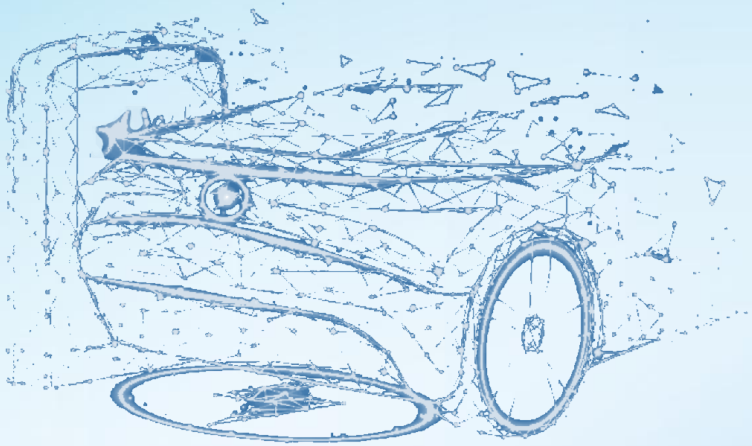
XXXIX Riunione Annuale dei Ricercatori di Elettrotecnica – ET2025 Villasimius



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

Vincenzo Cirimele

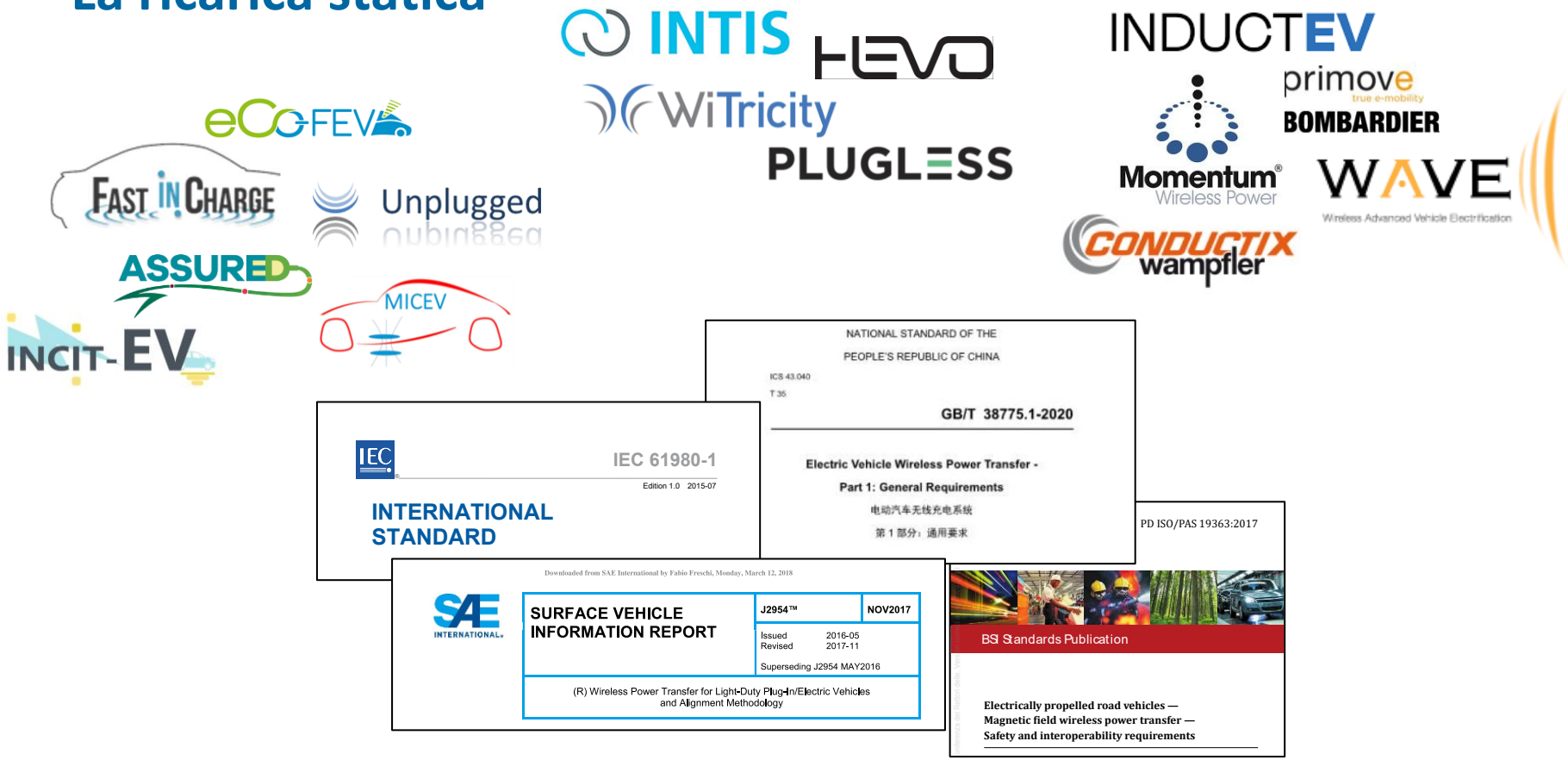
Dipartimento di Ingegneria dell'Energia Elettrica e dell'Informazione "G. Marconi"
Alma Mater Studiorum Università di Bologna

La ricarica statica

La ricarica statica

La ricarica statica

La ricarica statica



La ricarica dinamica

KAIST OLEV

FABRIC

La ricarica dinamica

WirelessPower#One OLEV a KAIST spin-off company

Mannheim project

KAIST OLEV

ENRX

Lommel project

FABRIC

electreon

SMART ROAD GOTLAND CHARGING THE WAY FORWARD

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

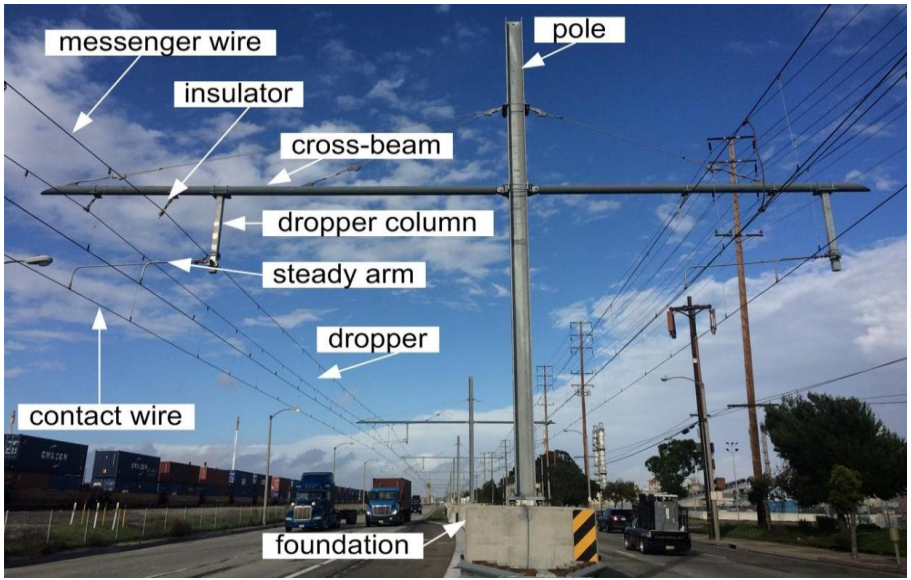
Livelli di potenza ovvero tipologia di veicoli

Architettura elettrica

Quanto si sta davvero puntando sulla alimentazione wireless?

