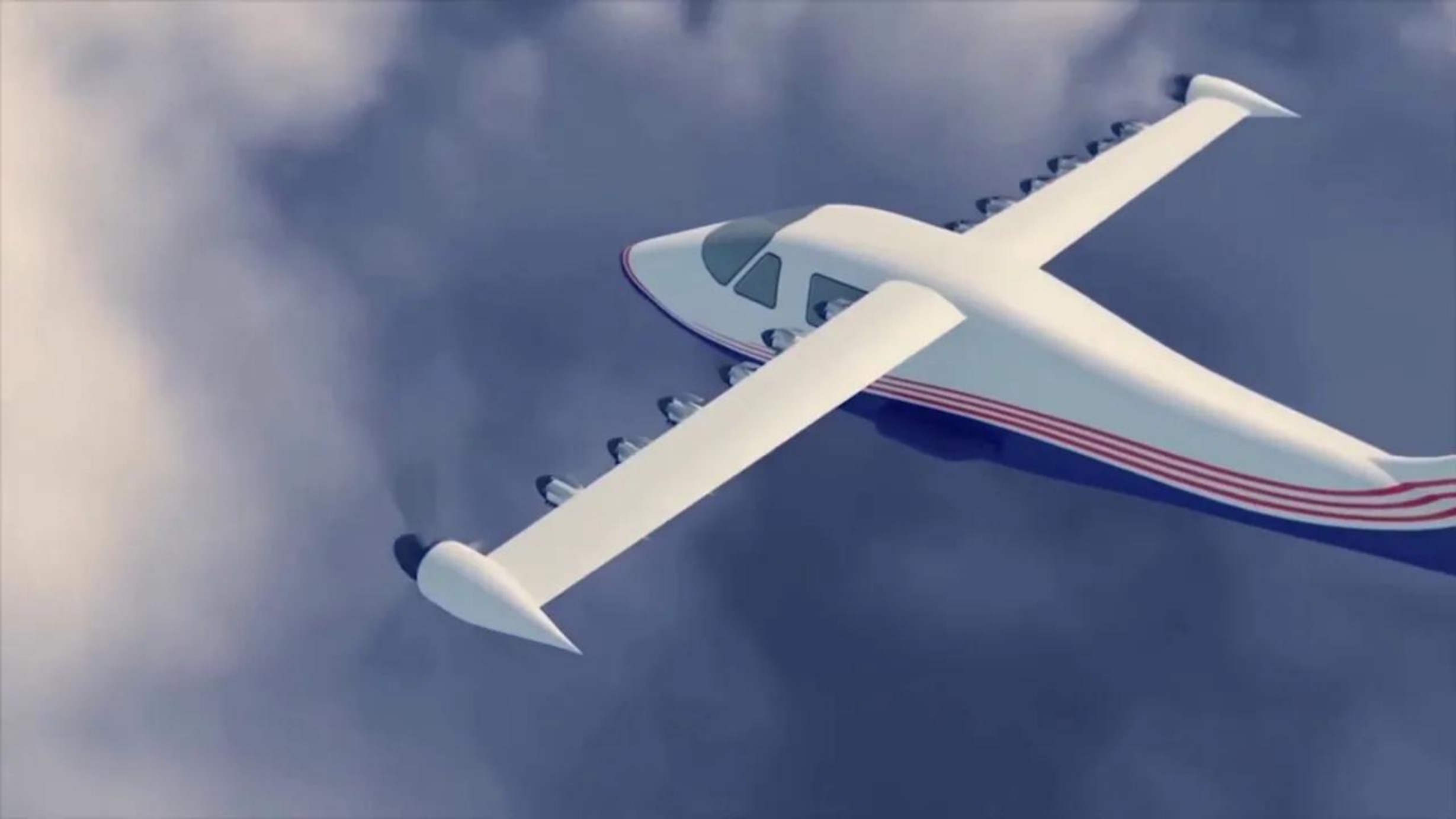

1
00:00:14,769 --> 00:00:15,769
[MUSIC]

2
00:00:15,769 --> 00:00:18,199
>> ON DECEMBER 17TH, 1903,
TWO BROTHERS FROM

3
00:00:18,199 --> 00:00:21,580
DAYTON, OHIO WOULD ALTER
HUMAN HISTORY FOREVER.

