

# International Solar Alliance Expert Training Course: Session 17

## Peer-to-Peer and Blockchain

*In partnership with the Clean Energy Solutions Center (CESC)*

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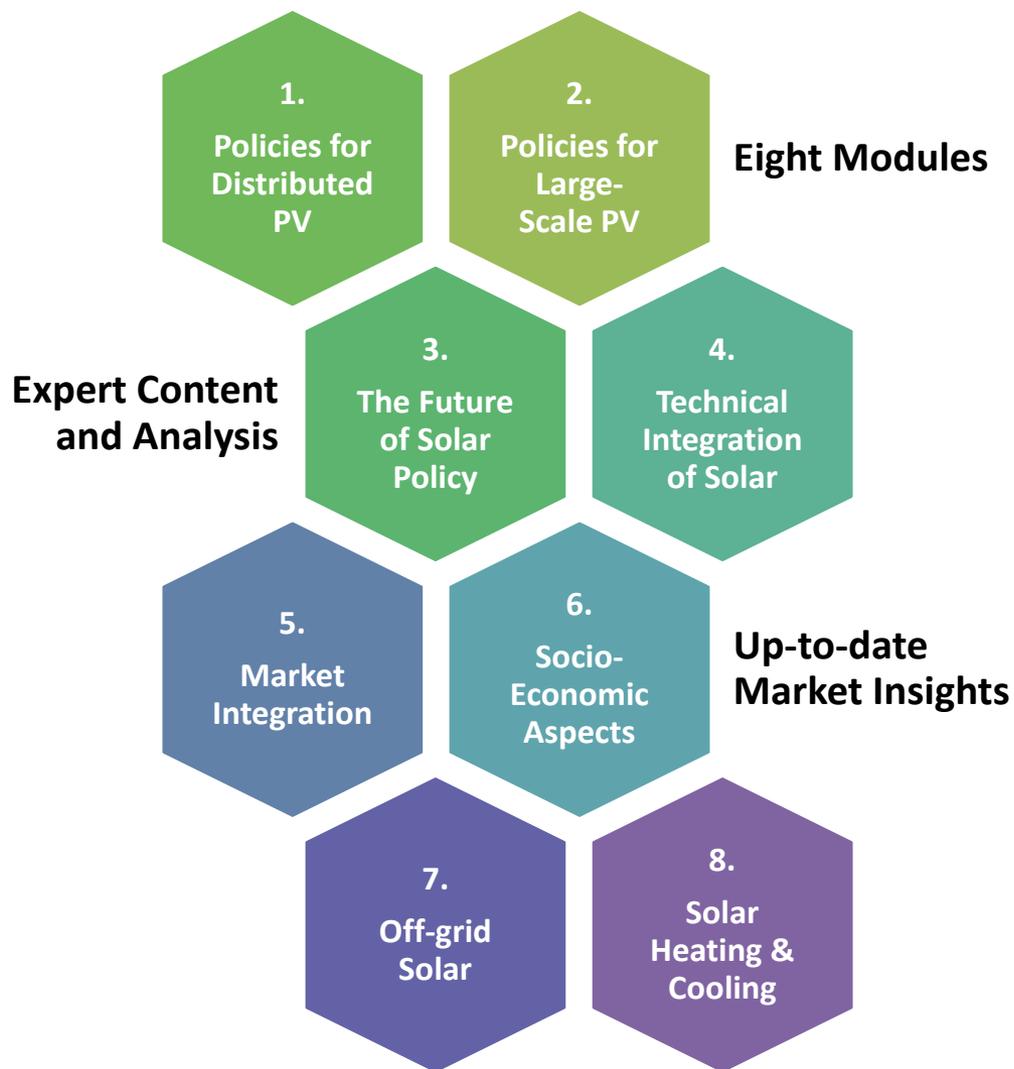
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ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

# Overview of Training Course Modules

This Training is part of Module 3, and focuses on the issue of **The Future of Solar Policy**



# Overview of the Presentation

- 1. Introduction: Learning Objective**
- 2. What is P2P Electricity Trading?**
- 3. What is Blockchain?**
- 4. Benefits of P2P Electricity with Blockchain**
- 5. Challenges**
- 6. Case Studies**
- 7. Concluding Remarks**
- 8. Further Reading**
- 9. Knowledge Check: Multiple-Choice Questions**