Alimentazione conduttiva

Alimentazione conduttiva

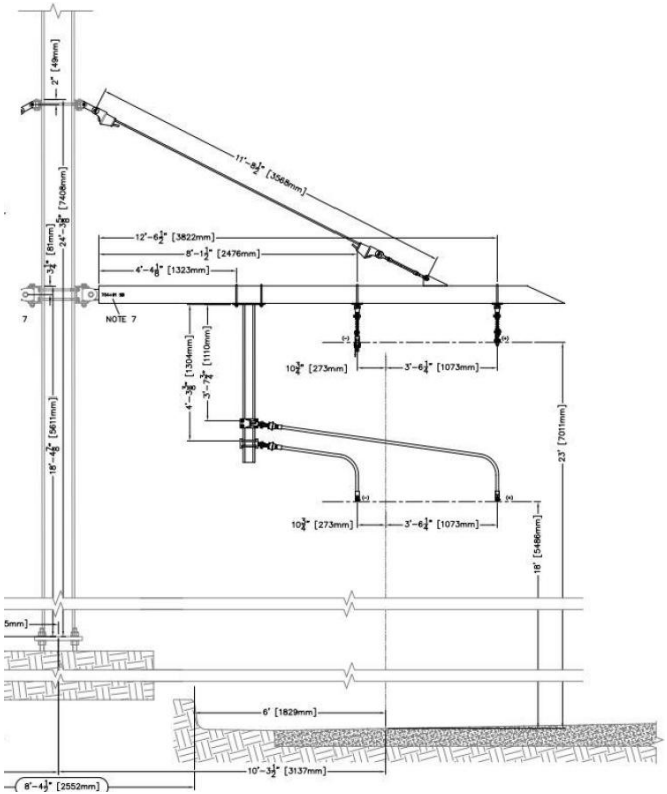


Manutenzione complessa

Infrastruttura invasiva (anche visivamente)

Solo per veicoli pesanti

Alimentazione conduttiva



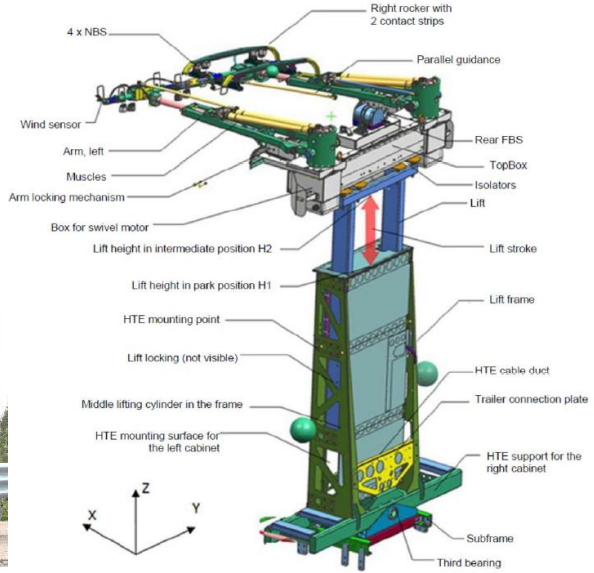
Manutenzione complessa

Infrastruttura invasiva (anche visivamente)

Solo per veicoli pesanti

Distanza minima dal suolo 5 metri!!!

Alimentazione conduttiva



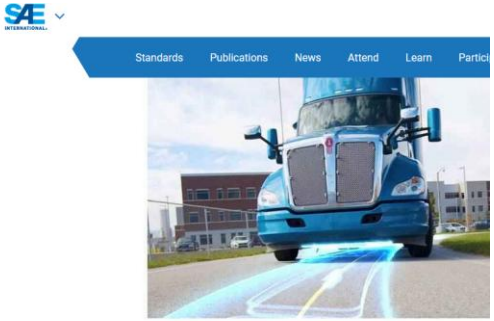
Un solo detentore della tecnologia!

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…

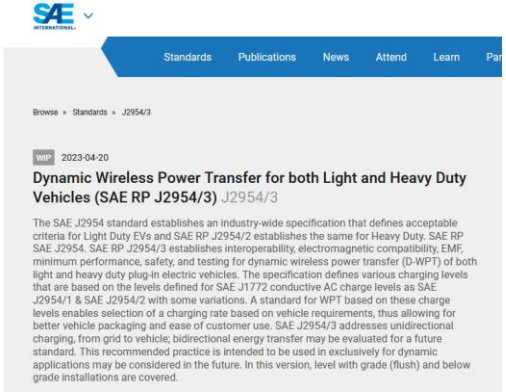


SAE TIR J2954/2 Paves the Way for Heavy-Duty EV Charging Without a Plug & Static and Dynamic Wireless Power Transfer