4
00:00:21,580 --> 00:00:24,300
ON THAT DAY, WILBUR
AND ORVILLE WRIGHT FLEW

5
00:00:24,300 --> 00:00:27,610
THEIR WOODEN AND CANVAS MACHINE
OFF THE SANDY DUNES IN

6
00:00:27,610 --> 00:00:32,099
KITTYHAWK, NORTH CAROLINA,
BECOMING THE FIRST TO FLIGHT.

7
00:00:32,099 --> 00:00:33,860
HEAVY EXPERIMENTATIONS
WITH GLIDERS,

8
00:00:33,860 --> 00:00:36,320
LIKE ADVANCEMENTS
IN ENGINE TECHNOLOGIES,

9
00:00:36,320 --> 00:00:39,680
CONTROLS, AND AERODYNAMICS,
PROVIDED A PATHWAY FOR

10
00:00:39,680 --> 00:00:44,149
HEAVIER THAN AIRCRAFTS,
LIKE THE WRIGHT BROTHERS' FLYER.

11

00:00:44,149 --> 00:00:47,170
BY THE 1930s, AIRSHIPS,
WHICH HAVE DOMINATED

12
00:00:47,170 --> 00:00:50,530
THE LONG-DISTANCE FLIGHT,
WERE REPLACED BY FLYING BOATS

13
00:00:50,530 --> 00:00:52,850
AND OTHER RUDIMENTARY
AIRCRAFTS.

14
00:00:52,850 --> 00:00:56,550
BY THE 1930s AND '40s
DEVELOP OF AIRCRAFT

15
00:00:56,550 --> 00:00:59,730
FOR WAR EFFORT,
GREATLY ACCELERATED INFUSION

16
00:00:59,730 --> 00:01:04,640
OF NEW TECHNOLOGIES INTO
CIVILIAN, GENERAL AVIATION.

17
00:01:04,640 --> 00:01:06,850
THIS STREAM OF INNOVATION
LED TO THE START OF

18
00:01:06,850 --> 00:01:10,180
THE JET AGE, WHICH WOULD
REVOLUTIONIZE BOTH GENERAL

19
00:01:10,180 --> 00:01:13,619
AND MILITARY AVIATION.

20
00:01:13,619 --> 00:01:16,070
LATER IN 20th CENTURY,
EVEN MORE ADVANCED TECHNOLOGIES

21
00:01:16,070 --> 00:01:20,479

LIKE DIGITAL ELECTRONICS
WOULD BRING ABOUT FLY-BY-WIRE,

22
00:01:20,479 --> 00:01:24,899
DIGITAL ENGINE CONTROLS, GPS.
AND THESE ADVANCEMENTS

23
00:01:24,899 --> 00:01:28,560
EVEN CHANGED THE WAY WE GO
ABOUT DESIGNING AIRCRAFTS.

24
00:01:28,560 --> 00:01:31,850
THIS CENTURY HAS BEEN
MARKED BY TRANSITIONING TO

25
00:01:31,850 --> 00:01:36,369
LARGE-SCALE, PILOTLESS DRONES,
AND FOR THE FIRST TIME EVER,

26
00:01:36,369 --> 00:01:39,200
INHERENTLY UNSTABLE AIRCRAFTS
SUCH AS HIGHLY-INTEGRATED

27
00:01:39,200 --> 00:01:43,600
FLYING WINGS,
HAVE BECOME A POSSIBILITY.

28
00:01:43,600 --> 00:01:47,799
AND WITH ALL THESE ADVANCEMENTS
IN THE PAST 112 YEARS,

29
00:01:47,799 --> 00:01:49,799
WE'RE STILL ONLY
SCRATCHING THE SURFACE OF

30
00:01:49,799 --> 00:01:52,350
CAPABILITY AND PERFORMANCE.

31
00:01:52,350 --> 00:01:53,689
BUT WE'RE PAYING

A HEAVY PRICE FOR

32
00:01:53,689 --> 00:01:55,490
LAGGING INNOVATION.

33
00:01:55,490 --> 00:01:58,959
WHO HERE HAS TRAVELED BY AIR
IN THE PAST SIX MONTHS?

34
00:01:58,959 --> 00:02:00,429
WERE YOU SURPRISED?

35
00:02:00,429 --> 00:02:04,750
BY-BY THE COST AND TIME
OF YOUR TRIP?

