Solutions

Researchers Seek to Recreate Fusion Power

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In southern France researchers are working on an idea for producing essentially limitless power without greenhouse gases. They're building a massive machine that will recreate what usually only happens in stars or the sun — fusion. That's where two atoms become one, and release energy.

RENEE MONTAGNE, host:

This is MORNING EDITION from NPR News. I'm Renee Montagne.

(Soundbite of music)

MONTAGNE: In our Climate Connections series from National Geographic, we're traveling the world to explore how climate shapes people and how people shapes the climate.

Today, we take you to a spot in southern France, where researchers from around the globe are working on an idea for producing essentially limitless power without greenhouse gases. They're building a massive machine that will recreate what usually

only happens in stars or the sun - fusion - where two atoms become one and release energy.

There are smaller fusion experiments around the world, monuments to the huge difficulties involved. Researchers say this new machine will come close to their final goal - a fusion power plant that generates electricity.

NPR's David Kestenbaum visited the project earlier this year.

DAVID KESTENBAUM: There is a joke about fusion, that it's the energy source of the future, and it always will be. This project is called ITER, for International Thermonuclear Experimental Reactor. But that made people think of bombs, so now it's just called ITER.

When I visited, the staff had business cards to hand out, but text only - no one has agreed on the logo yet. And the land here is still wild.

Ms. JENNIFER HAY (Public Relations, ITER): Generally, I got photographs of wild boar running around outside.

(Soundbite of laughter)

Ms. HAY: Yes. First there's boar, then wild sheep.

KESTENBAUM: This is Jennifer Hay, who works in public relations.

Ms. HAY: Can't think of what else there is.

Unidentified Man: Deer.

Ms. HAY: Deer. Deer, yes. So deer, sheep and boar.

KESTENBAUM: The offices here, like the business cards, are temporary, more trailer park than building. The hallways all look identical. Room 112 is the office of Norbert Holtkamp. His title is temporary, too.

Dr. NORBERT HOLTKAMP (Principal Deputy Director General Nominee, ITER): My title is, right now, principal deputy director general nominee.

KESTENBAUM: You know the joke that fusion is the energy source of the future and it always will be?

Dr. HOLTKAMP: Yes. And I've made that joke myself until about 12 months ago.

KESTENBAUM: When he was recruited for this job. I asked him for three reasons why fusion was a good idea.

Dr. HOLTKAMP: Fusion, of course, is a good idea because it could solve the energy problem of the world.

KESTENBAUM: There is that. Reason two? No one would have to fight over it. The raw materials are everywhere. Take the lithium from a laptop battery and a bathtub of water, and you've potentially got enough fuel to cover your energy needs for life.

Dr. HOLTKAMP: Second reason is that it's clean.

KESTENBAUM: No greenhouse gases. And unlike nuclear reactors, which split atoms, there's no danger of a runaway chain reaction. In fact, it's really hard to get fusion going. That's the problem.

Today's nuclear power plants split atoms apart. Fusion does the opposite. It forces two atoms together until they become one bigger atom, freeing up some energy. The problem is the atoms don't want to go together. You have to heat them to millions of degrees so they zip around incredibly fast.

Dr. HOLTKAMP: Like with a whole number of ping pong balls in a big bowl that you shake around that they hit each other, and then they fuse.

KESTENBAUM: A handful of these experiments have succeeded at fusing atoms together, but they require lots of energy to run. And at best, they only produced as much energy as they took in for something like a second.

When it's built, ITER should produce 10 times more power than it sucks up, and it will run for minutes at a time. Add some turbines, and you could convert the heat produced by the fusion into actual electricity.

Dr. HOLTKAMP: ITER is at the scale of a real reactor.

KESTENBAUM: Are you convinced this is going to work?

Dr. HOLTKAMP: Well, you cannot ask a scientist that - whether he is sure. Scientists talk in terms of percentages, or talk in terms of, you know, probability.

KESTENBAUM: Okay. So what percentage?

