark, all the jurisdictions discussed in section 5.1, which for reference are mature markets, operate a physical settlement market (may perhaps operate a virtual market in parallel to physical markets). Therefore, we have chosen to exclude a benchmark for this capability. However, the scoring scale and capability maturity levels carry the same weight as they do for the assessments performed on functions preceding this.

People

NTESMO's current capability is driven by a small team including a few technically proficient individuals performing high level reconciliation and invoice preparation via the EnDimensions settlement engine. These individuals understand system operations and have adapted current tools effectively (and developed new tools) for both data analysis and the provision of additional supporting information to market participants. As of 1 July 2025 there will be greater system integration between NTESMO, Metering Unit and market participants with the utilisation of AEMO's Marker Settlements And Transfer Solutions (MSATS) system for Business-to-Business (B2B) transactions and meter data delivery. This will replace a lot of the remaining current manual processes such as loading meter data into the EnDimensions Settlement engine.

Performance-wise, despite the challenges in meeting strict regulatory timeframes with respect to the submission of settlement statements due to a variety of factors upstream and outside of the team's control, the function consistently meets its key performance indicators (KPIs). Therefore the people capability in the current state within this function has been rated highly.

Process

Current state processes for settlements are highly standardised through the use of the EnDiemnsions settlements tool. engine and analytical tools. Those processes that are manual (such as loading the data onto the EnDiemnsions'

platform) are changing as of 1 July 2025 with the deployment of the MSATS as a basis of its B2B communication protocol to underpin data delivery for settlements and B2B transactions between market participants. It is worth noting that NTESMO does not intend to use the Settlement component of MSATS and will be using their own settlement system built by EnDimensions. Settlement cycles are executed reliably and with the MSATS deployment which will also ensure that the meter data delivery takes place daily as opposed to manually collecting monthly data at the end of each month.

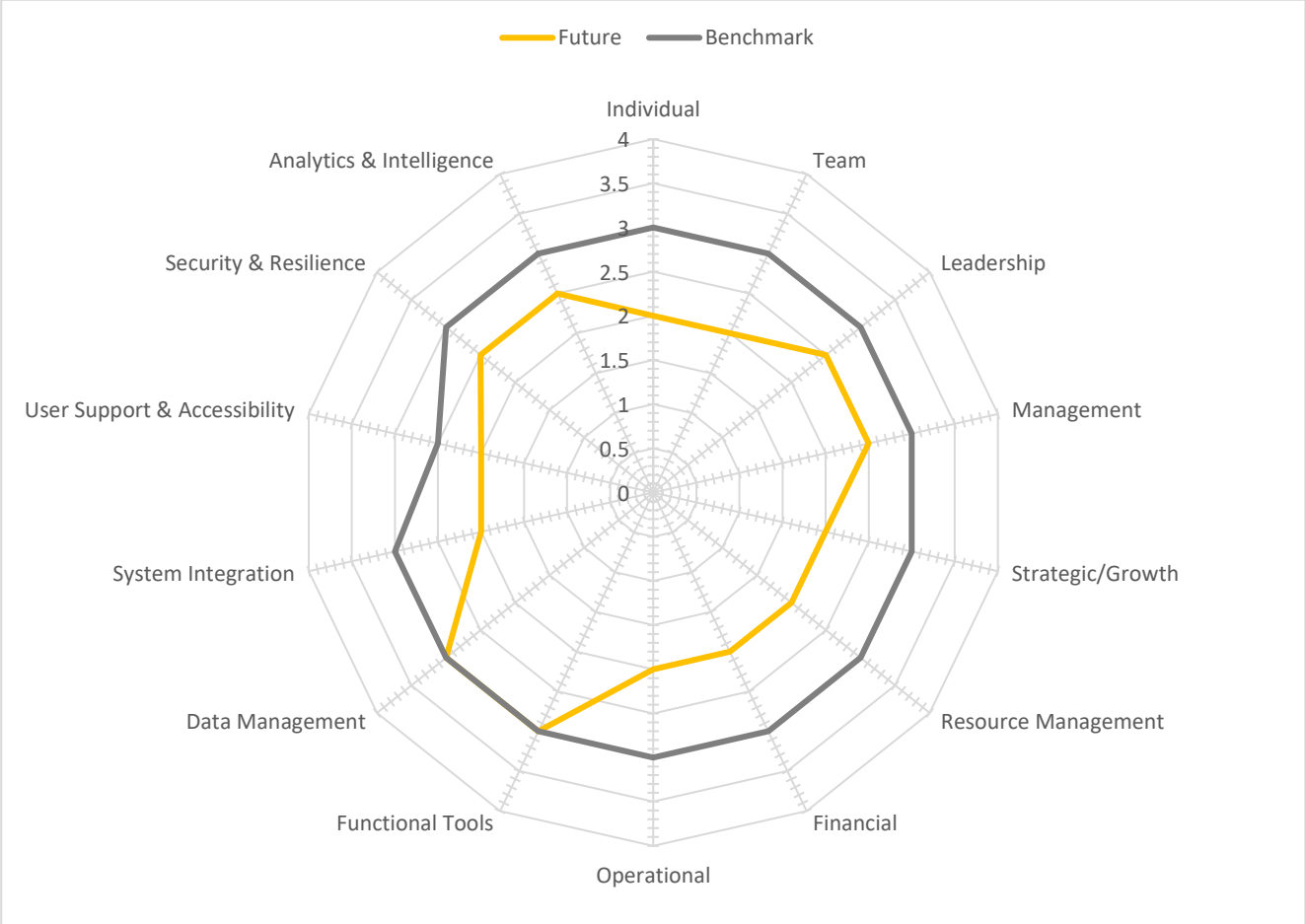
All factors in the process capability assessment metric rate highly in the current state owing to a standardised process of extracting meter data, validating it, and processing it to prepare settlement statements. This team's function also includes managing the meter changes (from one retailer to another) from a data perspective, extracting and processing any meters that may have changed during a settlement period. A mix of tools are utilised currently that enable process standardisation within the function. Overall this function has a robust set of processes that enable smooth and effective delivery of the outcomes from this function.

Technology

NTESMO performs settlements via the EnDimensions' settlement tool called EnSuite which is used to conduct settlements and automate settlement invoices and credit notes. This system is used by other electricity market operators around the world including the California Independent System Operator (CAISO). The MSATS implementation for automated meter data delivery is another example of this function leading by a margin in terms of scoring highly on the technology front.

The two areas that score relatively poorly but still are at mature levels of capability are in the System Integration and User Support and Accessibility. System integration scores lower than other aspects in this area because the systems used by this function are far more advanced than the speed of deployment of other planned systems at NTESMO, thereby lacking the necessary integration to those. However, the ability to be integrated once wider systems like the TDE and other Transitional Tools are deployed also favours a higher score for the capability. With respect to User Support and Accessibility there is a deficit in the capability from an ICT perspective thus scoring lower than other aspects. Given NTESMO's systems operate on a basis such that IT services are leveraged from Power and Water through (implicit) SLAs, there is a risk that if the systems go down due to any reason and not rectified in a timely manner owing to any reason there may be knock-on impacts on this function that would materially affect the market participants.

