enosi

Open-source community energy

WHITE PAPER v0.2

April 2018

PROVIDING CONSUMERS WITH CHOICE, TRANSPARENCY AND EFFICIENCY

ENOSI VALUES

The Enosi Foundation will use its values as a compass to define and drive its vision of affordable and clean electricity for all.

ACCESS

Clean, low cost electricity is a basic human need

INNOVATION

Everyone should be able and encouraged to shape the future

ECONOMICS

Monopolies lead to sub-optimal economic outcomes and need to be disrupted

ENVIRONMENT

We must leave the planet in a better condition than we found it

DECENTRALISATION

Communities should be in charge of their electricity

Contents

EXECUTIVE SUMMARY

The Enosi blockchain protocols are designed to challenge the big incumbent energy companies and their existing legacy systems by reducing the transactional and compliance costs for new retailers, and allowing customers to trade their rooftop generation with their community.

Affordable clean electricity for all

At Enosi we believe that access to affordable clean electricity is a basic human need. Electricity has the power to pull people out of poverty and satisfy many essential needs. With rooftop solar now the cheapest form of new electricity generation, the traditional approaches to electricity supply, distribution and pricing based on centralised generation, regulated grids and mass retailing simply cannot achieve this access or the benefits promised.

Decentralised Energy – Grid 2.0

We believe it is time for a paradigm shift in the energy industry from central to local, from mass market to community based, from infrastructure heavy to asset light, from analog to fully digital. This will release the potential of solar, wind power, batteries, electric vehicles and smart appliances. This can be the future of electricity delivered through a model that we call Grid 2.0.

Grid 2.0 will be a world of distributed energy, close to the point of consumption, where the low cost and flexibility of local resources is fully exploited. The emergence of distributed ledgers and blockchain technology means the move towards Grid 2.0 can be fast tracked, with low cost, renewable energy and services accessed on a multi-party and trustless transaction platform, accelerating innovation and the transition from our centralized past.

The Enosi Foundation will develop such platform (the Enosi Platform) as an open-source, global, truly decentralized exchange. With this enabling Platform, Grid 2.0 can be realized.

Scalable innovation from the outset

Adopting the Enosi Platform will enable innovative energy providers to provide lower cost community based energy schemes - without having to change the current rules or do a one-off deal with the incumbents. Using the Enosi Protocols households with solar can become prosumers and sell the energy from their home power station (solar) to buyers of their choice at fair prices. They will be able to participate in peer-to-peer trading, community-owned generation, and take advantage of offers from innovative new energy retailers that benefit from the lower cost structure of the Enosi Platform.

In this new decentralised world, costs across the electricity value chain can be dramatically reduced. This is achieved by more efficient use of infrastructure, increasing the level of competition with existing incumbents, and improving the economic signals to market participants.

What are the Enosi Protocols?

The protocols will consist of a set of open-source Ethereum smart contracts (Enosi Smart Contracts) deployable by a Decentralised Autonomous Organisation (DAO). The DAO will provide a set of Enosi distributed Apps for electricity customers. These components will perform much of the transactional activity typically performed by the traditional energy retailers such as receiving metering data, billing, buying and selling distributed energy and financial settlement, at a fraction of the current cost. It is envisaged that the Enosi Smart Contracts will interface with the existing regulated grid and market participants such as the metering data providers, grid owners and market operators to allow widespread global adoption from the beginning.

The contracts will also enable complex multiple party transactions such as peer to peer trading, proof of energy provenance, and community energy programs. An extended set of Enosi applications will be made available to neo-retailers and partners to assist in customer engagement functions as well as wholesale market interaction.

The Enosi Platform differs from other electricity blockchain platforms, in that it will be a completely open-source platform that can be deployed without an incumbent grid partner and encourages development of a multitude of solutions tailored for each specific market need. This will foster innovation, competition, customised solutions, and rapidly accelerate real-use deployment globally.

Proven team and Partner network

The team behind Enosi has over 120 years of collective experience leading transformative businesses in blockchain, energy, technology and finance markets. We have already developed the first demonstration of smart contracts performing the transac-

tional activity within a community, and have an extensive ecosystem of partners. One of these partners, Solar Analytics, is leveraging their 18,000 customer households and world-leading solar home energy management service to launch a peer-to-peer shared solar trading application that will be deployed through their network of 350+ solar partners.

Introducing the JOUL Token

To facilitate access to the Enosi Platform and its functions such as electricity trading, a new ERC20 cryptocoin will be created called the JOUL. Details of the proposed token generation event (TGE) and the mechanics of JOUL operation are available in our TGE Terms and Conditions document.

Enabling the shift to Grid 2.0

We believe that electricity has the potential to pull people out of poverty and satisfy our most essential needs. Rooftop solar power generation is now the cheapest form of new electricity generation[1], challenging the traditional approaches to electricity supply, distribution and pricing which have largely been based on centralised generation, regulated grids and mass retailing.

Peer to Peer Exchange of rooftop solar will be a core function of the Enosi Platform

Affordable electricity is a basic human need

Electricity has become the bedrock of our civilisation, providing for our cooking, heating, cooling, lighting, manufacturing, education, entertainment and even our transport. Without access to energy services people are destined to live in poverty[2].

Access to affordable, reliable, sustainable and modern energy[3] is vital to reaching all other UN Sustainable Development Goals and critical for many countries to meet their climate change mitigation targets.

Globally, 53% of people have limited or no access to electricity at any price, with 1.2 billion without access to electricity, and a further 2.8 billion who rely on wood or other biomass to cook and heat their homes[4].

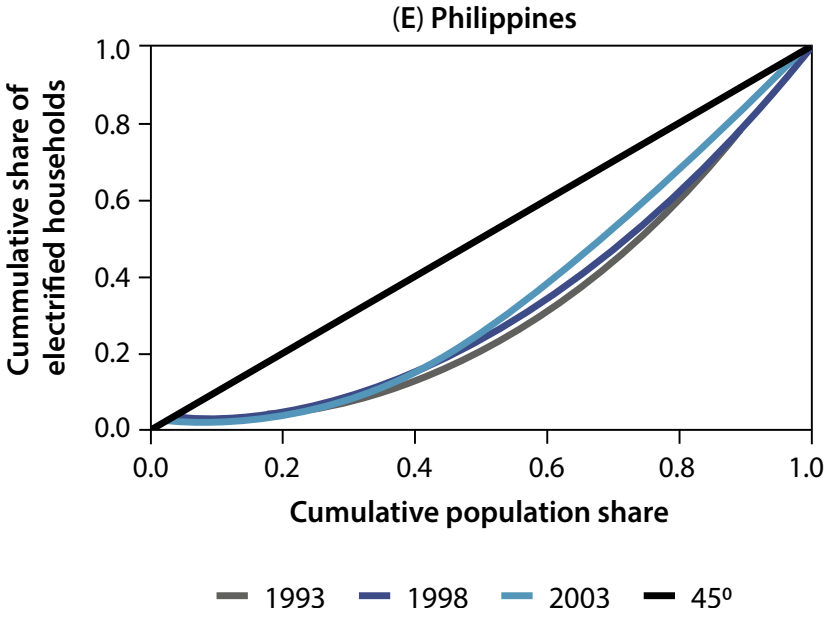
This figure from the World Bank[5] shows how electrification drives both economic growth and equity (using consumption as a proxy) and reduces world poverty.

For those with access to electricity, costs continue to rise despite the emergence of lower cost new generation sources . In Australia retail electricity prices have doubled over the past decade[6]. After decades of technological advance this basic need is becoming less affordable for all. In fact, in 2016 81% of Australian consumers rate electricity as the greatest cost of living concern[7].

Electricity generation and supply is one of the largest source of air pollution worldwide, and has been linked to the deaths of 7 million people annually[8]. Yet today's electricity industry continues to rely on technologies and business models invented in the 1880's by famous innovators like Nikola Tesla, Westinghouse and Edison.

To provide for the world's growing energy demand that underpins our societal and technological progress, the Enosi Foundation believes that we need affordable, reliable and sustainable energy for everyone. This requires an entirely new paradigm about how we generate, transport, store and sell electricity.

[1] US Dept of Energy, Levelized Cost of Electricity.
https://energy.gov/sites/prod/files/2015/08/f25/LCOE.pdf
[2] Access to Energy Services in a Human Rights Framework, Adrian J Bradbrook
Bonython Professor of Law, University of Adelaide, Australia http://www.un.org/esa/sustdev/sdissues/energy/op/parliamentarian_forum/bradbrook_hr.pdf
[3] UN Sustainable Development Goal 7
[4] SE4All Report, The World Bank http://www.worldbank.org/en/topic/energy/publication/Global-Tracking-Framework-Report.
[5] https://siteresources.worldbank.org/EXTRURELECT/Resources/full_doc.pdf
[6] EIA, USA Short Term Energy Outlook, https://www.eia.gov/outlooks/steo/report/electricity.php
Jacobs, AEMO Retail electricity price history and projected trends, Sept 2017, pg 5,
https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/EFI/Jacobs-Retail-electricity-price-history-and-projections_Final-Public-Report-June-2017.pdf EIA, USA Short Term Energy Outlook, https://www.eia.gov/outlooks/steo/report/electricity.php
Jacobs, AEMO Retail electricity price history and projected trends, Sept 2017, pg 5,
https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/EFI/Jacobs-Retail-electricity-price-history-and-projections_Final-Public-Report-June-2017.pdf
[7] CHOICE Consumer Pulse: Australians Attitudes to Cost of Living 2015 - 2016, July 2016 https://www.choice.com.au/~/media/39d94cb1e9e040ad94a458ac43da06e8.ashx?la=en

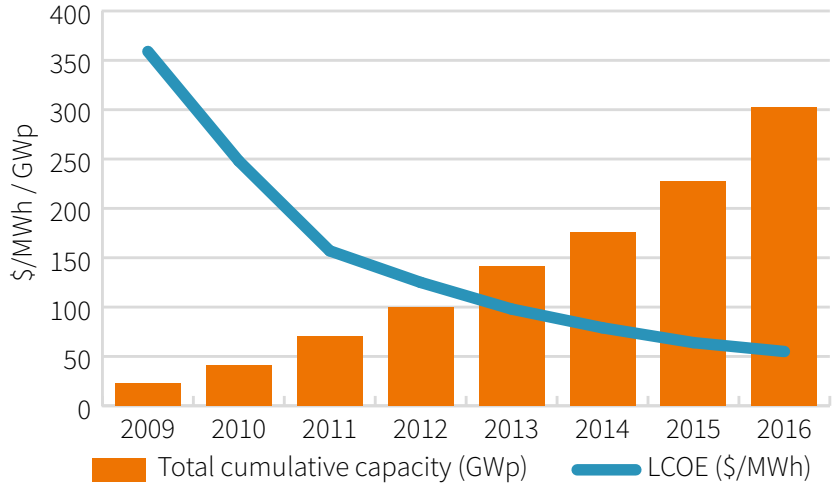


The electricity industry is ripe for disruption

Historically the energy industry, from electricity generation to retailing, has been viewed as a natural monopoly and has therefore been regulated that way. This approach has led to an outdated, heavily regulated electricity industry in most parts of the world with minimal competition and innovation. In countries where retail energy competition has been introduced the markets have quickly consolidated towards oligopolies, driven purely by scale economies rather than product innovation, and posing significant scaling barriers for new entrants.

Over recent decades the rapid cost reduction in renewable energy and particularly distributed rooftop solar has meant that this natural monopoly does not apply to all parts of the value chain.

Figure 2: *Levelised cost of electricity (LCOE) for solar and total cumulative solar capacity*



Source: International Energy Agency, Report IEA PVPS T1-31:2017;
Lazard 2017 Levelized Cost of Energy Analysis

[8] http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

The figure above[9] indicates how quickly rooftop solar has grown, and become the lowest cost method to deploy and generate electricity on a Levelized Cost of Electricity[10] basis.

