# Consultation on the Proposed Australian Energy Market Commission: Access, Pricing, and Incentive Arrangements for DER

## Enphase Energy Australia Pty Ltd. Submission

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| Project | AEMC DER Consultation – April 2021 |
| Filename | AEMC Rule Change Response 1 V1.03 |
| Revision | V1.03 |
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| Date | 23/04/2021 |

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## 1.0 Introduction

Enphase Energy thanks the AEMC for the opportunity to provide technical feedback regarding the Australian Energy Market Commission (AEMC) Draft Determination on access, pricing, and incentive arrangements for distributed energy resources (DER).

Australia is recognised as a world leader in the adoption of rooftop solar, as the world moves away from fossil fuels and increasingly adopts clean alternative energy solutions. The bipartisan support of this energy evolution, for nearly 20 years, has seen the transition from what was once considered a curiosity to a commercially viable generation platform across Australia and worldwide.

It is appreciated that renewable energy sources will soon generate, or even exceed, 100% of Australia's energy demand. A consequence of this can be grid stability issues when favourable sun and wind conditions are coupled with low energy demand, especially on mild spring and autumn days.

As correctly outlined in the AEMC report, rooftop solar will soon have greater capacity than the largest coal-fired power stations, with this figure set to double or even triple over the next 20 years. At present, there is over 20 GW of solar capacity in Australia. When household consumption is low, the power exported to the grid can change rapidly according to weather conditions, resulting in a dynamic energy source. With the load base changing, this now presents challenges to grid stability and the provision of generation capacity via the NEM or locally.

Although there is a myriad of technology standards and protocols in the pipeline, such as IEEE 2030.5, OpenADR, VPP's, etc., Enphase is a firm believer that grid services such as grid stability and dynamic connection agreements can be achieved within a short timeframe.

The following consultation paper outlines solutions to the problems posed by the AEMC to ensure renewable energy is fully utilised while remaining fair to customers and users of electricity countrywide. Enphase has been a pioneer in remote controllability of PV and storage by utilising a software-defined architecture. Because of this, Enphase can offer grid services without the need for customers to purchase additional hardware.

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## *2.0 Feedback on the proposed rule change*

Enphase Energy supports the controllability of DER to ensure grid stability while providing a fair export service that DNSPs can offer to DER customers. Enphase is a pioneer in the microgrid space, with active microgrid projects in central and north America such as the Hawaii microgrid project:

- https://seekingalpha.com/article/4208864-enphase-energy-worlds-1st-battery-less-microgrid
- https://enphase.com/en-us/stories/india-and-hawaii-%E2%80%93-tale-two-solar-markets

Enphase is currently an active participant in the South Australian (SA) proposal to provide dynamic connection agreements via dynamic power export limiting (PEL) to stabilise and maintain the integrity of the grid in South Australia. Enphase currently supplies remote disconnection and reconnection services to Enphase customers in South Australia, as the relevant technical provider and Agent, to comply with SA smarter homes regulations. The scope of Enphase compliance in SA will eventually expand into dynamic export limiting and dynamic connection agreements.

Enphase believes the future of DER lies in integrating PV generation through the incorporation of smart technology, which is fundamental to the future of DER integration. If IEEE 2030.5 is not finalised promptly in Australia, then the approach taken should be technology agnostic until the release of IEEE 2030.5 or another relevant standard is implemented – as undertaken in South Australia and accepted by manufacturers.

The initial release of dynamic connection agreements could be on a trial basis with various OEMs, with current static connection agreements still in place. Enphase agrees that static exports cannot exist forever, and offering customers a dynamic connection agreement will be the best solution to the problem that the AEMC has outlined.

With the introduction of dynamic operating connections, flexible energy pricing is a logical step. Some energy providers such as Amber Electric are already offering their customers wholesale market prices for the supply of electricity supply and export of DER. This flexible approach not only incentivises and rewards DER customers for self-consuming and exporting their energy when required, but it will also allow for more DER capacity on the network as well as increase grid stability.

With the implementation of dynamic connection agreements and wholesale electricity prices for customers, a smart algorithm can be created so that customers do not have to constantly monitor their energy use and make their own energy decisions. The algorithm will effectively change the export limit to zero when wholesale prices are low or in negative figures and visa-versa export as much energy as possible when the wholesale price is high and the grid, therefore, requires more electricity. This algorithm could also be overruled by any AEMO or DNSP concerns on-grid instability, and systems could be automatically disconnected or reduced to zero export.

The Enphase Enlighten cloud-based monitoring platform monitors over 1.5 million solar systems globally and over 80,000 systems and 17 MWh of battery storage in Australia, as well as 70 MWh globally. We expect these numbers to increase with the release of new products such as Ensemble, the latest Enphase storage technology.

