DOFINANSOWANO ZE ŚRODKÓW BUDŻETU PAŃSTWA

Nowe technologie w zakresie energii

APStorage 2.0.
Modułowy – konfigurowalny, zdalnie sterowalny i cyberbezpieczny, system magazynowania i kondycjonowania energii elektrycznej

DOFINANSOWANIE
28 980 481,70 zł

CAŁKOWITA WARTOŚĆ
43 499 962,09 zł

DATA PODPISANIA UMOWY
09.2022

NCBR
Narodowe Centrum Badań i Rozwoju

Program strategiczny
NOWE TECHNOLOGIE W ZAKRESIE ENERGII

POLITECHNIKA WARSZAWSKA
WARSAW UNIVERSITY OF TECHNOLOGY

Rzeczpospolita Polska

APS energia

P W IS EP

Politechnika Warszawska

Warsaw University of Technology

NCBR

National Centre for Research and Development

Program strategiczny

NOWE TECHNOLOGIE W ZAKRESIE ENERGII

Securing the Future: Cybersecurity Strategies for Renewable Energy Systems and Their Impact on Power Market Stability

IEEE PowerTalks

Energy Transition in Oman: Implementation Roadmap

Prof. Marek Jasinski

Supported By

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17.09.2024

Sultanate of Oman

Republic of Poland

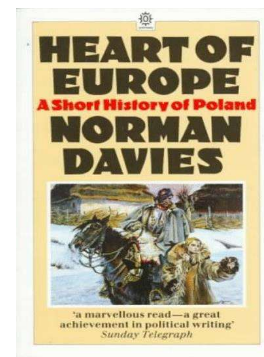
20 YEARS OF POLAND IN THE EUROPEAN UNION

European Union

The Republic of Poland

Poland is a country in Central Europe.
It extends from the Baltic Sea in the north to the mountains in the south.
Bordered by Lithuania and Russia to the northeast, Belarus and Ukraine to the east, Slovakia and the Czech Republic to the south, and Germany to the west.
The territory is characterised by a varied landscape, diverse ecosystems, and temperate transitional climate (from -35 (winter) to +40 (summer)).
Poland is composed of sixteen voivodeships and is the fifth most populous member state of the European Union (EU), with over 38 million people, and the fifth largest EU country by land area, covering a combined area of 312,696 km2 (120,733 sq mi).
The capital and largest city is Warsaw; other major cities include Kraków, Wrocław, Łódź, Poznań, and Gdańsk.

IEEE PowerTalks



Source: https://en.wikipedia.org/wiki/Poland

Source: https://www.google.com/maps

Source: "Heart of Europe: A Short History of Poland", Davies, Norman, 1986, Oxford University Press

The National Centre for Research and Development

New technologies in the field of Energy:

The main goal of the program is to support the achievement of Poland's climate neutrality by implementing solutions increasing the country's energy security and increasing the competitiveness of the Polish economy.

As a result, the share of energy from renewable sources in the overall energy mix of the country will increase by 20-50% (compared to the level from 2020)

The program was established for years 2020-2029

The allocation for the program is:
PLN 800 million =
= EUR c. 184 million (for 1 PLN = c. 0.23 EUR) =
= OMR c. 80 million (for 1 PLN = c. 0.1 OMR)

Source: https://www.xe.com/currencyconverter/convert/?Amount=800000000&From=PLN&To=OMR

The specific objectives of the program are:

I. increasing the potential of the renewable energy industry (including prosumers **and flexible + prosumers (flexumers)**);

II. development of intelligent grid infrastructure (energy);

III. lowering the emissions of the energy sector by increasing the use of biodegradable raw materials and waste products.

Source: https://www.gov.pl/web/ncbr-en/new-technologies-in-the-field-of-energy

New technologies in the field of Energy:

European Commission

The strategic national and European goals in the program will be achieved through the implementation of research and development tasks with high innovative potential and a high level of technology advancement (TRL 8 - 9) in the following 6 technological areas:

T1. Solar energy;
T2. Onshore and offshore wind energy;
T3. Technologies for the production and use of hydrogen;
T4. **Energy storage and energy and heat microgrids;**
T5. Energy use of waste and heat from post-process gases;
T6. Energetic use of geothermal heat (geothermal).

Source: https://www.gov.pl/web/ncbr-en/new-technologies-in-the-field-of-energy

The national energy and climate plans (NECPs) were introduced by the Regulation on the governance of the energy union and climate action (EU)2018/1999, agreed as part of the Clean energy for all Europeans (adopted in 2019).

The national plans outline how the EU countries intend to address the 5 dimensions of the energy union:

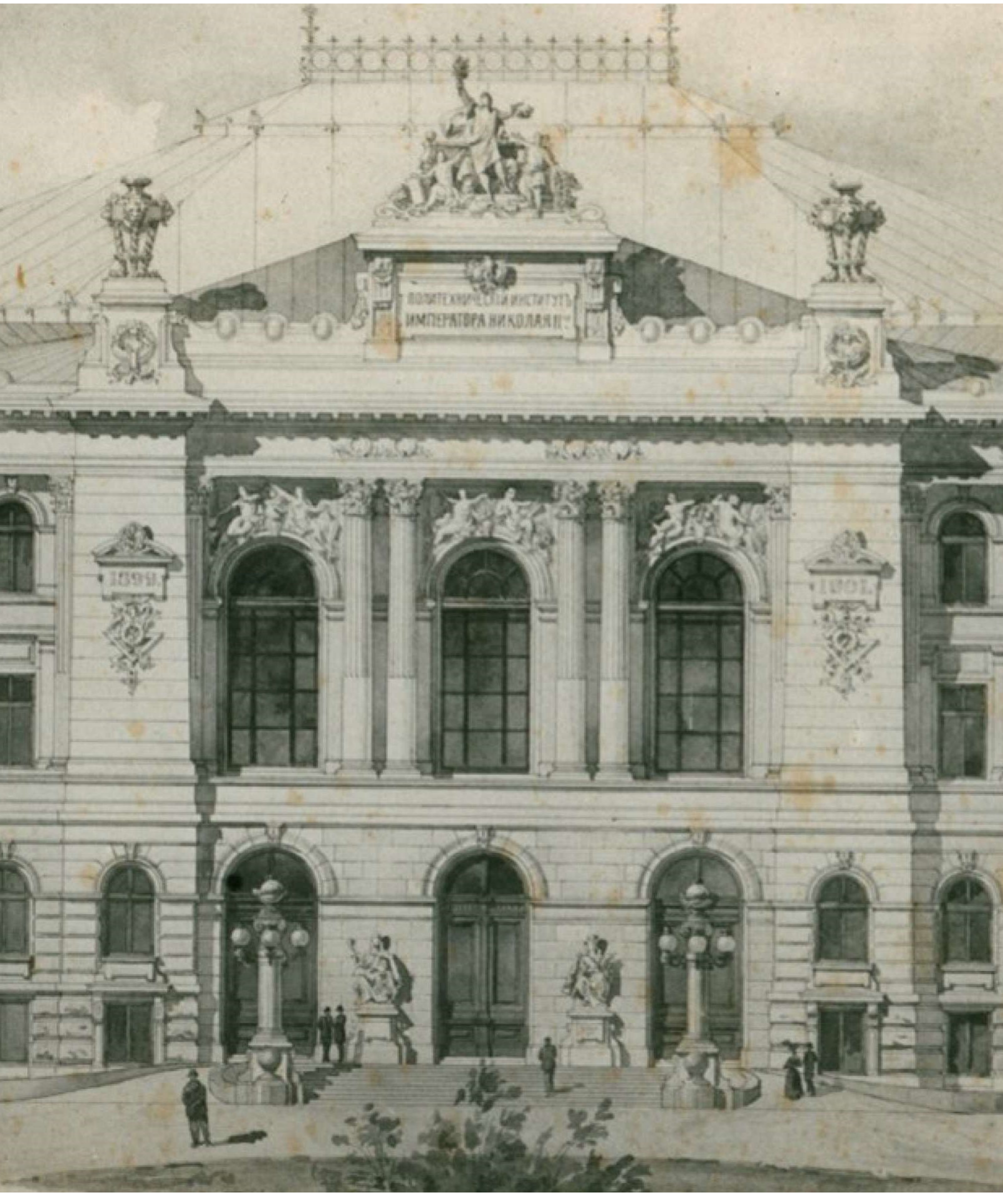
- ✓ decarbonisation
- ✓ **energy efficiency**
- ✓ **energy security**
- ✓ **internal energy market**
- ✓ **research, innovation and competitiveness**

Source: https://energy.ec.europa.eu/topics/energy-strategy_en

Warsaw University of Technology (WUT)

Marek Jasinski
Head of Industrial Electronics Division
17.09.2024

https://eng.pw.edu.pl/



WUT: Facts & Figures

- Establishment year: **1826**
- The Main Building was designed by famous Warsaw architects: Stefan Szyller and Bronisław Brochowicz-Rogóyski. The construction was completed in just two years, at the turn of the 20th century (**1899-1901**).
- Establishing the status as the University of Technology: **1915**

WUT: Facts & Figures*

* in 2021 according to the Polish university ranking, led by the Perspektywy Foundation

1

The best technical university in Poland

3

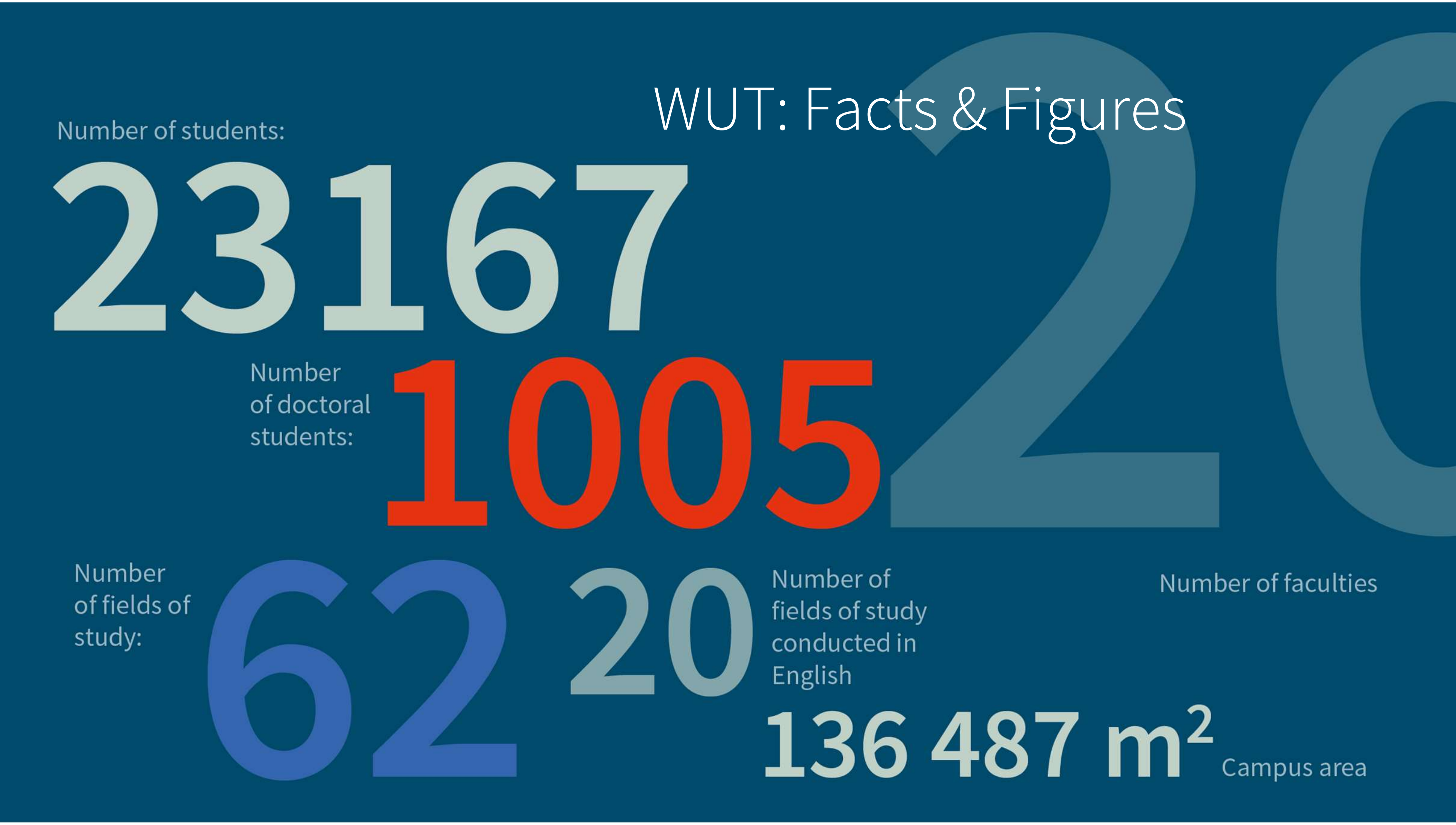
Third place among all universities in Poland

Warsaw University of Technology

ENHANCE

EXCELLENCE INITIATIVE RESEARCH UNIVERSITY

WUT: Facts & Figures



WUT: Facts & Figures

2017–2021
the evaluation period

1177 grants conducted

1.400.000.000 PLN

Total amount of funding

WUT: Facts & Figures

2017–2021

12982 articles published

including **1828** from the top decile of the best journals

692 monographs

108 coursebooks

WUT: Facts & Figures

168 partners

with whom letters of intent, agreements and contracts on international cooperation were signed

Strategic impact fields

- Scientific foundations: Nature and apparatus of its description
- Information and digital environment
- A healthy, balanced living environment
- Sustainable industry, materials and production processes

