

Cooperative Innovation for Energy Efficiency, Digitalization and Predictive Maintenance

by Dr. Pilar Molina Gaudó



Figure 1: Map of AECAE members in Spain

Energy efficiency has gained prominence in recent years, leading to the exploration of new ways of generating and managing electricity. In this new paradigm, the companies Beltrán Ascensores, Epic Power and Nayar Systems, all members of the Association of Component Companies for Lifting Devices (AECAE), have joined in an innovation

consortium for the project described in this article. The project is relevant in this sector because it tackles not only energy efficiency but also two very important issues: digitalization and predictive maintenance, in particular of batteries.

AECAE is a Spanish non-profit association that represents the interests of companies

Exporters of Parts of lifts, skip hoist or escalators (2020)

Total: \$4.61B

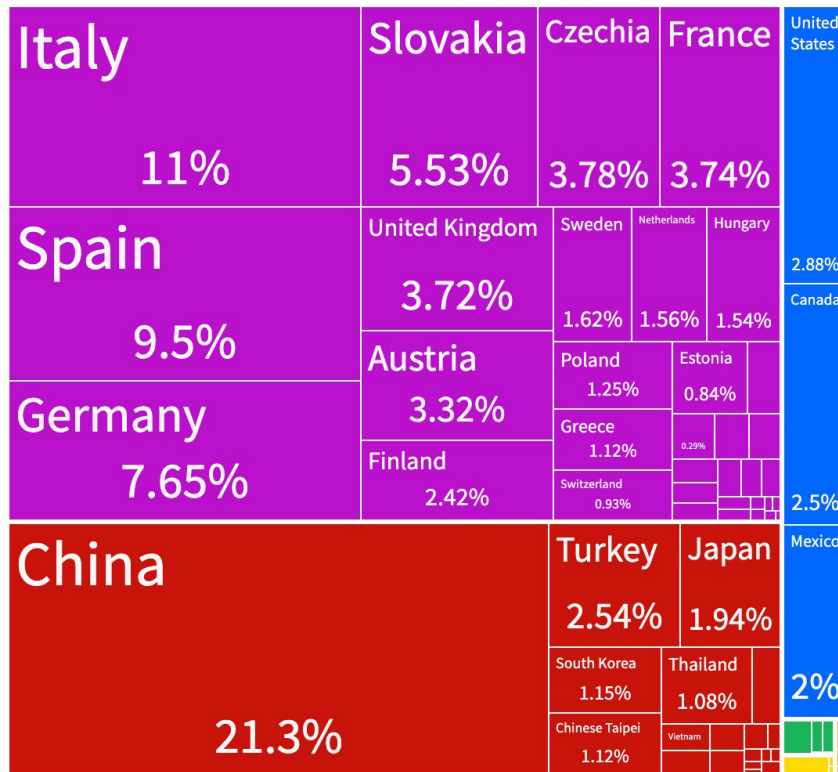


Figure 3: Exporting countries in percentage in year 2020. Source: The Observatory of Economic Complexity (OEC), oec.world. Data based in TARIC 843131.



Figure 2: Formal recognition of Interest Cluster by the Ministry of Industry, Trade and Tourism.

manufacturing elevator components in our country. The map and the names of all current members of the association are shown in Figure 1. In addition to companies, the cluster is also formed with other types of innovation entities, in this case ItaInnova, as well as formal collaborations with incumbent associations such as FEPYMA (Federation for Small and Medium Size Elevator Installers and Maintenance Enterprises) and FEEDA (Federation of Elevator Enterprise Associations). AECAE was founded in 1993 and, recently, we received the official recognition of Industrial Interest Cluster granted by the Ministry of Industry, Trade and

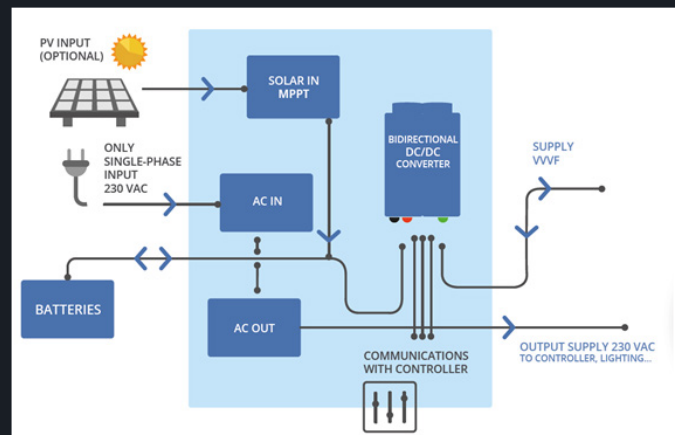


Figure 4: (a) Block diagram of P2S system and (b) Example of P2S system with lithium batteries taken at interlift 2022

Tourism. This official consideration, achievable only in cases of relevant conditions of prevalence, market share and size, underlines the importance of this sector in the Spanish industrial framework.