6.5.4.2 Future state capability: People, Process, Technology



People

In the context of what is likely to change in the future, NTESMO's future state capability is expected to weaken from a people perspective, if not proactively restructured. With the potential transition to cash settlements, NTESMO will need to act as a financial clearing house, assuming full responsibility for calculating, issuing, and reconciling payments between market participants instead of issuing virtual settlement statements that depict MWh amounts only. This will require additional personnel and leadership within the team who possesses deeper financial, regulatory, and prudential experience – skillsets that currently do not exist in-house.

While the current leadership and management can provide the strategic steering and oversight for the overall functioning of the unit even in a cash settlement future, this shift will require a transformation in the functioning of the unit itself. The current capability is centred around data reconciliation, extraction, validation, and processing along with elements of market information publication and some dispute resolution (largely in relation to the meter change between retailers). The future with a cash settlement and a clearing house setup means that NTESMO will need to process settlements more frequently than the current frequency. For example, AEMO settles the market typically every week. NTESMO will be required to undertake prudential financial management of market participants to monitor their exposure and ensure they can meet their obligations. These capabilities do not exist currently thus rated low.

Process

Future processes must support, multi-layered validation, automated invoice generation (this capability exists in the EnSuite tool but not utilised at present), and secure participant communications in relation to the financial transactional statements and other settlement details. They must also include robust prudential management processes where the monitoring of market participants' exposure occurs continuously to ensure that they can meet their obligations. There are newer processes such as the transaction management and financial management processes to be establish that

manage the cash inflows and outflows based on the settlement statements and that this takes place automatically in a secure way once validated through a mechanism (such as Austraclear). These would also require the establishment of processes that are outward facing for the market participants that provides information on the settlement processes and the systems, tools, processes that they are required to set up to facilitate integrating with NTESMO.

These capabilities were not found to be present in the processes currently, given this complexity is not required in the current state. Furthermore, it was a observed that NTESMO's knowledge and understanding of the processes that would be required to be established in a move to a cash settlement future was relatively advanced, thus enabling a higher-than-average scores in the capability rating.

Technology

NTESMO current has the market management system from EnDimensions that is fully capable and readily adaptable to effect any change required in the future if the present-day virtual market moves to a cash settlement basis. The modules that can integrate directly with the TDE and wider applications in use at NTESMO evidence that the capability exists at a reasonably high level. It however depends on the wider systems that are planned to be deployed over the coming period at NTESMO including various modules of the TDE package which present a slight risk in terms of the integration. Furthermore, the financial management system required to facilitate transactions and prudential management is yet to be determined and thus affects the integration aspect of the capability scoring.

Table 30 - Settlements function skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
4.8 (it is fit-for-purpose and suitable for the current state of the NT market that requires a virtual settlement market)	5.8 (assumes that the additional capability for Prudential financial management, credit and risk assessment capability, and an overall financial settlement management capability is warranted in the future should NTESMO be required to transition to a cash settlement market)	Current process is largely automated with the Market Management System and MSATS deployment. Future state will require NTESMO to act as a physical settlement agent, manage prudential obligations, and respond to increased data complexity and regulatory scrutiny. Function will need financial, analytical, and compliance skills and that could come from an additional FTE being added to the team	Financial reconciliation and reporting Market rules interpretation (settlements-specific) Data analysis and meter validation Prudential risk management Regulatory audit response Invoice management and exception handling

Table 31 - Settlement systems required

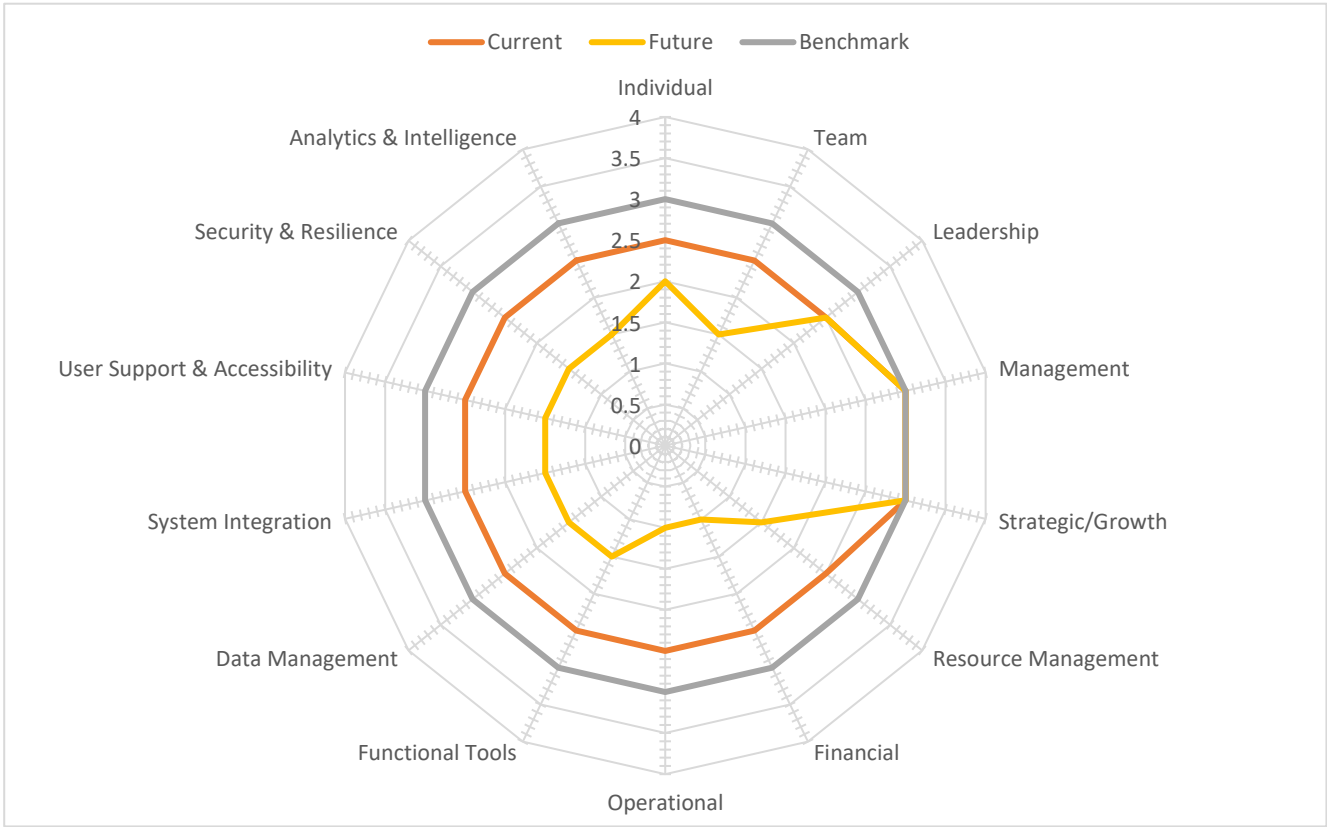
Systems and tools required	Purpose
Settlements Engine (core platform)	EnDimensions' platform implemented already and been In use since November 2023.
Meter Data Integration (e.g. MSATS link or alternative)	MSATS planned to go live in in July 2025 and will be automatically delivering meter data to the settlement engine daily as well facilitating B2B transactions between market participants for data delivery and customer transfers.
Invoice Generation Module (if NTESMO is required to move to a cash settlement market)	Creates and distributes compliant invoices, manages due dates, and enables structured reconciliation
Prudential Risk Management Tool (if NTESMO is required to move to a cash settlement market)	Tracks participant exposure against posted collateral or credit limits. Triggers margin calls or breaches.

