

1

00:00:00,000 --> 00:00:16,221

command

2

00:00:16,241 --> 00:00:26,914

Anything

3

00:00:26,914 --> 00:00:31,599

This series presents information based in part on theory and conjecture.

4

00:00:31,599 --> 00:00:36,204

The producer's purpose is to suggest some possible explanation, but not necessarily

5

00:00:36,204 --> 00:00:39,288

the only one to the mysteries we will examine.

6

00:00:39,288 --> 00:00:56,308

What links this modern sun worshiper to this girl who is about to die?

7

00:00:57,269 --> 00:01:01,954

In this reenactment, she is about to be sacrificed to the sun in a ritual

8

00:01:01,954 --> 00:01:08,202

practiced many centuries ago on the plains of North America.

9

00:01:08,202 --> 00:01:14,529

Continents away, great civilizations built soaring temples, and their priests

10

00:01:14,529 --> 00:01:20,896

devoted their lives to the worship and study of the sun.

11

00:01:20,976 --> 00:01:25,422

Human sacrifice, fantastic architectural achievement,

12

00:01:25,422 --> 00:01:29,106

entire cultures dedicated to the sun.

13

00:01:29,106 --> 00:01:33,351

Are these also haunting reminders of earlier civilizations?

14

00:01:33,351 --> 00:01:40,839

Or do these silent sentinels point the way to the future?

15

00:01:40,839 --> 00:01:45,685

This Aztec calendar depicts a vengeful sun at its center,

16

00:01:45,685 --> 00:01:54,295

a god who could only be appeased with human blood.

17

00:01:54,295 --> 00:01:58,179

Over the centuries, our views and our rituals have changed.

18

00:01:58,179 --> 00:02:04,987

We can hardly wait for the first sparkle of morning light to rush to our mechas of solar worship.

19

00:02:04,987 --> 00:02:08,231

To the beaches, the mountains, the deserts,

20

00:02:08,231 --> 00:02:14,518

anywhere that we can put on ritual garments, cover ourselves with soothing ointments,

21

00:02:14,518 --> 00:02:21,086

and dedicate our bodies to the sun.

22

00:02:21,086 --> 00:02:25,651

Technology has brought the sun indoors for year-round worship.

23

00:02:25,651 --> 00:02:30,657

Does a vengeful sun god still exact his price?

24

00:02:30,657 --> 00:02:33,260

This is skin cancer.

25

00:02:33,260 --> 00:02:34,862

I'm a sun worshiper.

26

00:02:34,862 --> 00:02:38,146

I spend a lot of time in the sun, and I always have.

27

00:02:38,146 --> 00:02:39,868

Up until the time I had the cancer.

28

00:02:39,868 --> 00:02:44,273

John McMahon was cured of skin cancer by Dr. James Sternberg.

29

00:02:44,273 --> 00:02:47,757

The problem is that most of these people who are going out and getting tanned

30

00:02:47,757 --> 00:02:51,201

don't understand what they're doing to themselves,

31

00:02:51,201 --> 00:02:53,203

because the sun really can be hazardous.

32

00:02:53,203 --> 00:02:57,208

You know, and you don't think about the horrible aspects of the sun,

33

00:02:57,208 --> 00:03:03,215

because it's wonderful, it's warm, and it's a lot of the social thing in there.

34

00:03:03,215 --> 00:03:07,900

Nobody thinks about the cancerous aspects of it. Nobody.

35

00:03:07,900 --> 00:03:10,904

The important thing is that you understand what the sun does.

36

00:03:10,904 --> 00:03:17,912

Each individual person can make their own decision on whether or not they want to get sun or not.

37

00:03:18,633 --> 00:03:24,840

Is the same sun that once demanded human sacrifice now the key to human survival?

38

00:03:24,840 --> 00:03:29,085

And there are several forms of solar energy that are ready to use right now.

