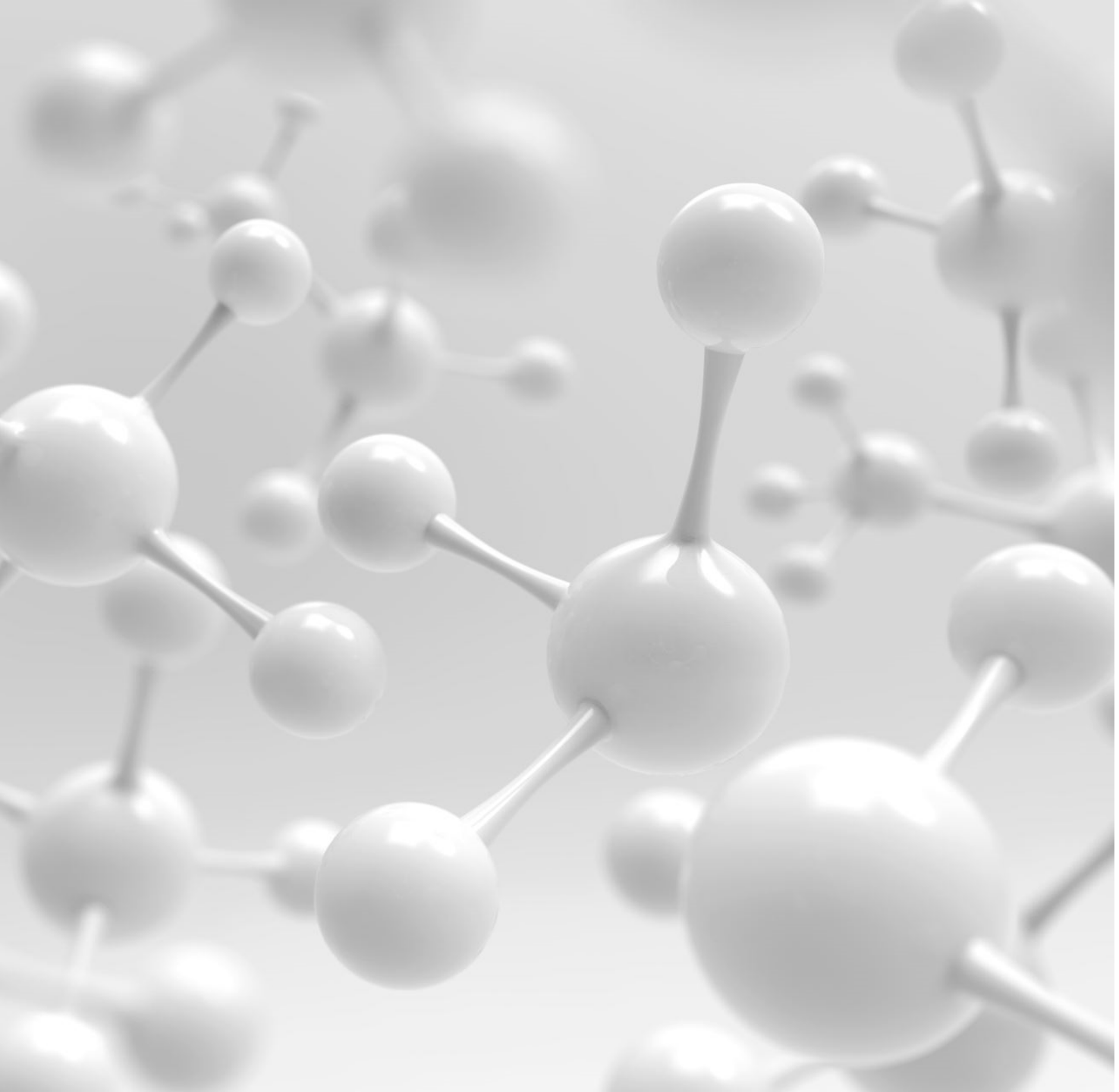


Neutrinos: Stepping Stones on the Kardashev Scale

Mackenzie Jean Kaskie

Physics Undergraduate

IU SOUTHEAST
HONORS PROGRAM

Earth's Energy Progression

Astrobiology & Applied Science

Social

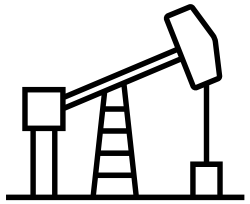
Environmental

Technological

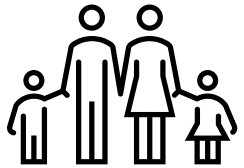
Civilization Growth

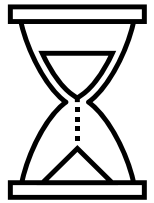
- **People**
- **Plan**
- **Progress**

