Denmark Eyes Automation to Address Electrician Shortage

Photo credit: Bjarke Reggelsen, HowToRobot

Electrical contractors in Denmark have a significant potential for overcoming labor shortages and improving the working environment using robot technology and automation, a new study finds. It was conducted by HowToRobot for the industry's trade union and employers' association.

In a bustling Danish construction site, two electricians grapple with a stubborn cable, their arms stretched overhead as they maneuver it into place. But today, they're not alone – two robot engineers watch intently, their minds already racing with possibilities. Could a machine assist with this physically demanding task, allowing a single electrician to do the job of two?

The scene unfolded as part of a new initiative that could significantly impact Denmark's electrical contracting industry. As the country faces a growing shortage of skilled electricians, industry leaders are exploring a novel solution: automation and robotics.

To map out the industry's automation potential, the trade union (Dansk El-Forbund) and employers' association (TEKNIQ Arbejdsgiverne) commissioned an independent study by HowToRobot, a consultancy specializing in robotics and automation. The just-released study reveals a promising potential for automation and robotics to address the pressing labor challenges facing the industry:

- By 2030, Denmark is projected to face a shortfall of 6,700 electricians

- Implementing existing off-the-shelf automation technologies could address 14% of the expected electrician shortage by 2030, the study finds

- With the development of new, fully automated solutions, up to 70% of the expected shortage could potentially be addressed

"There is already a shortage of labor in the industry, and the green transition increases the need for electricians even further," says Maria Schougaard Berntsen, Deputy Director at TEKNIQ Arbejdsgiverne. "This study shows that automation could be a key part of the solution."

The study looked at how various electrician tasks could be automated - such as cable pulling. Image: AI generated

Growing Electrician Shortage Increases Need for Automation

The skilled labor shortage is experienced across many industries, but electrical contractors are particularly hard hit. 37% of electrical contracting companies experience 'production restrictions' due to a lack of labor – far more than the 24% for the general industry according to Statistics Denmark (data from May 2024). Electricians are also among the occupational groups in Denmark that companies have the hardest time recruiting. Just over a third of all advertised electrician positions end up with unsuccessful recruitment, according to the Danish Agency for Labor Market and Recruitment.

"This increased demand puts additional pressure on the current electricians in the industry to work more with the risk of getting worn out faster," says Lars B. Sørensen, area manager at the union, Dansk El-Forbund.

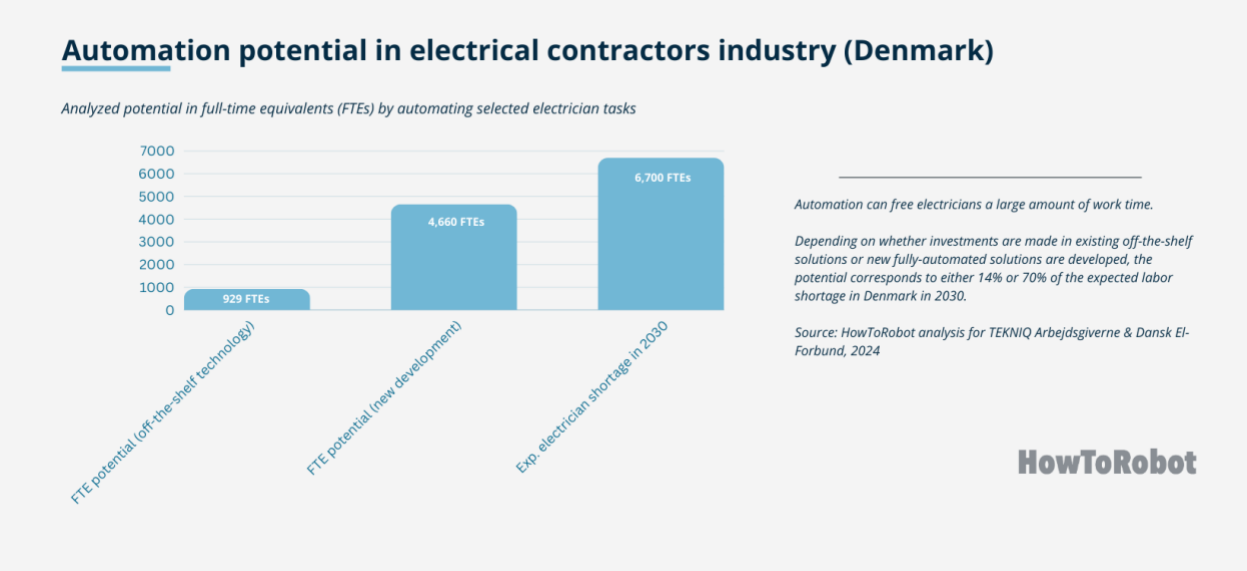
The hope among the companies participating in the project has been that they could find ways to free electricians from the heaviest, most monotonous, and repetitive tasks – thereby addressing the labor shortage. This goal has been successfully achieved, according to Mikkel Viager, one of the robot engineers from HowToRobot, who observed