36
00:02:04,750 --> 00:02:07,640
TODAY WE FIND OURSELVES
AT THE DOORSTEP OF YET ANOTHER

37
00:02:07,640 --> 00:02:10,770
REVOLUTIONARY ADVANCEMENT
IN AVIATION HISTORY.

38
00:02:10,770 --> 00:02:15,140
THE ELECTRIC OR
HYBRID-ELECTRIC AIRCRAFTS.

39
00:02:15,140 --> 00:02:17,670
NASA IS INVESTING IN
ELECTRIFIED AIRCRAFT PROPULSION

40
00:02:17,670 --> 00:02:21,270
RESEARCH, OR EAP, AS PART
OF ITS PORTFOLIO TO IMPROVE

41
00:02:21,270 --> 00:02:24,680
FUEL EFFICIENCY, EMISSIONS,
AND NOISE LEVELS IN

42
00:02:24,680 --> 00:02:27,860
COMMERCIAL TRANSPORT AIRCRAFTS.

43
00:02:27,860 --> 00:02:31,451
EAP USES ELECTRIC MOTORS
TO DRIVE SOME OR ALL OF

44
00:02:31,451 --> 00:02:33,950
THE ENGINES ON AN AIRCRAFT.

45
00:02:33,950 --> 00:02:37,360
THE ENERGY SOURCE FOR
THIS SYSTEM CAN BE ELECTRIC,

46
00:02:37,360 --> 00:02:40,510
HYBRID, OR TURBOELECTRIC.

47
00:02:40,510 --> 00:02:42,460
NASA IS WORKING ACROSS
A RANGE OF MARKETS

48
00:02:42,460 --> 00:02:45,980
FROM URBAN AIR MOBILITY
TO SUBSONIC TRANSPORT.

49
00:02:45,980 --> 00:02:49,520
EACH MARKET HAS DIFFERENCES
IN VEHICLE SIZE, RANGE,

50
00:02:49,520 --> 00:02:51,099
AND SPEEDS.

51
00:02:51,099 --> 00:02:54,860
OUR STRATEGY AT NASA IS TO WORK
WITH OUR INDUSTRY PARTNERS

52
00:02:54,860 --> 00:02:57,660
TO ENABLE TECHNOLOGY
DEVELOPMENT, DEMONSTRATE

53
00:02:57,660 --> 00:03:00,790
THESE TECHNOLOGIES IN FLIGHT,
AND TRANSFER THE KNOWLEDGE

54
00:03:00,790 --> 00:03:06,690
TO COMMERCIAL SECTOR FOR
FUTURE PRODUCTS AND MARKETS.

55
00:03:06,690 --> 00:03:10,760
ONE SUCH EMERGING MARKET
IS URBAN AIR MOBILITY,

56
00:03:10,760 --> 00:03:12,960
DEVELOPED THROUGH NASA'S
REVOLUTIONARY VERTICAL LIFT

57
00:03:12,960 --> 00:03:14,360
TECHNOLOGY PROJECT.

58
00:03:14,360 --> 00:03:18,730
URBAN AIR MOBILITY, OR UAM,
IS A CONCEPTUAL MARKET THAT

59
00:03:18,730 --> 00:03:22,870
WOULD ENABLE PASSENGER-CARRYING
AIR TRANSPORTATION IN AND AROUND

60
00:03:22,870 --> 00:03:24,820
METROPOLITAN AREAS.

61
00:03:24,820 --> 00:03:27,760
THINK OF FLYING UBERS.

62
00:03:27,760 --> 00:03:30,540
THESE VEHICLES COULD USE
ALL-ELECTRIC OR HYBRID-ELECTRIC

63
00:03:30,540 --> 00:03:36,340

PROPULSION SYSTEMS CAPABLE OF
VERTICAL TAKEOFF AND LANDING.

64
00:03:36,340 --> 00:03:39,610
THE OVERARCHING GOAL OF
NASA'S WORK IN THIS SPACE

65
00:03:39,610 --> 00:03:42,040
IS TO DEVELOP AND VALIDATE
TOOLS, TECHNOLOGIES,

66
00:03:42,040 --> 00:03:44,700
AND CONCEPTS TO OVERCOME
KEY CHALLENGES FOR

67
00:03:44,700 --> 00:03:46,910
VERTICAL LIFT VEHICLES.