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We regularly see that the voltage set point on the NEM and other marginal grids within Australia are consistently around the 240 Vac rather than the proposed 230 Vac supply that Australian standards require. Voltages over 240 Vac are often present in the middle of the night with no PV generation. Therefore the higher voltage range cannot be because of high solar PV patriation alone. With some locations experiencing the lowest voltage of around 240 Vac, many customers experience loss of production due to high voltage grid conditions when this voltage is increased during the daytime. We are actively working with several DNSPs, e.g., SAPN, Western Power, and AusGrid, to identify areas with high PV penetration and voltage issues. This is something that the AEMC should consider in this reform as it affects all consumers of electricity in Australia.

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## 3.0 Existing technology options available

The provision of power export limiting has been a capability of Enphase Energy systems for some time. All Enphase Energy installations in Australia since 2016 utilise our current Envoy-S metered central controller, which has both production and consumption current transformers (CT's), as well as PEL ability. Enphase Energy systems must be connected online to maintain system warranty. This is done through the Enlighten cloud-based platform, and full remote control is available to change PEL parameters if required to work towards a true dynamic response.

Dynamic power export limiting can be implemented using existing capabilities or utilising emerging standards and supporting technology. These differ according to the reaction time and the granularity of power control.

**Option 1.** Using existing Demand Response Modes (DRM) steps

The current inverter standard AS/NZS4777.2:2015 specifies in clause 6.2 Inverter demand response modes (DRM's) for the remote control of PV inverters. DRM 0 is mandatory for all inverters with DRM 1 to 8 as further (optional) control modes to remotely enable 25/50/75% consumption and generation levels. It would be feasible for the 25% steps to be used as the basis of a dynamic PEL system with a "slow loop response" time (typically 15 – 20 minutes) to smooth the reaction. Full remote control would be available via DRM control.

**Option 2.** Adopting Emerging Technology and standards from other countries.

Globally, technologies are currently in development to provide this function for standards such as IEEE 2030.5 "Standard for Smart Energy Profile Application Protocol", JET GR0002-1-11 Section 16.0 ECHONET, Open-ADR or the framework in IEC 14543-4-3 and IEC 62934. Enphase Energy recommends that guidance be taken from these standards as these will directly influence the direction of Australian standards. IEEE 2030.5 and Open-ADR are seen as the front runners for Australia.

For Australia, the current AS/NZS4777.2:2020 update has not incorporated changes to embrace overseas changes. This will form part of a future update, and until such time it may be difficult to provide general certification of product. Alternatively, product could be approved to specification as is currently done for SA smarter homes.

- An Enphase Energy system can be connected via an API for high-level control to not only achieve dynamic export limiting control but a wider range of functions. We have a grid services team that is actively rolling out projects throughout the USA and Europe. For more information visit https://enphase.com/en-us/gridservices

- Several Enphase systems in South Australia and Victoria are connected to deX and, with owners' consent, enable near-instant visibility of their system to the appropriate grid operators. Initially set up as a trial, connection to deX is now advancing through other states as a path to participate in future grid services. For more information on deX visit https://dex.energy/case_study/case-study-enphase/

Enphase Energy has been an active participant in the development of the DER Visibility and Monitoring Best practice Guide (included as an attachment to this submission).

See below a diagram overview of a network connected Enphase system:

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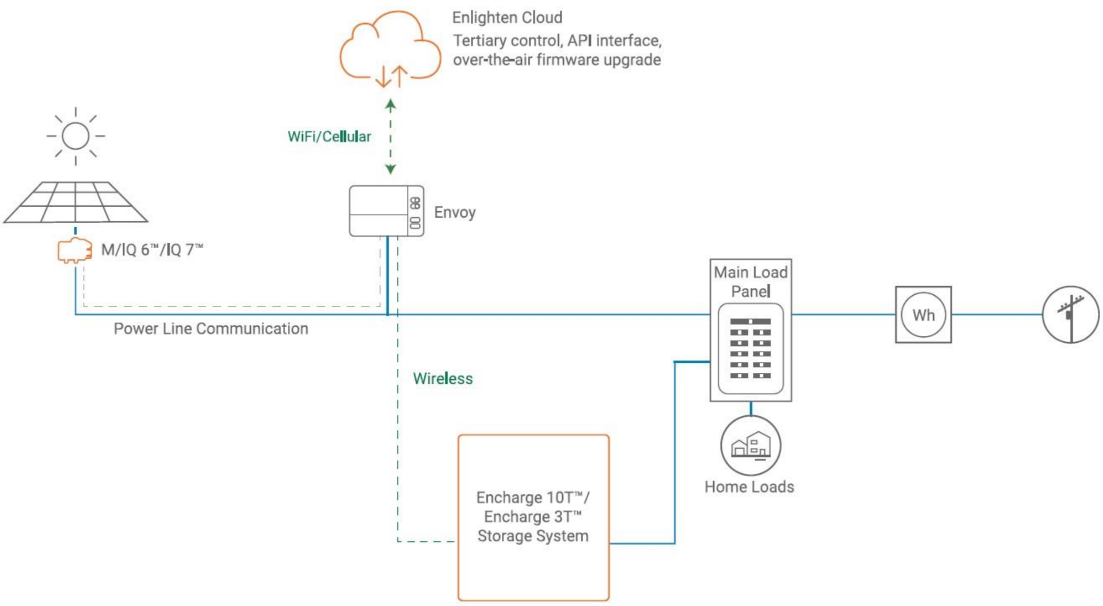


