

Integrazione dei sistemi di WPT dinamici in contesto autostradale: presente, prospettive e sfide future

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La ricarica statica



La ricarica statica



La ricarica statica



La ricarica statica





IEC 61980-1
Edition 1.0 2015-07

INTERNATIONAL STANDARD

NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA

ICS 43.040
T 36

GB/T 38775.1-2020

**Electric Vehicle Wireless Power Transfer -
Part 1: General Requirements**

电动汽车无线充电系统
第1部分：通用要求

PD ISO/PAS 19363:2017

Downloaded from SAE International by Fabio Freschi, Monday, March 12, 2018

	SURFACE VEHICLE INFORMATION REPORT	J2954™	NOV2017
		Issued Revised	2016-05 2017-11
		Superseding J2954 MAY2016	
(R) Wireless Power Transfer for Light-Duty Plug-In/Electric Vehicles and Alignment Methodology			



BS Standards Publication

**Electrically propelled road vehicles —
Magnetic field wireless power transfer —
Safety and interoperability requirements**

La ricarica dinamica

KAIST OLEV

F^oBRIC

La ricarica dinamica



Mannheim project

Lommel project

KAIST OLEV

ENRX[®]

F^oBRIC

electreon



La ricarica dinamica

**Nessuna sperimentazione è stata ancora
effettuata in ambiente autostradale reale**

La ricarica dinamica

**Nessuna sperimentazione è stata ancora
effettuata in ambiente autostradale reale**

Materiali e procedure installative

Metodologie e tecnologie per il billing

Business model

Chiara definizione dei costi

Topologie bobine

Topologie di compensazione

Manutenzione del sistema WPT e
della pavimentazione

Livelli di potenza ovvero
tipologia di veicoli

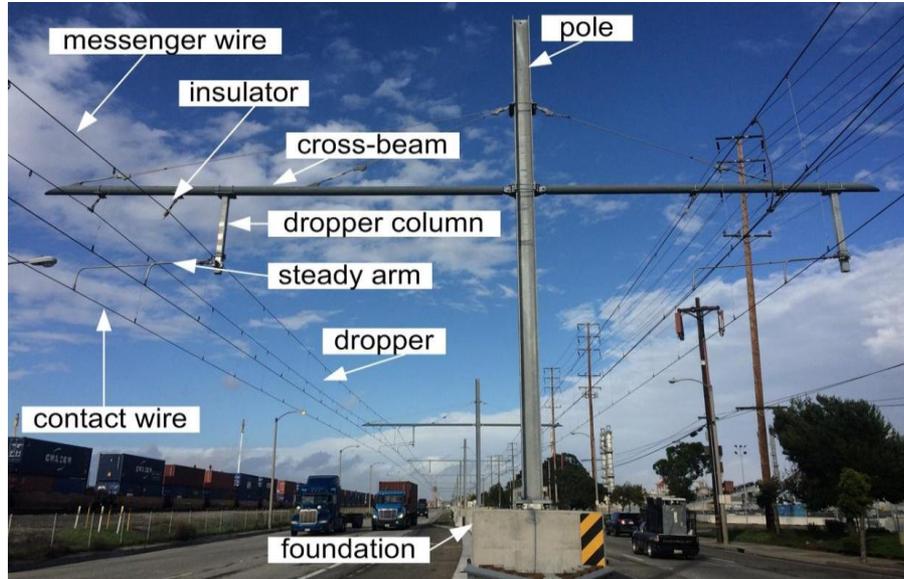
Architettura elettrica

**Quanto si sta davvero
puntando sulla
alimentazione wireless?**

Alimentazione conduttiva



Alimentazione conduttiva

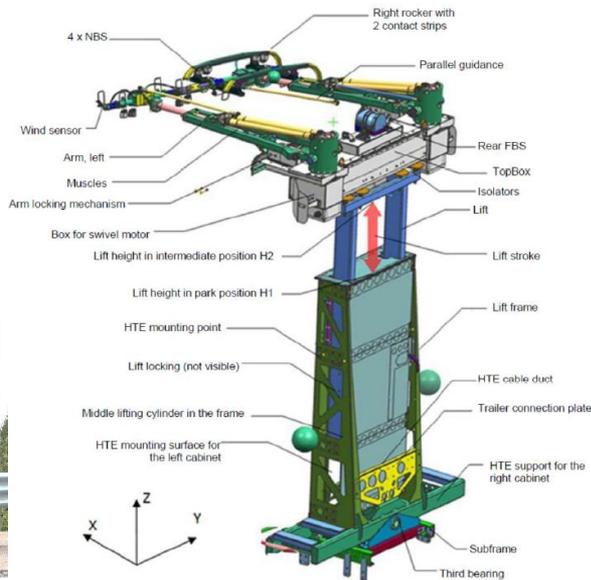


Manutenzione complessa

Infrastruttura invasiva
(anche visivamente)

Solo per veicoli pesanti

Alimentazione conduttiva



Un solo detentore della tecnologia!



Construction of a 1 Mile Catenary System and Develop & Demonstrate Catenary Electric Trucks

Final Test Results and Project Report
Project Period: 2014/7/14 - 2018/02/28

Provided by Siemens Industry INC

Intanto...



Standards Publications News Attend Learn Par

Browse » Standards » J2954/3

WPT 2023-04-20 Dynamic Wireless Power Transfer for both Light and Heavy Duty Vehicles (SAE RP J2954/3) J2954/3

The SAE J2954 standard establishes an industry-wide specification that defines acceptable criteria for Light Duty EVs and SAE RP J2954/2 establishes the same for Heavy Duty. SAE RP SAE J2954. SAE RP J2954/3 establishes interoperability, electromagnetic compatibility, EMF, minimum performance, safety, and testing for dynamic wireless power transfer (D-WPT) of both light and heavy duty plug-in electric vehicles. The specification defines various charging levels that are based on the levels defined for SAE J1772 conductive AC charge levels as SAE J2954/1 & SAE J2954/2 with some variations. A standard for WPT based on these charge levels enables selection of a charging rate based on vehicle requirements, thus allowing for better vehicle packaging and ease of customer use. SAE J2954/3 addresses unidirectional charging, from grid to vehicle; bidirectional energy transfer may be evaluated for a future standard. This recommended practice is intended to be used in exclusively for dynamic applications may be considered in the future. In this version, level with grade (flush) and below grade installations are covered.



SAE J2954/2 (TM) SAE International Wireless Power Transfer Rendering. Image of Truck Courtesy of Scania.

SAE TIR J2954/2 Heavy-Duty Wireless EV Charging both Static and Dynamic to 500kW. SAE J2954 Light Duty Standard enables certification with UL.