68
00:03:46,910 --> 00:03:49,710
A CRITICAL CHALLENGE FOR
UAM MARKET GROWTH

69
00:03:49,710 --> 00:03:52,190
IS PUBLIC'S ACCEPTANCE
THAT THESE VEHICLES

70
00:03:52,190 --> 00:03:55,510
CAN BE AS SAFE AS
COMMERCIAL AIR TRAVEL

71
00:03:55,510 --> 00:03:58,130
OR AUTOMOTIVE TRANSPORTATION.

72
00:03:58,130 --> 00:04:02,240
HOWEVER, THE MOST IMMEDIATE
IMPACT FROM NASA'S WORK

73
00:04:02,240 --> 00:04:05,930
FOR THE FLYING PUBLIC IS
THE REDUCTION IN COST THROUGH

74
00:04:05,930 --> 00:04:09,630
FUEL-BURN IMPROVEMENTS
AND LOWER AIRFARE PRICES.

75
00:04:09,630 --> 00:04:13,150
TO PUT THAT IN CONTEXT,
LET'S LOOK AT SOME NUMBERS.

76
00:04:13,150 --> 00:04:15,410
THE OVERALL GLOBAL FLEET
OF LARGE COMMERCIAL--

77
00:04:15,410 --> 00:04:20,410
COMMERCIAL AIRCRAFTS TOTALED
OVER 25,000 IN 2017,

78
00:04:20,410 --> 00:04:25,180
AND IS EXPECTED TO GROW
TO 37,000 AIRCRAFT BY 2027.

79
00:04:25,180 --> 00:04:30,490
OUT OF THE 25,000 AIRCRAFT
TODAY, NEARLY 60% OF THOSE

80
00:04:30,490 --> 00:04:34,740
ARE NARROW-BODY AIRCRAFT,
SMALL, ORIGINAL AIRCRAFTS,

81
00:04:34,740 --> 00:04:37,740
BOTH JET AND TURBOPROPS.

82
00:04:37,740 --> 00:04:40,129
SAVING JUST 10% IN
FUEL CONSUMPTION

83
00:04:40,129 --> 00:04:43,629
ACROSS THIS FLEET WOULD YIELD
MORE THAN 5 BILLION GALLONS

84
00:04:43,629 --> 00:04:46,740
OF FUEL SAVINGS PER YEAR,
AND IS FORECASTED TO SAVE

85
00:04:46,740 --> 00:04:50,930
APPROXIMATELY 10 BILLION GALLONS
BY 2040.

86
00:04:50,930 --> 00:04:53,240
WE ALSO HAVE TO TAKE
INTO ACCOUNT THE REDUCTION

87
00:04:53,240 --> 00:04:55,750
INTO CO2 EMISSIONS.

88
00:04:55,750 --> 00:04:57,660
SO HOW DO WE GET THERE?

89
00:04:57,660 --> 00:04:59,939
THE LEADING CONCEPT THAT NASA
IS CURRENTLY INVESTIGATING

90
00:04:59,939 --> 00:05:02,189
FOR PARTIALLY TURBOELECTRIC
CONFIGURATION IS

91
00:05:02,189 --> 00:05:06,060
SINGLE-AISLE TURBOELECTRIC
WITH AFT BOUNDARY-LAYER

92
00:05:06,060 --> 00:05:09,210
PROPULSOR, KNOWN AS STARC-ABL.

93
00:05:09,210 --> 00:05:11,789
THIS CONFIGURATION IS BEING
DEVELOPED, ASSUMING ENTRY

94
00:05:11,789 --> 00:05:14,919
INTO SERVICE BY 2035.

95
00:05:14,919 --> 00:05:18,909
IT CONSISTS OF TWO UNDER WING
TUBER FANS, WITH GENERATORS,

96
00:05:18,909 --> 00:05:21,469
EXTRACTING POWER FROM
TUBER FAN SHAFTS

97
00:05:21,469 --> 00:05:24,080
AND TRANSMITTING IT ELECTRICALLY
TO REAR FUSELAGE

98
00:05:24,080 --> 00:05:27,439
BOUNDARY-LAYER INGESTING FAN.

99
00:05:27,439 --> 00:05:30,319
ONE OF THE MAIN SOURCES OF DRAG
ON AN AIRCRAFT IS A LAYER

100
00:05:30,319 --> 00:05:32,629
OF SLOW-MOVING AIR
THAT BUILDS UP ALONG

101
00:05:32,629 --> 00:05:36,860
THE FUSELAGE AND WINGS
KNOWN AS BOUNDARY-LAYER.

