AI POWER

Maximizing Energy Efficiency: A white paper comparing a solar energy plant running on its own to a plant using the AI SaaS solution IntelliCharge.AI

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INTELLICHARGE.AI
BY AIPOWER

Executive Summary

The following analysis aims to investigate if the deployment of a battery and AI can allow ordinary households with PV to decrease electricity bills without changing their daily routine.

AI Power is a clean energy company that drives sustainability and provides intelligent energy management solutions for manufacturers in the solar industry.

This paper looks into the outcome of a solar energy plant running on its own compared to using a battery and our AI SaaS solution IntelliCharge.AI. Here the possible savings are analyzed by deploying an AI powered optimization solution using real-time data from January to October 2023.

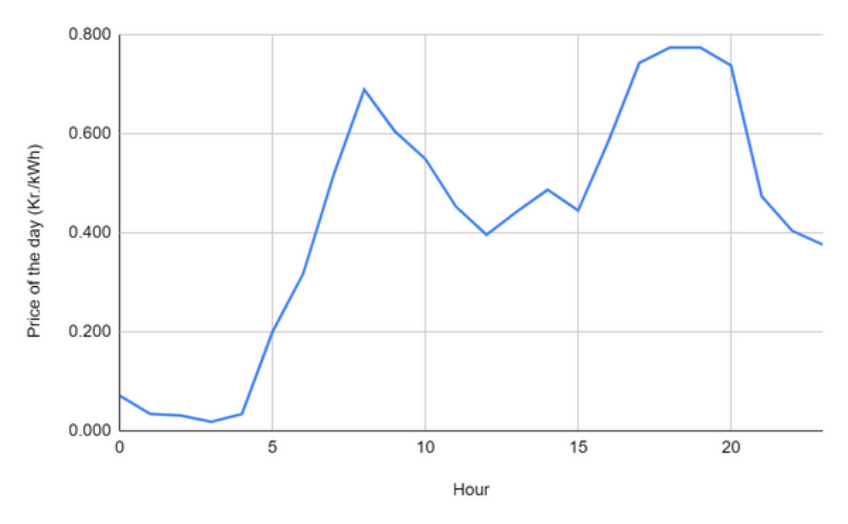
Our analysis concludes that using a battery and the AI SaaS solution IntelliCharge.AI, compared to running the system on its own in the Danish market, will provide savings of more than 46% on the electricity bill.

"Case household is found to save DKK 7,064 yearly on their electricity bills without changing their daily routine, corresponding to over 46% savings"

The Danish Market

In the Danish electricity market, prices vary throughout the day due to supply and demand. These fluctuations are further influenced by local distribution tariffs, taxes, and other elements that vary among companies, periods, and seasons. The spot market prices can vary significantly hourly, ranging from more than DKK 2 per kWh at the highest to nearly DKK -1 per kWh at the lowest in the first half of 2023.

The graph below shows the March 14th, 2023, hourly prices, exemplifying the daily spot market price fluctuation.