Jesse Schneider
CEO/ CTO at ZEV Station



Standards Publications News Attend Learn Partic



SAE TIR J2954/2 Paves the Way for Heavy-Duty EV Charging Without a Plug & Static and Dynamic Wireless Power Transfer

2022-12-18 WARRENDALE, PA.

FOR IMMEDIATE RELEASE

SAE Publishes Update to SAE J2954 Light-Duty Wireless Power Transfer Standard and SAE J2954/2 Technical Information Report for HD EV Wireless Charging to 500kW

Electreon, Toyota, and Denso Collaborate on Advanced Wireless Vehicle Charging Technology

EV THE EV REPORT / MARCH 24, 2023 / ENERGY

**Uno sguardo su alcuni
degli aspetti aperti**

Potenza e frequenza

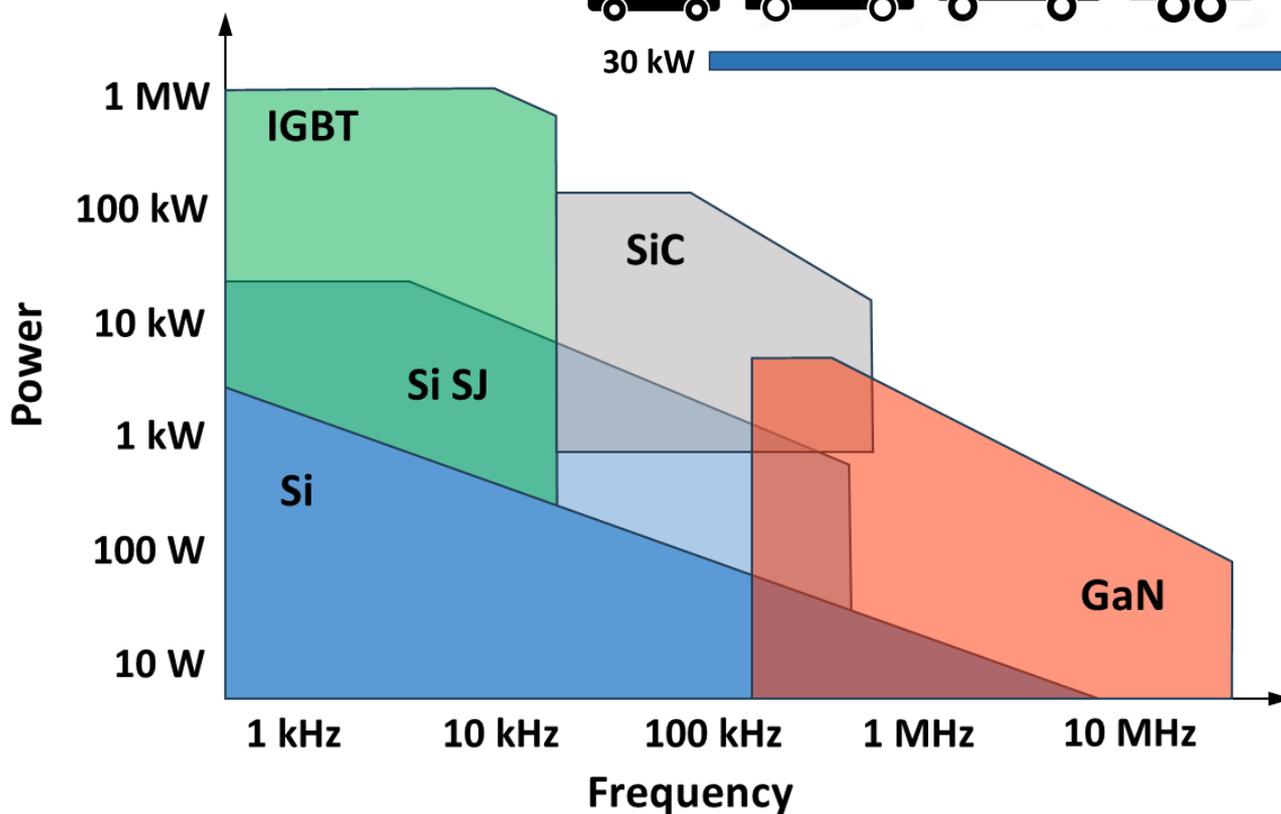
Potenza e frequenza

85 kHz

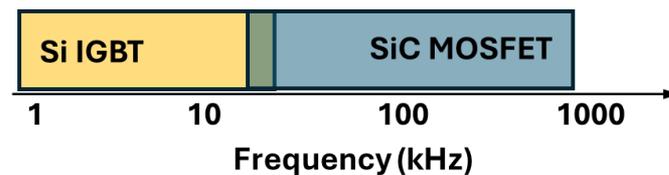
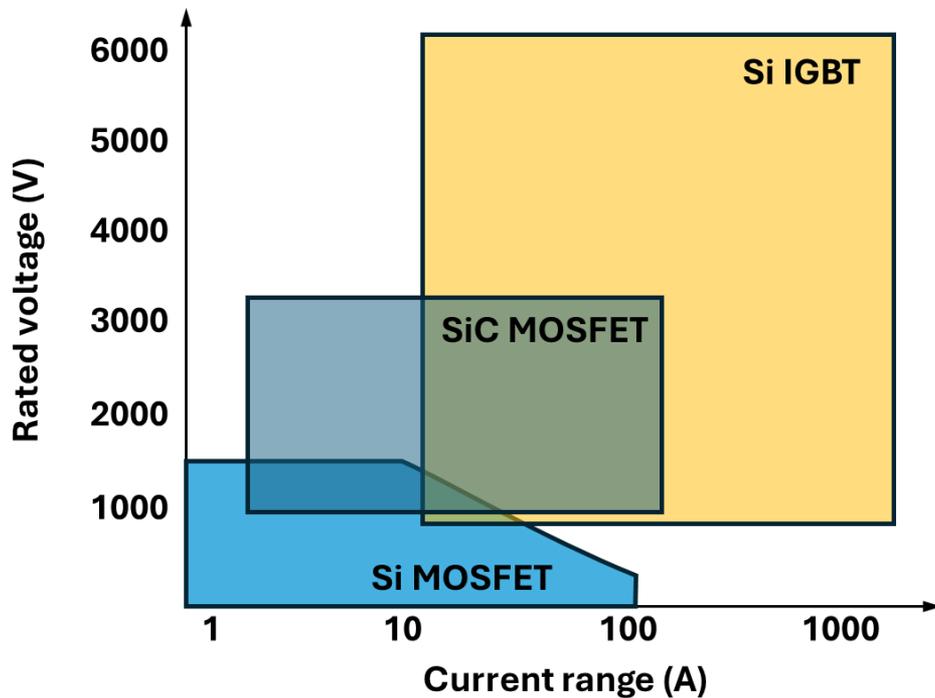
Potenza e frequenza



