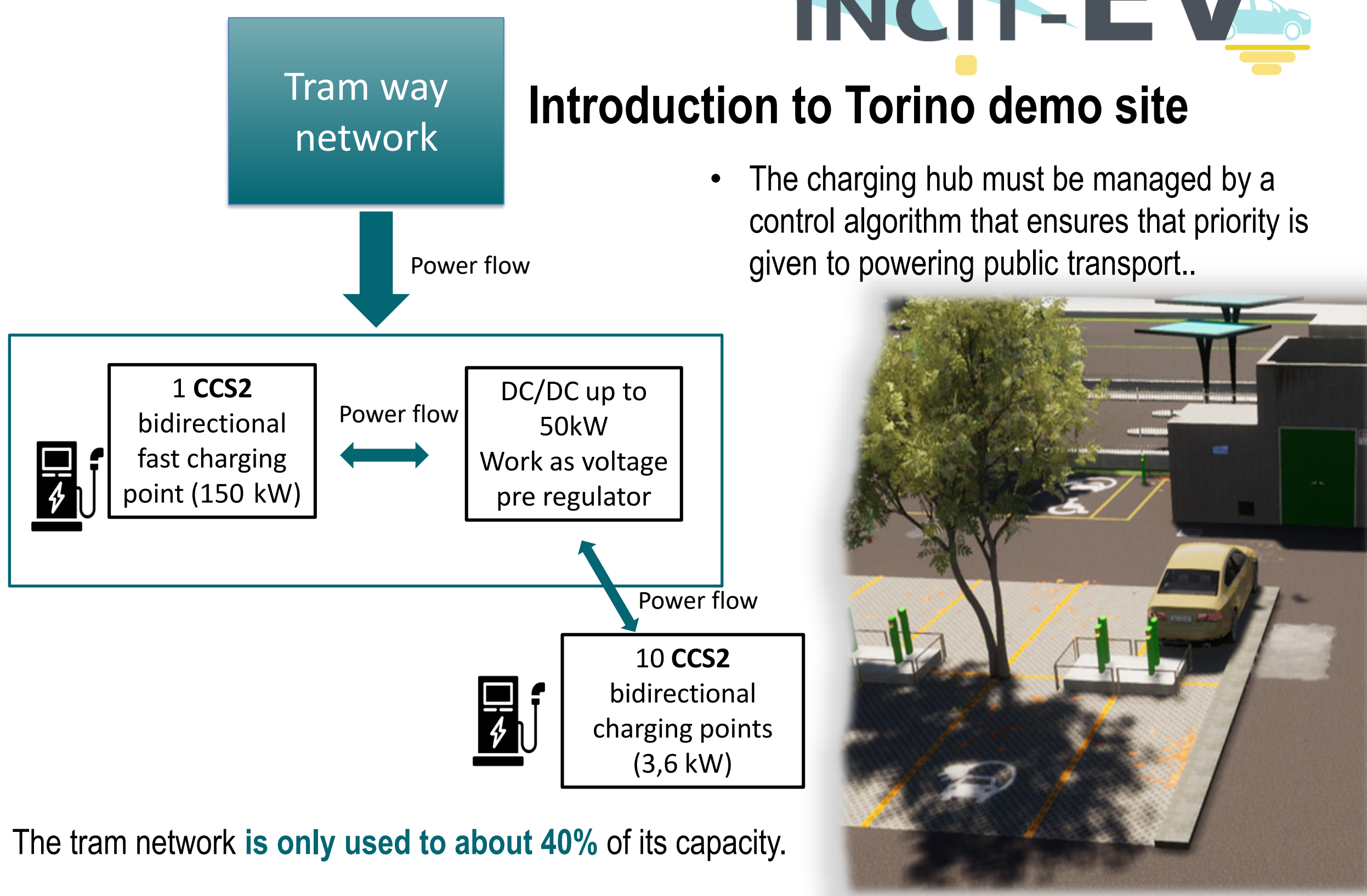


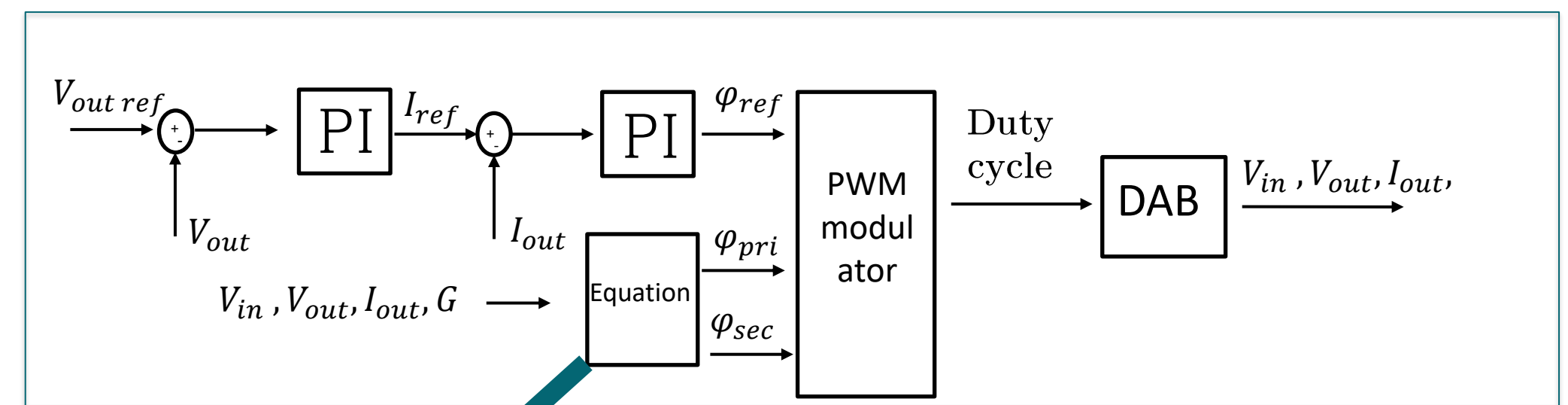
Research context and motivation

The European Project



Novel contributions

Minimal Current Stress Operation, proposed control schema



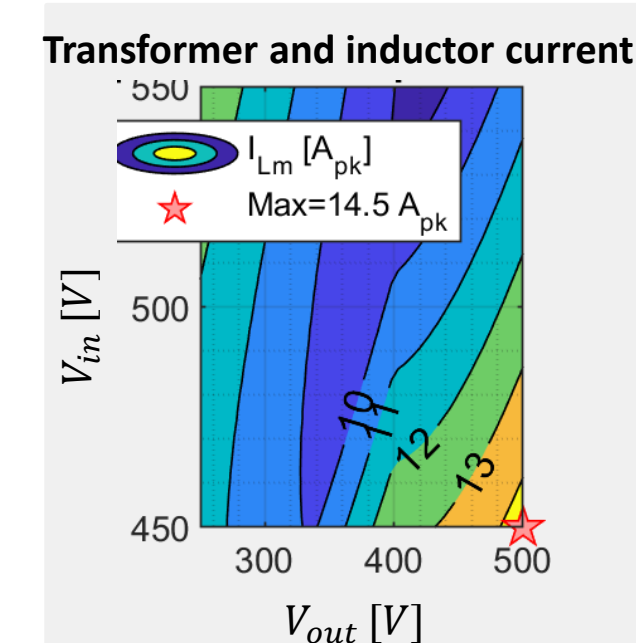
Equations that allow from φ_{ref} , which ensures power transfer, to calculate φ_{pri} and φ_{sec} to minimise the current between the reactive elements

i.e.

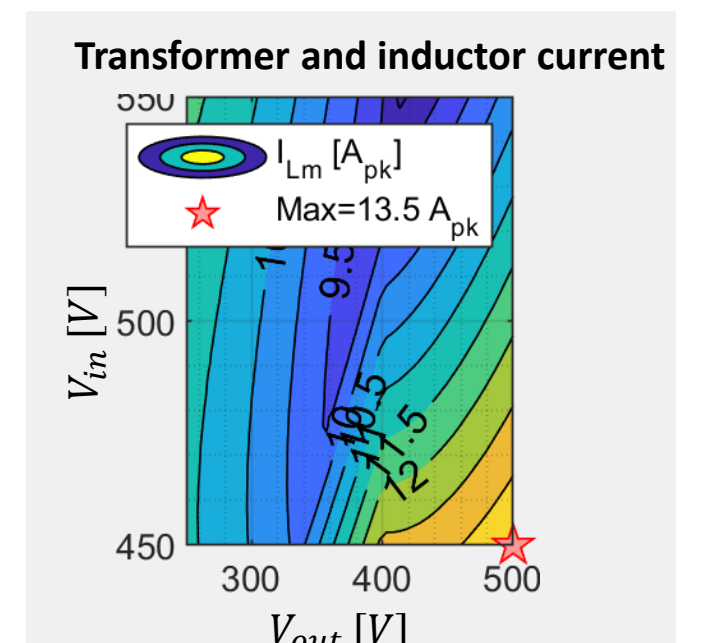
$$G > 1 \ \&\& \ \frac{2(G-1)}{G^2} \leq P_{calc} \leq 1$$

$$\varphi_{pri} = (G-1) \sqrt{\frac{1-P_{calc}}{G^2-2G}} + 2$$

SPS modulation



MCSO modulation



Addressed research questions/problems

The structure chosen for the DC/DC is the Dual Active Bridge

Planar transformer

- Layout designed to minimize the parasitic capacitance $C_p < 200pF$

L series	L_s	90 μH
N_p/N_s	t	1.33
Range voltage input	V_{in}	450-550 V
Range voltage output	V_{out}	250-500 V
Maximum power	P_{max}	3.6kW