39

00:03:29,085 --> 00:03:33,890

Too many people have been misled to believe that the sun is going to solve all of our problems.

40

00:03:33,890 --> 00:03:35,612

We could achieve

41

00:03:35,612 --> 00:03:38,175

100% use of solar energy.

42

00:03:38,175 --> 00:03:42,380

There's no way that this can be done in this century.

43

00:03:42,380 --> 00:03:46,785

For a century and a half we have mined our planet for fuel.

44

00:03:46,785 --> 00:03:51,030

But the earth and her resources are not limitless.

45

00:03:51,030 --> 00:03:53,633

There are signs that nature is beginning to choke

46

00:03:53,633 --> 00:03:58,118

in the grip of technology.

47

00:03:58,118 --> 00:04:05,127

How long can we afford to ignore a source of energy greater than any that man has created?

48

00:04:05,167 --> 00:04:07,770

We need to have power

49

00:04:08,370 --> 00:04:13,857

Robert Deitch of Southern California Edison does not believe solar technology is ready.

50

00:04:13,857 --> 00:04:20,865

But in order to meet our demands in the 1980s we're going to have to depend on the conventional technologies that we know and that we can install now.

51

00:04:20,865 --> 00:04:23,988

And that is coal and nuclear.

52

00:04:23,988 --> 00:04:28,994

Dr. Barry Cominer of Washington University has doubts about nuclear energy.

53

00:04:28,994 --> 00:04:31,077

Nuclear is not renewable.

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00:04:31,077 --> 00:04:36,643

Nuclear energy as we now use it is based on burning up uranium.

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00:04:36,643 --> 00:04:41,048

And if we built all the nuclear power plants that we're supposed to

56

00:04:41,048 --> 00:04:45,013

the uranium supplies would run out in 25 to 30 years.

57

00:04:45,013 --> 00:04:48,016

That's why we have to turn to solar energy.

58

00:04:51,701 --> 00:04:55,024

The search for a solar future starts with a trip back

59

00:04:55,024 --> 00:04:58,629

almost to the Stone Age.

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00:04:58,629 --> 00:05:05,156

Back to these Indian dwellings literally carved out of the side of a mountain.

61

00:05:05,156 --> 00:05:12,445

The Indians of Mesa Verde scratched their existence from the hostile soil of the Colorado Desert.

62

00:05:12,445 --> 00:05:17,090

They survived against the freezing winters and burning summers.

63

00:05:17,090 --> 00:05:25,099

They protected themselves against the elements in houses heated and cooled by solar energy.

64

00:05:25,139 --> 00:05:32,388

Without machines or technology the Anasazi Indians created these houses that shaded themselves in summer

65

00:05:32,388 --> 00:05:36,753

and in winter stored needed heat in thick stone walls.

66

00:05:36,753 --> 00:05:42,359

Do these lessons hold any value today?

67

00:05:42,359 --> 00:05:47,525

This house uses techniques developed over 800 years ago.

68

00:05:47,525 --> 00:05:54,413

Bill Wilson, an expert in solar energy, explains the more advanced techniques used.

69

00:05:54,413 --> 00:06:01,902

Active solar is a situation where you are capturing the sun by use of a collector

70

00:06:01,902 --> 00:06:12,915

and then using a pump or a blower to move that heat to some place else where it will be utilized or stored.

71

00:06:12,915 --> 00:06:21,405

These rocks store the sun's energy and make it available at night and on cloudy days.

72

00:06:21,405 --> 00:06:28,613

The technology may seem simple but the fact is the sun provides most of the heating and cooling needed here

73

00:06:28,613 --> 00:06:33,819

and the sun is absolutely free.

74

00:06:33,819 --> 00:06:40,827

An even greater test of the techniques developed at Mesa Verde occurred here in Modesto, California.

75

00:06:40,827 --> 00:06:46,434

Using only light from the sun this commercial greenhouse maintains a controlled environment

76

00:06:46,434 --> 00:06:51,840

essential for the growth of vulnerable young plants.