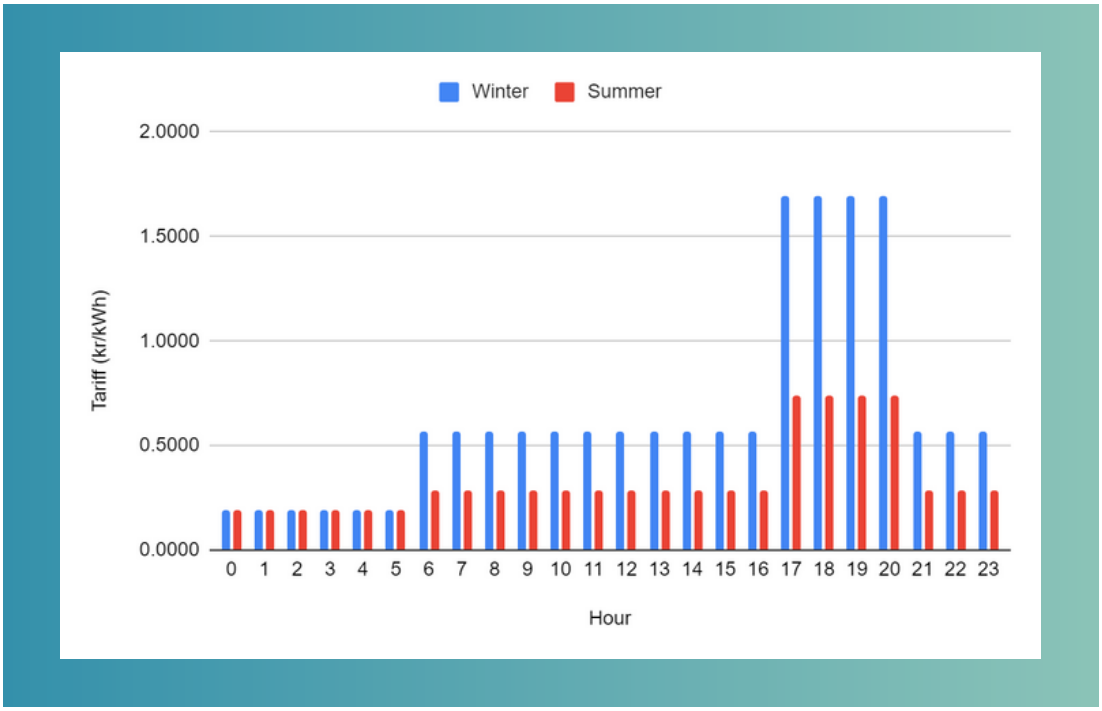
In the dynamic energy landscape of Denmark, there is a complex interplay between more than 20 distribution companies and their individual variable price tariff schemes. These tariffs, which can vary throughout the day, add an additional layer of complexity for consumers seeking to optimize their energy usage and reduce costs.

Understanding and effectively managing these variable price tariffs and distribution schemes is crucial for households and companies. It requires staying abreast of the pricing structures implemented by each distribution company and being able to adapt energy consumption patterns accordingly.

Winter vs Summer

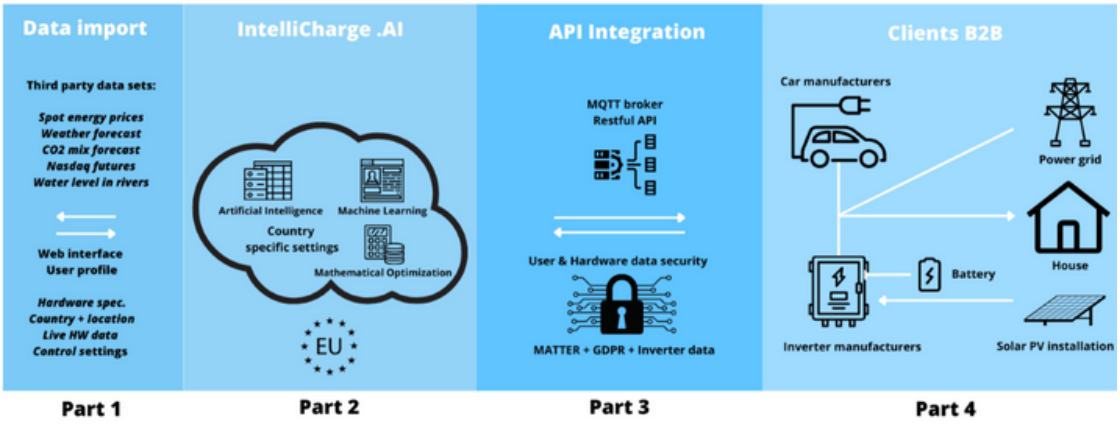
The savings are different from summer to winter, as in the Nordic region, there is a notable contrast in sunlight hours between winter and summer. January experiences approximately 7.5 hours of sunlight here, and June enjoys around 17.5 hours. The role of batteries becomes pivotal in both seasons. During winter, when PV production is limited, the batteries facilitate shifting consumption to cheaper hours. In contrast, during summer, surplus energy generated by PV systems is stored in the batteries for use during expensive hours.

The graph illustrates the winter and summer tariff schemes for the distribution company Radius at Zealand, Denmark. It showcases the tariff variation, with prices reaching as high as 1.69 DKK per kWh during fall and winter (blue) and 0.73 DKK per kWh during spring and summer (red). This fluctuation highlights the importance of understanding and managing energy costs during different seasons to optimize household savings.