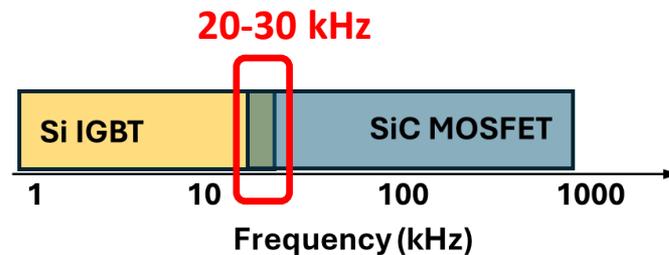
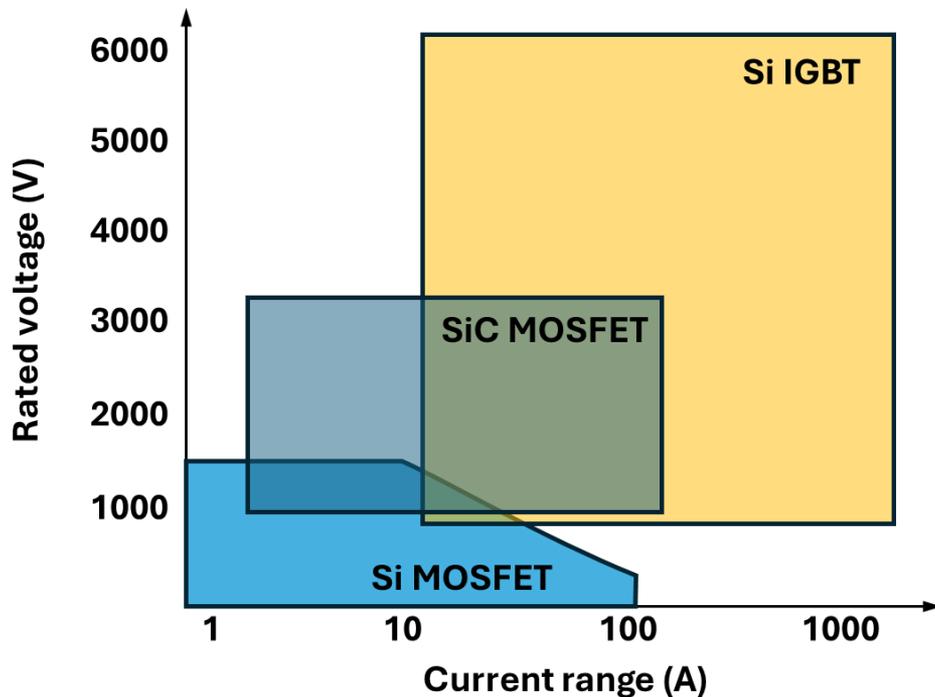
Potenza e frequenza



