CLEAN ENERGY COUNCIL FUTURE-PROOFING IN AUSTRALIA'S ELECTRICITY DISTRIBUTION INDUSTRY PROJECT

CLEAN ENERGY COUNCIL

ARENA

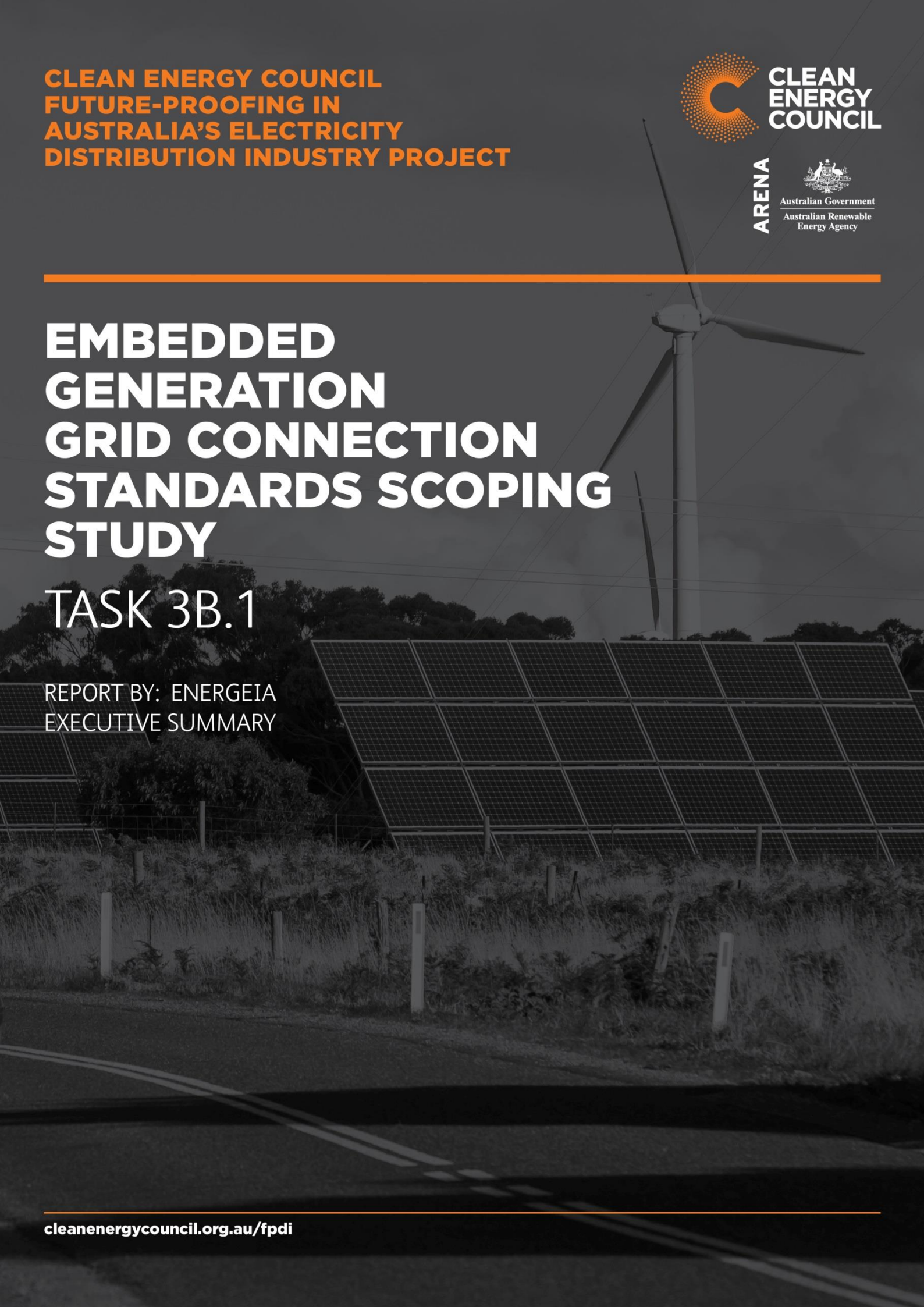
Australian Government
Australian Renewable Energy Agency