Reactive element losses

Terminal simulation - Air cooling

Analysis of the losses

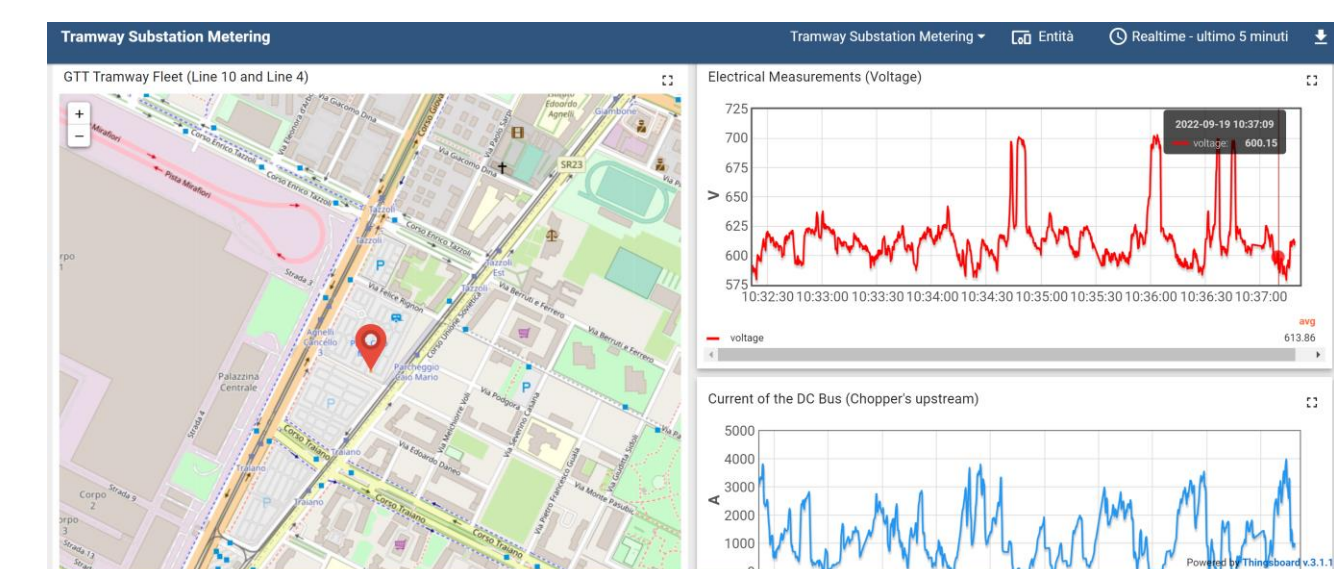
Adopted methodologies

Dual active bridge 3.6kW prototype

- Up to 97.4 efficiency
- DC contactor
- Wide output voltage range

Substation monitoring

Real-time monitoring of substation voltage, current and tram position.



Future work

Future works

- Connection to vehicle according to the iso 15118-20 for bidirectionality
- implementation of plant and building works necessary for the completion of the demonstration site, installation of battery chargers
- Test the demo site

Submitted and published works

- Colussi, Jacopo, Roberto Re, and Paolo Guglielmi. 2022. "Modelling and Design of a Coils Structure for 100 kW Three-Phase Inductive Power Transfer System" *Energies* 15, no. 14: 5079
- Colussi, Jacopo, Alessandro La Ganga, Roberto Re, Paolo Guglielmi, and Eric Armando. 2021. "100 kW Three-Phase Wireless Charger for EV: Experimental Validation Adopting Opposition Method" *Energies* 14, no. 8: 2113.
- La Ganga, Alessandro, Roberto Re, and Paolo Guglielmi. 2021. "Input Parallel Output Series Structure of Planar Medium Frequency Transformers for 200 kW Power Converter: Model and Parameters Evaluation" *Energies* 14, no. 5: 1450
- A. L. Ganga, S. Reyhan, R. Re, J. -M. Dalbavie and P. Guglielmi, "Losses and thermal considerations on an IPOS structure with 20kW high-frequency planar transformers," 2020 International Conference on Electrical Machines (ICEM), 2020, pp. 921-926

List of attended classes

- 02LGXRV Valutazione di impatto ambientale di campi magnetici ed elettrici a frequenza industriale (19/7/2021, 26.67)
- 02ITTRV Generatori e impianti fotovoltaici (12/5/2021, 33.33)
- 02LCPRV Experimental modeling: costruzione di modelli da dati sperimentali (6/8/2021, 45.33)
- European PhD School: Power Electronics, Electrical Machines, Energy Control and Power Systems (23/5/2022, 40)
- ECPE online Tutorial "EMC in power electronic" (28/4/2022 12)
- ECPE Online Tutorial 'Drivers and Control Circuitry for IGBTs and MOSFETs (23/2/2021, 16)
- ECPE Online Tutorial 'Wide Bandgap User Training' (19/5/2021, 13)