77

00:06:51,840 --> 00:06:57,046

How does it differ from greenhouses that rely on conventional energy sources?

78

00:06:57,046 --> 00:07:02,252

The design is intended to heat and cool the greenhouse with minimum energy input

79

00:07:02,252 --> 00:07:04,855

and is proving very successful so far.

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00:07:04,855 --> 00:07:12,464

In the winter time the sunshine comes through that skylight and gives us a very broad band.

81

00:07:12,464 --> 00:07:20,873

In the middle of winter it strikes these barrels and they'll soak up the heat to keep the house warm.

82

00:07:20,873 --> 00:07:27,681

In the summer time you'll notice the X implies that we have no direct sunshine coming in

83

00:07:27,681 --> 00:07:36,291

but we have enough light to give our plants the energy to grow well by the fact that we're bouncing it off the reflective roof

84

00:07:36,291 --> 00:07:39,495

and off the white ceiling.

85

00:07:39,495 --> 00:07:45,302

This greenhouse is staying cooler by 5 or 10 degrees with no energy input

86

00:07:45,302 --> 00:07:52,710

than are the two commercially designed greenhouses of which have electrical cooling.

87

00:07:59,919 --> 00:08:04,924

Sunshine, universal, inexhaustible and free.

88

00:08:04,924 --> 00:08:10,130

It is clear that the legacy of the Mesa Verde Indians is a valuable and practical lesson

89

00:08:10,130 --> 00:08:16,938

but 800 years of scientific and technological development have increased our ability to exploit the sun

90

00:08:16,938 --> 00:08:20,543

and its enormous store of power.

91

00:08:20,543 --> 00:08:25,548

In Modesto, California, scientists are releasing solar energy from sewage

92

00:08:25,548 --> 00:08:31,555

and running city vehicles at a cost of only 35 cents a gallon.

93

00:08:33,558 --> 00:08:36,962

In order to understand this process called biomass,

94

00:08:37,362 --> 00:08:43,169

we must realize that every living thing gets energy from the sun.

95

00:08:43,169 --> 00:08:49,977

This energy is stored in every plant, in every leaf, in every flower.

96

00:08:49,977 --> 00:08:57,786

And when plants die, their energy can be recaptured as methane gas.

97

00:08:57,786 --> 00:09:02,792

Is it possible that America's great farmlands could become a source of fuel?

98

00:09:02,792 --> 00:09:06,596

According to Bill Wilson, the answer may be yes.

99

00:09:06,596 --> 00:09:13,404

The Modesto plant is doing nothing more than taking what was before a wasted fuel,

100

00:09:13,404 --> 00:09:22,414

taking some of the unneeded gases out of it, compressing it and using it to run the pickups and cars for the city.

101

00:09:22,414 --> 00:09:31,425

The plant is producing methane at 35 cents a gallon and producing a thousand gallons per day.

102

00:09:32,226 --> 00:09:41,236

A seemingly impossible dream is becoming a reality in this laboratory in Santa Monica, California.

103

00:09:41,236 --> 00:09:46,242

Solar energy is turning water into fuel.

104

00:09:46,242 --> 00:09:51,248

This jeep runs on hydrogen made from water.

105

00:09:51,248 --> 00:09:56,253

Gerald Schaaflander pioneered a new process to make automotive fuel.

106

00:09:57,054 --> 00:10:02,060

It relies on free energy from the sun to manufacture hydrogen.

107

00:10:02,060 --> 00:10:05,064

We make a liquid hydride which we call high fuel.

108

00:10:05,064 --> 00:10:11,071

That's non-flammable, that's very inexpensive, is done through a well-known process called the Haber process.

109

00:10:11,071 --> 00:10:14,074

The process starts with this solar cell.

110

00:10:14,074 --> 00:10:18,079

It turns light into electricity.