# 1. Introduction: Learning Objective

# Learning Objectives

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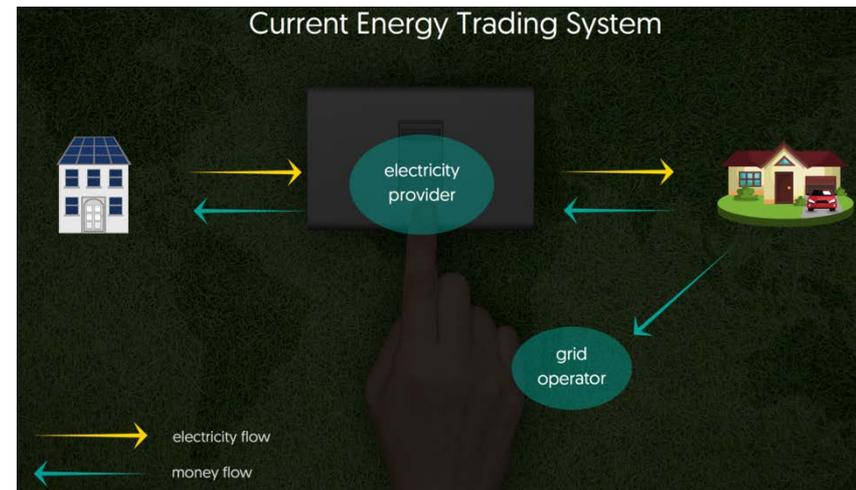
- ❖ **Understand how P2P and blockchain technologies work**
- ❖ **Understand the benefits of such applications**
- ❖ **Understand challenges facing more widespread uptake of such technologies**
- ❖ **Learn from case studies demonstrating the current state of play**

## 2. What is P2P Electricity Trading?

# What is P2P Electricity Trading?

## Traditional Electricity Trading

- In traditional electricity trading, households and small businesses buy 100% of their electricity from a dedicated provider.
- Electricity providers are typically partnered with organisations that own and operate electricity generating equipment.
- The profit margin of providers is determined by the difference between their price of purchase from such organisations, and their price of sale to consumers.



Sources:  
<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>  
<https://medium.com/swlh/understanding-p2p-energy-trading-a477eb7b55e0>

# What is P2P Electricity Trading?

## Microgeneration (Distributed Generation)

- Microgeneration is the production of small volumes of electricity by individual households and small businesses using methods such as solar panels.
- Uptake of microgeneration has been steadily increasing globally.
- Traditionally, any electricity generated by the householder, or business owner, can only be used at the generation site or sold directly to the grid for a nominal price.



Sources:

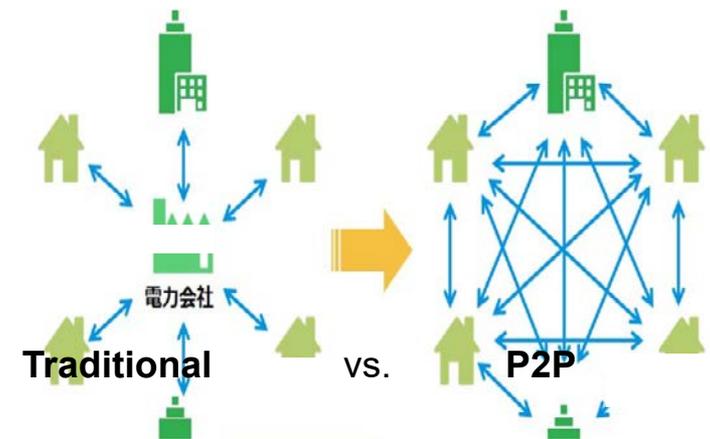
<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>

<https://www.theguardian.com/environment/2013/nov/18/microgeneration-renewable-energy>

# What is P2P Electricity Trading?

## Microgeneration Electricity Market

- One microgeneration model is the concept of peer-to-peer (P2P) electricity trading, which enables producers and consumers to trade electricity directly, rather than selling to, and buying from, the grid.
- P2P trading is an electricity market that exists directly between microgenerators.
- Can be considered part of the 'sharing' economy which sees things such as housing (Airbnb), cars (ShareNow) and loans go from person to person rather than from large commercial enterprise to consumer.