EMBEDDED GENERATION GRID CONNECTION STANDARDS SCOPING STUDY

TASK 3B.1

REPORT BY: ENERGEIA

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY
EMBEDDED GENERATION GRID CONNECTION STANDARDS SCOPING STUDY

Clean Energy Council introduction to this report

Australia's electricity markets and networks are undergoing significant change with the rapid and increasing deployment of commercial-scale 'embedded' generators such as solar PV and storage.

Consumers have invested heavily in these new and emerging technologies. Market objectives expect that these investments occur within a framework that balances economic efficiency with electricity supply security, safety and reliability. To date, the requirements to connect these generators to the local electricity grid have been established by individual Distribution Network Service Providers. They generally incorporate technical settings that are determined locally, by state and/or by related Australian and international standards.

While this approach has been effective in allowing connections, it has also led to a wide diversity of requirements for, and approaches to, embedded generator connections. These differences have led to high compliance costs for generator proponents and high assessment efforts for distribution networks. Both parties see inefficiencies and opportunity costs that are inconsistent with market objectives.

These costs could be largely resolved by a national embedded generation grid connection guideline. To understand the opportunities and benefits of producing such a guideline the Clean Energy Council engaged Energeia to analyse views across the industry and the costs and benefits of various options to develop a national guideline in the Australian context.

Energeia found that a nationally consistent guideline for the connection of mid-scale embedded generation is expected to make a significant advancement to addressing this inefficiency. The research also found that a nationally consistent approach could produce a net present value saving of $189 – $210 million over ten years for the industry.

Energeia consulted broadly with industry and recommended that an industry-led approach to the development of these guidelines would be the most cost-effective and timely means to deliver them. The Clean Energy Council supports the development of the guideline as recommended by Energeia and encourages the industry to consider this work and the shared benefits of working collaboratively to access the potential efficiency gains.

ACKNOWLEDGEMENTS

This report was produced with funding support from Australian Renewable Energy Agency (ARENA). ARENA was established by the Australian Government to make renewable energy technologies more affordable and increase the supply of renewable energy in Australia. ARENA invests in renewable energy projects, supports research and development activities, boosts job creation and industry development, and increases knowledge about renewable energy. ARENA has a portfolio of more than 240 supported projects and is actively seeking new projects to fund in 2016. For more information, visit www.arena.gov.au.

The CEC thanks Energeia for their efforts in preparing this report and the FPDI Project Steering Committee for their time and effort in providing crucial guidance and review of this work. These stakeholders include AGL, Alternative Technology Association, ARENA, AusNet Services,

Australian Energy Regulator, CSIRO, Department of Industry and Science, Energex, Energy Networks Association, Energy Retailers Association of Australia, Energy Supply Association of Australia, Marchment Hill Consulting, Pacific Hydro Pty Ltd, Sunpower and University of TechnologySydney

ABOUT THE CLEAN ENERGY COUNCIL

The Clean Energy Council is the peak body for the clean energy industry in Australia. We represent and work with hundreds of leading businesses operating in solar, wind, energy efficiency, hydro, bioenergy, energy storage, geothermal and marine along with more than 4000 solar installers.

We are committed to accelerating the transformation of Australia's energy system to one that is smarter and cleaner. For more information on this project, visit fpdi.cleanenergycouncil.org.au.

Embedded Generation Grid-Connection Standards Scoping Study

Prepared by ENERGEIA for the
Clean Energy Council

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Executive Summary

The Clean Energy Council (CEC) is currently leading the Future Proofing in Australia's Electricity Distribution Industry (FPDI) Project with the objective of enhancing the flexibility and resilience of Australia's electricity distribution system. As part of this overall objective, the FPDI Project has identified the importance of the role of embedded generation (EG) within the distribution network in providing network benefits[1] and improving the overall efficiency of the electricity system. Notwithstanding, there are a number of barriers to realising the full extent of these benefits which will require regulatory and policy reform over the medium term.