Dr. HOLTKAMP: I would say much higher than 50 percent.

KESTENBAUM: Holtkamp is a busy man these days. He takes off for a meeting, pitched forward as we walks as if it could get him there faster.

Roam the halls here, and you might, well, hear a bit of Russian, Japanese, Chinese, or an American accent.

Dr. GARY JOHNSON (Vacuum Vessel Group Leader, ITER): My name's Gary Johnson from Knoxville, Tennessee.

KESTENBAUM: It's been said that the problem with trying to put the sun in a bottle is that we don't know how to build the bottle. The bottle here will be shaped like an enormous, hollow doughnut - 45 feet high, 85 feet across, made of steel and fancier metals. Johnson is in charge of building it. He takes out a blueprint.

Dr. JOHNSON: Take a look at a couple here. The components inside are very, very heavy. You can see here, it's about 23,000 tons for everything you see here.

KESTENBAUM: The device is called the Tokamak. This one would be 10 times larger than any ever built. The fuel, basically hydrogen, goes inside, powerful magnetic fields keep the atoms floating while they're heated until they buzz around like angry bees - what scientists call a plasma. Temperature: 100 million degrees.

Dr. JOHNSON: Whenever everything's running perfectly and the plasma is right where it's supposed to be, everything runs great. The potential problem with ITER is containing the plasma, because if it gets against the wall, it can certainly damage it. And then if you damage it, it can take a while to repair.

KESTENBAUM: The fusion reactions will weaken some of the metals and make them slightly radioactive. It's thought some parts will have to be replaced on a yearly basis. And if fusion is going to make it commercially, these machines will have to work flawlessly, reliably, and the cost will have to be right. The price tag for this research project is about $13 billion. It's being funded by the European Union and six other countries, including the U.S.

Mr. JOHNSON: There are lots of advantages to getting, you know, lots of brainpower on this planet involved. That's definitely a plus.

KESTENBAUM: It can also be a minus. ITER's been in the works for over 20 years. The U.S. at one point pulled out, then agreed to join again. Japan badly wanted to build it in Japan. France really wanted it in France.

Mr. JOHNSON: Right, well, you know, there's always lots and lots of politics involved.

KESTENBAUM: What language do you all speak?

Mr. JOHNSON: Everything is done in English.

KESTENBAUM: We won that one.

(Soundbite of laughter)

KESTENBAUM: I asked one scientist if he ever felt like Icarus, the guy in the Greek myth who flew too close to the sun and fell from the sky. And he mentioned another figure, Sisyphus, the man condemned to rolling a ball uphill forever. The sense here, though, is that they will get there.

(Soundbite of walking)

Mr. MARK WESTRA (ITER): So we are walking up now to the outside perimeter, in the direction of the future ITER sites.

KESTENBAUM: This is Mark Westra, a physicist and a tour guide.

Mr. WESTRA: And what you see at the moment is just lots of porta-cabins and lots of heavy machinery.

(Soundbite of machinery)

KESTENBAUM: Westra says it's okay fusion is taking a while. It's a long-term solution for a long-term problem. China last year built two big coal plants a week. In the future, Westra says, the world is clearly going to need more electricity - a lot more.

Mr. WESTRA: We need it a sustainable way, meaning without greenhouse gasses. Now, that is a huge challenge and it's the biggest challenge that we face in this century. I think it's really fair to say so. Maybe some people say, oh, we can do it with wind, we could do it with sun.

No, we will need everything. We will need all the power we can get. There's not something in a closet hidden, another power, another source of energy. It's just not going to happen. And fusion is the last energy source that can be used on potentially a very, very large scale.

KESTENBAUM: If ITER works its designs, the plan is to build a more advanced machine that will actually generate electricity. So far it has a name: Demo.

David Kestenbaum, NPR News.

MONTAGNE: Find out what greenhouse gasses are doing to the world's climate at npr.org/climateconnections. And while you're there, check out the cartoons about carbon from public television's series "Wild Chronicles."