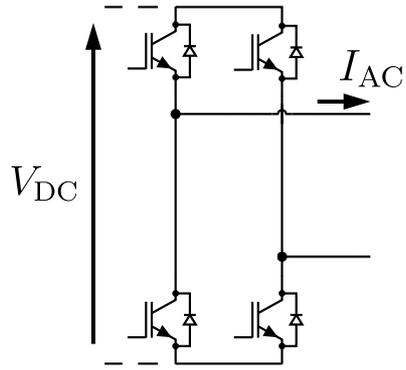
Potenza e frequenza



Potenza e frequenza

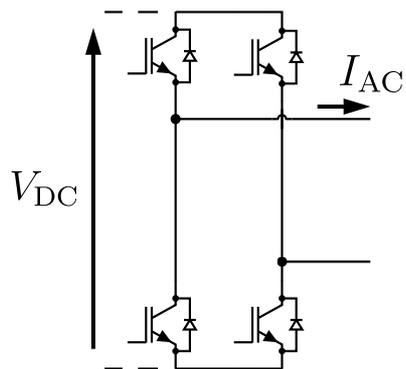


Potenza e frequenza



$$\eta \propto \frac{1}{I_{AC}^2}$$

Potenza e frequenza

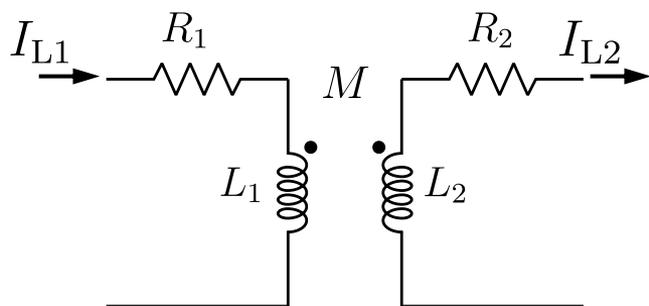


$$\eta \propto \frac{1}{I_{AC}^2}$$

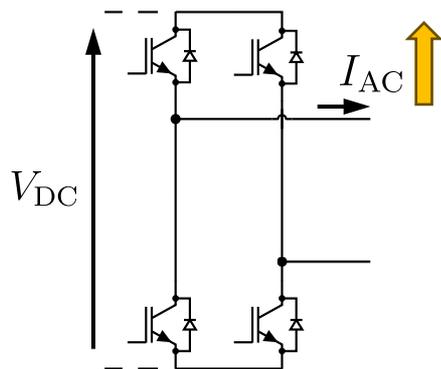
$$\eta \propto \omega^2 M^2$$

$$\eta \propto \frac{1}{I_{L1,2}^2}$$

$$P_{out} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

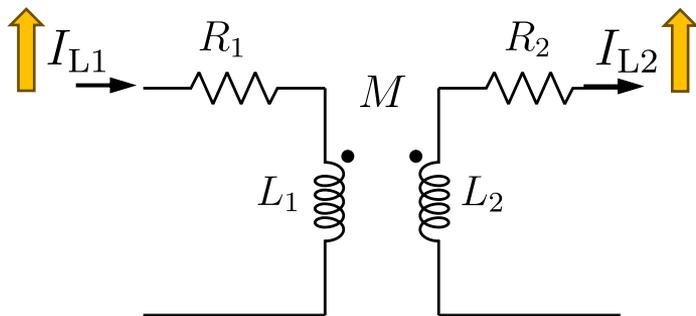


Potenza e frequenza



$$\eta \propto \frac{1}{I_{AC}^2}$$

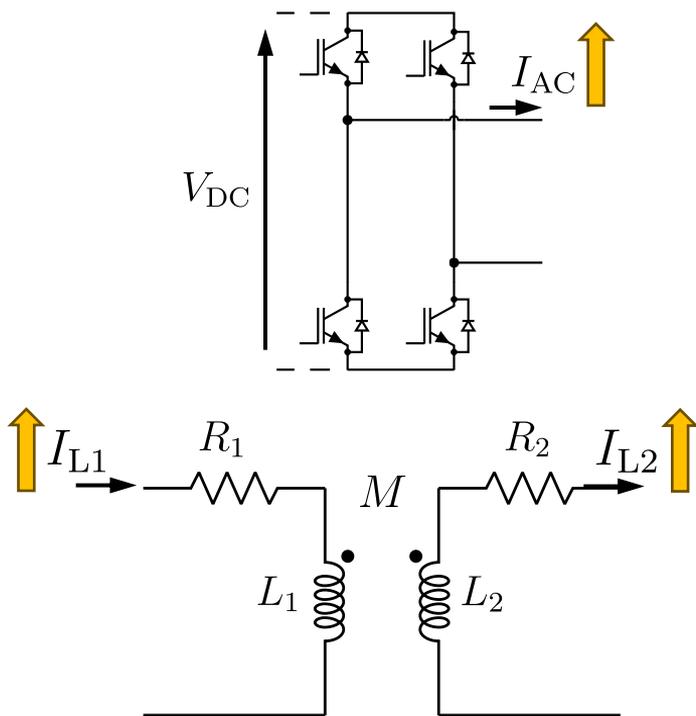
$$\eta \propto \omega^2 M^2$$



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$$P_{out} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

Potenza e frequenza



Esposizione ai campi magnetici!

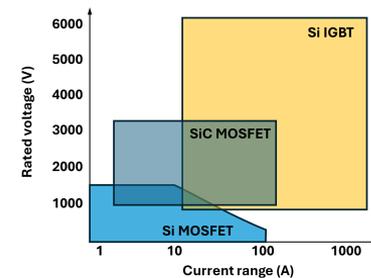
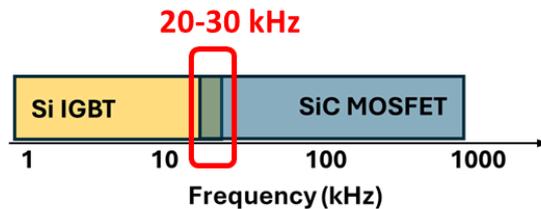
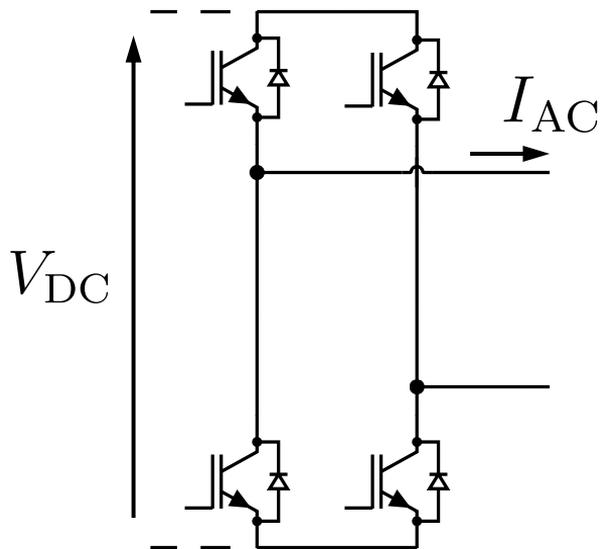
$$\eta \propto \frac{1}{I_{AC}^2}$$

$$\eta \propto \omega^2 M^2$$

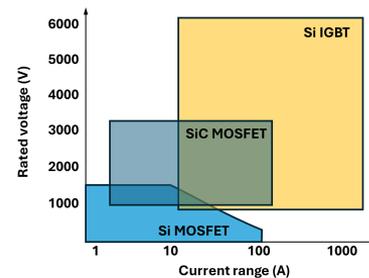
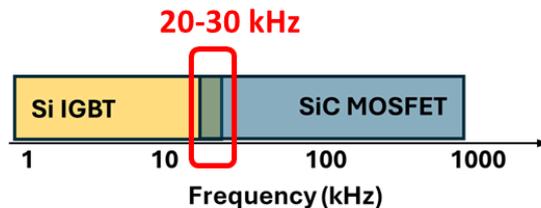
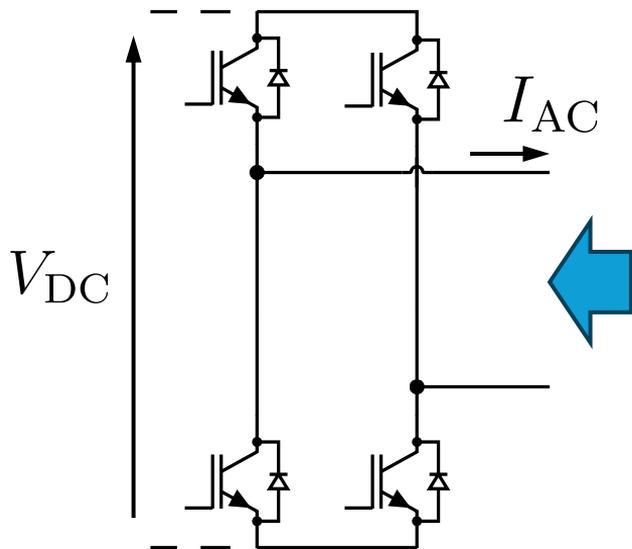
$$\eta \propto \frac{1}{I_{L1,2}^2}$$

$$P_{out} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

Potenza e frequenza

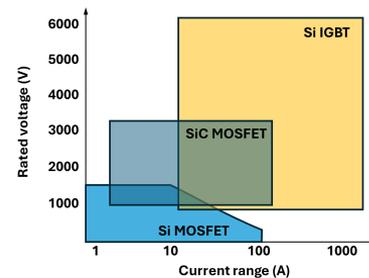
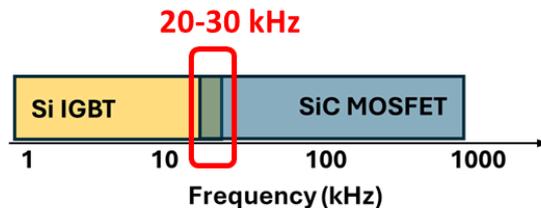
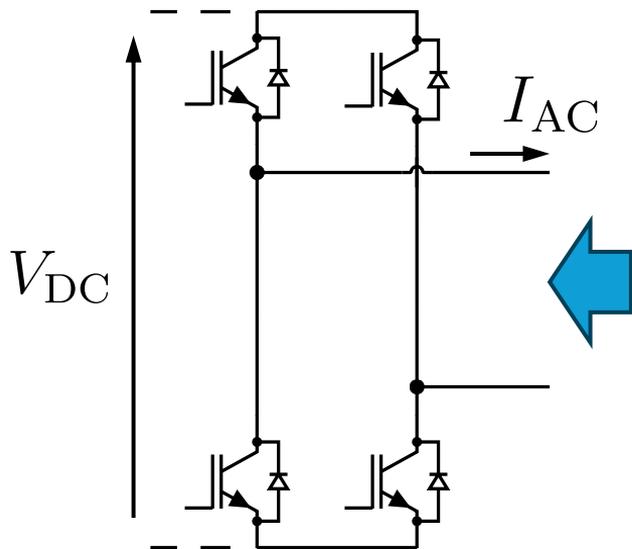