Systems and tools required	Purpose
Dispute and Exception Handling Workflow (if NTESMO is required to move to a cash settlement market)	Manages settlement discrepancies, logs participant disputes, supports resolution timelines, and ensures transparent closure.
Participant Portal / Statement Viewer (if NTESMO is required to move to a cash settlement market)	enables participants to view invoices, transaction logs, and prudential positions. Supports transparency and data self-service.

6.5.5 Supply Procurement, Market Rules, and Government and Industry Liaison

Given these are three (3) new functions that are likely to be required in the future, they are being assessed as part of this review. Therefore, similar to Corporate Services function these are being assessed at an aggregated level. To the extent practical, we have outlined any skills and systems that were identified as gaps in capability to deliver these functions.

Figure 18 - 2.5, 2.7, and 2.8 capability



6.5.5.1 People

Benchmark operators allocate dedicated resources to each of these areas:

- Procurement teams with commercial, legal, and technical evaluation expertise.
- Market Rules teams with legal, regulatory, and policy advisory capability, supporting consultation and rule drafting.
- Government and Industry Liaison staff with senior stakeholder engagement and strategic communications responsibilities.

NTESMO's current capability across all three functions is approaching the benchmark, given the relative requirements of these functions in the NT at present. To carry out these functions, NTESMO is reliant on a small number of people working in the Electricity and Market Reform team. Personnel involved in carrying out elements of these functions are experienced, capable leaders and managers. However, some of them operate across a wider variety of functions within system operations and market operations as well. Some of these functions (Supply Procurement for instance) are essentially not regulated functions in the current state context [redacted]

Current state scores are largely flat across these three functions given the relative need of these functions at this stage. Rules drafting, although not necessarily anticipated requiring a lot of effort in the future either, is a minor function performed in the current state to the extent that the SCTC requires amending, if any. Drafting is outsourced with legal review performed by resources from Power and Water – which is sufficient for the current state requirement. Personnel from this function are repurposed when not required. Government liaison currently is performed through the appropriate channels with Power and Water, while Supply Procurement is not a required function currently.

Future state capability remains stable in the leadership and management categories, however, scores low across individuals and teams given the need to add additional capability that is dedicated to these functions due to anticipated necessity under the reform. Capability required to carry out these functions in a future state that can be envisioned from the reform are as follows:

- Procurement and commercial management for the supply procurement function which, as noted in the TEM Reform, would consist of a panel with NTESMO, NT Government, Power and Water, and an independent electricity expert,
- Legal and regulatory capability in-house to manage both the procurement and market rules aspects within NTESMO, and
- Stakeholder management capability that effectively liaises with both the industry and government stakeholders.

Auxiliary capability required is listed in the table below.

Table 32 - Function 2.5, 2.7, 2.8 skills and capacity required (combined)

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
6.6 FTE	8.1 FTE (detailed allocation in Appendix C)	Future requires NTESMO to centrally procure services, shape market rules, and represent market operator positions to government and stakeholders. Each function has distinct skill needs and must be independently resourced	Commercial negotiation (Procurement) Technical bid evaluation (leverage Connections team) Regulatory drafting / amendments (Market Rules) Consultation and issues management Stakeholder strategy (Govt/Industry) Policy analysis and briefings Legal and compliance input

6.5.5.2 Process

Benchmark processes are defined, structured, and linked to regulatory instruments:

- Procurement follows probity protocols, evaluation frameworks, and milestone tracking.
- Rule development follows published consultation procedures, review windows, and drafting guidelines.
- Government liaison is governed by comms protocols, issue logs, and briefing cycles aligned to key decision points.

Current processes at NTESMO are partially existent for those functions performed currently. The scores therefore are less than benchmark, reflective of the same. Though not overly complex and requiring multi-step workflow mapping, processes are existent at present, to the extent that functions relating to rules (present day SCTC) and stakeholder liaison are required to be performed. Reform-specific staffing is limited and likely temporary in nature but may have a pathway to be repurposed within the newer functions created as part of the reform.

Future process capability is expected to worsen in all but one segment. The appointment of the reform-specific resource and the capability in the leadership and management to drive strategic decision-making that enables reform implementation shows forward thinking processes in the organisational thinking for this function. However, the other aspects are bound to worsen over time if additional reinforcement is not built in processes. Given the impact of reform is likely to be evident on these three functions at the earliest, it is imperative to establish robust, well-designed, and simple processes and procedures. Unless NTESMO embeds process ownership, accountability layers, and public-facing governance protocols, these functions will continue to lag behind expectations for an independent market body.

6.5.5.3 Technology

Benchmark operators use specialised tools to deliver these roles:

- E-tendering platforms and contract management systems (for procurement),
- Online consultation platforms and version-controlled rule libraries (for rules),
- Stakeholder engagement CRMs and issue trackers (for liaison).

Current technology capability is almost non-existent. No platform is in use today for any of these functions. The functions currently performed, associated with rules and stakeholder liaison, utilise the standard basic platforms such as MS Office suite applications for communication. Procurement is not a currently performed function. The current capability is fit-for-purpose and thus scoring evenly. Clearly, the basic nature of these platforms, a manual Excel-based maintenance of communications records and reliance on Power and Water document management systems to track and systemise any formal document revisions (such as the SCTC) shows that it is not, yet, up to the benchmark.

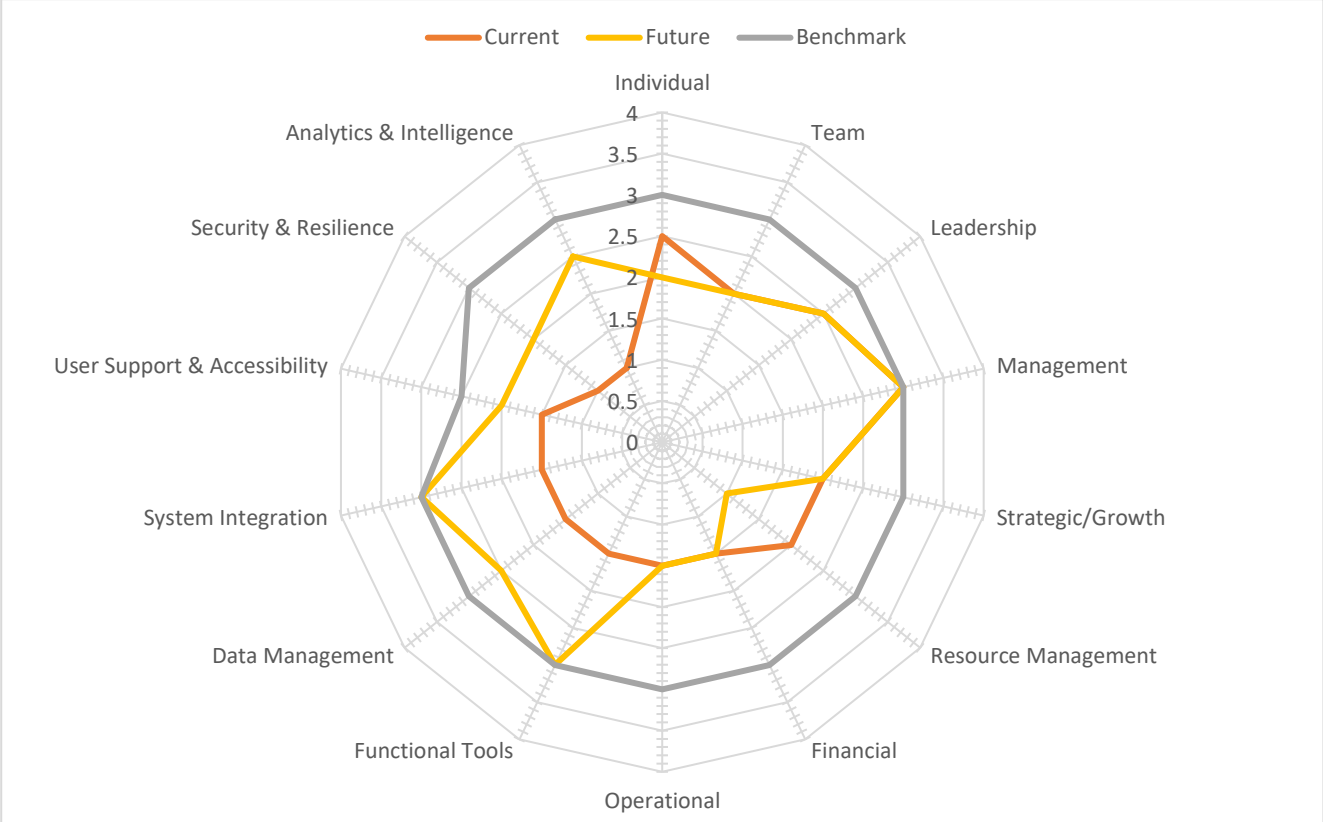
Future technology capability would require NTESMO to uplift and implement minimum viable systems to manage public consultations, procurement workflows, and strategic engagement. However, tools alone won't solve capability gaps without clarity of function ownership and role definition. The scores in the future state, therefore, are rated low given the deficit in the systems and tools required for the future.

