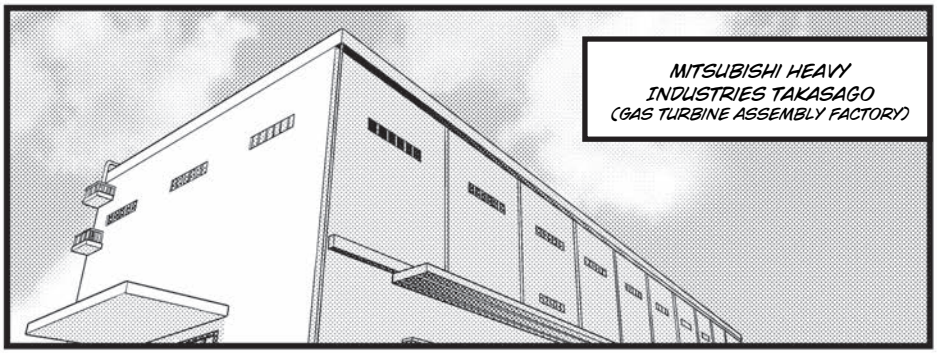
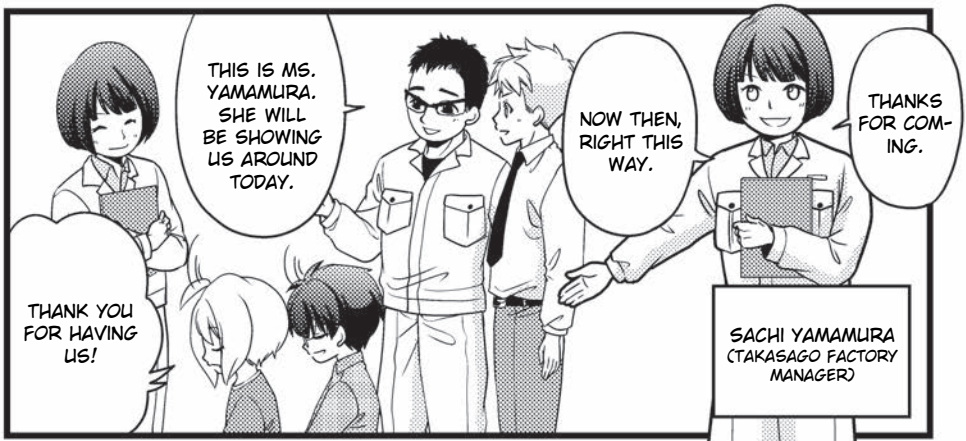
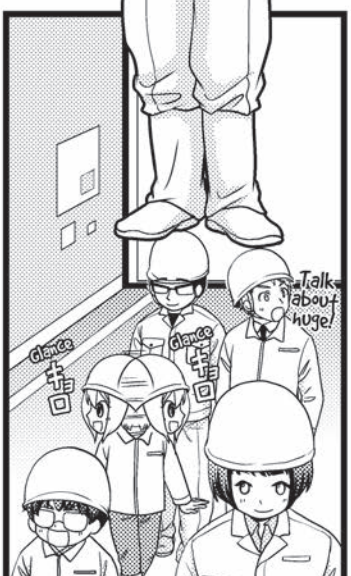
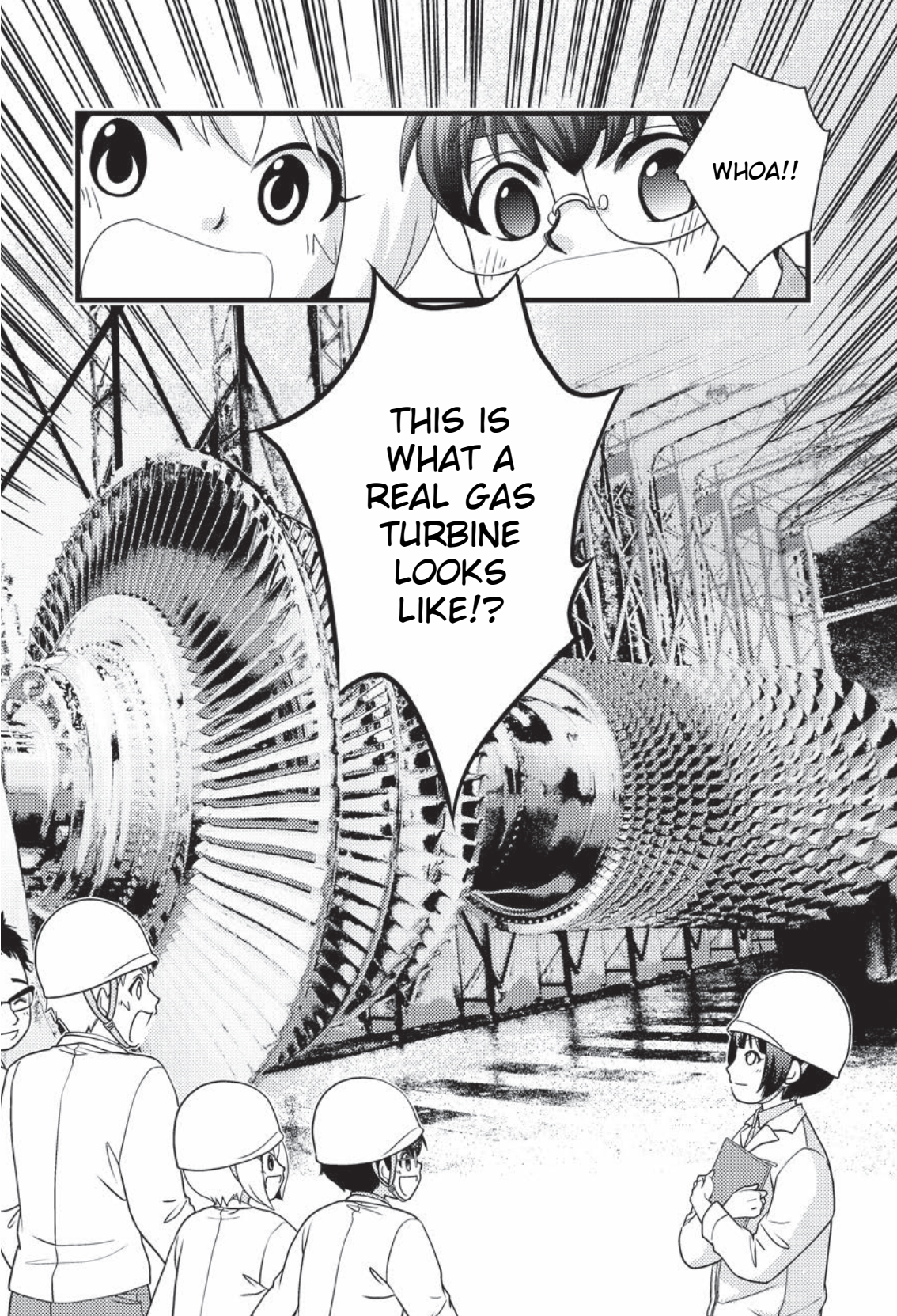
CHAPTER 4 A CHANGING WORLD.





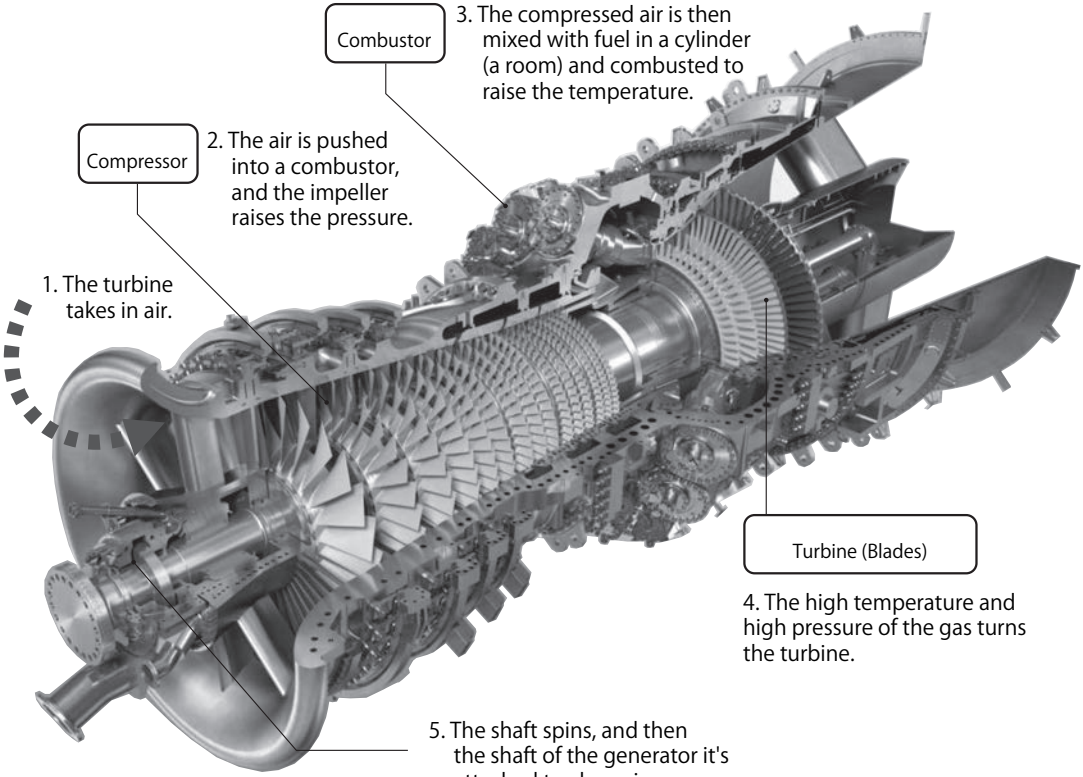


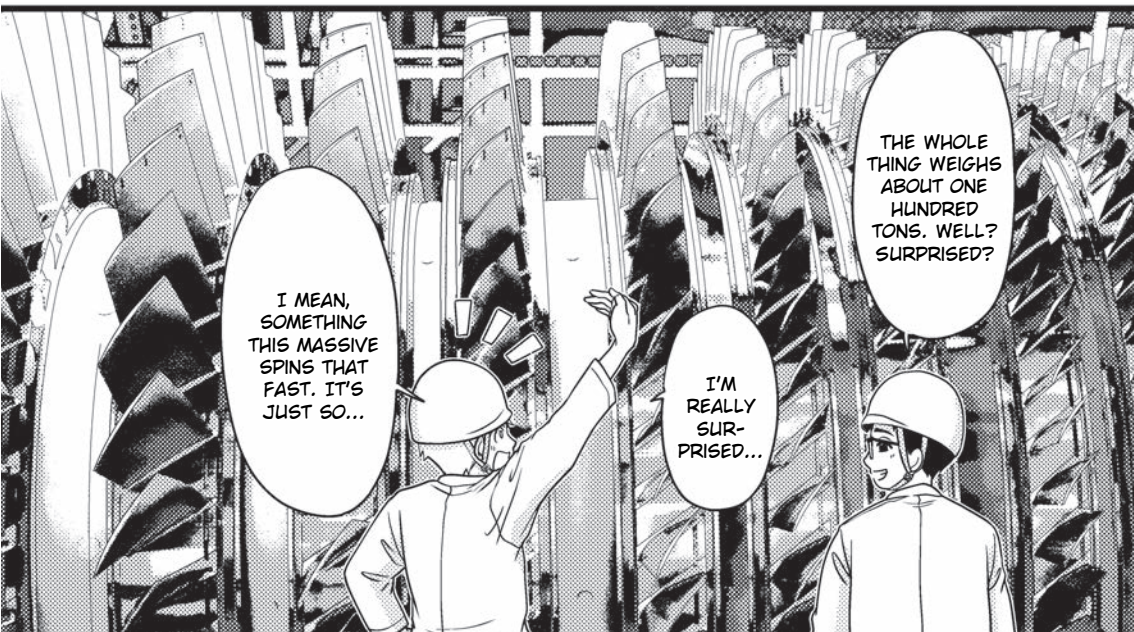

WHOA!!
THIS IS WHAT A REAL GAS TURBINE LOOKS LIKE!?

TRIVIA

A MACHINE THAT GENERATES MOTION VIA A SPINNING SHAFT WITH BLADES ATTACHED IS CALLED A TURBINE. IT USES GAS (E.G. AIR), WATER, OR STEAM.