EXCELLENCE INITIATIVE
RESEARCH UNIVERSITY

ENHANCE

European Universities of Technology Alliance

https://enhanceuniversity.eu/

Technische Universität Berlin

Warsaw University of Technology

Universitat Politècnica de València

Politecnico Milano 1863

RWTH Aachen University

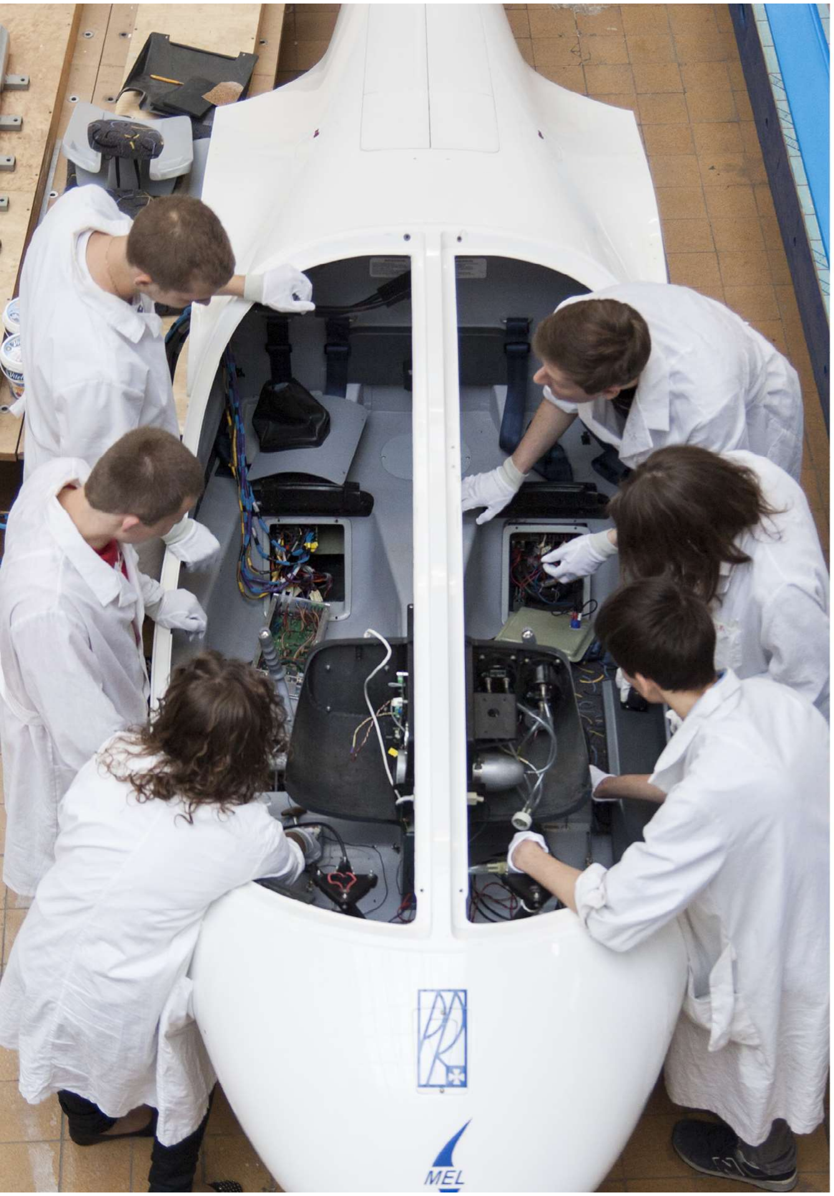
NTNU Norwegian University of Science and Technology

Chalmers

ETH Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Gdańsk University of Technology

TU Delft



Wisdom, Development, Passion & Commitment

WUT students often combine their studies with their interests, associating themselves in research clubs, student unions and various associations.

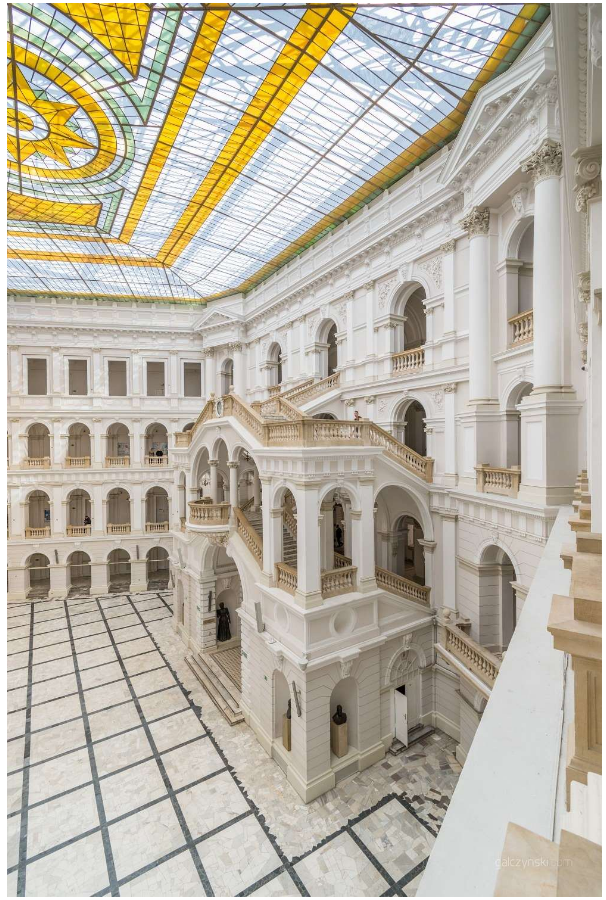
Over **150 student research clubs** operate at our University. Student satellites PW-Sat2 and PW-Sat3, rockets, robots, aerial vehicles, autonomous vehicles, electric bolides, mobile and web applications are just some of the projects implemented recently by our students.

WUT Large Aula in Main Building

Maria Sklodowska-Curie of the Nobel Prize Winner
in WUT's Main Building Large Aula

Home of Maria Sklodowska-Curie in Warsaw

https://www.mmsc.waw.pl/en/



Mieczysław Wolfke (29 May 1883 – 4 May 1947) was a Polish physicist, professor at the Warsaw University of Technology, the forerunner of holography and television.
He discovered the method of solidification of helium as well as two types of liquid helium.

European Physical Society
more than ideas

2022 is the Year of Mieczyslaw Wolfke in Poland

In Poland, 2022 has been announced as the year of Mieczyslaw Wolfke by Polish Physical Society.

In 1920 he published the first ever idea of two-step imaging which is today treated as a pioneering work in holography.

In 1927 together with Willem Keesom in Leiden (NL) he discovered a new form of liquid helium, which later was turned out to be superfluid.

Official website for the celebrations:

https://wolfke.fizyka.pw.edu.pl/en
Article about Wolfke for Photonic Letters of Poland: https://doi.org/10.4302/plp.v13i4.1107

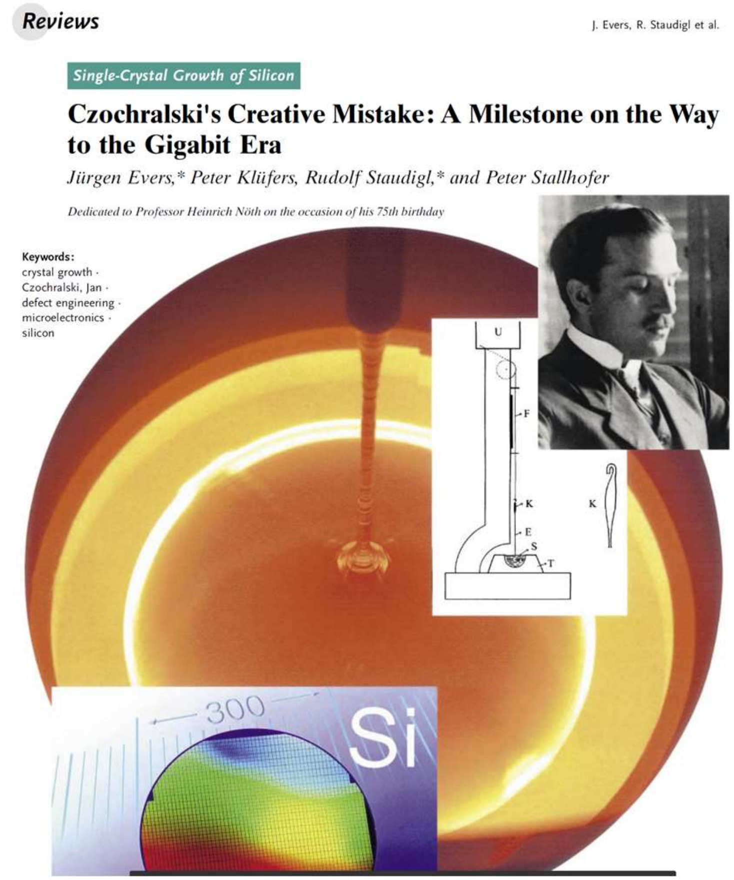
Source: https://www.eps.org/blogpost/751263/458577/2022-is-the-Year-of-Mieczyslaw-Wolfke-in-Poland

Jan Czochralski

Prof. Jan Czochralski zdj.przedwojenne
gabinet przy ul. Nabielaka w Warszawie

Crystals wafers
In NARLabs + TSRI

NARLabs 國家實驗研究院
台灣半導體研究中心
Taiwan Semiconductor Research Institute


Reviews J. Evers, R. Staudigl et al.

Single-Crystal Growth of Silicon

Czochralski's Creative Mistake: A Milestone on the Way to the Gigabit Era

Jürgen Evers, Peter Klüfers, Rudolf Staudigl,* and Peter Stallhofer*

Dedicated to Professor Heinrich Nöth on the occasion of his 75th birthday

Keywords: crystal growth · Czochralski, Jan · defect engineering · microelectronics · silicon

The IEEE Milestone is the highest-ranking honor and the most important IEEE award given to authors for discoveries and inventions of global significance to the development of humanity worldwide.
"Milestone" symbolizes epochal discoveries and has been awarded to such explorers as Edison, Marconi, Tesla, Bell and other outstanding inventors.

https://ethw.org/Milestones:Czochralski_Process,_1916 https://www.ieee.org/

WUT
#alwayscurious

Wydział Elektryczny
Politechnika Warszawska

Faculty of Electrical Engineering
Warsaw University of Technology

Securing the Future: Cybersecurity Strategies for Renewable Energy Systems and Their Impact on Power Market Stability

IEEE Power Talks
Prof. Marek Jasinski

17.09.2024

Faculty of Electrical Engineering

WARSAW UNIVERSITY OF TECHNOLOGY

Faculty of Electrical Engineering of WUT – Industry cooperation

PSE S.A.

pesa

Enea wytwarzanie

DACPOL

TRUMPF HÜTTINGER Electronic generating confidence

ABB

SIEMENS

RWE The energy to lead

ENERTEL

Danfoss

VESTAS Wind Systems A/S Vestas

SAG Elbud Gdańsk S.A.

Schneider Electric

globema

Lopi

Ørsted

TWERD ZAKŁAD ENERGOELEKTRONIKI

APATOR

WIBAR

APS energia

MAN

EKO ENERGETYKA SMART ENERGY SYSTEMS

INFUSION POLSKA

TRAMWAJE WARSZAWSKIE

Faculty of Electrical Engineering

Institute of Control and Industrial Electronics

1 IED - ZEP

Industrial Electronics Division (IED)
Zakład Elektroniki Przemysłowej (ZEP)

2 EDD - ZNE

Electrical Drive Division (EDD)
Zakład Napędu Elektrycznego (ZNE)

3 CD - ZS

Control Division (CD)
Zakład Sterowania (ZS)

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3 CD - ZS

Control Division (CD)
Zakład Sterowania (ZS)

Warsaw University of Technology + Faculty of Electrical Energy + Industrial Electronics Division

Warsaw University of Technology
Faculty of Electrical Engineering

Institute of Control and Industrial Electronics

Director – Andrzej Dzieliński, Prof. Dr.Sc. Ph.D.
Deputy Director for Science and Research – Jacek Rąbkowski, Dr.Sc. Ph.D. Prof. of University
Deputy Director for Education - Piotr Fabijanski, Ph.D.

Control Division
Head – Marcin Iwanowski
Dr.Sc. Ph.D. Prof. of University.

Industrial Electronics Division
Head – Marek Jasinski
Dr.Sc. Ph.D. Prof. of University

Electrical Drive Division
Head – Bartlomiej Ufnalski
Dr.Sc. Ph.D. Prof. of University

Industry Projects

Focused on cooperation with the industry and implementation

Research and Development Projects

Focused on new ideas and future possible applications in the industry

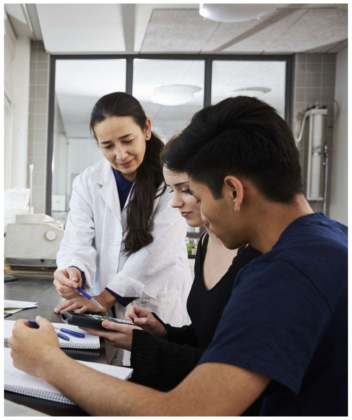
Educational Projects

Focused on academia needs, academic staff and students excellence

Selected Research Projects and Challenges in the –

Securing the Future:

Cybersecurity Strategies for Renewable Energy Systems and Their Impact on Power Market Stability



P W IS EP

Outline

Role of the:

1) Telecommunication and information processing
2) Energy conversion (przekształcanie) and processing (przetwarzanie)
3) Smart grids and energy storage's
4) Safety, reliability and resilience
5) Society and sustainability
6) Impact on power market stability
7) Summary and conclusions

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https://www.un.org/en/observances/telecommunication-day

PTI
POLSKIE TOWARZYSTWO INFORMATYCZNE

The Polish Information Processing Society, PIPS (Polskie Towarzystwo Informatyczne, PTI)

https://pti.org.pl/eng/

P W IS EP

ŚWIATOWY DZIEŃ SPOŁECZEŃSTWA INFORMACYJNEGO

SDSI

„Green Energy” - more possibilities or threats?

Information and Energy Technologies (IT+ET) =
Smart Power Electronics Converter (SPEC)

Marek Jasinski
Warsaw University of Technology
Faculty of Electrical Engineering

PTI
POLSKIE TOWARZYSTWO INFORMATYCZNE

SEP

www.sdsi.pl

PW ISEP

1) Telecommunication and information processing

Information Technology in Power Electronics or rather Power Electronics in X Technologies?

