

revolution will be born. Eyeing China, Australia, Canada and other countries that have invested huge sums of money in quantum technology, Europe does not want to miss out. With €1 billion (US\$1.1 billion) of funding, scientists and businesses will be expected to translate quantum research into quantum products to create “a more sustainable, more productive, more entrepreneurial and more secure European Union”.

These are great expectations. Europe is no doubt encouraged by the various quantum technologies that have matured in recent years. Quantum sensors, for example, can achieve high sensitivity and resolution through quantum superposition or entanglement, outperforming classical sensors in various imaging applications. Strategic use of funds could indeed take quantum sensors to market in a few years.

But for most quantum technologies, the path to commercialization is much longer and more contrived. The arguable peak of quantum technologies — the construction of a universal quantum computer — is decades, and billions of euros of targeted investment, away. But it promises perhaps the greatest gains: substantially greater power for key computations, such as simulations of chemical reactions and — maybe — machine learning.

Revolutions happen through popular uprising and not through carefully directed government investment. At some point, investors, entrepreneurs and academics are supposed to conspire on this revolution without directives from above. Hence the European Quantum Manifesto seeks to mobilize a broad base of quantum technologists. Specifically, it plans an environment in which small, high-potential quantum-tech businesses can thrive.

Given that a large majority of start-up firms fail, how is this plan supposed to work in the risky and unproven quantum-technology business? Predicting the likely outcome of the European Commission's plan is as hard as determining whether Schrödinger's cat is dead or alive without opening its box.

Can we peek inside the box to get some insights on how this commercial future might unfold? *Nature* has designed an experiment to try.

The project (see go.nature.com/53iww6) trained seven young quantum physicists to conceive and evaluate business ideas in quantum technologies. The project culminated in a presentation day last week at *Nature's* London office, where the physicists' ideas were scrutinized by a panel of experienced entrepreneurs and leaders in quantum technologies.

A PhD student from University College London invented a quantum-inspired accelerometer with a relatively safe and clear route to market.

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And two postdocs from the University of New South Wales in Sydney, Australia, have the ambition to outshine Google and IBM and build a universal quantum computer based on silicon qubits.

Two of the five ideas that were presented — an invention that permits quantum computers to be linked, and a start-up that will design quantum machine-learning algorithms — set out to depend on the few companies and groups who have already invested huge sums of money to try to build quantum-computing hardware. Both ideas are betting on being able to sell their products to only a few customers. It sounds like a risky strategy, but it might indicate a way to create and sustain the necessary critical mass of start-ups that the European Quantum Manifesto is aiming for. Focusing investment on one high-risk, high-gain goal — such as a universal quantum computer — could create a string of start-ups that each specialize in one integral component or aspect.

Still, it is unlikely that Europe's quantum-technology initiative will take this route. Given the many scientific goals in the manifesto, the authors seem to hope that the plan will have its own quantum properties and be able to address all the goals simultaneously. That looks like a mistake. It would be a missed opportunity if the quantum world that the commission hopes to create is hamstrung by the small steps and endless compromise that haunt other European projects. The initiative needs a clear and a bold goal. This is one project that should not have to be in several places at once. ■

Smoke out

Scientists should unite over electronic-cigarette regulation, or big tobacco will step in.

Six million people die every year as a result of tobacco smoking, according to an estimate by the World Health Organization. It is a number worth keeping in mind as the scientific disputes over electronic cigarettes continue to smoulder.

The US Food and Drug Administration last week announced a “historic rule” that gives it the right to regulate e-cigarettes — which vaporize nicotine — as it does tobacco products. Nearly all e-cigarettes will now have to go through an approval process, with sales to young people prohibited, and health warnings included on packaging and advertisements.

Sylvia Burwell, the US Secretary of Health and Human Services, noted that e-cigarette use is shooting up among young people in the United States, “creating a new generation of Americans who are at risk of addiction”, even as cigarette smoking continues to decline.

Some states are already ahead of federal law — earlier this month, California defined e-cigarettes as tobacco products, with all that that entails. The European Union is also set to take a tougher stance. An EU-wide directive that comes into force this year on tobacco products will control nicotine content.

These ‘vaping’ devices have split researchers. Some see a route to end the tobacco scourge. Conventional medicine provides few escapes from nicotine addiction, and the speed at which smokers embrace electronic systems seems to be a blessing. If the world's smokers switched from

burning to vaping, that figure of six million deaths would fall.

But other scientists see problems. They fear that electronic devices subvert the message that smoking is bad, and offer people a nicotine fix in places where cigarettes have long been excluded. They fear a new age of nicotine, and that the six-million figure will rise.

This difference of opinion has spilled messily over into the research arena. Published studies are ruthlessly spun or picked apart by opposing sides. Sometimes the fight happens even before publication, with journalists sent quotes under embargo that critique claims and conclusions before they are publicly available.

Both sides are acting in good faith, but their arguments and increasingly entrenched positions frequently generate more heat than light. To progress, researchers on both sides must establish what evidence should be gathered to answer the central question: how can e-cigarette use and regulation lead to the largest possible reduction in deaths from tobacco? As part of this process, they should identify key data that, if forthcoming, would change their current view.

There is good reason for researchers to come together on this, and quickly. Conventional tobacco firms are grabbing an increasingly large share of the e-cigarette market. This should concern everyone — and focus minds. Few industries have historically been quite so willing to dissemble, and to market products with so few benefits and so many harms.

Researchers should remain focused on the enemy that needs to be fought — the horrific harm caused by tobacco. Disputes are part of science. They must be conducted in the open, and no researcher — and no piece of research — can be immune from criticism. But the tobacco-science community must find a way forward. It is not hyperbole to say that millions of lives are at stake. Six million of them are, every year. ■

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