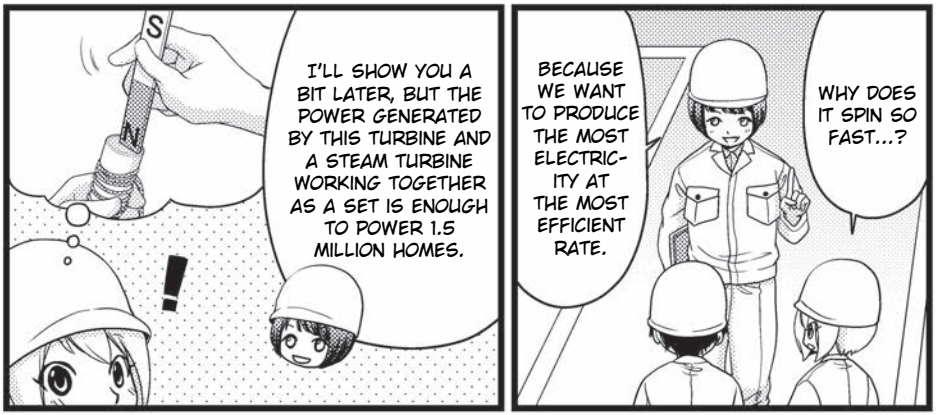
THE PARTS OF A GAS TURBINE

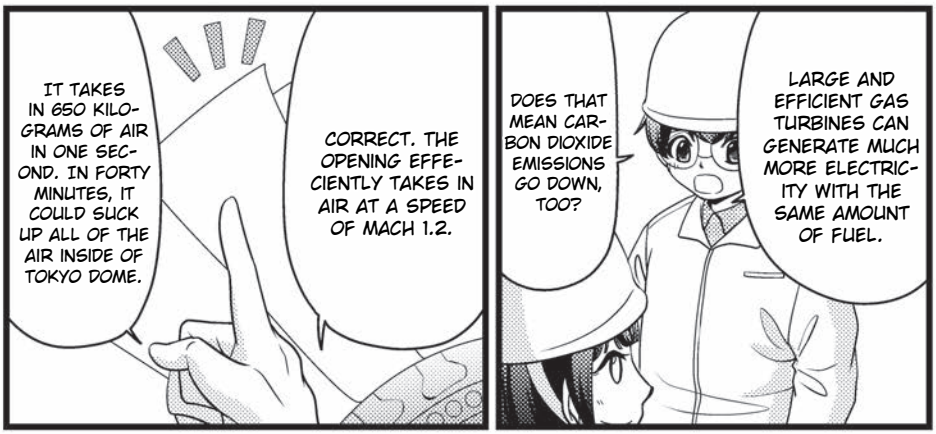


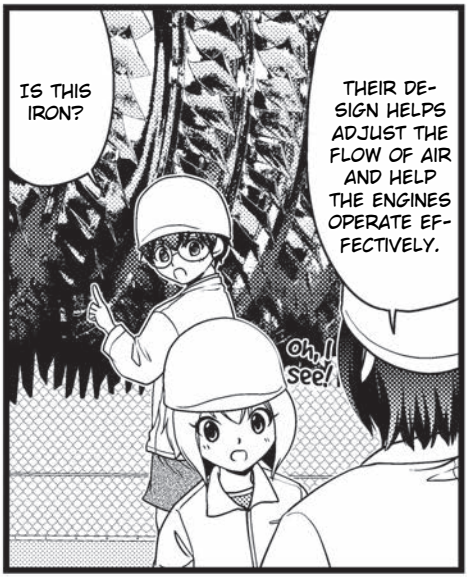


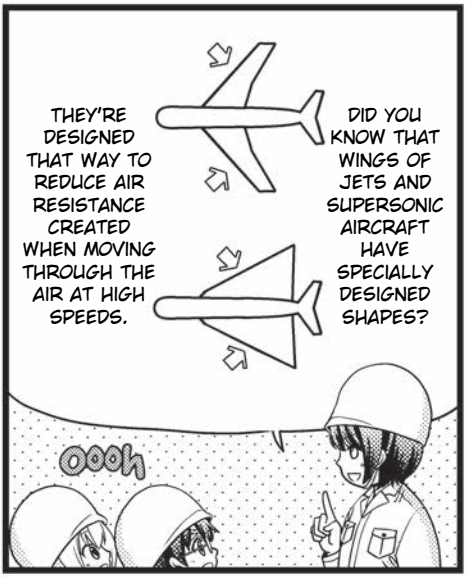
TRIVIA

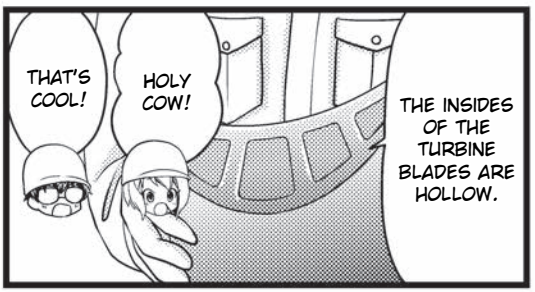
ONE LITER OF AIR WEIGHS 1.3 GRAMS. SO, A ROOM THAT'S 5M X 4M X 3M HAS A VOLUME OF 60 SQUARE METERS, MEANING ALL OF THE AIR IN THAT ROOM WOULD WEIGH 78 KILOGRAMS.











*400°C = 752°F.

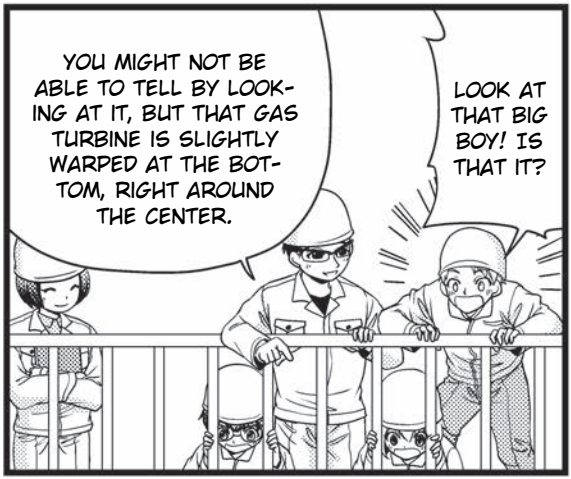
*1650°C = 3002°F.

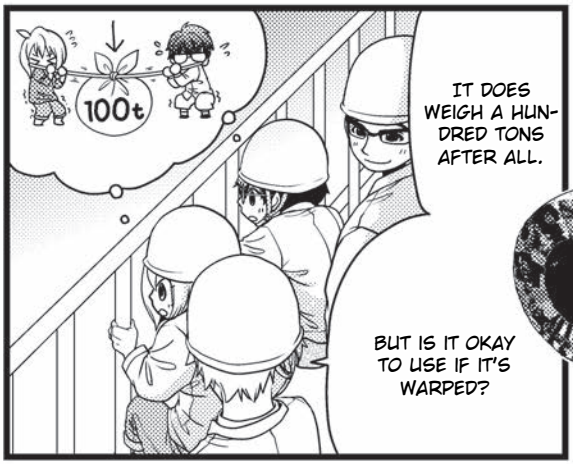
TRIVIA

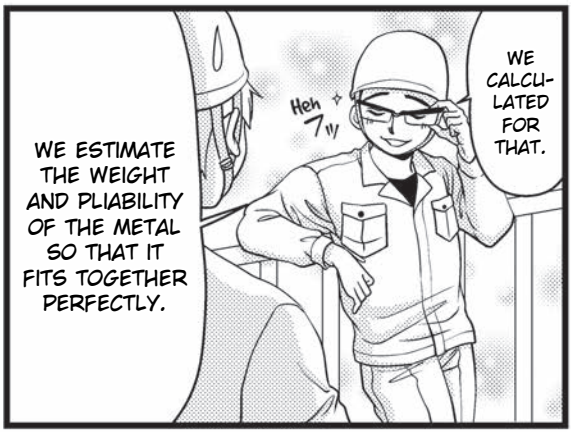
THE TEMPERATURE AT WHICH A SOLID BECOMES A LIQUID IS CALLED ITS MELTING POINT. IRON'S MELTING POINT IS 1538°C (2800.4°F), SO IT WILL MELT IN A TURBINE SINCE THE INTERNAL TEMPERATURE HITS 1650°C (3002°F).

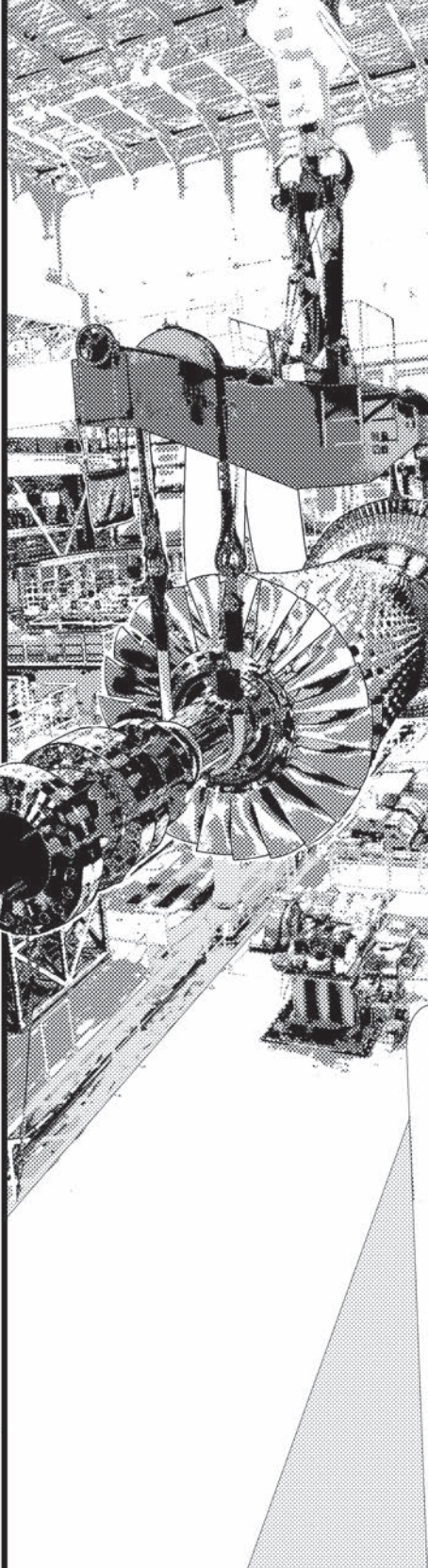
TRIVIA

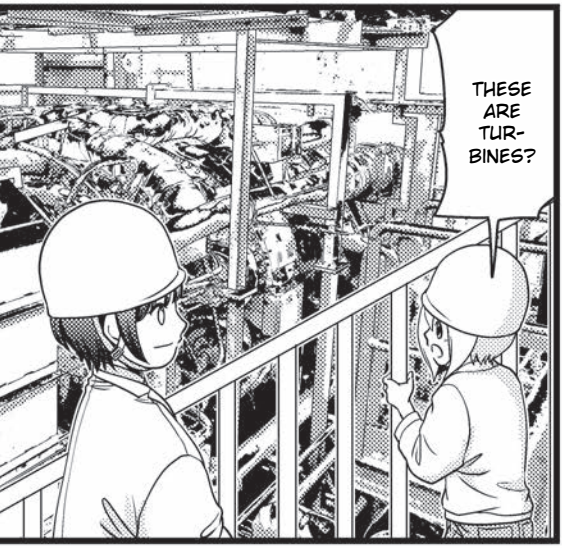
THE BLADES OF A GAS TURBINE ARE MADE FROM A SPECIAL NICKEL-BASE SUPERALLOY.

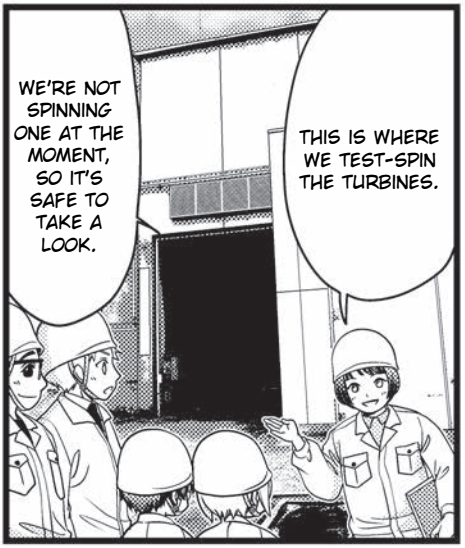










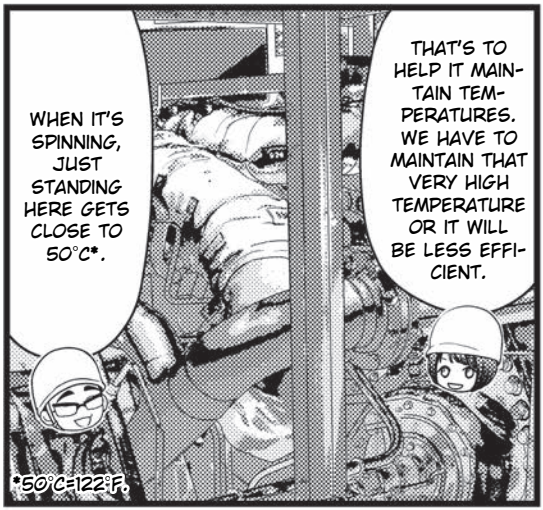


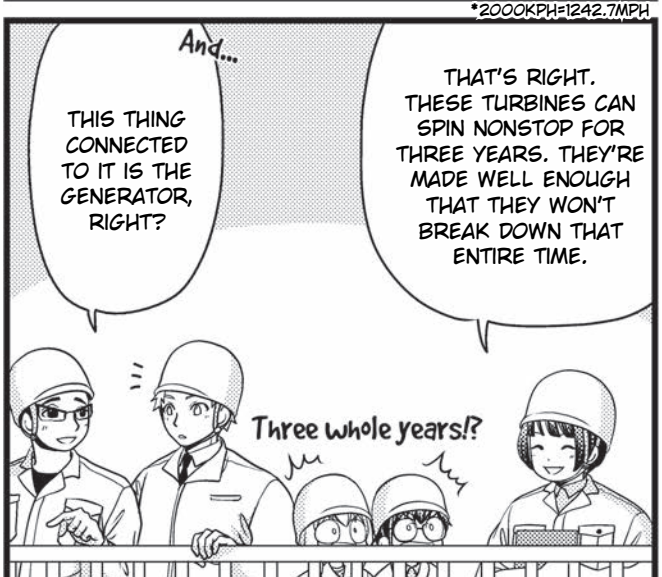
TRIVIA

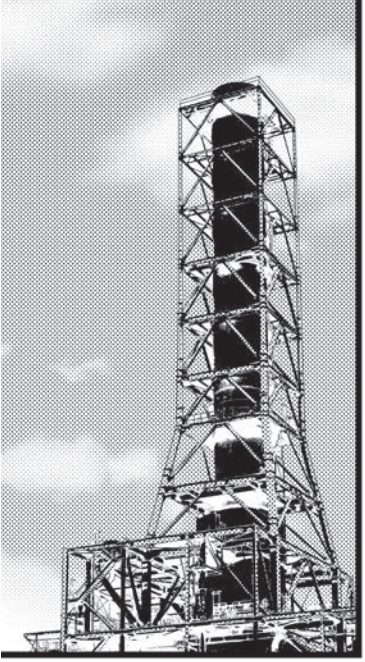
ALTHOUGH IT'S UNNOTICEABLE, OUR BODIES EXPERIENCE PRESSURE EQUAL TO ONE KILOGRAM PER SQUARE CENTIMETER, ALSO EXPRESSED AS ONE ATMOSPHERE (ATM).