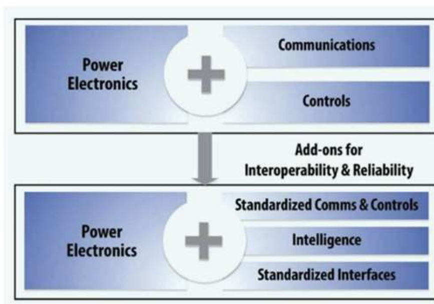
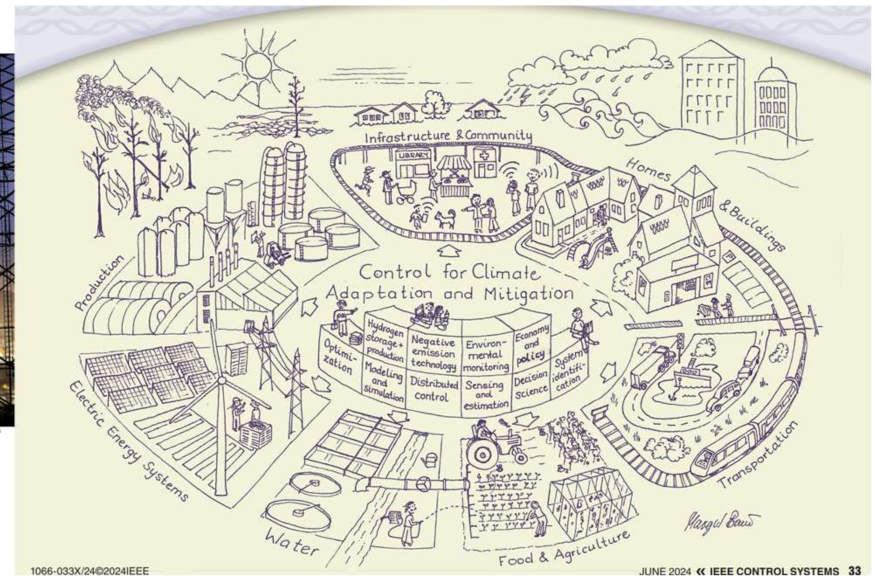


FIG 1 Needed evolution in PE systems architecture. Source: Radha Krishna Moorthy, ORNL/US DOE.



Development of Power Electronics Systems in Industrial and Automotive Environments

by Darko Vračar

D. Vračar, "Development of Power Electronics Systems in Industrial and Automotive Environments," in IEEE Power Electronics Magazine, vol. 11, no. 2, pp. 46-51, June 2024, doi: 10.1109/MPEL.2024.3397153.

keywords: {Renewable energy sources;Low voltage;Tutorials;Power electronics;Hardware;Product development;Complexity theory},

Building the Electric Power Grid One Unit at a Time

by Radha Sree Krishna Moorthy and Madhu Chinthavali

R. S. K. Moorthy and M. Chinthavali, "Building the Electric Power Grid One Unit at a Time," in IEEE Power Electronics Magazine, vol. 11, no. 2, pp. 26-33, June 2024, doi: 10.1109/MPEL.2024.3393188.

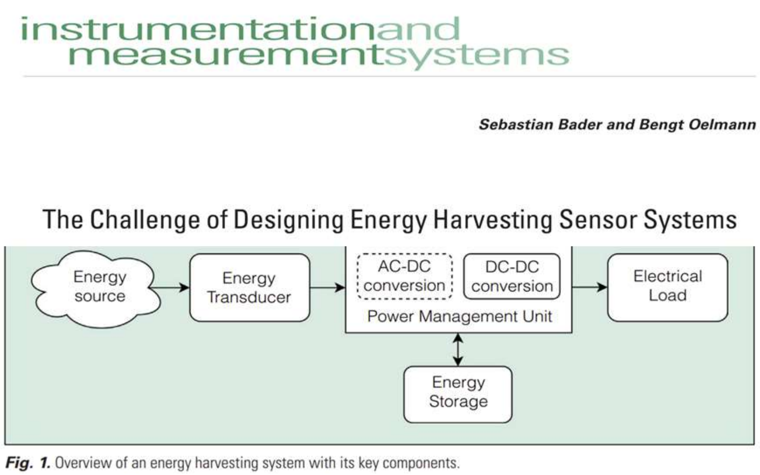
keywords: {Procurement;Power conditioning;Wind;Technological innovation;Renewable energy sources;Architecture;Standardization},

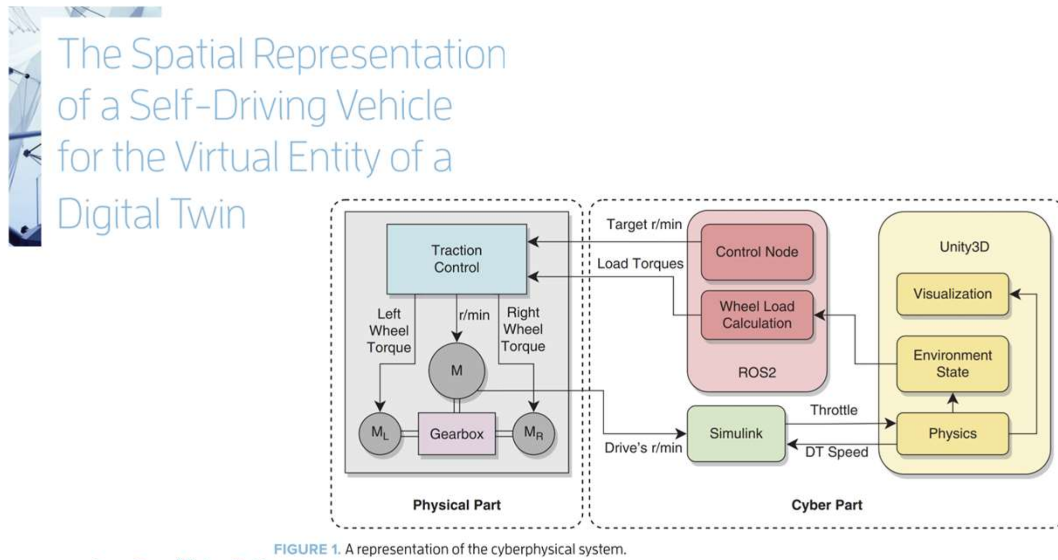
P. P. Khargonekar et al., "Climate Change Mitigation, Adaptation, and Resilience: Challenges and Opportunities for the Control Systems Community," in IEEE Control Systems Magazine, vol. 44, no. 3, pp. 33-51, June 2024, doi: 10.1109/MCS.2024.3382377.

keywords: {Climate change;Carbon emissions;Human factors;Greenhouse gases;Government policies;Control systems;Meteorology;Renewable energy sources;Optimization methods;Control systems;Resilience;Sustainable development;Market opportunities;US Department of Energy;Wind power generation},

1) Telecommunication and information processing

Information Technology in Power Electronics or rather Power Electronics in X Technologies?





S. Bader and B. Oelmann, "Instrumentation and Measurement Systems: The Challenge of Designing Energy Harvesting Sensor Systems," in IEEE Instrumentation & Measurement Magazine, vol. 27, no. 4, pp. 22-28, June 2024, doi: 10.1109/MIM.2024.10540407.

keywords: {Condition monitoring;Power supplies;Area measurement;Sensor systems;Real-time systems;Environmental monitoring;Business;Low-power electronics;Energy consumption;Industrial power systems;Energy harvesting},

A. Rassõlkin, P. Maksimkins, A. Stupans, V. Rjabtsikov, A. Senfelds and V. Kuts, "The Spatial Representation of a Self-Driving Vehicle for the Virtual Entity of a Digital Twin," in Computer, vol. 57, no. 5, pp. 58-66, May 2024, doi: 10.1109/MC.2023.3319108.

keywords: {Propulsion;Digital twins;Standards;Electric vehicles;PD control;Adaptive control;Error analysis;Spatial resolution;Autonomous automobiles},

Digital Twins IT+ET = Safety and Resilience?

Digital Twins for Modern Power Systems

[Source: Digital Twins for Power Systems | Hardware-in-the-Loop | OPAL-RT]

Source: D. Vinnikov, "Students & Young Professionals of the IEEE Industrial Electronics Society (IES) at the 24th IEEE International Conference on Industrial Technology 2023: It Is Also a Strategic Priority of IES for the Next Decade! [Students and Young Professionals News]," in IEEE Industrial Electronics Magazine, vol. 17, no. 3, pp. 103-104, Sept. 2023, doi: 10.1109/MIE.2023.3297351.

Students & Young Professionals of the IEEE Industrial Electronics Society (IES) at the 24th IEEE International Conference on Industrial Technology 2023: It Is Also a Strategic Priority of IES for the Next Decade!

First, I would like to stress my thanks to Harindra Sandun Mavikumbure, Victor Cobilean, Hani Vahedi, Marek Turzyński, Milos Manic, and Marek Jasinski, who were involved in the process of the Students & Young Professionals (S&YP) seminar preparation.

S&YP represents society's future leaders and innovators. The IEEE Industrial Electronics Society (IES) S&YP Activity Committee (IES S&YP-AC) actively supports them by providing necessary guidance, mentorship, and resources. Moreover, the IES S&YP-AC hosts a variety of events aimed at helping students and young professional members stay connected in the IES community. Included in these events are the Student Forums, regularly organized during the

Digital Object Identifier 10.1109/MIE.2023.3297351
Date of current version: 20 September 2023

FIGURE 1 – Warm greetings from Dr. Marek Jasinski, IES SYPA chair; Dr. Antonio Luque, VP of membership; and Dr. Mariusz Malinowski, IES president.

Digital Twins IT+ET = Safety and Resilience?

By Pablo Arboleya and Alberto Méndez

Real-Time Grid Digital Twins

The backbone of the next generation of network technology for distribution system operators.

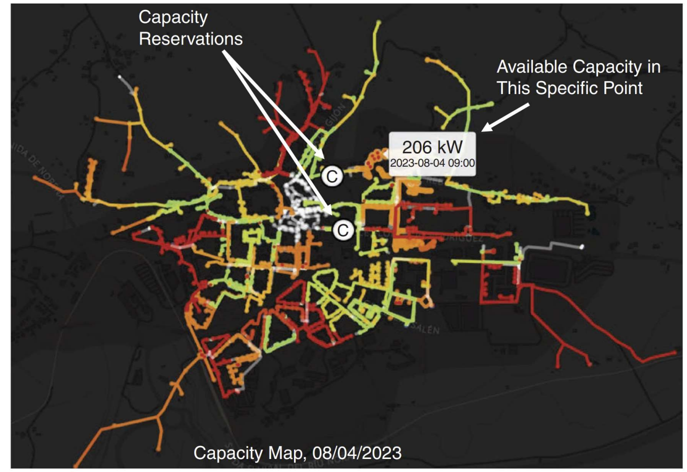


Figure 3. Example of the use of the digital twin for the analysis and management of available network capacity.

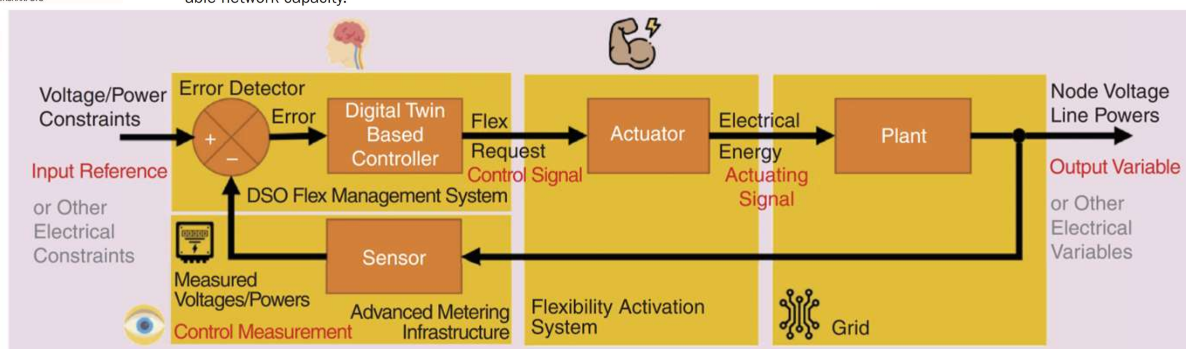


Figure 4. General scheme of a flexibility management system based on the use of digital twins for the operation of the distribution network.

P. Arboleya and A. Méndez, "Real-Time Grid Digital Twins: The backbone of the next generation of network technology for distribution system operators," in IEEE Electrification Magazine, vol. 12, no. 3, pp. 39-49, Sept. 2024, doi: 10.1109/MELE.2024.3423110.

keywords: {Urban areas;Electrification;Real-time systems;Digital twins;Solar panels;Vehicle dynamics;Solar heating},

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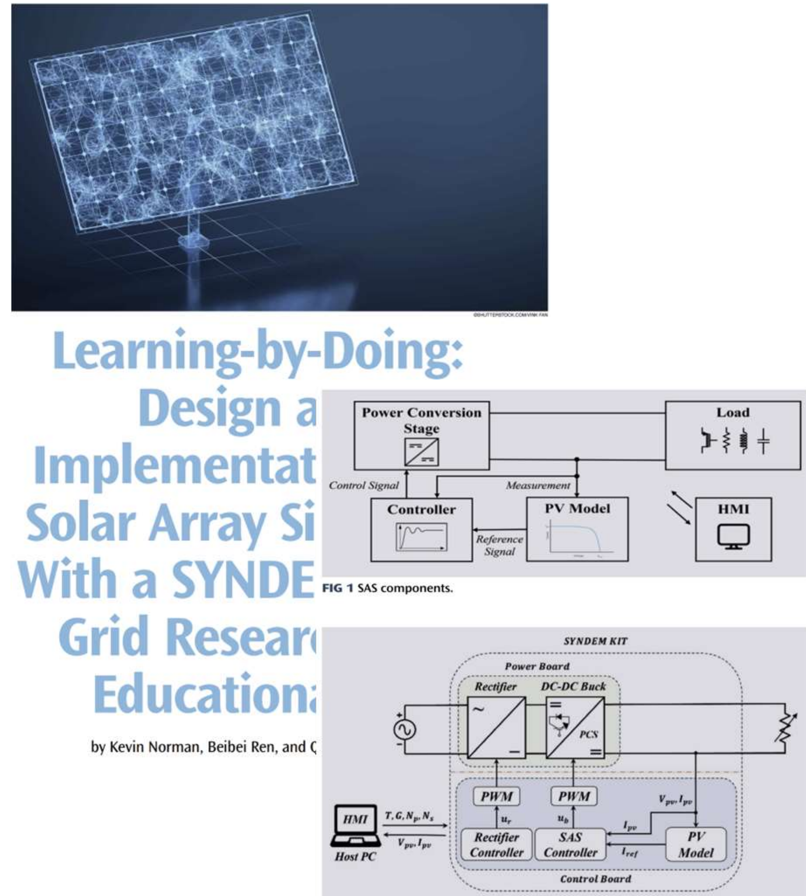


K. Norman, B. Ren and Q. -C. Zhong, "Learning-by-Doing: Design and Implementation of a Solar Array Simulator With a SYNDEM Smart Grid Research and Educational Kit," in IEEE Power Electronics Magazine, vol. 11, no. 1, pp. 47-54, March 2024, doi: 10.1109/MPEL.2024.3352209.

keywords: {Solar power generation;Power system control;Wind power generation;Centralized control;Power electronics;Distributed power generation;Education;Renewable energy sources;Power system dynamics;Vehicle dynamics;Smart grids;Electricity supply industry},

❖Is the AC/DC war ending now?