Potenza e frequenza



$$Z_{eq} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

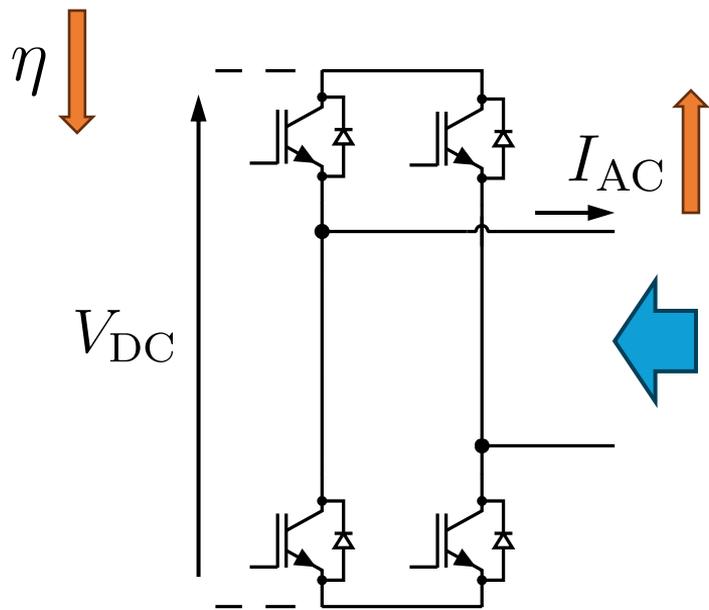
Potenza e frequenza



$$Z_{eq} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

ω ↓

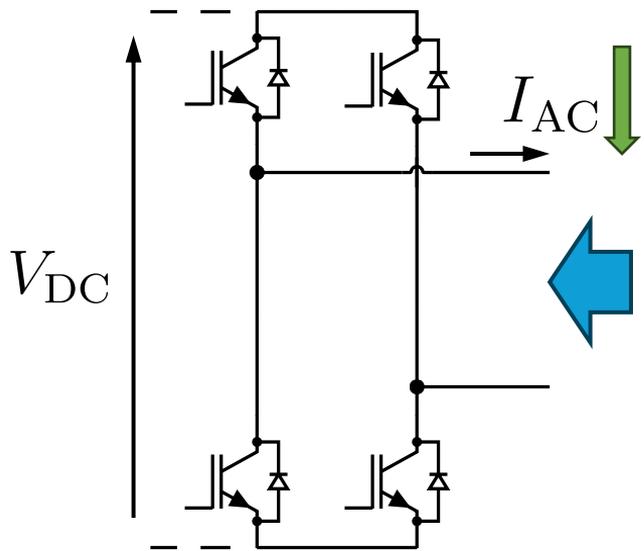
Potenza e frequenza



$$Z_{eq} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

ω ↓

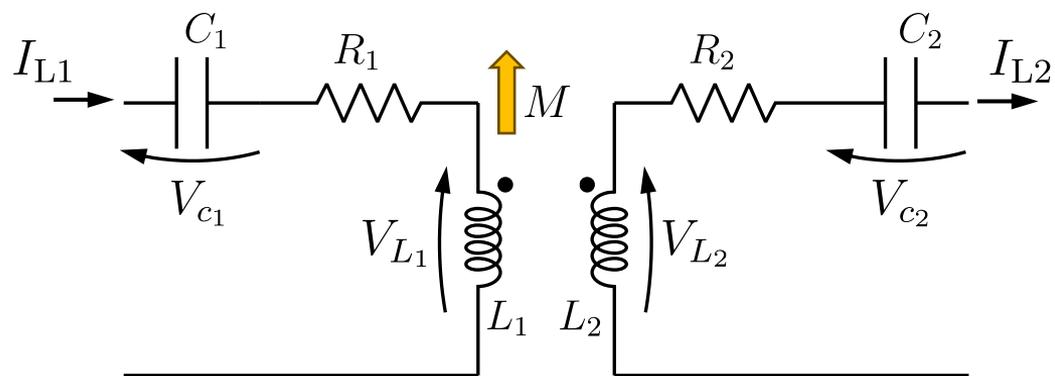
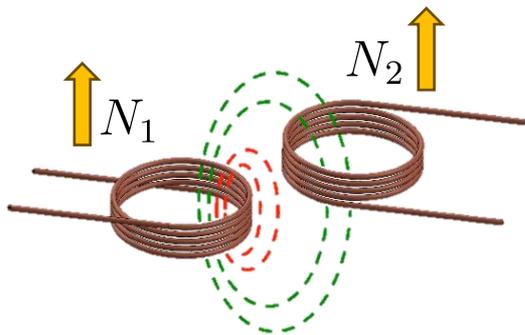
Potenza e frequenza



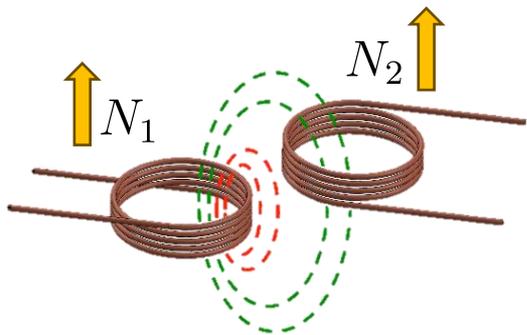
$$Z_{eq} \propto \omega^\alpha, M^\beta \quad (\alpha, \beta = 1, 2)$$