In this context, FPDI has recognised that there are potential gains to be made by improving the efficiency of the grid connection process for embedded generators. Previous studies have identified that there is a need to develop a nationally consistent set of technical requirements for grid connection, particularly for small to medium sized EG (30kW to 5MW) which are not currently covered by regulatory instruments.

This study builds on the previous studies to identify a preferred governance framework, structure and work plan for the development of a set of nationally consistent technical requirements.

Current State

Technical standards for grid connection are developed and implemented by DNSPs in a largely self-regulated framework, resulting in inconsistency between DNSPs in terms of structure, clarity, coverage and onerousness of technical requirements. These factors contribute to inefficiencies in the connection process in terms of the time required for an EG proponent to understand the exact network requirements, especially for its first few applications to a new network, as well as the DNSP's own time required to process incomplete or inappropriate applications.

As a result of a Rule change in 2014, distribution network service providers (DNSPs) are now required to produce information packs available on their websites, outlining the technical requirements for grid connection of embedded generators of all types. However, there is still no prescribed overarching governance framework or agreed structure for the DNSPs guidelines nor any guidance as to how the technical requirements should be set so as to adequately balance network risks of safety, voltage, stability and capacity issues with connection efficiency.

Non-network stakeholders, including EG proponents, have limited ability to influence the technical requirements except via submissions to the DNSPs' guideline revision process, where such processes exist, or via the Australian Energy Regulator's dispute resolution process for individual connection agreements.

Options Identification and Assessment

Energeia identified eight potential options for the governance framework for the nationally consistent set of technical requirements via review of international approaches and the current Australian approach. The eight potential options were validated with stakeholders via two stakeholder workshops in Melbourne and Sydney.

The options are summarised in Table 1.

[1] Ernst and Young (2015) Calculating the Value of Small Scale Distribution to Networks http://fpdi.cleanenergycouncil.org.au/reports/value-of-small-scale-generation.html

Table 1 – Options for Embedded Generation Connection Documentation

Option	Publisher				Supplementary DNSP Document
	CEC	ENA	CEC/ENA	AS	
Option 1B: CEC Industry Guideline	✓				
Option 1B: ENA Industry Guideline		✓			
Option 1C: CEC/ENA Industry Guideline			✓		
Option 2A: CEC Industry Guideline with supplementary DNSP documents	✓				✓
Option 2B: ENA Industry Guideline with supplementary DNSP documents		✓			✓
Option 2C: CEC/ENA Industry Guideline with supplementary DNSP documents			✓		✓
Option 3: Australian Standard				✓	
Option 4: Australian Standard with supplementary DNSP documents				✓	✓

The options were assessed via a qualitative assessment which scored each of the options in terms of their relative benefits and relative costs. The weighted average score was calculated by assigning each score a numeric value ranging from zero (✗✗✗) to five (✓✓✓).

The results of the assessment are shown in Table 2 below. Further detail on the rationale for the scoring is presented in Section 3.2.

Table 2 – Qualitative Options Assessment

	Option	Network Risk / Efficiency Balance	Benefits (Weighting 50%) High Acceptance DNSP / Adherence	Clarity of Requirements & Process	Cost (Weighting 50%) Timeframe / Cost to Implement	Weighted Average Score
OPTION 1	1.A: CEC Guidelines	✗✗✗	✗✗✗	✓	✓✓✓	3.0
	1.B: ENA Guidelines	✗✗✗	✗✗	✓	✓✓✓	3.2
	1.C: Cobranded CEC & ENA Guidelines	✓	✗✗	✓	✓✓✓	3.7
OPTION 2	2.A: CEC Guidelines & DNSP Documents	✗✗	✗	✗	✓✓	2.8
	2.B: ENA Guidelines & DNSP Documents	✗✗✗	✓✓	✗	✓✓	3.0
	2.C: Co-branded CEC & ENA Guidelines & DNSP Documents	✓✓	✓✓	✓	✓✓	3.8
OPTION 3	Australian Standards Only	✓✓✓	✓✓✓	✓✓✓	✗✗✗	2.5
OPTION 4	Australian Standards & DNSP Documents	✓✓	✓✓✓	✓✓	✗✗	2.7