111

00:10:18,079 --> 00:10:24,086

In normal use, the light would be sunshine.

112

00:10:24,086 --> 00:10:33,096

When the solar cells are arranged in collectors like these, the sun's energy is focused and multiplied.

113

00:10:37,101 --> 00:10:44,109

The electricity created produces hydrogen, but hydrogen is explosive.

114

00:10:44,109 --> 00:10:50,116

In this synthesizer, it combines with ammonia to create a safe liquid called a hydride.

115

00:10:51,117 --> 00:10:56,123

It is the fuel that powers this engine.

116

00:11:01,129 --> 00:11:07,136

We can make modest changes in the carburetor and the fuel line, modest change in the gas tank,

117

00:11:07,136 --> 00:11:15,145

and we can run any vehicle, any vehicle, any standard car can be verted down about three hours to run on our high fuel.

118

00:11:16,146 --> 00:11:23,154

A simple jeep, but with a new carburetor and the addition of this pressure regulator,

119

00:11:23,154 --> 00:11:28,160

it now runs on solar-created hydrogen fuel.

120

00:11:30,162 --> 00:11:34,167

The exhaust is almost entirely water vapor.

121

00:11:34,167 --> 00:11:43,177

Soon, this non-polluting solar fuel may be sold to the public for only 59 cents a gallon.

122

00:11:45,180 --> 00:11:51,187

From the simple stone dwellings of the ancients, we have taken many steps toward a solar future.

123

00:11:53,189 --> 00:11:58,195

What new technologies will tomorrow's sunrise reveal?

124

00:11:58,195 --> 00:12:05,203

Lacking the oil resources of its neighbors, Israel is turning to an intriguing form of solar energy.

125

00:12:05,203 --> 00:12:10,209

Israel was the first country to move forward into solar energy.

126

00:12:10,209 --> 00:12:14,213

Tom Hayden, chairman of Solar Cow, explains.

127

00:12:14,213 --> 00:12:20,220

They have a project at the Dead Sea called a solar pond and it generates electricity

128

00:12:20,220 --> 00:12:26,227

and potentially it could generate the 3,000 megawatts of electricity that the whole country needs.

129

00:12:28,230 --> 00:12:34,237

The Dead Sea absorbs and stores heat from the sun because of the extreme amount of salt in its water.

130

00:12:34,237 --> 00:12:39,242

A natural property of salt water is the ability to retain heat.

131

00:12:40,244 --> 00:12:48,253

A layer of fresh water is added to trap the heat at the bottom where the water becomes so hot, it actually boils.

132

00:12:51,256 --> 00:12:56,262

The steam created can run a turbine and generate electricity.

133

00:12:56,262 --> 00:12:59,266

We see solar ponds having a wide area.

134

00:12:59,266 --> 00:13:03,270

Bob French of Jet Propulsion Laboratories is an advocate.

135

00:13:03,270 --> 00:13:11,279

We can use that 200 degree source temperature for heating greenhouses, for drying crops.

136

00:13:11,279 --> 00:13:17,286

In certain industrial applications it can be used. We even think we can use it for desalinating water.

137

00:13:18,288 --> 00:13:24,295

This potent source of power is not confined to the ancient waters of the Dead Sea.

138

00:13:25,296 --> 00:13:32,304

At the Salton Sea in Southern California, Israeli and American scientists are working on a similar project.

139

00:13:33,305 --> 00:13:42,315

Without burning a drop of oil or using an ounce of uranium, this project could supply the daily needs of 600,000 people.

140

00:13:43,317 --> 00:13:53,328

I am very excited about solar ponds and I think that holding it in perspective, it can be one major element in our quest to solve our energy problems.

141

00:13:53,328 --> 00:13:56,332

It's not the solution but it is a piece of it.

142

00:13:57,333 --> 00:14:00,336

Robert Deitch of Southern California Edison.