Unleashing the Potential of AI Solutions

IntelliCharge.AI is an advanced artificial intelligence (AI) system designed to optimize energy usage and maximize cost savings for households with solar energy hardware and batteries. It leverages data analysis and smart algorithms to determine the most efficient charging and discharging plan for the batteries based on various factors, such as energy prices, solar energy production, and consumption patterns.



IntelliCharge.AI in action:

1. Data Integration: IntelliCharge.AI gathers real-time energy price and solar energy availability data from relevant sources.
2. Energy Price Analysis: The system analyzes hourly price variations, including market prices, taxes, and distribution fees.
3. Solar Energy Monitoring: IntelliCharge.AI tracks surplus solar energy production for battery storage.
4. Consumption Analysis: The AI system examines historical and real-time consumption data to understand energy usage patterns.
5. Optimization Algorithms: IntelliCharge.AI uses advanced algorithms to determine the most cost-effective battery charging and discharging plan.
6. Automated Management: The system automatically controls battery charging and discharging according to scheduled time slots, minimizing costs while meeting energy needs.

By employing a battery in combination with IntelliCharge.AI, households can effortlessly reduce electricity costs without changing their consumption habits, contributing to a sustainable future. The system seamlessly integrates with existing solar hardware and batteries.

Case Study Household

The following analysis is based on the following real-life case:

- Location: Greater Copenhagen, Denmark
- Household: 4 people, 180m², built in the 80s
- Annual electricity consumption: 14,500kWh incl.heat pump usage: 8,000kWh/year
- Three-phase AC-coupled 12kW inverter, 15kWh battery
- PV annual energy production: 6,000kWh
- Distribution company: Radius Category: C
- Spot market electricity price zone: DK2 January 2023 to October 2023

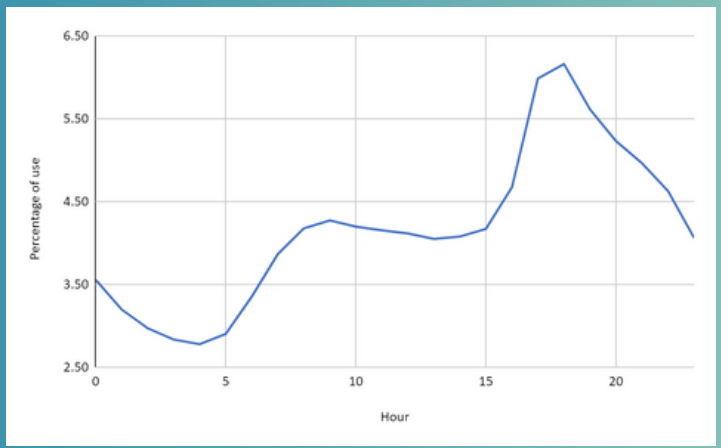
Comparing Solar Energy Plant Performance: Battery and IntelliCharge.AI vs. Standalone Operation

The following analysis compares a solar energy plant running on its own or using a battery in combination with our AI SaaS solution IntelliCharge.AI. The analysis is divided into summer and winter months, as the underlying optimization scenarios vary greatly in the Nordics during the seasons.

In the Nordics, the summer season brings longer daylight hours than in the winter and allows customers to generate surplus energy from their PV production. As a result, the charging plan and calculations need to be adjusted accordingly. When exporting to the grid, the distribution company pays the customers the spot market price, but tariffs are charged for electricity distribution. Therefore, instead of adding the tariff to the final price, it is subtracted, making exporting to the grid an ineffective solution in Denmark. This illustration is showcased in the figure below, exemplifying the hourly variation for the electricity usage pattern in percent for one day in May 2023 for a household in Copenhagen, Denmark.

In this analysis, the key optimization elements include hourly:

- Usage patterns
- Spot prices
- Tariffs
- PV production



The figure illustrates the electricity usage pattern in percent employed by households in May from Copenhagen, Denmark.