102
00:05:36,860 --> 00:05:38,960
BOUNDARY-LAYER CREATES
EXTRA DRAG, AND WE BELIEVE

103
00:05:38,960 --> 00:05:42,129
WE CAN IMPROVE AIRCRAFT
PERFORMANCE BY EMBEDDING

104
00:05:42,129 --> 00:05:45,110
ENGINES INTO THE AIRFRAME
AND HAVING THOSE ENGINES

105
00:05:45,110 --> 00:05:47,770
CONSUME BOUNDARY-LAYER AIR.

106
00:05:47,770 --> 00:05:50,279
BY INGESTING BOUNDARY-LAYER,
THE DRAG IS SIGNIFICANTLY

107
00:05:50,279 --> 00:05:53,039
DECREASED, WHICH LEADS TO
AN OVERALL IMPROVEMENT

108
00:05:53,039 --> 00:05:56,410
IN AIRCRAFT EFFICIENCY.

109
00:05:56,410 --> 00:05:59,789
RESULTS INDICATE THAT
THIS TURBOELECTRIC CONCEPT HAS

110
00:05:59,789 --> 00:06:04,270
AN ECONOMIC FUEL BURN REDUCTION
OF 7%, AND EMISSION FUEL-BURN

111
00:06:04,270 --> 00:06:10,500
REDUCTION OF 12% COMPARING
TO OTHER AIRCRAFT DESIGNS.

112
00:06:10,500 --> 00:06:14,039
SEVERAL YEARS AGO,
NASA HAS DEVELOPED AN ADVANCED

113
00:06:14,039 --> 00:06:18,470
AND HIGHLY-INTEGRATED CONCEPT
KNOWN AS [INDISTINCT]

114
00:06:18,470 --> 00:06:21,969
WHICH EXPLORED FUEL SAVINGS
BY COMBINING A BLENDED

115
00:06:21,969 --> 00:06:25,020

WING BODY DESIGN,
WITH FULLY TURBOELECTRIC

116
00:06:25,020 --> 00:06:28,210
AND FULLY DISTRIBUTED
PROPULSION SYSTEM BASED ON

117
00:06:28,210 --> 00:06:30,089
THE SUPERCONDUCTING
ELECTRIC MACHINES

118
00:06:30,089 --> 00:06:32,729
AND POWER DISTRIBUTION.

119
00:06:32,729 --> 00:06:34,539
THE FUEL BENEFITS OF
THIS CONFIGURATION IS

120
00:06:34,539 --> 00:06:38,889
VERY SIGNIFICANT, ESTIMATED
AT NEARLY 70% REDUCTION,

121
00:06:38,889 --> 00:06:43,970
COMPARING TO CONVENTIONAL
AIRCRAFTS, SUCH AS BOEING 777.

122
00:06:43,970 --> 00:06:47,289
THIS CONCEPT HAS THE BEST
BENEFITS SO FAR STUDIED.

123
00:06:47,289 --> 00:06:50,719
HOWEVER, IT REQUIRES
THE MOST AGGRESSIVE TECHNOLOGY

124
00:06:50,719 --> 00:06:53,560
AND INFRASTRUCTURE DEVELOPMENT.

125
00:06:53,560 --> 00:06:57,069
AND LAST BUT NOT LEAST,
NASA IS BUILDING ITS FIRST-EVER

126
00:06:57,069 --> 00:07:01,169
ALL-ELECTRIC X-PLANE,
X-57 MAXWELL.

127
00:07:01,169 --> 00:07:04,099
THIS DESIGN WILL DEMONSTRATE
AN EFFECTIVE INTERACTION

128
00:07:04,099 --> 00:07:06,919
BETWEEN A WING,
THE ENGINE PROPELLERS,

129
00:07:06,919 --> 00:07:09,180
AND THE FLIGHT MISSION
FLIGHT PATH, WHILE

130
00:07:09,180 --> 00:07:12,419
SIMULTANEOUSLY SOLVING
A NUMBER OF CHALLENGING

131
00:07:12,419 --> 00:07:15,270
TECHNICAL ISSUES FOR
ELECTRIFIED PROPULSION

132
00:07:15,270 --> 00:07:18,169
IN CREW RATED AIRCRAFTS.