143

00:14:00,336 --> 00:14:04,341

Solar energy has a place in the future. There's no question about that.

144

00:14:05,342 --> 00:14:10,348

It's a matter of how much and how fast we get solar energy.

145

00:14:11,349 --> 00:14:19,358

How much, how fast? These questions are a prime concern of Sandia Laboratories in Albuquerque.

146

00:14:19,358 --> 00:14:25,365

We spoke to the director, Glenn Brandford, about the potential of photovoltaic cells.

147

00:14:25,365 --> 00:14:32,373

Photovoltaic cells are a relatively new invention, something like only 25 years old.

148

00:14:32,373 --> 00:14:47,391

A solar cell is one of the simplest devices you can think of. You take one of the most common materials on earth, silicon, purify it, put a very small amount of electrode material on it, expose it to sunlight and electricity flows.

149

00:14:47,391 --> 00:14:53,398

No moving parts, nothing to wear out. Kind of the ideal solar to electric converter.

150

00:14:53,398 --> 00:15:01,407

Can this simple device be even more efficient? Sandia engineer, Glenn Schaefer, explains one approach.

151

00:15:01,407 --> 00:15:12,420

We can use a concentrating lens such as this one to concentrate the sunlight onto the solar cell and thus replace expensive solar cell with a low-cost lens.

152

00:15:13,421 --> 00:15:26,436

It turns out nature is occasionally kind. If one doubles the sunlight illumination on a cell, you

get more than twice as much electricity out.

153

00:15:26,436 --> 00:15:36,448

Presently, we're designing systems with optical concentrations of, as we say, 50 to a couple of hundred suns illumination.

154

00:15:36,448 --> 00:15:45,458

And the prospects are encouraging that these kind of systems, in fact, can be lower cost than flat panel silicon cells.

155

00:15:45,458 --> 00:15:54,469

Producing electricity in a laboratory is one thing, but can photovoltaic cells work under actual conditions?

156

00:15:54,469 --> 00:16:03,479

Strangely enough, the search took us back to a desert landscape like the one seen from the cliffside dwellings of Mesa Verde.

157

00:16:04,480 --> 00:16:11,488

The village is Chuchulik, and the 95 people who live here are Papago Indians.

158

00:16:13,491 --> 00:16:22,501

Many generations of their people are buried in this parched soil. In many ways, the passing generations have brought little change.

159

00:16:22,501 --> 00:16:31,511

The people of Chuchulik still struggle against the elements to raise their livestock and eke out a living under a burning sun.

160

00:16:32,513 --> 00:16:39,521

Until recently, the town had no electricity. The villagers gathered water by hand from a single well.

161

00:16:39,521 --> 00:16:44,527

The only sources of light were candles and kerosene lanterns.

162

00:16:49,532 --> 00:16:57,542

In 1978, Chuchulik became the first community in the world to rely entirely on solar power.

163

00:17:02,547 --> 00:17:08,554

These photovoltaic cells were installed by the National Aeronautics and Space Administration.

164

00:17:08,554 --> 00:17:15,563

They create 3.5 kilowatts of electricity, which can be stored in this special cluster of batteries.

165

00:17:15,563 --> 00:17:28,578

David Santos, chairman of the village, monitors the system. In spirit at least, he is a descendant of the cliff-dwelling Indians of Mesa Verde, pioneering a solar future.

166

00:17:28,578 --> 00:17:38,589

What the Nesa people put in was the refrigerators and the washing machine and the sawing machine and also the water pump.

167

00:17:38,589 --> 00:17:41,593

It runs the water pump. Everything is automatic.

168

00:17:42,594 --> 00:17:49,602

A single washing machine, electric lights, refrigeration.

169

00:17:49,602 --> 00:17:55,609

A humble step perhaps, but a fundamental one for these Papago Indians.