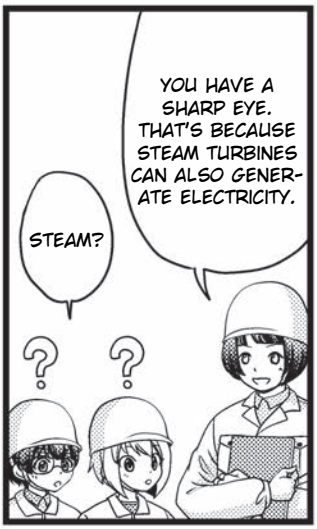
TRIVIA

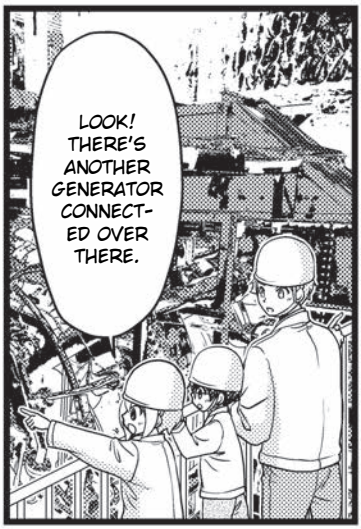
WHEN GAS IS COMPRESSED, IT HEATS UP. FOR EXAMPLE, IF YOU TAKE AIR AT 15°C (59°F) AND COMPRESS IT TO 25 ATM (OR 1/25TH ITS NORMAL VOLUME), IT REACHES A TEMPERATURE OF OVER 400°C (752°F).

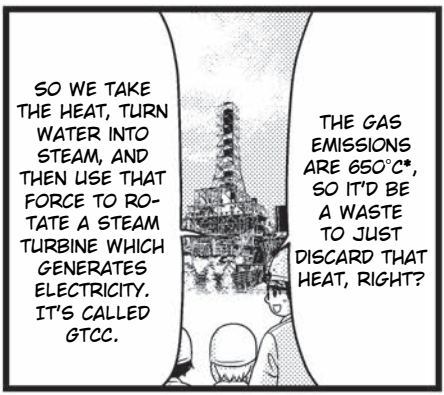


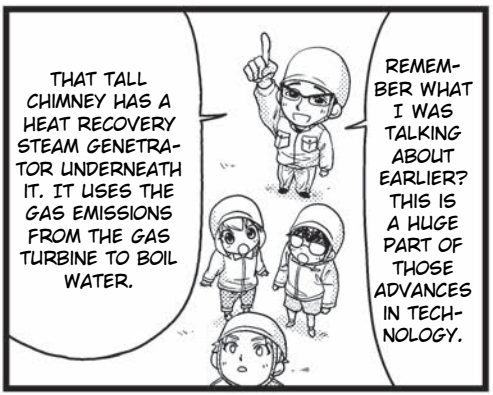






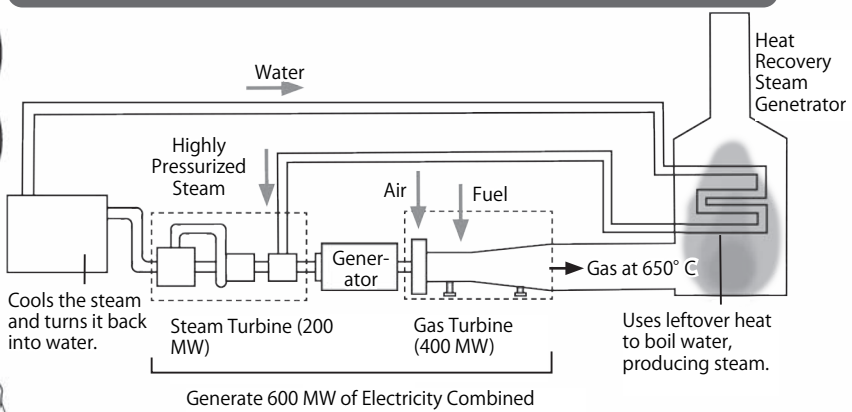


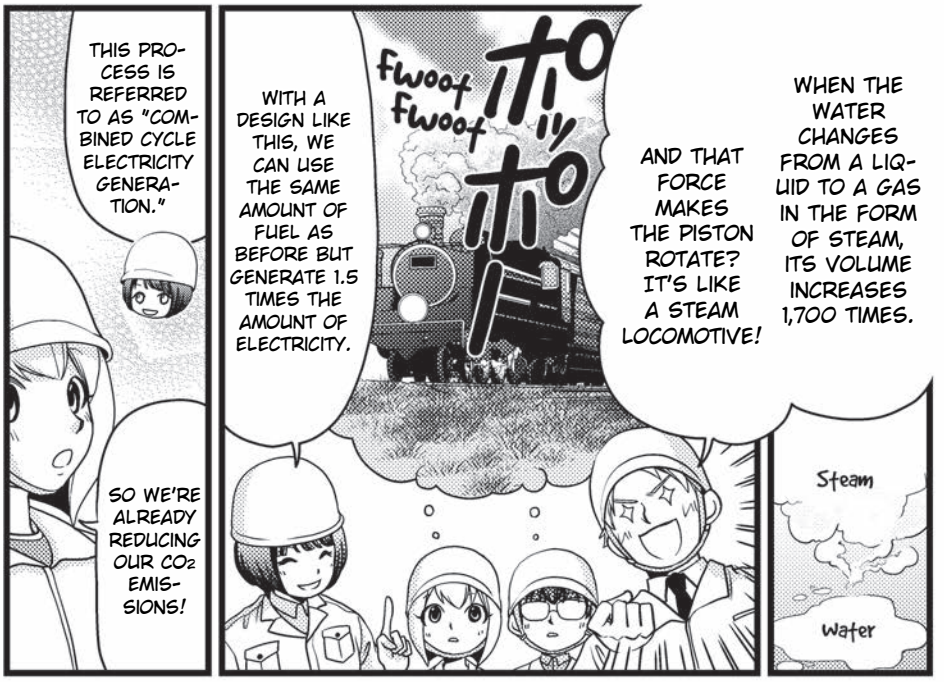


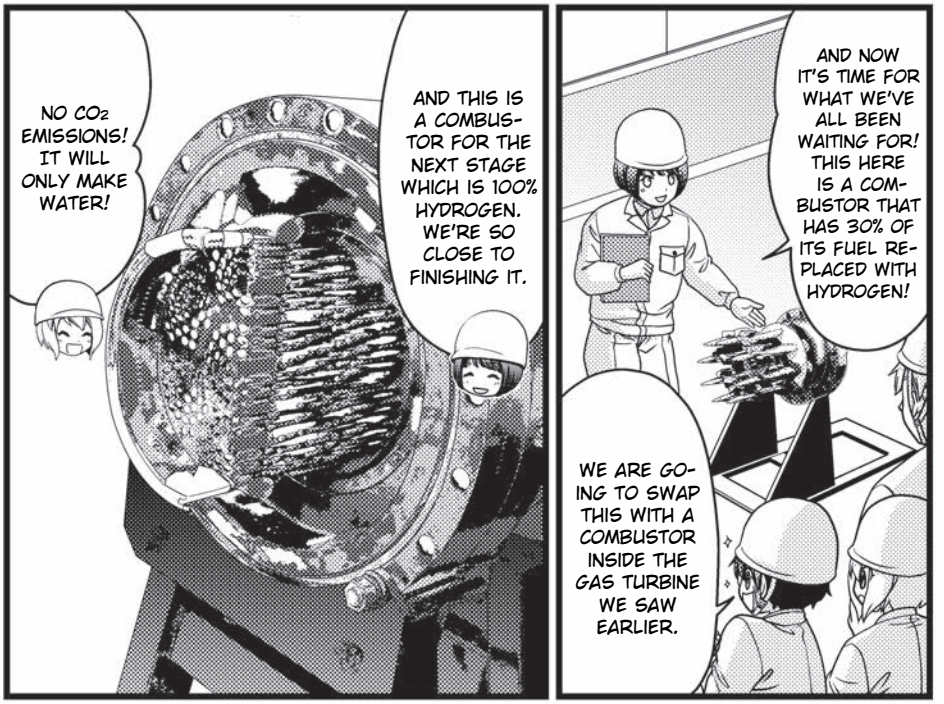


*650°C =1202°F.

WHAT'S GTCC? (GAS TURBINE COMBINED CYCLE POWER PLANTS)



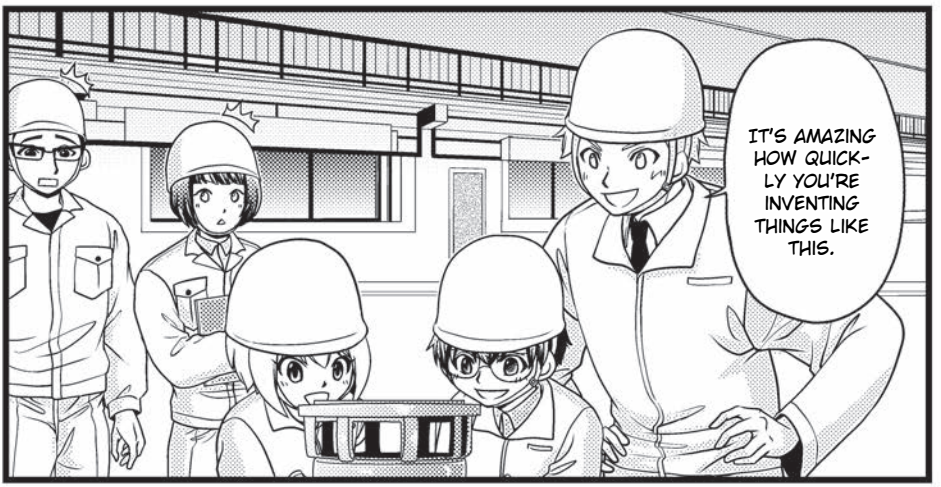


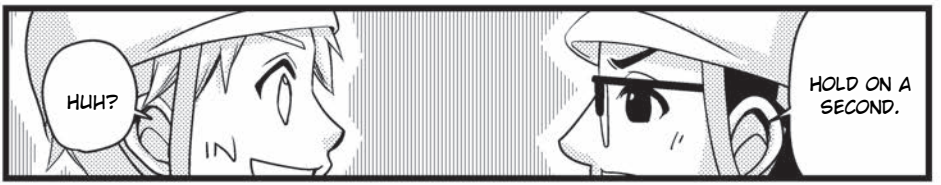


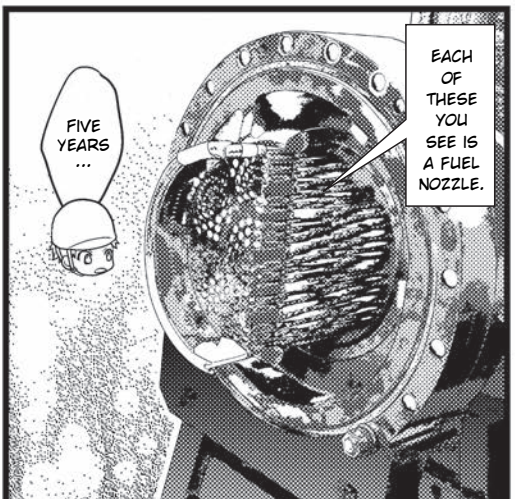
TRIVIA

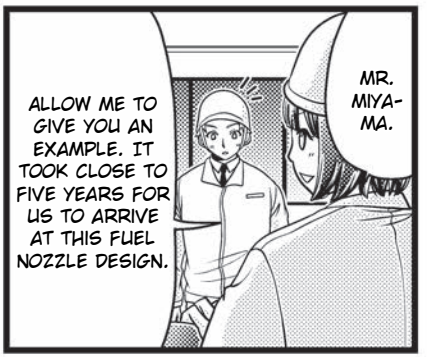
BECAUSE GAS TURBINE COMBINED CYCLE POWER PLANTS BY MITSUBISHI HEAVY INDUSTRIES CONVERT HEAT INTO MOTION ENERGY, THEY ARE DESIGNED TO BE RELEASE THE LEAST WASTE POSSIBLE (AS OF 2021).