There is an urgent and growing need for widespread and rapid disruption of the energy industry. The rising direct cost and finite lifetime of fossil fuels coupled with the rising cost of pollution threatens our world. Current, a large proportion of current centralised, electricity generation infrastructure in developed countries is aging and is nearing its end of life. In the developing world, a central approach to electricity infrastructure is unlikely to suit the low cost requirements and rapid infrastructure build required to meet their growing energy needs.

Unfortunately, the energy industry is dominated by a small number of incumbents in each regional market that wield oligopolistic control, and are either not incentivised or not capable of responding to the need to transition to lower cost, decentralised and more sustainable energy sources. Although in some markets deregulation has begun, monopolistic and oligopolistic control remains across generation, transport and selling of electricity to the end consumer.

Industries with similar characteristics such as telecommunication, finance and even satellites, and space cargo transport have been faced with the same requirement for disruptive innovation. Those industries all underwent rapid disruption when the cost of innovation and barriers to entry were reduced.

In order to truly transform the energy industry four criteria should be met:

1. Competition facilitated by low barriers to entry and access to market

2. Trusted transactive platforms that enable new participants at all levels of the value chain

3. Decentralised and affordable renewable energy generation

4. Greater regulatory confidence in the bene fits of continued market deregulation

The Enosi Foundation is focused on achieving these criteria by leveraging recent advances in blockchain technology to deliver:

1. A more efficient transactive services plat form

2. Greater access for secure competition throughout the value chain

3. The ability for distributed renewable generation to be accessed broadly as the lowest cost source of new electricity generation

4. Market led adoption of decentralised energy solutions

Decentralised energy services using blockchain technology are fundamental to change

We believe that the recent emergence of low cost, fully-scalable renewable energy, combined with the ability of the blockchain to create a tokenized and trusted transaction platform, is the bedrock on which this energy transformation will be built.

Across the world, one of the lowest cost source of new electricity generation is locally deployed solar photovoltaics. Rooftop solar has a Lifetime Cost of Electricity (LCOE) below 6 c/kWh, and it is generated exactly where it is used. Coal and gas generation have an LCOE of 7-10 c/kWh and cost a further 4-6 c/kWh to transport it to where it will be used[11] (and

[9] http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf page 7
https://www.lazard.com/media/450436/rehcd3.jpg
[10] https://energy.gov/sites/prod/files/2015/08/f25/LCOE.pdf
[11] Global averages and Enosi analysis. Selected sources for averages
https://www.lazard.com/media/450436/rehcd3.jpg
https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/energy-in-aust/Energy-in-Australia-2015.pdf p 51
https://www.ofgem.gov.uk/data-portal/network-indicators

as high as 10-12 c/kWh in Australia). However, the widespread uptake of this low cost and sustainable electricity is hampered by the ability of consumers and new service providers to enter the market and to receive a fair market based return on their excess energy.

Enosi will provide the tools and access required to address the above issues and enable new players to disrupt the entire global electricity industry. Enosi will enable more affordable, decentralised and sustainable electricity for everyone, everywhere.

All commodity markets are highly driven by costs and pure commodity markets can generally achieve lowest costs through broad competition. To disrupt energy markets, the main problem to solve is to fully commoditise the components of the supply chain, reducing barriers to entry and monopoly rents. Enosi wants to reduce these costs and barriers to entry by:

1. Enabling competition:

Increasing competition within each segment of the supply chain by building a platform and tools that enable new entrants to participate in the market

2. Disaggregation:

Separation of each segment in the electricity supply chain to allow the entry of more efficient market participants

3. Reducing regulatory hurdles:

Lowering the regulatory and establishment hurdles for new market entrants by providing a suite of automated "retailer-in-a-box" tools, adaptable for each region

4. Significantly lowering customer servicing costs:

Lowering the overall cost to serve for new energy retailers by at least partially automating the market procurement, settlement and compliance functions

5. Enabling new innovative technologies to monetize:

Enabling new energy retailers (neo-retailers) to provide innovative electricity supply and billing arrangements for communities and niche market segments, or as an add-on to an existing customer base where they have lower customer acquisition costs

6. Providing tools and mechanisms:

Developing capabilities such as peer-to-peer energy trading which are designed to encourage and facilitate the uptake of lower cost distributed electricity generation.

The key differences between Enosi and many other platforms and market participants are:

Open platform: There are thousands of different and highly regionalised markets across the world. Each requires unique customisation to tackle the regulatory and market structures. This needs developers across the world creating lower cost, more efficient services for all participants.

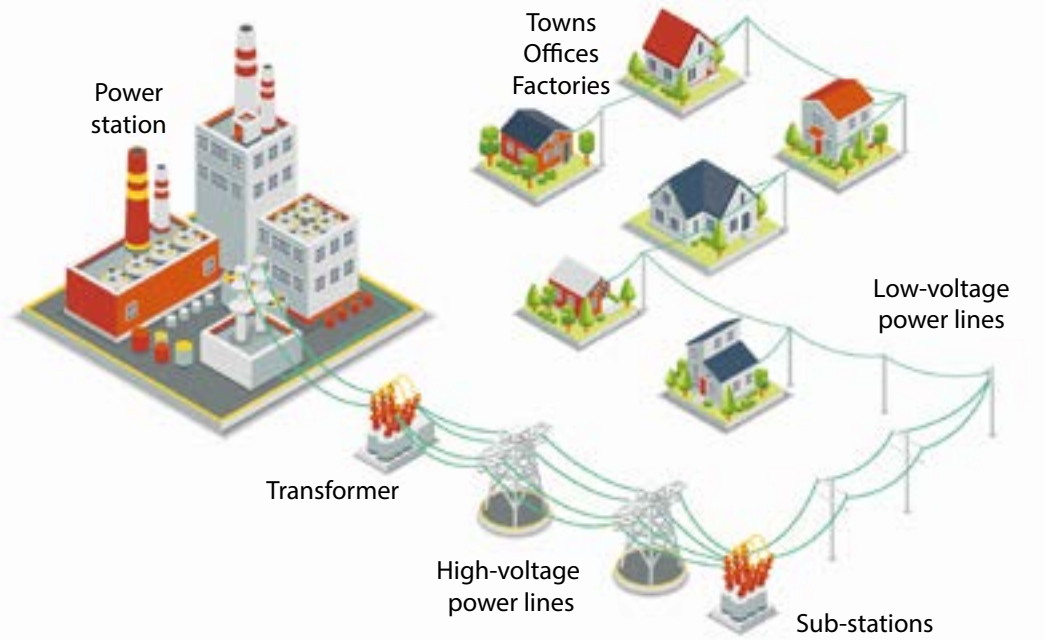
Independent: Enosi is not controlled or indebted to any of the incumbent oligopolies that have a vested interest in the status quo. Enosi will make its platform and suite of tools open source so new participants are able to increase competition and innovation.

Experienced: Enosi leverages world-leading experts in blockchain, solar and electricity sectors to build the platform and tools needed to disrupt each market one by one. Key Foundation members have a combined 120+ years experience in energy research and development, and have founded an existing business (Solar Analytics) which provides a solar monitoring tool for over 18,000 households in Australia.

Decentralised Energy - Benefits and Barriers

A shift to decentralised generation has occurred in the physical energy infrastructure

Figure 4: *Grid 1.0 Centralised*



This centralised architecture depicted in the image above can be referred to as Grid 1.0, and is used in most developed countries. Large central power plants, typically fossil fuel powered such as coal, gas or nuclear, located close to fuels sources generate electricity that is transported at very high voltages across large distances in a transmission network, before being input to the distribution network where the voltage is lowered such that devices at homes and businesses can use the electricity. For years this approach enabled the highest reliability, lowest cost electricity.

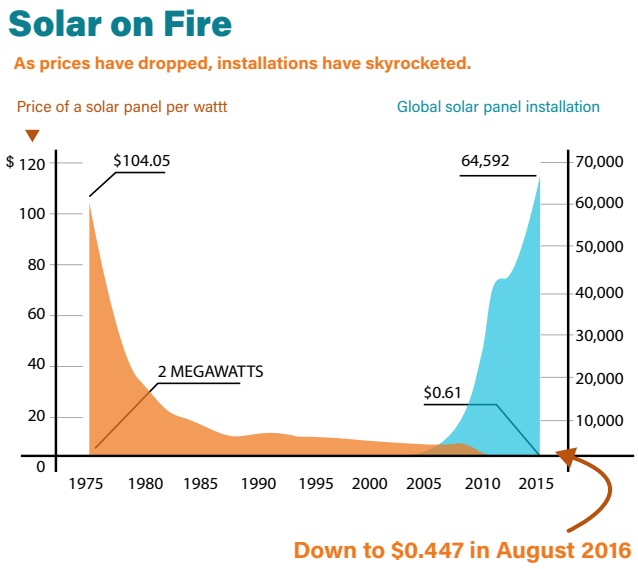
Recent innovations such as the rapid cost reduction of rooftop solar electricity, intelligent Internet of Things appliances, low cost battery storage and electric vehicles means that this grid architecture is no longer the most cost effective approach to deliver electricity.

Grid 2.0, has fundamentally different characteristics to Grid 1.0. An increasing amount of electricity is generated in a distributed manner, close to the point of consumption, or in the case of rooftop solar on people's homes or businesses. New smart home energy management systems are able to adjust consumption patterns to benefit from times when electricity is available in abundance. Within a few years the widespread uptake of electric vehicles and new battery technologies will enable the storage of electricity for periods when renewables are not available. This type of localised supply can be lower cost not only by using the lowest cost generation, but also by distributing the energy network loads more evenly across both space and time. Higher reliability can also be achieved through redundancy of sources.

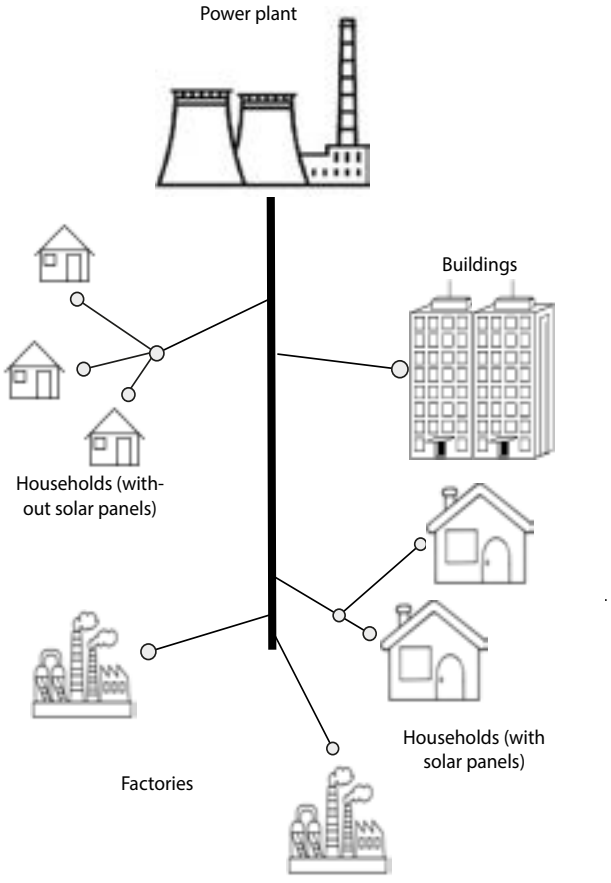
Such a grid will be less reliant on central command and control, but instead be based on a set of guidelines that define the standards and rules for interaction, and rely on clear transparent mar-

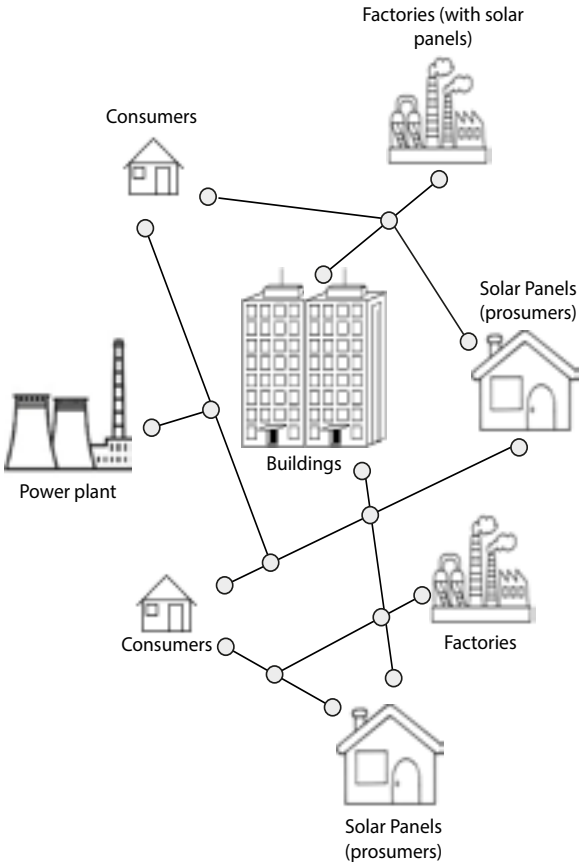
ket pricing to drive the correct behaviour by market participants. This will improve access, lower cost and drive towards a more sustainable set of energy sources.