Sources:

<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>

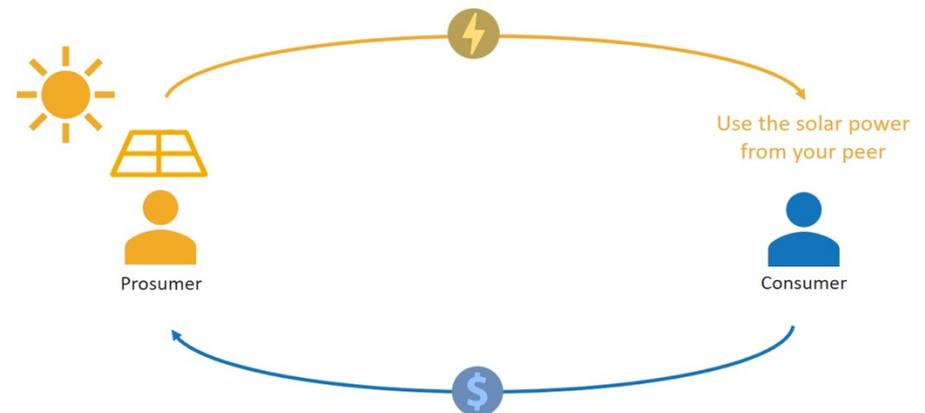
<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>

# What is P2P Electricity Trading?

## Basics of P2P Trading

- Microgenerators who generate excess electricity are known as prosumers (a combination of producer and consumer).
- Prosumers, using P2P, are able to market their unneeded energy, benefiting from an extra income stream.
- Consumers, using P2P, see a far greater choice over their energy source, with the ability to pick the exact source of their supply, for example by supporting local green energy projects.



Sources:  
<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>  
<https://medium.com/swlh/understanding-p2p-energy-trading-a477eb7b55e0>

# 3. What is Blockchain?

# What is Blockchain?

## The Traditional Energy Market

- Traditionally, to buy or sell power, traders need to draft contracts and communicate with each other directly.
- This can get complicated and is a time-consuming and expensive process.
- It is challenging to make this system fully transparent.



Sources:

<http://theylaughedatnoah.blogspot.com/2017/10/energy-trading-why-we-need-those-big.html>

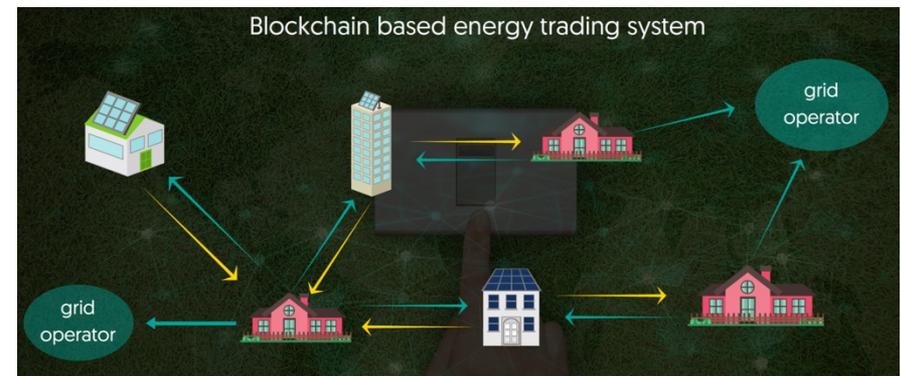
<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

<https://www.linkedin.com/en/jellsmoor>

# What is Blockchain?

## The Blockchain Energy Market

- P2P energy trading involves a large number of transactions between prosumers and consumers and needs technology that allows for low-cost authentication, validation and settlement while protecting privacy.
- One of the most promising technologies to enable this is blockchain.
- Blockchain's best known and original use is as the technology supporting cryptocurrency and distributed trading, an example being Bitcoin.

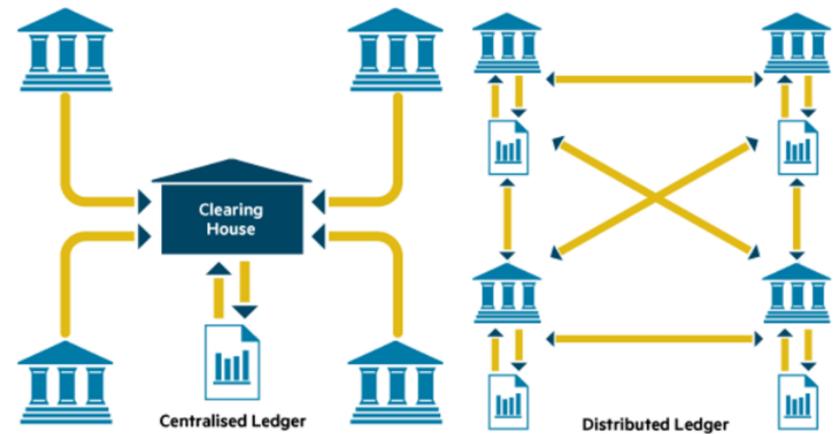


Sources:  
<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>  
<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>

