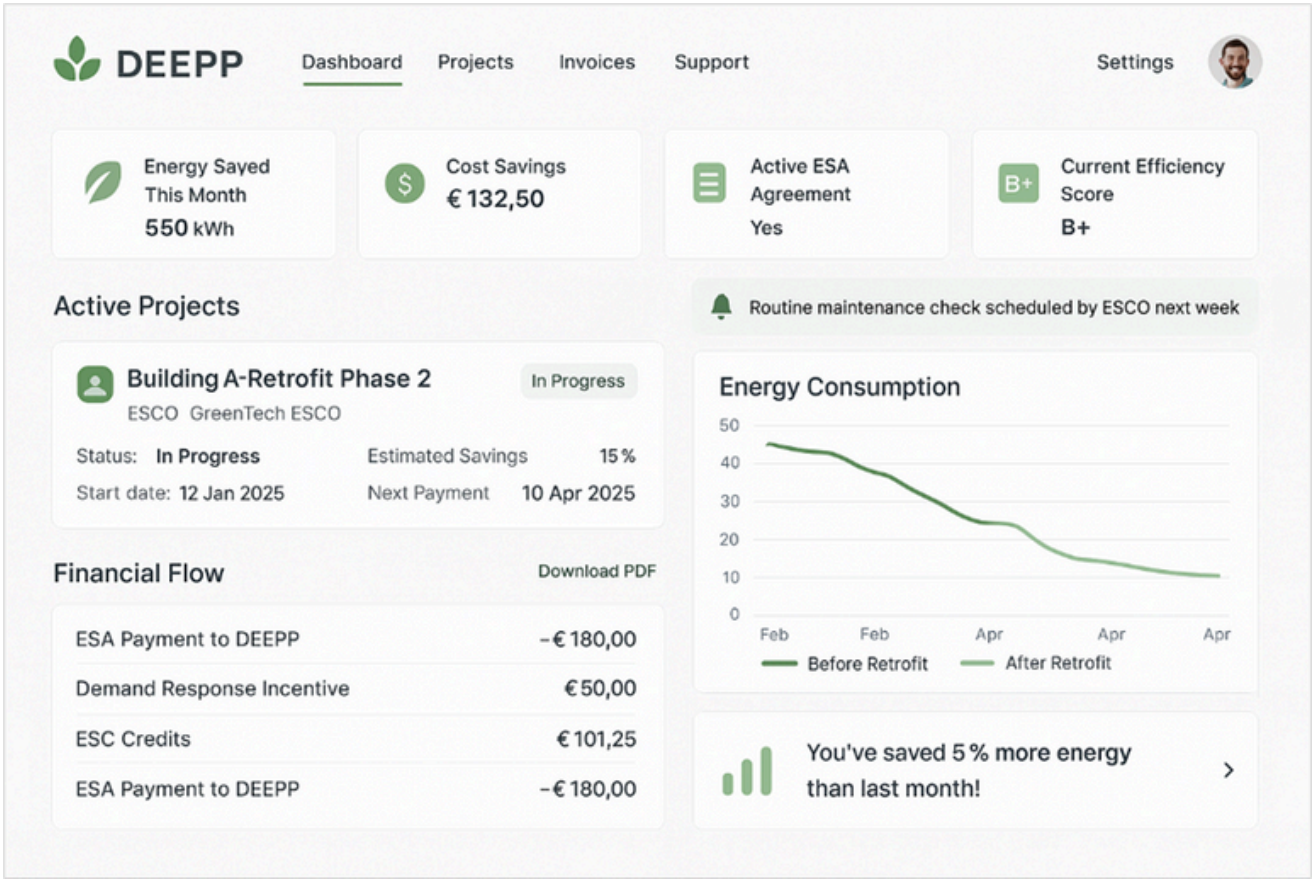
Business Model 5: DEEPP-Decentralized Energy Efficiency Power Plant

IEECP

This project seeks to transform energy consumption in commercial and residential buildings by integrating sustainable technologies with innovative financial mechanisms. As a demand side Virtual Power Plant (VPP), DEEPP focuses on the efficient management of demand-side assets, including energy-efficient insulation, batteries, and demand response technologies. Acting as a centralized platform, it orchestrates the financing and aggregation of energy efficiency projects, facilitating exchanges between financial institutions, Energy Services Companies (ESCOs), contractors, building owners, and energy utilities.

At the core of DEEPP's operations are **Energy Savings Agreements (ESAs),** which enable project financing without or with minimum upfront capital from building owners. Payments are directly tied to verified energy savings, aligning financial incentives across stakeholders and ensuring a continuous focus on improving energy efficiency.