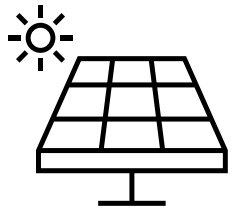
Stage 1: **Need**



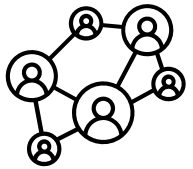
Stage 2: **Efficiency**

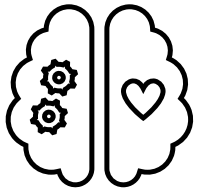






Stage 3: **Sustainability**





End-goal Energy

Are **current renewables** sustainable?

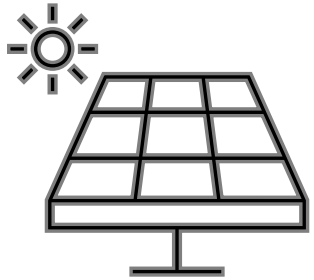
Kardashev's scale

Introduction to **neutrinos**

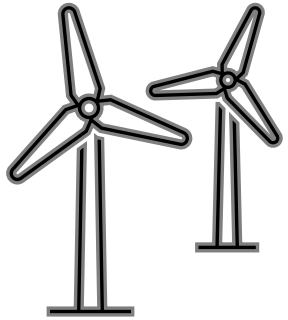
Comparing current **renewables** & **neutrino energy**

