

## ACCOMMODATION

Suggested hotels, close to the Engineering School are:

Hotel Barceló Renacimiento \*\*\*\*\*

Isla de la Cartuja, s/n

41092 Sevilla

Phone. 954462222, Fax 954463383

[http://www.barcelo.com/BarceloHotels/es\\_ES/hoteles/Espana/Sevilla/hotel-barcelo-sevilla-renacimiento/descripcion-general.aspx](http://www.barcelo.com/BarceloHotels/es_ES/hoteles/Espana/Sevilla/hotel-barcelo-sevilla-renacimiento/descripcion-general.aspx)

Hotel Tryp Macarena \*\*\*\*

C/ San Juan de Ribera, 2

41009 Sevilla

Phone. 954375700; Fax 954381803

<http://www.melia.com/es/hoteles/espana/sevilla/tryp-sevilla-macarena-hotel/index.html>

Hotel NH Plaza de Armas \*\*\*

Avda. Marqués de Paradas, s/n

41001 Sevilla

Phone. 954901992; Fax 954901832

<http://www.nh-hoteles.es/hotel/nh-sevilla-plaza-de-armas>

Hotel Eurostars Islacartuja \*\*\*\*

Isla de la Cartuja-Sector Norte, s/n

41092 Sevilla

Phone. 954081700; Fax 954081779

<http://www.exeislacartuja.com>

## COURSE FEES

The course fees include lectures attendance, documentation, coffee breaks and lunches.

Members of the EES-UETP: **300 EUR**

University non-members of EES-UETP: **700 EUR**

Industry non-members of EES-UETP: **1400 EUR**

The course secretariat will send an invoice to each registered participant, after the reception of the filled registration form, together with the bank transfer information.

Other information can be found at:

<http://www.ees-uetp.com/upcoming.php/>

## INFORMATION, REGISTRATION AND COURSE LOCATION

Secretariat: Mr. Rafael Gómez-Martin

[secre\\_ie@us.es](mailto:secre_ie@us.es)

Phone: +34 954487283, Fax: +34 954487284

### Course Coordinators

Prof. Antonio Gómez Expósito

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Escuela Técnica Superior de Ingeniería

Isla de la Cartuja

Av. de los Descubrimientos s/n

E-41092 Sevilla



## ELECTRIC ENERGY SYSTEMS UNIVERSITY ENTERPRISE TRAINING PARTNERSHIP

<http://www.ees-uetp.com/>

### 2015 Course Program

## Building-to-Smart-Grid Integration

June 17 to 19, 2015



Escuela Técnica Superior de Ingeniería

Isla de la Cartuja

Av. de los Descubrimientos s/n

E-41092 Sevilla, Spain

### Organized by

Department of Electrical Engineering  
UNIVERSITY OF SEVILLE

## OBJECTIVES

Despite continuous upgrades and improvements to the systems that form electricity grids, the fundamental operation of these systems has changed relatively little over almost one hundred years. Assuming that neither grid-scale nor distributed storage are deployed at scale for a decade or more and that renewable generation will continue to become an increasing component in the generation mix, the problem becomes one of how best to enable flexible demand side participation of building sited electricity consumers given a mix of traditional and renewable generation.

Historically, resources on the demand side have played a relatively inflexible role in energy markets, requiring grid balancing to be achieved solely through modulation of generating resources. However, buildings can create additional grid flexibility to aid in absorbing the intermittency of variable generation resources. Previous work has demonstrated that significant peak electric demand reductions can be achieved through active thermal energy storage systems and by utilizing passive building mass as a thermal storage medium.

Buildings with significant thermal mass may also be well suited to provide ancillary services, including spinning and non-spinning reserve. Recent work has also considered controllable building electric loads for economic dispatch in energy markets, including transmission constraints. As an example, researchers recently demonstrated that chilled water supply temperature could be modified to create responsive changes in electric demand. Frequency regulation in commercial buildings has also recently been investigated. Moreover, combined heat and power (CHP) plants, installed in individual buildings or campuses, can provide both distributed generation and building HVAC services at high efficiencies.