The DEEPP model incorporates **advanced monitoring and verification technologies (M&V)**, utilizing smart meters and IoT (Internet of Things) devices to track energy performance. As a third-party verifier it can certify the resulting energy savings, issuing **Energy Savings Certificates (ESCs)**. To increase transparency, all information is available in **Distributed Ledger Technology (DLT)** infrastructure, making all calculations available to all parties. DEEPP's revenue streams include direct payments from building owners based on realized savings, participation in demand response markets, and the sale of ESCs to entities with energy reduction obligations.



DEEPP's primary objective is to catalyse large-scale building retrofits through the allocation of investment capital, thus driving significant improvements in energy efficiency.

Context

The DEEPP business model is being developed within a policy framework driven by key EU directives such as the **Energy Efficiency Directive, Energy Performance of Buildings Directive, and the Electricity Market Design Directive**. These frameworks setambitious targets for enhancing the energy performance of buildings and supporting system flexibility.

The concept of a demand-side **Virtual Power Plant (VPP)** involves aggregating and managing energy efficiency resources on the consumer side, allowing buildings and businesses to participate in energy efficiency markets while supporting grid operations.
The integration of **Demand-side management (DSM)** in VPPs encourages consumers to allow the automated adjustment of their energy use in response to energy price fluctuations or power grid signals.

Barriers

Technology: diverse communication protocols and technology interoperability pose significant obstacles. The uneven deployment of technologies, particularly in older buildings, creates gaps in efficiency and capability, while secure encryption and transmission protocols are needed to prevent data breaches.

Regulations: Current regulations lack comprehensive frameworks to allow DEEPP and VPPs to participate fully in electricity markets with demand-side assets. In the EU, energy efficiency is not yet recognized as a tradable resource within energy trading mechanisms.

Economy: high upfront costs associated with deploying the necessary infrastructure for VPPs and energy efficiency retrofits. DEEPP seeks to overcome this barrier by offering ESAs, which secure project financing without upfront capital requirements.

Consumer behaviour: many consumers are either unaware of the benefits or resistant to changing their energy consumption habits. Requiring DEEPP to provide simple, user-friendly platforms that facilitate consumer engagement.

Target group

- **Primary Customers:** Building owners (residential, commercial, industrial).
- **Indirect Beneficiaries:** Tenants benefiting from energy savings and comfort improvements.
- **Regulatory Bodies:** Use DEEPP data on blockchain to verify compliance with energy efficiency targets.
- **Segment Focus:** Multi-sided platform serving both technical (utilities, ESCOs) and end-user (building owners, tenants) needs.

Impacts

Estimation over a two-year period, assuming 200 single-family homes at 20 MWh/year each, 200 small multifamily residential buildings of 5-10 apartments at 50 MWh/year each and 100 office properties at 50 MWh/year each.

Investment covers:

- **Fixed costs:** Salaries for core staff, IoT deployment, software development, blockchain infrastructure.
- **Variable costs:** Maintenance of IoT devices, scaling MRV systems, regulatory compliance fees.
- **Economies of scale:** Automated systems reduce per-unit costs as portfolio grows.

	500 buildings, higher tech deployment
Energy savings	9,7 GWh/y
Renewable energy production	0,8 GWh/y
Avoided CO2 emissions	3,166 tCO2eq/y
Total investment planned	CAPEX: 7,800.000€ OPEX: 2,500.000€/y

Regulations

- **Energy Efficiency Directive** (EU/2023/1791) - supports DEEPP's objectives of aggregating demand-side energy savings and enabling market participation.
- **Energy Performance of Buildings Directive (EPBD) -** establishes minimum energy performance standards for new and existing buildings, requiring that member states implement measures to achieve a highly energy-efficient and decarbonized building stock by 2050.
- **Electricity Market Directive** - DEEPP aligns with the directive's emphasis on demand-side participation and market integration by enabling buildings to act as active participants in energy markets through demand response and energy efficiency.
- DEEPP must negotiate connection agreements with TSOs and DSOs to ensure access to the grid.
- **General Data Protection Regulation (GDPR)** - ensuring secure and compliant handling of personal and energy consumption data.

MRV (Measurement, Reporting, and Verification)

Based on the data collected through smart meters, DEEPP's M&V system evaluates the energy efficiency performance of buildings and assets. M&V methodologies, such as those offered by CalTrack, are employed to ensure accuracy in savings calculations.