BECAUSE HYDROGEN'S COMBUSTION RATE IS EIGHT TIMES FASTER THAN NATURAL GAS IN A GAS TURBINE, "FLASHBACKS" CAN OFTEN OCCUR.



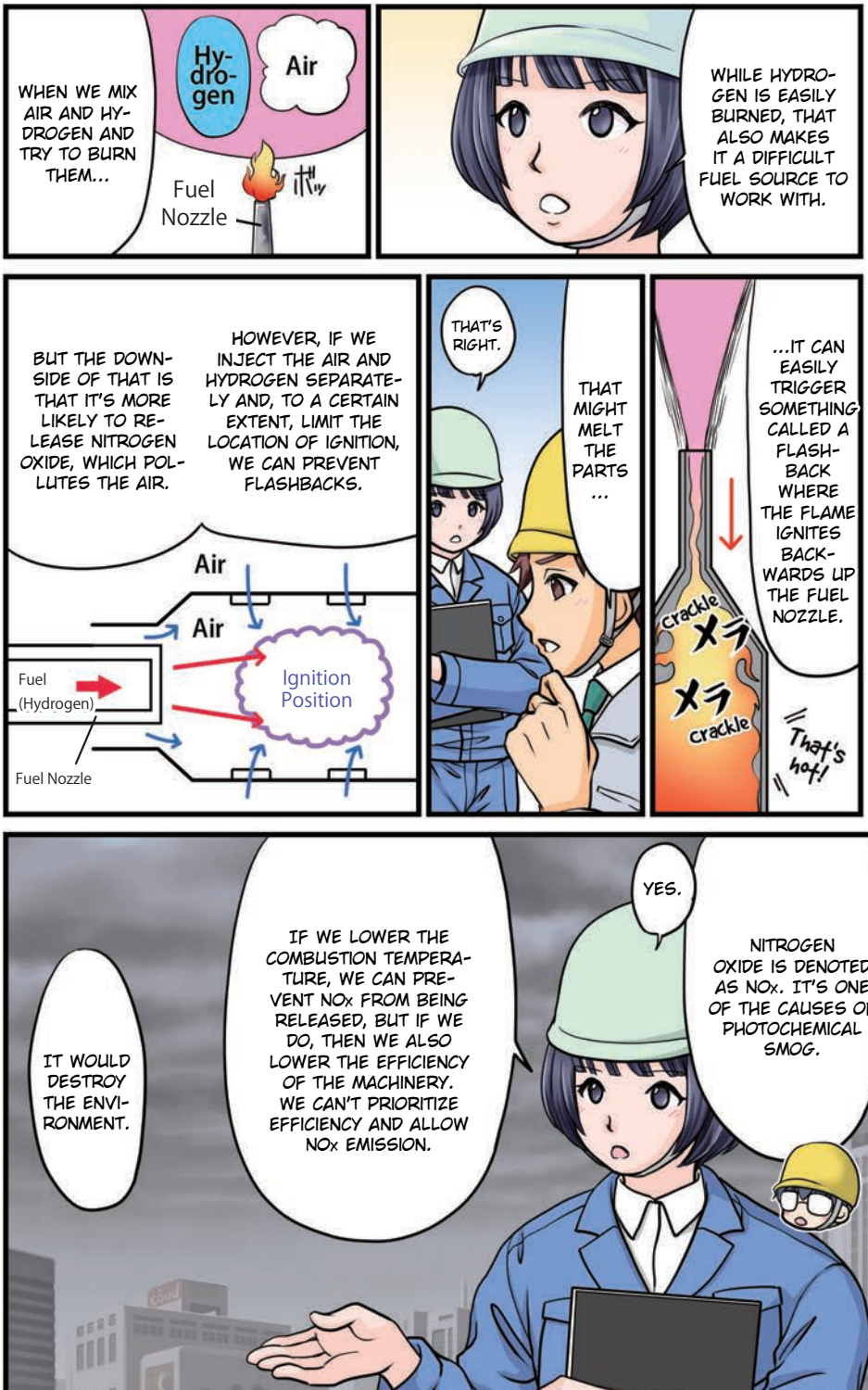


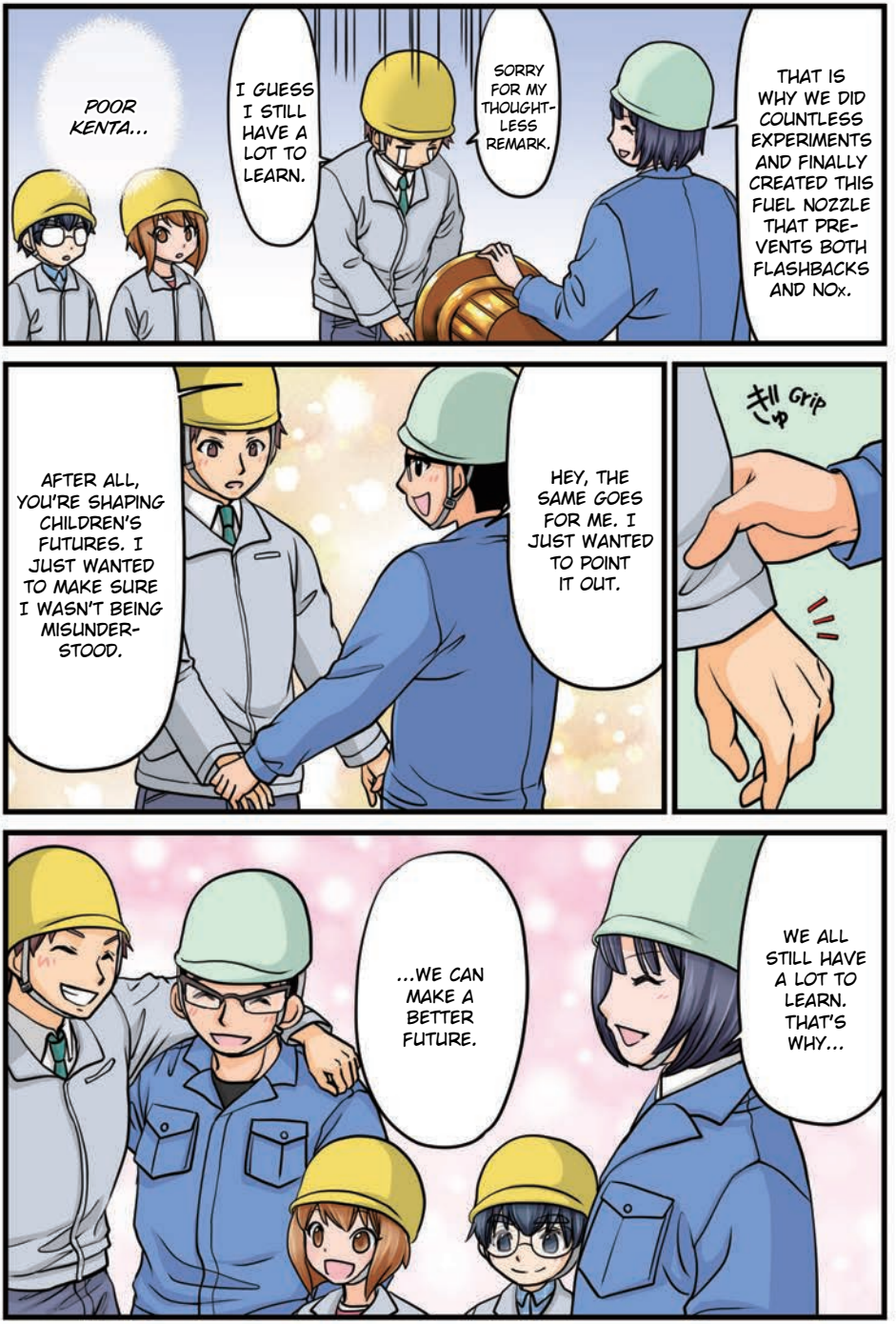




TRIVIA

WHEN SOMETHING IS IN ROTATION, FORCE MOVES OUTWARD, AWAY FROM THE CENTER OF ROTATION. THIS IS CALLED CENTRIFUGAL FORCE. ONE BLADE OF A TURBINE REQUIRES ONE HUNDRED TONS OF CENTRIFUGAL FORCE TO MOVE.



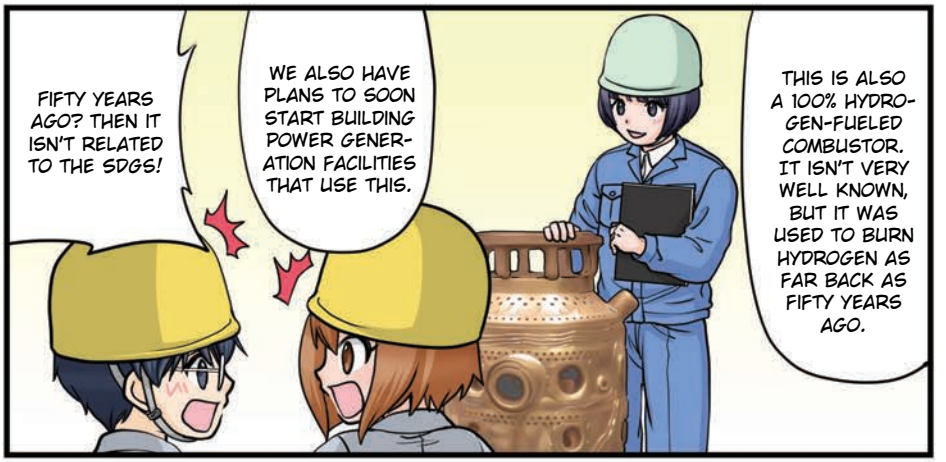


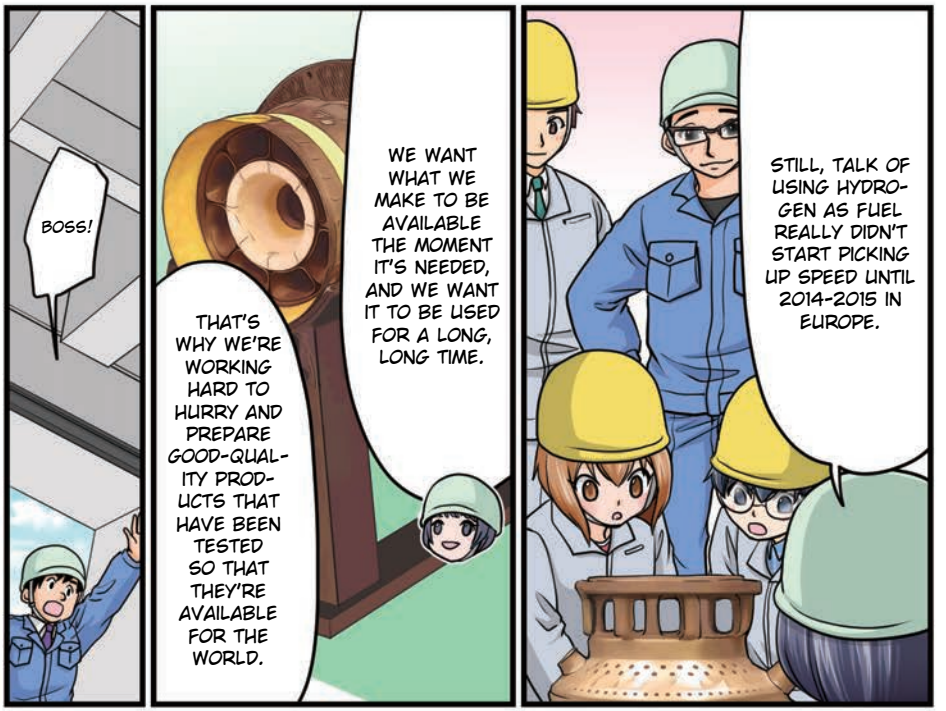
THE JAPANESE GOVERNMENT REVISED THE FIT* SYSTEM IN MAY, 2016. THIS STARTED INITIATIVES TO PRODUCE RENEWABLE ENERGY CHEAPLY AND EFFICIENTLY.

*FIT REFERS TO THE "FEED-IN TARIFF" SYSTEM AND IS A SPECIAL MEASURE INTRODUCED TO ENCOURAGE THE PROCUREMENT OF RENEWABLE ENERGY ELECTRICITY BY ELECTRICITY COMPANIES.