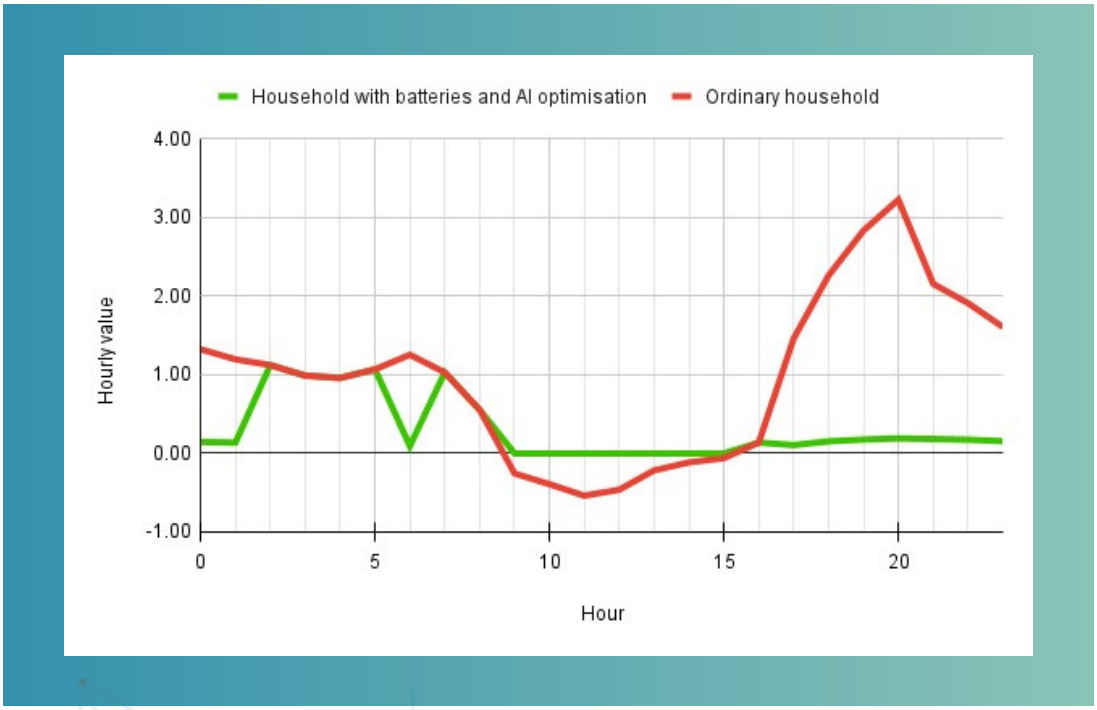
Summer optimization analysis

Based on live data, IntelliCharge.AI's optimization capabilities strategically charge the batteries from the grid in the cheapest time slots 13:00 and 14:00 approximately 5kWh of low-cost energy is stored from the grid, supplemented by 10kWh of surplus energy from the PV system in this period.

Subsequently, IntelliCharge.AI intelligently utilizes the stored energy from 17:00 to 02:00, and again at 06:00, aligning with the period of expensive and less sustainable energy available in the grid. By leveraging the stored energy, the system efficiently powers the household, minimizing costs and promoting sustainable consumption.

The graph below illustrates the cost per hour on June 2nd, 2023. The red line represents the system's ordinary electricity cost, while the green line represents the purchased energy from an optimal hour determined by the AI-powered IntelliCharge.AI solution. On this particular day, the total energy cost without IntelliCharge.AI was DKK 23.07, while with IntelliCharge.AI, it was reduced to DKK 9.20. The space between the green and red lines represents the cost savings of DKK 13.87 (60.12%) achieved by utilizing a battery in combination with IntelliCharge.AI.

Notably, if this household sold the surplus energy back to the grid, it would make only DKK 2.04 for the whole day. Instead, the AI optimization stores it in the batteries to help reduce the cost of electricity during peak hours.



Aggregated savings in the summer months:

Based on real data, the household from this study can expect total savings of DKK 2,664.70, and the average monthly savings is 62.81%. These are also illustrated in the table below and demonstrate the effectiveness of IntelliCharge.AI in delivering significant cost reductions and financial benefits throughout the summer season.