$$M \uparrow$$

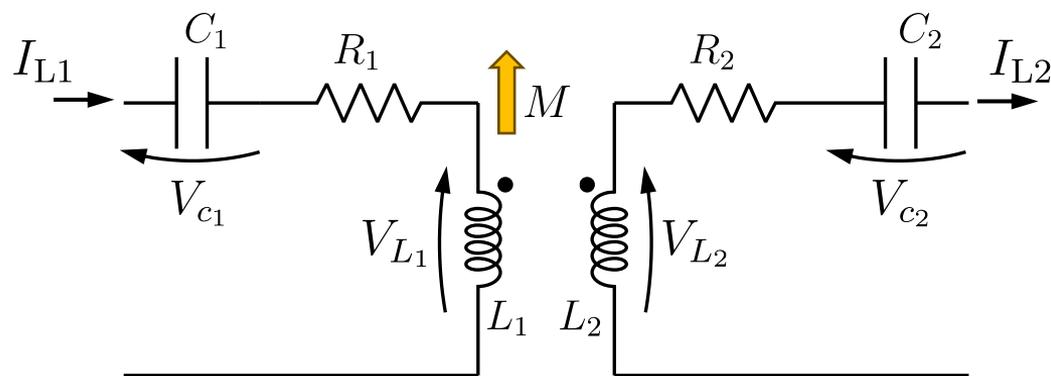
Potenza e frequenza



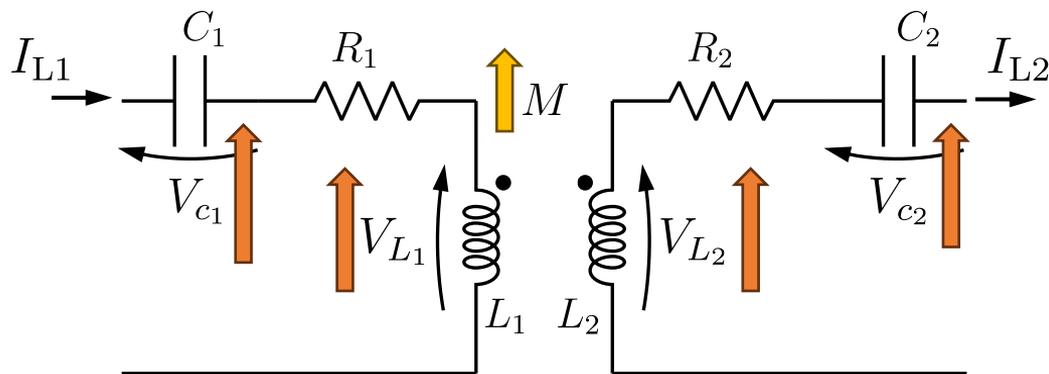
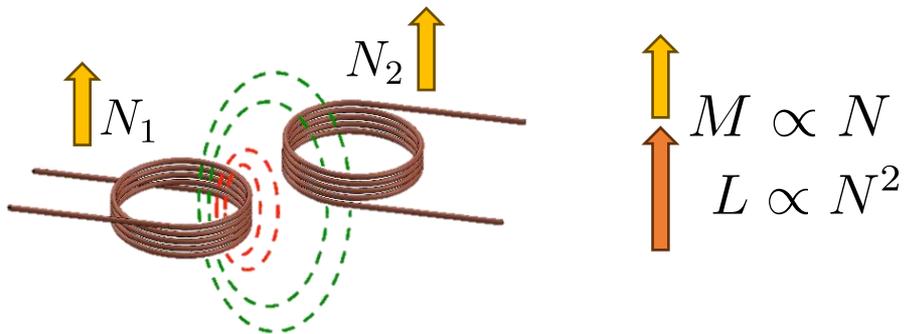
Potenza e frequenza



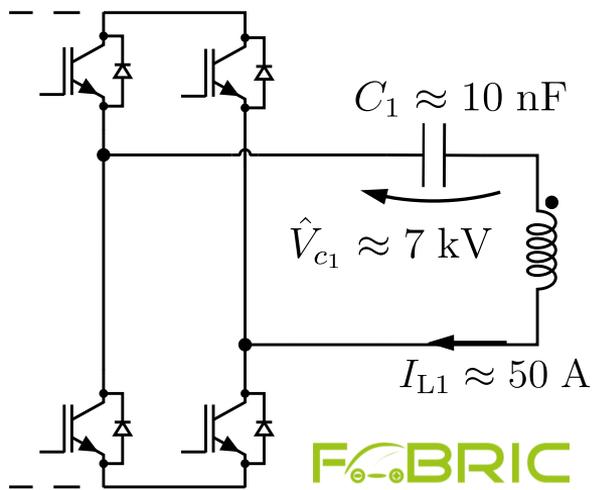
$$M \propto N$$
$$L \propto N^2$$



Potenza e frequenza

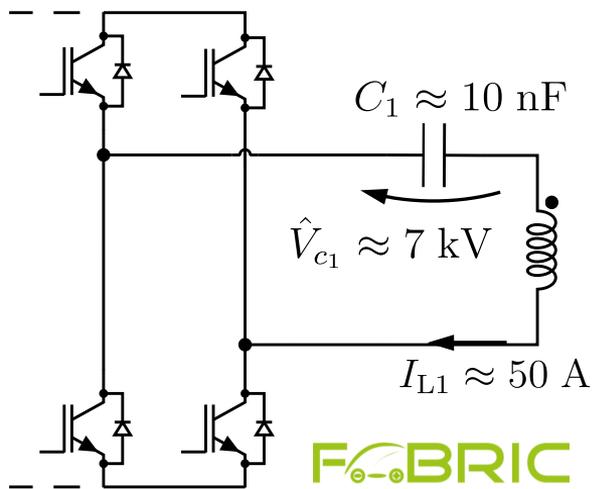


Potenza e frequenza



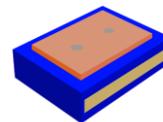
20 kW – 85 kHz

Potenza e frequenza

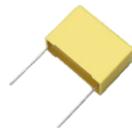


20 kW – 85 kHz

Film

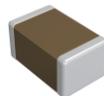


$\sim 1 \text{ kVrms}$ $\sim 100\text{-}1000 \text{ A}$



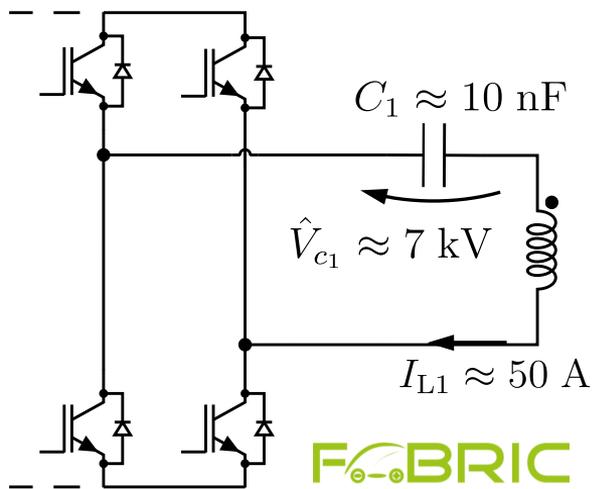
$\sim 1 \text{ kVrms}$ $\sim 1\text{-}10 \text{ A}$

Ceramici



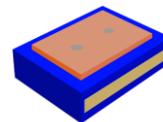
$\sim 1 \text{ kVrms}$ $\sim 1\text{-}10 \text{ A}$

