UNDP-Accelerator-Labs-Network

October 12, 2022

1 UNDP Accelerator Labs Network Exploration and Visualization

[1]:
```
#importing libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import datetime
import matplotlib as mpl

#telling matplotlib to display the graphs
%matplotlib inline
```

[2]:
```
# Setting default figsize
mpl.rcParams['figure.figsize'] = (20, 10)
```

[3]:
```
df = pd.read_excel(io='Viz4SocialGood_submissionV1.xlsx',␣
 ↪sheet_name='Energy_sol_data')
```

[4]:
```
data = df
```

[5]:
```
df.head()
```

[5]:

	contribution_date	new_date	id	Energy source
0	Sun May 30 2021 13:48:32 GMT+0000 (Coordinated…	Sun May 30 2021 13:48:32	3100	Thermal
1	Mon Jun 28 2021 13:56:30 GMT+0000 (Coordinated…	Mon Jun 28 2021 13:56:30	3177	Wind
2	Mon Jun 28 2021 13:32:36 GMT+0000 (Coordinated…	Mon Jun 28 2021 13:32:36	3176	Hydro
3	Thu Nov 12 2020 06:03:43 GMT+0000 (Coordinated…	Thu Nov 12 2020 06:03:43	2261	Renewable general
4	Wed Jul 21 2021 10:12:39 GMT+0000 (Coordinated…	Wed Jul 21 2021 10:12:39	3236	Household application

```
  Clean cooking application (yes)                                    title  \
0                             NaN                                 Eco Char
1                             NaN                     Wind power generator
2                             NaN                         Hybrid Generator
3                             NaN  Electric Power Microgeneration System
4                               x                             Solar Cooker

           Mapper Contributor anonymized  \
0  AccLab Algeria          Contributor 1
1   AccLab Angola          Contributor 2
2   AccLab Angola          Contributor 3
3   AccLab Angola          Contributor 4
4   AccLab Angola          Contributor 5

  What is the purpose of the solution? (brief problem & solution description)  \
0  We upcycle wastes such as food organic wastes …
1  The system to obtain electrical energy through…
2  The production of fuel from water is done thro…
3  The electric power microgeneration system is d…
4   Solar Cooker\n\n\n\t\t\t\n\n\n\t\t\t\n\n\n\t\t\t

  Please insert a link to the solution  …  Longitude         image_1  \
0                                  NaN  …   3.0261856            NaN
1                                  NaN  …  13.6010742   file: img-10
2                                  NaN  …  16.0817871  file: img-121
3                                  NaN  …   15.687688  file: img-230
4                                  NaN  …  13.8098145  file: img-305

  image_2 image_3 image_4 image_5 image_6 image_7 image_8 image_9
0     NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
1     NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
2     NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
3     NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
4     NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN

[5 rows x 44 columns]
```

[6]:
```
pd.set_option('display.max_columns', 44)
```

[7]:
```
df.head()
```

[7]:
```
                                contribution_date  \
0  Sun May 30 2021 13:48:32 GMT+0000 (Coordinated…
1  Mon Jun 28 2021 13:56:30 GMT+0000 (Coordinated…
2  Mon Jun 28 2021 13:32:36 GMT+0000 (Coordinated…
3  Thu Nov 12 2020 06:03:43 GMT+0000 (Coordinated…
4  Wed Jul 21 2021 10:12:39 GMT+0000 (Coordinated…
```

```
                  new_date    id          Energy source  \
0  Sun May 30 2021 13:48:32  3100                Thermal
1  Mon Jun 28 2021 13:56:30  3177                   Wind
2  Mon Jun 28 2021 13:32:36  3176                  Hydro
3  Thu Nov 12 2020 06:03:43  2261     Renewable general
4  Wed Jul 21 2021 10:12:39  3236  Household application

  Clean cooking application (yes)                                  title  \
0                             NaN                            Eco Char
1                             NaN                Wind power generator
2                             NaN                    Hybrid Generator
3                             NaN  Electric Power Microgeneration System
4                               x                        Solar Cooker

          Mapper Contributor anonymized  \
0  AccLab Algeria          Contributor 1
1   AccLab Angola          Contributor 2
2   AccLab Angola          Contributor 3
3   AccLab Angola          Contributor 4
4   AccLab Angola          Contributor 5

  What is the purpose of the solution? (brief problem & solution description)  \
0  We upcycle wastes such as food organic wastes …
1  The system to obtain electrical energy through…
2  The production of fuel from water is done thro…
3  The electric power microgeneration system is d…
4   Solar Cooker\n\n\n\t\t\t\n\n\n\t\t\t\n\n\n\t\t\t

  Please insert a link to the solution  \
0                                  NaN
1                                  NaN
2                                  NaN
3                                  NaN
4                                  NaN

  This solution is Do it Yourself / open source  \
0                                           NaN
1                                           NaN
2                                           NaN
3                                           NaN
4                                           NaN

  This solution is protected by Intellectual Property  \
0                                                  NaN
1                                                  NaN
2                                                  NaN
```

```
3                                                   NaN
4                                                   NaN

  The solution holder is able to train others (including end-users) in using or
replicating the solution  \
0                                                   NaN
1                                                   NaN
2                                                   NaN
3                                                   NaN
4                                                   NaN

  What is the unit cost of this Solution along with any additional cost for
maintenance and training?  \
0                                                   NaN
1                                                   NaN
2                                                   NaN
3                                                   NaN
4                                                   NaN

  This solution is a Prototype This solution is a Product  \
0                          NaN                         NaN
1                          NaN                         NaN
2                          NaN                         NaN
3                          NaN                         NaN
4                          NaN                         NaN

  If this solution is a product, is it available in market?  \
0                                                   NaN
1                                                   NaN
2                                                   NaN
3                                                   NaN
4                                                   NaN

  If this solution is a product, does advance order has to be given?  \
0                                                   NaN
1                                                   NaN
2                                                   NaN
3                                                   NaN
4                                                   NaN

  What is the Technological Readiness Level (TRL) of this solution?  \
0                                                   NaN
1                                                   NaN
2                                                   NaN
3                                                   NaN
4                                                   NaN
```