❖Czy zaczyna się era symbiozy AC+DC?

HPBCEV- High efficiency and high-power density bidirectional DC-DC converters

PW ISEP

TWERD®

- Project financed by the National Research and Development Center under the program 7th competition as part of the Polish-Taiwanese Research Cooperation (2019 - 2024).

NSTC 國家科學及技術委員會 National Science and Technology Council

Warsaw University of Technology

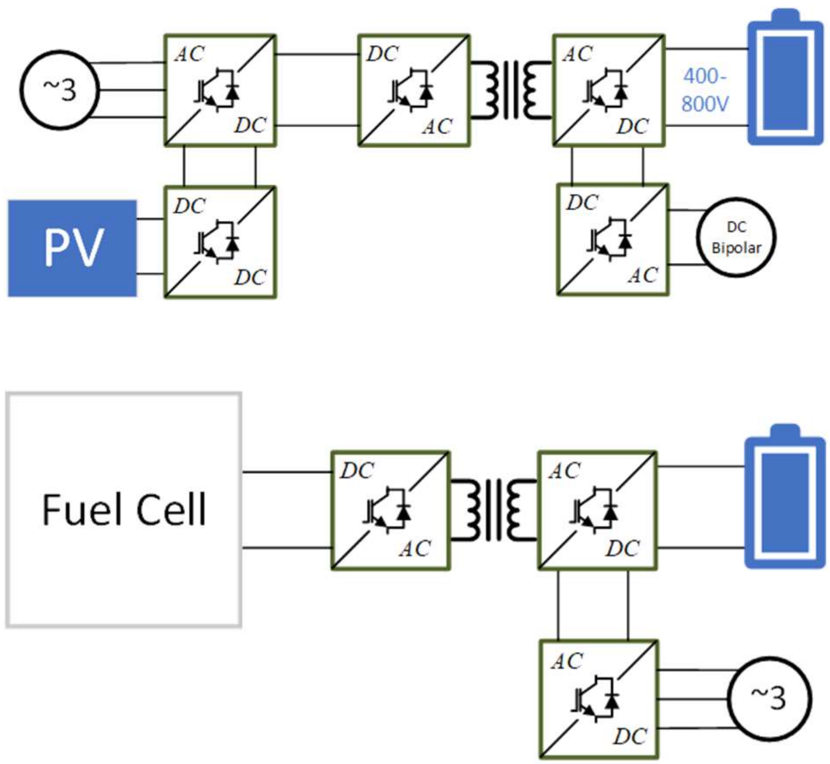
MOST 科技部 Ministry of Science and Technology

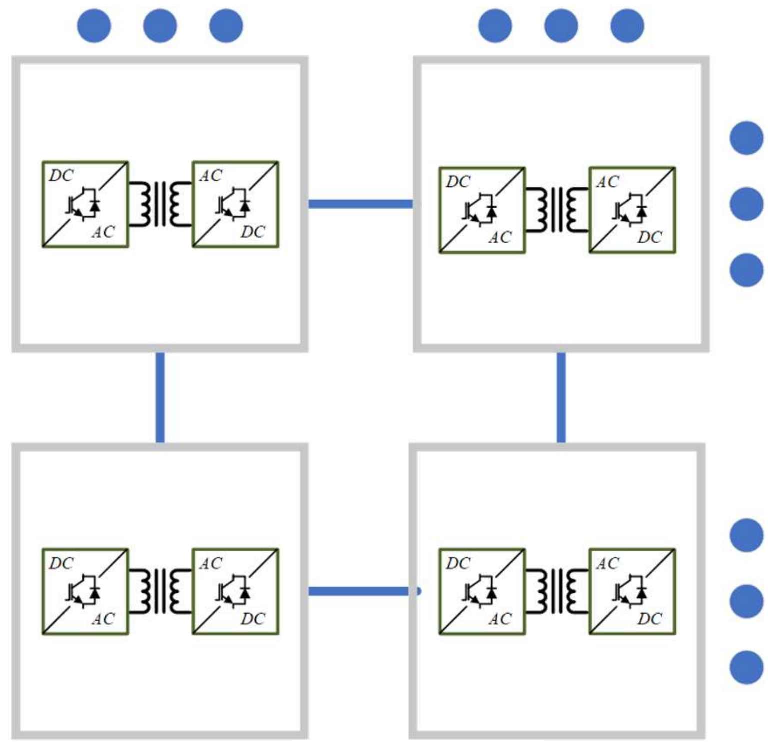
NCBR National Centre for Research and Development

TAIWAN TECH NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Source: https://www.isep.pw.edu.pl

Is communication between converters important?

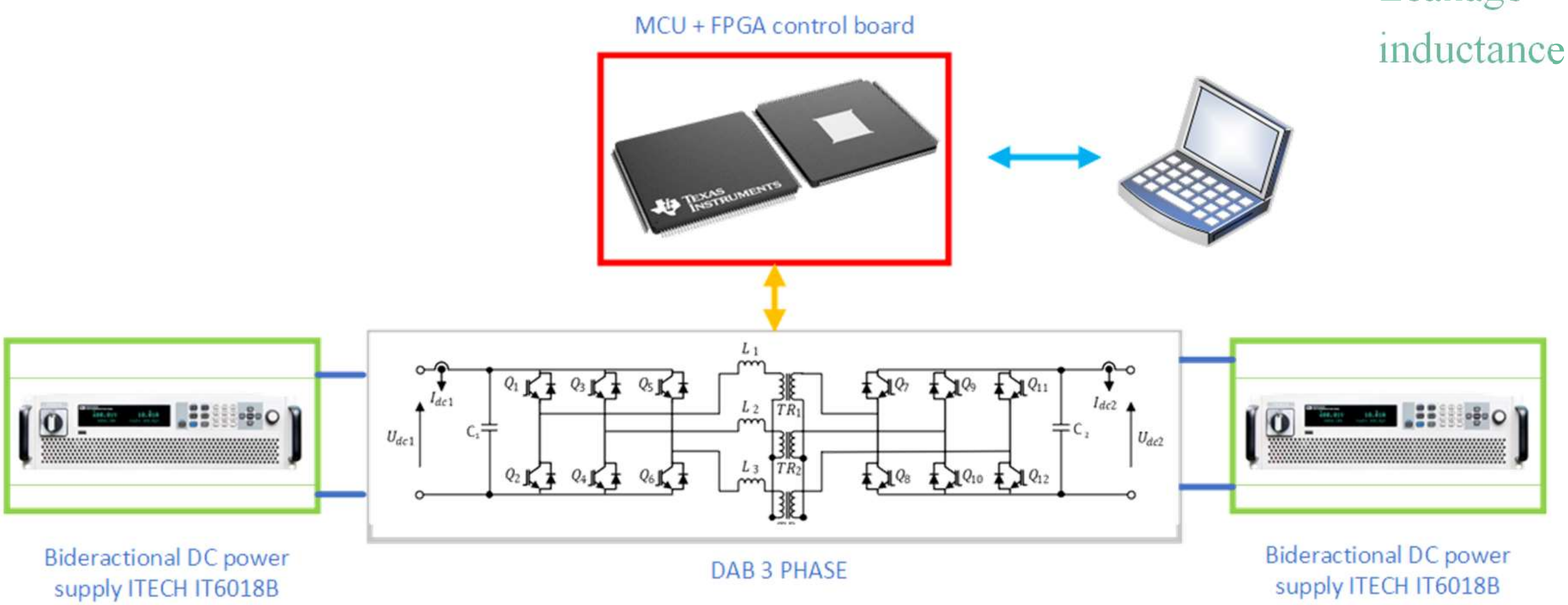




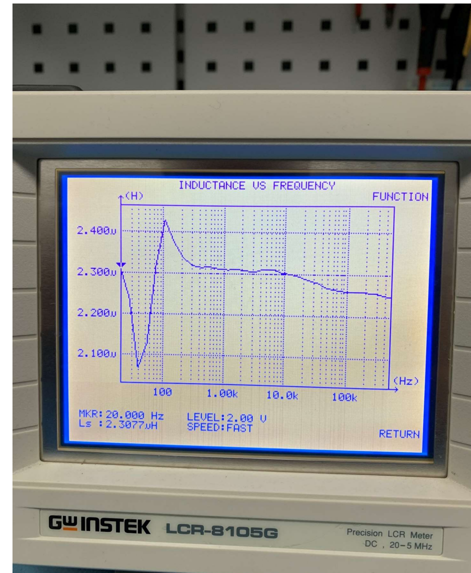
Warsaw University of Technology
MOST 科技部 Ministry of Science and Technology
NCBR National Centre for Research and Development
TAIWAN TECH NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

[Source:

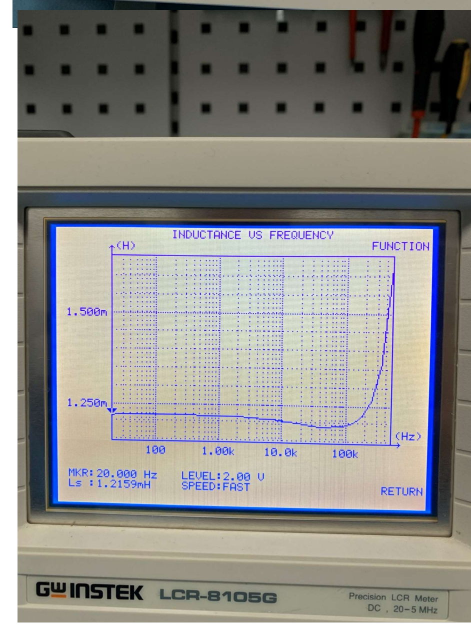
Is the role of Information Technology (IT) in Energy Technology (ET) important?



Leakage inductance



Main inductance + 100 pF capacitance



PW ISEP

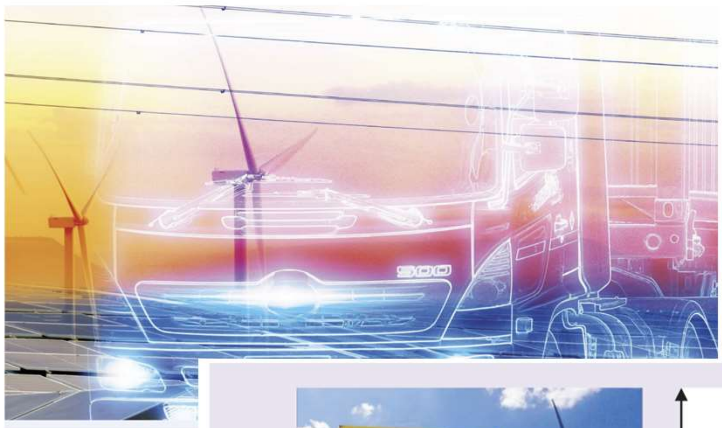
Warsaw University of Technology

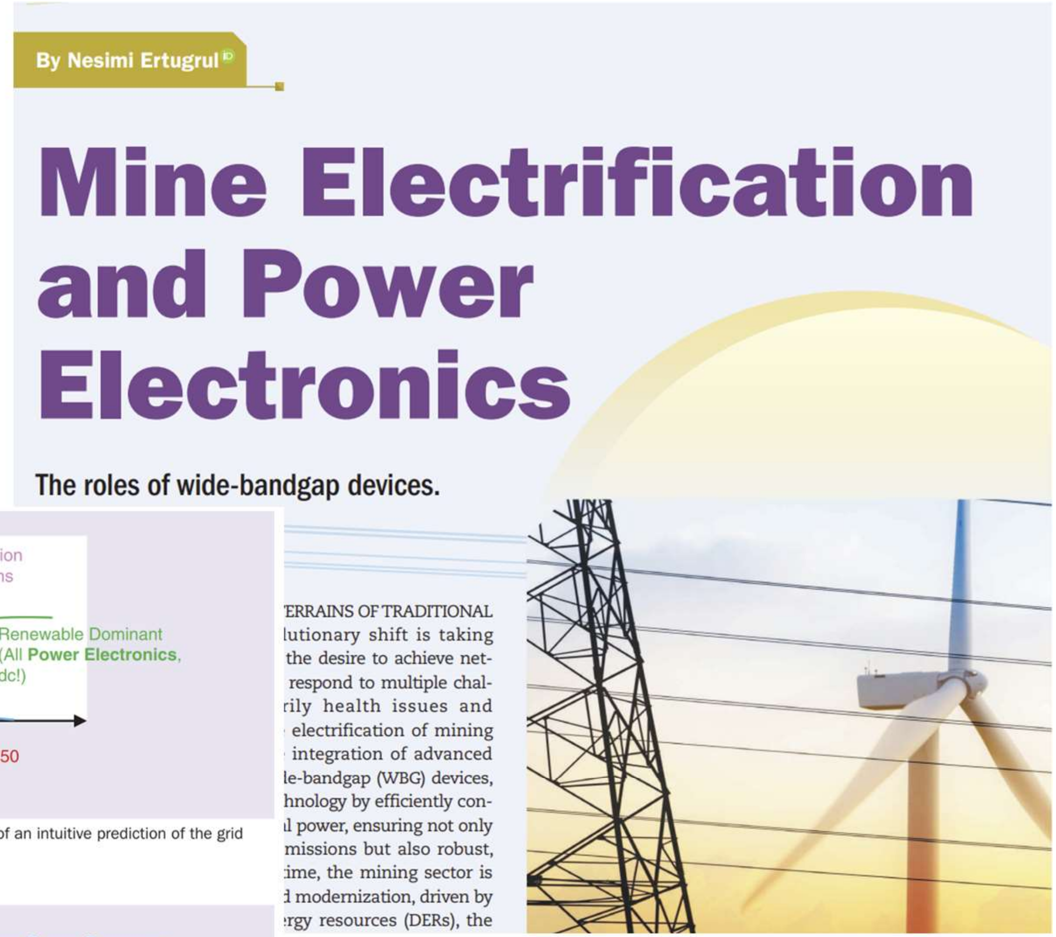
MOST 科技部 Ministry of Science and Technology

NCBR National Centre for Research and Development

TAIWAN TECH NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Are Modern Semiconductors important? Wide-bandgap semiconductors (WBG)




By Nesimi Ertugrul

Mine Electrification and Power Electronics

The roles of wide-bandgap devices.

