period of interest and ought to be globally synchronous[4,5]. Therefore, it should provide the independent time-marker necessary to directly test our hypothesis.

The date of the AD 774–775 radiocarbon event was initially established using tree rings from two trees in Japan[4]. Subsequently, Usoskin *et al.*[5], Wacker *et al.*[6] and Büntgen *et al.*[1] established that the event occurred at the same year in two tree-ring records from Germany and two from the Alps. This illustrates that the dating of these trees is consistent and accurate.

Based on our previous results[3], we can make predictions that are consistent with our hypothesis and that can be tested using the AD 774–775 radiocarbon event and existing tree-ring chronologies. First, regarding the Alps series, our results predict that there will be no missing rings in this region. The Alps regional series we used[3] — taken from D'Arrigo *et al.*[7] — begins in AD 1350, and was included in our analysis of the climate response to the 1815–1816 Tambora eruption sequence. Our resulting 'best match' surrogate ensembles for this eruption (Fig. 2 in ref. 3) use the Alps series on its original timescale. Thus, our results are consistent with those of Büntgen *et al.*[1]. Second, of the 19 regional series used in D'Arrigo *et al.*[7] and Mann *et al.*[3], only three — coastal Alaska, Tornestraesk and Taymir — begin before AD 774 and can be directly tested by the AD 774–775 radiocarbon event. Our results[3] predict the following minimum offsets for the AD 774–775 radiocarbon event in these three series: the coastal Alaska series is four years too young, the Tornestraesk series is between one and five years too young (any offset in that range would be consistent with the AD 1258 eruption, though perhaps a one year offset is the most probable), and the Taymir series is one year too young (Fig. 1). In addition, we predict that the Icefields tree ring series[8] is correctly dated, but it starts in AD 918 and cannot be directly tested using this method.

The discovery of the AD 774–775 radiocarbon event seems to be the key to testing our missing-ring hypothesis. As proposed by Büntgen *et al.*[1], a systematic analysis of material from tree-line sites will show if the missing-ring hypothesis is correct, or if the cause of the difference between model-based estimates of post-volcanic cooling and proxy-based reconstructions of past climate lies elsewhere. ❐

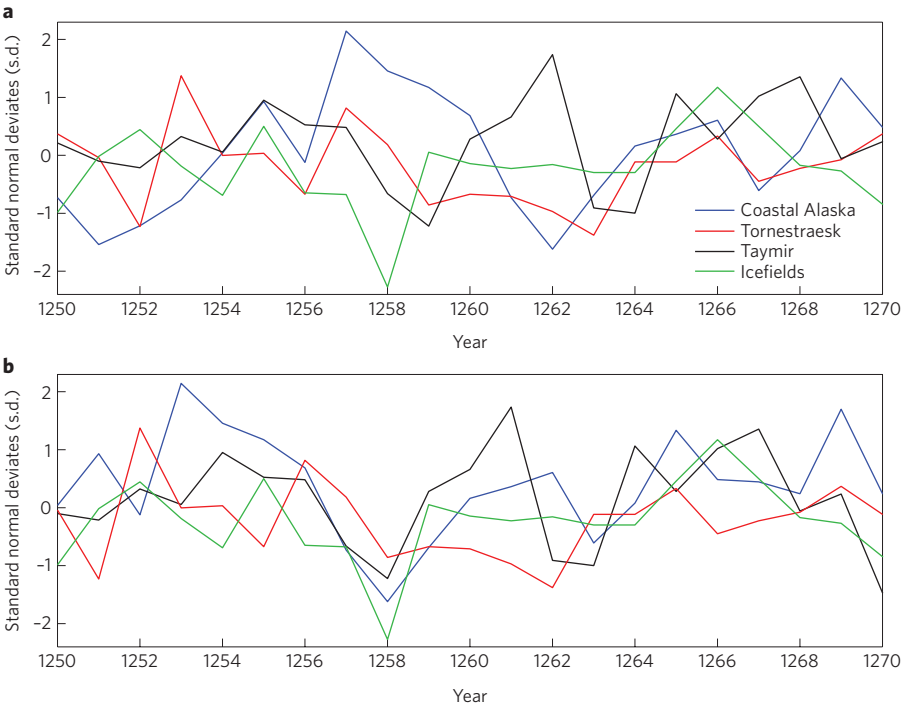

Figure 1 | Tree-ring records over the AD 1258 eruption displayed as standard deviations (s.d) about a normalized value. **a**,**b**, The three D'Arrigo *et al.*[7] regional series that begin before AD 774 — coastal Alaska (blue), Tornestraesk (red) and Taymir (black) — and, for reference, the Icefields series (green), are displayed with their original timescales (**a**) and age-adjusted timescales, consistent with our hypothesis[3] (**b**). The Icefields series is unaltered, the coastal Alaska series is shifted by -4 years (~0.6%), and the Tornestraesk and Taymir series are both shifted by -1 year (~0.1%).

References
1. Büntgen, U. *et al. Nature Clim. Change* **4,** 404–405 (2014).
2. Mann, M. E., Fuentes, J. D. & Rutherford, S. *Nature Geosci.* **5,** 837–838 (2012).
3. Mann. M. E., Rutherford, S., Schurer, A., Tett, S. F. B. & Fuentes, J. D. *J. Geophys. Res. Atmos.* **118,** 7617–7627 (2013).
4. Miyake, F., Kentaro, N., Masuda, K. & Nakamura, T. *Nature* **486,** 240–242 (2012).
5. Usoskin, I. G. *et al. Astron. Astrophys. Lett.* **552,** L3 (2013).
6. Wacker, L. *et al. Radiocarbon* **56,** 573–579 (2014).
7. D'Arrigo, R., Wilson, R. & Jacoby, G. *J. Geophys. Res.* **111,** D03103 (2006).
8. Luckman, B. H. & Wilson, R. J. S. *Clim. Dynam.* **24,** 131–144 (2005).