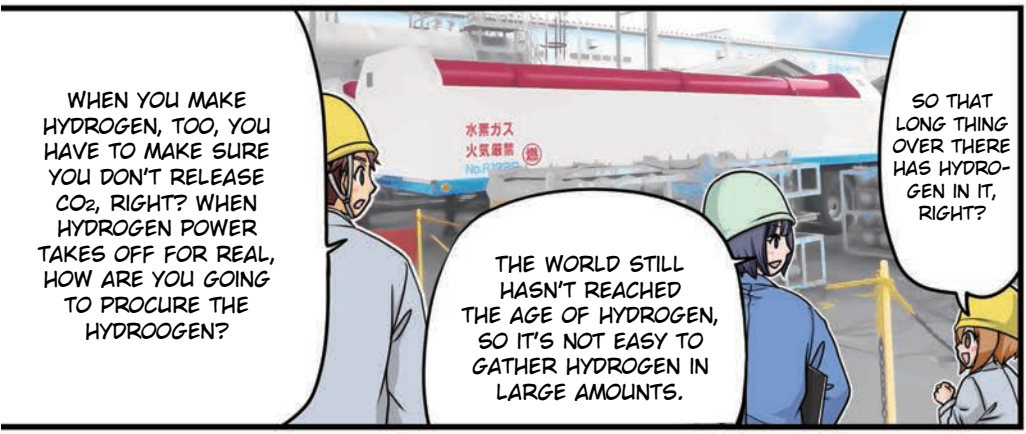
TRIVIA

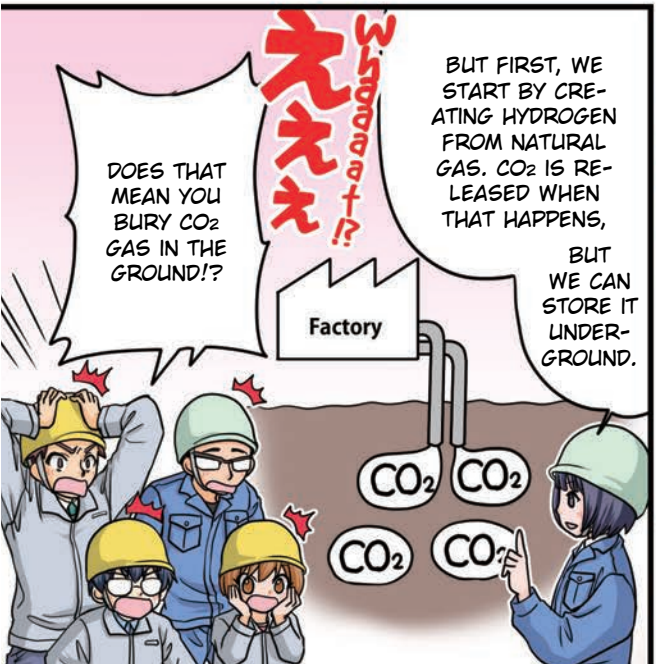
RISING SEA LEVELS AS A RESULT OF CLIMATE CHANGE ARE A SEVERE PROBLEM FOR COUNTRIES LIKE THE NETHERLANDS, WHICH HAVE A VERY LOW ELEVATION. THEY ARE IN DANGER OF LOSING A LARGE PART OF THEIR LAND.

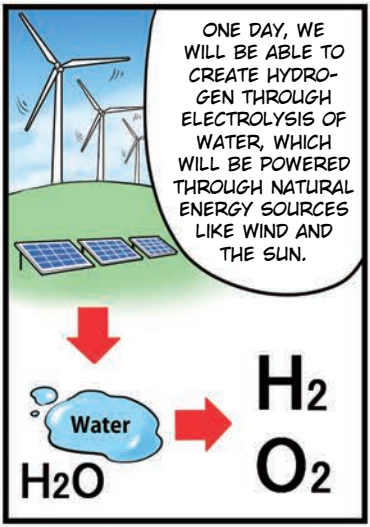




HYDROGEN'S MOLECULAR FORMULA IS H_2 AND AMMONIA'S IS NH_3. AMMONIA IS USED AS A MEDIUM FOR TRANSPORTING HYDROGEN.

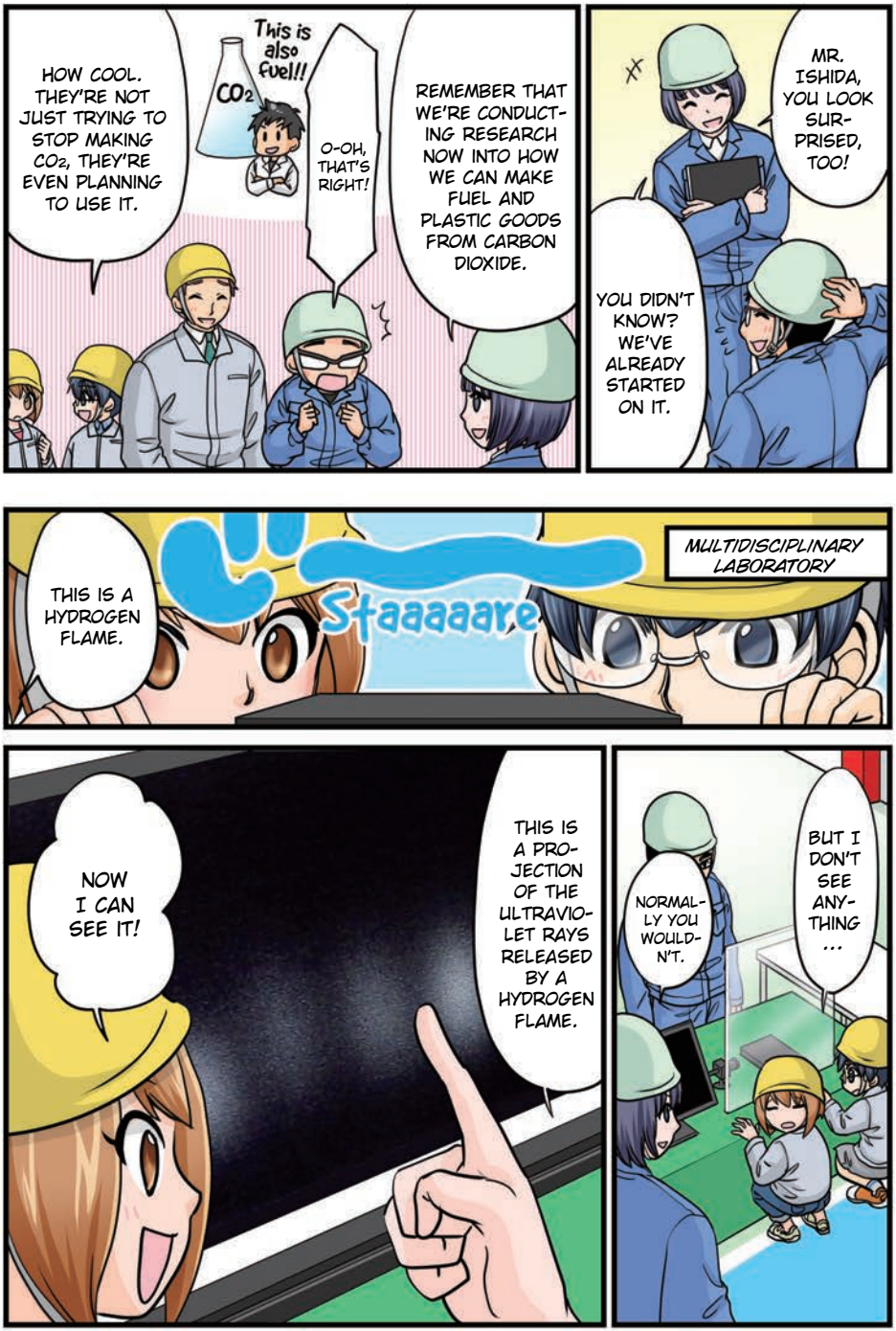


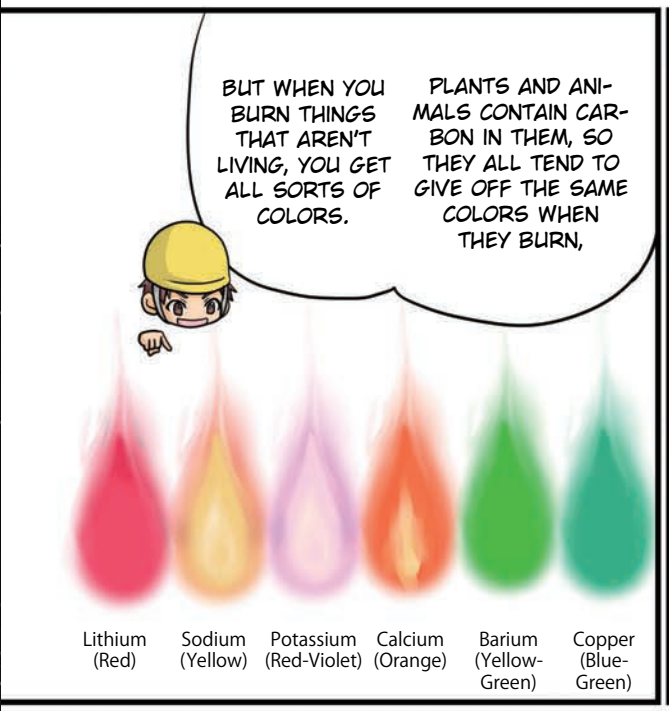


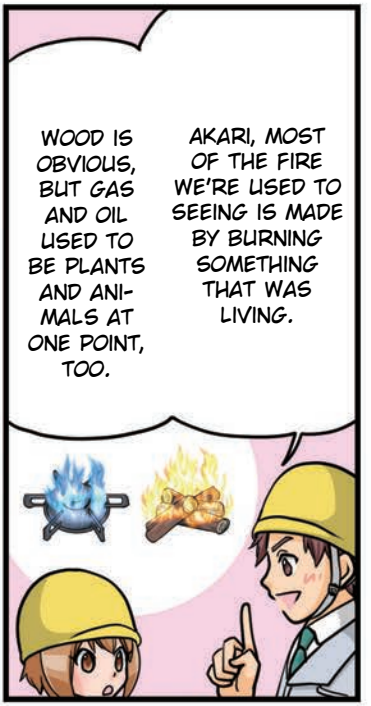


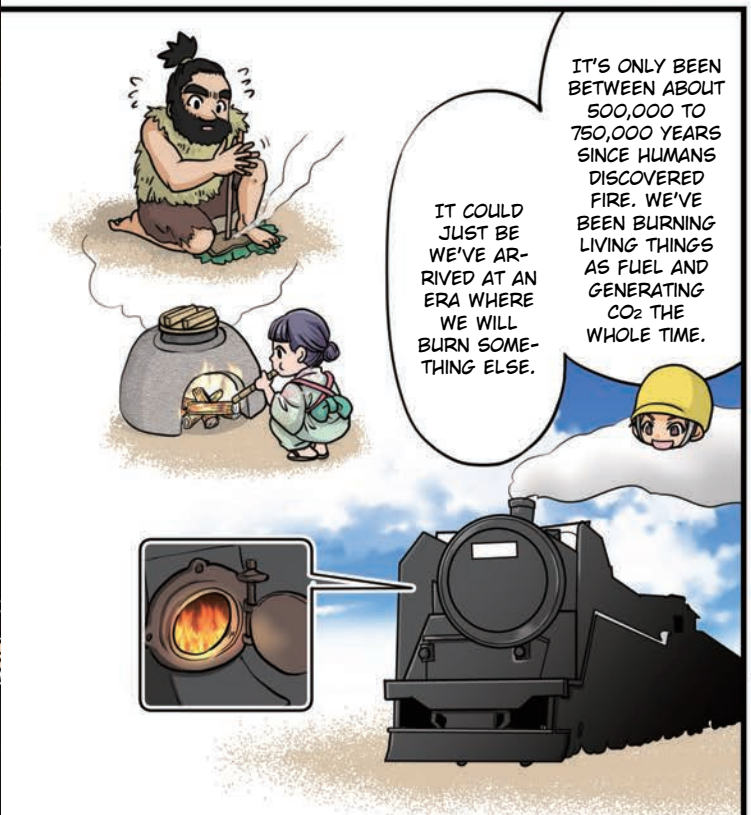
TRIVIA

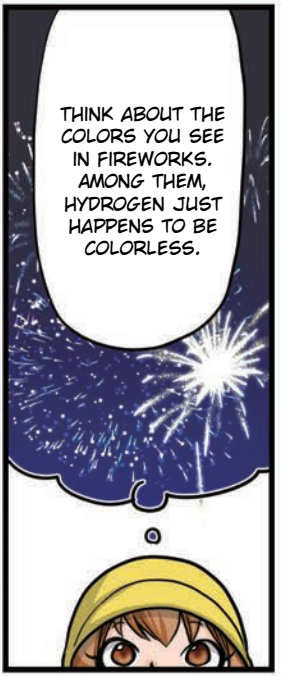
IT'S EASIER TO TURN AMMONIA INTO A LIQUID THAN HYDROGEN. AMMONIA ALSO HAS A GREATER CONCENTRATION OF HYDROGEN ATOMS BY VOLUME.