ERRAINS OF TRADITIONAL
lutionary shift is taking
the desire to achieve net-
respond to multiple chal-
rily health issues and
electrification of mining
integration of advanced
le-bandgap (WBG) devices,
hnology by efficiently con-
l power, ensuring not only
missions but also robust,
ime, the mining sector is
d modernization, driven by
rgy resources (DERs), the

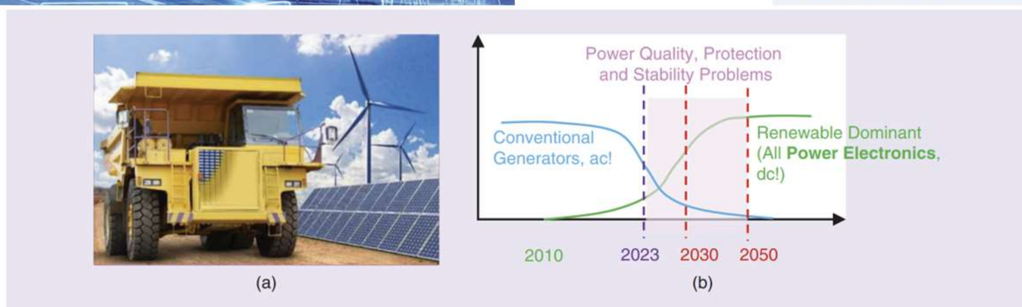


Figure 1. (a) Mining sites lead grid transformation with DERs and electrified trucks. (b) A rough time line of an intuitive prediction of the grid transformation from ac to dc grid.

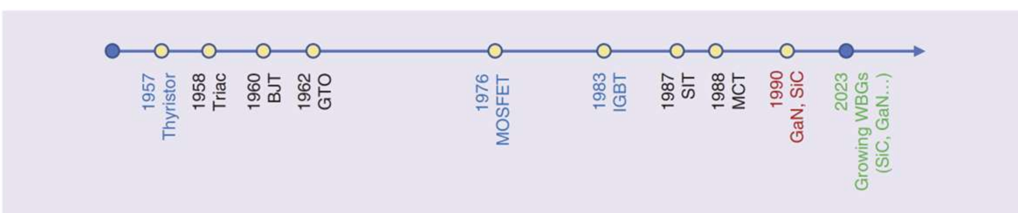


Figure 2. The historical time line in PE switches. BJT: bipolar junction transistor; IGBT: insulated gate bipolar transistor; MCT: MOS-controlled thyristor; SIT: static induction transistor; GTO: gate turn-off thyristor.

N. Ertugrul, "Mine Electrification and Power Electronics: The roles of wide-bandgap devices," in IEEE Electrification Magazine, vol. 12, no. 1, pp. 6-15, March 2024, doi: 10.1109/MELE.2023.3348254.

keywords: {Renewable energy sources;Microgrids;Power electronics;Power system reliability;Waste heat;Machinery;Resilience;Mining industry;Net zero;Wide band gap semiconductors;Power system reliability;Occupational safety;Electrification},

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5) Society and sustainability
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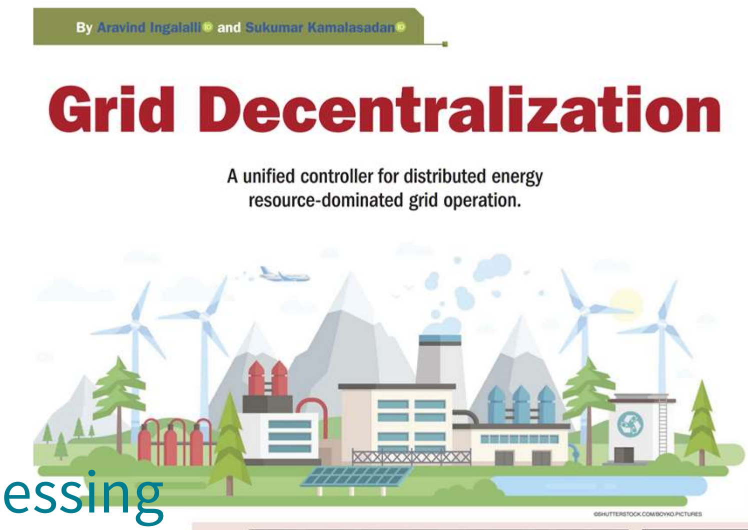


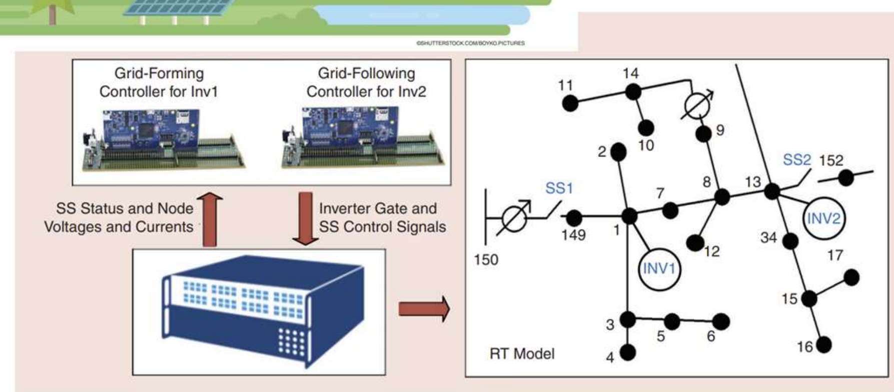


Figure 7. A typical controller hardware in the loop set up to validate the unified controller operating modes utilizing a section of the IEEE 123 node system and TI Delfino inverter control cards. Inv: inverter.

A. Ingalalli and S. Kamalasadan, "Grid Decentralization: A unified controller for distributed energy resource-dominated grid operation," in IEEE Electrification Magazine, vol. 12, no. 2, pp. 71-79, June 2024, doi: 10.1109/MELE.2024.3386037.

keywords: {Low-carbon economy;Costs;Climate change;Wind energy generation;Sustainable development;Stakeholders;Resilience;Power systems;Photovoltaic systems;Power grids;Distributed power generation;Renewable energy sources;Power distribution networks},

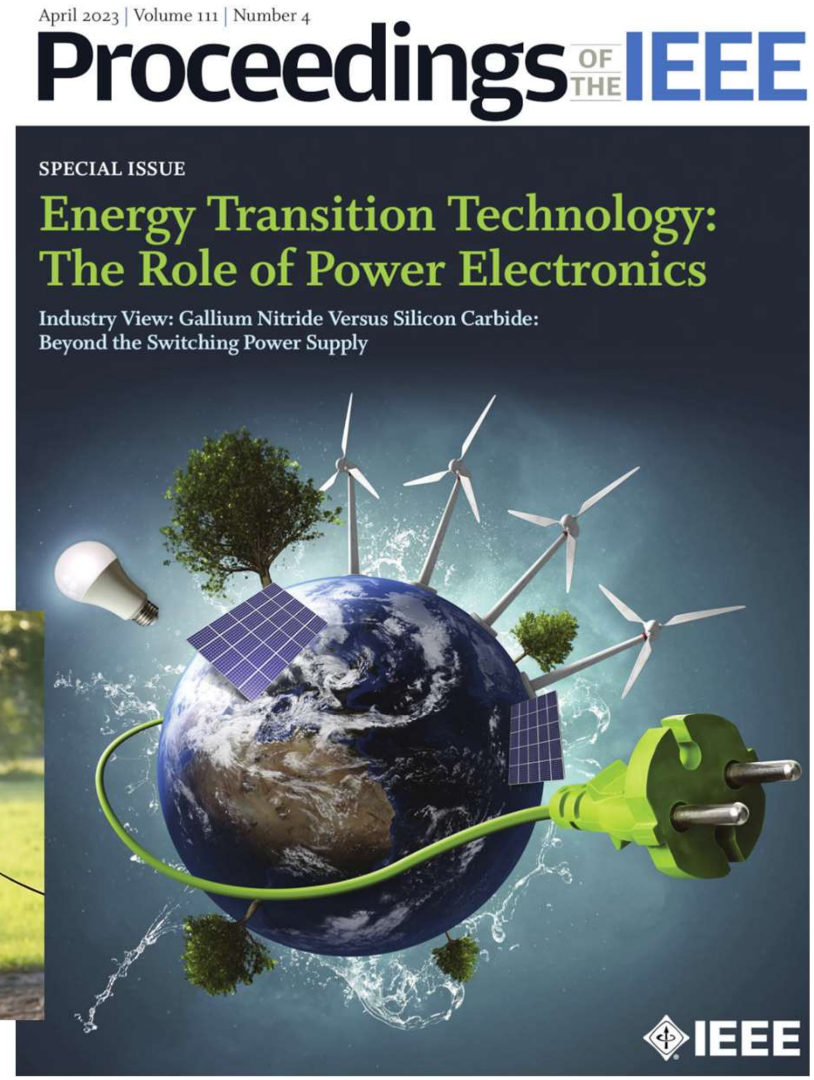
Are Modern Semiconductors important?
Wide-bandgap semiconductors (WBG):
Gallium Nitride (GaN)
and
Silicon Carbide (SiC)

the **horses** of the **sustainable** Power Electronics

09-13 August 2024
Polish Arabian Horse Days

Silicon Carbide (SiC)

Gallium Nitride (GaN)



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https://www.polisharabianhorsedays.com/

https://pubstore.ieee.org/proceedings-of-the-ieee-april-2023-vol-111-no-4.html

Are Modern Semiconductors important?
Wide-bandgap semiconductors (WBG):
Gallium Nitride (GaN)
and
Silicon Carbide (SiC)

the **horses** of the **sustainable** Power Electronics

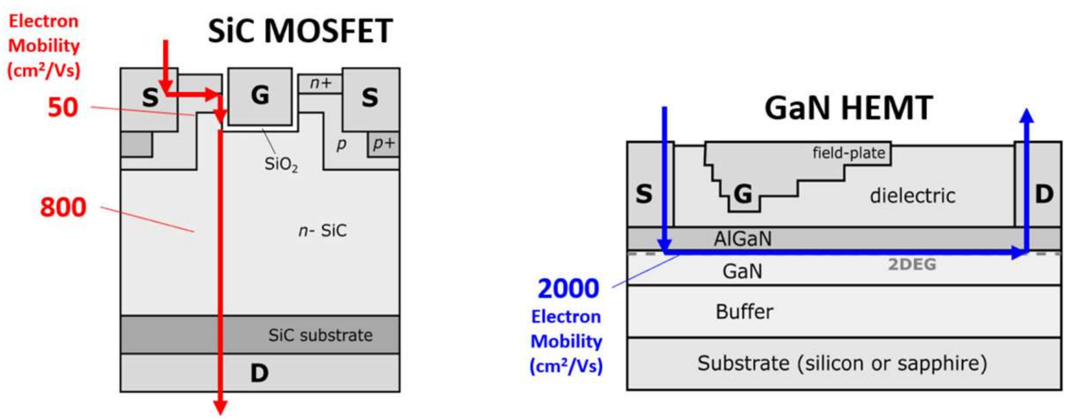
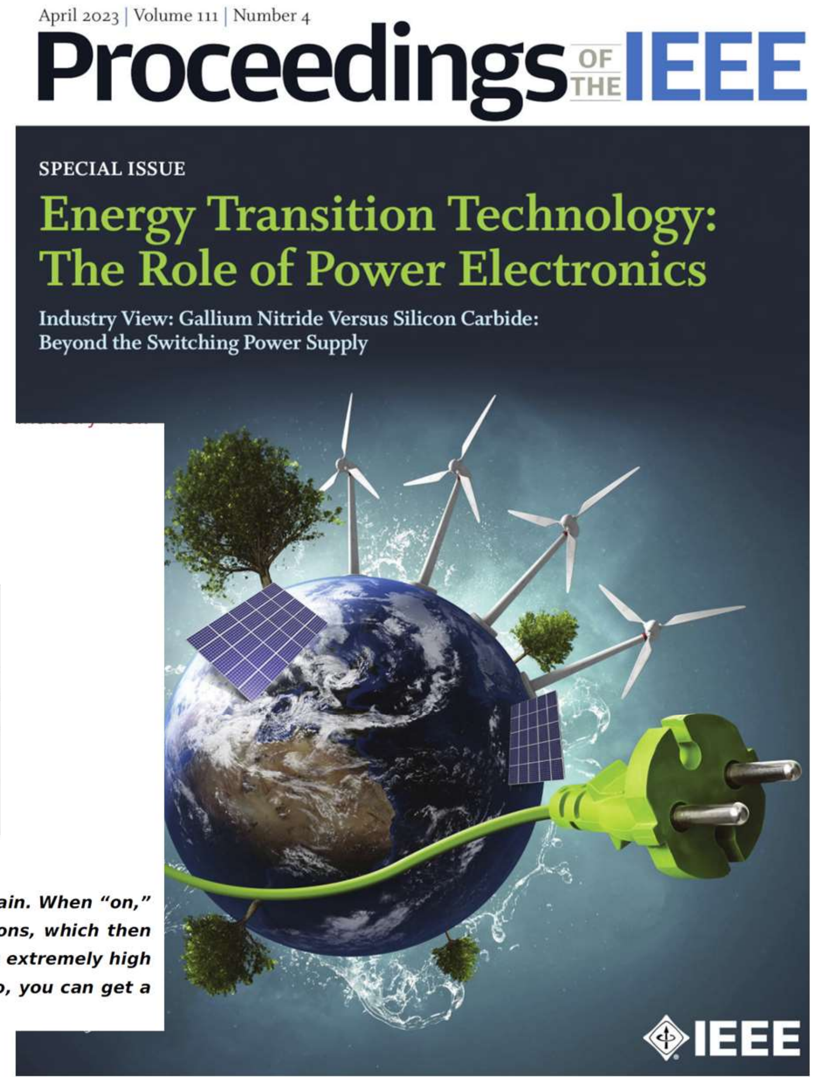