This transformation to Grid 2.0 is occurring at varying rates around the world with the slowest and most difficult transition being for developed countries that have already invested in an extensive transmission and distribution networks. Countries like Australia with many remote communities are already shifting people to microgrid networks (for example within the Horizon Power and Ergon Energy grids[14]). Even within dense urban grids across Australia like South Australia Power Networks and Ausgrid in Sydney, this transformation is beginning, with distributed generation being used in certain cases to defer or avoid upgrading existing infrastructure[15].



Solar panel prices and installations[13]





GRID 1.0 VS GRID 2.0

[13] source:https://cleantechnica.com/2017/04/08/no-executive-order-can-make-clean-energy-economy-disappear-9-bullets

[14] Horizon Power, WA leads the way in energy transformation, Feb 2017, https://horizonpower.com.au/our-community/news-events/news/wa-leads-the-way-in-energy-transformation/

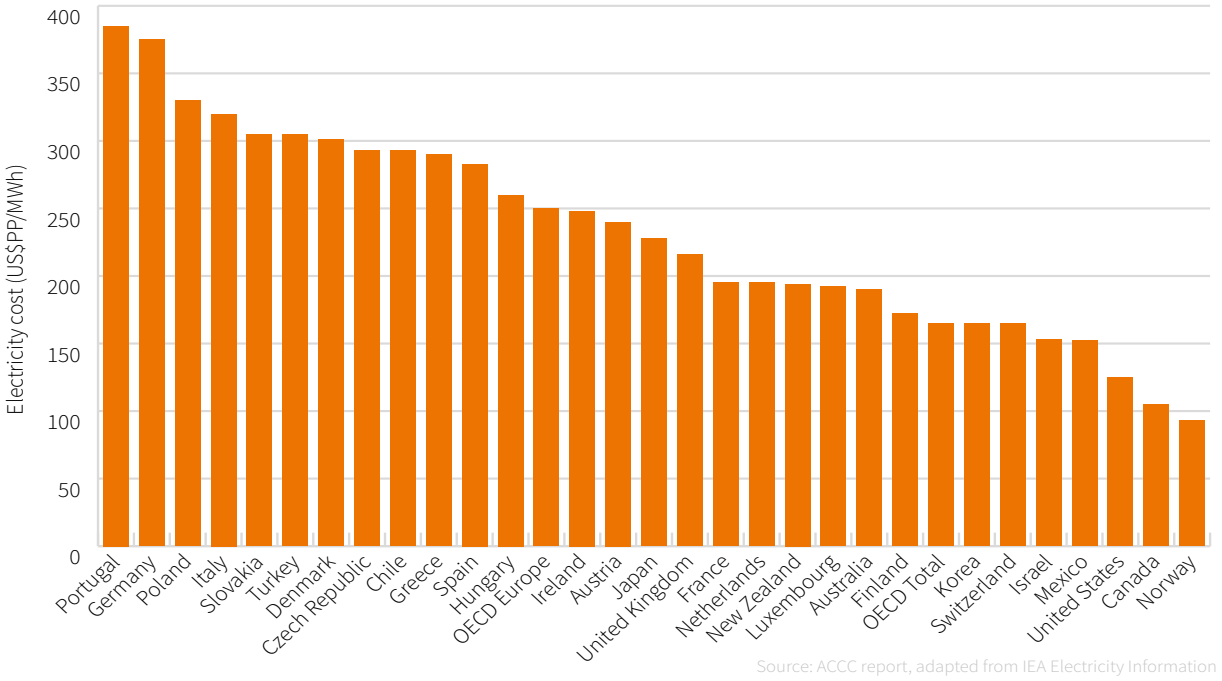
[15] Ecogeneration, SA trial shows the ups and downs of batteries, Jan 2018 http://www.ecogeneration.com.au/sa-trial-shows-the-ups-and-downs-of-batteries/

Developing countries have an opportunity to leap-frog directly to the lower cost and more reliable Grid 2.0. Just as many parts of Africa have avoided widespread landline telephone installation and went straight to mobile, they may need to rely less on centralised generation and move more quickly to a set of mesh connected microgrids.

	Current Grid - Grid 1.0	Future Grid - Grid 2.0
Reliability	A single point of failure in one generator or transmission line has potential to cause widespread blackouts	Increased reliability due to multiple redundancies in generation and distribution
Flexibility	Requires large capital investment in plant and infrastructure	Much faster to expand where needed Relocatable generation sources
Speed	Slow to build with a long payback period	Ability to scale from 1kW to 1GW as appropriate
Energy Sources	Fossil fuels are heavily polluting and are not compatible with meeting our climate goals	Dominated by low or zero emissions technology
Cost	Electricity needs to be transmitted long distances, increasing cost The transmission and distribution systems need to be built for the peak demand, hence adding significant costs (up to 45% of the electricity bill in Australia)	Much lower transmission infrastructure required Overall less distribution infrastructure required due to on-site generation and ability to incentivise and harness storage and demand response
Control	Central command and control of dispatch Concentrated wholesale markets Limited distribution grid management flexibility	No single operator can influence market conditions Distributed dispatch by Consumers and Prosumers hence increasing participation in the market Grid management for reliability and utilisation optimisation

Significant economic and environmental imperative to move to Grid 2.0

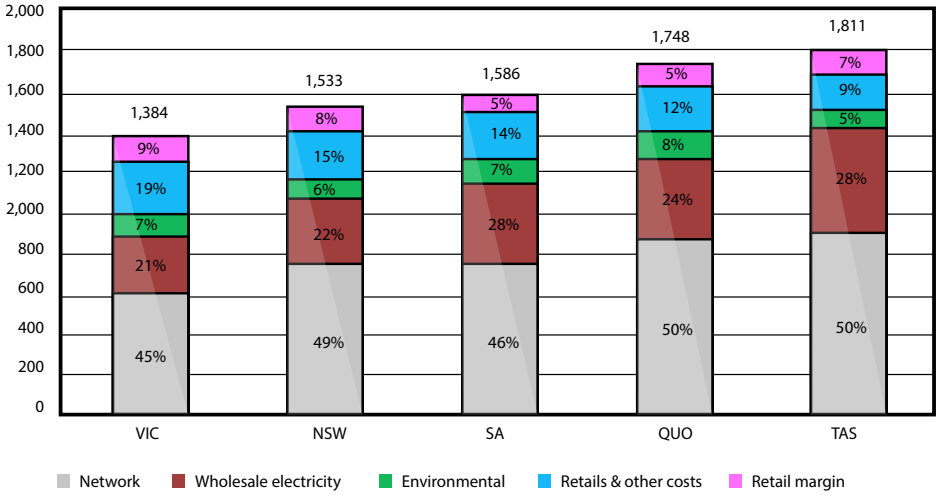
Electricity costs around the world vary significantly due to a range of factors such as availability of fuel resources, geography, historic infrastructure investment decisions, regulatory environment, and level of government intervention. As the below figure shows the resulting consumer electricity costs around the world vary from as high as US$380/MWh down to US$90/MWh.



Consumer electricity cost comparisons[16]

The cost of electricity can be broken down into five major cost categories: wholesale electricity, network (transmission & distribution), environmental subsidies, retail costs and retail margin. As shown in the below figure, using Australia as an example, in 2016-2017 the average residential electricity bill was A$1,691, with the breakdown of cost varying significantly even within a single country.

Average residential bills by state, 2015-16, $ per customer excluding GST

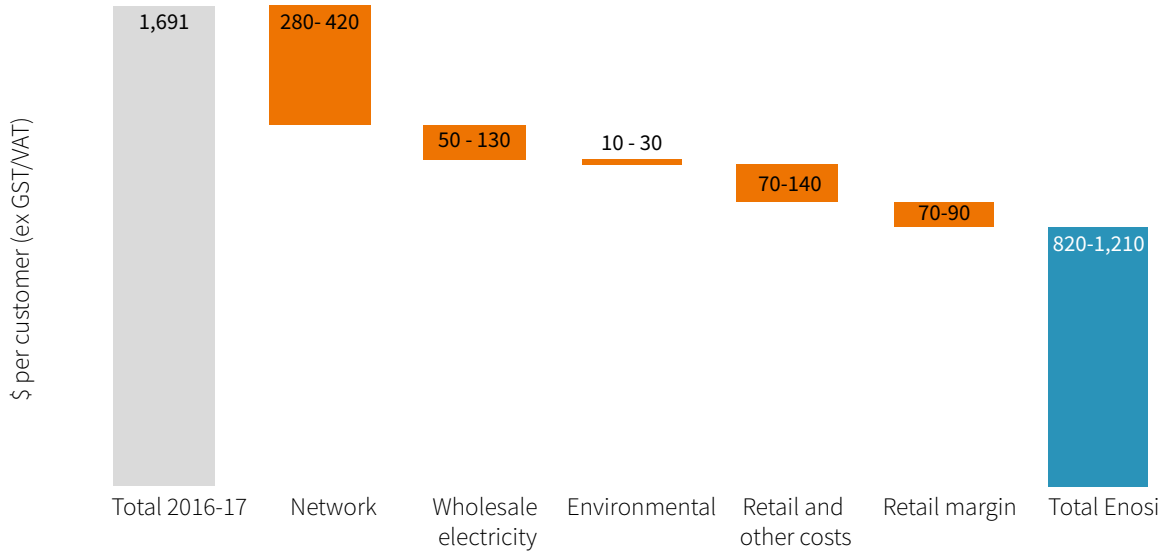


Australian electricity price breakdown [17]

[16] Source: ACCC report, adapted from IEA Electricity Information¶

[17] Source: p.39 file:///C:/Users/flore/Documents/Stage%20Australie/Retail%20Electricity%20Inquiry%20-%20Preliminary%20report%20-%20 13%20November%202017.pdf

Shifting to Grid 2.0, as supported by the Enosi platform, could potentially result in a 40-60% reduction in household electricity costs as the platform will impact all components of the energy cost. Using Australia as an example, our estimates show an approximate $750 cost reduction with the full implementation of Grid 2.0. The source of these savings will evolve as the benefit may accrue to different parties with regulatory rule changes.



Estimation of potential Grid 2.0 cost reduction - Australian example

A complete breakdown of the assumptions made for the Australian cost saving example is shown in the below table.

Cost Component	Assumptions	Benefit
Network (40% of costs)	Solar household with 20% of electricity traded with the grid Electricity transport costs incurred when purchasing and selling electricity Cost reduction due to reduced reliance on HV transmission from central generation sites Reduce losses Regulation shift towards cost reflective tariffs, better aligning network charges with next lowest cost alternative e.g. disconnecting from the grid	~40-60% relative reduction
Wholesale electricity (30% of costs)	Peer-to-peer trading to pass through savings of localised generation Reduction from current wholesale rate of 9.5 c/kWh to the rooftop solar LCOE of 6.9 c/kWh Assume 80% of electricity requirements met with rooftop solar	~10-25% relative reduction
Environmental (6% of costs)	Transparent economic price signals to be a major driver of renewables adoption Reduced need for government intervention and resulting costs	~10-60% relative reduction
Retail costs (14% of costs)	Application of blockchain technology to completely automated transactional activity and lower cost to serve Targeted offerings will enable lower costs to acquire/retain Expected large cost reductions in Ethereum or similar distributed ledger and cloud based technology	~30-60% relative reduction
Retail margin (7% of costs)	Current retail margin to be replaced with transaction fees paid to DAO and neo-retailers Greater competition to lead to lower overall retail margin	~60-80% relative reduction

Enosi Team

Foundation Team

Steve Hoy | *EXECUTIVE MANAGEMENT*

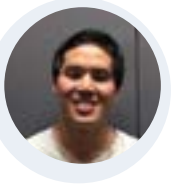
Steve is a global utility industry executive and recognised subject matter expert in smart grid and distributed energy resource management systems. He has over 35 years experience in engineering, IT and strategy concentrating on the utilities sector, most recently leading a team of subject matter experts in grid operations and engineering systems as part of IBM's Global Center of Competence for Energy & Utilities.