# What is Blockchain?

## How Blockchain Works

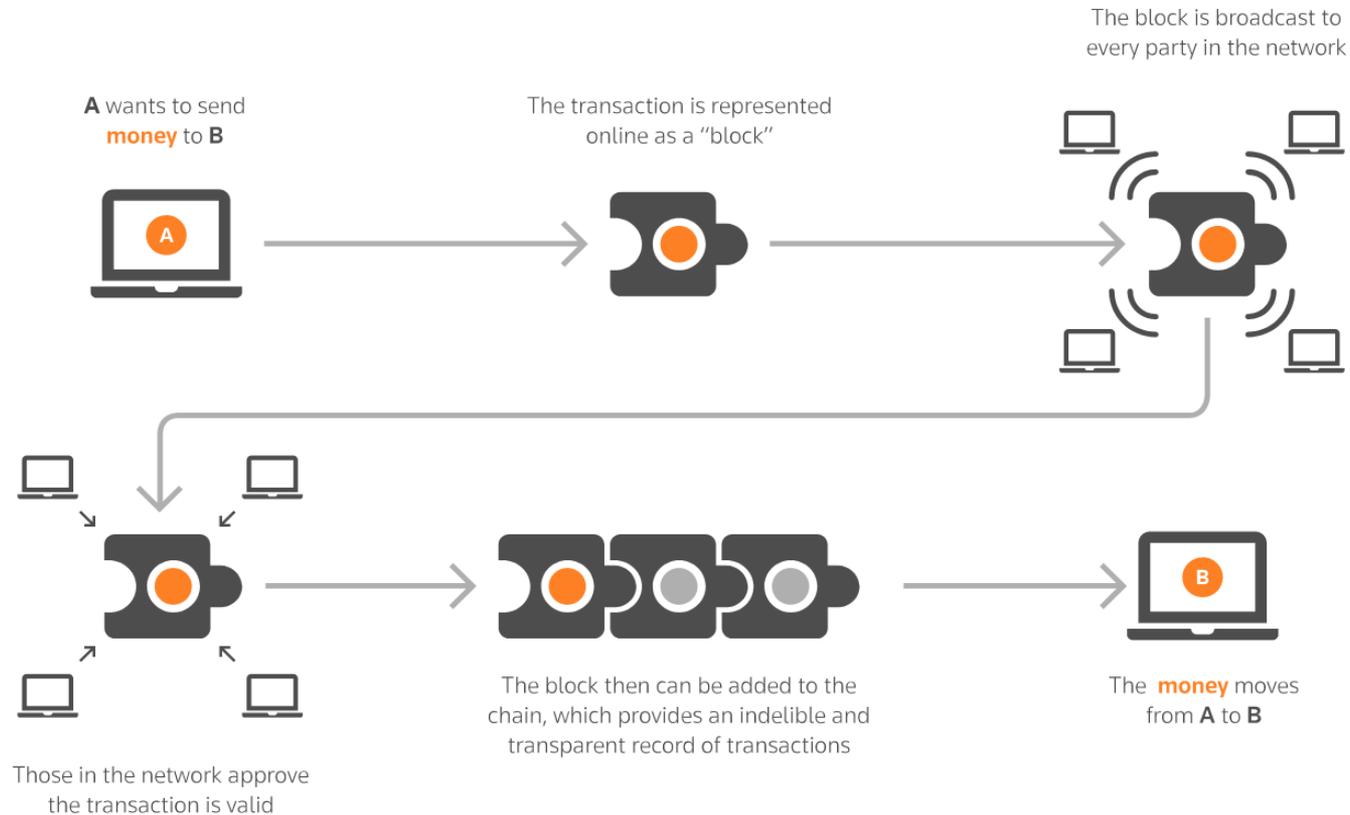
- Blockchain can be thought of as a shared database with unique properties: instead of a single entity managing the database, data is controlled by everyone on the network.
- A complete history of all transactions that have ever occurred within a particular network is retained.
- Blockchain technology offers a cryptographically secure, distributed ledger that can track where electricity was generated, where it travelled and who used it.