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Power to the people

To the Editor — Sonja van Renssen[1] sets out a compelling case for the adoption of demand-side management (DSM) in the energy sector. However, despite invoking 'people power', her appraisal of DSM does not address the important role of end users. If DSM's potential is to be met, then citizens must be considered alongside generators and distributors, policy makers, industrialists and technologists[2].

Unless existing social roles are changed, considerable danger lies in DSM being implemented as a purely regulatory and technical innovation. Within the existing energy system, the end user is simply a

consumer, energy being expended as an overwhelmingly invisible part of their daily lives[3,4]. Their engagement with the energy system is limited to occasional — often poorly understood — bills, and their views of energy providers are marked by much distrust[5]. We believe that such an arrangement is poorly suited for the development of a smart grid using DSM, which fundamentally alters the part played by the end user, from a passive to an active role.

Certainly, some demand-response could be achieved in a manner that does not require the householder to be active, but examples, such as smart fridge-freezers that schedule cooling according to grid signals, are rare. Most DSM solutions require the householder to modify their practices to varying degrees. DSM advocates must then attend to the question of how this shift in role can best be achieved.

Demand-side management as set out by van Renssen assumes a reliance on demand-responsive pricing. Trials have demonstrated successful results; however, the vast majority have required end users to opt-in[6], skewing results. One of the few large-scale non-voluntary schemes, run in northern Italy, actually resulted in increased energy use[7]. Furthermore, monetizing incentives can undermine 'social good' incentives that studies suggest can be highly effective[8,9]. A final danger in relying on a consumer frame for DSM is highlighted by van Renssen's claim that "comfort [can] not be compromised." In fact, perceptions of 'comfort' are constantly evolving, and fixing particular demands can unnecessarily exacerbate energy demand[9,10].

To harness people power, we must recognize power in terms of social agency, as well as physical forces, and approach users as energy citizens rather than consumers. One way this has already been achieved is when users become generators as well as consumers. Whether through privately- or community-owned renewables, this can be important in fostering a sense of agency; it also helps people perceive the grid as a shared resource[11]. The next step is to find further means of supporting such active engagement, giving people a real stake in the energy system. A smart grid that fails to recognize the value of smart users will be a missed opportunity. ❐

References
1. van Renssen, S. *Nature Clim. Change* **4,** 417–419 (2014).
2. Goulden, M. *et al. Energy Res. Soc. Sci.* **2,** 21–29 (2014).
3. Burgess, J. & Nye, M. *Energy Policy* **36,** 4454–4459 (2008).
4. Shove, E. *Comfort, Cleanliness and Convenience: The Social Organization of Normality* (Berg, 2003).
5. Parkhill, C., Demski, C., Butler, C., Spence, A. & Pidgeon, N. *Transforming the UK Energy System: Public Values, Attitudes and Acceptability: Synthesis Report* (UKERC, 2013); http://go.nature.com/ATa5Gv
6. Faruqui, A. & Sergici, S. *J. Regulatory Econ.* **38,** 193–225 (2010).
7. Torriti, J. *Energy* **44,** 576–583 (2012).
8. Spence, A., Leygue, C., Bedwell, B. & O'Malley, C. *J. Environ. Psychol.* **38,** 17–28 (2014).
9. Strengers, Y. *Energy Policy* **38,** 7312–7322 (2010).
10. Strengers, Y. *Policy Studies* **32,** 35–58 (2011).
11. Wolsink, M. *Renew. Sustain. Energy Rev.* **16,** 822–835 (2012).

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COMMENTARY:

Debt relief and financing climate change action

Adrian Fenton, Helena Wright, Stavros Afionis, Jouni Paavola and Saleemul Huq

Slow progress in scaling-up climate finance has emerged as a major bottleneck in international negotiations. Debt relief for climate finance swaps could provide an alternative source for financing mitigation and adaptation action in developing countries.

The institutional framework for climate finance has evolved considerably during the past two decades. However, the inability to mobilize adequate and predictable funds to support adaptation and mitigation in developing countries has become a principal source of tension between developed and developing countries.

In the Marrakesh Accords of 2001[1], it was agreed to deliver finance through the replenishment of the Global Environment Facility, bilateral and multilateral sources, the Least Developed Country Fund, the Special Climate Change Fund and the Kyoto Protocol Adaptation Fund.

The Green Climate Fund was announced during the 2009 Copenhagen Conference of the Parties (COP) and it will join the architecture of climate finance when it becomes fully operational in 2015[2]. In the Copenhagen Accord of 2009, developed countries also agreed to a goal of raising US$30 billion of 'fast-start finance' during the period 2010–2012, and to mobilize US$100 billion annually by 2020 from a variety of sources to support mitigation, adaptation, forest loss prevention (REDD+) and technology development and transfer to address the needs of developing countries.

According to the Overseas Development Institute, developed countries mobilized over US$30 billion of fast-start finance during 2010–2012[3]. Although a variety of financial instruments have been used to provide climate finance, grants and loans have dominated (Table 1). Climate finance is expected to grow further following negotiations in the 2012 Doha and 2013 Warsaw COPs, where Annex-I countries were encouraged[4] and urged[5] to continue to mobilize additional climate finance from "a wide variety of sources, public and private, bilateral and multilateral, including alternative sources"[5].

Problems

It remains debatable whether sufficient progress has been made in mobilizing

Correction

In the Commentary 'Power to the people' (*Nature Climate Change* **4,** 649–650; 2014), the two co-authors Ben Bedwell and Alexa Spence were missing. This error has been corrected in the online versions after print 8 August 2014.