✓✓✓	5	Highly desirable	✗	2	Undesirable, with minor risks
✓✓	4	Desirable, with minor risks	✗✗	1	Undesirable, with manageable risks
✓	3	Desirable, with material but manageable risks	✗✗✗	0	Undesirable, risks difficult to manage

The qualitative assessment revealed greatest potential benefits for the Australian Standard approach (Option 3 and 4) and to a lesser extent industry guidelines co-published by CEC/ENA with supplementary DNSP guidelines. These options were deemed to have high DNSP acceptance, achieve clarity and consistency and adequately balance network risks with the need for connections efficiency.

The Australian Standard options however were deemed to have a high cost and longer timeframe to implement compared to the industry guideline approach.

Energeia also developed a quantitative net benefits analysis as shown in Table 3 which provides an estimate of the benefits from implementing each of the options. The benefits analysis estimates the reduced time and effort for EG Proponents and DNSPs as a result of improved clarity of requirements, and increased consistency between DNSP documents.

Table 3 – Cost Benefit Analysis Results

Option	Net Present Value
Option 1A – CEC Industry Guideline	$189M
Option 1B – ENA Industry Guideline	$189M
Option 1C – CEC/ENA Industry Guideline	$194M
Option 2A – CEC Industry Guideline and DNSP Documents	$200M
Option 2B – ENA Industry Guideline and DNSP Documents	$200M
Option 2C – CEC/ENA Industry Guideline and DNSP Documents	$210M
Option 3 – Australian Standards	$181M
Option 4 – Australian Standards and DNSP Documents	$189M

The quantitative cost benefit assessment revealed that despite the relatively high benefits of an Australian Standard approach, the additional timeframe to produce such a document would delay the realisation of the net benefits such that the overall net benefit (in present value terms) for industry guideline approach was the highest at approximately $210M over a ten year period.

It should be noted that the superior benefit of Option 2C requires:

- Achieving 100% DNSP acceptance of the voluntary guideline in order to derive the consistency benefits without which would reduce the benefits of Option 2C to $140M
- Achieving 100% DNSP implementation of the voluntary guideline within one year of commencing the process in order to deliver the “quick wins” which could otherwise not be delivered by a lengthy Australian Standard development process
- Continuous management of the industry guideline over a ten year period to reflect changes in both EG and network technology and operation practices.

Stakeholder Preferences

While long term, there may be a benefit in the development of an Australian Standard, stakeholders agreed that an industry led process to address the “quick wins” would provide high value for money with an increased likelihood of overall success.

For the majority of stakeholders, the preferred governance framework was a tiered approach with an overarching guideline or standard governed by an industry body, with each DNSP producing its own detailed guideline aligned to a standardised template (similar to the approach adopted in the US).

For the DNSP stakeholders, this retention of control over technical requirements avoiding a one size fits all approach which could potentially expose DNSPs to unacceptable risks. Conversely, the tiered approach also avoids a "lowest common denominator" situation whereby overly onerous requirements are set based on the most complex network requirements creating unnecessary barriers to connections and reducing the connection process efficiency for both DNSP and EG proponents alike.

EG proponents were also generally supportive of the tiered approach so long as the overarching document was able to create the impetus for DNSPs to publish greater detail on network constraints with respect to embedded generation which would then enable the proponent to assess project feasibility *prior* to the application stage. EG Proponents also requested that the overarching document lead to more detailed justification when connection applications are rejected to improve future decision making.

Recommended Approach

It is recommended that a tiered framework is adopted via an industry guideline (developed by both CEC and ENA) complemented by detailed DNSP guidelines aligned to a template defining overall content and structure. This approach was deemed to adequately balance risks to DNSPs with connection efficiency, improve consistency and clarity and, where there was strong ENA direction (i.e. co-branding), would promote DNSP adherence.

