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<i>Korth, T., Loistl, F., Schweigler, C.</i>	<b>1218</b>
<b>Development of an Active High Temperature PCM Storage Concept with Coated Heat Exchanger Plates</b>	
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<i>Puertas, A.M., Battles, F.J., Gil, B., Grageda, M., Kasperski, J., Luján, M., Maldonado Castro, D., Nems, A., Nems, M., Romero-Cano, M.S., Rosiek, S., Ushak, S.</i>	<b>1268</b>
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### **Seasonal Thermochemical Heat Storage: First Measurements on a Falling Film Tube Bundle Laboratory Setup**

*Daguenet-Frick, X., Gantenbein, P., Haerle, A., Lichtensteiger, F., Lustenberger, D.* **1345** .....

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*Nem, A., Bathes, F.J., Gil, B., Kasperski, J., Nem, M., Puertas, A.M., Rosiek, S.* **1393** .....

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*Schäppi, R., Basler, P., Furler, P., Haueter, P., Muroyama, A., Rutz, D., Steinfeld, A.* **1405** .....

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*An, S.M., Kim, J.H., Park, M.K.* 1564 .....

#### **Analysis of the Integration of an Electric Bus and an Electric Vehicle with Grid-Connected PV Systems and a Storage System**

*Kirsten Vidal de Oliveira, A., Goulart, V., Mendes Ferreira Gomes, A., Rüther, R., de Albuquerque Montenegro, A.* 1574 .....

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*Balderrama, S., Colombo, E., Howells, M., Lombardi, F., Peña, G., Quoilin, S., Sahlberg, A., Stevanato, N.* **1638**
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*de Oliveira Carvalho Malaquias, P., Alencar de Souza, B.* **1648**
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*Wills, S., Cosgrove, A., Kam, S.Z., Margets, P., Rickard, D.* **1660**

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- Field Experiences and Lessons Learned with Photovoltaic Off-Grid and On-Grid Applications in Northern Chile**  
*Schmidt, R., Allende, M., Martinez, M., Potter, W.* 1726 . . . . .

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*Avsec, J., Brandl, D., Ferec, J., Novosel, U., Schober, H., Strušnik, D.* 1740 . . . . .
- Experimental Investigation and Characterization of Façade Integrated PVT Collectors With and Without Insulation**  
*Dannemand, M., Furbo, S., Jensen, A.R., Sifnaios, I.* 1752 . . . . .
- Study on the Guiding and Control Index for the Design of Residential Building in the Northwest China Focuses on Generalized Solar Energy Utilization**  
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*Du, J., Li, D.* 1780 . . . . .
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*Gremmelspacher, J.M., Campama Pizarro, R., van Jaarsveld, M.P.B.* 1791 . . . . .
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*You, K., Kim, S., Park, M., Yun, Y.* 1802 . . . . .

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Du, J., Wang, Y.**1858** .....

### IEA SHC Task 61 / EBC Annex 77 Integrated Solutions for Daylighting and Electric Lighting / Subtask D: Lab and Field Study Performance Tracking

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### Building Integrated Photovoltaic (PV) Systems – Energy Production Modelling in Urban Environment

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### Life-Cycle Assessments of Near Zero Energy Buildings (NZEBS) and Beyond in Comparison with Regular New Buildings

Mørck, O., Engelund Thomsen, K., Sanchez Mayoral Gutierrez, M., Wittchen, K.B.**1889** .....

### Methods and New Results for Design Recommendations on Sustainable Solar and Passive Housing in Emerging Countries and in Mediterranean Climate Zones

Müller, E.**1900** .....