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



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

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

THE EV REPORT / MARCH 24, 2023 / ENERGY

Uno sguardo su alcuni degli aspetti aperti

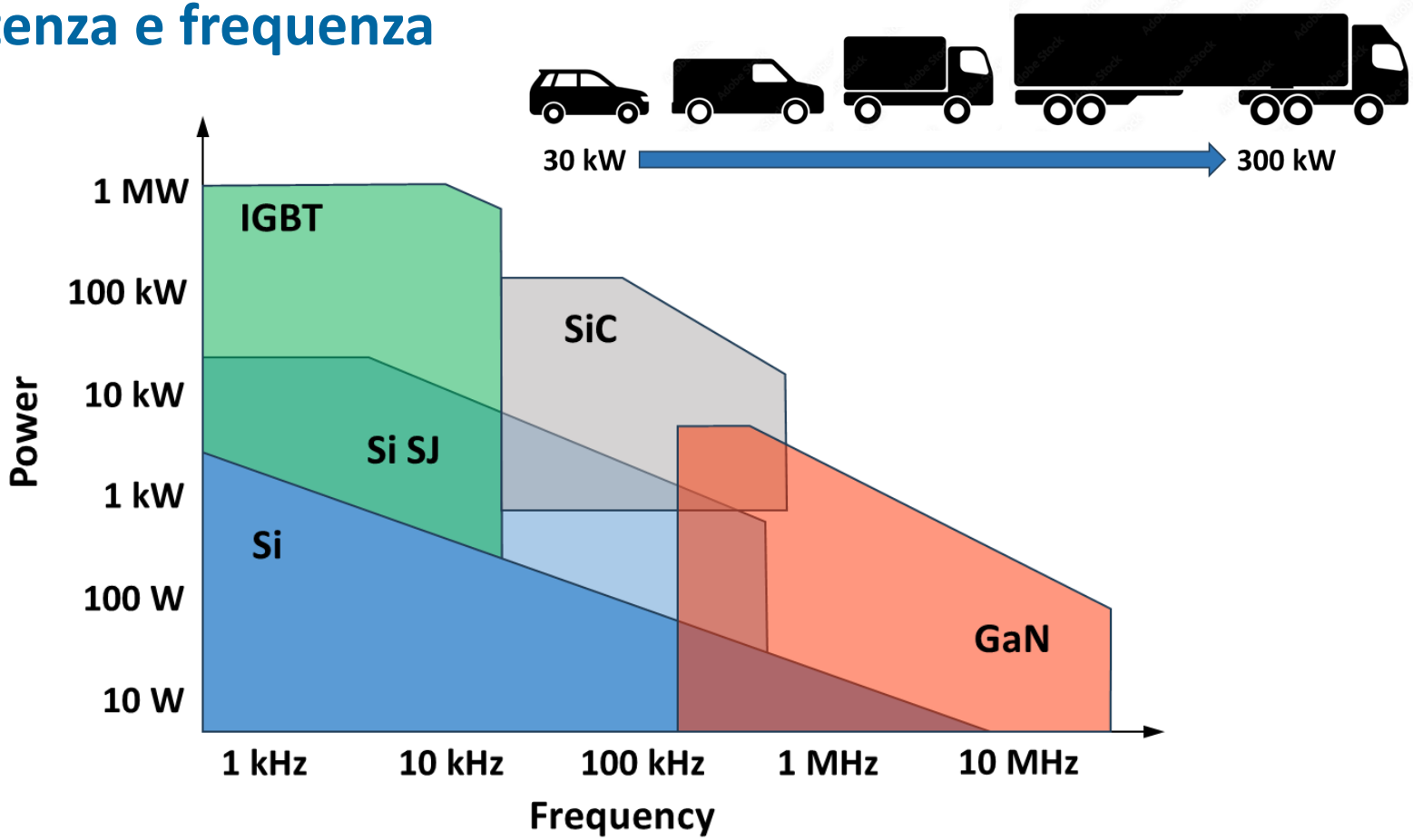
Potenza e frequenza

Potenza e frequenza

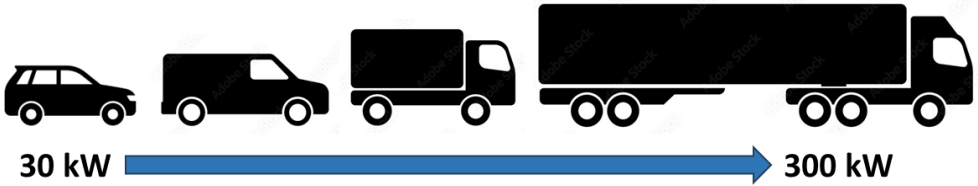
85 kHz

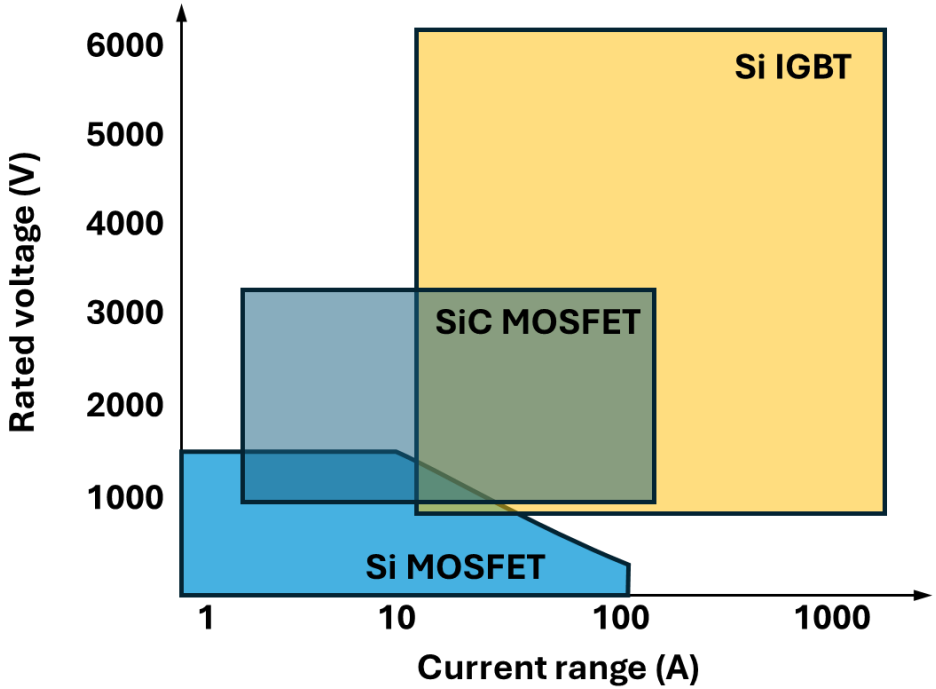
Potenza e frequenza

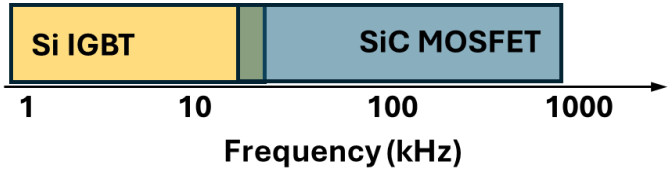
Potenza e frequenza



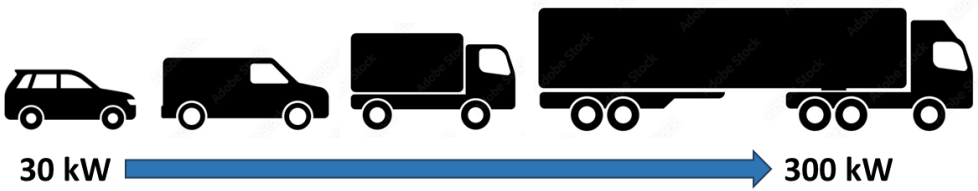
Potenza e frequenza

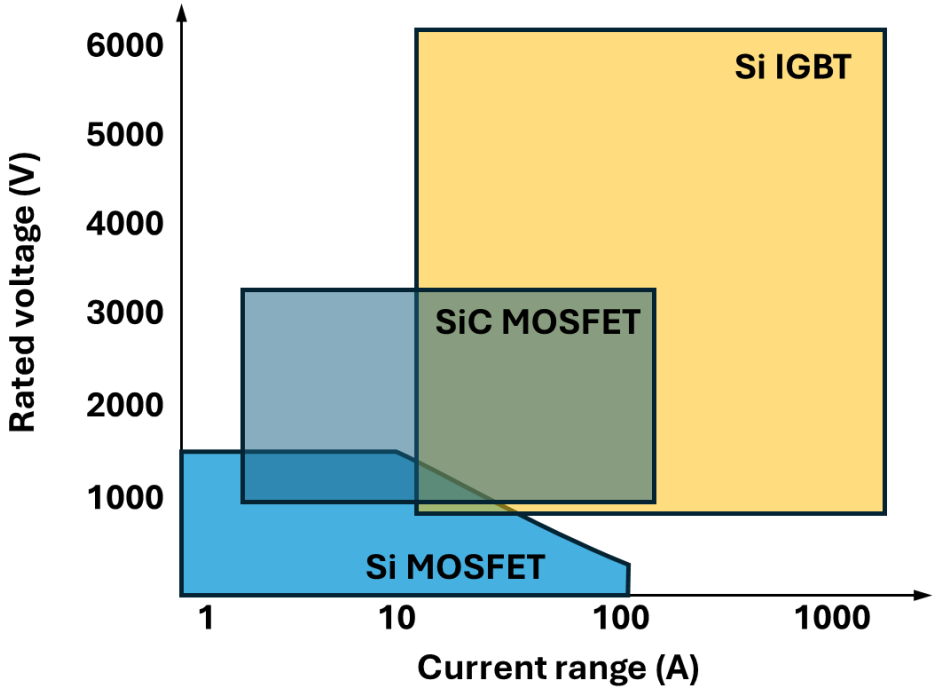


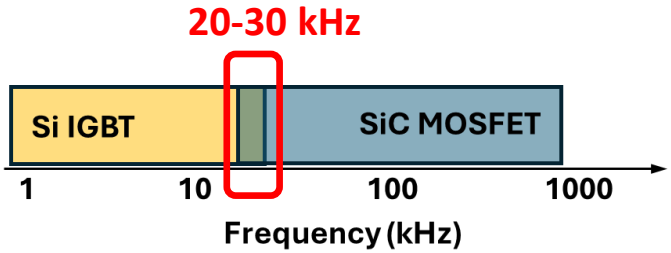




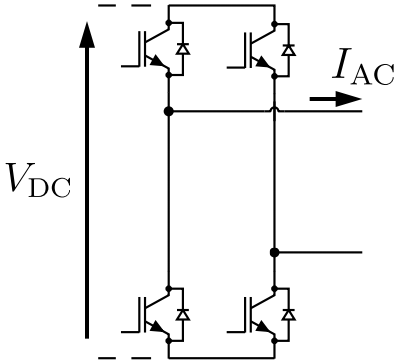