Dr John Laird | *PLATFORM ARCHITECTURE*

CTO and co-founder of Solar Analytics, where he designed and implemented Australia's largest solar monitoring and home energy management solution. He was also the winner of multiple NICTA and UNSW academic awards in computer science and has in-depth experience with real-time sensor and data streaming applications in complex ecosystems.

Dr Renate Egan | *SOLAR, ENERGY MARKETS*

led one of world's largest Photovoltaic (PV) R&D teams for over 10 years. She is a globally recognised PV scientist and industry leader, represents Australia on the International Energy Agency and is Chair of the Australian PV Institute.



Michael Kong | *BLOCKCHAIN DESIGN*

Smart contract developer who has been involved in blockchain for several years. Previously the CTO at Block8, a VC backed blockchain incubator, and built one of the first Ethereum decompilers and smart contract vulnerability detectors, for which he won the 2017 Microsoft award for Senior Software. Now CTO of DigitalCurrency Holdings, an adivsory firm to a cryptocurrency fund and ICO projects.

Valantis Vais | *STRATEGY*

Serial entrepreneur with multiple solar ventures. Worked with Australia's largest companies as part of the Boston Consulting Group and KKR private equity group. MBA from University of California - Berkeley Haas School of Business. Val holds three patents in solar cell research.

Stefan Jarnason | *ENERGY EXPERTISE*

solar industry pioneer with two decades of global technical and company leadership across the solar industry value chain. He is an internationally recognised PV reliability expert who established international practice in PV lifetime testing, developed world's first modular rooftop solar system, and is the holder of several solar patents.

Bill Barden | *FINANCE, COMPLIANCE*

25 Years banking and finance experience, last 6 years in venture capitalism concentrating on new technology. Australian Financial Services Licences responsible manager and compliance officer.

Enosi Development Team

Enosi has partnered with Block8, one of Australia's leading blockchain development companies to advise, design and build the first releases of the Enosi Platform.

Block8

Block 8 is Australia's leading blockchain venture studio. They joint venture with leading companies and domain experts to incubate innovative applications with worldwide disruptive potential. These applications transform business models and disrupt industries, using the unique qualities of blockchain technology. Block8 bring deep experience in Blockchains, decentralised file systems, digital currencies, and Ethereum smart contracts to architect platforms and applications that creates new digital business models such as Enosi's.

Block8 chose Enosi as one of a small number of world-class blockchain programs that they support. Other recent projects have been the Havven stablecoin development, and MyStake share registry blockchain development.

Block8's on-going work with Enosi includes overall platform architecture, design and development of the first releases of the Enosi Platform.

Tim Bass | *CEO BLOCK8*

Tim Bass is a Solutions Architect with 13 years experience in IT infrastructure and cloud technologies. He has deep technical experience designing highly available, flexible and scalable cloud architectures across a wide range of customers. He is passionate about building the next generation of decentralised applications using Blockchain technologies, and believes decentralised peer-to-peer systems will revolutionise the way people and

Matthew Hale | *BLOCK8*

Matthew Hale is a solutions architect at Block8. He graduated from UNSW with a BSc (advanced) and BA an subsequently has more than 2 years experiece working on projects in both the blockchain and energy sectors, such as Everty, a PMP electric vehicle charging network and marketplace for EV services. At Enosi, Matt is responsible for delivering technical

Samuel Brooks | *CTO BLOCK8*

Samuel Brooks is Chief Technology Officer at Block8. He has a degree in Electrical Engineering from UNSW and has over 10 years experience in both the financial services and energy industries in both technical and manageriel roles. He started working on blockchains in 2014, and now leads the technical solution architecture for the Enosi

Advisory Board

Enosi is also supported by a strong community of energy industry, blockchain and platform technology, and crypto-finance sector experts as it develops its vision, and solutions for industry disruption.

Energy Industry Experts

(see future releases of this whitepaper)

Paul Fox | *ENERGY EXPERT*

Paul Fox is the Managing Director of Blockchain Pacific Capital. Paul has held technology investment roles at AGL Energy, Southern Cross Ventures, the California Clean Energy Fund and Flex. He worked in Silicon Valley for 12 years as an executive, start-up CEO and venture capitalist. He was a strategy consultant during the deregulation of the energy industry in the 1990s.

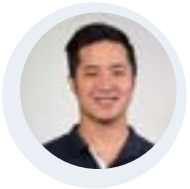
Crypto-Finance Experts

Steve Bellotti | *PARTNERSHIPS*

Steve has worked in leadership roles in financial markets for over 30 years across all major asset classes - managing fixed income (including rates, credit and derivatives), foreign exchange, cash equities and derivatives, debt and equity capital markets, including both sales and trading at the Managing Director level for over 22 years. He has built a number of large complex global markets operations for global banks,including Merrill Lynch and Dresdner Kleinwort in London, New York, Sydney, Hong Kong and Singapore. Steve's most recent role was MD – Global Markets & Institutional Loans, ANZ Bank (managing over AUD$300b in assets); and MD – Head of Global Markets, Dresdner Kleinwort Group. Steve founded Token Coin Management and Digital Currency Holdings Asset Management (DCH) in early 2017.

Bob Tucker | *PARTNERSHIPS*

Chartered Accountant with more than 25 years of experience managing businesses for leading financial institutions and top tier asset managers in London, Chicago, San Francisco and Sydney. Former COO of Man Group. Bob has also been directly involved in a number of early stage ventures, from start-up phase through to IPO.



Jake Choi | *TOKEN ECONOMY ADVISOR*

Vice President of Sales at digi.cash, led the Digital Currency Group at Capital Market Cooperative Research Centre

Enosi Institute Members

Internationally, the energy landscape is complex, interconnected and highly regulated, with operating conditions varying significantly across the world. To help the Enosi Foundation navigate this landscape, a group of experts and academics from around the world are being selected to form the Enosi Institute, whose mission is to help the Foundation find the optimal technical and economic method for providing electricity to its members in each jurisdiction.

Enosi Institute members already include:

The Australian PV Institute is a not-for-profit, member-based organisation, which focuses on data analysis, independent and balanced information, and collaborative research, both nationally and internationally. Its objective is to support the increased development and use of PV via research, analysis and information.
Enosi has signed Letter of Intent with APVI and commenced co-operative projects with APVI's membership and oversight, including the :
- "Energy Data for Smart Decision Making" (SunSpot) program recently launched by the Australian Federal Minister for Urban Development and Cities.
- Getting Large Scale Solar Right" Cooperative Research Centre Program submission

Enosi has signed a Memorandum of Understanding with UNSW underpinning agreements for cooperative work on UNSW-led research programs such as modelling smarter energy communities.
The details, credentials and potential contributions of additional Enosi Institute members will be provided in future releases of the draft whitepaper, subject to;
- Agreed non-disclosure and privacy provisions
- Finalisation of individual terms and participation agreements

Enosi's Industry Partners

Our partnership program is well underway with two energy neo-retailers already making agreements to cooperate in the development of the platform. This ecosystem will rapidly expand as the results of our trials and our partners' successes are publicised, and the merits of our open-source approach and efficient technology are understood.

Melbourne based neo-retailer Energy Locals will work with Enosi on the user requirements and design of our P2P trading and customer applications. In many ways Energy Locals presents an ideal profile as a user of our technology since they so closely share our vision of industry disruption. Their mission statement is clear:

"Our purpose is to kill the traditional energy model, so that Australian customers can use as much clean energy as they need to live comfortable lives at a great value price they can control. We achieve that through a fixed rate model and partnerships with organisations that add complementary technology or services, each of which reduce customers' reliance on the traditional grid."

Wattwatchers is an Australian-based energy technology company specialising in accurately monitoring and controlling electricity at circuit-level in real time over the internet. The Wattwatchers solution suite answers the question of 'Where do you get the data for that?' for the digitisation of electricity systems independently of traditional market metering, and focuses on unlocking granular data and remote switching capabilities behind the meter for the clean, distributed and 'Internet of Things' era for energy.

Its intelligent, ultra-compact, highly-flexible devices are architected to work with a wide range of communications, software and other hardware; support multiple APIs on a fully-scalable energy data cloud platform; deploy across residential, commercial and industrial, and utility use cases; hold key international certifications for electrical and telecommunications safety; and are operational in commercial rollouts, pilots or test installations in a dozen countries on six continents.

Wattwatchers is a primary hardware and energy data services provider to Solar Analytics. It won the Australian Technologies Competition New Energy Award in 2016.

WattWatchers is producing a metering device designed for the 'new energy paradigm', they will provide data or services that are necessary to complete energy transactions under the Enosi protocols.

A key partner and founder of Enosi, Solar Analytics will become a Neo Retailer in the Enosi ecosystem. Solar Analytics will also be a trusted 'Oracle' with their world-leading solar home energy management service that others on the Enosi Platform will be able to access. Solar Analytics are also providing assistance in the P2P Platform design, by sharing their experience with the P2P Platform (off chain) they have recently built.
Solar Analytic brings to Enosi (and our Retailer partners) the potential to tap into their 18,000 household customers and their network of 350+ solar partners. In the spirit of truly open source and open competition Solar Analytics are encouraging these solar partners to be either distributors of SA's Neo Retail offer, to join SA's EDAO as a Neo Retailer under Energy Locals Retail Licence, or to initiate their own EDAO.
Importantly Solar Analytics have been openly sharing their analysis of their own customer base, which includes showing that approximately 55% of solar electricity is exported, at an average per site of 8.4 kWh/day.

National Renewable Group, design, sell, install and maintain premium, affordable solar panel and energy storage systems. NRG have a national reputation for providing expert solar panel system service and support.
NRG's objective is similar to Enosi's as they want to give a simple access to their clients to renewable energy by helping them to manage their solar installations for maximum benefit. They will work with Enosi on defining the needs of suitable retail products on the platform and exploring neo-retailing opportunities.