Notwithstanding, it is recommended that that industry guideline is established with the potential to transition to an Australian Standard at a later date upon demonstration of a successful voluntary process.

It is further recommended that both the industry guideline and DNSP guidelines adopt a similar structure and format. The industry guideline will provide the overarching framework, high level detail and DNSP requirements for improved documentation with respect to decision making.

It is recommended that the individual DNSP guidelines are distinguished by size and technology type to ensure that smaller systems are not penalised with excessive requirements and the flexibility and in-built protection elements of inverter based technologies are recognised.

At least three different size classifications are recommended (nominally 30kW to 200kW, 200kW to 1MW, 1MW to 5MW) due to the differing protection requirements with two technology classifications (inverter based and rotating machines) so that each DNSP has a minimum of six guidelines. These definitions should be consistent across networks. Classification by voltage level should be left at the DNSP discretion depending on the relevant network.

Recommended Work Plan

The recommended work plan suggests that the industry guideline and corresponding consistent DNSP guidelines can be produced with a one year period at a cost of $575,000 (+/-30%), of which approximately 30% could be supplied by in kind support from industry by way of participation in workshops.

These costs exclude any costs to DNSPs to update their own guidelines to be consistent with the industry guideline. It is assumed that the incremental costs to update the DNSP guidelines would be negligible and could be undertaken as part of the regular review of their connection guidelines. Notwithstanding, it is noted that some DNSPs will require updates to their processes and procedures in order to ensure consistency with the guidelines. This may include upgrades to their connection applications processing procedures, training of staff and updates to websites.

The work plan suggests the formation of a Steering Committee with both CEC and ENA representation and relevant member organisations. The work plan also suggests five separate technical working groups to address the key technical issues as identified by stakeholders which would be comprised of combinations of some or all of the following ten key technical issues as identified by stakeholders:

- Connection Arrangements
- Generator Requirements
- Protection
- Power Quality
- Communications
- SCADA
- Treatment of Storage
- Network Technical Study Requirements
- Testing and Commissioning (and Accreditation of Testers)
- Calculation of Fees and Charges

The industry guideline would need to be delivered within a six month period to allow DNSPs to update their own guidelines and any relevant internal processes such that a full set of standardised guidelines would be in place within a 12 month period. The high level schedule is shown in Figure 1 below.

Figure 1 – Preferred Option Work Plan

Tasks	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13
1. Define Governance Arrangements													
1.1. Establish Steering Committee Terms of Reference													
1.2. Request, review nominations and appoint Steering Committee members													
1.3. Convene 1st Steering Committee Workshop													
1.4. Establish Technical Working Group Terms of Reference													
1.5. Request and review nominations for Technical Working Group members													
1.6. Convene 2nd Steering Committee Meeting													
2. Scope and Explore Key Technical Issues													
2.1. Convene 1st Technical Working Group meetings													
2.2. Prepare Draft Issues Papers													
2.3. Convene 2nd Technical Working Group meetings													
2.4. Prepare Final Issues Papers													
2.5. Publish Final Issues Papers and solicit public feedback													
2.6. Collate public feedback													
2.7. Convene 3rd Technical Working Group meetings													
2.8. Convene 3rd Steering Committee Workshop													
3. Preparation of Industry Guideline													
3.1. Prepare Draft Guideline													
3.2. Convene 4th Steering Committee Workshop													
3.3. Revise Draft Guideline													
3.4. Publish Draft Guideline and solicit public feedback													
3.5. Collate feedback													
3.6. Convene 5th Steering Committee Workshop													
3.7. Prepare Final Guideline													
4. Preparation of DNSP Guidelines													
4.1. Review of Industry Guideline													
4.2. Internal business workshops													
4.3. Draft 1 DNSP Guideline													
4.4. Internal business review													
4.5. Publish Draft Guideline and solicit public feedback													
4.6. Draft 2 DNSP Guideline													
4.7. Internal business review													
4.8. Prepare Final DNSP Guideline													