Potenza e frequenza





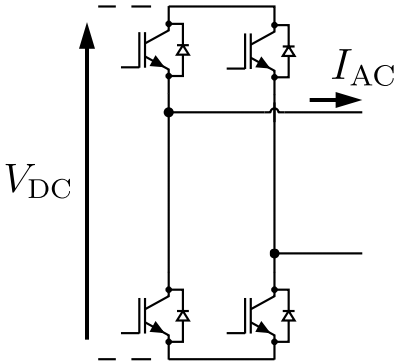


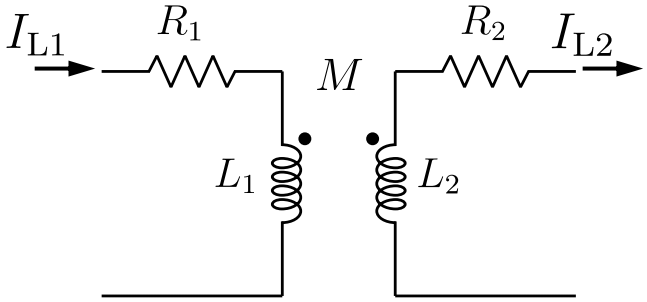
Potenza e frequenza



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

Potenza e frequenza





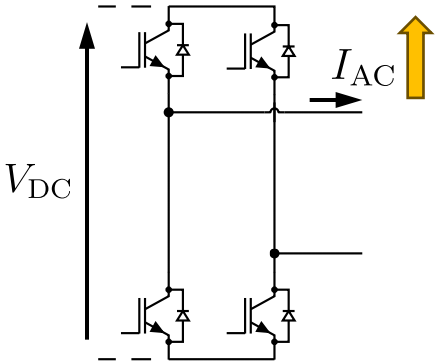
$$\eta \propto \frac{1}{I_{AC}^2}$$

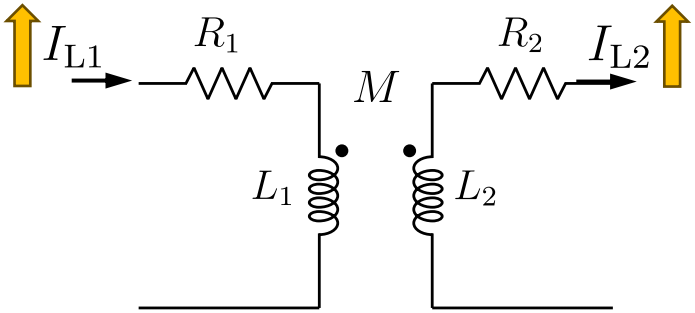
$$\eta \propto \omega^2 M^2$$

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

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

Potenza e frequenza





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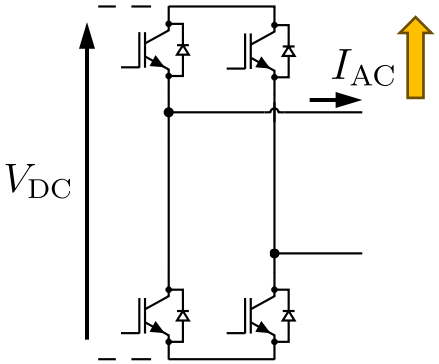

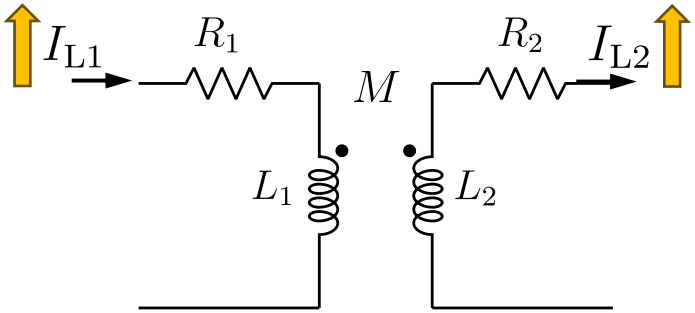

Esposizione ai campi mangetici!