Table 33 - 2.5, 2.7, 2.8 functions - systems and tools

Systems and tools required	Purpose
Procurement Workflow Platform	(Could perhaps re-purpose NT Government's existing portal) Manages end-to-end tender lifecycle: RFQs, submissions, evaluation, contracts.
Contract Lifecycle Management (CLM)	Tracks contract milestones, obligations, expiry, and compliance.
Market Rules Register	Houses all current rules and procedures. Supports version control, change history, and public consultation integration
Consultation / Stakeholder / Engagement Platform	Allows stakeholders to view proposals, lodge submissions, and track process timelines. Records government and industry interactions, issues raised, decisions made, and follow-up actions. Supports reporting to the NT Government, Utilities Commission, and market participants.

6.5.6 System Development and Implementation

Figure 19 - 2.6 System Development and Implementation function



6.5.6.1 People

Benchmark operators maintain in-house technology and program delivery teams with defined roles across architecture, business analysis, IT/OT portfolio management, vendor engagement, and implementation support. They typically include program managers, IT delivery leads, enterprise architects, and subject matter experts across market and operational systems.

NTESMO's current capability is fragmented, heavily dependent on a small number of internal resources working across multiple tools that all form part of the overall TDE suite and managing several vendor relationships. There is a System Development and Integration team within NTESMO, however, no clear demarcation as to what happens once the systems are developed, tested, and integrated. These systems are, therefore, often considered to be piecemeal and discreet systems working independently to each other and requiring laborious manual transfers of data and inputs. There are 4 resources within this team, however, the management having a wider focus on other market operator functions than this function alone. Team leadership is capable but requires experienced resources to execute on the function's objectives and plans. Even foundational activities like solution architecture or integration design are heavily reliant on contractors and external consultants.

Future state capability is expected to worsen slightly, given the lack of resourcing required to support with the transition to a revamped technology portfolio – with or without the reform being implemented. Specifically, the TDE implementation between now and 2027 would not only require development resources (which are expected to be external consultants and contracted resources) but some dedicated resourcing to manage the portfolio/program of works during this period. In addition to that, some capability that exists currently could be considered to be repurposed to be the ongoing resources that manage, upgrade, and continue to implement cross-organisation integration of various systems into a central technology portfolio alongside TDE. There may be some relief if the future transitions NTESMO into statutory form or as current reforms stabilise, thereby allowing dedicated resourcing and / or the direction in which priorities should lie through this function. NTESMO will remain at risk of vendor-dependency and institutional knowledge loss unless it develops internal technical capacity to scope, own, and operate future-state platforms.

Table 34 - 2.6 System Development and Integration skills and capacity

Current FTE	Future FTE	Rationale for capacity and skill level required	Skills required
4.4 FTE	5.4 (detailed allocations in Appendix C)	System ownership today is spread across reform and project leads. Future state will require centralised oversight across all tools (TDE, EMS, DMS, forecasting, settlements, etc.). Function needs capability in system delivery, lifecycle management, architecture, and integration	IT/OT systems delivery Program and portfolio management Solution architecture Vendor and contract management Systems integration and data governance Business analysis Cyber and resilience awareness

6.5.6.2 Process

Benchmark operators use structured program and portfolio management frameworks (e.g. Prince2, MSP, PMBoK), including stage-gated investment governance, release planning, test coordination, and change control. Program performance is tracked through dashboards and aligned with strategic delivery plans.

Current process capability is very limited, owing to a suite of discreet, disparate legacy system and tools that were either inherited as part of the Power and Water suite or developed as needed. There is no formal project delivery framework, no asset lifecycle model, and no system for prioritising, sequencing, or integrating multiple streams of delivery. Each system is managed as a one-off initiative. Handover between reform, operations, and IT support is ad hoc or non-existent given the lack of specific responsibilities with dedicated personnel performing these functions. Dependencies between tools are tracked informally, and implementation progress is highly person dependent.

Future state process capability requires a major uplift, posing as an opportunity to reset and document the process workflow for system development, implementation, and other aspects of the lifecycle cohesively into a common process map. A portfolio delivery framework is required (including prioritisation, risk tracking, and stakeholder governance), to enable NTESMO to operate efficiently into the future.

6.5.6.3 Technology

Benchmark operators operate modular, interoperable system architectures with API-based integration layers, centralised monitoring, and structured data governance. System development functions are supported by toolsets for version control, test management, and vendor tracking.

Current technology capability reflects NTESMO's reliance on existing tools that may not have process documentation or integration studies carried out to assess effort and resources required to implement a system wide integration exercise. transitional tools, each in varying stages of implementation. No central platform exists for managing system configuration, integration, or architecture governance. Most tools are vendor-built and contractor-implemented. There is no internal roadmap for tool alignment or standardisation. Support tools (e.g. test environments, deployment tracking) are fragmented or absent.

Future technology capability may improve as legacy tools are replaced, and project completion occurs (e.g. full deployment of TDE, EMS). However, without system ownership and internal technical stewardship, NTESMO will remain vulnerable to loss of system context, high dependency on third-party expertise, and limited innovation potential or tool evolution.

Table 35 - 2.6 System Development and Implementation skills and capacity

Systems and tools required	Purpose
Project Portfolio Management System (e.g. Smartsheet, MS Project Online)	Tracks projects across system reform and BAU, manages interdependencies, milestones, and governance gates
IT/OT System Architecture Register	Stores design documents, integration architecture, dependencies, and system limits. Supports technical debt tracking and vendor handover

Change Management and Release Coordination Tool	Enables version tracking, rollout planning, and rollback if required. Essential for coordination across parallel systems
Test Environment and Deployment Tracker	Supports UAT planning, test case logging, and defect management during implementation. Critical during transition periods.