Fig. 3. ***SiC MOSFET operates in essentially the same way as an ordinary silicon MOSFET. There is a source, a gate, and a drain. When "on," electrons flow from a heavily doped n-type source through a gate where the electron charge modulates the flow of electrons, which then drift through a lightly doped bulk region before being "drained" through a conductive substrate. GaN's main advantage is its extremely high electron mobility. Electric current, a flow of charges, equals the concentration of the charges multiplied by their velocity. So, you can get a high current because of high concentration or high velocity or some combination of the two.***



Silicon Carbide (SiC)

Gallium Nitride (GaN)

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Modern semiconductors
the **horses** of the **sustainable grow**

Energy Transition Technology: The Role of Power Electronics

By JOSE RODRIGUEZ, *Life Fellow IEEE*
Guest Editor
FREDE BLAABJERG, *Fellow IEEE*
Guest Editor
MARIAN P. KAZMIERKOWSKI, *Life Fellow IEEE*
Guest Editor

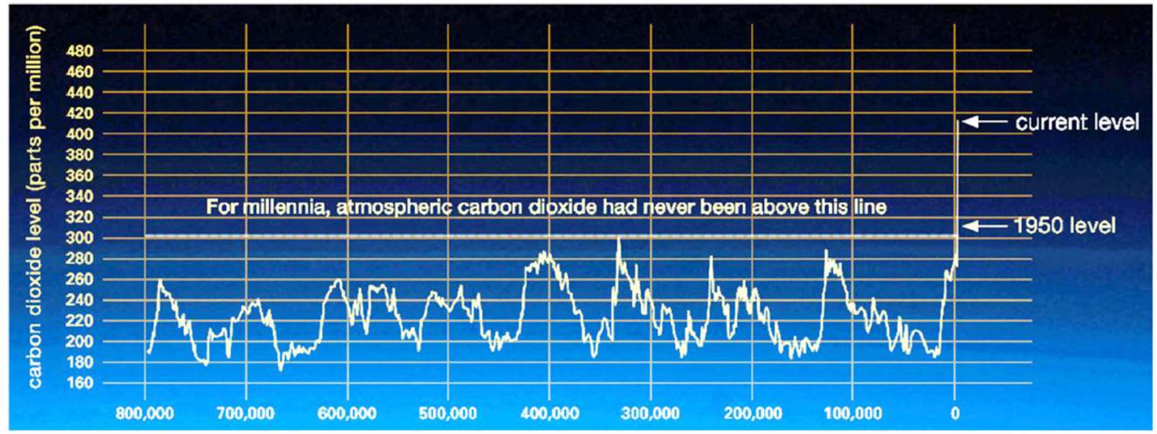
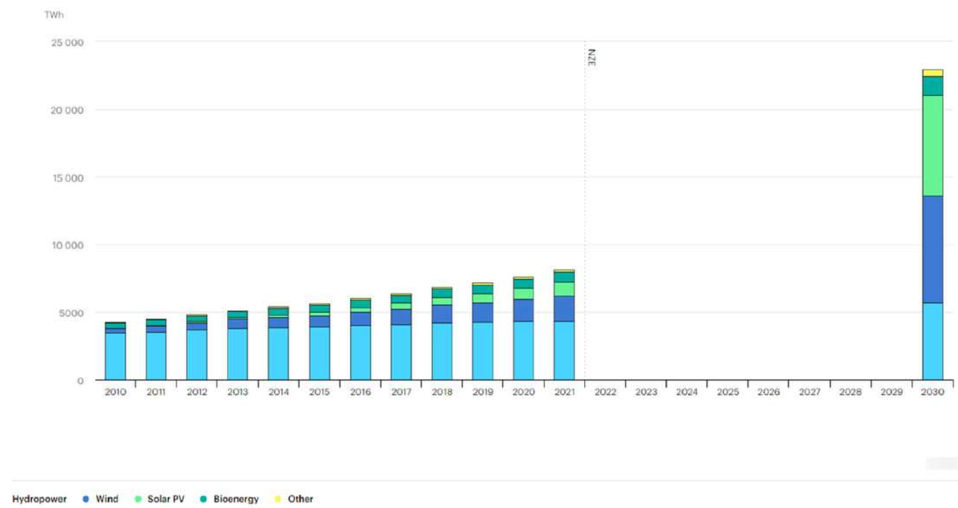


Fig. 1. *NASA estimate and measurements of CO_2 level (NASA: https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/).*



2. *Renewable power generation by technology in the Net Zero Scenario, 2010–2030 (IEA: https://www.iea.org/reports/ wable-electricity).*

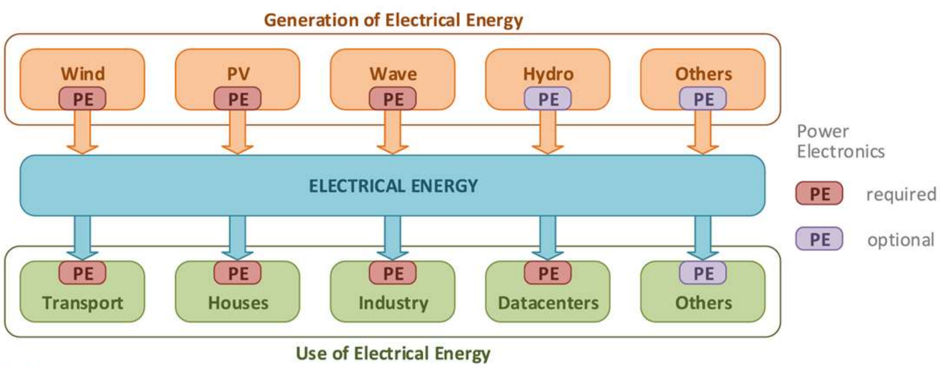


Fig. 3. *Role of electrical energy in the future electrification of society.*

Development of product innovation: configurable and controllable stationary energy storage units consisting of scalable energy and converter modules with extensive functional properties of the system, i.e.:

- ✓ **energy storage,**
- ✓ **energy conditioning,**
- ✓ **power compensator,**
- ✓ **active filter,**
- ✓ **cyber-physical system protection**

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5) Society and sustainability
6) Impact on power market stability
7) Summary and conclusions

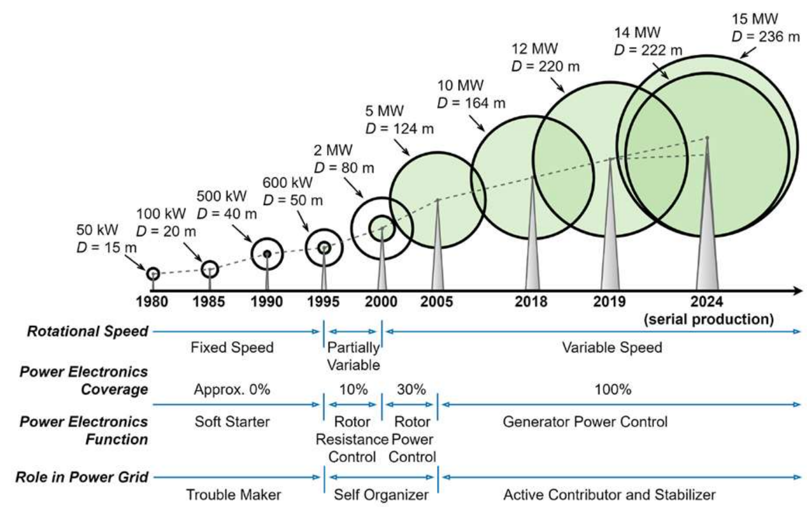

Fig. 9. *Development of WT technologies, where "green area" indicates that the use of power electronics has been increasing significantly to process a large amount of power from WT systems. Here, D represents the diameter of the WT rotor; MW stands for megawatts.*

Blaabjerg et al.: Power Electronics Technology for Large-Scale REN Generation

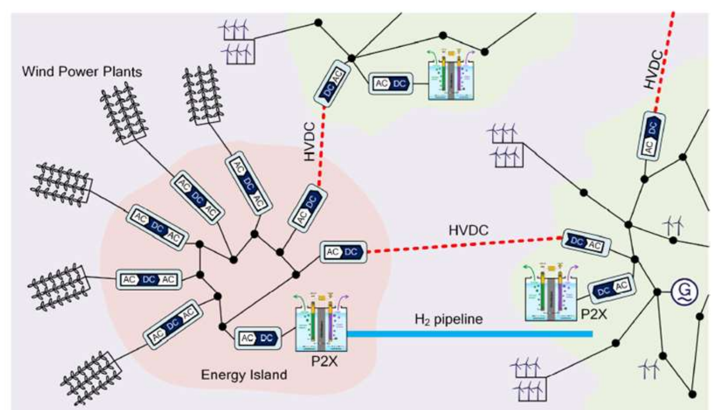

Fig. 25. *Energy island with large-scale offshore wind farms, a P2X station on the island, and also power/energy connection to shore, which can be done both electrically and by a gas pipeline (here, HVdc and hydrogen H2 pipeline). The P2X can also be located on shore. The ac/dc/ac power conversion is shown on the island for the WT connection, but, in practice, it will be in each WT, and here, G represents a synchronous generator.*

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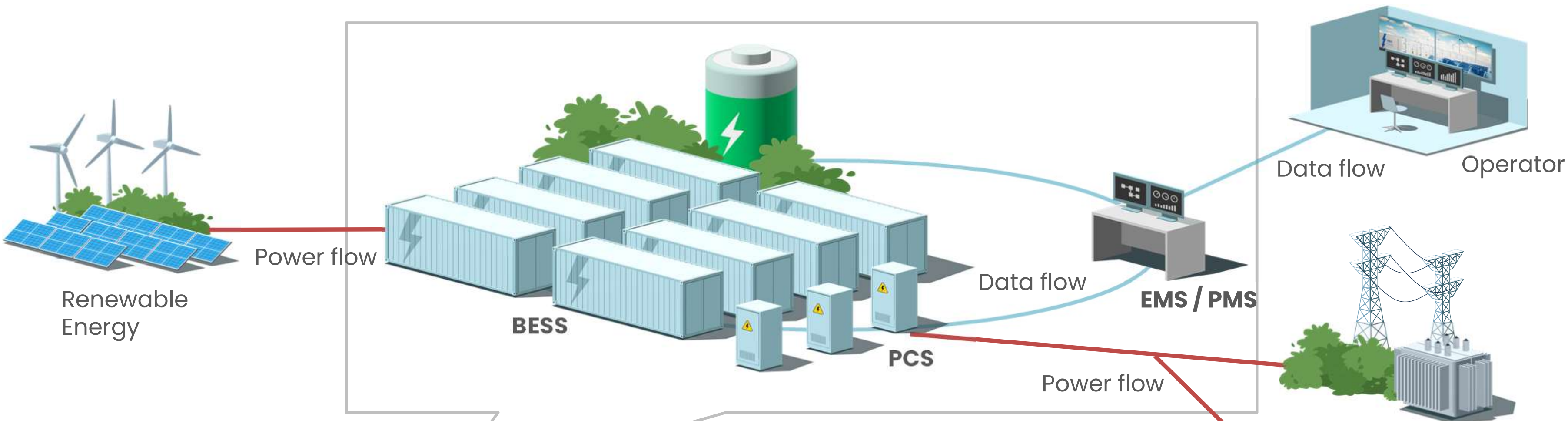
P W IS EP