- Global Solar Transmittance of Vertical Glazings Oriented Towards the Equator**  
*Vitale, G., Abal, G., Bove, I., Pereyra, J.* **1912**
- Public Response to Installation of Building Integrated Photovoltaic System (BIPV) to Residential Buildings in Wuhan, China**  
*Yang, W., Li, C., Ozansoy, C.* **1923**

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- Worldwide Climate Modeling of Diffuse Solar Fraction from One-minute Irradiance**  
*Barni, C.M., Boland, J., Cardemil, J., Colle, S., Lemos, L.F.L., Machado, R.D., Starke, A.R.* **1934**
- The Use of Solar Radiation Models to Derive Atmospheric Turbidity from Measured Irradiance: An Inter-Comparison Study**  
*Behar, O., Fuentealba, E., Marzo, A., Moran, L., Sbarbaro, D., Trigo, M.* **1946**
- Evaluation of Two Procedures for Selecting the CIE Standard Sky Type Using High Dynamic Range Images**  
*García, I., Hernández, B., Ormazábal, M., Sáenz, C., Torres, J.L., de Blas, M.* **1958**
- Assessment of Empirical Models to Estimate UV-A, UV-B and UV-E Solar Irradiance from GHI**  
*Laguarda, A., Abal, G.* **1969**
- Life Cycle Assessment of Two Experimental Recycling Processes for c-Si Solar Modules**  
*Monteiro Lunardi, M., Corkish, R., Marcelo Veit, H., Ribeiro Dias, P., Schmidt, L.* **1981**
- On the Complementary Variability of Wind and Solar Power**  
*Perez, M., Perez, R.* **1991**
- Importance of Time Averaging Conventions**  
*Perez Astudillo, D., Bachour, D.* **1996**
- IEA PVPS Task 16 – Solar Resource for High Penetration and Large Scale Applications**  
*Remund, J., Polo, J., Renné, D., Sengupta, M., Silva Pérez, M., Wilbert, S.* **2001**
- Advances in Aerosol Optical Depth Evaluation from Broadband Direct Normal Irradiance Measurements**  
*Salmon, A., Cardemil, J., Escobar, R., Gueymard, C., Ibarra, M., Marzo, A.,  
Polo, J., Quiñones, G., Soto, G.* **2007**
- Method and System for Accessing PV Resource Data from the NSRDB**  
*Sengupta, M., Buster, G.* **2017**
- Development of Daylight Availability Maps in Italy: Methodology and Validation**  
*Spinelli, F., Signoretti, P., Terrinoni, L., Zinzi, M.* **2022**
- Evaluation of the Heliosat-4 and Flashflux Models for Solar Global Daily Irradiation Estimate in Uruguay**  
*Teixeira Alves Branco, V., Alonso-Suárez, R., Gonzalez, J.* **2033**

<b>Assessment of Six Different Methods for the Estimation of Surface Ultra-Violet Fluxes at One Location in Uruguay</b>	
Thomas, C., Arola, A., Laguarda Cirigliano, A., Pfeifroth, U., Ranchin, T., Trentmann, J., Wald, L., Wandji Nyamsi, W.	<b>2043</b>
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Alonso-Montesinos, J.	<b>2062</b>
<b>Probabilistic Solar Forecasts Evaluation Part 1: Ensemble Prediction Systems (EPS)</b>	
David, M., Lauret, P., Le Gal La Salle, J., Ramahatana Andriamasomanana, F.H.	<b>2074</b>
<b>Performance Assessment of Intra-Day Solar Irradiation Forecast in Uruguay Using Satellite Cloud Motion Vectors</b>	
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<b>Probabilistic Solar Forecasts Evaluation Part 2: Quantile Forecasts</b>	
Lauret, P., David, M., Le Gal La Salle, J., Ramahatana-Andriamasomanana, F.	<b>2091</b>
<b>Effect of Cloudiness on Solar Radiation Forecasting</b>	
López, G., Alonso-Montesinos, J., Barbero, J., Batllés, F.J., Ferrada, P., Gueymard, C.A., Martín-Chivelet, N., Marzo, A., Polo, J., Sarmiento-Rosales, S.M., Vela, N.	<b>2098</b>
<b>Implementing k-Nearest Neighborhood as a Forecast Method for Intra Hour Resolution with No Exogenous Outputs</b>	
Martins, G., Braga, M., Campos, R., Rüther, R.	<b>2109</b>

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*Hota, S.K.*2325.....

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*Jahn, N., Bilbao, J., Saldivia, D.*2336.....

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