The Spanish elevator market is one of the most relevant in the world, with a total turnover of almost EUR4.7 billion in 2019. The sector in Spain is comprised of 440 companies that employ 22,500 people, representing 0.38% of internal GDP. Many of the companies are small, with almost 96% having 250 or fewer employees. In this scenario, R&D is a matter of joining forces and finding synergies among different small and medium-size enterprises (SMEs).

Spain has more than a million elevators in operation; therefore, internal trade is important. Nevertheless, the Spanish elevator market is clearly an exporting one. Spain is the third country in the world in volume of exports. Data from the Observatory of Economic Complexity (OEC) shows that Spain, with US\$439 million in exports, is third, behind China (US\$982 million) and Italy (US\$506 million) and above Germany (US\$353 million) in 2020. The next figure shows the exporting countries in percentage:

This consortium gained a favorable resolution from the Ministry of Industry, Trade and Tourism of the Government of Spain (Grant No. AEI-010500-2021b-129) to coordinate the development of a monitoring and big data architecture to manage energy consumption in elevators powered by batteries and solar energy, which is expected to be realized in mid-2022. For this purpose, they will use a system developed by Epic Power (P2S) integrated into a platform developed by Nayar Systems, which will then be validated through a pilot test at the Beltrán Ascensores elevator park.

The P2S system developed by Epic Power (Figure 4) consists of an advanced power supply and energy-saving system for elevators, through which elevators with electric traction and three-phase multi-brand drives can be fully powered through a single-phase grid connection of a maximum of 500W. Optionally, the P2S system, which requires the inclusion of batteries, can be connected to two 300W solar panels to achieve close to zero energy consumption. Because of the inclusion of energy accumulators, the elevators can operate approximately 100 times after a power failure. P2S further recovers braking energy into the

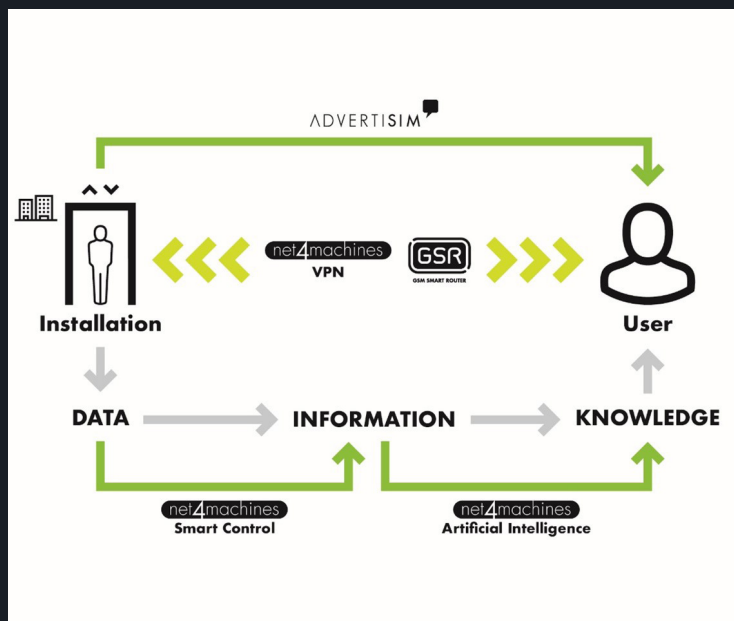


Figure 5: Flow diagram of Nayar subsystems, GSR, ADVERTISIM and net4machines



Figure 6: Screenshot of Nayar System's Advertisim screen with timely information on energy generation and consumption

batteries. Through the data captured by the P2S, it is possible to determine the precise energy consumption of the elevators, the state of the batteries, the solar energy created and the energy regenerated by the elevator motor. Besides, the system will significantly reduce standby energy consumption of the elevator, a state that involves significant energy losses, especially in ISO category 1-3 elevators.