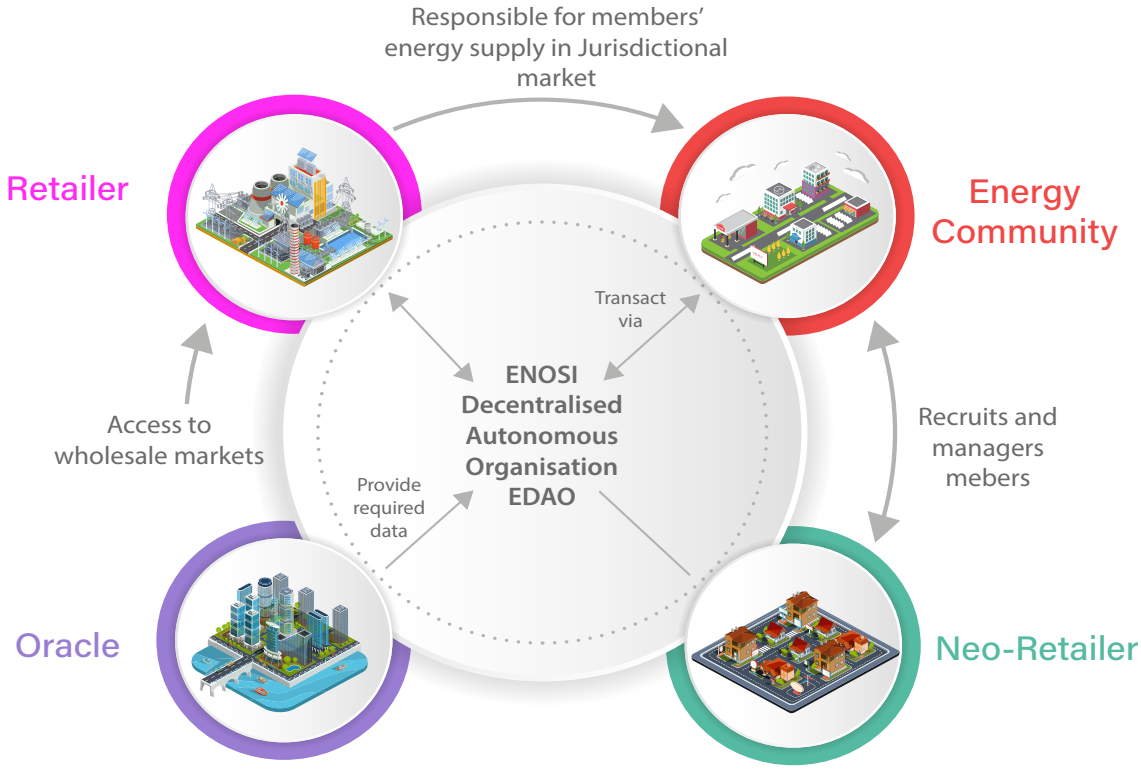
DC Power is building a retail energy business focused on solar energy. They intend to provide billing and energy transactional services. They will work with Enosi on the retailing opportunities and they will help us to identify core or related capabilities for our platform.

Additional Partners

(see future releases of this whitepaper)

Enosi Ecosystem

The Enosi ecosystem is comprised of participants, the Enosi Platform, and the Enosi token (the JOUL), each detailed in the following sections.



Participants

The Enosi ecosystem contains many participants, both passive and active. Following is an overview of each of these participants to describe how they interact with and utilise the Enosi platform.

Members

Members are electricity customers such as households and businesses who use the Enosi platform to trade their electricity within their community, and access the wholesale market via a participating licensed retailer. Members are a core part of the Enosi ecosystem and will primarily interface through a set of dApps to select their neo-retailer, their pricing plans, their community trading parameters and to participate in the community. Some members who are willing to self-service will be able to perform this autonomously. Other members who require support will be able to reach out to neo-retailers who will provide member support.

Enosi Decentralised Autonomous Organisations EDAO

The Enosi platform is powered by smart contracts. These smart contracts allow the formation of Distributed Autonomous Organisations (DAOs). The contracts together contain a set of specific programmatic rules which may only be executed by decentralised consensus of JOUL holders and actors, who are governed by the rules of a particular DAO.

Each DAO is intended to function autonomously, in a decentralised manner, and function without the need for centralised parties to make decisions for the organisation to achieve its stated goals. The purpose of the DAO is to ensure that the functions traditionally performed by the existing corporate entities can be carried out without the inefficiency of running a large organisation.

Enosi will appropriate the concept of a DAO to produce a set of smart contracts that can be used to create an Enosi Decentralised Autonomous Organisation, or "EDAOs". An EDAO will abide by a set of

specific programmatic rules along with a set of rules that are executed by decentralised consensus. The Enosi Foundation believes that using DAOs to govern and manage the relationships between retail energy license holder(s), neo-retailer(s) and members will become the most cost efficient way to meet local regulatory requirements while delivering energy services to neo-retailers and their energy community members.

Neo-Retailers

Neo-retailers will be integrated with an EDAO (explained below) to provide tailor-made member management functionality. Much of the management functionality will be provided through the Enosi Platform, however certain functions such as member acquisition and support will be performed by the neo-retailers themselves. In particular we expect neo-retailers will often represent community based organisations interested in offering their members a community energy sharing scheme of some type. A neo-retailer may also hold a full Retail licence, but only one such licence holder is required for the EDAO to operate.

EDAO Creator

The EDAO Creator will play an important role in the Enosi ecosystem and is most likely to also be a neo-retailer aiming to enable a particular community energy plan. The EDAO Creator is simply the entity (individual, community organisation, company etc.) that creates the EDAO.

The EDAO is created via a dApp, where the creator is required to fill out a form specifying all the required parameters of the DAO such as the regulatory jurisdiction, the energy retail license, and other constraints, and required to stake a certain amount of JOUL tokens.

Due to the heavy regulation in the electricity industry the EDAO Creator will have special rights to ensure that the EDAO meets all regulatory rules. These administrative abilities may include:

- Ability to choose the energy retail license holder
- Define region-specific rules and constraints on members and neo-retailers
- Expel neo-retailers and members for not abiding by the rules
- Choose the provider of third-party services for the EDAO e.g. metering providers, payments processors etc.
- Choose the transaction fee level for the EDAO

Retail License Holder

A Retail Licence Holder will be a participating electricity supplier who supplies direct to consumers, and will hold a license to conduct this activity in accordance with the licensing requirements of the relevant region. The dApp will allow retail licence holders to register and advertise themselves to EDAOs, creating a marketplace of participating Retailers and EDAOs. The members of each EDAO will be able to vote on accepting a particular license holder, and the license holder can choose whether or not to accept. Through group purchasing power, members of EDAOs will be well placed to negotiate a good deal. And, viewed from the retailers perspective, the EDAO members represent an attractive new customer base.

The retail licence holder will provide a wallet address and be listed as the license provider in connection with the relevant EDAO within the relevant smart contract. Over time, for certain volume transacted on the Enosi platform through the EDAO, a nominated fee will be escrowed by the smart contracts, with corresponding payouts to be distributed to the license holder's virtual wallet. The provision of these fees are included to encourage new EDAOs and neo-retailers to be developed and deployed in new regions on the Enosi platform.

Note that in current retail markets, the license holder is typically responsible for performing all the actions required by the jurisdiction, i.e billing and reconciliation and hedging in the wholesale energy market. Within the Enosi ecosystem, any or all these activities may be performed by the EDAO.

Typically the Retail Licence Holder also undertakes energy trading and procurement in the jurisdictional wholesale market (run typically by a government owned independent system operator (ISO)). In many such markets the physical spot price of electricity can be highly volatile. Today, most trading is in the form of bilateral hedge contracts (against the physical spot market) performed over the counter or in other private markets. The Enosi platform will initially interface with the Retailer providing detailed information enabling trading and procurement. As the platform is developed over time, it may interface directly with futures commodity markets and other market makers who are willing to take on the wholesale risk associated with providing energy to the EDAO members.

Enosi will also investigate the creation of machine learning trading algorithms to enable EDAOs or other parties to become market makers within the ecosystem, and provide particular insight into the future behaviour of their downstream energy communities.

Energy Metering Oracles

One critical physical interface for the ecosystem is energy metering; to inform the EDAO of the members' energy consumption and production. Clearly, some of this infrastructure already exists in the form of specialist metering companies or maybe specialised departments of existing grid companies. In Australia they are called Meter Data Agent companies and perform defined roles as Metering Coordinators, Meter Providers and/or Meter Data Providers. The entities will deploy and often operate fleets of "smart" interval meters and are subject to regulation, particularly with respect to the accuracy of the data provided. Within the Enosi ecosystem these participants will be called Energy Metering Oracles.

Another possibility for retrieving energy measurements is a combination of "dumb" meters that meet local regulation coupled with lower cost third-party devices.The device would need to be highly accurate and produce measurements equivalent to an interval meter installed at the location. An Oracle would also be required to pre-process the data stream before submission to the Enosi blockchain for energy transactions. One of Enosi's industry partners, Wattwatchers provides a typical such device.

The final possibility is a configuration that consists of a "smart" interval meter that meets local regulation and includes an appropriate Ethereum light client installed on the meter that will enable the members to be their own Oracle. The key problem here will be to create a configuration that works in a trustless environment where it is possible to physically tamper with the energy meter and we are encouraged by recent developments in this technology space.

The Core Enosi Protocols

The Enosi platform aims to provide each transactional component necessary to enable the delivery of energy services to members through a set of open-source smart contracts. The Enosi platform will be reusable and extendable to enable rapid deployment and uptake while ensuring future improvement by the developer community.

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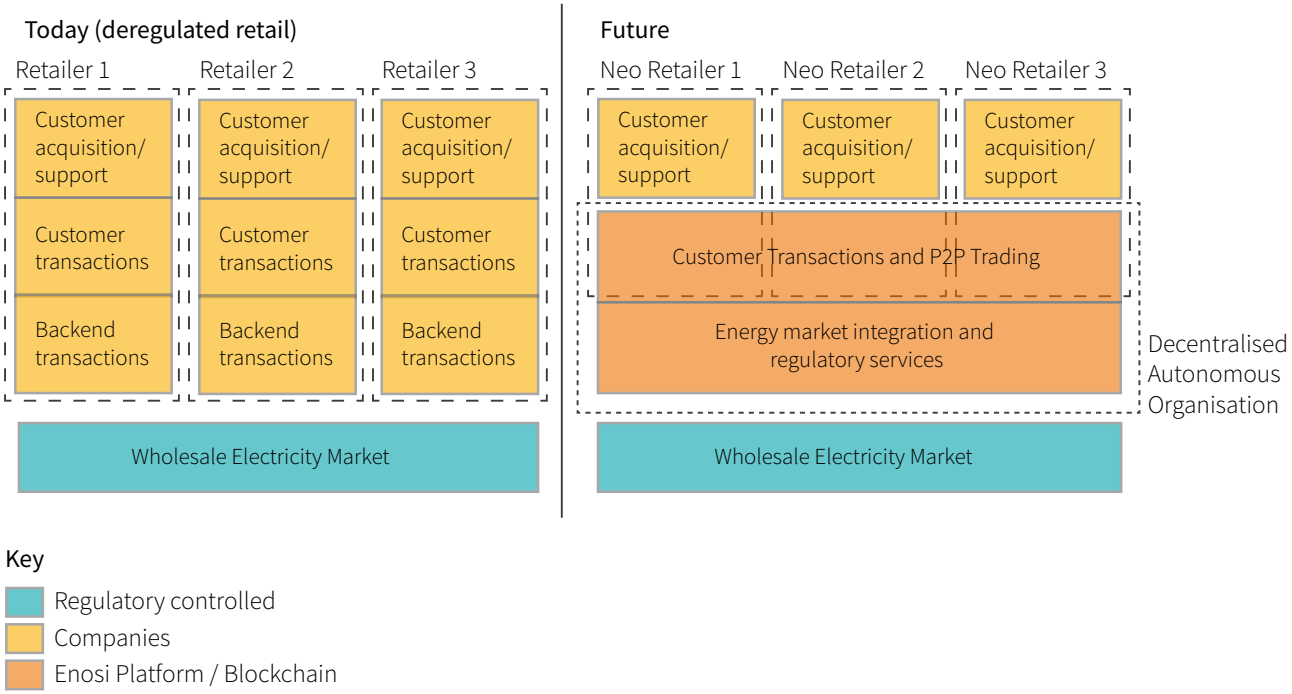
The platform will provide the components typically duplicated in the current energy ecosystem. By automating these core industry components and enabling in the future, critical new use cases such as peer-to-peer trading, Enosi will move towards its goal of minimising the cost of electricity to consumers.