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## 4.0 Remote control considerations

All Enphase Energy systems must be connected online and monitored via our Enlighten cloud-based monitoring platform to satisfy warranty requirements. There are over 1.5 million systems on this platform in more than 130 countries and around 80,000 in Australia. While this network is proprietary to Enphase compatible systems, it does provide the means to control, via API, not only systems post-implementation but also systems already installed should they elect to be part of future grid requirements or requirements of DNSPs/AMEO.

- Enphase is partnering with EV chargers (V2G) and energy management systems such as Sensibo to offer full home energy management and increased self-consumption.
- As any Enphase Energy system is essentially a software-defined solution, we can integrate with other systems via an API. We would be happy to discuss further what could be implemented based on what has already been adopted in Australia or overseas.

## 5.0 Implementation time frame

All Enphase Energy hardware available in Australia can meet the solutions outlined in this consultation paper. All Enphase equipment installed since 2016 can retrospectively enable a dynamic export, so we are not limited to just new installations. Older systems may require an updated Enphase Envoy controller and consumption and production CTs but not Inverter replacements. We believe that once existing systems are upgraded or replaced, they should also be affected by this rule change.

In South Australia, Enphase is actively working with SAPN and the OTR on the constructability of solar and storage as part of SA Smarter Homes compliance. We recommend that an adaption of IEEE 2030.5 guidelines should be implemented as a final solution. Enphase already has the capability and approvals largely in place, so meeting a relatively short deadline would be achievable. Like most OEMs, Enphase will have to meet the requirements for dynamic controllability of DER in South Australia by July 2021. Again, we would welcome further discussion around the specific requirements of a dynamic connection agreement once set.

Other fundamental grid stability issues are addressed in updated Australian Standards such as AS4777.2:2020, the Volt-Var, Volt-Watt, and low voltage ride-through requirements. This standard will enhance the stability and durability of the NEM and other marginal grids within Australia. It is, therefore, fundamental that all new DER is installed to meet this standard and all upgraded legacy systems comply with this new standard when they are upgraded or replaced. As Volt-Var and Volt-Watt functionality could reduce DER generation, DNSPs should also take full responsibility for ensuring the set point of voltage follows Australian standards at 230 Vac and not the legacy 240 Vac model.

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## A.1 About Enphase Energy

Enphase Energy Australia Pty Ltd is a member company of Enphase Energy, Inc. based in Silicon Valley, California, USA.

Enphase is a provider of energy management hardware and software solutions. It is engaged in designing, developing, manufacturing, and selling microinverter systems for the solar photovoltaic and battery storage industry. Enphase invented semiconductor-based microinverters in 2008 to convert direct current (DC) electricity to alternating current (AC) electricity directly at the PV module (solar panel). Enphase is now the world's largest manufacturer of microinverters. The USA is the largest market where Enphase is installed in ~41% of all systems (2020). Enphase has shipped more than 34 million microinverters to over 130 countries, representing over 10 GW of solar capacity.

Worldwide, Enphase employs over 1,000 people, and this includes over 200 software engineers. Recent acquisitions of Solargraf and DIN engineering will aid Enphase customers to design and install a complete home energy system. In Australia, Enphase is based in Melbourne, with staff located in all mainland states. Enphase runs an online technical support centre in Melbourne linked to other global centres to provide 24/7 support. Enphase New Zealand is the worldwide hardware design and testing hub for Enphase, employing over 100 engineers and technicians in Christchurch.

An Enphase AC coupled microinverter system differs from the classic DC-coupled string inverter systems found in most installations. An Enphase system consists of several parts rather than a single inverter: Enphase microinverters at each solar panel, an Envoy gateway, and Enlighten cloud-based software. Optionally, an Enphase battery system can be installed to form a single solar and battery storage platform that can be controlled remotely via an app on a smartphone.

Enphase microinverters provide power conversion at the individual solar module level via a digital architecture that incorporates custom application-specific integrated circuits (ASIC), specialized power electronics devices, and an embedded software subsystem. The Envoy bi-directional communications gateway collects and sends data to Enlighten software. Enlighten cloud-based software provides the capabilities to remotely monitor, manage, and maintain an individual system or a fleet of systems.