Potenza e frequenza

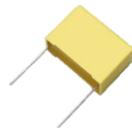


20 kW – 85 kHz

Film

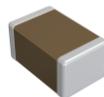


$\sim 1 \text{ kVrms}$ $\sim 100\text{-}1000 \text{ A}$



$\sim 1 \text{ kVrms}$ $\sim 1\text{-}10 \text{ A}$

Ceramici

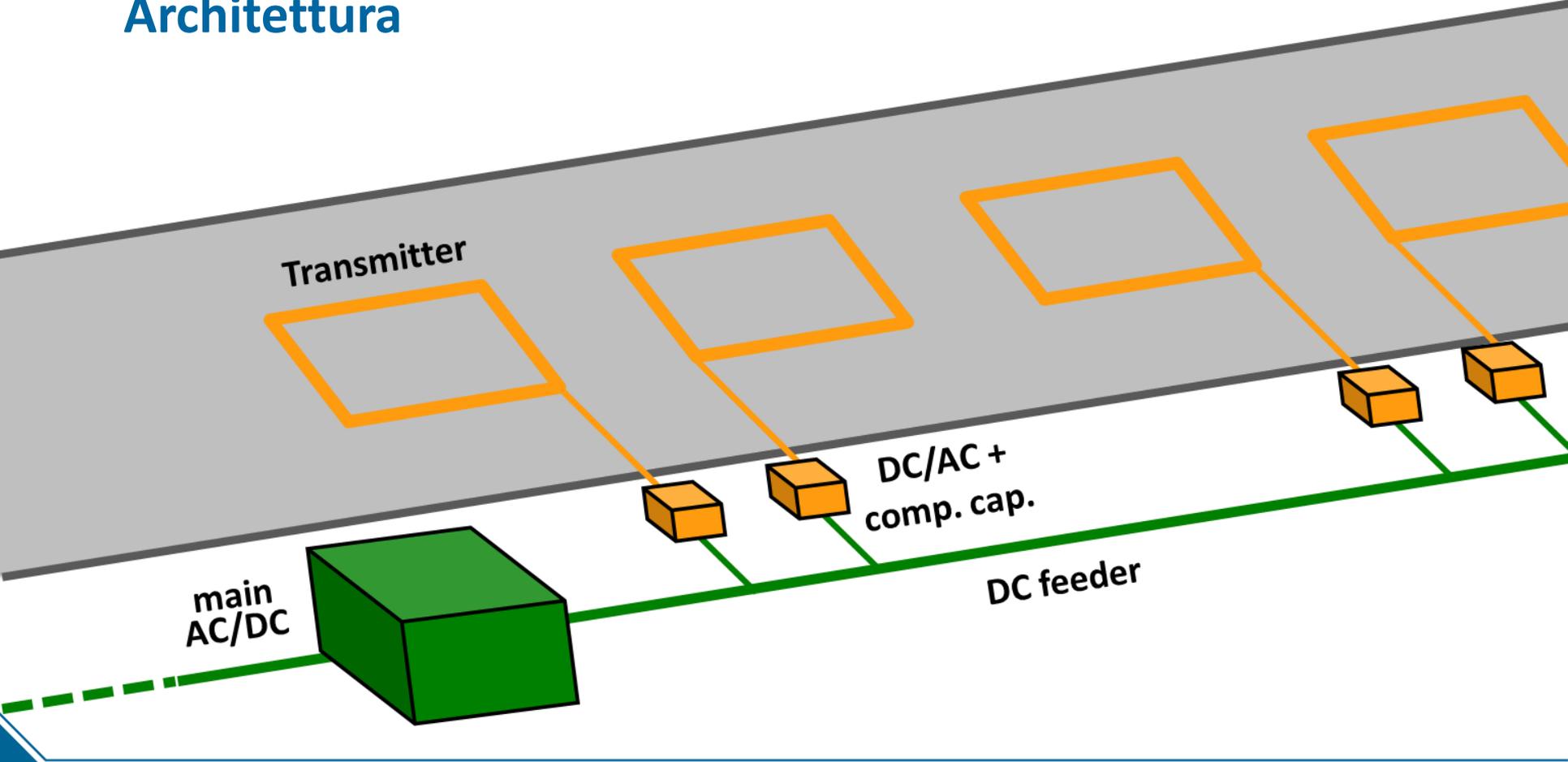


$\sim 1 \text{ kVrms}$ $\sim 1\text{-}10 \text{ A}$

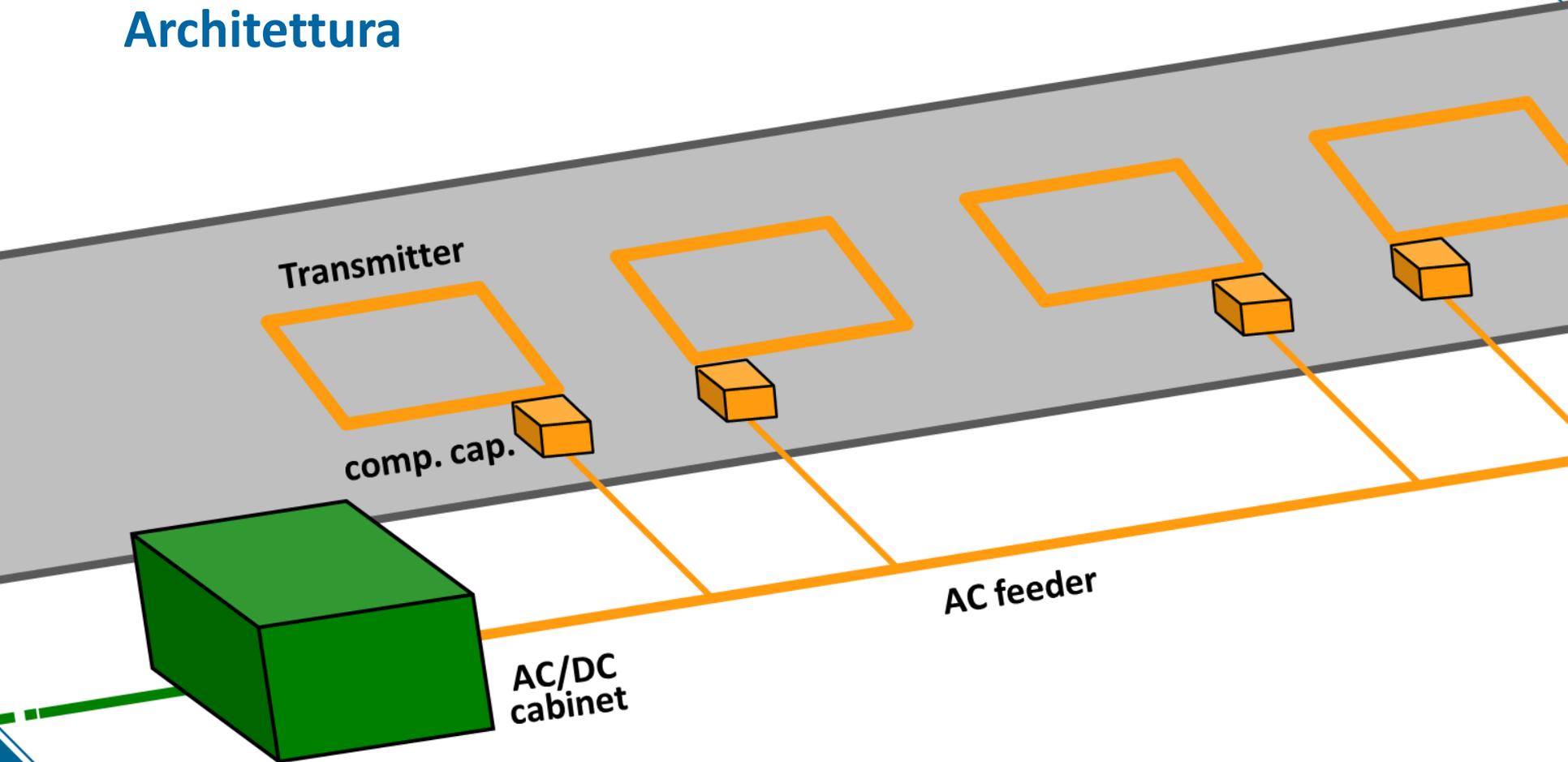
Banchi di condensatori!