BUT WHEN YOU BURN THINGS THAT AREN'T LIVING, YOU GET ALL SORTS OF COLORS.
PLANTS AND ANIMALS CONTAIN CARBON IN THEM, SO THEY ALL TEND TO GIVE OFF THE SAME COLORS WHEN THEY BURN,
Lithium (Red)
Sodium (Yellow)
Potassium (Red-Violet)
Calcium (Orange)
Barium (Yellow-Green)
Copper (Blue-Green)

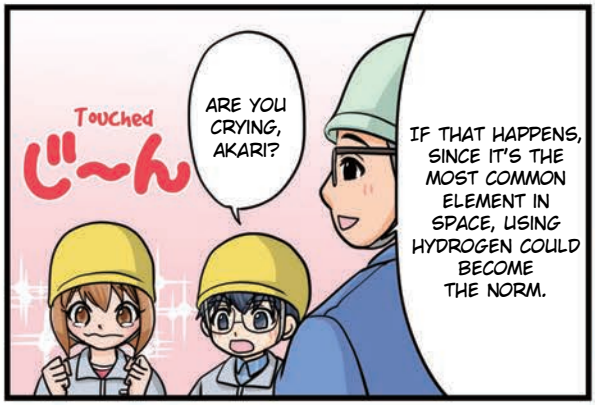

WOOD IS OBVIOUS, BUT GAS AND OIL USED TO BE PLANTS AND ANIMALS AT ONE POINT, TOO.
AKARI, MOST OF THE FIRE WE'RE USED TO SEEING IS MADE BY BURNING SOMETHING THAT WAS LIVING.

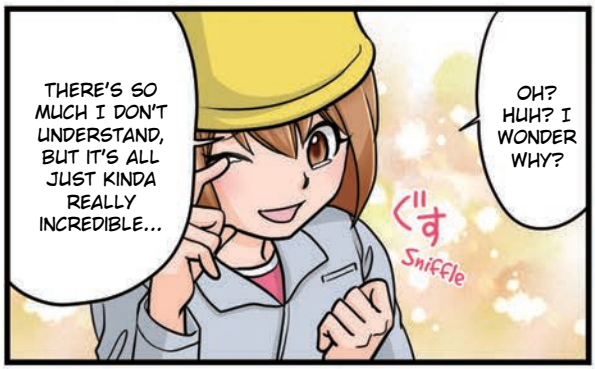

IT'S ONLY BEEN BETWEEN ABOUT 500,000 TO 750,000 YEARS SINCE HUMANS DISCOVERED FIRE. WE'VE BEEN BURNING LIVING THINGS AS FUEL AND GENERATING CO_2 THE WHOLE TIME.
IT COULD JUST BE WE'VE ARRIVED AT AN ERA WHERE WE WILL BURN SOMETHING ELSE.

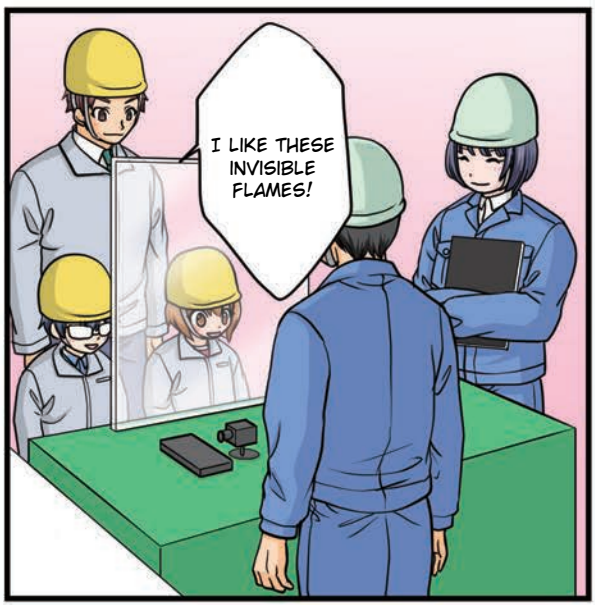

THINK ABOUT THE COLORS YOU SEE IN FIREWORKS. AMONG THEM, HYDROGEN JUST HAPPENS TO BE COLORLESS.

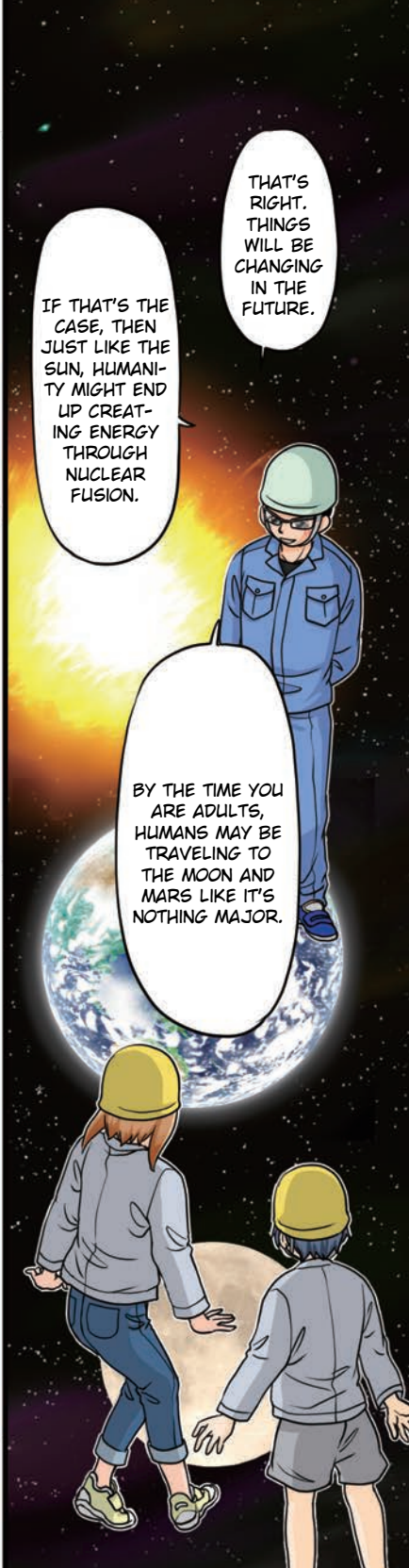
TRIVIA

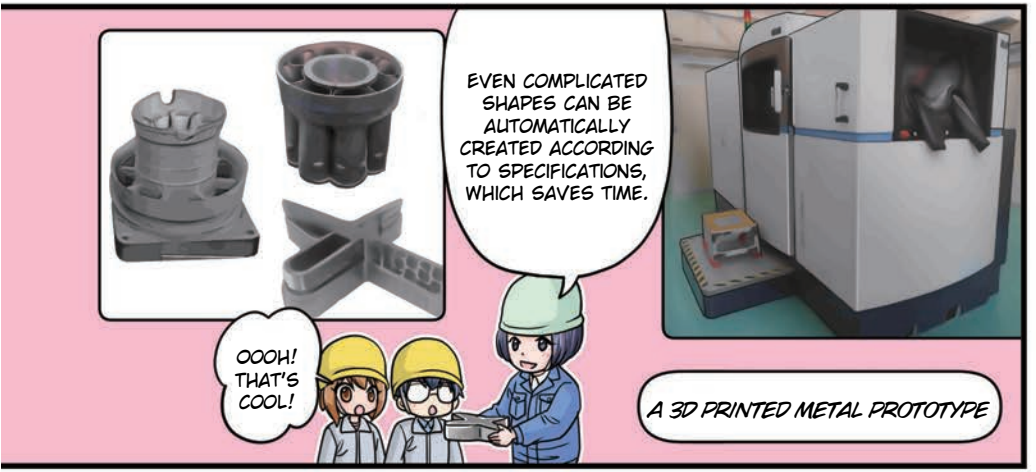
USING AMMONIA IN THERMAL POWER ALSO DOESN'T PRODUCE CO_2, SO SOME POWER STATIONS ARE BEGINNING TO USE AMMONIA.

