區塊鏈: POWERLEDGE (1~2)

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PowerLedge 白皮書 (1~2)

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Power of Power

- 傳統 (~現今)
  - 电力公司处于系统中间位置，获得了对电的绝对控制权。他们决定在何时、何地增加发电量; 他们决定如何跨越距离，连接发电机和负载; 他们通过使用各种中心化方案来的维持电力系统的平衡
    - 通过连接到中心化运营的电力网络，消费者获得了稳定的价格和产品。 能源安全包括（可控性，确定性和经济独立性）也得以保证
- 全球技术革命改变消费者与集权部门间的权力平衡
  - 分布式能源资源（DER）的蓬勃发展，如太阳光伏系统（PV）、电池、微电网和嵌入式网络，将权利平衡从集权部门转移到电网边缘，从而赋予普通用户控制权

Market Size

- Stationary energy: 大樓、工廠、住屋用能源
  - 电力是社会进步的关键推动力
    - 目前全球人口的电气化程度为84%
  - 在过去二十年，数亿人（特别是在中国和印度）通过电力输送网络获得了现代能源。这意味着：与与以往任何时候相比，地球上更多的人口可以享受到不断增长的互联电力网络的便利
- Non-stationary energy: 電動車
  - 除了静态电力外，非静态电力用户正在推动全球电力的需求
  - 2015 年，全球的电动车辆（EV）超过100 万辆的门槛，总数高达126 万辆。全球电动汽车充电站估计已经达到145 万。
  - 全球電動車 (EV) 數量成長預估
    - 2 ~ 20 million by 2020
    - 18 ~ 60 million by 2025
    - 22 ~ 140 million by 2030

Energy Revolution (1/2)

- 2012 年，在纽约，桑迪飓风摧毁了百年公共电力供应的概念，并预示着重灵活、轻传统的分布式能源供应新时代的到来
- 在澳大利亚，在2011 至2016 年间，住宅屋顶安装的新发电量远超过传输电网
- 传统能源供应行业面临的困境
  - 在某些阶段，与依靠电网相比，自给自足的供电提供更便宜、更可靠和更清洁的能源

Energy Revolution (2/2)

- 德意志银行2015 年分析的已达到电网对等的30个国家。在这些国家，太阳能发电等于或低于本地零售电价。

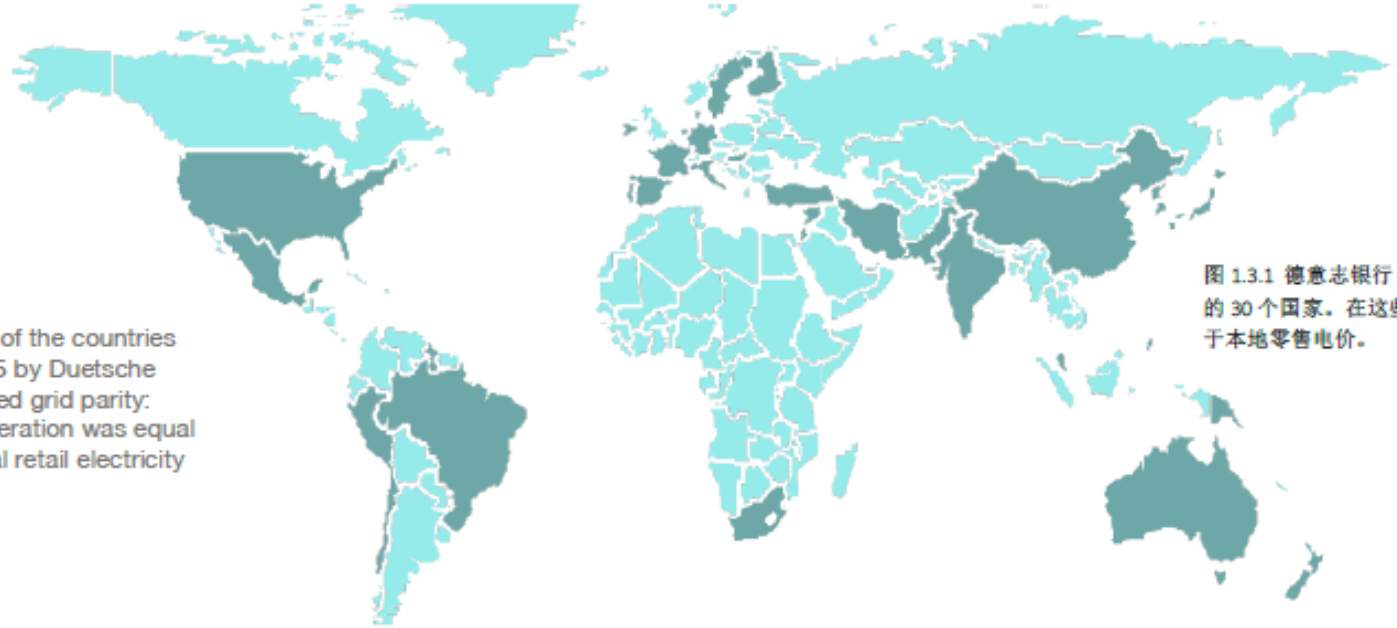

Figure 1.3.1: 30 of the countries analyzed in 2015 by Duetsche Bank had reached grid parity: where solar generation was equal or less than local retail electricity prices.

