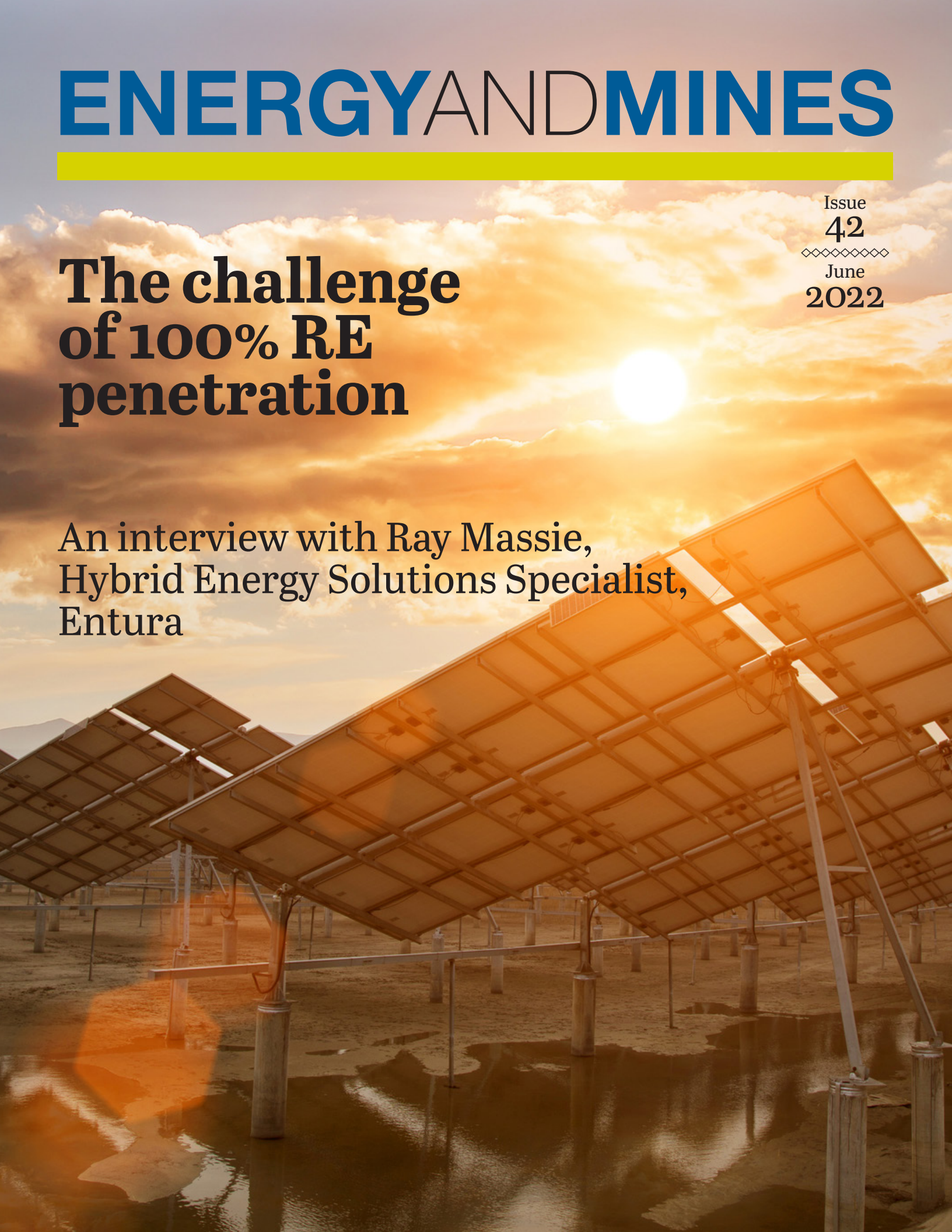
ENERGYANDMINES

Issue
42
June
2022

The challenge of 100% RE penetration

An interview with Ray Massie, Hybrid Energy Solutions Specialist, Entura



The challenges of 100% RE penetration

Entura's Hybrid Energy Solutions Specialist Ray Massie goes deep in to the details on the limits of renewable energy penetration for mines in this *Energy and Mines* Q&A.

Energy and Mines: What has changed in the last six months in terms of the scale and adoption of renewable energy hybrids for off-grid mines?

Ray Massie: We're seeing the number and size of hybrid power systems being considered, growing significantly, with systems in the order of 50 MW and 70 to 80% renewable energy for a single mine. The adoption is becoming more confident, with the challenges and risk becoming more widely understood. Though, there is still significant scope to make technical advances, the conversation has turned to more about optimisation of economic sizing rather than concerns over making it work. The integration of multiple interconnected mine site power systems are in the conceptual phase, with first phases of execution likely to begin in the near term.

EandM: What are the main drivers for this shift to bigger and more complex hybrids for mines?