Figure 11: *Grid 1.0 vs Enosi enabled Grid 2.0*

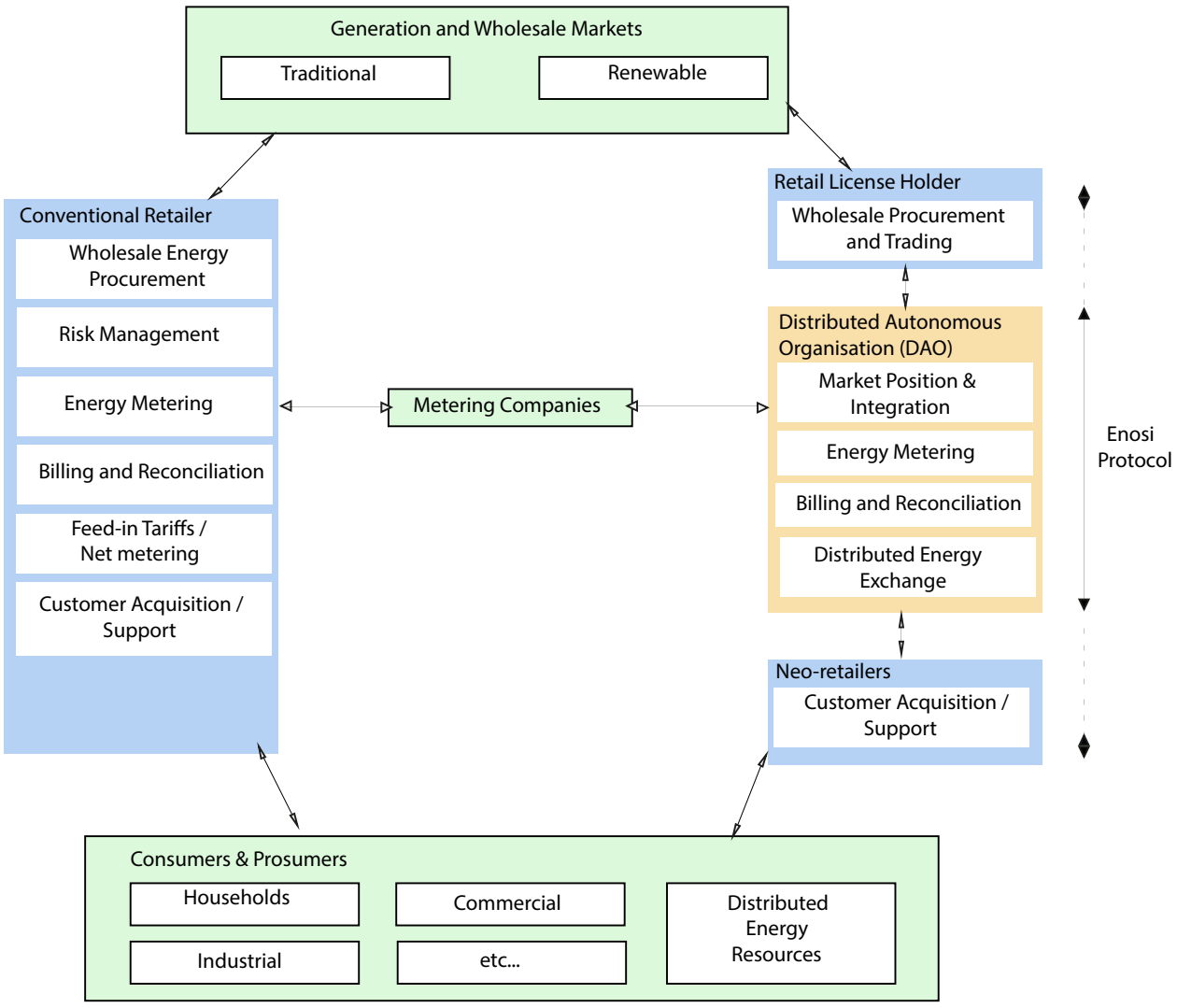


Providing an alternative for the full suite of services offered by current energy retailers is not trivial as there are multiple components that need to be addressed. The Enosi platform aims to provide the protocols to allow neo-retailers to provide the full vertical stack of energy services to any of their customers. The figure above describes how the range of energy retailer services required will be decoupled and integrated into the Enosi platform.

In addition, the geographic requirements of the platform will vary dramatically so the only way to develop the required components quickly and efficiently is by making it open source and extendable by developers around the world. These contributions can be of new features or improvements to the existing services, and will provide a community-driven platform that encourages a shift away from the traditional monopoly model of delivering energy.
The Enosi platform will provide each EDAO with a suite of key energy and regulatory capabilities required to enable neo-retailers and members. These capabilities include energy metering, participant fees, transaction settlement, billing, and regulatory reporting and compliance, described below.

In the diagram below, a simplified view of the Enosi enabled business model is illustrated on the right hand side, shown in comparison to the functions of a conventional energy retailer. The Enosi protocols will replace existing metering, billing and settlement functions while supporting new capabilities particu-

larly in the areas of P2P energy exchange, proof of energy provenance, and community energy programs . An extended set of Enosi applications will be made available to neo-retailers and partners to assist in customer engagement functions as well as wholesale market integration and possibly position optimisation.



Comparison of core Enosi Protocol Stack with Typical Retail Functions

Energy metering

To minimise the number of interfaces, Enosi will define the open protocols for this component and the data from Oracles will be available to all EDAOs within specific regions. The data provided from these Oracles will need to be analysed for consistency and errors before submitting for transactions on the Enosi platform. Processes for reconciliation of missing, estimated and substituted meter readings will be captured in smart contracts and/or interface rules between the Platform and the Oracles.

Participation fees

In order to compensate all the various participants in the ecosystem, the EDAO will collect and distribute a small fee that will be levied on the access charges. The fee will be automatically charged when the access is granted or renewed via the smart contract, with the fee being paid in JOULs to the recipients digital wallet. These participation fees will remunerate Energy Metering Oracles, computation costs of running on Ethereum where required, payment to the Energy License Holder, fees to the neo-retailer, fees to the EDAOs and the Enosi Foundation.

All these fees will be paid out instantaneously to the relevant party if possible otherwise they will be kept in escrow either as JOULs or fiat currency depending on the nature of the liability.

Transaction settlement

Evolution in the energy market is both a necessity and an inevitability. Energy members will be consumers, producers, or both and will buy and sell energy in transactions with their peers in peer-to-peer trading or with the energy generators or wholesale intermediaries. This emerging demand for transactions provides the opportunity for a highly liquid market that can be accessed by a large number of participants.

Trading of energy on the Enosi platform will have an Applications Programming Interface (API) clearly defined for transacting between two parties, described in the "Enosi Applications" section of this whitepaper. Transactions will be addressed using public keys, which are unique member identifiers, and payments will be made automatically within a specific geography. In addition, the volume of energy will be referenceable to allow neo-retailers and third parties to provide dashboard services to visualise energy usage and value-driven data.

Billing Services

The Enosi Platform will provide billing as one of its core administrative services. Billing services will allow participants to procure a final balance over a given time period. At the time of billing, all market participants will need to ensure transactions are final and completed. The protocols will allow for the creation of billing determinants for the participating Retail Licence Holder, effectively netting out local community trades, while allowing the Retailer to adhere to local regulations and requirements. Ultimately a fully compliant billing engine for the jurisdiction can be made available directly on the Enosi platform eliminating the need for duplication of EDAO and Retailer systems.
Access charges using the JOUL token will be exchanged for the appropriate fiat with external services, or by using, when available, stable coin, internal or external crypto wallets. The crypto wallet can also be used to serve future transactions on the Enosi platform if appropriately funded. Furthermore, a crypto wallet will enable customer (and associated balance) transfer to other neo-retailers deployed on the Enosi platform, and will be a simple experience with minimal friction for the customer.

Regulatory reporting and compliance

Compliance with government regulation will be a key component of the platform. Mechanically, this will include reconciliation of transactions for payment settlement, accurate energy usage information over required periods of time, customer transfers, and customer-level data required in the event of complaints. Due to the unique reporting requirements of each regulator in various countries, Enosi will be focused on finding commonality to build a stable protocol while the development and integration of highly customised jurisdiction-specific components will need to be created on a case-by-case basis.

For each confirmed region of operation, it will be possible to adapt the Enosi Platform to automatically generate regulatory reports and compliance statements taking into consideration specific requirements in particular jurisdiction. Examples of such reports and functions from the Australian market context may include:

- Market statistics (customer numbers, churn etc)
- National Energy Customer Framework (NECF) requirements such as customer hardship and consumer protection rules,
- National Energy Market prudential requirements and financial stability rules
- Wholesale market fees (if not covered by the wholesale trading partner)
- Distribution and Transmission Use of System (DUOS & TUOS) bill validation & settlement
- Complaints and resolutions
- Renewable energy certifications

Participant Management Services

There are many participants and components within the Enosi ecosystem that will require specific programmatic interfaces with the platform. Examples include:

Decentralised applications

Participants will be able to interface with the Enosi platform smart contracts through downloadable mobile applications available in iOS and Android. Such applications, combined with the smart contracts, are commonly known as "Decentralised Applications" (dApps). A dApp is an application that runs on a distributed, decentralised network (such as the blockchain) and does not rely on a centralised server or 3rd party, which is a single point of failure.

Digital wallets

All participants will be able to register their digital wallets with the EDAO, via a dApp. This will be used to pay and receive JOULs. For most members this functionality will be managed by the neo-retailer.

Sign-up and Member Management Services

The Enosi Platform will provide the functionality for neo-retailers to be created and attached to a specific EDAO. Once created, customers will be able to signup with their customer metadata, and with the unique identifier specific to the desired neo-retailer. The information required on signup will satisfy all requirements in regards to customer metadata as well as metering identification and validity for the platform.

A customer may also request to transfer to an alternative neo-retailer or to remove their account from their EDAO. Migration to another valid neo-retailer will be possible through smart contracts and customer metadata information being transferred. The security and privacy of customer's details will be ensured as part of the process. Final settlement will occur with the original neo-retailer as required as part of the process.

Enosi Token : The JOUL

The JOUL is an ERC20 based token that will be used to provide access to the Enosi Platform functions and compliant services through the retail licence holder, and gives the tokenholder the ability to perform certain actions within the ecosystem. An ERC20 compliant token adheres to a set of rules allowing it to be integrated and supported by the Ethereum network.

Access to the platform

The JOUL will be a pre-requisite to access the Enosi Platform and its functions within a particular EDAO. JOULS may be procured by neo-retailers on behalf of their community members.

Access to the Retail Licence Holder Services

The JOUL will enable and validate the member's access to the Retail Licence Holder's services. Since neo-retailers may or may not hold a licence, joining an EDAO through such a channel does not exempt members from local jurisdictional rules and obligatory processes and costs such as:

- Registration with the jurisdictional energy market
- Procurement of (nett) energy requirements from wholesale markets
- Grid access requirements and charges
- Authorised metering services

A Retail Licence Holder (RLH) will be associated with each EDAO (or indeed several), and neo-retailers establishing community energy schemes will need to ensure that RLH services are available to their members. They will do this by procuring JOUL tokens from the RLH on behalf of their participating community members.

Stewardship of an EDAO

Members of each EDAO along with the EDAO Creator will be able to make decisions on changes to the EDAO. These changes could include, but are not limited to, appointing a new member to take on the role of the EDAO Creator, or adjustment of the community energy trading rules within the EDAO.

Stewardship of the ecosystem

Once a significant numbers of members have joined the Enosi Foundation, JOUL holders will be able to make proposals, with respect to a limited number of domains, to the Enosi Foundation and its open-source community. Enosi believes this will foster engagement between the community and the Foundation, increase accountability, and allows members to shape the future of the Foundation and its impact on the open source platform.

Enosi Applications

Distributed ledger technology (DLT), due to the write-once nature of its update processes and replication across multiple members, can act as the trusted source of truth for consumers, generators, retailers, networks, auditors and regulators.

There are dozens of individual applications where DLT can reduce cost or provide innovative services. Each of these applications will be subtly different and may require unique software in each of the thousands of distinct energy markets across the world.

The key attribute of the Enosi platform is that it is an open platform that allows thousands of individual organisations to participate in providing customised services for their specific requirements. By leveraging the common platform and sharing software developments across regions, each participating organisation is able to use this lower cost technology to rapidly create their specific application.

Peer-to-peer (P2P) electricity trading

Peer-to-peer (P2P) trading is the ability for households and businesses with solar systems (Prosumers) to trade their excess electricity within their community to those without solar (Consumers). P2P markets offer more trading options than the standard one-way energy retailer to customer or standard 'feed-in-tariffs', but are also more complex to manage, track and verify.

Enosi envisions three core types of community trading arrangements.