and analyzed more than 50 electrical installation and maintenance tasks as part of the project.

"We uncovered a wide range of existing, often semi-automatic, aids and solutions that can reduce the time electricians spend on many of their tasks. It was far more significant than we had dared to hope," he says.

During the project, 13 specific electrical tasks across renovation, maintenance, and new construction were identified as suitable for automation and optimization with new or existing technology. In particular, the study found great potential in automating processes such as cable pulling behind ceilings and walls, hole drilling for electrical installations, measuring and marking, and channel cutting for wiring.

"The analysis shows enormous potential. Automation can help ensure that a company can say yes to orders that they would otherwise have to decline due to staff shortages," says Maria Schougaard Berntsen. “This debunks the myth that robots are taking jobs from people.”



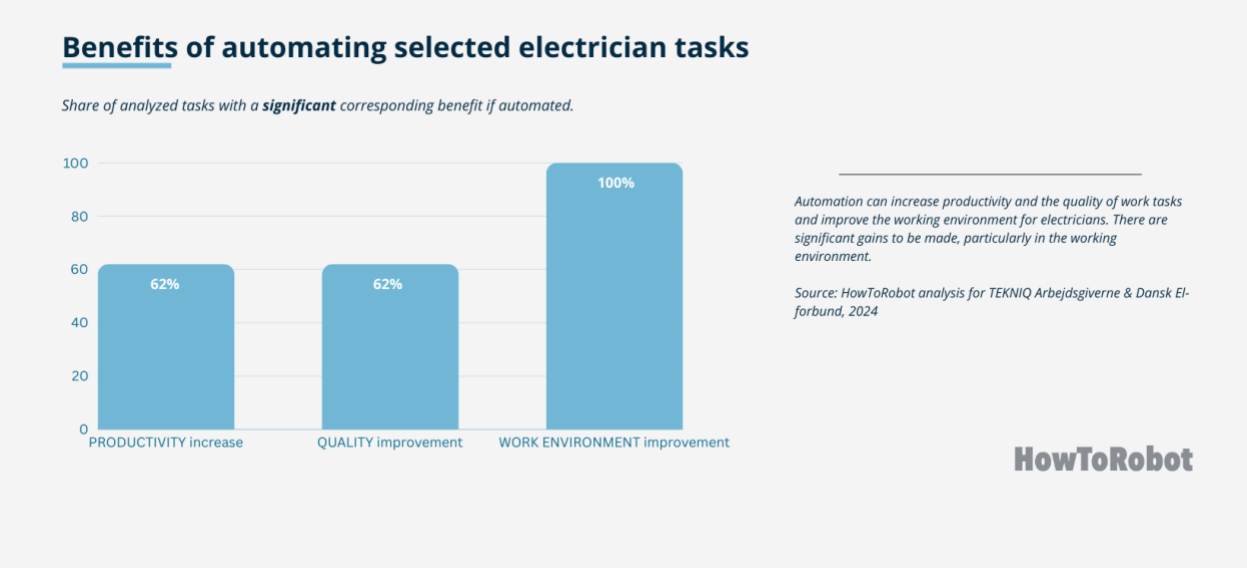
Automation Reduces Heavy and Tedious Tasks

One thing is to automate to optimize work time, but in the bigger picture, there are other considerations motivating electrical contracting companies.