Sources:  
<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>  
<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>  
<https://knowledgecrypto.com/the-difference-between-blockchains-distributed-ledger-technology/>

# What is Blockchain?

## How Blockchain Works



Sources:

<https://www.thomsonreuters.com/en/reports/blockchain.html>

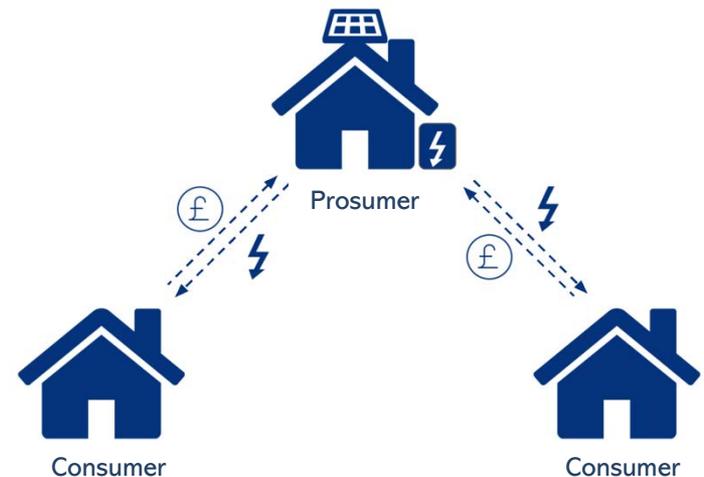
# What is Blockchain?

## Blockchain's Suitability for P2P Trading

**Transparency** - All data stored is visible to anyone. The technology is transparent and secure and does not require a central entity to store and manage shared data.

**Auditability** - Data is immutable and visible, transactions can be confirmed or disputed by anyone. There is no question about where a kWh came from and how it was produced.

**Trust** - Interactions between individuals can be direct, i.e. no third party can interfere or control transactions.



Sources:  
<https://www.edfenergy.com/about/energy-innovation/innovation-blog/research-development-peer-to-peer-trading>  
<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>  
<https://www.linkedin.com/en/tellsmoor>

# What is Blockchain?

## Blockchain's Uses in Energy Networks

***“Blockchain has several use cases that are able to help facilitate a responsible, productive mission for the production and consumption of energy going forward.”***



Sources:

<https://www.disruptordaily.com/blockchain-use-cases-energy/>

## 4. Benefits of P2P Electricity with Blockchain

# Benefits of P2P Electricity with Blockchain

## Advantages for Prosumers / Consumers:

- No middle man, therefore higher sale price for prosumers, lower purchase price for consumers.
- Transparent transactions.
- Choice of supply, for example:
  - Trade solar energy to friends and family for free or at a discount.
  - Choose to buy solar energy from a neighbour, local wind or solar farm.
  - Choose to source as much energy as possible from distributed rooftop solar systems or home battery banks, or even neighbours.



Sources:

<https://spectrum.ieee.org/computing/networks/blockchains-will-allow-rooftop-solar-energy-trading-for-fun-and-profit>

<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

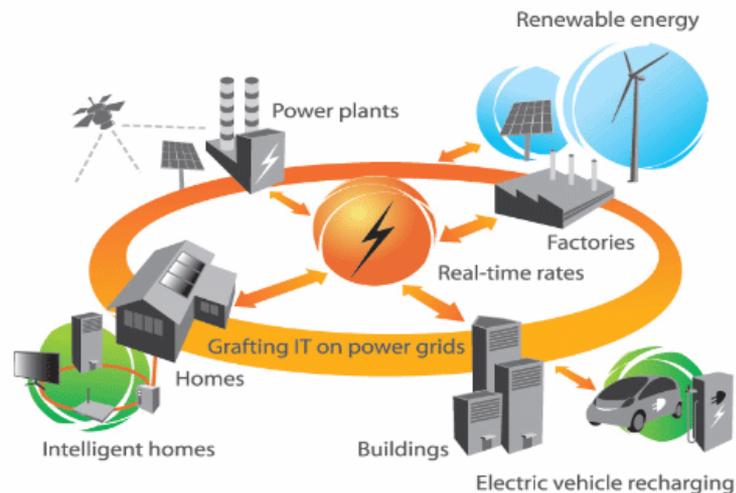
<https://medium.com/wolverineblockchain/p2p-energy-trading-on-the-blockchain-db61fa2c8caf>

<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>

# Benefits of P2P Electricity with Blockchain

## Advantages for Society:

- Prosumers produce their own electricity, sell it and/or store it using battery technologies. This reduces congestion on distribution lines and helps improve grid stability.
- P2P electricity trading is greatly aided by innovations in 'smart grid' technology, hence P2P trading is promoting such efforts.
- Smart grids use innovative products and services with intelligent monitoring, control, communication and self-healing technologies.