**Dove posizioniamo i
condensatori?**

Architettura



Architettura



Architettura



Fonte: <https://www.brebemi.it/arena-del-futuro/>

Materiali e procedure installative

La procedura di Electreon



Fonte: <https://www.brebemi.it/arena-del-futuro/>

La procedura di Electreon



**Macchinari non standad
per la fresatura**

Fonte: <https://www.brebemi.it/arena-del-futuro/>

La procedura di Electreon



Fonte: <https://www.brebemi.it/arena-del-futuro/>

La procedura di Electreon



Connessione dei coil in AC (85 kHz)

Fonte: <https://www.brebemi.it/arena-del-futuro/>

La procedura di Electreon



Fonte: <https://www.brebemi.it/arena-del-futuro/>

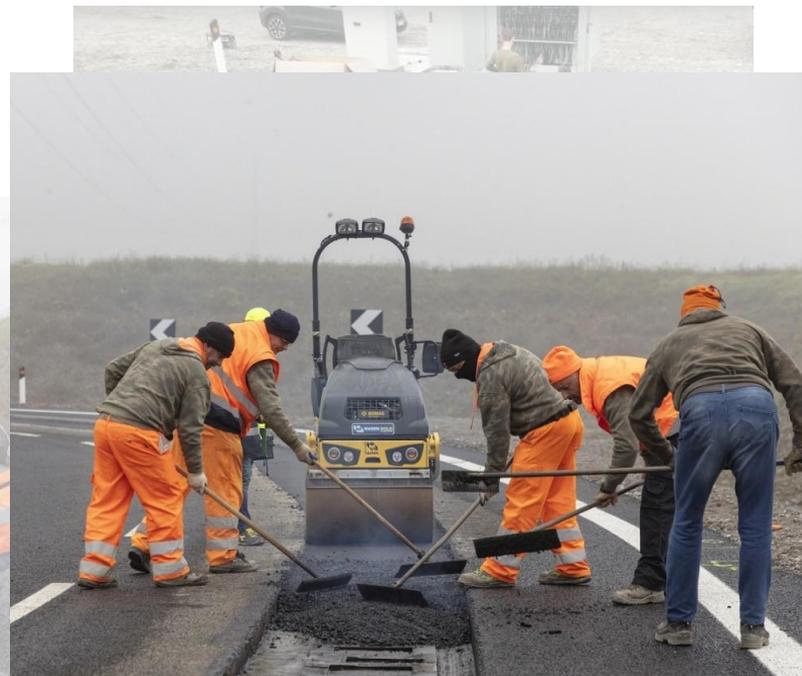
La procedura di Electreon



**Spessore strato di usura (4 cm)
non accettato**

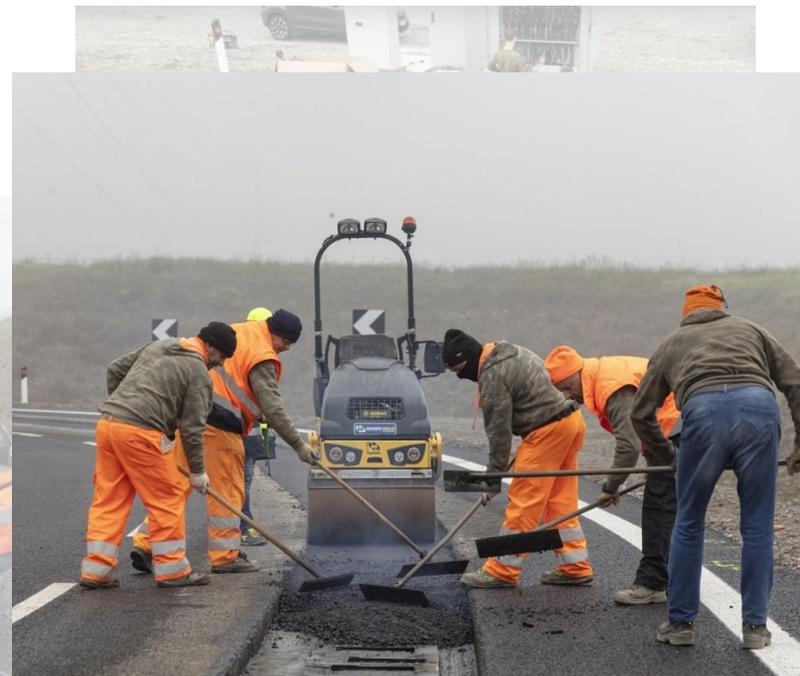
Fonte: <https://www.brebemi.it/arena-del-futuro/>

La procedura di Electreon



Fonte: <https://www.brebemi.it/arena-del-futuro/>

La procedura di Electreon



**Condensatori non
manutenibili o sostituibili**

Fonte: <https://www.brebemi.it/arena-del-futuro/>

In conclusione...

Le sfide aperte sono molte
Sono complesse e fortemente interdisciplinari

Le sfide aperte sono molte

Sono complesse e fortemente interdisciplinari

C'è tanto lavoro per noi elettrotecnici!!!



Grazie a tutti per l'attenzione!!!

*Per info, domande, critiche e commenti scrivetemi pure all'email
vincenzo.cirimele@unibo.it*