

ESTECO DESIGN COMPETITION 2018 RULES AND REGULATIONS



ESTECO S.p.A. and Cummins Inc. are proud to announce the launch of the ESTECO Academy 2018 Design Challenge dedicated to Engineering Students around the world.

Test your skills in energy system sizing, numerical analysis, simulation and optimization to design the perfect Microgrid system. The top 3 teams will receive cash prizes while exceptional work might also be rewarded with the opportunity of an internship at a Cummins site.

Competing teams will enjoy a hands-on experience and learn how to balance the use of cutting edge software technology with their analytical applied mathematics and engineering background, in the quest for the optimal design.

1. GENERAL INFORMATION AND DEADLINES

Teams of undergraduate and graduate students of engineering and applied science departments around the world are invited to compete in the ESTECO Academy & Cummins Microgrid Design Challenge in collaboration with ANSYS and Gamma Technologies.

The competition challenge consists of the design/sizing of a hybrid microgrid that uses both conventional and renewable energy sources to provide energy supply to a manufacturing facility. By leveraging the power and flexibility of ESTECO's modeFRONTIER optimization platform, the participating teams will use principles of engineering and modelling tools to design the best microgrid with reduced overall costs and minimized CO₂ emissions, taking into account the operating conditions and respecting the constraints. In addition, they are also encouraged to design and optimize, at their choice, one or more of the components of the microgrid to optimize system performance. The submitted work should be innovative and should demonstrate the use of the modeFRONTIER optimization platform; the jury will favor designs which lead to significant improvements in energy usage and sustainability.

The most successful entries will be those that leverage advanced or novel engineering applications while adding creativity to the entire design (sizing) process. The objective of the competition is to encourage students to model, simulate and optimize, at all levels (system, subsystem and component) an unconnected microgrid. The scope of the design problem is intentionally broad to foster creative thought and produce innovative designs.

All intellectual property (IP) generated during the competition will be wholly owned by the inventors. ESTECO, Cummins Inc. and the other partners ANSYS and Gamma Technologies, will not claim any stake in the students' IP as a result of their participation in the ESTECO Academy Microgrid Design Competition.

a. ADMISSION REQUIREMENTS AND PARTICIPANTS

Participants can be individuals or teams up to 5 people currently enrolled in a postgraduate or undergraduate university course. Each member of the team must be able to prove his/her student status by means of a current enrollment certification.

To participate in the competition, individuals/teams must register by filling in this form > academy.esteco.com/competition

b. DEADLINES AND IMPORTANT DATES

3rd September 2018 > Registrations open

7th December 2018 > Closing team registration

30th May 2019 > Closing project work submissions

September 2019 > Winner announcement and Award Ceremony

c. DELIVERABLE FORMATS

Submissions will be judged on the basis of a technical report (maximum 12 pages), accompanied by a presentation (maximum 20 slides), with project strengths and the motivations behind the proposed design solution. Additional materials - video of a pitch explaining why proposed solution works (max 1.30 min) - is highly recommended to support the submission.

The technical report should clearly identify the assumptions made and the possible limitations of the simulation model(s) used. Engineering choices not verified by a quantitative analysis should be justified using other means.

Templates for both the technical report and the presentation will be available for download on the web page.

All submissions must be sent to academycompetition@esteco.com



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d. JUDGING PANEL AND CRITERIA

The judging panel will include one member for each company promoting the competition and will be either a company representative or an external judge chosen by the company. The jury's decision is final.

The results will be judged on the basis of the following three criteria:

- innovation proposed by the team compared with traditional solutions and/or solutions already available in the open technical and scientific literature
- methodology adopted
- predicted (and justified) performances at the system (microgrid) and component (if applicable) level

e. PRIZES *

1st Prize:

\$ 600

1 year of ESTECO Academy membership for each team member

2nd Prize:

\$ 300

1 year of ESTECO Academy membership for each team member

3rd Prize:

\$ 300

1 year of ESTECO Academy membership for each team member

f. AWARD CEREMONY

To be held in September 2019.

* Cash prizes will be kindly provided by ESTECO North America.