Future **plans** & possible **outcomes**

Current Renewable Energy Sources

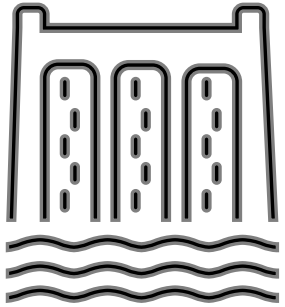


Solar

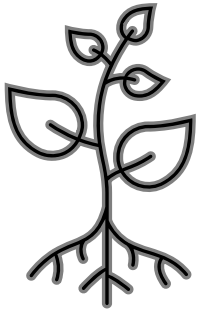


Wind

Geothermal



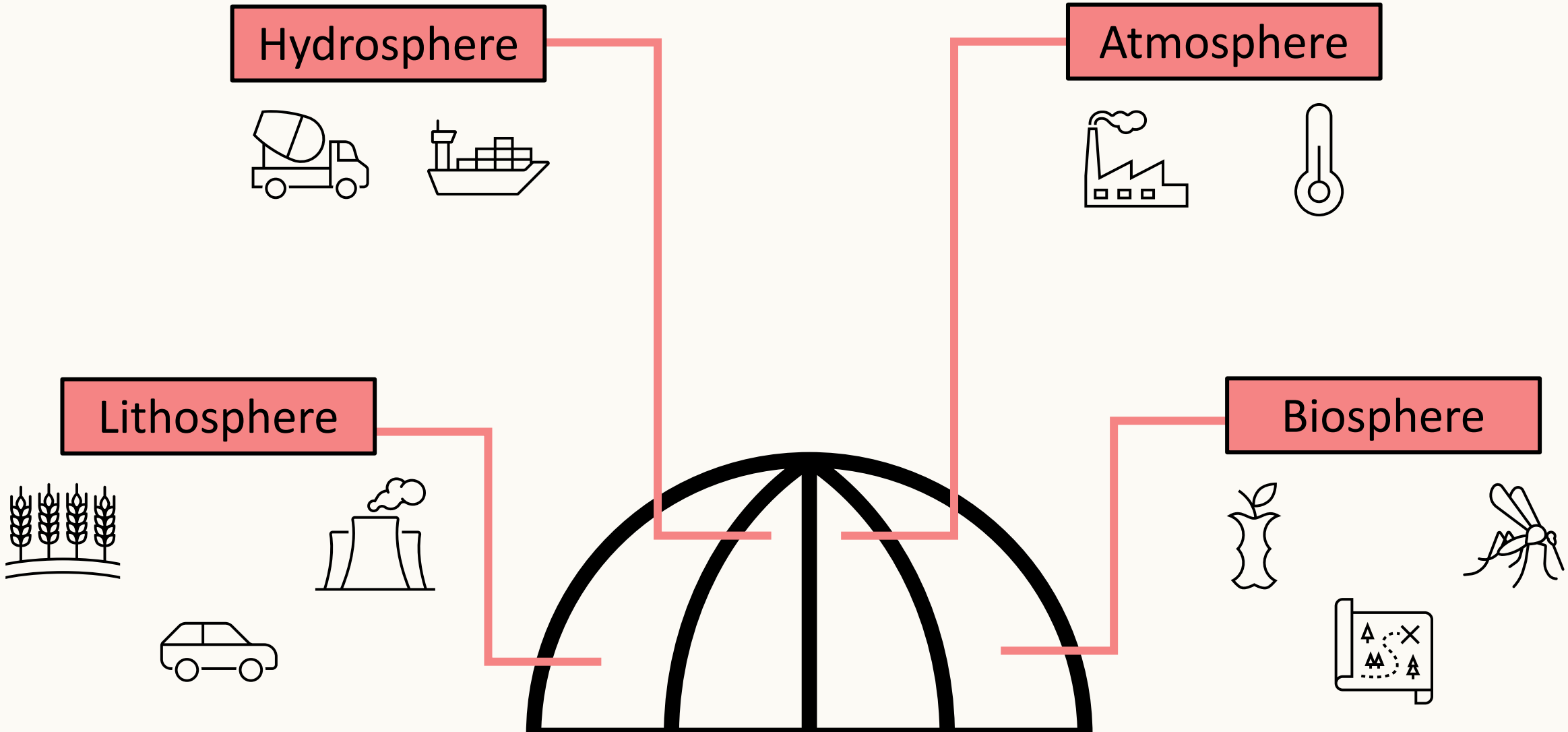
Hydro



Biomass

The issue is the type of source used

Current Renewables & Environmental Problems



Current Renewables & Societal Problems

(Matteo & Agostinelli 2022)
(United Nations 2004)

- Health
  - Conditions
  - Collection
- Security
  - Interest
  - Consumption
  - Monetary
- Availability
  - <u>Technology</u>
  - Testing
  - Resources

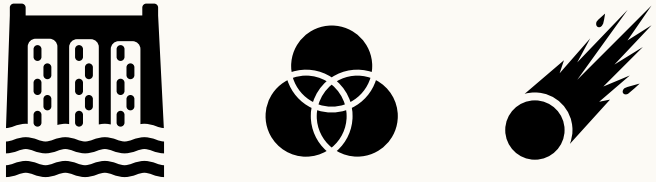
"Two billion people lack access to affordable modern energy."

(Goldemberg et al 2001)

<u>Current Renewables</u>

X Environmental
X Societal

Cross-sectional evaluation



(Zhang, et al 2021)

"quantitative assignment... combined with neural network and intelligent algorithm... expression parameter **optimization and function** expression fitting **can be realized**."