6.6 Corporate Services

The assessment below has been performed based on the benchmark, current, and future corporate function as discussed in section 5.3.1.

Figure 20 - Corporate Services function capability

6.6.1 People

NTESMO currently lacks both the corporate headcount, and the foundational HR planning needed to evolve into a structurally independent statutory body if the NT Government established NTESMO as an independent statutory corporation. Without focused investment and transition planning, the future state faces continued risk of fragmentation and non-compliance.

Benchmark organisations (e.g. AEMO, IMO WA) typically operate as standalone statutory entities with fully formed corporate structures. Their People theme scores reflect well-defined job roles and organisational design, fully staffed functional teams for HR, finance, legal, IT and other departments, strong management and leadership layers with succession planning, and broad expertise drawn from commercial, regulatory, and strategic backgrounds

NTESMO currently scores within basic capability across all People dimensions. This is consistent with a non-existent internal corporate structure, as all corporate services are delivered via implicit or underdeveloped SLAs from Power and Water. There is no dedicated HR, finance, legal, audit, or governance, risk, and compliance resourcing (compliance from an organisational standpoint, not functional), heavy dependence on one or two senior managers for coordination of strategy, risk, and external engagement

Even under the future separated statutory entity model, capability remains weak across the People theme. This reflects the absence of implementation plans, workforce design, or established leadership for future corporate services, no currently recruited Heads of Function to prepare for the transition, and an increasing functional complexity that could erode existing leadership effectiveness in the absence of support.

Table 36 below shows the overall capacity comparison between benchmark and current and future state capacity required at NTESMO. Note that current state assumes corporate functions are effectively being delivered by Power and Water though implicit SLAs. Since this is an NTESMO review, providing commentary on Power and Water's resourcing toward this is out of the scope of this review. However, the future state assumes a separated NTESMO and has been assessed accordingly.

Table 36 - Corporate Services function capacity assessment

Level 2 Functions	Current FTE to deliver the function	Future FTE (detailed allocations in Appendix C)
0.1 Management	Delivered via an implicit SLA	3.5 FTE
0.2 Human Resources and Training	Delivered via an implicit SLA *assumed existing 1.2 FTE providing Operational Training here	3.2 FTE
0.3 Asset Management, IT and OT Services (this is the function which assumes resourcing from *Maintain Operational Systems* function in NTESMO's model	To be delivered via an explicit SLA (currently under development) *assumes existing 2 FTEs within NTESMO currently (for OT)	5.5 FTE
0.4 Legal and Regulatory	Delivered via an implicit SLA	1.5 FTE
0.5 Compliance and Audit	Delivered via an implicit SLA *assumed existing 0.8 FTE from Compliance Monitoring here	1.3 FTE
0.6 Accounting and Finance	Delivered via an implicit SLA	2.5 FTE
Total		17.5 FTE

Skills required

The FTE required envisages a future in which reform is being implemented and operationalised. Skills wise, where the FTE identification is for C-suite executives or Heads of Departments the skill-level anticipated is at board-level and senior management level. This would set effective leadership and management at the helm of a reforming NTESMO, navigating the ambiguity that comes with operationalising a reform in the midst of corporate separation, with relative ease.

A critical function is the Digital layer comprising of Asset Management, IT and OT Services. This will require a robust set of experienced personnel including senior professionals with experience in technology transformation in the utility industry, transitioning from legacy on-premises server-based approach to cloud solutions, deployment of new control and management systems including integrating custom or off-the-shelf systems into an operational-yet-transitioning system. These technical skills and implementation know-how along with critical technology portfolio management skills are essential.

6.6.2 Process

Process capability is not only low but fragile, given a lot of this capability is embedded in Power and Water's structure. The transition to statutory independence without process planning will expose NTESMO to governance risk, budget instability, and staff attrition without the ability to respond structurally.

Benchmarked operators demonstrate high capability in strategic planning, budgeting, and workforce forecasting, documented and repeatable governance processes, embedded performance frameworks, tracked through dashboards and rolling cycles, and risk-based compliance programs and internal audit functions.

NTESMO scores very low across almost all process dimensions. This reflects the complete absence of in-house processes for strategic/HR/financial planning, no documented governance, risk, or compliance framework within NTESMO itself, no use of scorecards, benchmarking, or internal feedback loops, and ad hoc and reactive reliance on Power and Water corporate functions, without process visibility or quality assurance

In the future state, some marginal uplift is expected through necessity rather than readiness. However, without embedded processes for budgeting, hiring, audit, compliance, or capital allocation, these functions remain theoretical. NTESMO risks having to define, test, and embed every core corporate service process from scratch and high initial administrative burden with low institutional knowledge.

6.6.3 Technology

Independent market and system operators operate integrated technology stacks including ERP platforms with modules for finance, HR, risk, and procurement, standalone compliance tools and contract lifecycle platforms, digital learning systems, cyber-secure document repositories, and automation of internal workflows and audit trails.

NTESMO scores quite low across technology dimensions. There are no standalone digital systems under NTESMO's control for corporate functions, there is reliance on Power and Water's platforms, accessed on a limited basis, no integration between tools and no direct ownership of system configuration, nor any embedded ICT staff managing or optimising corporate platforms.

The future state assumes modest uplift due to the assumed necessity of system deployment in the event of separation regardless of how it is delivered. We have observed some evidence of revised, explicit SLAs being developed to give effect to this reality where a separated NTESMO operates on strict SLAs on service delivery (particularly regarding systems/technology) with Power and Water. However, this remains highly dependent on implementation. There is missing evidence on ERP platform, ICT architecture for standalone operations. No specific digital service model or ICT SLA has been reviewed to say with certainty the extent of readiness. No cyber-readiness or continuity planning exists if corporate services are to operate outside Power and Water.

Systems

From a systems standpoint, the requirements for NTESMO to effectively be a standalone, statutory entity are as shown in Table 37 below.

Table 37 - Systems requirements summary for Corporate Services function

Level 2 Functions	Systems and Tools required
0.1 Management	- Executive dashboard for business performance and strategic KPI tracking - Action tracking and internal reporting tools - Secure collaboration platform for senior leadership
0.2 Human Resources and Training	- HR Information System (HRIS) with role-based access control - Payroll and leave management system - Workforce planning and capability mapping tool - Performance appraisal and learning and development module - Learning Management System (LMS) for internal training, market participant onboarding/training
0.3 Asset Management and IT OT systems	- Asset register with lifecycle tracking (for IT, ops infrastructure, facilities) - Maintenance scheduling and audit log tools
0.4 Legal and Regulatory	- Legal matter management platform (case tracking, documentation control) - Contract lifecycle management (CLM) system - Document version control and clause library - Integration with procurement and audit tools
0.5 Compliance and Audit	- GRC (Governance, Risk, Compliance) platform for: risk registers and treatment plans, and compliance calendar and audit tracking - Controlled policy and procedures repository - Breach management and incident reporting workflows
0.6 Accounting and Finance	- Enterprise financial management system - Budgeting, forecasting, and cost centre reporting tools - Invoice processing, receivables and payroll integration - Internal audit support module and regulatory reporting engine

A brief description of these systems is as follows:

- General purpose Enterprise Resource Planning (ERP) system (e.g., SAP) that includes several modules (Finance and Accounting, HR and Payroll, Compliance, Procurement) or integration plug-ins for separate third-party platforms like Asset Management and other platforms NTESMO may already be using.