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

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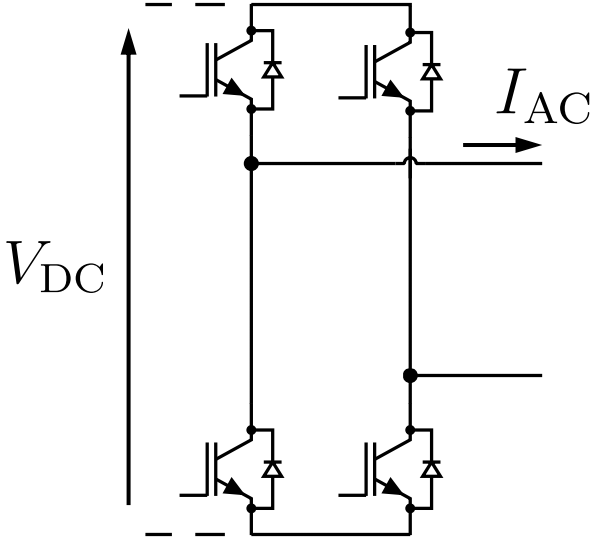
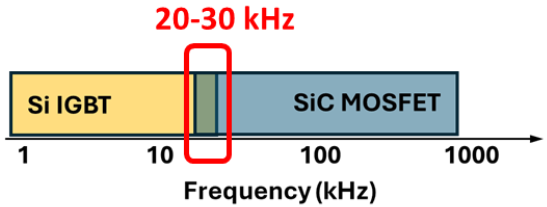
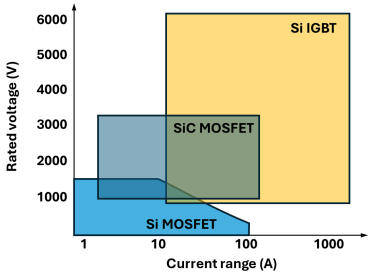
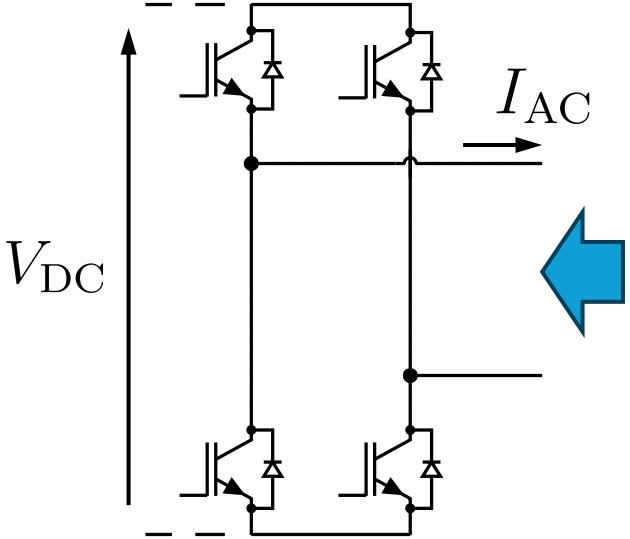
Potenza e frequenza

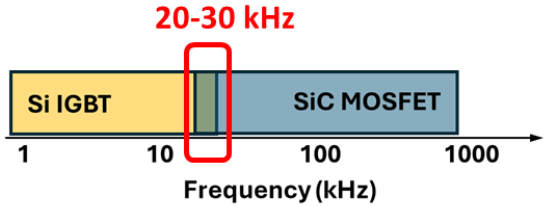


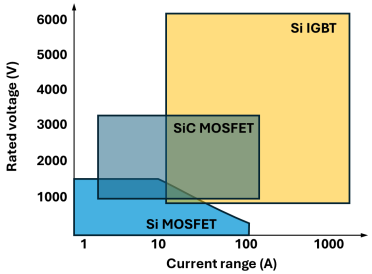




Potenza e frequenza

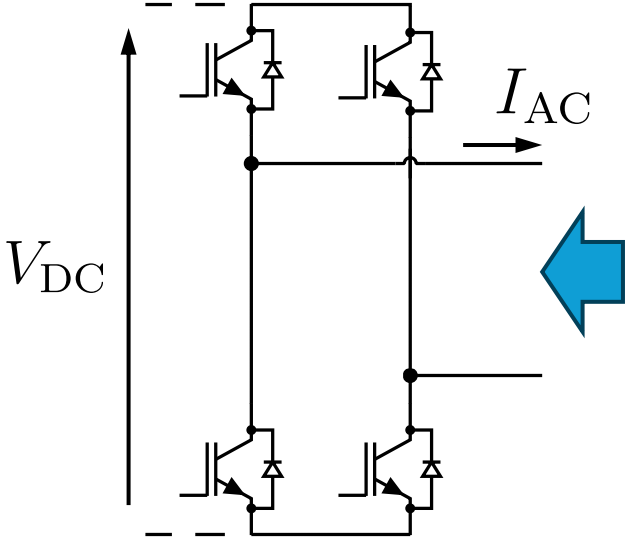


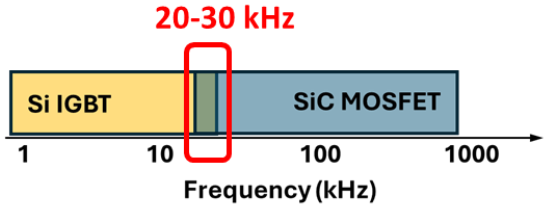


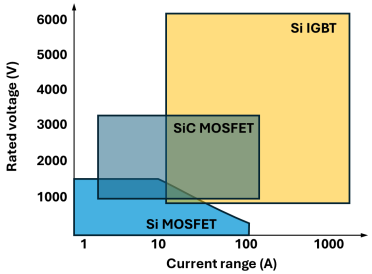


$$Z_{\mathrm{eq}} \propto \omega^{\alpha}, M^{\beta} \quad (\alpha, \beta = 1, 2)$$