	How much has this solution already been diffused? Is there potential feedback from end-users available?
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN

	Please upload a link of end-user feedback
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN

	Are there any efficiency benchmarks for this solution (eg. how much energy does it save; how much cheaper does it produce energy than current market rates/ current household expenditure / cost per kW h)?
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN

	Are there any other potential bottlenecks affecting cross-border or in country diffusion of this solution?
0	NaN
1	NaN
2	NaN
3	NaN
4	NaN

	What Sustainable Development Goal is this Solution addressing? Tag 1
0	1.0
1	1.0
2	10.0
3	1.0
4	7.0

	What Sustainable Development Goal is this Solution addressing? Tag 2
0	6.0
1	7.0
2	12.0
3	7.0
4	12.0

	What Sustainable Development Goal is this Solution addressing? Tag 3

```
0                                                 13.0
1                                                 13.0
2                                                 13.0
3                                                  9.0
4                                                 13.0

   What Sustainable Development Goal is this Solution addressing? Tag 4  \
0                                                  NaN
1                                                  NaN
2                                                  NaN
3                                                 10.0
4                                                  NaN

   What Sustainable Development Goal is this Solution addressing? Tag 5  \
0                                                  NaN
1                                                  NaN
2                                                  NaN
3                                                 11.0
4                                                  NaN

  What thematic tags apply to this solution? Tag 1  \
0                          food waste management
1                             alternative energy
2                                            NaN
3                                   clean energy
4                                     innovation

  What thematic tags apply to this solution? Tag 2  \
0                                          youth
1                                   clean energy
2                             alternative energy
3                          community empowerment
4                             polution reduction

  What thematic tags apply to this solution? Tag 3  \
0                                         coffee
1                                climate change
2                                   electricity
3                          rural electrification
4                                   solar energy

  What thematic tags apply to this solution? Tag 4  \
0                                         olives
1                          community empowerment
2                             polution reduction
3                                 social justice
4                                            NaN
```

```
  What thematic tags apply to this solution? Tag 5   Latitude   Longitude   \
0                                                NaN  36.7607349   3.0261856
1                                                NaN  -12.833226  13.6010742
2                                                NaN  -8.5158356  16.0817871
3                                            welfare  -12.776115   15.687688
4                                                NaN   -12.86536  13.8098145

         image_1 image_2 image_3 image_4 image_5 image_6 image_7 image_8  \
0            NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
1   file: img-10     NaN     NaN     NaN     NaN     NaN     NaN     NaN
2  file: img-121     NaN     NaN     NaN     NaN     NaN     NaN     NaN
3  file: img-230     NaN     NaN     NaN     NaN     NaN     NaN     NaN
4  file: img-305     NaN     NaN     NaN     NaN     NaN     NaN     NaN

  image_9
0     NaN
1     NaN
2     NaN
3     NaN
4     NaN
```

[8]:
```
# Let's rename columns with code for better replicability
df.columns
```