- Enterprise Asset Management (EAM) solutions like IBM Maximo or Service Now IT Asset Management platforms are required (if not opting for an EAM module within an ERP system) that can integrate with the ERP system are needed to manage the asset lifecycle for the digital and control assets and systems (including transitional tools) that NTESMO will deploy in the future. Current systems are developed piecemeal, bespoke in nature and largely out of a specific need, which may cause integration issues down the line and burden resources reducing operational efficiencies.
- Document Management System is a small but necessary requirement for NTESMO given increased reporting requirements as statutory organisation and other regulatory requirements. Furthermore, communications and publications would increase several fold in order to continuously review, update, and maintain SCTC, Market Procedures, notices among a range of other market facing publications.

6.7 Capability assessment summary

Current state analysis: NTESMO is managing the current system (consider only System and Market Operations in this instance) but capability is stretched, the ability to manage risk is low, and performance depends on individual effort and processes that appear workaround intensive.

- System Operations is the function operating with relative stability. Capability across all three dimensions is functional, though heavily person-dependent and manually executed.
- Market Operations is fragile but currently delivering core outputs (e.g. dispatch scheduling) with significant manual effort, basic tools, and informal processes with the capability lifted by the settlements function alone.
- Corporate Services is not required as part of NTESMO's regulated function at present. However, it has been reviewed in the context of future addition to provide a holistic assessment. All support functions (HR, finance, legal, IT) are delivered via implicit SLAs with Power and Water. Internal ownership, leadership depth, and digital enablement are minimal to non-existent, owing to limited mapping of implicit requirements.

Future state analysis: NTESMO's current structure and capability are not sufficient to support a reformed electricity market or a separated NTESMO without targeted, staged investment across People, Process, and Technology. In the absence of formalisation of corporate (a consideration if reform agenda to separate NTESMO is adopted) and reform-enabling functions, the organisation will face significant risk to operational integrity and reform execution. This includes the execution of the additional functions outlined in the reform program to be potentially executed by NTESMO.

- Capability either declines or remains stable across most functions when measured against the demands of a reform, including statutory separation, physical market operation, and centralised procurement. Certain functions are required in the future and thus have no or limited current capability to carry those out in the future thus necessitating building that capability through recruitment. Certain capability sees improvement either across People, given the surplus in a certain function where demand is expected to reduce, or Technology aspects given the uplift in certain planned system upgrades that have already been delivered or are underway.
- Corporate Services remains underprepared, with no uplift forecast for necessitating a structural reset and full organisational design, however, only relevant in the event of a full separation
- System Operations faces slight regression due to increased system complexity (DER, ESS and co-optimised dispatch), but a balancing impact from some systemic upgrades including upgraded EMS, introduction of OMS, DMS, and forecasting tools alongside SCADA integration of these modules. Aging workforce is a risk, but with appropriate succession planning and training to exploit decision-support tools that are embedded in the function, this can be addressed.

Market Operations shows a mix of readiness for the future and a regression in a few areas. Readiness comes from a major overhaul of the systems and tools that have either already been implemented and are future-ready (e.g. Settlements platform) or are planned systemic upgrades (e.g. the TDE suite and packages). Key concern then becomes around the people and processes that need to match the potential which has them leverage the platforms to seamlessly progress into a reform-ready environment.

<1 >2 and <3 >3

		Corporate Functions						System Operations							Market Operations							
		Management	Human Resources & Training	Asset Management, IT and OT Services	Legal and Regulatory	Compliance and Audit	Accounting and Finance	System and Operational Planning	Forecasting	Connections	Outage Management	R-T Monitoring and Control	Performance Reporting	Network Operations	Participant Support and Market Registration	Dispatch Scheduling	Market Information	Settlements	Supply Procurement	System Development and Implementation	Market Rules	Government and Industry Liaison
	F.No.	0.1	0.2	0.3	0.4	0.5	0.6	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
Current	People	0.0	1.0	1.0	0.0	1.0	0.0	2	2.0	2.5	3	3	3	3	3	2.5	2.5	3.5	1.0	2.5	3	2
	Process	0.0	0.0	0.0	0.0	0.0	0.0	2	2.5	2	2.5	2	2.5	3	2.5	2	2	3.5	0.0	1.5	2.5	2.5
	Technology	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	2	1.5	2	2	2	2.5	1.5	2	3	0.0	1.5	2.5	2.5
Future	People	0.0	1.0	1.0	0.0	1.0	0.0	2.5	2	3	2.5	3	2.5	2.5	2.5	2	2	2	2	2	2	2
	Process	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2	1.5	1.5	1.5	1.5
	Technology	0.0	0.0	0.0	0.0	0.0	0.0	2	2	1.5	2	2.5	1.5	2	2	3	2.5	3	1.5	2.5	1.5	1.5

7. Recommendations

This section outlines the recommendations arising from the assessment of NTESMO's current and future capability and capacity to deliver the functions of a power system and market operator under a transitioning electricity market. These recommendations are intended to support NTESMO in strengthening its functional maturity, preparing for potential market reform, and managing increasing system complexity.

1. Build a bespoke resourcing strategy
   NTESMO's current recruitment regime is reactive and caters to fill a void but is unable to factor in the strategic, long-term resourcing requirement of a modern power system. This is due to a variety of reasons from regulatory caps to an uncertain reform. To prepare itself for the future, a systematic, methodical approach to resourcing strategy is recommended to ensure maximum utilisation of the latent capability within the organisation and the new capability required.

2. Increase depth and diversity of staffing across critical functions
   NTESMO's current workforce is aging, has skills that are rapidly in need of an evolution with the changing needs of the power system. This, along with a heavy reliance on junior (often part-time undergraduate) resources across operational and market functions poses a risk to carry out the functions that require a mix of the industry-hardened experience with the new-age agility to leverage decision-support tools. This creates a skill bottleneck, limits succession planning, and increases operational risk. Immediate targeted recruitment of mid-to-senior resources across Forecasting, Real-Time Control, Dispatch Scheduling, Settlements, and Reform is recommended.

3. Undertake necessary succession and resource planning

NTESMO is subject to significant change to its operating and regulatory environment which will impact the necessary skills mix required to undertake its function. This requirement is compounded by the aging composition of particularly staff undertaking the System Operation function and the expanding reliance of systems to undertake this function.

4. Embed cross-functional collaboration and knowledge transfer
   Critical operational insights from real-time teams are not systematically shared with Forecasting, Market Reform, or Connections functions. Establish regular knowledge exchange loops across functional boundaries, potentially through a rotating integration role or a cross-functional operations analyst team.

5. Develop a transition roadmap for potential separation from Power and Water
   While separation is not currently mandated, NTESMO should prepare a staged transition plan detailing governance, finance, ICT, legal, and HR capability requirements. This will allow optionality and reduce risk if separation is enacted. We note that the SLAs have been mapped that would be required to be in place, in the event that NTESMO decides to operate on that basis for an interim period. However, transition planning does not need to wait for a formal announcement on legal separation.

6. Expedite delivery of the TDE and establish an Asset Management function (assumed in corporate functions)
   The manual dispatch scheduling process is unsustainable and exposes the system to cost, compliance, and stability risks. TDE is essential not only for market optimisation but to enable automated merit-order dispatch, spinning reserve co-optimisation, and real-time constraints handling. The lack of a dedicated asset manager to manage the lifecycle from inception to decommissioning of systems and assets that NTESMO has (primarily operational technology systems and tools) creates the issue of piecemeal technology deployment and issues with integration thereby disabling seamless operations / data hand off. An immediate need is to secure an asset management function regardless of the status and pace of the reform. Given that the TDE program may kick off in the immediate term, the time is opportune to add this capability.