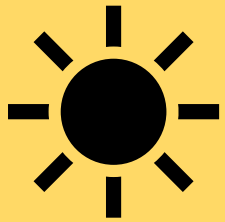
Filling in the gaps

1. Move beyond facilities
2. Evaluations completed in comparison
3. Proposed & possible sources

Kardashev's Scale

Type I

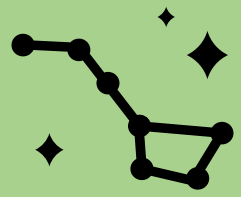
Type I-minus



Type II

Type II-minus

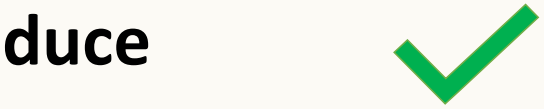
Type III-minus



Type III

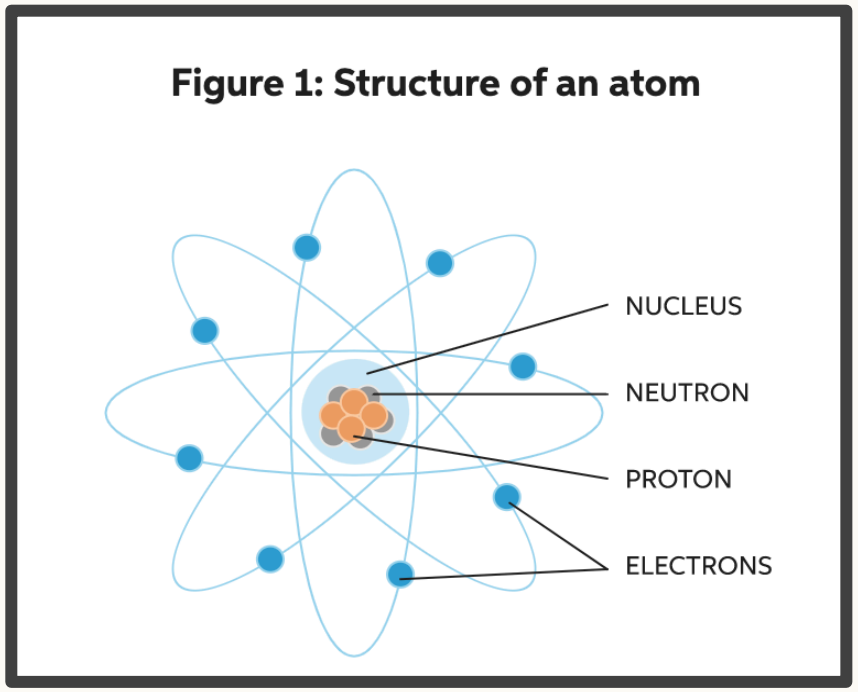
Type IV-minus...

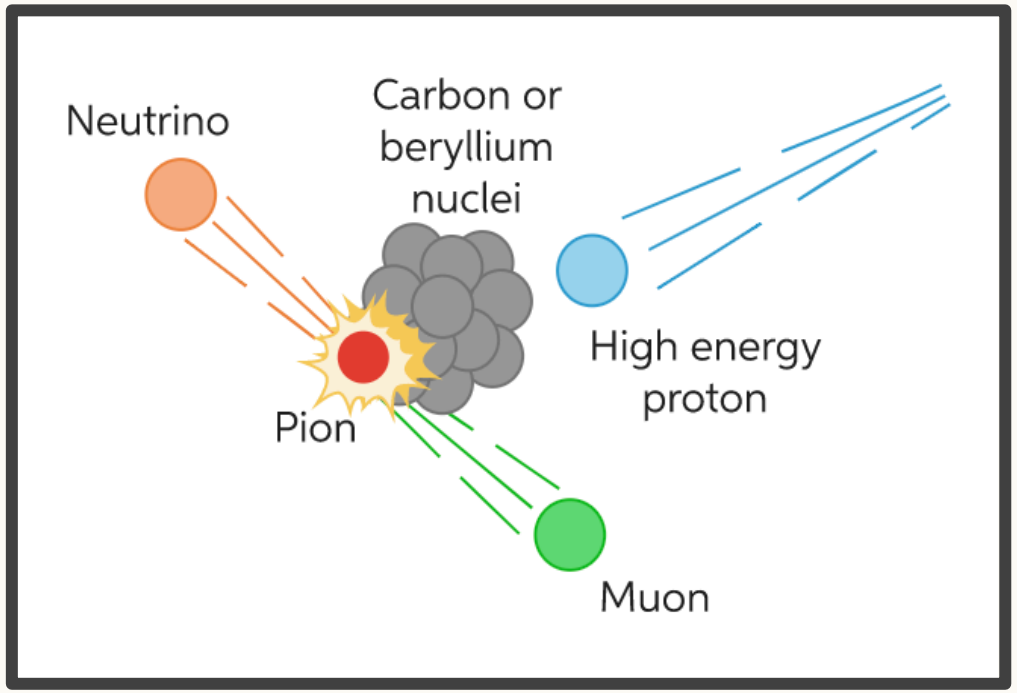
Shimizu's calculations prove that current renewables **don't produce enough energy** (Ćirković 2015)



Barrow hypothesizes, that Type VI-minus can manipulate **elementary particles** of matter. (Ćirković 2015)