"What appeals to me most about automation is that we can spare our employees and reduce wear and tear. Some of those entering the labor market now will be working until they are over 72 years old. If they are to stay in the industry, we need to take good care of them," says Jesper Timming, Managing Director of the Danish electrical contractor Linde-El – one of the companies studied in the project.

Particularly heavy tasks in difficult working positions, such as working on ladders with hands above shoulder height, can be wearing – especially on the shoulders. One of the project's goals was, therefore, to map out how automation can help reduce the number of wearing tasks and thus improve the working environment. Across the tasks analyzed, the study found an 'improved working environment' to be the overall most significant positive effect of automation.

Exoskeletons can relieve electricians, for example, when working above shoulder height. Image: AI generated.



Cable Pulling, Measurement, Grooving: Much, but Not All, Can Be Automated

Which Tasks Are Suitable for Automation?

The study identified 13 electrician tasks across service, renovation, and new construction that were particularly suitable for automation. The tasks were selected based on their prevalence in the installation industry, the significant benefits to be gained from automating them, and the practical feasibility of automating the tasks or parts of them – with off-the-shelf solutions or by further developing existing technology.

- Cable pulling
- Installation of construction power
- Work on ladders and stools
- Measurement and marking
- Stripping of wires
- Hole drilling in walls and ceilings
- Cleaning
- Work with arms above shoulders
- Assembly of complete panels
- Transport of materials and tools
- Installation of PDS
- Channel cutting/Grooving
- Building grooves

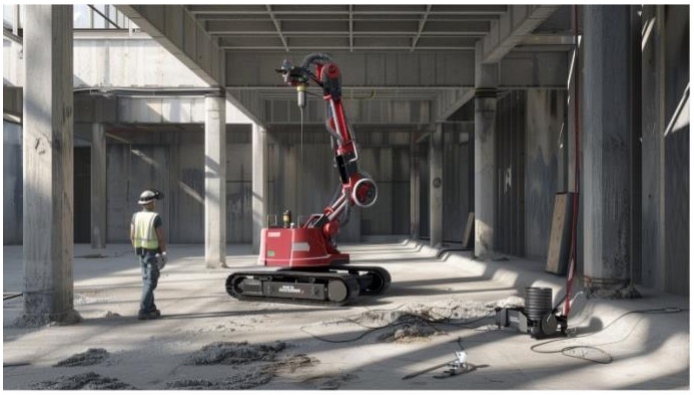
Image: AI generated.

During the project, several electrician tasks suitable for automation emerged, beyond cable pulling.

One of these was the measurement and marking of placements for sockets, conduits, etc. Various solutions already exist today that can reduce the time spent on these tasks and minimize measurement errors. An automation solution using a 3D scanner would make it possible to scan a room and then plot installations directly from a technical drawing onto walls, floors, and ceilings for marking. Additionally, mobile robots exist that can print the drawing directly on the floor.

Marking robots can automatically make drawings on the floor.

Another task identified during the project was drilling holes in ceilings and walls for sockets, cable routing, and installation. Drilling is both a dusty and noisy process that often involves poor working positions for electricians. During the project, a range of off-the-shelf tools were found that can ease the work – from simple drills for making square holes for embedded sockets to more advanced mobile drilling robots.



Mobile drilling robots can aid electricians but may require some adjustments at construction sites. Image: AI generated

A third electrician task identified in the project was channel cutting for concealed cable routing. This task is typically noisy, dusty, and time-consuming, and a higher degree of automation can, therefore, improve both the working environment and free up work time for electricians.

Automating channel cutting for wiring can help improve electricians' working environment. Depending on the complexity, the task can be automated to varying degrees. Photo: Bjarke Reggelsen, HowToRobot.

Regardless of the task to automate, electrical contractors should aim to find a balance and focus on what provides the most value for money, the robot advisor Mikkel Viager recommends.

“Although almost everything can theoretically be automated, it is rarely a good idea to aim too high. When you break a task down into smaller parts and look at the technologies available on the market today, you might find a reasonable solution that can handle a portion of the task, which can still be hugely valuable,” he says.