133
00:07:18,169 --> 00:07:19,939
WHILE ELECTRIC MOTORS
ARE MORE EFFICIENT

134
00:07:19,939 --> 00:07:22,759
AND FUEL-BURNING ENGINES,
THEY PRODUCE A SIGNIFICANT

135
00:07:22,759 --> 00:07:26,389
AMOUNT OF HEAT DURING OPERATION,
REQUIRING AN INTEGRATED

136
00:07:26,389 --> 00:07:28,370
THERMAL MANAGEMENT SYSTEM
TO BE INCORPORATED

137
00:07:28,370 --> 00:07:29,669
INTO THE DESIGN.

138
00:07:29,669 --> 00:07:33,280
NOW, A COMMON METHOD OF SOLVING
SUCH HEAT-RELATED PROBLEMS

139
00:07:33,280 --> 00:07:37,610
IS TO EMPLOY AN EMBEDDED,
UH, UH, HEAT SINK

140
00:07:37,610 --> 00:07:42,240
OR A LARGE METAL HEAT SINK
OR, UH, WATER COOLING SYSTEM.

141
00:07:42,240 --> 00:07:44,580
BUT THIS CAN CAUSE
A DRAMATIC INCREASE IN WEIGHT,

142
00:07:44,580 --> 00:07:48,789
THUS REDUCING THE BENEFIT GAINED
BY ELECTRIC CONVERSION.

143
00:07:48,789 --> 00:07:51,360
ONE SUCH RESEARCH EFFORT
TO CONTROL THE HEAT GENERATED

144
00:07:51,360 --> 00:07:55,460
BY THESE SYSTEMS WAS PERFORMED
LATE LAST YEAR BY MY TEAM,

145
00:07:55,460 --> 00:07:58,861
WHERE WE DEVELOPED
A 98% EFFICIENT, 13 KILOWATT

146

00:07:58,861 --> 00:08:03,259
POWER SYSTEM FOR
X-57 HIGH-LIFT PROPULSORS.

147
00:08:03,259 --> 00:08:06,759
WEIGHING ONLY TWO POUNDS
AND COMPLETELY AIR-COOLED.

148
00:08:06,759 --> 00:08:10,349
THIS SYSTEM WAS FULLY-QUALIFIED
ACROSS THE VARIOUS FACILITIES

149
00:08:10,349 --> 00:08:13,620
AT NASA GLENN IN
TEN SHORT MONTHS,

150
00:08:13,620 --> 00:08:16,469
AND WITHIN NEXT TWO YEARS,
OUR SYSTEM WILL BE FLYING

151
00:08:16,469 --> 00:08:20,610
ON X-57 FLIGHTS, PROVING THAT
IT IS POSSIBLE TO HAVE

152
00:08:20,610 --> 00:08:26,119
A LIGHTWEIGHT, AIR-COOLED
SOLUTION FOR AIRCRAFTS.

153
00:08:26,119 --> 00:08:28,199
IN ORDER TO QUALIFY
THE COMPONENTS IN THIS

154
00:08:28,199 --> 00:08:31,789
ELECTRIFIED AIR IN AVIATION,
NASA NEEDED TO DEVELOP

155
00:08:31,789 --> 00:08:34,870
CAPABILITY TO TEST
AND VERIFY THEM BEFORE

156

00:08:34,870 --> 00:08:37,390
IN-FLIGHT TESTING.

157
00:08:37,390 --> 00:08:39,530
SO WE CONVERTED OUR
HYPERSONIC TEST FACILITY

158
00:08:39,530 --> 00:08:43,800
IN PLUMBROOK STATION IN
SANDUSKY TO A NASA ELECTRIFIED

159
00:08:43,800 --> 00:08:46,910
AIRCRAFT TEST BED, NEAT.

160
00:08:46,910 --> 00:08:50,330
CURRENTLY, THIS STATE OF THE ART
FACILITY'S BEING USED TO TEST

161
00:08:50,330 --> 00:08:53,100
FULL-SCALE MEGAWATT
POWER TRAINS, WITH AN EYE

162
00:08:53,100 --> 00:08:55,910
TOWARDS INCORPORATING
COMPONENT TECHNOLOGIES

163
00:08:55,910 --> 00:08:58,260
INTO AN OVERALL SYSTEM.