A) Bilateral Trades
Where members agree prices between themselves (including the zero price charity scenario)
B) Community determined trading rules
Where particular trading rules apply based on the community's particular proposition. For example in a community established by a local school members may agree to meet the school's energy needs by selling excess solar to the school at a discounted rate before other trading is undertaken between members.
C) Clearing Market Rules
Application of a clearing mechanism or bid/offer matching allowing community members to set their minimum sell price or max buy price.

P2P can occur in four market situations as described below:

1) Virtual Peer to Peer Trading

While it is sensible to limit P2P trading to participants within the same wholesale market jurisdiction (so that retailer is not subject to wholesale hedging risks from divergent prices), there is no strong reason why prosumers and consumers engaging in trading need to be connected to the same part of the grid or even the same physical grid owner's infrastructure. In most markets the consumer (and not the prosumer) pays the grid transport charges and these will therefore not depend on the agreed source of the energy. So it is perfectly feasible for a neo-retailer to include participants potentially thousands of kilometres apart in his P2P community. Nevertheless the value available from such trades may depend on the nature of the grid transport tariffs that apply.

a) Fixed electricity distribution pricing
Most regulated electricity markets charge a combination of fixed and per $/kWh to transport electricity to a grid connection point regardless of the location of that connection point or distance from generation sources. The cost is distributed across all consumers rather than being based on actual cost of use of the infrastructure. The price paid for any exported electricity may also have a regulated minimum. Similarly the retail energy price may be fixed by regulation. In this market situation there may be negligible financial benefit available from P2P since the Consumer will pay exactly the same for the electricity regardless of where it comes from. However, as has been demonstrated by Solar Analytics, LO3, Nexergy and others, that there is considerable interest from both Prosumers and Consumers to be able to track and exchange their electricity locally even with no net financial gain.

b) Localised electricity distribution pricing
A more efficient use of resources is to have more cost-reflective pricing, where the price charged to

transport the electricity is proportional to the actual cost of providing local grid capacity.
i.e. if I am located close to sufficient generation sources I am charged less than if I rely on generation sources very far away since theoretically I am using less infrastructure. This market dynamic is being tested in both new-build grids and within existing grids as a more efficient way to optimise the infrastructure. In this situation, Consumers and Prosumers could benefit from reduced transmission and distribution charges.

2) Micro-Grid P2P Trading

Most Peer-to-Peer models proposed to date require the participants to be connected behind a single aggregation metering point. This might apply to a whole subsection of the power grid or just an embedded LV network such as a gated residential community. It might also apply to power grids that are (or can be) completely disconnected from any large scale grid and wholesale market - such as an island or remote community.

a) Embedded metering communities

These are communities such as estate housing or apartment buildings where there is a single electricity head meter for the community, and sub meters behind this head meter. This allows all of the consumers within this community to trade electricity with each other without paying any of the main grid's transmission and distribution charges on that energy (other than grid charges levied at the head meter and shared across the community). In this situation, Consumers and Prosumers can avoid the full cost of the standard transmission and distribution charge, (in Australia on average 43% of the cost of electricity) for all electricity that can be generated and consumed within their community.

b) Microgrids

These are communities that are or can be, fully disconnected from the main electrical grid. There will still be an operator of the microgrid, who will typically manage both the local electrical distribution infrastructure and some medium scale local generation, e.g. diesel. In this situation, the microgrid operator needs an open transactive platform to manage the grid and incentivise Prosumers and Consumers to minimise the need for additional infrastructure.

In each of the above market situations, the Enosi platform will enable Consumers, Prosumers and neo-Retailers to participate in an open and fully competitive market that will encourage increased distributed generation and optimise infrastructure expenditure.
Our demonstration systems trials with Solar Analytics will facilitate P2P trading in situation 1a), which is the most challenging of these market situations due to the limited financial incentive.

Proof of provenance

Provenance is a method for establishing and maintaining the history of a unit of electricity (kWh) from when it first came into existence, and through all the transactions that subsequently deal with that unit of electricity. Since electricity is fungible and will travel according to the laws of physics rather than any economic directives, it is impossible to physically trace to ensure that when a Consumer chooses to buy electricity from a nominated source such as a community wind farm they are receiving electricity from that source. Thus provenance is in reality a verification that each kWh generated from a particular source is assigned to one and only one consumer of that energy.

The Enosi platform will provide a transparent, auditable and immutable transaction record which accurately and rapidly accounts for each kWh of electricity traded on the platform.

Community owned generation

There is growing interest and development of medium scale renewable generation that is located close to the point of use. Local communities band together to finance the construction and operation of these solar or wind farms so they can provide a sustainable financial return and local electricity generation. An application of the Ensoi platform could enable each community member to invest in the solar or wind farm, and receive either a proportional share of the electricity generated, or the financial returns from the sale of this electricity.

Same day energy switching

In deregulated energy markets that allow multiple electricity retailers, churn can be significant. In Australia approximately 20% of consumers will elect to switch electricity retailers each year. However, these processes can be slow, expensive and fraught with data and transactional timing errors. In Australia it takes up to three months and on average approxi-

mately $60 to process this transaction[21].
Application of a shared ledger approach and smart metering enablement to such transactions could enable the switching of electricity accounts within a single day at a cost of less than $10[22].

Demand response (energy technology monetisation)

The lowest-cost way to meet peak electricity demand is actually through a reduction in electricity demand, or demand response. Many electricity markets around the world either already have or are introducing financial incentives to encourage demand response, however their constrained technologies and consumer engagement has resulted in limited uptake.

Enosi will enable Consumers and diverse market participants to offer new ways to engage with consumers to share in the value from this real-time market responsive demand response.

Energy efficiency

In a similar vein to demand response, in developed grids the highest ROI from energy investment is often through improvements in energy efficiency that reduce the daily electricity consumption. However, these demand side abatement technologies struggle to secure widespread adoption because the business case is often complex and the financial benefits are difficult to measure accurately.

The Enosi platform will enable new business models such as installing energy efficient appliances with cost recovery through reduced energy bills, similar to energy service companies (ESCOs) today. The trusted ledger, low cost processing and transparent transactions of the Enosi platform are all essential for these business models to be effective.

Electricity billing

Independent industry analysis has shown[23] that there is value in adopting DLT (distributed ledger technology) to reduce billing costs. In the Australian market where three major retailers have dominant market positions, the cost to the electricity retailer to service their customers averages A$80 p.a per customer[24].

By Enosi's estimates the platform will enable:

- Reducing the cost of billing to below $20 p.a. through the use of automated smart contracts
- Reduction of other customer service costs through automation and lower exception volumes
- Increased billing options such as predictive fixed billing, fixed charge monthly billing, near real time transactions and innovative usage incentives

Low cost neo-retailer

The average cost for an energy retailer in Australia to serve their customers is approximately $80 p.a[25]. Electricity retailers also have very poor customer satisfaction ratings, with the electricity sector receiving the lowest customer satisfaction ratings of any sector (-38 to -23 NPS[26]).

Even more compelling is that the installation of the typical 6kW rooftop solar results in a 43% drop in revenue for the energy retailer. Combined, these factors make it extremely difficult for the incumbent retailers to justify cannibalising their own customers base and transition from Grid 1.0 to Grid 2.0.

A neo-retailer is a new energy retailer such as Energy Locals that does not have these legacy issues. They include new companies that want to use new technologies and innovative business models to provide lower cost electricity, and existing non-energy companies with large customer bases that want to expand their services. These companies have lower cost of customer acquisition through their existing channels, and by bundling their services can sell electricity at lower margins. In some cases they seek to associate their services with inclusive community brands and alternative perceptions of customer value.

Enosi will enable these neo-retailers to enter the market by providing many of the required back-end energy retail processes built upon market specific, low cost, secure energy retailer tools either directly

[21] Source: Australian Retailer reports and regulatory submissions.
[22] Based on Enosi modelling of churn transaction failure rates
[23] Marchment Hill Consulting. IBM & AGL Peer-to-Peer Distributed Ledger Technology Assessment, Oct 2017, https://arena.gov.au/assets/2017/10/Final-Report-MHC-AGL-IBM-P2P-DLT.pdf
[24] Source: Australian energy retailer annual reports.
[25] Source: Major Australian retailer annual reports and regulatory filings
[26] Energy Consumer Sentiment Survey, Energy Consumers Association, 2016

or through a DAO operating in the Enosi ecosystem. Specific examples of the neo-retailers with whom Enosi is in discussions include:

- Large retail chains
- Large membership based organisations, eg automotive
- Telecommunications companies
- Solar specialist energy retailers and installer chains
- Community based energy retailers

Wholesale market trading

In many electricity markets energy retailers are required to purchase each kWh of electricity they sell to consumers from the wholesale electricity market. Depending on the regulations of the specific market, this requires each retailer to perform the following functions:

- Purchase of electricity sold to consumers
- Forward procurement to cover expected sale to consumers
- Forecasting of electricity purchase requirements
- Hedging trading positions taken
- Financial management and exposure

Each of these functions could be performed at a lower cost through the use of smart contracts. In particular where the retailer is trading/procuring energy on behalf of neo-retailers operating P2P markets between their customers, Enosi dApps could provide nett position reporting and potentially forecasting and optimisation signals for the trader.

Further, by enabling multiple Retailers to participate in an EDAO with appropriate anonymisation and permissions (and/or EDAO to EDAO transactions) it would be possible to combine their aggregate load profiles to create a more competitive wholesale trading position.

Bill reconciliation and settlement

Each energy retailer is required to reconcile the total amount of electricity they have sold to consumers and purchased from generators for each transaction period. In most markets this is conducted through cumbersome, expensive, and slow centralised processes. As a result this reconciliation and settlement process is expensive and can take months to complete.

DLT can utilise smart contracts to reduce the time and separate processing required. Operational benefits can be achieved if the market administrator or regulator has greater real-time visibility over these multi-party trades, compared to the current system which only provides a retailer with visibility over their own customers' data.

By disintermediating third parties that support the transaction verification process, settlement time could be substantially reduced and enable retailers, generators, and financial market participants to settle their accounts at any specified interval, in near real-time and with lower transaction fees.

Electricity market regulatory oversight

In order to manage the operation of a regulated electricity market, the regulator requires the ability to track and audit each transactive process. With a myriad of different organisations participating in the market, this requires extensive command and control of different market ledgers.

DLT enables near real-time monitoring and auditing of trading and operational activity though a single shared and trusted ledger. This could reduce the regulatory burden on both regulators and market participants by providing greater visibility, transparency and up-to-date information for all parties over the market and its operations.

Moving house

When a consumer moves house they need to disconnect or cease payment for the electricity at their old address, and connect or commence paying for electricity at their new premises. Due to the number of parties involved, this process typically requires significant effort on behalf of the consumer, can take months to complete, has limited transparency for each party, and can result in transactional errors.

The use of DLT can provide each party with the information they require in an automated process, enabling a rapid, accurate and transparent relocation process.

Blockchain technology: Why Ethereum?

Ethereum is an open-source general programming framework that will allow Enosi to build the required software to successfully run distributed energy markets. Because the Ethereum Mainnet is a public blockchain, it allows the community to validate and view transactions without going through a centralised third-party. Enosi believes that energy markets should be transparent, decentralised and run by software that is available to view and be built-upon by any individual or organisation wishing to create improved software, or to adapt the software to work with different regulatory environments worldwide.

The Ethereum network can currently only verify approximately 15 transactions per second in contrast to say the >40,000 transactions per second by Visa. Each verified transaction costs roughly $0.50 - $1.00. Ethereum, in its current form, cannot support any large-scale applications including those Enosi plans to build. However, we believe that over the medium to long-term, Ethereum will have technology that will dramatically improve its scalability (known colloquially as “Ethereum 2.0”) in five main projects:

1. Sharding:

Sharding is the process of validating transactions on shards that follow protocols on the Ethereum mainchain, ensuring that all data is properly verified by a consensus mechanism. The consensus mechanism would only require a subset of nodes to view and verify the transactions, instead of every node in the Ethereum blockchain (which currently occurs). Buterin believes this will scale Ethereum up to “thousands of transactions per second”.