Monitoring and measuring energy consumption after the retrofit or efficiency improvement, with real-time adjustments based on environmental or operational changes.

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Establishing a baseline of pre-retrofit energy use, accounting for seasonal and operational variations.

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Verifying the energy savings using standardized protocols to ensure that reported savings are both measurable and attributable to the implemented efficiency measures.

DEEPP delivers periodic performance reports that summarize the energy savings achieved and overall energy efficiency improvements. These reports detail the actual energy savings realized in comparison to the baseline, providing evidence of the financial and environmental impact of the energy efficiency measures. The accountability of the MRV system is strengthened by its integration with third-party verification agencies, issuing ESCs as tradable assets representing verified savings.

DLT (Distributed Ledger Technology)

- **DLT's decentralized, immutable ledger** ensures secure and verifiable energy data for all stakeholders.
- **Timestamped and cryptographically hashed** data entries guarantee trustworthy reporting.
- Smart Contracts:
  - **Automate DEEPP's ESAs** and demand response coordination (e.g., automatic payment distribution when savings targets are met).
  - **Adjust energy loads** automatically based on grid needs, creating efficiency and reliability in real-time.
- **Real-time monitoring with IoT:**
  - Allows dynamic comparison of post-retrofit consumption vs baseline.
  - Adjustments based on IPMVP's "chaining" method ensure measurement accuracy despite changes in occupancy/environment.
- **Tokenized ESCs** further allow DEEPP to trade verified savings as digital assets, providing additional revenue for stakeholders.
- Enhances privacy and security:
  - **Encryption and zero-knowledge proofs** protect data and ensure GDPR compliance.
  - **Blockchain's built-in auditability** supports regulatory compliance, enabling easy verification for third-party auditors under the Energy Efficiency Directive.

Benefits

Zero-Cost Access: Pay-As-You-Save (PAYS) model reduces barriers for building owners

Transparency and Trust: Blockchain-enabled MRV ensures accurate savings validation.

Enhanced Comfort: Improved indoor conditions via retrofits

Market Integration: Monetization of energy savings through tradable certificates

Cost Reduction: Lower energy bills for users

Environmental Impact: Reduced carbon emissions through efficient energy use

Risk Mitigation: Performance guarantees for savings

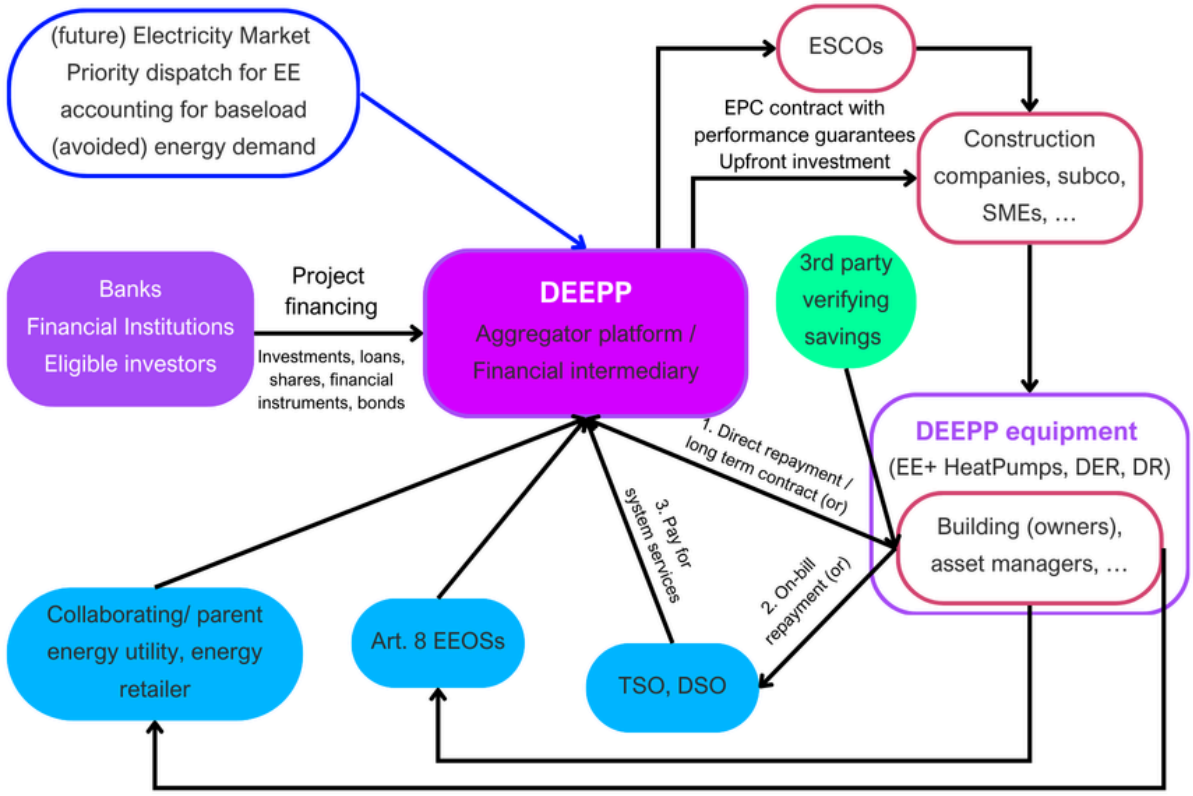
Characteristics: Accessibility, performance, cost reduction, usability