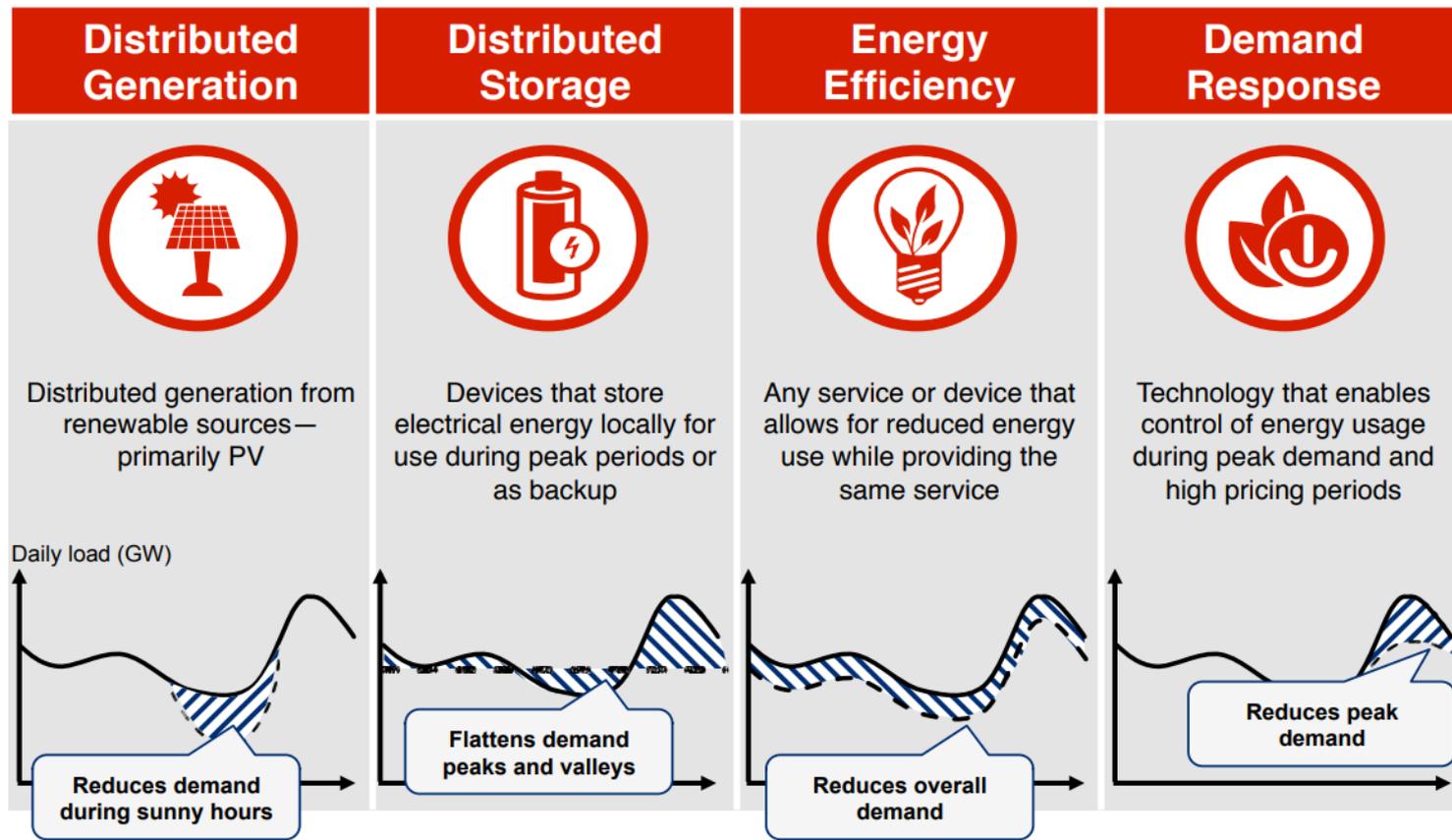
Sources:

<http://www.simplydecoded.com/2013/06/28/smart-grid-technology-decoded/>

<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

# Benefits of P2P Electricity with Blockchain

## Advantages for Energy Networks:



Sources:

<https://rctom.hbs.org/submission/the-democratization-of-energy-how-machine-learning-is-empowering-both-the-consumer-and-the-utility/>

# 5. Challenges

# Benefits of P2P Electricity with Blockchain

## General Challenges:

- P2P is not yet mainstream or fully commercialised.
- Immature market for technology solutions.
- Multiple stakeholders that need to be convinced of the business case (e.g. retailers).
- Regulatory barriers.
- Perception and trust



Source:  
<https://www.bspq.com.au/energy-retailers-solar-power/>  
<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>  
<https://blog.bisgrp.com/unleashing-the-power-of-digital-regulatory-barriers-and-dilemmas/>

# Benefits of P2P Electricity with Blockchain

## ‘Network Charge’ Challenges:

- Electricity is normally transported using infrastructure owned by grid distribution and transmission companies – they charge a fee for this use, known as ‘network charges’.
- Networks charges can be up to 50% of a traditional energy bill.
- In Sydney, Australia, efforts are underway to introduce ‘Local Generation Network Credits’, which would reduce this bill for microgenerators using P2P.



Sources:

<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

<https://100percentrenewables.com.au/electricity-supply-chain-electricity-bill/>

## 6. Case Studies

# Case Studies

## Current global status of P2P energy trading

- Progress with P2P energy trading is slow across the globe.
- Regulated network tariffs often means there are little benefits to local energy trading; in some countries, regulation entirely prevents P2P energy trading.
- Globally, there is still low uptake of installed controllable distributed energy resources, which makes it challenging to reach a critical mass to bring the technology into the mainstream.



Sources:

<https://www.ft.com/content/6d62b494-209a-11e9-b126-46fc3ad87c65>  
<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>

# Power Ledger, Australia

## Overview

- Perth-based Power Ledger is a blockchain-based P2P energy exchange platform.
- Raised USD 26.5 million, have implemented several successful trials of their technology.
- Aims to create a power system that is long-lasting, low cost, zero-carbon, and allow consumers to take more control of their energy purchasing options.



Sources:

<https://medium.com/wolverineblockchain/p2p-energy-trading-on-the-blockchain-db61fa2c8caf>

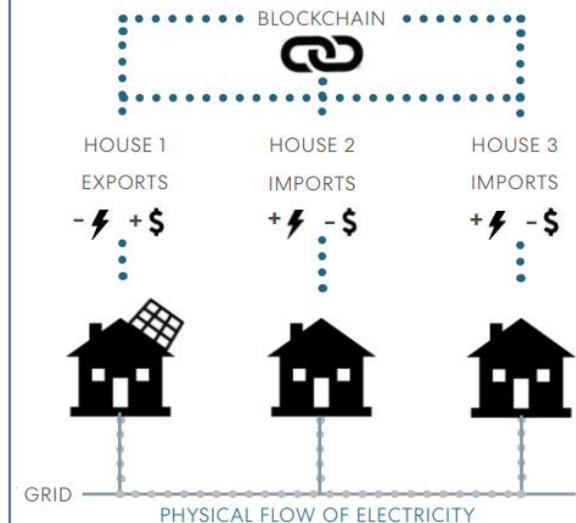
<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>

# Power Ledger, Australia

## Technology

- The Power Ledger Platform enables interoperability between diverse market pricing mechanisms and units of electricity (kWh) by way of pre-purchased tokens.
- The tokens are pegged to the local currency and can be traded on the Power Ledger platform within defined trading groups that interface with smart meters.
- The Power Ledger system tracks the generation and consumption of all trading participants and settles energy trades on pre-determined terms in near real time.



Sources:

<https://medium.com/wolverineblockchain/p2p-energy-trading-on-the-blockchain-db61fa2c8caf>

<https://www.energymatters.com.au/misc/peer-to-peer-solar-energy-trading-guide/>

<https://100percentrenewables.com.au/peer-to-peer-energy-trading/>

# EDF Energy, 'Project CommUNITY', UK

## Overview

- Electricity generated from a rooftop solar installation at a housing estate in London.
- Power will be used by residents of the estate and stored in domestic batteries for trading.
- Consumer-facing app is to be introduced, facilitating trading.
- Transactions will rely on blockchain technologies for tracking trade.