170

00:17:56,610 --> 00:18:06,622

They do believe that they are happy with the lights and out of their refrigerators, getting ice

cubes and the washing machine.

171

00:18:06,622 --> 00:18:08,624

I believe they are pretty happy about it.

172

00:18:10,626 --> 00:18:18,636

Next, producing enough electricity for a small town is one thing. But can solar energy meet the needs of our high-tech society?

173

00:18:18,636 --> 00:18:22,640

We'll take a look when In Search of continues.

174

00:18:26,645 --> 00:18:37,658

Today, there is electricity in Chuchulik. What does the future hold? Can solar energy meet the demands of a growing technological society?

175

00:18:40,661 --> 00:18:43,665

Glenn Brandvold of Sandia Labs.

176

00:18:43,665 --> 00:18:51,674

The country is a big country. We need a lot of energy for a variety of purposes, both centralized

and decentralized.

177

00:18:51,674 --> 00:18:56,680

To do that with solar would require land size, the size of the state of Oregon.

178

00:18:59,683 --> 00:19:07,692

These huge mirrors are still now. They are part of an experimental power plant called a central receiver tower.

179

00:19:07,692 --> 00:19:15,702

When these heliostats begin to move, they will act as a concentrating lens the size of eight football fields.

180

00:19:16,703 --> 00:19:21,709

Computer control allows each mirror to track the sun with total precision.

181

00:19:24,712 --> 00:19:33,723

As they begin to move and turn their reflecting surfaces skyward, the mirrors will multiply the power of the sun over 2,000 times.

182

00:19:33,723 --> 00:19:42,733

The heat generated will be so great that our In Search of crew was only allowed to film the process from the safety of ground level.

183

00:19:43,734 --> 00:19:50,742

Liquid in the boiler at the top of the tower will be heated to temperatures of up to 4,000 degrees.

184

00:19:51,744 --> 00:19:58,752

This super heated liquid could be used to generate electricity without the use of oil or uranium.

185

00:19:58,752 --> 00:20:08,763

The forecast for solar thermal systems, whether from central receivers or line focused technology, suggests that within the next five or ten years,

186

00:20:08,763 --> 00:20:17,774

really mostly depending on volume production, that energy can be delivered at cost competitive with energy from oil or natural gas.

187

00:20:17,774 --> 00:20:24,782

This is an experiment, but at this moment a working power plant is being built at Barstow, California.

188

00:20:24,782 --> 00:20:30,789

Its 1,900 heliostats will produce 10 million watts of electricity.

189

00:20:31,790 --> 00:20:41,802

That facility will operate and cost on the order of 90 cents per kilowatt hour once it's in operation, and this is the cost to the customer.

190

00:20:41,802 --> 00:20:49,811

Whereas other energy sources, for instance, today, our nuclear energy costs approximately 1.7 cents per kilowatt hour.

191

00:20:49,811 --> 00:20:58,821

Oil generation costs approximately 4 to 5 cents per kilowatt hour and coal approximately 2 cents per kilowatt hour, so there's a vast difference in cost.

192

00:20:58,821 --> 00:21:09,834

Dr. Barry Commonerle, it's entirely possible, as I've said, to have solar devices that are bad, that are economically costly,

193

00:21:09,834 --> 00:21:13,839

and even solar techniques that are harmful to the environment.

194

00:21:13,839 --> 00:21:20,847

I think one should be very careful about creating a new solar mythology.

195

00:21:20,847 --> 00:21:31,860

From solar worship to advanced solar technology, there seems little doubt that our civilization will build its own temples to the sun.

196

00:21:34,863 --> 00:21:47,878

Solar power may never meet all of our energy needs. The future may be unclear, but here, in the isolated village of Tchuculik, right now, it works.

197

00:21:50,882 --> 00:22:06,900

A lot of people don't understand what the sun can be useful, and I don't either, but I know, I mean, it's going to, because I work at it, and so I know what the sun can do, and I'm happy about it.