Anatomy & Creation of the Neutrino

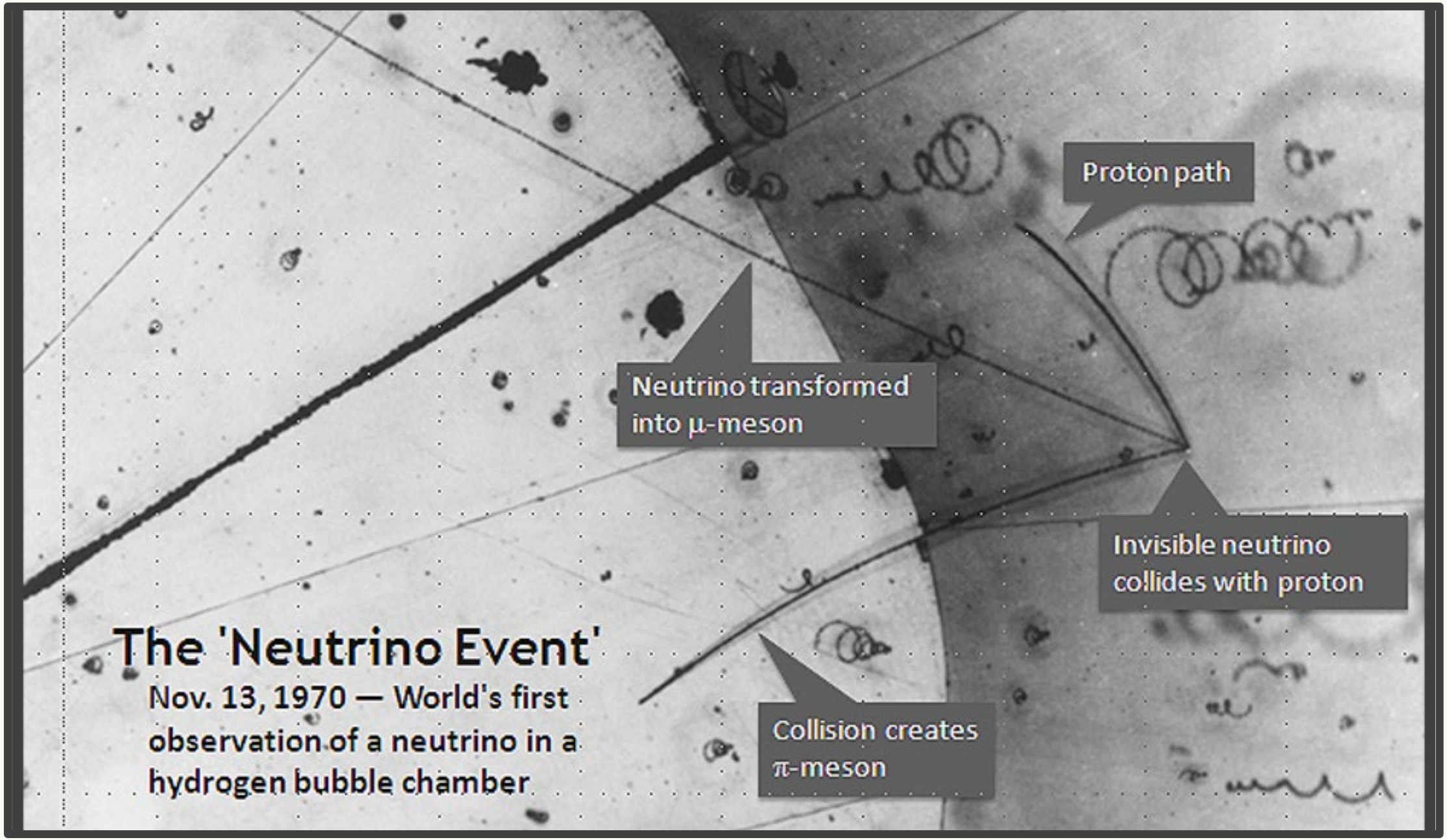




(Chegg, date unknown)

Neutrinos: **subatomic particles** created from **beta decay** (**proton** is **gained** and a **neutron** is **released** to **balance** the **atomic nucleus**

(Molen, 2005)