Potenza e frequenza



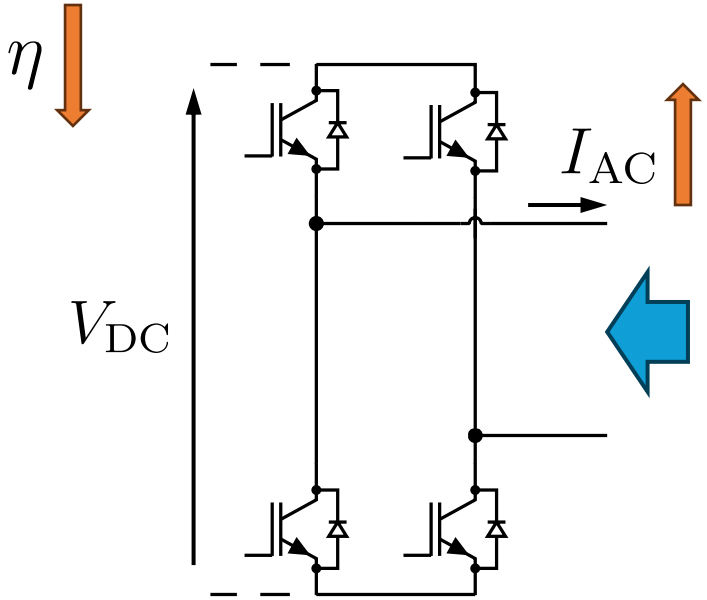




$$Z_{eq} \propto \omega^{\alpha}, M^{\beta} \quad (\alpha, \beta = 1, 2)$$

$\omega \downarrow$

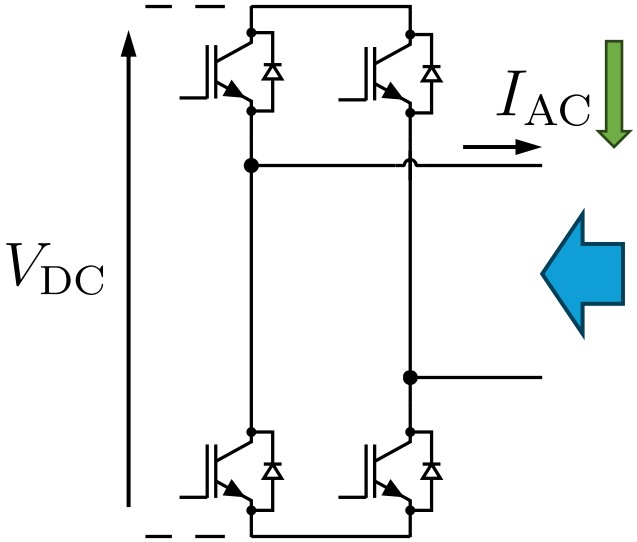
Potenza e frequenza



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

ω

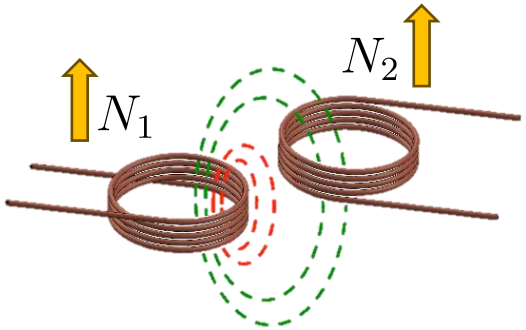
Potenza e frequenza

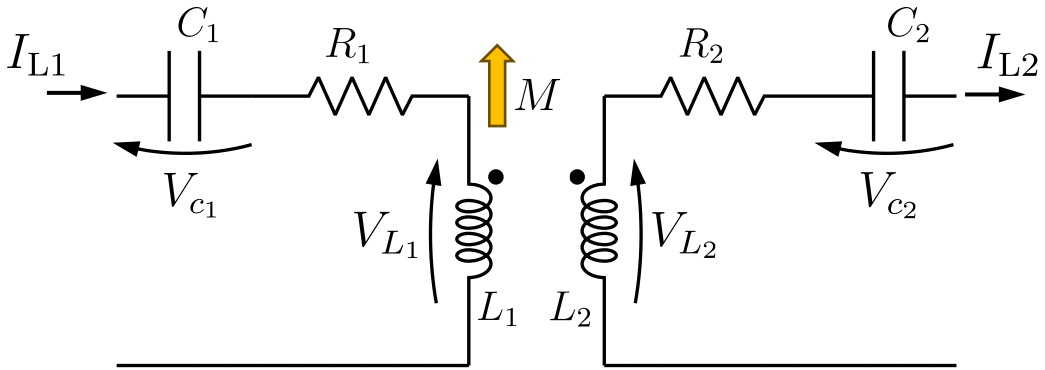


$$Z_{\mathrm{eq}} \propto \omega^{\alpha}, M^{\beta} \quad (\alpha, \beta = 1, 2)$$

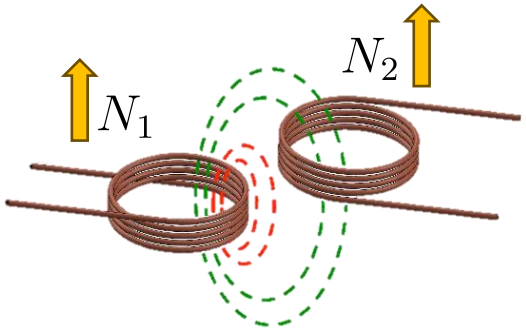
M

Potenza e frequenza

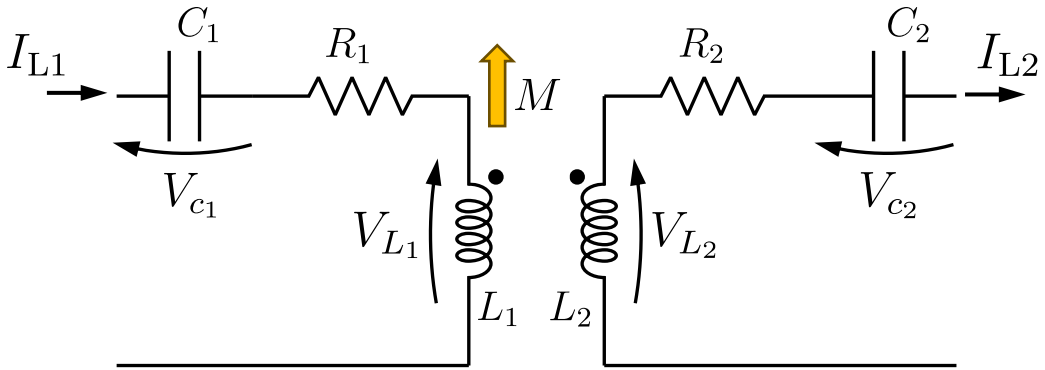




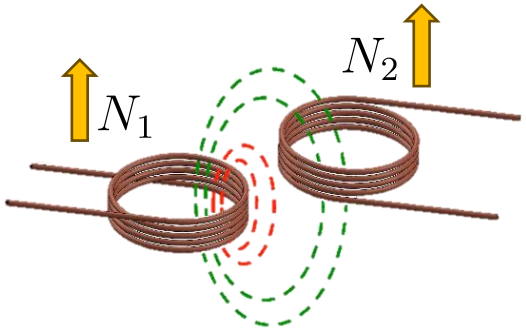
Potenza e frequenza



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



Potenza e frequenza



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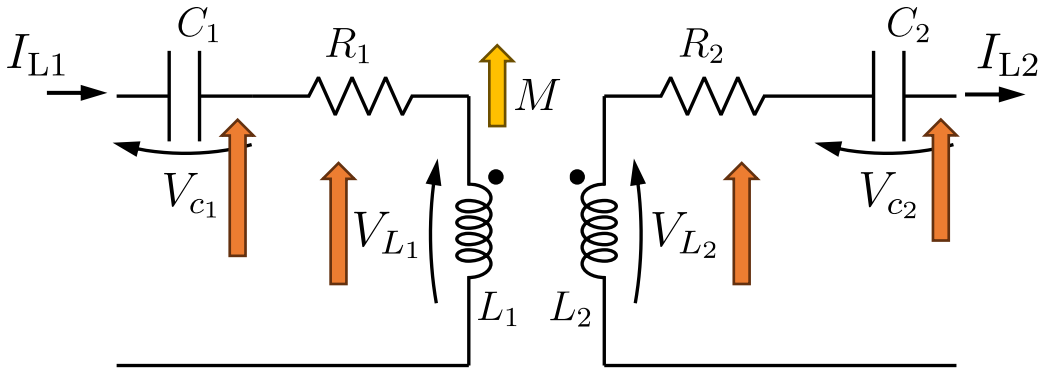