7. Invest in supporting operational platforms
   To maintain system security and transparency, NTESMO must move away from spreadsheet-based tracking and toward platform-based operational execution. Priority systems include DMS (for network and outage management), OMS (for integrated outage planning), and EMS/SCADA enhancements (for real-time visibility).

8. Advocate for role clarity and cost-recovery certainty
   The blurring of roles between NT Government and NTESMO in reform design and implementation has created

uncertainty and strain. NTESMO should actively seek formal confirmation of its responsibilities under reform, supported by clear funding models, and articulate the minimum viable functional footprint required to deliver those roles.

Appendix A – List of documents reviewed

Filename	Description
TEM reform program overview paper	8-page overview published by the NT Government describing NTEM Reform
System-Control_Technical_Code-V7	The current system and market operation protocol
Shopping list of SCTC and NTC areas of amendment	List of areas of amendment required to be addressed in SCTC/NTC revisions that allow efficient network, system, and market operations.
Power and Water change management standard	The Power and Water Change Management Standard supports the People Policy Statement and aims to outline the minimum and mandatory requirements for: ▪ supporting people through change ▪ embedding changes so that they become new and sustainable ways of working ▪ achieving our organisational goals.
NTESMO SLA Progress	This document tracks the status of the different SLAs that are in the process of being developed for the scenario where NTESMO fully separates from Power and Water , while retaining the ability to receive corporate services incl HR, IT among others.
2025.02.27 - NTESMO structure	List of personnel within NTESMO (incl. contractors) split by Market Operations (incl. Market Reform) and System Control functions - allocated to specific teams within the two major functional groups.
2025.02.14 - NTESMO work program briefing	Overview document elucidating what work programs are being carried out at NTESMO and why in order to preserve system security and reliability in the context of TEM Reform.
2025.02.13 - Planning and functional capability kick off meeting	RFQ0036 and RFQ0037 kick off meeting presentation that provides context and background on NTESMO and the market reform.
2025.02.13 - NTESMO's functional capability review	Current state functional process documentation review. It lists down how well documented the various functional processes within NTESMO are
2024.09 - NTESMO current state capability and functional model - responsibility	Document listing down the 2 functional groups, 14 functions, and 79 sub-functions
Current State Capability and Functional Model - Level 2,3 and 4	Document clarifying the Level 1, 2, 3, and 4 functional classification
Functional Capability Review 022025 with evidence	Document preceding the *2025.02.13 - NTESMO's functional capability review* - containing same information
Various	Visio files for processes (and work steps) for some L4 functions.

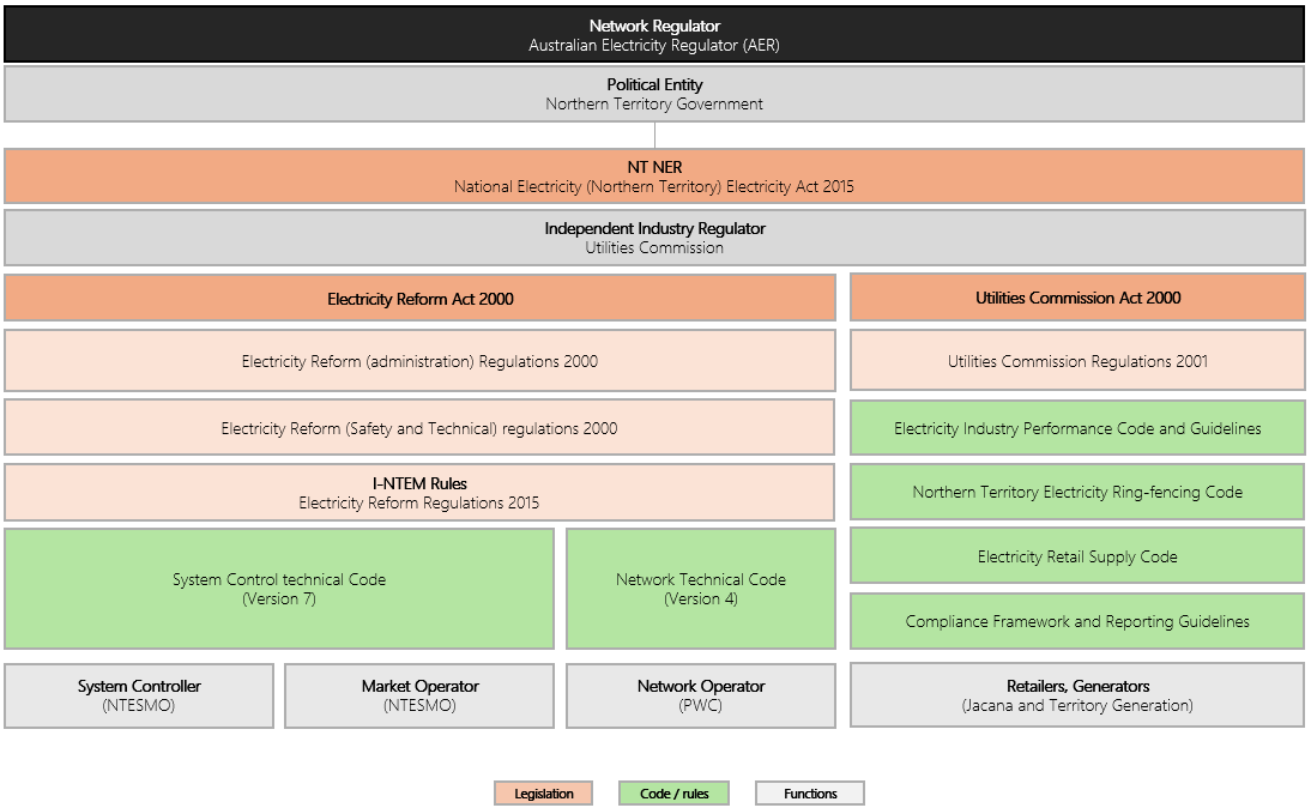
Filename	Description
[redacted]	[redacted]
DKIS Challenges - Drivers for Change	Describes the context for the trends, implications, and operational challenges being faced by the DKPS
NTESMO work program and TDE project briefing Feb -25 (D2025-074202)	Provides context for TDE and lays out an overview of the TDE work program
Summary - NTESMO Dispatch System Roadmap	Executive Summary document derived from TDE Business Case
Concept Proposal for EMRT Project Delivery	Describes the proposal for capability and capacity uplift required within the Project Delivery function at NTESMO for the NTEM Reform
Concept to Delivery End to End v2.0	Described the end to end conception to delivery process in NTESMO's context
EMRT BU Planning Day 27 February 2025	Electricity and Market Reform business unit planning, achievements, organisational update
[redacted]	[redacted]
Visio-Desktop Maturity Assessment - Power and Water NTESMO v1.0	NTESMO's function as the system controller and market operator visualised in a form depicting whether or not and to what degree have the systems and processes digitised compared to those that need manual processing.
[redacted]	[redacted]
NTESMO resource requirements FY2025-FY2028 (D2025-108221)	NTESMO's Reform team's analysis of prospective activities, work programs, tasks, and workload to form part of NTESMO's responsibility in delivering, implementing, and managing the reform and the associated resourcing (personnel-only) required to meet the workload anticipated
Overview of NT regulatory framework	An organised view of the different legislations, regulations, standards, licensed functions, codes / rules, guidelines, procedures, and amendments applicable in the NTEM.