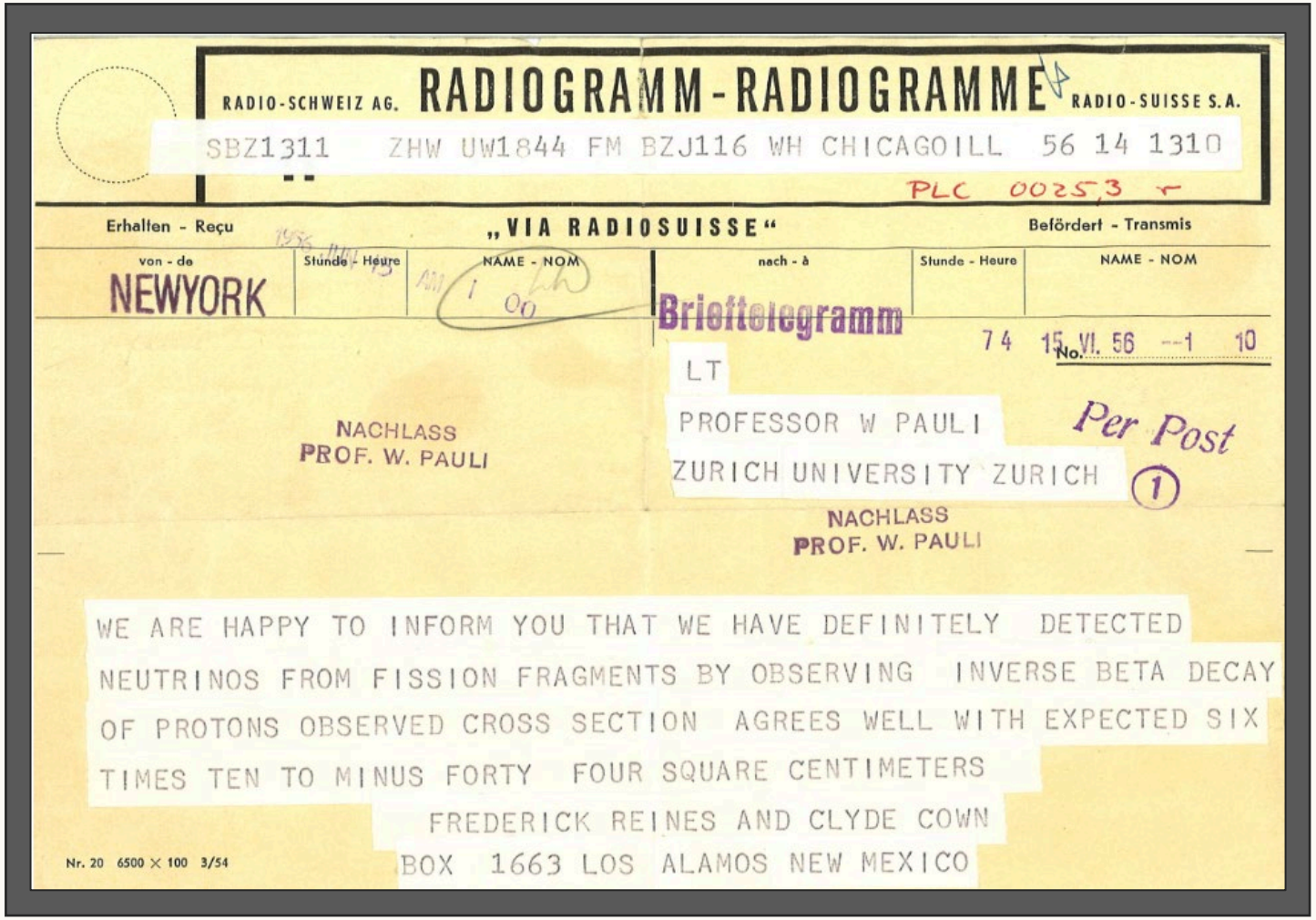

Proton path
Neutrino transformed into μ-meson
Invisible neutrino collides with proton
Collision creates π-meson
The 'Neutrino Event'
Nov. 13, 1970 — World's first observation of a neutrino in a hydrogen bubble chamber

Neutrino Background

1956
Frederick Reines &
Clyde Cowan
observe neutrinos

(Reines & Cowan 1956)

Description of photo
Telegram to **Wolfgang Pauli**
A **theoretical physicist** and
a pioneer of quantum physics



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PROFESSOR W PAULI

ZURICH UNIVERSITY ZURICH

NACHLASS
PROF. W. PAULI

Per Post

(1)

NACHLASS
PROF. W. PAULI

WE ARE HAPPY TO INFORM YOU THAT WE HAVE DEFINITELY DETECTED NEUTRINOS FROM FISSION FRAGMENTS BY OBSERVING INVERSE BETA DECAY OF PROTONS OBSERVED CROSS SECTION AGREES WELL WITH EXPECTED SIX TIMES TEN TO MINUS FORTY FOUR SQUARE CENTIMETERS