For its part, Nayar Systems has developed a telemetry system that allows elevator maintenance companies to remotely monitor their equipment (provided they are compatible with its technology), thus having the ability to receive and interpret information about each installation. This is done through the multipurpose GSR device (Figure 5), which is connected to the controller and works as a link to the internet and to the Nayar Systems cloud, net4machines. With this, the Castellón-based technology company provides direct collection of and consultation on data from GSR, which provides both the communication logic with the different elevator devices, as well as the connectivity to upload the data obtained to the cloud.

At last, Beltrán Ascensores offers this technology as an integrating element in the market of rehabilitation and energy improvement of the existing building stock, interacting with the building and its neighbors and owners. They have been early adopters of Epic Power's technology and have plenty of case studies and installations to retrofit and further improve project results. With the use of solar energy, the elevator can become a generator element within the building, making it necessary to create the appropriate system so that the surplus energy created is used and rerouted to other existing consumption elements. Thus, Beltrán Ascensores stands as a key element for the development of the system architecture, the programming of its various components and the development of pilot tests. Figure 6 showcases one such installation.

This product will bring a new way of understanding elevator maintenance service, moving from a traditional maintenance service to a remote-monitoring system based on IoT technologies, which will make maintenance predictions before

failures happen and will allow actions to be taken accordingly. The new services generated with this product, expected to be ready by fall 2022, will improve the flow of travel, speed, reliability and safety of maintenance, as well as the development of new applications and solutions for elevator maintenance. In particular, novel algorithms will be incorporated to improve the understanding of the State-of-Health (SoH) of batteries. This feature incorporated as a predictive feature will strongly benefit the efficient maintenance process and avoid any discomfort to the end user.

Additionally, the project aims to go beyond the main objectives described before and to present an expanded solution consisting of an energy hub to be installed in electric elevators, highlighted in Figure 7. With this solution, the excess energy generated by the elevators, the energy from low-power grid connections or the energy of renewable sources (solar or wind) can all be harnessed and stored to power

www.meiller-aufzugtueren.de



SPARE PARTS

Customer service is ...

... when
spare parts
are available
at short
notice.



Your Premium Partner for
High Quality Elevator Doors,
located in Munich, Germany.



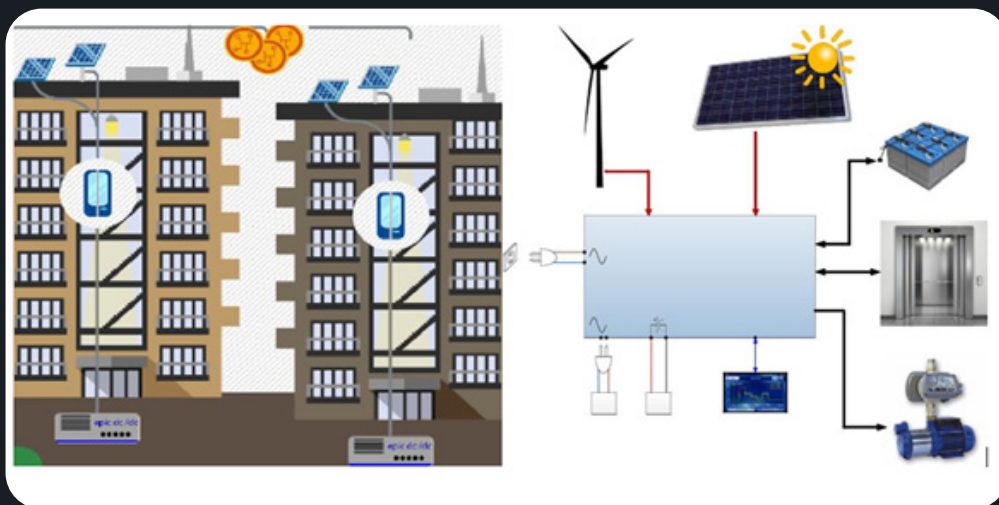


Figure 7: Overall energy hub connection to sources, loads (both DC and AC) and potential seed for formal energy community.

other common needs of a residential building, thus reducing the building's overall energy consumption.

