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RENEWABLE ENERGY

Market integration in Germany

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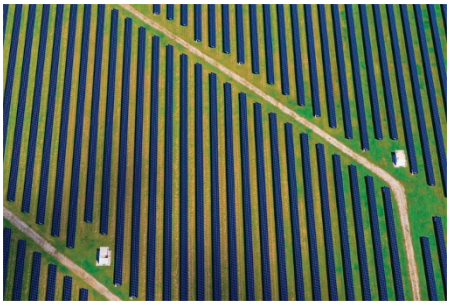

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Renewable energy (RE) has been insulated from market dynamics in most energy systems to stimulate investments and to offer an appropriate incentive, particularly for small and private investors. However, some decades since their first implementation, and considering the significant penetration of RE into the energy mix, instruments that are able to shift risk away from RE generators need to be reconsidered to give room for more efficient mechanisms. Now, Michael Pahle from the Potsdam Institute for Climate Impact Research and Henriette Schweizerhof from Allianz Climate Solutions study ways in which incremental risk exposure to RE generation in Germany can couple improved efficiency with reduced total costs.

Using an approach that combines an auctioning framework with power purchasing agreements (PPAs), the researchers find that these two elements can improve market readiness for both private investors and risk-averse financial counterparts. The proposed business model creates incentives for RE generators to participate in the market by designing a cascading mechanism with a decreasing reserve price. This is coupled with price risk transfer guaranteed by a portfolio of PPA provisions, that partially offset price and/or volume risk. However, the proposed arrangement requires a credible regulatory environment able to provide a stable long-term vision, where carbon pricing and mitigation policies will define the upper limit on the potential risk transfer. *AR*

RESIDENTIAL ENERGY DEMAND

Consumption unzipped

Energy Rep. **2,** 21–27 (2016)

Residential energy consumption is driven by a number of factors, from the size and energy efficiency of dwellings to the behaviours and circumstances of the individual occupants. A better understanding of these factors would enable the design of more effective policies aimed at conserving energy and promoting sustainable behaviours. To shed light on this issue, Afamia Elnakat and colleagues at the University of Texas, San Antonio studied the socioeconomic and demographic characteristics of the inhabitants of the city of San Antonio and explored their effect on energy consumption.

The researchers analysed 2010 census information to build profiles of 54 ZIP code areas within San Antonio. They then matched these profiles with the corresponding region's electricity and natural gas consumption data for a period of 48 months. From this, they were able to examine the relationship between the different socioeconomic and demographic variables and total energy use, energy use per capita and energy use per home. They found that ZIP codes with more female than male residents used significantly more energy on a total and per household basis. The researchers also found that energy consumption increases with educational attainment and income, and that areas with more owner-occupied homes tend to use more energy than those with more renter-occupied homes. Such analyses can help to build more region-specific interventions for utilities and local governments. *ND*

CATALYSIS

Structurally sensitive synthesis

Nat. Commun. **7,** 13057 (2016)

Methanol is a versatile fuel and energy vector that can be used directly in fuel cells, blended with transportation fuels or deployed as a hydrogen carrier. Its synthesis from syngas (a mixture of CO and H_2) over copper–zinc catalysts is well-known, but there is debate about whether the surface-specific activity (turnover frequency, TOF) of copper nanoparticles is affected by particle size. Petra de Jongh, Krijn de Jong and colleagues in the Netherlands and Denmark now demonstrate that the TOF decreases significantly for particles below a certain size, suggesting that the reaction is indeed structurally sensitive.

The researchers synthesize 42 catalysts with a range of copper particle sizes (2–15 nm) and varying loadings of zinc. Since previous studies have suggested that chemisorption techniques to measure the copper surface area are affected by preconditions and catalyst structure, the researchers instead use X-ray diffraction and microscopy to characterize the particle size distributions. Under industrially-relevant conditions, they find that decreasing the size of the particles from 8 nm to 2 nm results in a decrease in TOF by a factor of 3, whether or not the catalyst contains zinc. They propose that this could be due to changes in the fraction of specific step sites or the higher number of low-coordinated copper atoms at small particle sizes, which are more easily poisoned by reaction intermediates. *JG*

THERMOELECTRIC MATERIALS

Telluride free

Energy Environ. Sci. http://doi.org/br9r (2016)

Thermoelectric materials are able to transform thermal energy into electricity and have found increasing applications in energy-harvesting devices. Bismuth telluride (Bi_2Te_3) is a commercialized thermoelectric material, but the rarity of the Te element hinders its large-scale use. Te-free Bi_2Se_3 has been proposed as an alternative thermoelectric material but its energy conversion, often characterized by the figure of merit, ZT, remains inefficient, largely because of its low band degeneracy in the conduction band minimum. Now, Wenqing Zhang, Jihui Yang and colleagues in USA and China report on how electronic and phononic properties can be improved in iodine-doped $(Bi,Sb)_2Se_3$: the maximum ZT can reach 1.0 at 800 K, which is three times that of Bi_2Se_3 and comparable to that of Bi_2Te_3.

Starting with the Te-free $(Bi,Sb)_2Se_3$ system, the researchers identified a significant phase transition in $(Bi,Sb)_2Se_3$ due to the Sb alloying, which exerts profound effects on the physical properties of the system. The band degeneracy at the conduction band minimum is doubled, thereby improving the electron transport. Furthermore, substantial softening of the chemical bonds, along with the phase transition, significantly lowers phonon velocity and increases bonding anharmonicity, which leads to favourable phonon transport features for thermoelectrics. The researchers also showed that the iodine doping at the Se sites increases the carrier concentration, further contributing to the much improved electrical conductivity and thus the conversion efficiency. *CZ*

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