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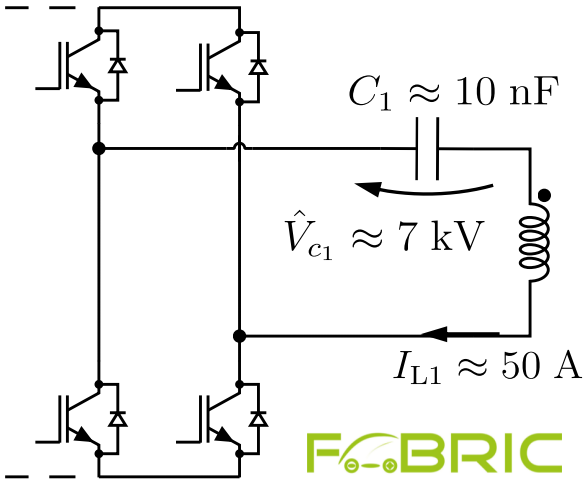
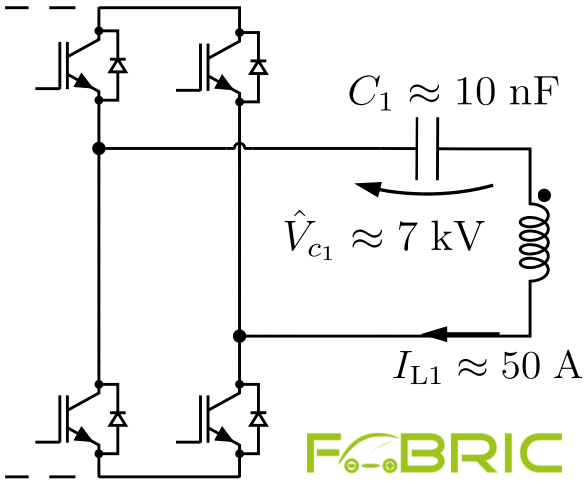


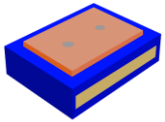
20 kW – 85 kHz

Potenza e frequenza

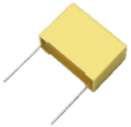


20 kW – 85 kHz

Film

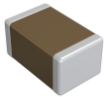


~1 kVrms ~100-1000 A



~1 kVrms ~1-10 A

Ceramici



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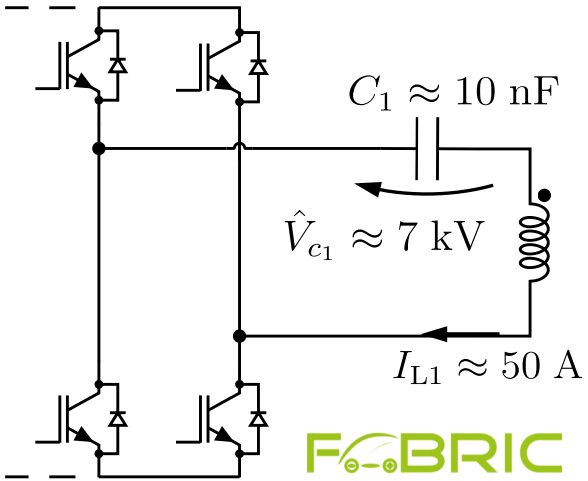
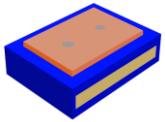
Potenza e frequenza



20 kW – 85 kHz

Film



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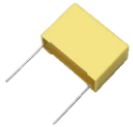
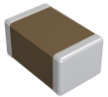


