POLITECNICO DI MILANO

# PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 38th cycle

## Research Area n. 3 - Systems and Control

**PNRR_352 Research Field: COMFORT CHARGING AND VEHICLE-GRID INTEGRATION (VGI)**

| Monthly net income of PhDscholarship (max 36 months) |
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| **€ 1400.0** |
| In case of a change of the welfare rates during the three-year period, the amount could be modified. |

| Context of the research activity | |
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| **Motivation and objectives of the research in this field** | The exponential growth of the Electrical vehicles (EV) diffusion will have a great impact on one side on the entire automotive industry and mobility experience and on the other side on electrical energy demand and infrastructure. In such a complex evolution, the recharging systems currently commercialized will have to evolve to improve on both aspects.<br> On the EV side there is the opportunity to revolutionize the entire charging experience, reducing the time to start a charging session and avoiding the intervention of humans' interaction. There are many strategies to reach this goal using wireless technologies or robotized solutions to be deepened and evaluate to guide future technologies.<br> On the other side to reduce the impact of the increasing number of EVs on the energy demand the charging solutions must be exploited on one hand to stabilize the grid, and on the other as an opportunity to explore VGI(Vehicle-grid-integration) schemes |
| **Methods and techniques that will be developed and used to carry out the research** | The process of the research will be articulate in following phases:<br> 1. Technology research on handsfree bidirectional solutions<br> 2. Technology research for the Vehicle-Grid-Integration<br> 3. Classification and comparison of found technologies |

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| | 4. Identification of KPIs to measure the impact on automotive and energy industries<br><br>5. Modelling and simulation of the more promising solutions identified<br>6. Feasibility study of the best solutions<br>7. Design of a testable prototype<br>8. Realization of a prototype in collaboration with an external partner<br><br>Will be used the following methods:<br><br>Theorethical studies:<br>- Technology watching<br>- Studies of possible application.<br>- SWOT and Benchmarking methods<br>- Standards and regulation studies<br>- Technology impact<br><br>Simulations tools:<br>- Matlab/SIMULINK<br>- Python<br>- Montecarlo Simulations<br>- Multiphysics simulations.<br><br>Design tools:<br>- Orcad/PSPICE/Altium design tools |
| **Educational objectives** | - Knowledge and understanding<br>The Ph.D. candidate will learn<br>- the EV Charing challenges,<br>- the principles of energy systems modeling (programming and optimization technique)<br>- Power electronics for charging modelling and design to be able to apply them to different tools and instruments.<br>The candidates will also learn standards and challenges of the Electrical vehicle and energy industries.<br><br>- Applying knowledge and understanding<br>The Ph.D. candidate will be able to apply environmental techno-economic evaluations to different case studies. |

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| | - Critical assessments<br>The Ph.D. candidate will learn how to identify crucial aspects:<br>- of a EV charging user experience,<br>- of energy demand and grid integration<br><br>- Communication<br>The Ph.D. candidate will learn how to communicate the results of the Ph.D. research presenting results analysis in a scientific context and policy brief to decision-makers. |
| **Job opportunities** | This research activity will qualify the candidate for future academic and research positions, as well as for a highly qualified professional career in industries or organizations. |
| **Composition of the research group** | 2 Full Professors<br>3 Associated Professors<br>5 Assistant Professors<br>30 PhD Students |
| **Name of the research directors** | Prof. Sergio Matteo Savaresi |

| Contacts |
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| sergio.savaresi@polimi.it<br>+39.02.2399.3545<br>https://savaresi.faculty.polimi.it/ |

| Additional support - Financial aid per PhD student per year (gross amount) | |
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| **Housing - Foreign Students** | -- |
| **Housing - Out-of-town residents (more than 80Km out of Milano)** | -- |

| Scholarship Increase for a period abroad | |
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| **Amount monthly** | 700.0 € |
| **By number of months** | 6 |

| National Operational Program for Research and Innovation | |
|---|---|
| **Company where the candidate will attend the stage (name and brief description)** | Free2move eSolutions S.p.A. - Piazzale Lodi 3 - 20137 Milano |
| **By number of months at the company** | 6 |
| **Institution or company where the candidate will spend the period abroad (name and brief description)** | Stanford University, Stanford Energy Control Lab (Prof. Simona Onori) |
| **By number of months abroad** | 6 |

| Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information |
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**Attinenza alla tematiche, alle missioni/componenti prescelte del bando PNRR v. D.M. 352, art.6**

Il Progetto di ricerca è attinente alle seguenti missioni del PNRR:

2. Rivoluzione verde e transizione ecologica: l'applicazione dei risultati dello studio sviluppato nel presente progetto di ricerca a un caso applicativo di eMobility contribuisce alla componente M2C2 "Transizione energetica e mobilità sostenibile" in quanto abilita la costruzione di un ecosistema di comunità energetiche che possono fornire servizi di ricarica a coloro che utilizzano veicoli elettrici, garantendo la sicurezza delle transazioni, dei pagamenti e dell'autenticazione verso il sistema.

3. Infrastrutture per una mobilità sostenibile: oltre che contribuire alla rivoluzione verde, l'approccio proposto può essere adottato in un contesto di logistica integrata in cui diversi attori collaborano e si coordinano per efficientare le logiche ed i sistemi di trasferimento di merci sia dal punto di vista economico che di impatto ambientale. Da questo punto di vista, il progetto contribuisce alla componente M3C2 "Intermodalità e logistica integrata".

**Impresa, presso cui si svolgerà l'attività esterna**

Free2move eSolutions S.p.A. (NHOA Group)

Settore attività: electric mobility, electric vehicle fast and ultra-fast charging infrastructure

L'attività dello studente in azienda riguarderà principalmente le attività sperimentali della ricerca, ovvero lo sviluppo di uno o più prototipi di sistemi di automazione ("hands-free") della ricarica di un veicolo elettrico, e lo studio/sperimentazione di soluzioni di gestione di flussi di energia vehiche-to-grid.

**Ente, università, azienda, centro di ricerca presso cui si svolgerà il periodo di studio e ricerca all'estero**

Stanford University, Stanford Energy Control Lab (Prof. Simona Onori)

The research activity will focus on the interconnection between the electric car and the grid (algorithms for managing power flows)

Previous collaborations on research projects and student exchange

**All information regarding educational activities, personal funding, regulations and obligations of Ph.D. candidates are available on the web site https://dottoratoit.deib.polimi.it/**