FREDERICK REINES AND CLYDE COWN

BOX 1663 LOS ALAMOS NEW MEXICO

Nr. 20 6500 × 100 3/54

(Fermilab 2023)

Neutrino Background Continued

2002

Davis and Koshiba share Nobel Prize for detection of **cosmic origin** neutrinos

(Aguilar et al 2022) (Kovalev et al 2022)

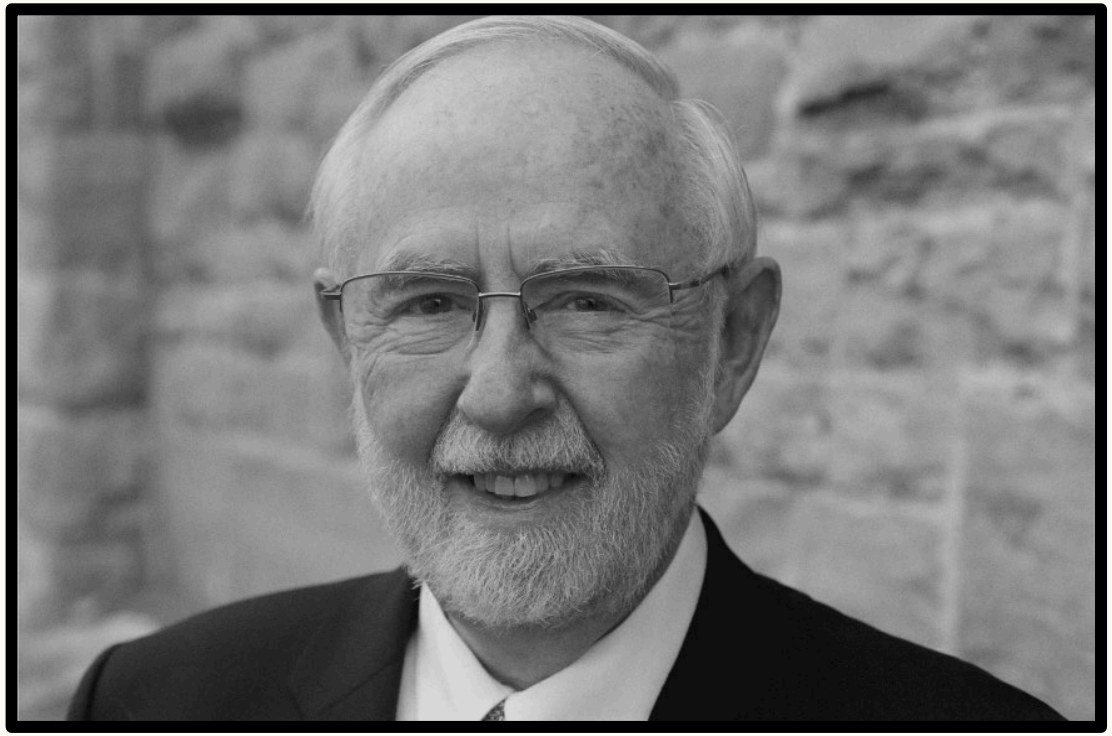
Description of photo

Kamiokande **neutrino detector** in Japan

(Fermilab 2023)

Neutrino Background Continued

(Peter Badge 2016)



2015

Mcdonald & Kajita share Nobel Prize for discovering **neutrinos have mass**

Description of photo

Arthur Mcdonald & Takkaki Kajita attend **Nobel Laureate Meeting**

Neutrino Energy Fruition

2023

Neutrino Energy Group & NeutrinoVoltaic Energy Group start **design** & **construction**

(Neutrino Energy Group 2023)