2. Raiden:

Raiden is developing a “lightning network” infrastructure layer that sits on top of the Ethereum network. The aim is to allow parties to create “payment channels” between each other where multiple transactions can occur, which are later batched and sent to the mainchain to be validated by the network. More information can be found here.

3. Plasma:

Plasma is a smart contract layer build on top of the Ethereum network that allows state changes in smart contracts to be validated by a group of private blockchains that interact with the root (Ethereum mainchain) blockchain. This allows a majority of computations to be validated by this private blockchains rather than the mainchain.

4. Truebit:

Truebit also builds a new layer on top of the Ethereum blockchain. The aim is to enable members to perform computation on behalf on of another party and verify each other’s computation via an incentive mechanism. This also means the parties can independently verify the correctness of each other’s computation and push the result to the Ethereum mainchain, thus eliminating the need for all nodes on the mainchain to verify every single computation made by a smart contract.

5. Casper:

Casper is the hybrid Proof of Work and Proof of Stake consensus mechanism that is currently under development and is available on the testnet. The aim is to significantly reduce the cost of validating transactions by making it easier to find and agree on the next block in the blockchain.

Competitive Analysis of Peer-to-Peer energy distribution models

There are several organisations and projects that are seeking to create blockchain technology for the energy sector. However it is Enosi's observation that most other projects are either focusing on narrow problems within the energy industry, providing tools to empower the incumbents, or are seeking to expand far beyond distributed energy enablement.

To date, innovation in the electricity market is stymied by both the inertia of the incumbent players, and powerful establishment protecting their market share. Most energy blockchain platforms and energy ICO's witnessed to date pay homage to this power, by trying to align themselves with the establishment, or alternatively concentrating on small micro-grid based projects. Their aim is to develop closed blockchain ecosystems and get current energy players to use their platforms. We believe we need a fully open source platform, designed by global energy market experts, yet one that can be tailored by local energy experts to meet the requirements of the thousands of individual energy markets globally.

Enosi is specifically focused on creating the protocols required to enable core energy transactions, that will meet most types of regulatory requirements and have the broadest global application. Enosi will achieve this by creating an open-source platform that addresses the common aspects of the various regulated and competitive marketplaces.

Enosi believes that the market will become further decentralised over time, as policy makers see the benefits of lower-cost, more secure energy generation. The Platform will be able to support applications for community energy programs, billing reconciliation and settlement, wholesale market trading, electricity billing, fast switching between retailers, and automatic hedging in the wholesale markets.

A number of key differences between our project and a selection of others is detailed in the table below.

Model	Experience	Distribution	Open-source?
Enosi			
Community Distributed Energy market, covering the common aspects of the regulatory frameworks and retail market rules. Developers can adapt to their own local regulatory framework.	120+ years combined in renewable energy industries and research. PhDs in physics and software engineering. CEO is a global utility industry expert and has done extensive consulting in blockchain P2P markets for IBM and its utility clients worldwide	18,000+ households currently using Solar Analytics. >90% surveyed wish to move to a peer-to-peer grid. Platform provided at very low cost to grow with any neo-retailer and their customer base.	Yes (aim is to open source under the GPL V3.0 license) Enosi specifically aims to encourage a community of dApp and smart contract developer to develop its open code libraries.
Powerledger			
Peer-to-peer microgrids partnered with existing large scale energy providers. By enabling microgrids the projects do not create pressure on the regulatory frameworks that exist in Australia or elsewhere. Potential for market led disruption seems limited.	Strong financial and energy partnership. Limited experience with renewables and distributed generation.	Some trials conducted in 2016 and 2017 on non-blockchain microgrids. Does not have an existing customer base they can roll out to, and so have to rely on trials with existing energy providers and the government.	Unclear. The whitepaper states that the smart contract layers of their platform "provides a trustless and open-sourced implementation" of their ecosystem, but no open-source code is currently available.
Grid+			
Building a Peer-to-peer distributed energy service in a deregulated energy market. Grid+ aims to be a retail energy provider rather than extend its solution to new entrants. It wants to create a generalised IoT platform for households.	Backgrounds in physics and software development, in particular, smart contract development. Strong team of advisors, but team not directly drawn from solar energy research or global electricity industry.	Conducted experiment on "a specific 3 kWh smart-battery from a European producer". Setting up in competition to existing Texas retailers, Grid+ has acknowledged they will need to "spend a relatively large amount on marketing" to acquire its initial customer base.	Yes. Available at https://github.com/gridplus However, Grid+ does not specifically call out energy blockchain community based development as a core objective of their program.
Lo3			
Peer-to-peer distributed energy microgrids through a private blockchain controlled by Lo3. "The Exergy blockchain is the private distributed ledger securing and managing the data needed to create marketplace transactions, and settling those transactions cost-effectively."	Background in software and hardware development.	Brooklyn Microgrid pilot. Dependent on incumbent utilities to allow P2P on their grids, or else limited to small embedded networks.	No. Lo3 (Exergy) is a company rolling out its own product. Lo3 is a centralised software provider. dApp available on App Store and Google Play.

ROADMAP

Foundation: Stand up organisation

Target date: Q2 2018

The focus of the Foundation in the short term is to continue to refine the platform and bring together all the various parties required to make this a success. This will include a Token Generation Event of a proportion of the JOULs to establish a market price, and develop a deep and liquid market along with allowing people in the community to join the Foundation.

Partners: Grow the ecosystem

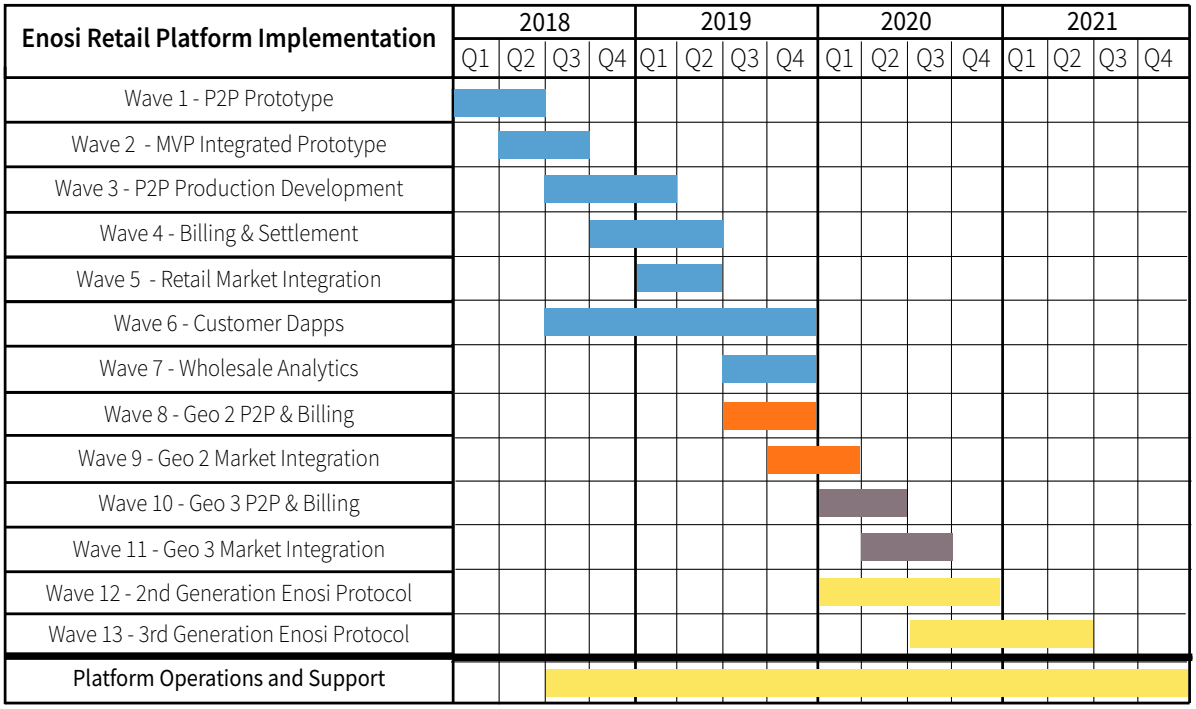
Target date: Q1 2018 - ongoing

The Enosi Foundation is already well underway with its partner recruitment program with two energy neo-retailers already signing agreements to cooperate in the development of the platform. This ecosystem will rapidly expand as the results of our trials and our partners' successes are publicised, and the merits of our open-source approach and efficient technology are understood.

Over the remainder of 2018 we expect to establish cooperative agreements with participants in multiple global markets, while deepening our platform capabilities based on the Australian national electricity market context.

Platform: Waves of Minimum Viable Products (MVPs)

The Enosi Platform Development Roadmap is illustrated in the high level chart below. The primary development waves are described briefly in the following sections.



Wave 1 P2P Prototype Development

Target date: Q3 2018

Our first wave of development is underway in collaboration with partner organisation Solar Analytics. It will connect solar owners with non-solar owners through a shared electricity trading platform.
This platform will enable solar homeowners or businesses to select from a range of options for how they sell their surplus solar, and non-solar households to choose from whom and at what price they want to buy this surplus solar.

By offering a P2P product the neo-retailer will help provide the benefits of solar to those who can't put solar on their roof, including lower electricity cost and greater visibility for their electricity decisions. An analysis of our partner's fleet shows that approximately 55% of solar electricity is exported, or an average per site of 8.4 kWh/day.

The Enosi platform will be developed to meet the functional needs of this P2P demonstration, taking advantage of the deep industry knowledge and experience of our Partners in the definition of requirements and translation into suitable smart contracts and dApps.

Wave 2: Integrated Prototype

Target release date: Q1 2019

User story: As an electricity customer, I want to sign up to the Enosi platform as a member such that I can buy and sell electricity both from local prosumers and from the wholesale market.

Capabilities:

- ERC20 compatible implementation of the JOUL token itself including functionality like trading tokens between addresses
- Interface with an energy metering provider and energy market prices through retailer
- Peer-to-peer energy trading between EDAO customers and with the Retailer
- Centralised Enosi blockchain platform for initial implementation according to the guidelines outlined in this paper.

Target number of members: 50 - 500

Wave 3: Community Energy Platform Production Development

Target release date: Q4 2018

User story: As a neo-retailer I want to register with the Enosi platform to start acquiring members (electricity customers) and helping members lower their electricity bill through the reduced operational cost.

Capabilities:

- Implementation of customer acquisition, migration and management
- Transaction settlement, reconciliation and integration with Retailer billing

Target number of members: 100 - 1,000

Wave 4: Billing and Settlement

Target release date: Q2 2019

In this wave of development Enosi is building out the Retail technology stack to allow neo-retailers the ability to create billing details directly from the platform without reference to the participating retail licence holder.

Wave 5: Retail Market Integration

Target release date: Q2 2019

Additional retail automation capabilities will include customer transfers and B2B transaction enablement for neo-retailers.

Wave 6: Customer dApps

Target release date(s): Q3 2018 - Q3 2019

In parallel with core retail protocol development, a series of dApps will be developed by Enosi (and its open source partners) to enable customer sign-up, energy monitoring and other energy community functions using the core data available and other innovations proposed by neo-retailers to enhance

customer engagement and network effects.

Wave 7: Wholesale Analytics

Target release date(s): Q4 2019

Ultimately the Retail technology stack needs to include integration with wholesale markets, and development of analytics to support this trading, such as supply and demand forecasting, trade aggregation and optimisation capabilities.

Wave 8 - Wave 11: Global Market Adaptations

From 2019 - 2020 the Enosi Foundation expects to be supporting the rollout of the core Enosi protocols and applications for multiple international markets.

Wave 12 - Wave 13: Next Generation Protocols

Over the planning horizon to 2021, we anticipate iterative development of the core protocols to take advantage of on-going innovation in the blockchain technology space and further maturity of energy market deregulation worldwide.

Beyond electricity

The Enosi Foundation believes that many commodity related transactional activities can be eventually transferred into a set of smart contracts as to improve global economic efficiency.
Once Enosi believes that the transition to Grid 2.0 is safely underway, it may investigate other commodities with similar market characteristics that require disruption such as gas, water, internet bandwidth and many more. To perform this we will be heavily reliant on our expected ever-growing community to help navigate these other markets.