Battery Energy Storage System

Battery Management System

Energy Management System

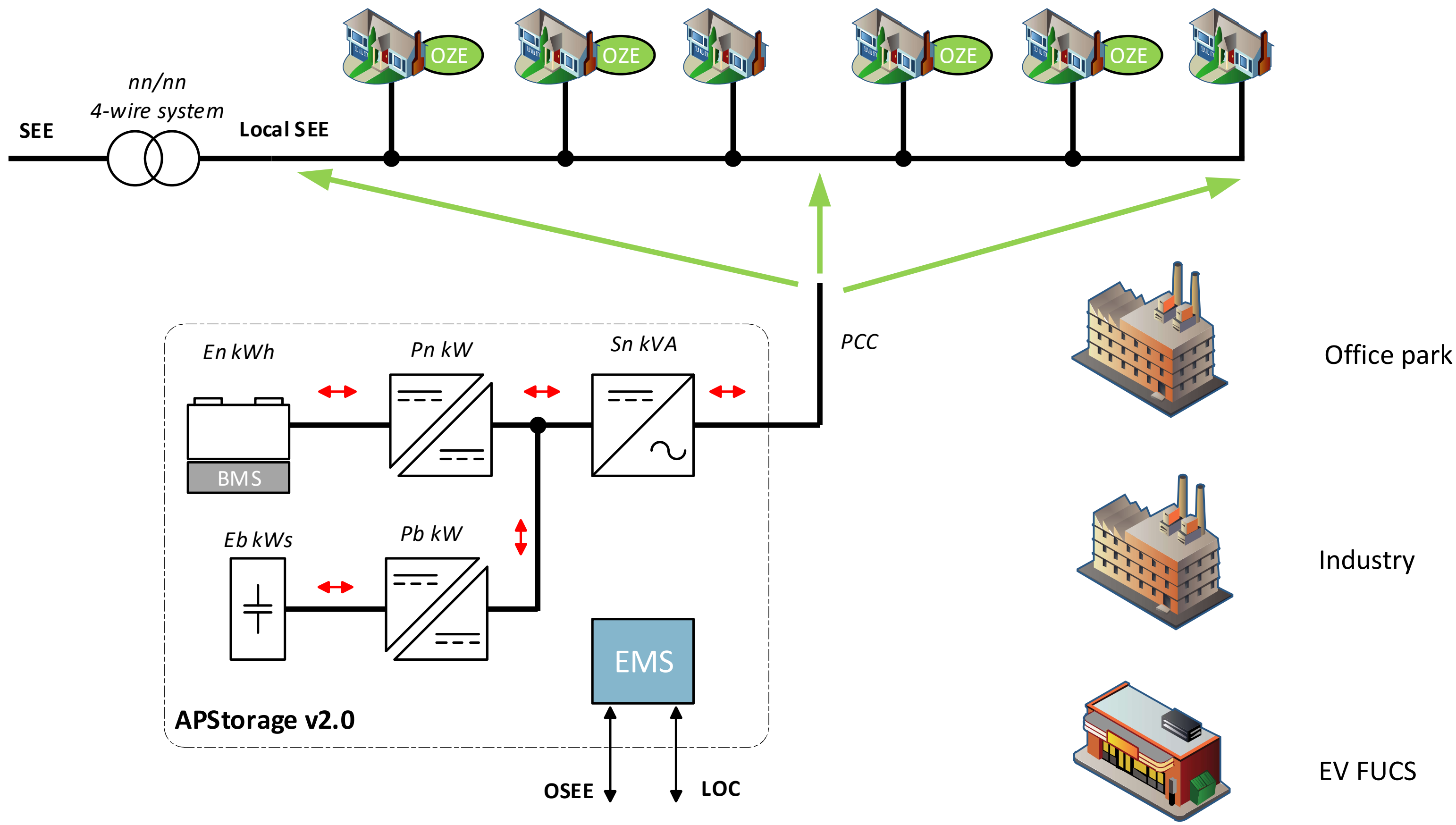
Power Management System

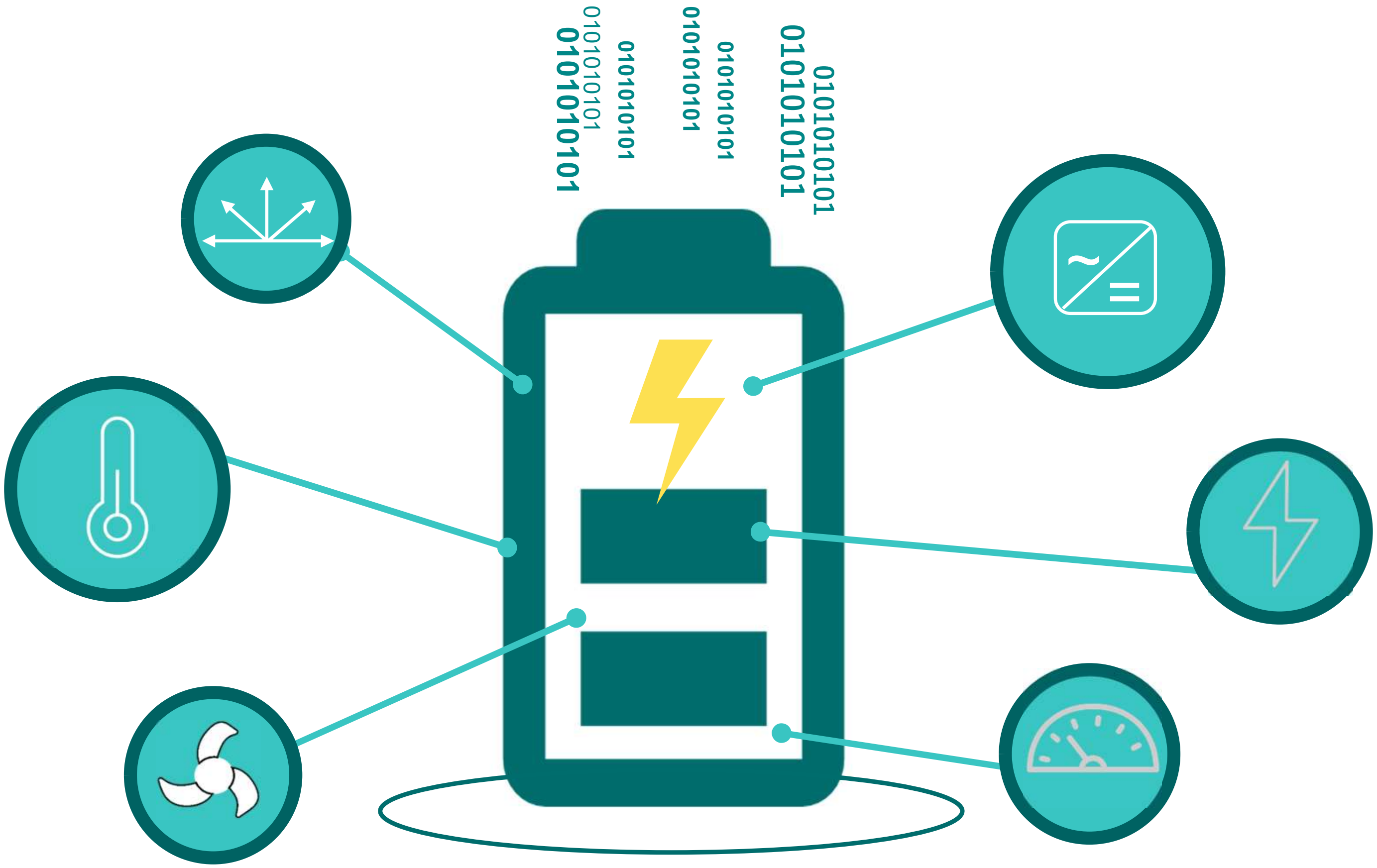
Power Conversion System

Source:: Elmark Automatyka S.A.

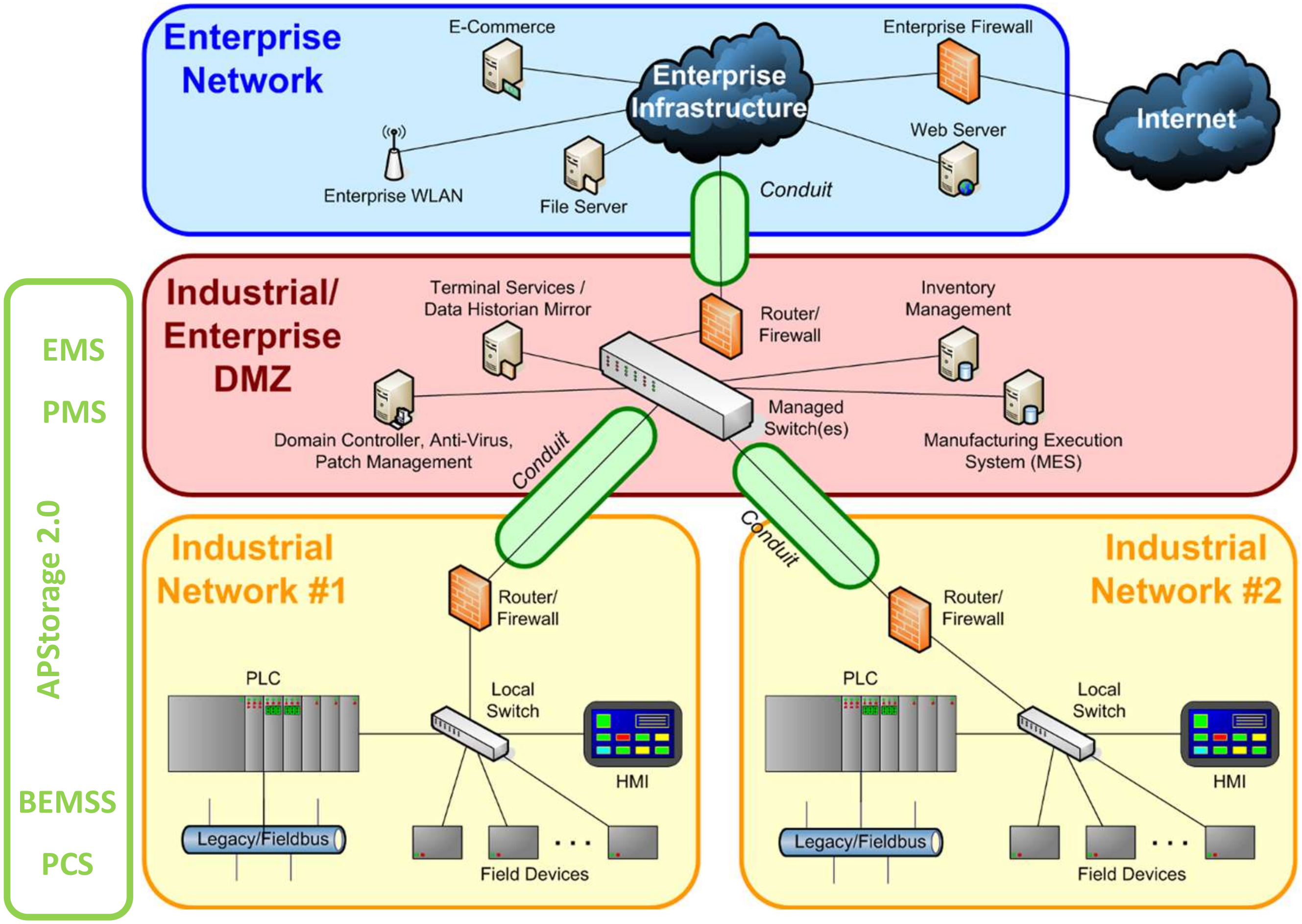
PQ control by:

- Current control
- Power control
- Energy control





A Guide to Securing Industrial Automation and Control Systems



Mastering IEC 62443: A Guide to Securing Industrial Automation and Control Systems

IEC 62443, "Industrial communication networks – Network and system security," provides a critical framework guiding the protection of Industrial Automation Control Systems (IACS). This series of standards recognizes the unique requirements of industrial environments and addresses the inherent challenges in securing them. Initially, IACS were not designed with cybersecurity in mind. Their security largely hinged on physical isolation, a concept rapidly becoming infeasible in today's interconnected world.

https://www.keyfactor.com/education-center/

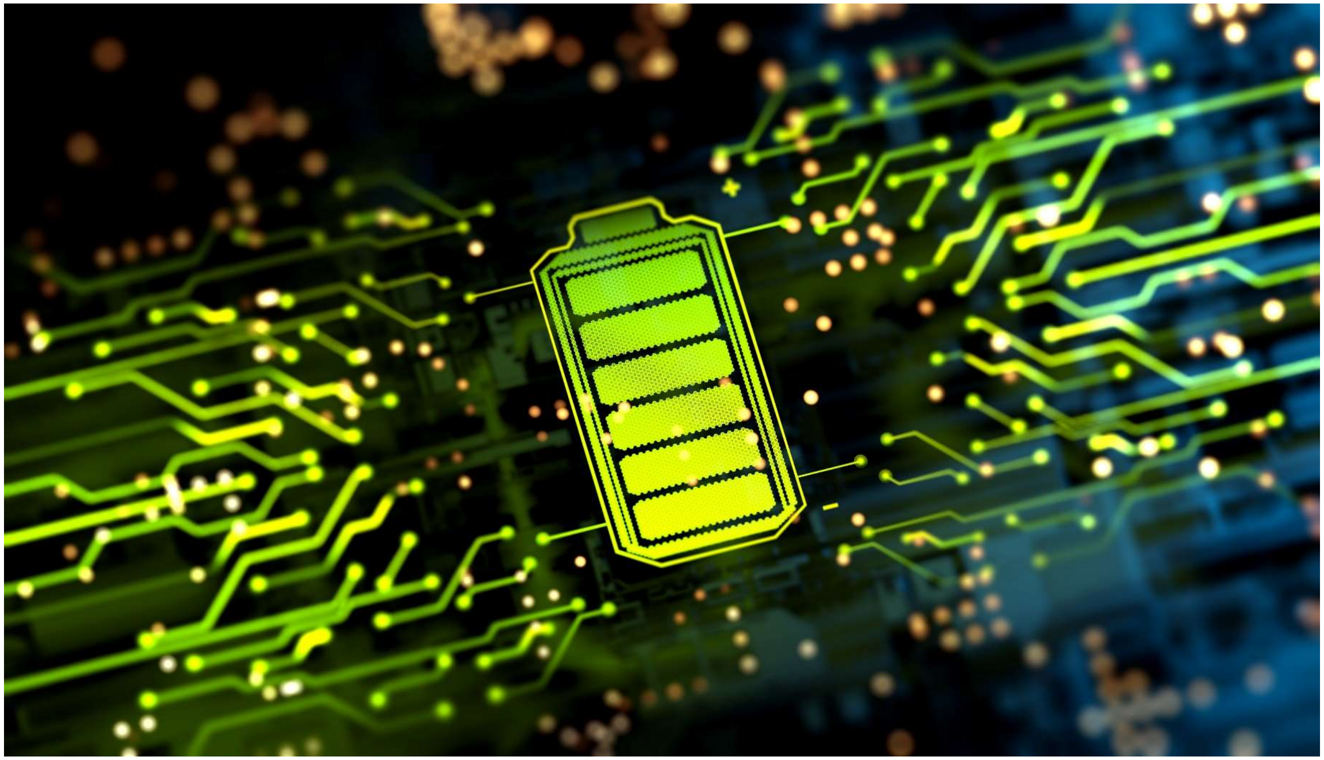
The NIS2 Directive: A high common level of cybersecurity in the EU

The Network and Information Security (NIS) Directive is the first piece of EU-wide legislation on cybersecurity, and its specific aim was to achieve a high common level of cybersecurity across the Member States.
While it increased the Member States' cybersecurity capabilities, its implementation proved difficult, resulting in fragmentation at different levels across the internal market.