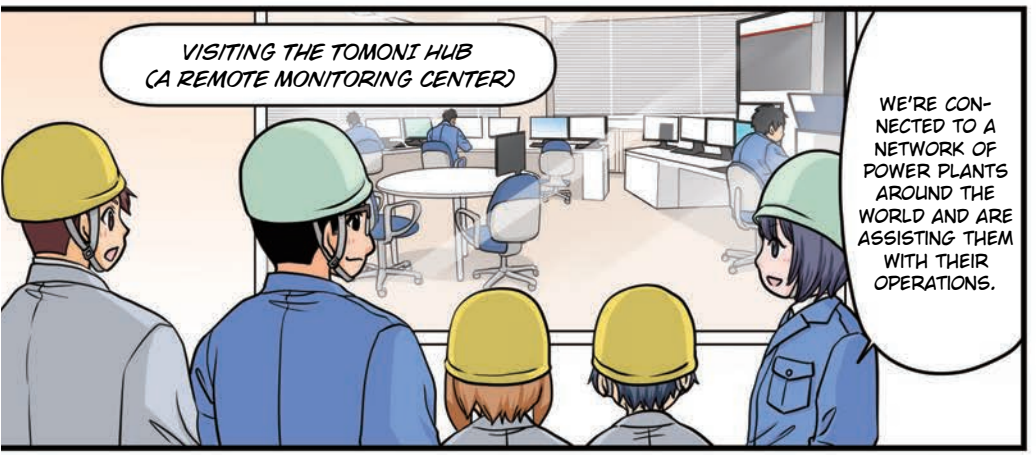


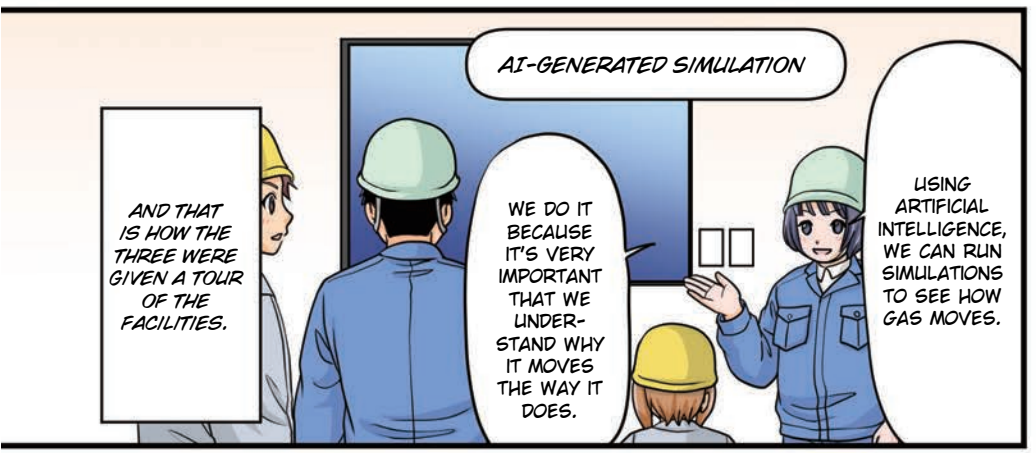








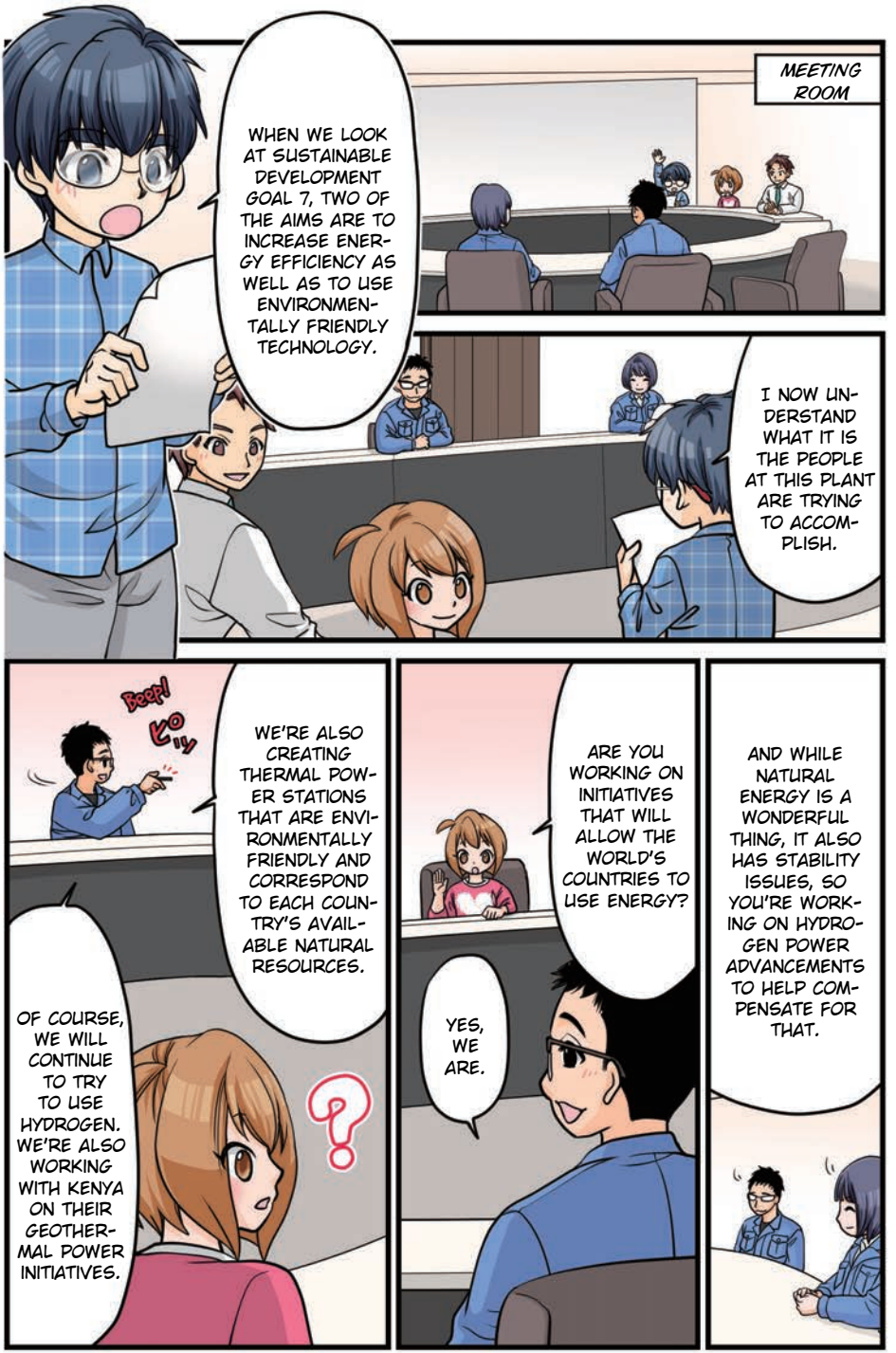




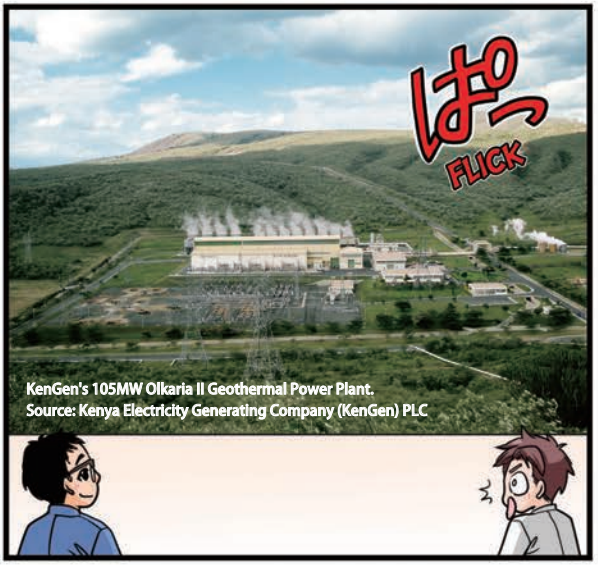
AT THE SUN'S CORE, NUCLEAR FUSION OCCURS WHERE HYDROGEN ATOMS ATTACH TO EACH OTHER BEFORE TURNING INTO HELIUM. THIS GENERATES MASSIVE AMOUNTS OF ENERGY.

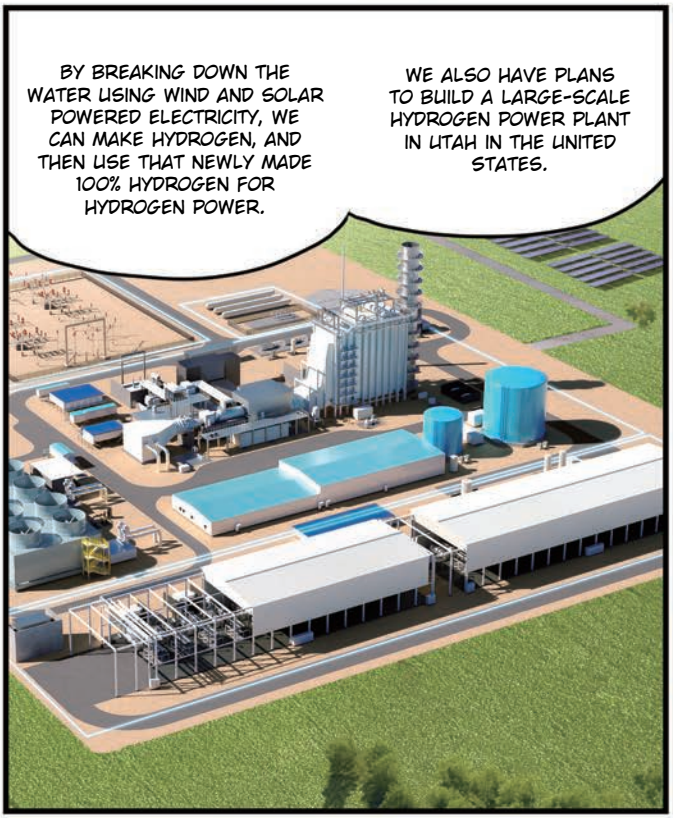
TRIVIA

A GAS TURBINE HAS 65,000 PARTS. FOR REFERENCE, A CAR HAS ABOUT 30,000 PARTS.

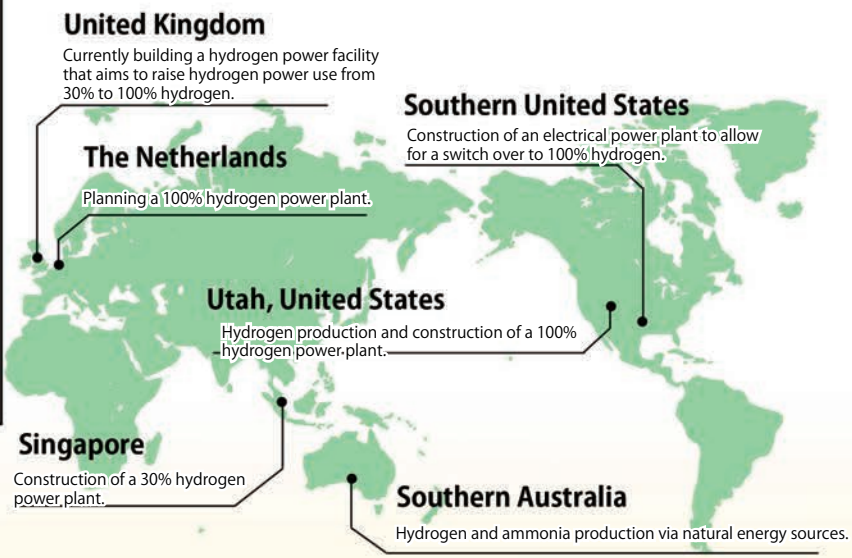


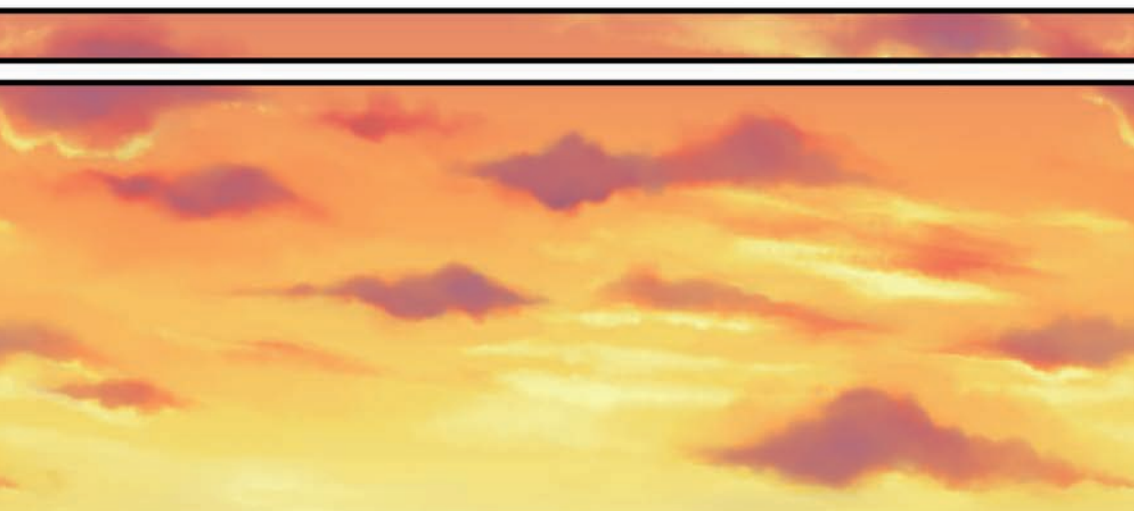
A SINGLE, BRAND-NEW, LARGE-SCALE GAS TURBINE CAN GENERATE ENOUGH ELECTRICITY TO POWER HALF OF A NUCLEAR POWER PLANT ON ITS OWN, AND AN ENTIRE NUCLEAR POWER PLANT USING GTCC.



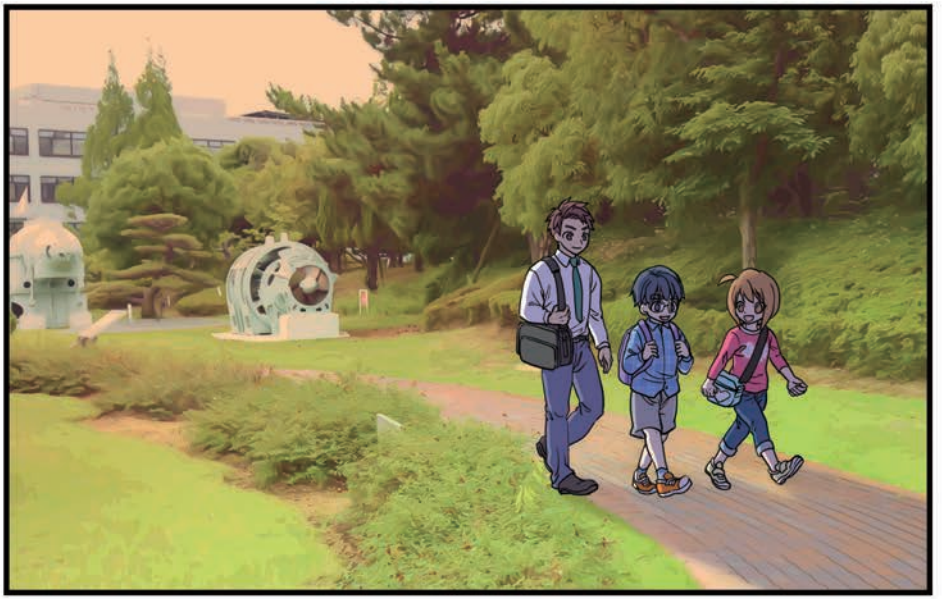


AND SO, THEY WERE ALSO ABLE TO LEARN ABOUT THEIR EFFORTS FOR GLOBAL OUT-REACH AS WELL.

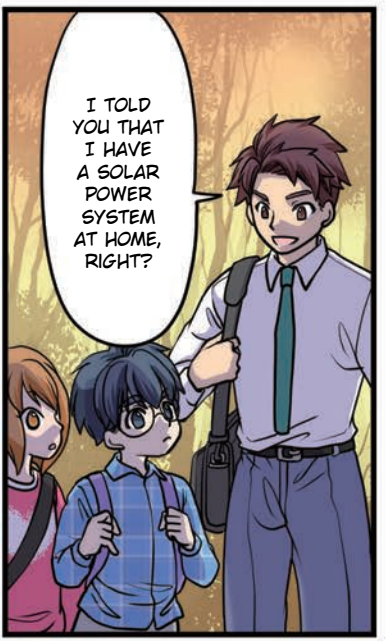


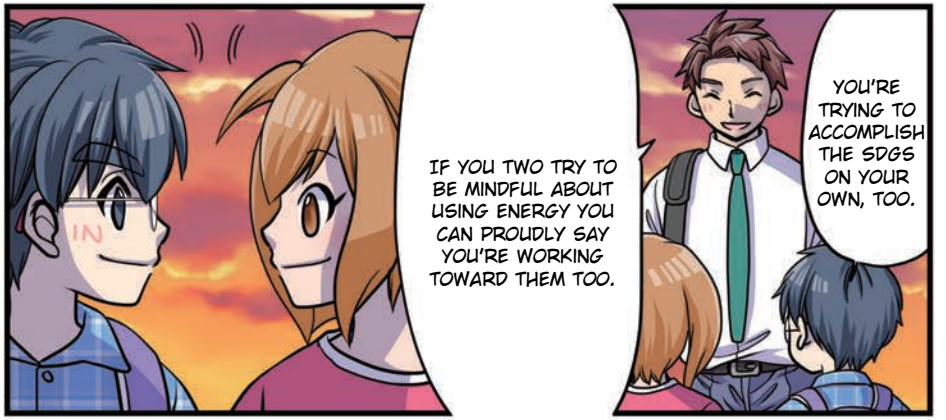


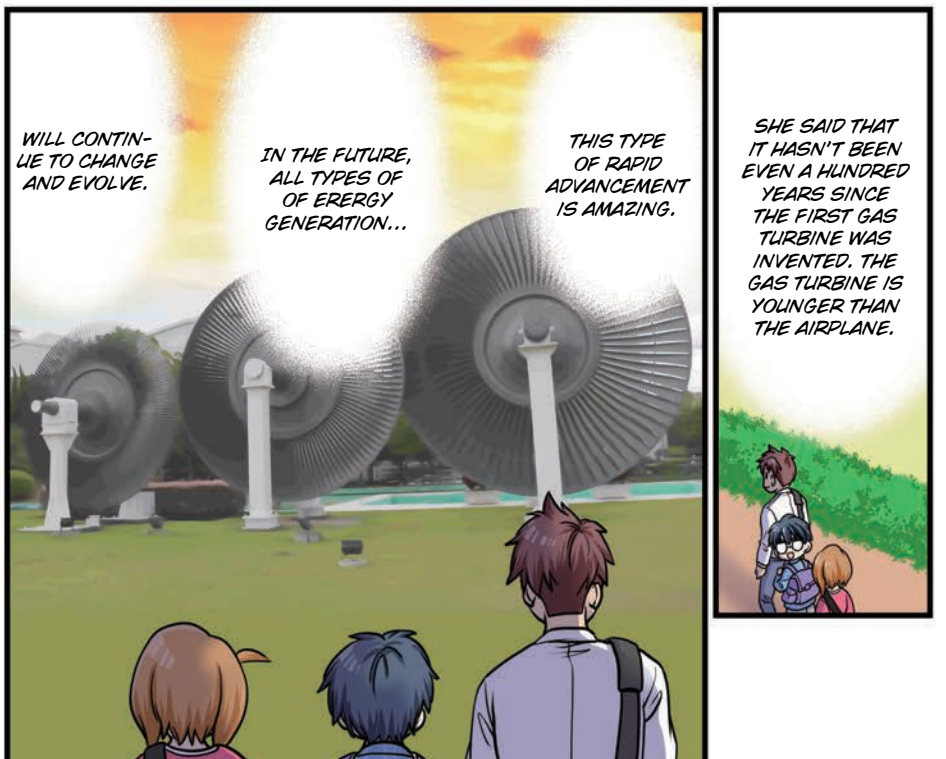
EPILOGUE




OH, THAT MAKES SENSE.
THAT ALSO HELPS WITH ENERGY CONSERVATION BECAUSE I CAN USE THE ENERGY GENERATED BY IT.