Revenue streams

- **Performance-Based Payments** where the revenue is tied to verified energy savings through ESAs.
- **Market Revenues** from trading ESCs, and aggregated demand response participation.
- **Financing Fees:** Margins from financing retrofits.
- **Subscription Services**: Fees for data analytics and performance insights.
- **Structure**: Fixed pricing for retrofits and dynamic pricing for market-based services.

Customer channels and relationship

- **Digital Platforms:** online dashboards, mobile apps for monitoring and interaction.
- **Direct Partnerships** with ESCOs, utilities for outreach.
- **Energy Efficiency Markets:** Trading platforms for ESCs.
- **Regulatory Channels:** Reporting compliance via blockchain-enabled transparency.
- **Efficiency:** Online platforms reduce customer acquisition costs and streamline reporting.



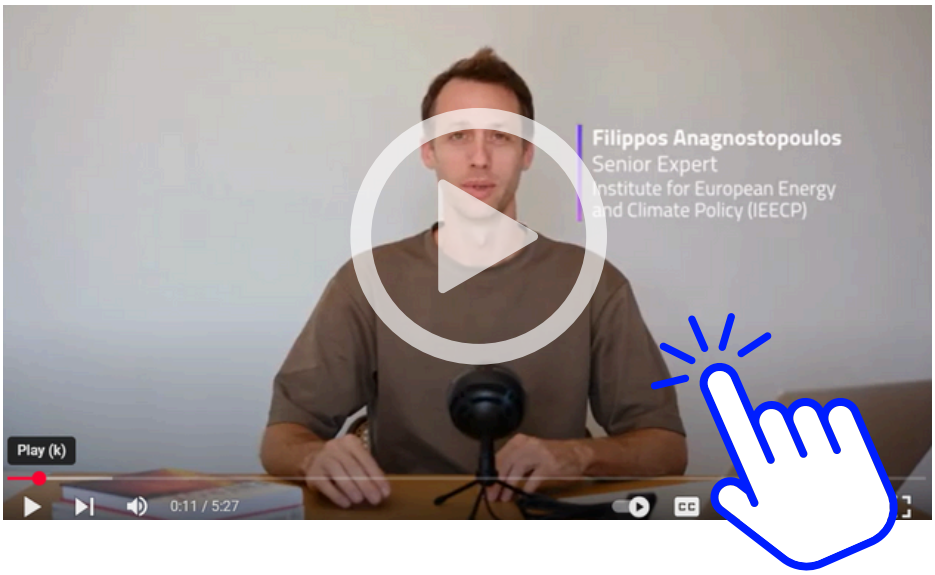
Key activities

- Energy efficiency retrofits coordination, advanced MRV protocols.
- Automated operations through blockchain and smart contracts.
- Market participation trading energy savings certificates and participate in demand response markets.
- Customer engagement with building owners, tenants, and utilities.
- Regulatory compliance.

Key partners and stakeholders

- **Utilities and Energy Providers:** Facilitate grid access and manage demand response.
- **DSOs/TSOs:** Provide grid services and enable demand-side participation.
- **ESCOs:** Conduct audits, design retrofit solutions.
- **Blockchain/DLT Providers:** Manage smart contracts and secure data.
- **Banks/Investors:** Provide project financing for retrofits.
- **Technology Providers:** Supply IoT devices, smart meters, and analytics tools.
- **Regulatory Bodies**: Ensure compliance with energy market rules and efficiency targets.
- **Contractors and Installers:** Execute retrofit measures.
- **Motivations**: Risk reduction through shared expertise, access to resources, optimized operations.

Watch the related video!



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