~1 kVrms ~1-10 A

Ceramici

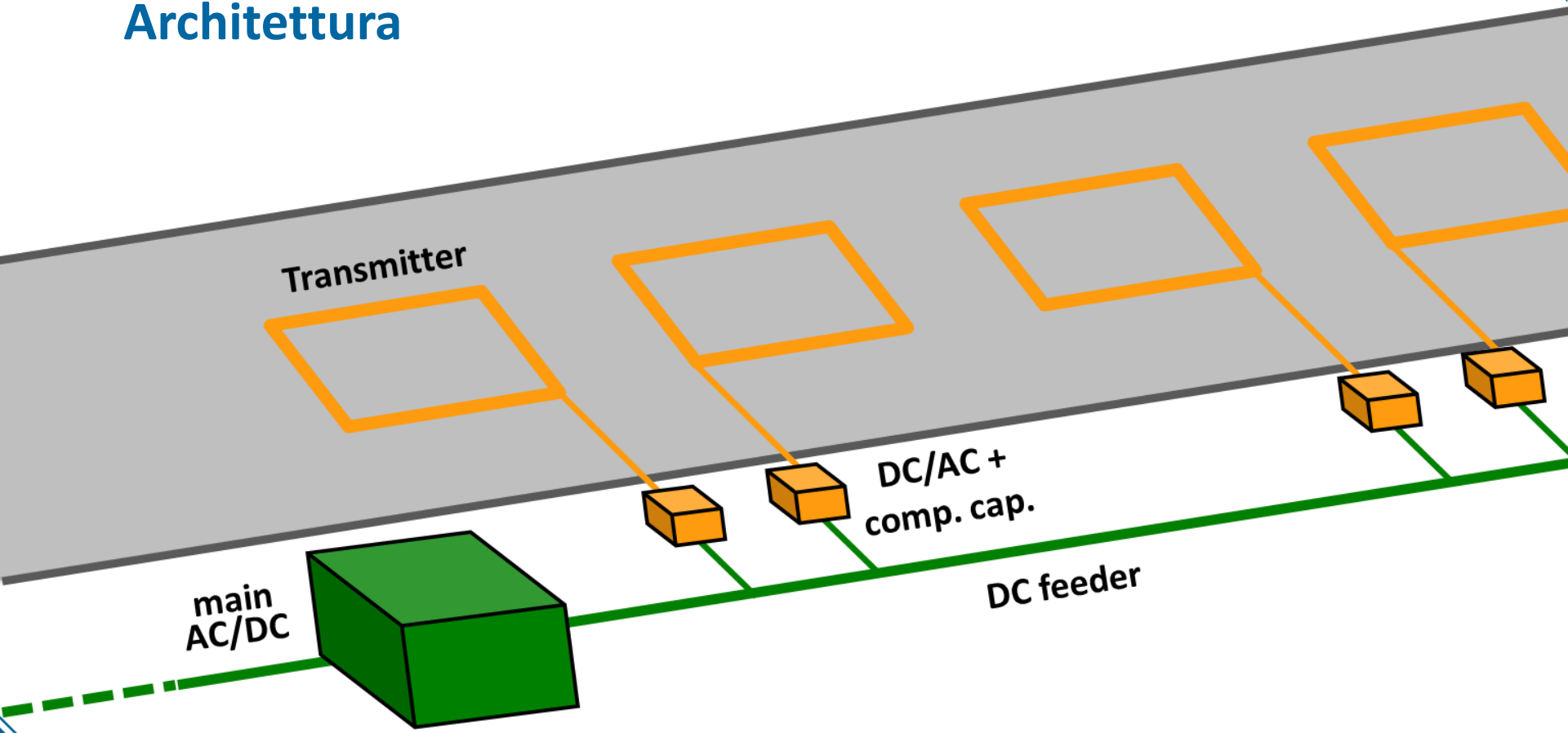


~1 kVrms ~1-10 A

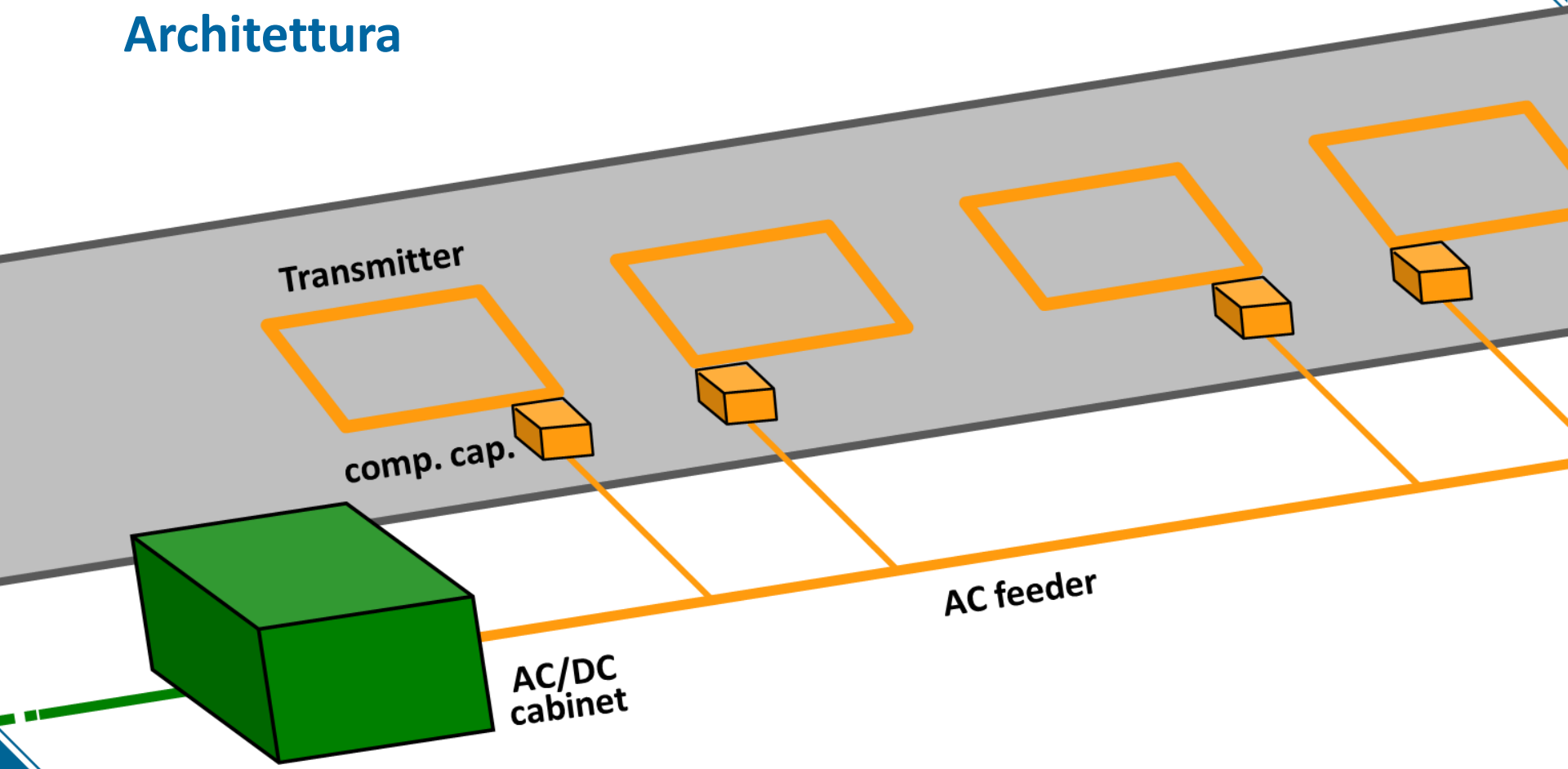
Banchi di condensatori!

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

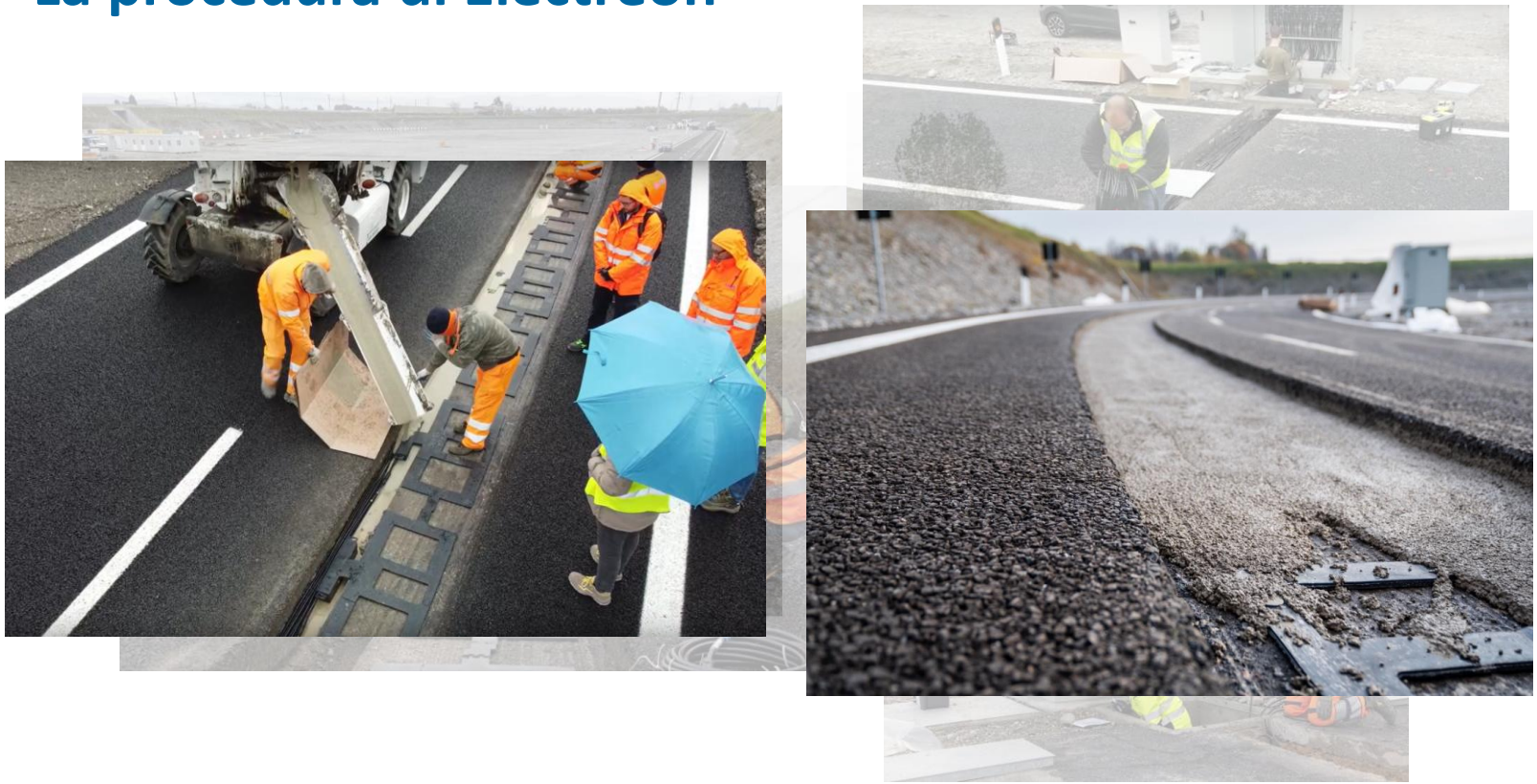
Fonte: https://www.brebemi.it/arena-del-futuro/

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

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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