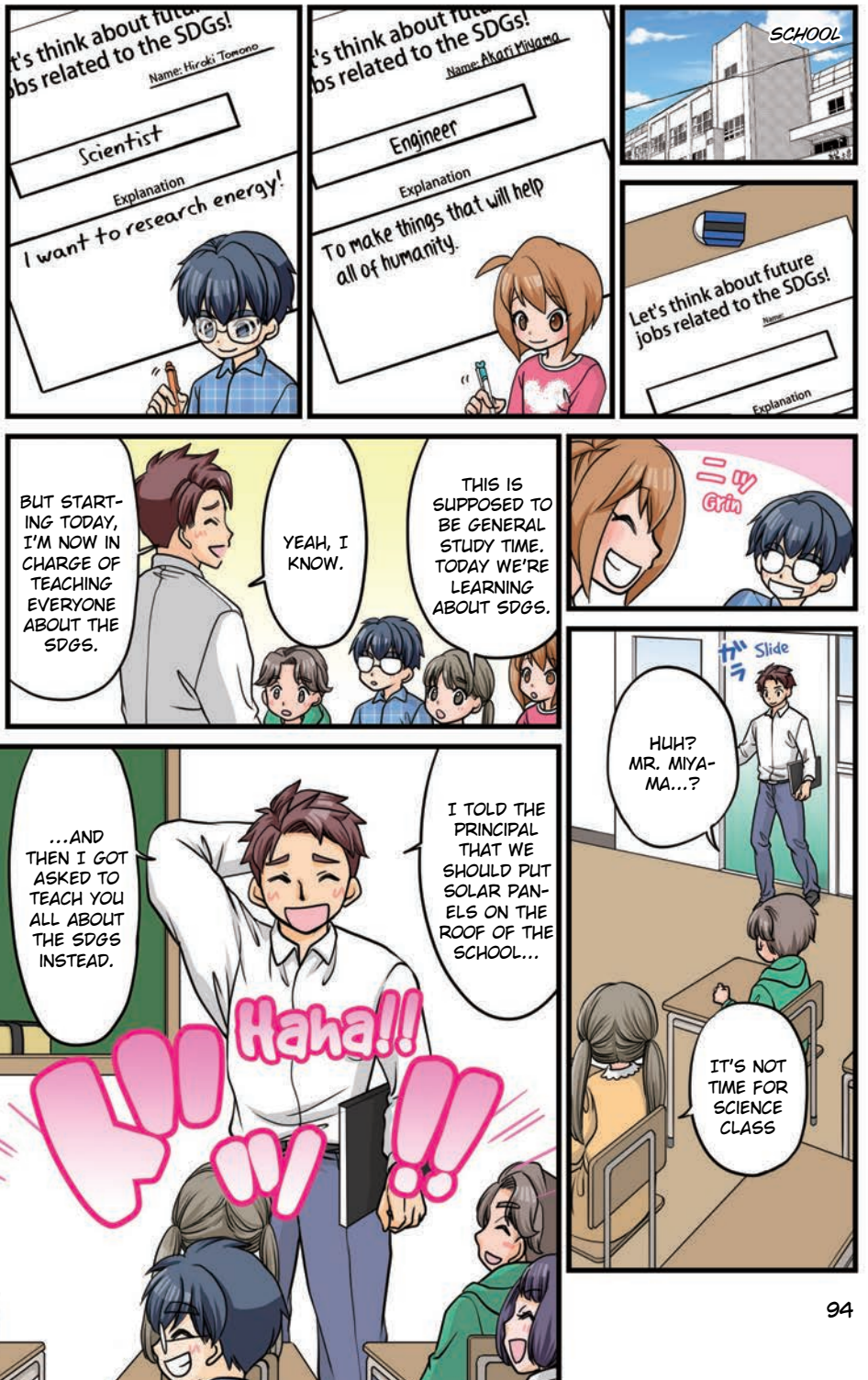

I TOLD YOU THAT I HAVE A SOLAR POWER SYSTEM AT HOME, RIGHT?





TRIVIA

GAS TURBINE PRODUCTION USES BERNOULLI'S PRINCIPLE, THERMAL CONDUCTION, AN ADIABATIC COMPRESSION, AND OTHER CONCEPTS ARE TAUGHT IN MIDDLE SCHOOL AND HIGH SCHOOL SCIENCE CLASSROOMS.


t's think about futu
bs related to the SDGs!
Name: Hiroki Tomono
Scientist
Explanation
I want to research energy!
t's think about futu
bs related to the SDGs!
Name: Akari Miyama
Engineer
Explanation
To make things that will help all of humanity.
SCHOOL
Let's think about future jobs related to the SDGs!
Name:
Explanation
BUT STARTING TODAY, I'M NOW IN CHARGE OF TEACHING EVERYONE ABOUT THE SDGS.
YEAH, I KNOW.
THIS IS SUPPOSED TO BE GENERAL STUDY TIME. TODAY WE'RE LEARNING ABOUT SDGS.
ニッ
Grin
...AND THEN I GOT ASKED TO TEACH YOU ALL ABOUT THE SDGS INSTEAD.
I TOLD THE PRINCIPAL THAT WE SHOULD PUT SOLAR PANELS ON THE ROOF OF THE SCHOOL...
Haha!!
ガラ
Slide
HUH? MR. MIYAMA...?
IT'S NOT TIME FOR SCIENCE CLASS

THIS BOOK'S GOAL

IT'S BEEN A WHILE SINCE SOMEONE SAID THAT CHILDREN HAVE STOPPED READING BOOKS, BUT DESPITE THE EXISTENCE OF THAT VERY SITUATION, I WONDERED WHY COMIC BOOKS AND MANGA REMAIN POPULAR. I BELIEVE THAT IT IS BECAUSE MANGA AND COMIC BOOKS ARE EASY TO READ FOR CHILDREN, AND THEY FIND THEM ENJOYABLE.
OUR COMPANY THEN DECIDED TO AIM TO TURN EDUCATIONAL MATERIALS INTO A COMIC BOOK LIKE THIS ONE. IT NEEDED TO BE EDUCATIONAL WHILE ALSO MAKING IT POSSIBLE FOR CHILDREN TO WANT TO CONTINUE READING ALL THE WAY TO THE END WITHOUT RESISTANCE. THAT WAS WHAT LED TO THE BIRTH OF *THE GAKKEN: LEARNING WITH MANGA SERIES.* THE STORIES ARE COMPILED TO EXPOSE ELEMENTARY STUDENTS ENCOUNTER TO A VARIETY OF ASPECTS OF REAL SOCIETY WHICH ARE DEEPLY CONNECTED TO THEIR LIVES THROUGH AMPLE AND ACCURATE DATA AND FIGURES.
FURTHERMORE, THE SERIES ISN'T JUST SUITABLE AS EDUCATIONAL MATERIALS FOR GENERAL STUDIES TIME AT SCHOOL, BUT IS ALSO VERY WELL-RECEIVED FROM BOTH EDUCATORS AND PARENTS. *THE GAKKEN: LEARNING WITH MANGA SERIES* HAS ALSO BEEN DONATED TO ELEMENTARY SCHOOL LIBRARIES AND MAJOR PUBLIC LIBRARIES.

FEATURES OF *THE GAKKEN: LEARNING WITH MANGA SERIES*

● IMPARTS A VAST AMOUNT OF KNOWLEDGE

THIS BOOK ALLOWS CHILDREN TO ACQUIRE VAST AMOUNTS OF KNOWLEDGE THROUGH THE THEMES PRESENTED AND THEIR ARRANGEMENT, AS WELL AS HISTORY, WHILE PRESENTING IT IN AN EASY TO COMPREHEND FORMAT. EACH PAGE HAS A PIECE OF TRIVIA RELATED TO THE INFORMATION AND KNOWLEDGE PRESENTED ON THE PAGE.

● COMIC BOOK FORMAT

THIS ALLOWS CHILDREN WHO AREN'T THE STRONGEST OF READERS TO STILL ENJOY THE STORY AS THEY PROGRESS.

● FEATURES THEMES & JOBS BASED ON MODERN SOCIETY.

THE STORIES ARE PREPARED WITH THE GOAL OF GETTING CHILDREN INTERESTED IN WORK AND MODERN SOCIETY IN AN EASILY UNDERSTOOD MANNER.

● USEFUL FOR GENERAL STUDIES

THIS BOOK IS USEFUL FOR HELPING TO DRAW OUT A CHILD'S INTEREST AND CONCERNS DURING CLASSES SET ASIDE FOR GENERAL STUDIES.

● BURSTING WITH INFORMATION

THIS BOOK FEATURES A WIDE BERTH OF PICTURES AND ILLUSTRATIONS. THEY'RE PRESENT TO ASSIST WITH UNDERSTANDING WHILE PROVIDING VALUE ON THEIR OWN AS DOCUMENTS.

● FULFILLS THEIR DESIRE TO LEARN MORE

PRESENTS CHILDREN WITH SPECIALIZED INFORMATION ABOUT THE UNIQUE WORKINGS OF A COMPANY AND JOBS SO THAT IT WILL ANSWER THEIR QUESTIONS AND CONCERNS.

The Secrets of SDGs 7
Affordable and Clean Energy

▶Cooperation
Mitsubishi Heavy Industries, Ltd.
▶Photographs and materials
Mitsubishi Heavy Industries, Ltd.
▶Supervisor
Norichika Kanie
(Keio University Graduate School of Media and Governance)
▶Composition
Noriyuki Irisawa
▶Illustration
Masaki Matsuoka
Akiko Shibata
Noriyuki Irisawa
Mineko Kobayashi
▶Cover / Book design
Mineko Kobayashi
▶Editorial cooperation
Sideranch Inc.
▶Editing & Production
λ production
▶Planning
Yomiurirengo Advertising Agency Co., Ltd.
▶Planning & Production
Hiroaki Suzuki (Gakken Co., Ltd.)
Kaneyuki Tsutsumi (Gakken Co., Ltd.)
Shuntaro Takao (Gakken Co., Ltd.)
Tomoka Miyata (Gakken Co., Ltd.)
▶Desktop Publishing
Adclair Co., Ltd.
▶Printing
Dai Nippon Printing Co., Ltd.

▶Manga illustrations
MAKO.

Manga artist and illustrator from Fukuoka, Japan.
Her representative works are “COMIC×STUDY Manga de Wakaru Chugaku Shakai Geography”, “Wangari Maathai (Gakken Manga NEW Sekai no Denki)” (Gakken), “47 Todofuken Hontou ha Kowai Mukashibanashi” (Rironsha), “Manga de Yoku Wakaru Badminton” (Oizumi Shoten), “Tetsugaku Friends” (PHP Institute), “Robot wo Ugokasou! mBot de Omoshiro Programming” (Ric Telecom), etc.

References

“Sekai ga Gutto Chikaku Naru SDGs to Bokura wo Tsunagu Hon” (Gakken)
“Gakken Perfect Course Chugaku Rika” (Gakken)

Information on the “Learning with Manga series” (in Japanese)

【Gakken Manga Himitsu Bunko】 https://bpub.jp/gakken-himitsu

【Gakken Manabista】 https://gakken.jp/manabista/himitsu

【Gakken Kids Net】 https://kids.gakken.co.jp/himitsu/

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The Secrets of SDGs 7

Affordable and Clean Energy

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For inquiries about this book, please contact:
By post: Gakken Co., Ltd. 2-11-8 Nishi-Gotanda, Shinagawa-ku, Tokyo 141-8416, Japan
By phone: (03)6431-1224 (Tokyo / Direct line)