Wind energy storage problems

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Peter Edwards, Peter Dobson and Gari Owen say that net-zero targets can only be met if renewable energy can be stored cost-effectively

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Adding 3 h of energy storage, but still without excess annual generation, increases the reliability so that the most reliable mixes (white circles) meet 78-93% (average 87%) of electricity demand. The share of solar generation in these most reliable mixes increases to 15-50% (36% on average; Fig. 2b). However, the share of solar generation increases less, or even decreases, in higher-latitude countries like Russia, Canada, and Germany (Fig. 2b). These trends continue as more storage is added, so that with 12 h of energy storage and no excess annual generation, 83-94% (average 90%) of electricity demand is met with mixes of 10-70% solar power (49% on average; Fig. 2c).

Shading of bubbles represents the annual average hours of long-duration (>24 h) power supply gaps. Storage and generation quantities are varied in each panel: a 1x generation without storage; b 1x generation with 3 h of storage; c 1x generation with 12 h of storage; d 1.5x generation without storage; e 1.5x generation

with 3 h of storage; and f 1.5x generation with 12 h of storage.

Figure 3 also points to the nature of systems" unreliability: the color of bubbles indicates the average number of events in which there would be unmet demand in each of at least 24 contiguous hours (i.e., "long-duration gaps"). In systems that meet >95% of a countrie"s demand, dozens of such long-duration gaps often remain each year (yellow and green circles). In some countries, excess annual generation reduces the number of such long-duration gaps more than adding 12 h of energy storage (e.g., compare Sweden, Australia, Canada, and Russia in Fig. 3c and d).

Maps show the reliability (i.e., hourly averaged resource adequacy) at country/region scale (a; Supplementary Data 4), the subcontinent scale (b; 19 multinational regions, and listed in the SI), and at continental scale (c; 6 continents: Asia, Europe, Africa, North America, South America, and Oceania). We also evaluated the reliability of the power supply system assuming several intercontinental connections (shown as the arrows: Asia-Oceania, Europe-Asia, Europe-Africa, North America-Europe, and North America-South America). The added reliabilities for each continental power system under various connections are labeled.