Filename	Description
TEM Reforms overview of market design elements	Depicts the market design areas that are impacted by current TEM reforms
Real Time Ops - Employees	List of current Real Time Ops employees, current org chart for Real time ops, and proposed structure and resourcing within the Reform changes.

Appendix B – Applicable codes, standards, rules and legislation

This appendix provides a description of legislation, rules and codes that govern and regulate the Northern Territory Electricity Market. Figure 21 illustrates the NT regulatory framework, and the codes and rules that guide the roles and responsibilities of the different stakeholders in the NTEM.

Figure 21 - NT Regulatory Framework



Note: The NT regulatory framework is simplified and only includes the key legislation, rules, codes and main market functions.

The National (Northern Territory) Electricity Act 2015 (NT NER) is the legislation that governments the Northern Territory Electricity Market. It is a modified version of the National Electricity Rules tailored for the Northern Territory and is managed by the Australian Electricity Regulator (AER). It governs market operations, network connection and access, economic regulation, metering, and includes specific jurisdictional modifications to suit the local electricity systems, and it specifies the different roles and responsibilities within the NTEM.

As identified in the NT NER, the Utilities Commission is the Independent Industry regulator, and is responsible for:

- Promoting competition and fair market conduct and preventing the misuse of monopoly power.
- Setting and monitoring prices for electricity, water, and sewerage services.
- Issuing licenses to market participants and ensuring compliance with regulatory requirements.

The Northern Territory Electricity System is regulated by the Electricity Reform Act 2000[46] and the Utilities Commission Act 2000[47]. In line with the evolution of the NTEM, as described in Section 2.2, modifications have progressively been

[46] Electricity Reform Act 2000
[47] Utilities Commission Act 2000

applied to the statutory framework e.g. The Electricity Reform Act 2015[48] (I-NTEM Rules), that specifies the code of the System and Market Operator functions under the current I-NTEM.

Specific territory codes and rules specifies the roles and responsibilities of the additional stakeholders in the NTEM, as highlighted in Figure 21:

- System Control Technical Code (SCTC)[49]: Establishes the standards and procedures for ensuring the secure and reliable operation of the Northern Territory's power system. It covers power system security, generation scheduling, ancillary services, and the operational responsibilities of the power system controller.

- Network Technical Code (NTC)[50]: Establishes the standards to support retail competition and efficient operations within the electricity market. It covers customer transfers between retailers, credit support arrangements, billing and metering, service order arrangements, consumer protection frameworks and dispute resolution procedures.

- Electricity Retail Supply Code[51]: Facilitates retail supply activities in the Northern Territory's electricity market, promoting competition while protecting market integrity. It includes rules for customer transfers, credit support, billing, metrology, Retailer of Last Resort arrangements, dispute resolution, and customer protection policies.

Power and Water Corporation, through its division NTESMO, plays several pivotal roles within the electricity market and system:

- Power System Controller: NTESMO ensures the secure and reliable operation of the power system. This involves managing system constraints, addressing fuel shortages, and implementing emergency demand reduction measures such as load shedding. Additionally, NTESMO oversees the scheduling and dispatch of generation units to maintain system balance and reliability, and procures and manages ancillary services like frequency control, voltage control, and black system restart. NTESMO monitors and controls the power system to ensure it operates reliably, safely, securely, and efficiently. This includes managing reportable incidents and ensuring compliance with operational standards, as well as overseeing the secure operation of the power system, including generation scheduling and ancillary services.

- Market Operator: NTESMO is responsible for the operations of the NTEM. This includes overseeing market settlements, registering market participants, providing settlement statements to licensed market participants for off-market settlement of bilateral contracts and payment of set rates for ancillary services to T-Gen, and publishing market prices and other relevant trading data.

- Network Operator: This role, also held by the Power and Water Corporation as the licensed network service provider, involves managing and maintaining the electricity network infrastructure. Responsibilities include ensuring the network's capacity, availability, performance and security, planning and implementing network expansions and upgrades, and monitoring and troubleshooting network issues to ensure maximum uptime and reliability

[48] Electricity Reform (System Control and Market Operator Functions Code) Regulations 2015
[49] System Control Technical Code
[50] Network Technical Code - Clean Version
[51] Electricity-Retail-Supply-Code-version-5-clean.pdf

CutlerMerz

Appendix C – NTESMO Future fucntional resourcing allocation

Functions

	Filled/Vacant	Shift	PT/FT	Name	Role	Corporate Services						System Control							Market Operations							
						0.1	0.2	0.3	0.4	0.5	0.6	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
Future	Vacant				CEO	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				CFO	0.5	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				Head - Digital (Assets + IT-OT)	0.5	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				Head - Legal, Compliance, Audit	0.5	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				Head - P&C	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant		PT		Recruiter	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				HR	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current	Filled				[redacted]	0	0.2	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0
	Filled				[redacted]	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Future	Vacant				IT 1	0	0	1	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0
	Vacant		PT		IT 2	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current	Filled				[redacted]	0	0	1	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0
	Filled				[redacted]	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Future	Vacant				ICT/OT Asset Manager	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant		PT		ICT/OT Analyst / Coordinator / Architect	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0
	Vacant				Legal	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0.1	0
	Vacant				Regulatory / Pricing	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0
Current	Filled				[redacted]	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Future	Vacant		PT		Audit	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				FPA/CFA	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant				Accountant	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant		FT		Head Procurement/Contract Mgmt	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0
	Vacant		PT		Procurment manager/coordinator	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0
						3.5	3.2	5.5	1.5	1.3	2.5	0	0	0	0	0	0	0	0	0	0	0	1.4	0.5	0.6	0
Current	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0.5	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Filled	Y		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0.2	0.2	0.2	0.2	0	0.2	0	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Filled			[redacted]	[redacted]	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Current	Vacant		[redacted]	[redacted]	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0.5	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0.35	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0	0
	Vacant		[redacted]	[redacted]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Filled		[redacted]	[redacted]	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vacant		[redacted]	[redacted]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					3.5	3.2	5.5	1.5	1.3	2.5	6.5	0.8	4.3	4.3	14.1	3.3	21.7	0	0	0	0	1.4	0.5	0.6	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0.3	0.5
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0.5	0.2
			[redacted]	[redacted]	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1	0	0	0	0.8	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Vacant		[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0.2	0.4	0.1	0	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0.2	0.4	0.1	0	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0.3	0.4	0.1	0	0	0	0	0
	Vacant		[redacted]	[redacted]	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0.3	0.4	0.15	0	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0.7	0		0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0.2	0.7
			[redacted]	[redacted]	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.4
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
			[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
		PT	[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0	0
		PT	[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0	0
		PT	[redacted]	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0	0	0	0
Future	Vacant		xxxxxxxx	Prudential Financial Mgr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Future	Vacant		xxxxxxxx	Techno-Economic Modeller	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					3.5	3.2	5.5	1.5	1.3	2.5	9.8	2.15	4.3	4.3	14.1	3.3	21.7	1.35	2.05	0.8	5.8	3.8	5.4	2.3	2

								Total	100.65
Future	Head	19	Head	62	Head	25		SC	59.65
	FTE	17.5	FTE	59.65	FTE	23.5		MO	23.5
							1	Corp	17.5