2. THE DESIGN CHALLENGE

The design challenge topic is the sizing and the definition of an unconnected hybrid microgrid that uses traditional and renewable energy sources to reliably cover the complete electric energy requirements of the Cummins Phaltan India Campus. In addition, participating teams are welcome to design and optimize, at their choice, one or more of the components of the microgrid for optimal system performance.

DESIGN OBJECTIVES

Teams have to concentrate on the optimization of an hybrid microgrid and, if desired, one or more of its components, by using modeFRONTIER multidisciplinary optimization platform in order to minimize the overall costs, for the 10 year period, and minimize annual CO2 emissions.

Since the two objectives are, in general, not compatible, the teams will need to select one of the optima solutions (Pareto front) using one or more criteria of their choice. Teams should innovate at topology/system level and/or utilize the physics/controls capabilities within GT/ANSYS tools, or other modelling tools of their choice, to optimize individual components of the system.

LOCATION, ENERGY REQUIREMENT AND LOAD PROFILE

- The microgrid is located in Phaltan, Maharashtra (India) and serves the Cummins Phaltan India Campus which includes 6 onsite facilities.
- The annual energy requirement is about 25000 MWh, and the microgrid would be the only source of energy to the site.
- The load profile will be provided for a typical year and consists of the power requirement for every hour of the year (8760 element vector).

WEATHER PROFILE

The weather profile will be provided for:

- Available global solar irradiance on horizontal surface every hour of year (8760 element vector W/m^2)
- Direct normal irradiance and diffuse horizontal irradiance every hour of year (2×8760 element vector)
- Temperature, pressure, dew point, wind velocity/direction every hour of year (8760 element vector)

ENVIRONMENTAL IMPACT

- Diesel CO₂ Production – 2.70 kg CO₂/Liter
- Utility electricity carbon factor - 0.822 metric tons CO_{2e}/MWh (for establishing benchmark)
- Land Cost - \$50000/acre (leave size unconstrained but this factor should be taken into account in overall cost)

ENERGY SOURCES

It is compulsory that each team utilize Diesel genset(s) as one of the elements of their microgrid system. Each team must either utilize existing Cummins genset(s) or design their own. Data sheets for Cummins gensets can be found at the following website: <https://power.cummins.com/commercial-industrial/generators> (India requires 50Hz gensets).

Required \$/kW, maintenance cost, etc. is provided, as an indication, for each of the potential energy sources. Teams have full design freedom/selection for all renewable sources of energy. They may create their own designs completely, utilize existing products or modify existing products to produce optimal system performance and cost.



Traditional Diesel Genset details (compulsory)

- \$500/kW installed new
- 30000 hr overhaul cycle with 60% cost of new
- Regular maintenance - \$.01/(kWh year)
- Diesel consumption – 4.2 kWh/Liter
- The fuel consumption increases by 3% for every 10% reduction in engine power from rated.
- 40ft ISO container per 2MW 8 ft by 8 ft

Solar photovoltaic system details (optional)

- \$900/kWp
- Maintenance - \$0.01/(Wp year)

Wind turbine details (optional)

- \$1000/kW
- Maintenance - \$.01/(kWh year)

Battery details (optional)

- Lithium NMC

- Power converters \$500/kW
- \$450/kWh
- 6MWh per 40ft ISO container

- LFP (Lithium Iron Phosphate)

- Power converters \$500/kW
- \$300/kWh
- 2MWh per 40ft container
- Maintenance - \$10/(kWh year)

3. SOFTWARE TOOLS AVAILABLE

Teams will be provided with the ESTECO Academy membership including the license of modeFRONTIER and access to the online training portal.

ANSYS and Gamma Technologies kindly offered to sponsor the competition and will provide their software suites and example models. The use of these modelling software tools is suggested, although teams may use other software tools to complement the analysis.

Specific training webinars will be organized to help teams set up their models and integrate the two tools with modeFRONTIER.

Once the registration is approved, the team will receive download links to install the ESTECO modeFRONTIER software and a VPN access to connect to the license server. The access will be granted for the entire duration of the competition, until the submission of projects deadline.

To know more about modeFRONTIER: **ESTECO Academy membership**

ANSYS and Gamma Technologies will directly provide access and licensing for their respective software tools and models. For more information about ANSYS and Gamma Technologies software, email us at **academy@esteco.com**.