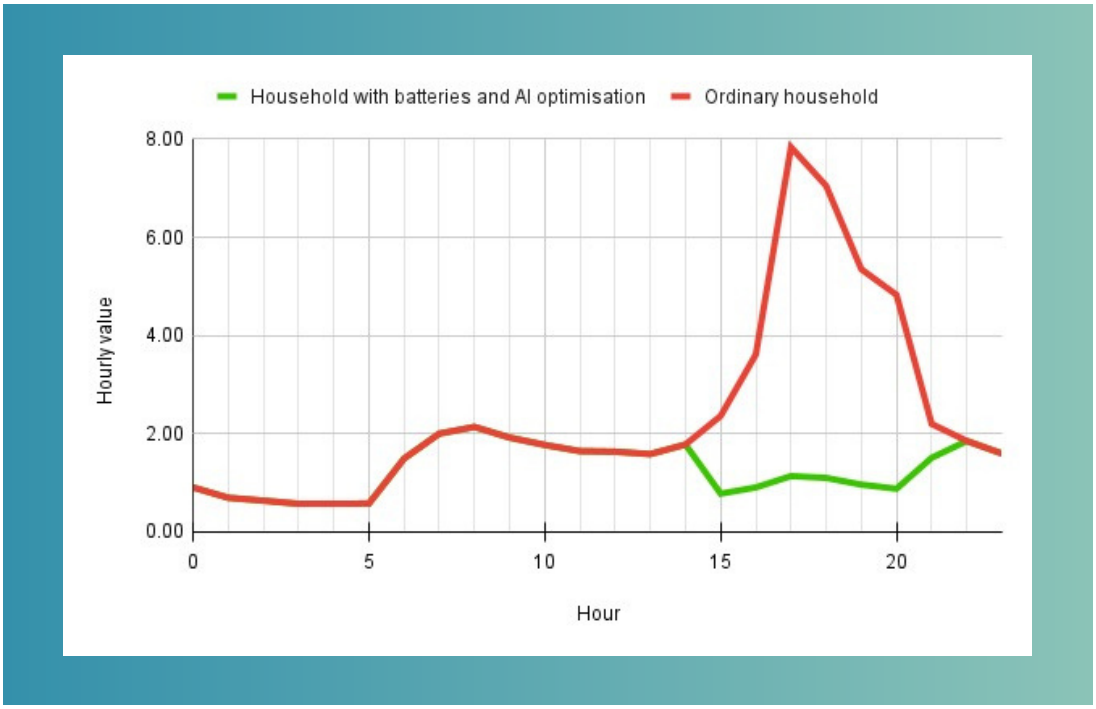
	April	May	June	July	August	September	Total
Days	30	31	30	31	31	30	183
Average savings per day	13.24 kr.	15.49 kr.	13.81 kr.	12.89 kr.	14.10 kr.	17.87 kr.	14.57 kr.
Energy bill	763.21 kr.	658.89 kr.	669.41 kr.	532.18 kr.	752.54 kr.	866.52 kr.	4,242.76 kr.
Energy bill with AI and battery	366.10 kr.	178.66 kr.	202.53 kr.	132.53 kr.	315.30 kr.	330.36 kr.	1,525.48 kr.
Total savings	397.11 kr.	480.23 kr.	414.30 kr.	399.65 kr.	437.24 kr.	536.16 kr.	2,664.70 kr.
Savings %	52.03%	72.88%	61.89%	75.10%	58.10%	61.87%	62.81%

Winter optimization analysis

This section deploys the AI on a winter optimization analysis and investigates the effectiveness of a battery combined with IntelliCharge.AI's optimization capabilities during the winter. The conclusion is that by strategically charging the batteries from the grid in the cheapest time slots from 2:00 to 6:00, where approximately 15 kWh of low-cost energy is stored from the grid.

Later, IntelliCharge.AI automatically utilizes the stored energy from 15:00 to 21:30, aligning with the period of expensive and less sustainable energy available in the grid. As showcased in the summer example above, this analysis also showcases that by leveraging the stored energy, the system efficiently powers households, minimizing costs and promoting sustainable consumption.

The graph below shows the cost per hour from January 11th, 2023. The red line shows the system's ordinary electricity cost, whereas the green line shows the AI's purchased energy from an optimal hour. The total cost of the energy on that day was DKK 56.63 without IntelliCharge.AI and DKK 30.68 with IntelliCharge.AI. The space in between the green and red lines represents the cost savings of DKK 25.95 (54.17%) on January 11th by using IntelliCharge.AI.