Sources:

<https://www.ft.com/content/6d62b494-209a-11e9-b126-46fc3ad87c65>

<https://www.smart-energy.com/industry-sectors/distributed-generation/edf-launches-blockchain-p2p-solar-and-storage-trading-pilot/>

# EDF Energy, 'Project CommUNITY', UK

## Pilot Project

- The project started in the first quarter of 2019 and will run through to October in an eight-month trial.

## UK Regulations

- Current regulations only permit customers to purchase electricity from a single party, intrinsically prohibiting peer-to-peer trading, however the energy authority is considering changes to regulations.



Sources:

<https://www.ft.com/content/6d62b494-209a-11e9-b126-46fc3ad87c65>

<https://www.smart-energy.com/industry-sectors/distributed-generation/edf-launches-blockchain-p2p-solar-and-storage-trading-pilot/>

# Sonnen,\* Germany

## Overview - Battery Energy Storage

- A different approach is provided by German battery system maker Sonnen. It is revolutionizing the electricity delivery model.
- The programme relies on controlling energy from its customers to create a virtual plant, a real alternative to the grid.
- This virtual plant concept combines all the benefits and opportunities associated with distributed battery storage e.g. solar self-consumption, energy self-sufficiency, P2P.



\*Note: Sonnen was recently acquired by Shell.

Sources:

<https://www.smart-energy.com/industry-sectors/distributed-generation/edf-launches-blockchain-p2p-solar-and-storage-trading-pilot/>  
<https://sonnengroup.com/smart-local-grids-blockchain-sonnen-participating-nemogrid-project/>

# Sonnen, Germany

## Project Details

- The NEMoGrid project is exploring the economic and technical impact of electricity trade via blockchain between households within a region.
- The project aims to provide insight into how flexible electricity prices and grid stability can best be combined at the local level.
- The project started in March 2018 and is currently ongoing.



Sources:

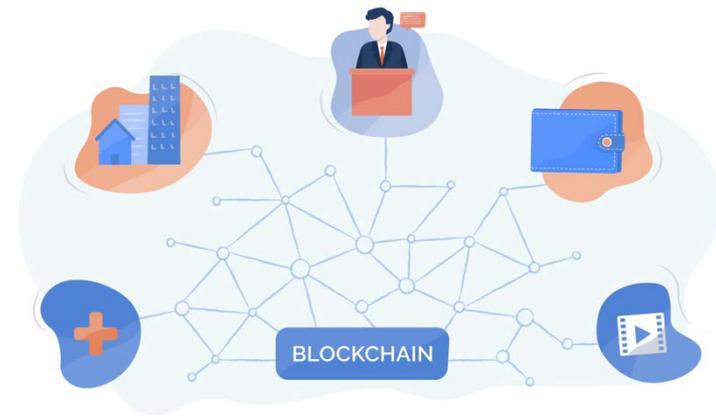
<http://nemogrid.eu/>

<https://sonnengroup.com/smart-local-grids-blockchain-sonnen-participating-nemogrid-project/>

# 7. Concluding Remarks

# Concluding Remarks

- P2P electricity trading with blockchain offers a new solution to electricity trading between microgenerators and consumers.
- Such a system would offer many qualitative benefits including increased transparency of transactions, choice of electricity supplier.
- This system would also reduce costs for consumers, and increase the profit of generators.
- If such a system is widely adopted, it would pave the way for a faster uptake of other smart energy technologies.



Sources:

<https://medium.com/sylo-io/the-power-of-blockchain-for-positive-change-a64084cbc31a>

## 8. Further Reading

# Further Reading

- **The power of blockchain for positive change**  
<https://medium.com/sylo-io/the-power-of-blockchain-for-positive-change-a64084cbc31a>
- **Blockchain beginners' guide**  
<https://www.singlegrain.com/blockchain/blockchain-explained/>
- **P2P energy: A threat or an opportunity for traditional suppliers?**  
<http://energy.sia-partners.com/20180911/peer-peer-p2p-energy-threat-or-opportunity-traditional-suppliers>

# Thank you for your time!



ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

## 9. Knowledge Checkpoint: Multiple Choice Questions