图 1.3.1 德意志银行 2015 年分析的已达到电网对等的 30 个国家。在这些国家，太阳能发电等于或低于本地零售电价。

Energy Revolution: 小結

- 趨勢
  - 傳統電網 → 分布式能源提供者
  - 少量的大規模集中投資 → 分布在整個系統中的數百萬微型投資

→ Trustless trading platform:
將傳統電力網路重新設計成一個去中心化, trustless 的交易平台

Trustless Trading Platform

- 若无中央部门控制所有参与方的数据、指定费用、获取信任、验证准确性并通过繁文缛节和官僚体系建立一个有序市场，在五分钟的交易间隔中为成千上万的交易者处理百万计交易，并提供第三方争端解决协议和对账支持几乎是“天方夜谭”

➔ Blockchain w/ smart contract:
作为一种协议机器，可有效促成这些交易的财务结算，其结算时间间隔与能源生产和消费的交易间隔一致。并且可以实现当前市场结算技术无法实现的速度执行结算

Human Energy 人性化能源

- 公民之间的能源交易让能源系统人性化
  - 公民电力将利润归还社区，激励社区投资创造资产，并允许能源分享或赠送
  - 随着动态分布式能源市场成为主流，分布式能源资源（DER）的所有者可以获得收入。收入不仅来自其所销售的能源，而且也来自其提供的网络服务（如频率和电压控制，负载转换，负载分配和负载下沉）
- 公民所有的微电网是一项重大技术飞跃
  - 这项技术支持所有发展中国家城镇和社区低成本、低碳、民主的电力系统的发展，从而实现电气化和经济现代化
  - Neo-retailers (新兴零售商: 创新能源零售商的新群体) 将通过有效透明得整合消费者偏好和一致性需求来支持P2P 交易，并通过利益消费者管理风险和安全性的能力为消费者提供选择

➔ 人性化能源将改变能源系统的面貌。相比于仅仅专注于利润，它将侧重于社区更广泛需求，对独立和共同创造能源的愿景，以及能源创造和消费的长期可持续性发展

Powerledge Platform

- A trustless, transparent and interoperable energy trading platform
- Tokens
  - Sparks
  - POWR

Achievements

Q3 2016: **Australian Blockchain Trial**
The pilot project with National Lifestyle Villages (NLV) demonstrated the capability of our concepts and technology, specifically EcoChain. The project was a huge success, becoming the first of its kind in Australia. 15 dwellings were connected via the blockchain giving way to a community energy marketplace.

Q4 2016: **First International Deployment**
After the first successful trial, Power Ledger deployed the technology with Vector Ltd., a New Zealand DSO. The partnership with Vector confirms Power Ledger's business strategy is not to cut out existing market participants, but rather to let consumers and utilities drive the disruption in a feasible way.

Q2 2017: **Bank On-ramping**
Power Ledger secured a financial channel to enable direct exchange between Sparkz and fiat-currencies in real-time. In addition, Power Ledger developed the functionality exchange energy for Sparkz for real-time fiat currency remuneration. By providing bank on-ramping Power Ledger cleared the largest barrier for P2P energy trading, democratizing power in a way no one thought possible.

Q2 2017: **Commercial Deployment at Multi-Tentanted Properties**
We began commercial operations in the White Gum Valley development in Fremantle, Western Australia. Power Ledger was the first company to successfully use distributed ledger technology to facilitate electricity trading across the meter and manage settlements without going through an electricity retailer.

Q2 2017: **Partnership With Indra Australia**
Power Ledger has signed a partnership agreement with leading global technology provider, **Indra**, to jointly develop network management solutions pairing **Indra's world-leading iSPEED** network control and optimisation platform, with Power Ledger's transactive energy platform, thus paving the way for the future development of autonomous distributed energy markets that respond in real-time to network conditions and consumer behaviour.

Platform Applications

- P2P trading
- NEO-retailer
- Microgrid/Embedded network operator/strata
- Wholesale market settlement
- Autonomous asset (AA) management
- Distributed market management
- Electric vehicles
- Power port
- Carbon trading
- Transmission Exchange

2.1 P2P Trading

- PowerPeers

This class of Platform Application gives retailers the ability to empower consumers (or in an unregulated environment, the consumers themselves) to simply trade electricity with one another and receive payment in real-time from an automated and trustless reconciliation and settlement system. There are many other immediate benefits such as being able to select a clean energy source, trade with neighbors, receive more money for excess power, benefit from transparency of all your trades on a blockchain, and very low-cost settlement costs, all leading to lower power bills and improved returns for investments in distributed renewables.