The project, coordinated by AECAE and developed by Beltrán Ascensores, Epic Power and Nayar Systems, will also have the collaboration of the University of Zaragoza, among other partners. Its development will have a positive impact on multiple sectors, and it is expected to be presented at various European trade fairs and definitely at the next interlift in 2023.

In addition to the project objectives currently under development, the project has created a positive impact in the AECAE community, triggering requests for new projects among other consortia and contributing to building a constructive cooperation ecosystem.

To be continued soon with more results ... and more projects.

References

- [1] AECAE Strategic Plan 2020-25 (in Spanish). Feb. 2020.
- [2] Elevator market Spain. (Informe sectorial Ascensor). 2021. Plimsoll Publishing Limited. 2021
- [3] Integrated registry of the Ministry of Industry, Trade and Tourism, Government of Spain. (Registro Integrado Industrial del Ministerio de Industria, Comercio y Turismo): <https://sedeaplicaciones.minetur.gob.es/RII/consultaspublicas/consultadatos.aspx>
- [4] Spanish National Institute of Statistics (INE) <http://ine.es>
- [5] Foreign Trade Statistics of Spain (Estadísticas de Comercio Exterior). Tax Agency Spain (Agencia Tributaria). <https://sede.agenciatributaria.gob.es/Sede/estadisticas/estadisticas-comercio-exterior.html>
- [6] The Observatory of Economic Complexity. <https://oec.world>

About AECAE



The purpose of the Cluster of the Association of Companies of Components for Elevating Devices (AECAE) is to promote the competitiveness of its associated members and enhance the collaboration between companies and other agents of the sector of components for elevating devices, to offer integrated and innovative solutions in the elevator sector, uniting the products and services of the value chain and providing solutions in packages that include products, installations, maintenance and management.

One of the operational areas highlighted in the activity of the Cluster is the realization of joint research, innovation and technological development projects. For more information about AECAE, please visit aecae.com.

About Beltrán Ascensores



Beltrán Ascensores y Montacargas S.L. is a family company founded in 1963. Dedicated to the design, manufacture, installation and maintenance of elevators, its innovative character has led it to publish several patents and utility models, in addition to take part in CDTI projects and projects with Research and Technological Development Centers of the Basque Network of Science,

Technology and Innovation. Its teams are present in the Middle East and seven European countries. For more information about Beltrán Ascensores, please visit beltransl.com.

About Epic Power



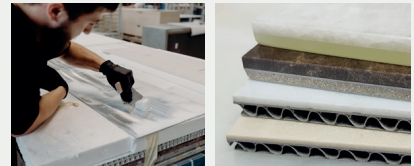
Epic Power Converters S.L. is a spin-off company of the University of Zaragoza. Founded in 2012, it designs and manufactures power electronics systems oriented to energy efficiency, in particular, bidirectional DC converters. Products applied to elevators constitute 50% of turnover for the company, which also markets products for bidirectional charging of electric vehicles, green hydrogen production, energy communities, microgrids, hybridization of different chemistries and energy vectors and electrification of industrial vehicles. The company exports to more than 25 countries and has extensive experience in European consortium projects and research and innovation projects of this and other public bodies at the national and regional level. For more information about Epic Power, please visit epicpowerconverters.com.

About Nayar Systems



Nayar Systems is a technological engineering company created in Spain 15 years ago, currently present in 31 countries around the world, with headquarters in Spain and China. The company is a reference in the elevator sector and an expert in offering solutions in industrial Internet of Things (IoT), standing as a partner and technology provider for companies wishing to carry out a technological revolution and achieve operational excellence. A benchmark in the elevator IoT sector, Nayar Systems makes its technological expertise in elevators and industrial systems available to third-party companies, offering quality IoT products and services that make life easier for people and corporations. For more information about Nayar Systems, please visit nayarsystems.com.

Made in Germany  Designed for the world



stone
it's
is not
all about.
a material.
stones
it's a
and your
passion
individualism

lightweight stone
for elevator cars

- extremely light and robust
- fast and easy installation
- increases the value of your elevator
- offers priceless millimetres of extra space

**grama
blend.**

grama blend GmbH
Industriestraße 44-46
92237 Sulzbach-Rosenberg

Telefon +49 96 61 - 10 43 0
Telefax +49 96 61 - 92 33
info@gramablend.com

www.gramablend.com