Through better integration of building and electric grid operations, greater system efficiencies can be achieved by buildings actively participating in energy markets which in turn can enable greater amounts of renewable generation by creating

elasticity in the demand for electricity. In addition, buildings can benefit from providing ancillary services through lower utility bills due to energy price arbitrage, demand charge reductions, demand response revenue, and ancillary service revenue.

This interdisciplinary short-course invites attendees from a wide spectrum of backgrounds interested in energy engineering to understand the demand and supply sides of the electric grid system, explore opportunities for integration of buildings into the smart grid, and quantify the benefits of load side flexibility through hands-on laboratory and simulation practice sessions.

## COURSE DURATION

Two days and a half: June 17<sup>th</sup> to 19<sup>th</sup>, 2015

## CONTENTS / SCHEDULE

### June 17 (Wednesday)

08:00-08:30 Registration

08:30-08:45 Welcome and course overview (A. Gómez-Expósito, G. Henze)

### Part I: Building Energy Systems

09:00-10:30 Building energy systems: Residential, commercial, and campus installations (G. Henze, M. Brandemuehl, C. Felsmann)

10:30-11:00 Building energy end uses: HVAC, lighting, DHW, miscellaneous electric loads, appliances, occupancy effects (M. Brandemuehl)

11:00-11:30 *Coffee break*

11:30-12:15 Thermal energy storage: Active, passive, ground-source HX (G. Henze)

12:15-13:00 Cogeneration systems (C. Felsmann)

13:00-14:30 *Lunch*

14:30-16:00 Building system response opportunities (G. Henze, M. Brandemuehl, C. Felsmann)

16:00-18:00 Practice session: Load flexibility in buildings energy systems (G. Henze, M. Brandemuehl)

### June 18 (Thursday)

### Part II: Smart Distribution Systems

09:00-10:00 Power systems basics (A. Gómez-Expósito)

10:00-11:00 Smart distribution grids (I): Power components (J. Maza-Ortega)

11:00-11:30 *Coffee break*

11:30-12:30 Smart distribution grids (II): ICT components (S. Carillo Aparicio)

12:30-13:30 Data mining and forecasting (F. Martínez Álvarez)

13:30-15:00 *Lunch*

15:00-16:00 Regulatory and market design issues (T. Gómez San Román)

16:00-17:00 Microgrids operation and control (J. Mauricio)

17:00-18:00 Energy procurement for active distribution systems (M. Carrión)

20:00-22:30 *Course Dinner*

### June 19 (Friday)

### Part III: Building-to-Grid Integration

09:00-11:00 Practice session: distribution networks including flexible loads and distributed generation (J. L. Martínez-Ramos, A. Marano)

11:00-11:30 *Coffee break*

11:30-12:30 Panel *"Removing barriers between buildings and grids"*

## COURSE COORDINATORS

**Prof. Antonio Gómez Expósito** *University of Sevilla*

**Prof. Gregor Henze** *University of Colorado*

## OTHER INSTRUCTORS

**Prof. Michael Brandemuehl** *University of Colorado*

**Dr. Susana Carillo Aparicio** *Endesa Malaga*

**Prof. Miguel Carrión** *Universidad de Castilla la Mancha*

**Prof. Clemens Felsmann** *Technical University of Dresden*

**Prof. Tomás Gómez San Román** *Pontificia Comillas*

**Prof. Alejandro Marano** *University of Sevilla*

**Prof. Francisco Martínez Álvarez** *Univ. Pablo de Olavide*

**Prof. José L. Martínez Ramos** *University of Sevilla*

**Prof. Juan M. Mauricio** *University of Sevilla*

**Prof. José M. Maza-Ortega** *University of Sevilla*

**The number of attendees is limited. In case of low enrollment, we reserve the right to cancel the course.**