AC coupled Enphase systems provide significant safety advantages over classic DC-coupled systems. Rather than running dangerous high DC voltages (up to 600 Volts) to a remote inverter that requires special protection from DC arcs that can lead to fire, Enphase directly converts low voltage DC to normal AC right at the panel. Enphase also invented the rapid shutdown system that is now mandatory in the USA. This system enables first responders to shut the entire system from one switch in a meter board so they can conduct search and rescue safely without fear of contact with high voltage DC from an unstable roof.

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## B.1 Enphase Energy Australia engineering and technical support

**Andrew Mitchell – Product Line Manager**

*With 12 years of experience in the solar industry, Andrew has managed projects and products that have delivered pioneering solutions from 300W portable power packs to multi-megawatt microgrid solutions. His work throughout the APAC region has allowed him to develop perspectives from all stakeholders such as consumers, installers, designers, manufacturers, and network operators.*

**David Minchin: Standards & Homologation Engineer**

*David is based in Adelaide and provides standards support and product homologation for Enphase Energy in the Asia/Pacific region. He is an active member of EL005 Storage, EL042 Alternative Energy, and EL064 Microgrid Standards committees. Most recently, David was engaged to formulate the test reports in the new AS/NZS4777.2 standard for new requirements, including the VDRT test that is the subject of this consultation. Prior work includes managing Clean Energy Regulator (CER) inspections across Australia and engagement by the CER to perform special analysis. David has more than 30 years of experience in solar/storage in both commercial and engineering roles.*

**Ryan Turner: Field Applications Engineer**

*Ryan provides pre and post-installation support for all Enphase projects in the APAC region. He is a fully accredited CEC design engineer. Ryan is an active member of the Standards Australia committee: EL062 – Smart Grids. He specialises in supporting larger, more complex commercial and industrial projects, as well as storage integration. Prior work includes technical support/advisor for Fronius Australia and Building Energy consultant at Arup. Ryan also has an undergraduate degree in Mechanical Engineering and a master's degree in Renewable Energy and Sustainability from the University of Nottingham, UK.*

**Wilf Johnston: General Manager APAC**

*Wilf has worked in the Australian solar industry for over 11 years, beginning with the leadership of the engineering and commercial project team at SunPower Corporation, then later as the General Manager of Energy Matters and Flex. At Flex, he introduced an innovative IOT platform focused on delivering energy insights and control to end customers. Wilf holds degrees in Engineering and Commerce from the University of Western Australia and has been a key contributor to industry associations, including the Smart Energy Council. At the Clean Energy Council, Wilf was a founding member of both the Utility Solar Directorate and the Distributed Energy Leadership Forum, which provides policy direction to the organisation.*

**Supply Chain:**

**AC Solar Warehouse** is a leading Australian wholesaler of solar energy and energy storage equipment. The business employs ten professional electrical engineers and is an industry recognised expert in the deployment of microinverter technologies. AC Solar Warehouse has an administration office in Queensland and distribution centres in Brisbane, Sydney, Melbourne, Adelaide, Perth, and Auckland, providing same or next day service to more than 6,000 solar installers around ANZ.

**Grant Behrendorff**: Managing Director

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*Grant Behrendorff is an Electrical Fitter/Mechanic, Electrical Engineering Technologist, and CEC accredited solar system designer and installer. He has been involved in the electrical industry in Australia for 35 years and in the solar industry for 23 of these. Grant has held technical, management, leadership, and governance roles in the utility, not-for-profit, consulting, and commercial sectors and was independent Chair of the Alice Springs Solar Cities Consortium for seven years from its inception to conclusion in 2013. This project was responsible for some of the most iconic and ground-breaking solar installations in Australia at the time, based on a wide range of solar technologies. Grant was awarded the Engineers Australia National Engineering Technologist of the Year in 2007 in recognition of his work in the solar power sector. Grant is Managing Director at AC Solar Warehouse, and is the non-executive Chair of Alice Springs based engineering consultancy firm Ekistica Pty. Ltd.*

**David Smyth: Director and Principal Engineer**

*David Smyth is a qualified electrician with a Bachelor of Electrical Engineering with Honours. he is a Registered Professional Engineer of Queensland, a Member of Engineers Australia and Clean Energy Council, and accredited for design and installation. David has been working with solar technologies since 1996, firstly designing remote area power supplies for cattle properties and national park ranger stations and later working on the design and installation of some of the earliest domestic and commercial solar grid-connected systems in Queensland. David was Principal Engineer of Generation at Ergon Energy for over seven years, where he was responsible for managing 33 power stations, including wind, biomass, geothermal and solar farms. David is Director and Principal Engineer at AC Solar Warehouse.*

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