164
00:08:58,260 --> 00:09:01,541
THE FACILITY CAN SUPPORT
SINGLE-AISLE AIRCRAFT

165
00:09:01,541 --> 00:09:04,830
GEOMETRIES WITH PROPER
CABLE LENS AND ELECTROMAGNETIC

166
00:09:04,830 --> 00:09:06,430
INTERFERENCE MITIGATION.

167
00:09:06,430 --> 00:09:10,790
IT CAN SUPPLY POWER FOR
UP TO 24 MEGAWATTS.

168
00:09:10,790 --> 00:09:13,570
THERMAL MANAGEMENT SYSTEM
FOR UP TO 2 MEGAWATTS,

169
00:09:13,570 --> 00:09:16,010
AND IT EVEN CONTAINS
AN ALTITUDE CHAMBER THAT CAN

170
00:09:16,010 --> 00:09:19,790
SIMULATE UP TO 120,000 FEET.

171
00:09:19,790 --> 00:09:23,550
ALL ELECTRIC AIRCRAFT CONCEPTS
THAT WE'VE SEEN SO FAR

172
00:09:23,550 --> 00:09:26,630
RELY HEAVILY ON ADVANCEMENTS
OF COMPONENTS SUCH AS

173
00:09:26,630 --> 00:09:29,400
ADVANCED MOTORS,
POWER CONVERTERS,

174
00:09:29,400 --> 00:09:32,280
AND MATERIAL SCIENCE
TO NAME A FEW.

175
00:09:32,280 --> 00:09:35,500
X-57 WORK IS AN EXAMPLE OF
MUCH LARGER RESEARCH PORTFOLIO

176
00:09:35,500 --> 00:09:38,160
WITHIN THE FIELD OF
POWER SYSTEMS LEAD BY

177

00:09:38,160 --> 00:09:39,430
NASA GLENN.

178
00:09:39,430 --> 00:09:42,840
OVER THE PAST TWENTY YEARS,
GLENN HAS PIONEERED DESIGNS

179
00:09:42,840 --> 00:09:46,570
OF VARIOUS HIGH-POWER DENSITY
AND HIGH-EFFICIENT MOTORS

180
00:09:46,570 --> 00:09:50,450
FOR SPACE, AERONAUTICS,
MEDICAL, AND TERRESTRIAL

181
00:09:50,450 --> 00:09:52,380
APPLICATIONS.

182
00:09:52,380 --> 00:09:54,630
ALL OUR WORK HAS ALWAYS
PUSHED THE BOUNDARIES OF

183
00:09:54,630 --> 00:09:57,020
WHAT'S POSSIBLE,
AND OUR NEWEST MOTOR WORK

184
00:09:57,020 --> 00:09:59,580
IS NO DIFFERENT.

185
00:09:59,580 --> 00:10:02,520
NASA GLENN HAS A SMALL
IN-HOUSE TEAM THAT IS DEVELOPING

186
00:10:02,520 --> 00:10:05,720
A 1.4 MEGAWATT MOTOR
WITH THE PERFORMANCE GOAL

187
00:10:05,720 --> 00:10:11,790
OF 16 KILOWATTS PER KILOGRAM,
AND EFFICIENCY GREATER THAN 98%.

188
00:10:11,790 --> 00:10:14,580
THE MOTOR CONTAINS
A SELF-COOLED SUPERCONDUCTING

189
00:10:14,580 --> 00:10:17,630
ROTOR, WHICH HAS NEVER BEEN
DONE BEFORE, ALLOWING

190
00:10:17,630 --> 00:10:20,410
THE MOTOR TO ACHIEVE
EXCEPTIONAL SPECIFIC

191
00:10:20,410 --> 00:10:23,220
POWER AND EFFICIENCIES,
WITHOUT IT HURTING

192
00:10:23,220 --> 00:10:26,060
EXTERNAL COOLING WEIGHT PENALTY,
COMMONLY ATTRIBUTED TO

193
00:10:26,060 --> 00:10:28,700
SUPERCONDUCTING MACHINES.

194
00:10:28,700 --> 00:10:33,210
INTEGRATED ROTOR SUPERCONDUCTOR,
SPINNING AT 6800 RPM,

195
00:10:33,210 --> 00:10:35,400
FOUR TIMES HIGHER THAN
THE STATE OF THE ART,

196
00:10:35,400 --> 00:10:37,840
AND WEIGHING ONLY 80 KILOGRAMS.