https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)689333

https://www.gov.pl/web/cyfryzacja/walka-z-cyberzagrozeniami-wchodzi-w-nowy-wymiar

Electrical energy storages - types



- Li-ion battery
- Lead-Acid Battery
- Supercapacitors
- PEM fuel cells
- Solid oxide fuel cel
- **Na-ion Battery**
- Power Generators

Energy storages – Hydrogen and Power Electronics

Green Hydrogen: Challenges for Commercialization

Figure 1: Production to end-use of hydrogen

[Green Hydrogen: Challenges for Commercialization - IEEE Smart Grid]

IEEE Smart Grid Partners

Power Electronics for Off-Grid Gigawatt-Scale Green Hydrogen Production for Steel Manufacturing—Architectures, Costs, and Efficiencies Analysis Tool[1]

Joao Onofre Pereira Pinto
Oak Ridge National Laboratory
Knoxville, TN, USA
pintoj@ornl.gov

Marcio L. Magri Kimpara
Oak Ridge National Laboratory
Knoxville, TN, USA
magrikimparm@ornl.gov

TABLE I. TYPES OF HYDROGEN PRODUCTION

Process	Designator	Energy Resource	Feedstock	Residue
Electrolysis	Green Hydrogen	Solar + Wind + Hydro	Water	Oxygen
	Yellow Hydrogen	Solar only	Water	Oxygen
	Pink Hydrogen	Nuclear	Water	Oxygen
Reforming	Blue Hydrogen	Grid	Natural Gas	CO_2 (stored)
	Grey Hydrogen	Grid	Natural Gas	CO_2 (released)

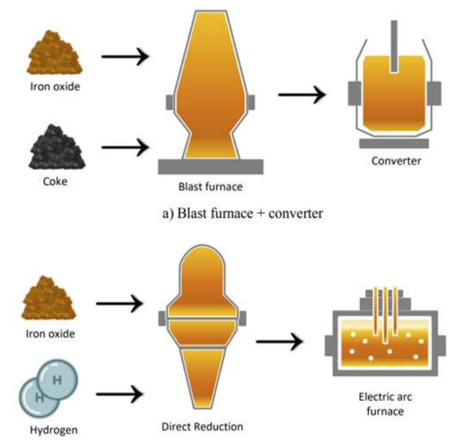


Fig. 1. Steel production processes based on [1]. (a) Conventional manufacturing process. (b) Decarbonized manufacturing process.

J. O. P. Pinto, M. L. Magri Kimpara, P. Kandula and M. S. Chinthavali, "Power Electronics for Off-Grid Gigawatt-Scale Green Hydrogen Production for Steel Manufacturing—Architectures, Costs, and Efficiencies Analysis Tool1," 2023 IEEE Design Methodologies Conference (DMC), Miami, FL, USA, 2023, pp. 1-6, doi: 10.1109/DMC58182.2023.10412585. keywords: {Costs;Monte Carlo methods;Production;Green

hydrogen;Transformers;Power electronics;Steel;Green hydrogen;green steel;power system architecture;power electronics;cost;efficiency;decision tool},

Green Hydrogen: Challenges for Commercialization

TABLE III. DEFAULT PARAMETERS USED IN THE POWER ELECTRONICS GREEN STEEL (PEGS) ANALYSIS TOOL

Power System Component	Individual Cost and Efficiency	
	Cost per Kilowatt (US$)	*Efficiency*
DC/AC converter	50.00	0.98
Thyristor-based AC/DC converter	37.00	0.992
DC/DC converter	35.00	0.985
Diode-based AC/DC converter	21.00	0.96
Transformer	20.00	0.95

TABLE IV. RESULTS OF THE POWER ELECTRONICS GREEN STEEL (PEGS) ANALYSIS TOOL

Inputs			
Total power (MW): 1500	Power of electrolyzer (MW): 10	Number of subsystems: 10	Battery power (%): 30
Outputs			
Architecture	**Cost per subsystem ($M)**	**Total cost ($M)**	**Efficiency (%)**
DFIG–AC-1	102.72	205.45	95.94
DFIG–AC-2	115.49	230.98	91.46
DFIG–DC	97.84	195.69	92.38
PMSG–AC-1	152.72	305.45	93.38
PMSG–AC-2	165.49	330.98	89
PMSG–DC	72.84	145.69	93.6

Power Electronics for Off-Grid Gigawatt-Scale Green Hydrogen Production for Steel Manufacturing—Architectures, Costs, and Efficiencies Analysis Tool[1]

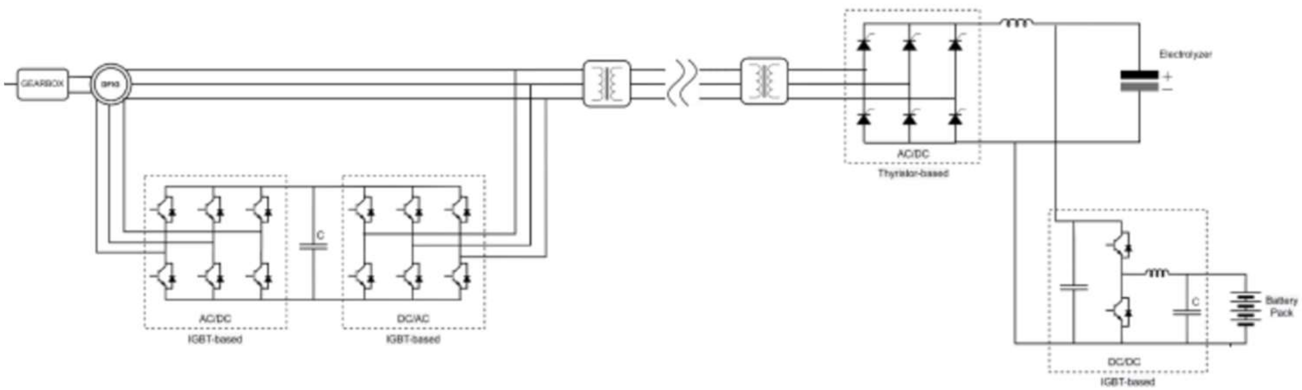


Fig. 8. Electric circuit diagram shown as the output for the best option (the option with the highest efficiency).

J. O. P. Pinto, M. L. Magri Kimpara, P. Kandula and M. S. Chinthavali, "Power Electronics for Off-Grid Gigawatt-Scale Green Hydrogen Production for Steel Manufacturing—Architectures, Costs, and Efficiencies Analysis Tool1," 2023 IEEE Design Methodologies Conference (DMC), Miami, FL, USA, 2023, pp. 1-6, doi: 10.1109/DMC58182.2023.10412585. keywords: {Costs;Monte Carlo methods;Production;Green

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[Green energy is set to match the world's growing electricity demand - IEA report | World Economic Forum (weforum.org)]

PROCEEDINGS OF THE IEEE APRIL 2023 VOL. 111 NO. 4

INTERACTIVE PUBLICATIONS

Demography of Europe – 2023 edition

[Demography of Europe – 2023 edition - Eurostat (europa.eu)]

The impact of demographic change in Europe

PAGE CONTENTS

The power of demography

The power of demography

Share of persons aged 65 and over

This share grew in the EU from 16% in 2002 to 21% in 2022

A growing population until 2020

EU population growth interrupted in 2020

[The impact of demographic change in Europe - European Commission (europa.eu)]

„Dzieje ludzkości przebiegają od początku — i przebiegać będą do końca — poprzez rodzinę."

"The history of humanity runs from the beginning — and will run to the end — through the family."

"يبدأ تاريخ البشرية من البداية – وسيستمر حتى النهاية – من خلال العائلة."

https://www.cytatownik.pl/cytaty-jana-pawla-ii/#zlote-mysli-jana-pawla-ii-o-rodzinie

https://www.gov.pl/web/rodzina/dobry-czas-dla-rodzin-polityka-prorodzinna-w-2021-roku

Eurofam

The conceptualisation and delivery of family policy and support in Europe: A review of international and European frameworks and standards

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

https://eurofamnet.eu/system/files/wg2_policyreviewreport_sept_2021.pdf

[Child Benefit - (spf.gov.om)]

Child Benefit

The program provides monthly financial support to Omani children from birth until the age of 18 to ensure a minimum level of monetary social protection for this segment in support of their needs at this stage.

In focus


REPowerEU


EU Solidarity with Ukraine


The Middle East crisis

European Commission, official website - European Commission (europa.eu)

عُمانُنا Omanuna The Official E-Government Services Portal CITIZEN

Home Page > Entities > Entity Detail

- General Information
- Citizen
- Investor
- Resident
- National Digital Economy Program
- EParticipation

Related Services

Request for a family consulting service (office)

The applicant provides a family counseling service, or it is provided upon the request of one of the concerned authorities

Conditions and regulations:

- Cases that suffer from problems of a psychological and social nature

Sectors	Fees	Service Provider
Social Service	No fees	Family Guidance and Consulting Department

Offical Contact:

Website https://www.mosd.gov.om

Tel: 1555

Entity Detail (oman.om)

“The history of humanity runs from the beginning — and will run to the end — through the family.”

"يبدأ تاريخ البشرية من البداية – وسيستمر حتى النهاية – من خلال العائلة."

https://www.cytatownik.pl/cytaty-jana-pawla-ii/#zlote-mysli-jana-pawla-ii-o-rodzinie

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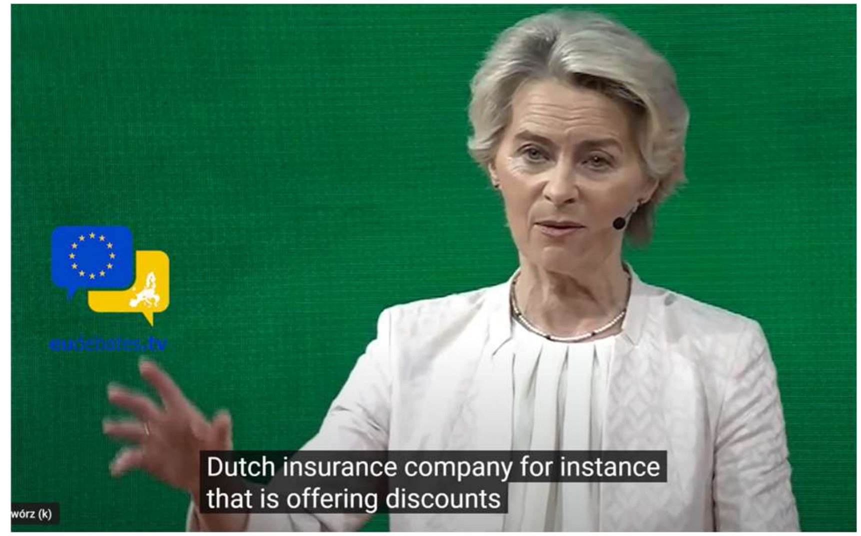

"…to customers who install green roofs.
Why that?
Because it will make a house and neighborhood safer…"

https://youtu.be/fMvpx9Q3JNI
EU Debates | eudebates.tv

Demography = Society = family = sustainability?

Renewable and Sustainable Energy Reviews 145 (2021) 111111

Contents lists available at ScienceDirect

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Check for updates

Power system stability issues, classifications and research prospects in the context of high-penetration of renewables and power electronics

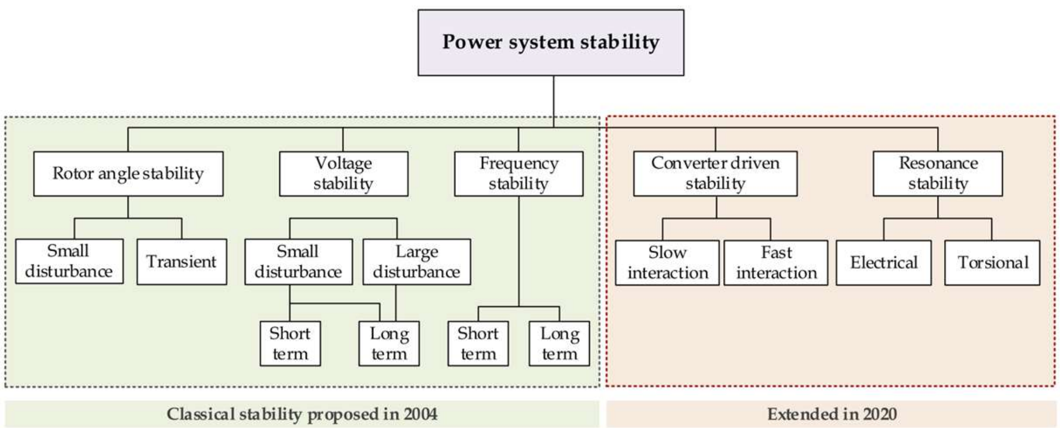

Fig. 1. IEEE classifications of power system stability (Year: 2004 and 2020).

https://doi.org/10.1016/j.rser.2021.111111

nature energy

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Editorial | Published: 20 October 2023

The politics of energy security

Energy security concerns must be considered not only in terms of energy availability at an affordable price, but also from a political and social sciences perspective.

The politics of energy security. *Nat Energy* **8**, 1047 (2023). https://doi.org/10.1038/s41560-023-01398-2

Role of the:

GALERIA AUTORSKA ANDRZEJA MLECZKI

https://www.sklep.mleczko.pl/pl/p/Oryginal-Ziemia-do-serwisu/1749

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PW
IS EP

How to securing the future ?

1) Innovation needs interdisciplinary and sustainable effort
2) Education – promote engineering in our family live
3) Super secure IT is important but not enough
4) All Hi-Tech of our civilization needs electrical energy
5) Energy Technology (ET) is like a digestive system of our body
6) Clean and sustainable World is expensive but luxurious (normal)
7) Education, cooperation, and synergy in differences is crucial now.

Politechnika Warszawska
Warsaw University of Technology

Program strategiczny
NOWE TECHNOLOGIE W ZAKRESIE ENERGII

NCBR
National Centre for Research and Development

APS energia

شكرًا!!

Thank you!
Dziękuję!

Prof. Marek Jasinski