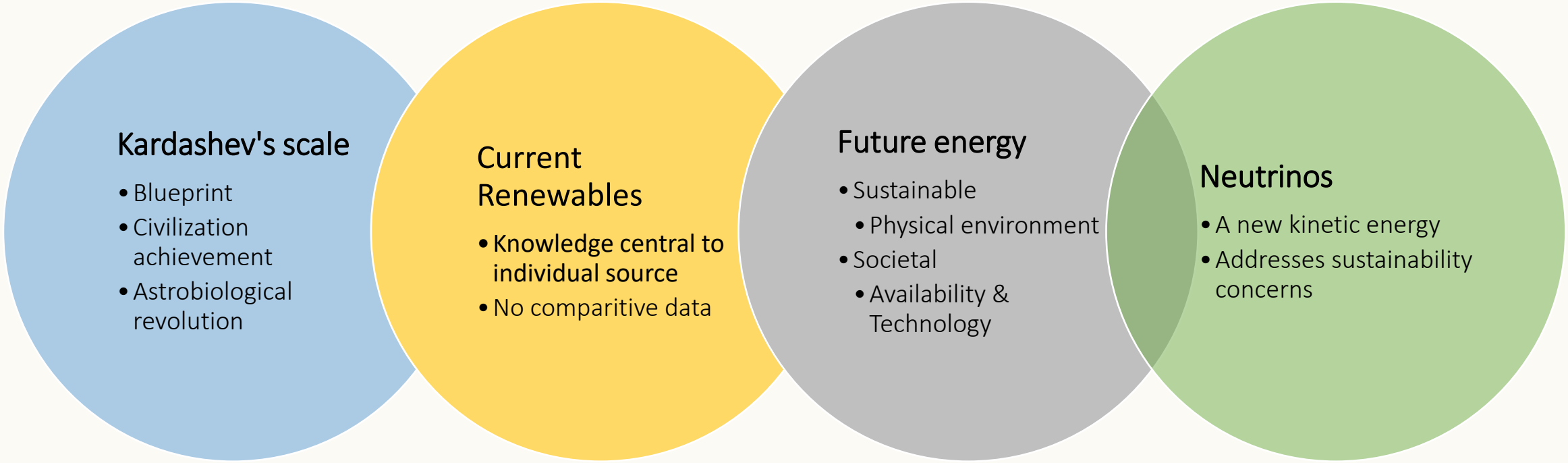
Description of photo

Schubart, CEO of Neutrino Energy Group Holds **PI-Car** brochure

Description of photo

Neutrino Energy Powercube **prototype**

Scope of Study



Kardashev's scale (Ćirković 2015)

Hydropower (Zhang, et al 2021)
Bioenergy (Welfe & Röder 2022)
Solar & wind (Huber & Steininger 2022)
Geothermal (Shortall, et al 2015)

Kinetic energy (Zou et al 2019)

Sustainability pillars (Goldemberg et al 2001)

Discovery (Reines & Cowan 1956)
Inventions (Aguilar et al 2022)
Abundance (Kovalev et al 2022)

Comparative Sustainability Beyond Facilities

✗ Hydropower (Zhang, et al 2021)	✓ Neutrino Energy (Neutrino Energy Group 2023)

Environmental

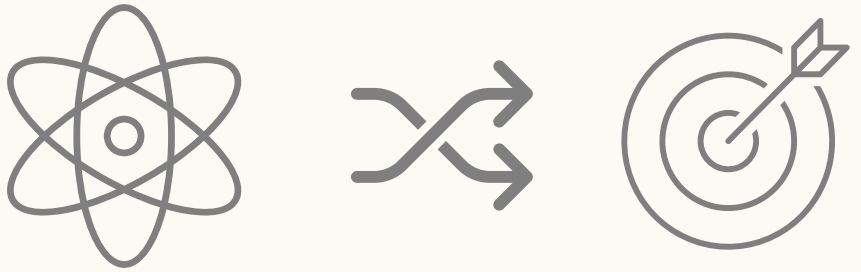
Lithosphere	Hydrosphere	Atmosphere	Biosphere
• Earthquakes • Lot requirement	• Water quality • Flooding	• Construction • Bio-decomposition	• Swamp formation • Aquatic life
• No terraforming • **Non-structural**	• No water affect	• **Used in Production** • **Carbon capture**	• No resource affect • Non-displacing

Societal

Health	Security	Availability
• Relocation • Pests	• Collapse • Obstruction	• Precipitation • Temperature
• **Fits into everyday lifestyle** • No attraction	• **Abundance** • **Non-dependent**	• Available globally 24/7 • **Materials abundance**

Plan of Action

- ☑ **Consider** neutrino energy
  - Environmentally & sustainably friendly
  - Full civilization advancement
- ☑ **Implement** & **study** neutrino energy
  - Theory to fundamentals
  - Neutrino energy in numbers
- ❑ Build a sustainability **portfolio**
  - Look beyond the source
- ❑ Cross-sectional **determination**
- ❑ **Change** current energy grids



Adams & Laughlin, "CDM **particles** and antiparticles could become **a viable source of energy** in physical-eschatological **future**." (Ćirković 2015)

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