How Automation Opportunities Were Mapped

Examples of Solutions and Tools (Off-the-Shelf)

Off-the-shelf tools as well as semi- and fully automated solutions to handle electrician tasks were identified in the study, including:

- Pulling springs with built-in camera for manual cable feeding
- Automatic solutions for pulling larger cables
- Remote-controlled cable-feeding robots for ceilings
- Self-driving mobile drilling robots
- 3D scanners and plotters for measurement on walls and ceilings
- Mobile robots for printing drawings on floors
- Semi-automatic wire stripping machines
- Robot vacuum cleaners
- Exoskeletons to relieve work above shoulder height
- Grooving machines with automatic feeding and wall fixation
- Robot solution for printing drawings on walls

The project involved robot experts from HowToRobot following electricians at work and analyzing their tasks in consultation with company management and the performing electricians. Although the consultants' method is best known in the manufacturing industry, it has increasingly found application in other sectors such as healthcare, agriculture, and now also the electrical contractors' industry, where automation is gaining ground.

"With a systematic review of the opportunities and a thorough knowledge of the technologies and the supplier market, you lay the foundation for sensible investments that help boost both the company's bottom line and employees' job satisfaction," says Mikkel Viager from HowToRobot.

The method fundamentally involves making automation a systematic process that openly maps both the opportunities, benefits, and risks of implementing robot and automation solutions in the work. As part of the project, each of the participating companies received a short and concise report that gave management an overview of the automation potential in their company. One of the companies is currently exploring the development of a new mobile automation solution to assist with pulling and pushing cables, and several are exploring how other existing solutions can help their electrician do a range of tasks more effectively and safely.

Participants highlighted one of the key benefits of the projects: the process of involving both management and employees in exploring new opportunities and ways of working.

“It is interesting to see that when employees and employers sit down together and ask what they can do smarter, a fantastic list of ideas and opportunities emerges on how they can make the workplace a better place,” says Lars B. Sørensen from the trade union.

In making the study, Maria Schougaard Berntsen from TEKNIQ Arbejdsgiverne also acknowledges the importance of bringing expertise in robotics and automation to the electrical contractors' industry:

"The project has confirmed that if you do not know the technologies, it can be difficult to see where the potential lies. When you look at it from a different professional perspective, it becomes clear that there is a great untapped potential to become more automated and use robot technology in the industry today," she concludes.

The Robot Expert's Good Advice to Get Started

Mikkel Viager from HowToRobot offers some good advice for companies looking to get started with automation:

1. Start by getting an overview of the possibilities. Avoid locking yourself into a particular technology or solution too quickly, but focus on what is most needed. It's also a good idea to consult with your employees and find out if you have some ambassadors who can help drive the project and push it forward.

2. Get out in the field and assess the potential for automating individual tasks. This can rarely be done from an office alone. Get experienced tech people with knowledge of the market and solutions to scrutinize the tasks. The aim is to look broadly at all the tasks and find the common denominators – and then be realistic about what can be done and whether the business case holds up.

3. Consult the market on what is possible. When you have a clear idea of your needs, describe them. Avoid designing the solution in advance, but describe the need and the task you want to automate and ask relevant suppliers. Sometimes, there will be existing off-the-shelf solutions; other times, it will require developing something new.

"Typically, 80% of the gain can be harvested for 20% of the cost. Trying to achieve 100% level of automation, the price to reach the last 20% will often be disproportionately high," Viager adds.

As an independent robot and automation consultant, Mikkel Viager worked with electricians to assess which tasks could be automated. He has many years of experience with robot technology and automation from a wide range of industries, from the manufacturing industry to the healthcare sector and waste sorting. Photo: Sine Smed (may be used editorially)

About the project

The project and study were initiated in collaboration between the Danish electrical contractors' employers' association, TEKNIQ Arbejdsgiverne, and the trade union Dansk El-Forbund. It aimed to map the possibilities for greater involvement of automation and robot technology in the electrical contractors industry, addressing labor shortages and working conditions. The project was carried out by independent robot experts from the consultancy HowToRobot and involved observing and analyzing on-site work from a range of electrical contracting companies within renovation, service, and new construction, as well as assessing the industry-wide potential for automation.

The project was funded by TEKNIQ Arbejdsgiverne and Dansk El-Forbund.