197
00:10:37,840 --> 00:10:40,960
THIS MOTOR REVOLUTIONIZES
THE FIELD OF ADVANCED MOTORS,

198

00:10:40,960 --> 00:10:44,390
AND GREATLY INCREASED NUMBER
OF AIRCRAFT CONCEPTS

199
00:10:44,390 --> 00:10:48,190
THAT CAN UTILIZE
HYBRID ARCHITECTURES.

200
00:10:48,190 --> 00:10:51,810
ALL OUR ELECTRIC MOTOR WORK
IS ALL DIVERSE IN

201
00:10:51,810 --> 00:10:54,070
SIZE APPLICATIONS
AND POWER LEVELS.

202
00:10:54,070 --> 00:10:57,940
AND IT'S, UH, BEYOND, UH,
THE WORLD OF AERONAUTICS.

203
00:10:57,940 --> 00:11:01,500
JUST FIVE YEARS AGO, MY TEAM
DESIGNED, BUILT, AND DELIVERED

204
00:11:01,500 --> 00:11:03,580
A BICONICAL MOTOR TO
UNIVERSITY OF INDIANA'S

205
00:11:03,580 --> 00:11:05,710
SCHOOL OF MEDICINE.

206
00:11:05,710 --> 00:11:08,270
THIS MOTOR WAS DESIGNED TO
HELP CATALYZE ADVANCEMENTS

207
00:11:08,270 --> 00:11:11,630
IN THE FIELD OF
CARDIOVASCULAR ASSIST DEVICES,

208
00:11:11,630 --> 00:11:13,810

SUCH AS PACEMAKERS FOR KIDS
WHO ARE BORN WITH

209
00:11:13,810 --> 00:11:16,300
A SINGLE-HEART VENTRICLE.

210
00:11:16,300 --> 00:11:19,360
THIS MOTOR IS A TINY COMPARISON
TO THE ONES IN AIRCRAFT.

211
00:11:19,360 --> 00:11:21,200
JUST TWO INCHES TALL.

212
00:11:21,200 --> 00:11:23,260
AND IT'S POWERED BY
A TOTAL OF FIVE WATTS,

213
00:11:23,260 --> 00:11:26,080
SAME POWER AS USB PORTS
ON YOUR COMPUTERS.

214
00:11:26,080 --> 00:11:29,540
CURRENTLY, OUR DESIGN IS
BEING USED TO DEVELOP

215
00:11:29,540 --> 00:11:32,920
A CLINICAL TRIAL VERSION
AND HOPEFULLY A VIABLE DEVICE

216
00:11:32,920 --> 00:11:36,650
WILL ENTER MARKET WITHIN
THE DECADE, SAVING AN ESTIMATED

217
00:11:36,650 --> 00:11:40,280
1500 CHILDREN PER YEAR.

218
00:11:40,280 --> 00:11:42,380
ALL GREAT PROGRESS
IS ACCOMPANIED WITH

219
00:11:42,380 --> 00:11:43,450
GREAT DIFFICULTY.

220
00:11:43,450 --> 00:11:45,840
IT MUST BE ENTERPRISED
AND OVERCOME WITH

221
00:11:45,840 --> 00:11:48,110
ANSWERABLE COURAGE.

222
00:11:48,110 --> 00:11:50,260
IN OUR EFFORTS, WE DON'T
UNDERESTIMATE THE POWER OF

223
00:11:50,260 --> 00:11:52,100
VISION AND DIRECTION.

224
00:11:52,100 --> 00:11:54,760
THESE ARE IRRESISTIBLE FORCES,
ABLE TO TRANSFORM WHAT

225
00:11:54,760 --> 00:11:58,490
MIGHT APPEAR TO BE
UNCONQUERABLE OBSTACLES.

226
00:11:58,490 --> 00:12:01,610
INTRA-TRAVERSABLE PATHWAYS
AND EXPANDING OPPORTUNITIES.

227
00:12:01,610 --> 00:12:05,460
I AM DEEPLY HUMBLED TO HAVE
AN OPPORTUNITY TO BE PART OF

228
00:12:05,460 --> 00:12:06,810
THIS AMAZING JOURNEY.

229
00:12:06,810 --> 00:12:09,570
THE JOURNEY THAT WILL
SURELY CHANGE THE WORLD.