Aggregated savings in the winter months:

When looking at the analysis during the winter months from October to March, the analysis has extrapolated the results to November and December, to provide a comprehensive overview of the potential savings. Based on this projection, the household from this study can expect total savings of DKK 4,399,50 and the average monthly savings is 40.64%, also illustrated in the table below. This illustration demonstrates how IntelliCharge.AI can deliver significant cost reductions and financial benefits throughout the winter season.

	January	February	March	October	November	December	Winter
Days	31	28	31	31	30	31	182
Average savings per day	28.28 kr.	21.54 kr.	23.52 kr.	21.54 kr.	21.54 kr.	28.28 kr.	24.12 kr.
Energy bill	2,345.90 kr.	1,677.81 kr.	1,517.27 kr.	1,142.00 kr.	1,797.65 kr.	2,345.90 kr.	10,826.53 kr.
Energy bill with AI and battery	1,469.21 kr.	1,074.79 kr.	788.00 kr.	474.26 kr.	1,151.56 kr.	1,469.21 kr.	6,427.03 kr.
Total savings	876.69 kr.	603.02 kr.	729.27 kr.	667.74 kr.	646.10 kr.	876.69 kr.	4,399.50 kr.
Savings %	37.37%	35.94%	48.06%	58.47%	28.80%	31.08%	40.64%

Findings

The analysis demonstrates the potential for ordinary households with PV and batteries to reduce their electricity bills without changing their daily routines. By deploying AI Power's intelligent energy management solution, IntelliCharge.AI, households can optimize their energy usage and realize substantial cost savings.

Seasonal variations play a crucial role in energy savings. In the Nordic region, sunlight hours differ significantly between winter (7.5 hours in January) and summer (17.5 hours in June). IntelliCharge.AI considers this, consistently generating optimal charging plans based on real-time data analysis. IntelliCharge.AI adapts to the varying hourly prices across days and seasons.

The AI-powered optimization solution will save households such as this DKK 7,064 yearly on their electricity bills without changing their daily routine, corresponding to over 46%.

Furthermore, the analysis demonstrates *that homeowners can greatly amplify their return on investment by harnessing the power of AI technology*, surpassing the benefits of traditional basic data sources such as Nord Pool and others.

The analysis further emphasizes that fluctuating distribution fees will become the new norm across the EU, posing a challenge that companies in the solar industry must address.

IntelliCharge.AI equips inverter manufacturers with the ability to navigate and adapt to these evolving distribution fees, ensuring they can optimize their systems effectively in this changing landscape.

By incorporating dynamic pricing and distribution fee considerations into its optimization algorithms, IntelliCharge.AI enables companies to proactively tackle this industry-wide trend and maximize their cost savings, all contributing to the green transition and improving overall energy efficiency.

Global Sustainable Development Goals

At AI Power, we are dedicated to supporting the UN Global Green Sustainable Development Goals

With IntelliCharge.AI, we address critical challenges in the renewable energy sector and directly contribute to the achievement of Sustainable Development Goals:

Goal 7: Affordable and Clean Energy - We enable the widespread adoption of renewable energy by optimising the performance of the battery and solar PV systems, making clean energy more accessible and affordable.

Goal 9: Industry, Innovation, and Infrastructure - Through our innovative AI-powered solutions, we enhance the efficiency and reliability of energy infrastructure, promoting sustainable industrial development.

Goal 13: Climate Action - By maximising solar energy utilisation and optimising battery storage, we help reduce carbon emissions and combat climate change.

Goal 17: Partnerships for the Goals - We actively collaborate with industry partners, governments, and organisations to drive sustainable development and create a meaningful impact on a global scale.

AI Power aims to accelerate the transition to a sustainable future by empowering battery and solar PV systems with intelligent technology.

Want to become a partner?

Contact us to unleash the power of IntelliCharge.AI. Our team of experts is available to discuss partnerships, provide product demonstrations, and explore opportunities. Let's take your solar energy solutions to new heights with IntelliCharge.AI.

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