RM: I see three main drivers: possibly increased confidence based on several successfully implemented projects; fuel costs presently, as well and the risk of future increases; and the social license to operate: for those lagging in adoption of renewable generation there is a risk to reputation and public perception. Further to this there is increased interest in carbon emissions in the supply chain for all goods, so low-carbon minerals and metals will become

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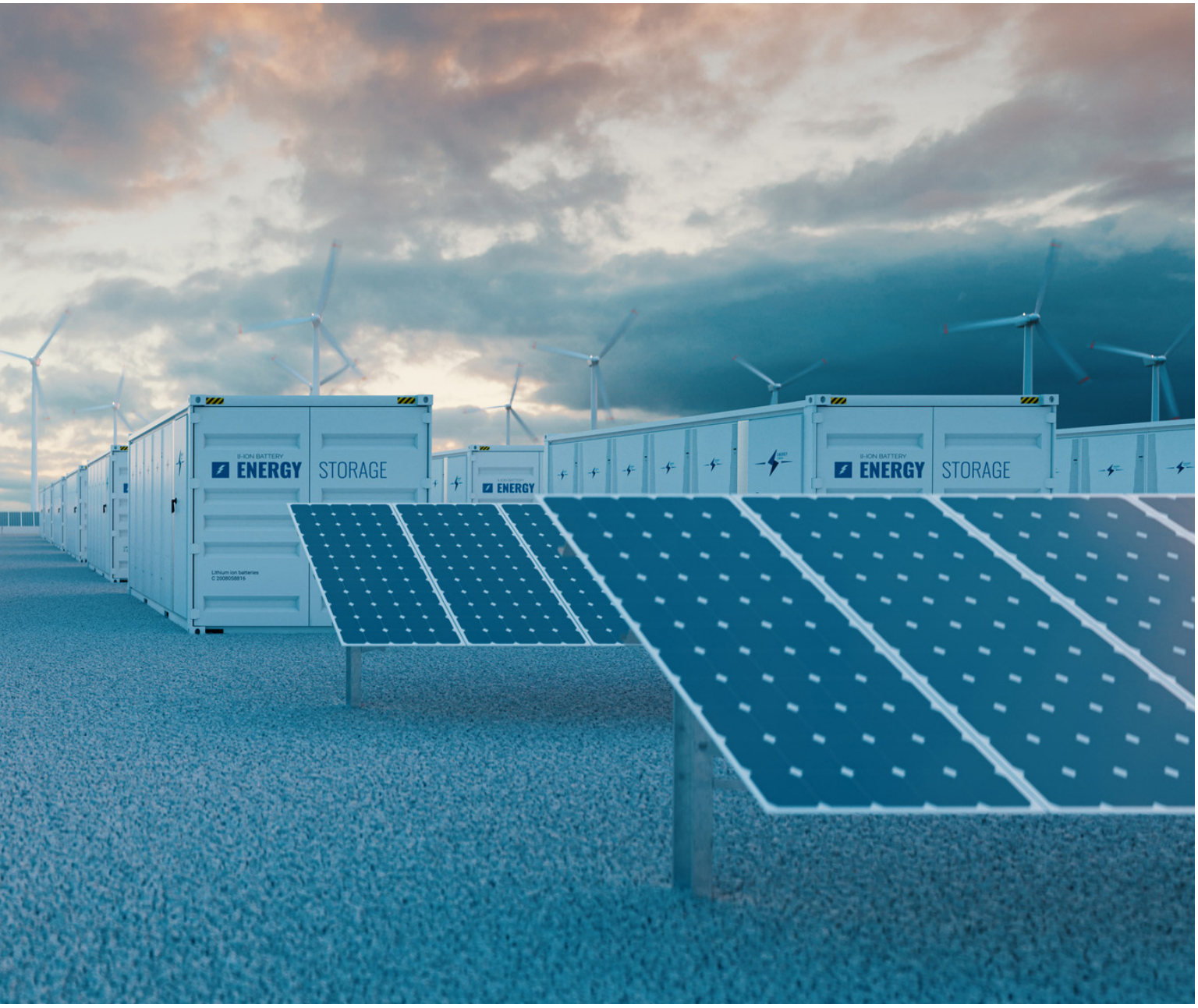
increasingly important.

EandM: What are some of the key technological considerations when moving to a higher percentage of renewable energy for a mining power system?

RM: To exceed 70% RE, it is necessary to have a zero-thermal mode of operation. During operation in this mode, the power system's stability is in the hands of inverters or artificial inertia. This comes with a set of technical challenges to meet system



requirement and responsiveness, considering both the supply and load sides. Additionally, wind, as well as solar with well-integrated storage and control is required to meet high RE targets. Otherwise night time operation will always require thermal generation since there isn't as yet a truly economical large 'deep' storage solution for solar only systems.

EandM: For mining companies, what are some of the common questions they encounter in trying to determine the right combination of renewable energy and storage technologies to

meet carbon and energy savings goals?

RM: Here are some of the common questions that mines are encountering

1. How large does the battery storage (BESS) need to be? In terms of MW, MVA, MW hr

2. How can we know if the short circuit performance of a BESS is enough?

3. Is it okay if my wind farm is 20 km away? Do I need to step up the voltage to connect this?

4. What is the worst case for sudden reduction in renewable energy output? That is, if the wind suddenly reduces, or a cloud covers the sun, how much will the generation output be reduced?

5. I've got a huge mill that runs off a variable speed drive. The manufacturer of this machine needs a short circuit level ten times the power rating of the mill. I'm not going to get that with renewables and BESS, what can be done?

EandM: What's next: When do you anticipate 100% renewable energy mining will be business as usual?

RM: It's reasonable to expect 60-80% RE as business-as-usual within the next five years though the difference between 80% and 100% renewables in a power system is significant. To bridge the gap, a mixture of the following is required: deep storage, oversized wind and solar generation, discretionary loads that can be run intermittently with stockpiles on the input and output such as hydrogen electrolysers. These things are being talked about theoretically at present but we probably will not see them implemented for a while.

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