通过这类平台应用程序，零售商可授权消费者（或在一个不受管制的环境中，即消费者本身）进行简化的相互之间的电力交易，并从自动化、无信任的对账与结算系统实时接收付款。此外还有诸多其他直接利益，如能够选择清洁的能源，与邻居进行交易，通过过剩电力获得更多资金，从区块链上所有交易的透明度中受益，以及非常低成本的结算费用，这些均可有助于降低电费账单和改善可再生能源的投资回报。

2.2 NEO-Retailer 新型零售商

This class of Platform Application provides Neo-retailers with smart demand and supply management, along with almost instantaneous remuneration and payment settlements while managing consumer exposure to the risk of non-supply. 这类平台应用程序为新 型零售商提供了智能化的需求和供应管理。在管理消费者无供应风险同时拥有 几乎即时的报酬和支付结算

2.3 Microgrid/Embedded Network Operator/Strata

This type of Platform Application enables electricity metering, big data acquisition, rapid micro-transactions, and grid management at an unprecedented granular scale. Trading in embedded networks breaks the nexus between generation ownership and energy consumption, meaning value can be derived from an investment in DER even if the investor is absent or doesn't consume all the energy they generate. 该种平台应用程序能以前所未有的颗粒尺度计算规模实现电力计量、大数据采集、快速微交易和电网管理。嵌入式网络交易打破了发电所有权和能源消耗之间的关系，意味着：即使投资者缺席或消费者未消耗完所有能源，分布式能源资源（DER）的投资价值也不会流失。

2.4 Wholesale Market Settlement 批發市場的結算

This Platform Application class offers rapid low-cost and transparent dispatch optimization and management, data aggregation, reconciliation, and settlement for wholesale energy marketplaces. 该类平台应用程序为批发能源市场提供了快速、低成本和透明的调度优化以及管理、数据聚合、对账和结算。

2.5 Autonomous Asset (AA) Management 自主資產管理

This current Platform Application allows for (1) shared ownership of renewable energy assets and (2) trading renewable asset ownership. The AA is able to buy and sell its own electricity and distribute its income to assigned wallet addresses. 目前该平台应用程序可实现（1）可再生能源资产的共享所有权；以及（2）交易可再生资产所有权。自主资产能购买和销售自有的电力，并将收入分配给所划分的钱包地址。

2.6 Distributed Market Management

This Platform Application provides optimized metering data, the collection of big data, right to access and dispatch of assets, rapid transaction settlement, network load balancing, frequency management, demand side response, and demand side and load management. The optimization of network assets is made viable by the near real-time remuneration of asset owners. 该种平台应用程序提供优化的计量数据，大数据收集，资产访问权和资产分配，快速交易结算，网络负载平衡，频率管理，需求方响应和负载管理。网络资产优化可通过资产所有者的近实时报酬结算得以实现。

2.7 Electric Vehicles

This class of Platform Application facilitates real time metering data (interfacing with the Open Charge Point Protocol (**OCPP**)), collection of data, user identification and rapid transaction settlement. 这类平台应用程序便于实时计量数据（与开放充电站协议（**OCPP**）接口），数据收集，用户识别和快速的交易结算。

2.8 Power Port

A class of Platform Application whereby virtual pipeline and roadside assistance type assets may be automated via the platform, such as EVs, and can provide a mobile storage discharge facility maintaining energy supplies to predominantly self-sufficient energy consumers. 通过该类平台应用程序，虚拟管道和路边援助型资产可通过诸如电动车之类的平台自动化，且可提供一种移动存储放电设施，主要为自给自足能源消费者提供能量供应。

2.9 Carbon Trading

This Platform Application class offers smart contracts for carbon traders to assure digital transactions across organizations: credibility of asset using immutable distributed ledger technology; and transparency and auditability. It supports reporting and surrendering of carbon credits or certificates to regulatory authorities. 该类平台应用程序为碳交易者提供智能合同，以确保跨组织的数字交易：由不可变分布式记账技术带来资产可信度以及透明度和可审计性。它支持向监管机构报告和提交碳信用额度或证书。

2.10 Transmission Exchange

In the management of transmission networks, the Platform can provide real time metering data, collection of big data, right to access and dispatch assets, rapid transaction settlement, and network load balancing, responding to non-stationary energy.

在管理传输网络的同时，平台可提供实时电表数据，大数据收集，访问权限与配置资产。提供快速的交易结算，网络负载平衡，并响应非静态能源。