[8]:
```
Index(['contribution_date', 'new_date', 'id', 'Energy source',
       'Clean cooking application (yes)', 'title', 'Mapper',
       'Contributor anonymized',
       'What is the purpose of the solution? (brief problem & solution
description)',
       'Please insert a link to the solution',
       'This solution is Do it Yourself / open source',
       'This solution is protected by Intellectual Property',
       'The solution holder is able to train others (including end-users) in
using or replicating the solution',
       'What is the unit cost of this Solution along with any additional cost
for maintenance and training?',
       'This solution is a Prototype', 'This solution is a Product',
       'If this solution is a product, is it available in market?',
       'If this solution is a product, does advance order has to be given?',
       'What is the Technological Readiness Level (TRL) of this solution?',
       'How much has this solution already been diffused? Is there potential
feedback from end-users available?',
       'Please upload a link of end-user feedback',
       'Are there any efficiency benchmarks for this solution (eg. how much
energy does it save; how much cheaper does it produce energy than current market
rates/ current household expenditure / cost per kW h)?',
```

```
       'Are there any other potential bottlenecks affecting cross-border or in
country diffusion of this solution?',
       'What Sustainable Development Goal is this Solution addressing? Tag 1',
       'What Sustainable Development Goal is this Solution addressing? Tag 2',
       'What Sustainable Development Goal is this Solution addressing? Tag 3',
       'What Sustainable Development Goal is this Solution addressing? Tag 4',
       'What Sustainable Development Goal is this Solution addressing? Tag 5',
       'What thematic tags apply to this solution? Tag 1',
       'What thematic tags apply to this solution? Tag 2',
       'What thematic tags apply to this solution? Tag 3',
       'What thematic tags apply to this solution? Tag 4',
       'What thematic tags apply to this solution? Tag 5', 'Latitude ',
       'Longitude ', 'image_1', 'image_2', 'image_3', 'image_4', 'image_5',
       'image_6', 'image_7', 'image_8', 'image_9'],
      dtype='object')
```

[ ]:

column sol_type to know wether the solution is a product or a prototype

column sol_status to know wether the solution is open source or is intellectual property

[9]:
```
new_col_names = {'contribution_date':'contribution_date',
                 'Energy source':'energy_source',
                 'Clean cooking application (yes)':'clean_cooking',
                 'Mapper':'mapper',
                 'Contributor anonymized':'contributor',
                 'What is the purpose of the solution? (brief problem &␣
 ↪solution description)':'purp_prob_sol_description)',
                 'Please insert a link to the solution':'solution_link',
                 'This solution is Do it Yourself / open source':
 ↪'sol_open_source',
                 'This solution is protected by Intellectual Property':
 ↪'sol_Intellectual_Property',
                 'The solution holder is able to train others (including␣
 ↪end-users) in using or replicating the solution':'sol_replication_training',
                 'What is the unit cost of this Solution along with any␣
 ↪additional cost for maintenance and training?':'total_sol_unit_cost',
                 'This solution is a Prototype':'prototype',
                 'This solution is a Product':'product',
                 'If this solution is a product, is it available in market?':␣
 ↪'product_availability',
                 'If this solution is a product, does advance order has to be␣
 ↪given?':'product_advance_order',
                 'What is the Technological Readiness Level (TRL) of this␣
 ↪solution?':'solution_trl',
```

```
                'How much has this solution already been diffused? Is there␣
↪potential feedback from end-users available?':'solution_diffused',
                'Please upload a link of end-user feedback':
↪'end-user_feedback',
                'Are there any efficiency benchmarks for this solution (eg.␣
↪how much energy does it save; how much cheaper does it produce energy than␣
↪current market rates/ current household expenditure / cost per kW h)?':
↪'efficiency_benchmarks',
                'Are there any other potential bottlenecks affecting␣
↪cross-border or in country diffusion of this solution?':'bottlenecks',
                'What Sustainable Development Goal is this Solution addressing?
↪ Tag 1':'sdg_tag_1',
                 'What Sustainable Development Goal is this Solution␣
↪addressing? Tag 2':'sdg_tag_2',
                 'What Sustainable Development Goal is this Solution␣
↪addressing? Tag 3':'sdg_tag_3',
                 'What Sustainable Development Goal is this Solution␣
↪addressing? Tag 4':'sdg_tag_4',
                 'What Sustainable Development Goal is this Solution␣
↪addressing? Tag 5':'sdg_tag_5',
                 'What thematic tags apply to this solution? Tag 1':
↪'thematic_tag_1',
                 'What thematic tags apply to this solution? Tag 2':
↪'thematic_tag_2',
                 'What thematic tags apply to this solution? Tag 3':
↪'thematic_tag_3',
                 'What thematic tags apply to this solution? Tag 4':
↪'thematic_tag_4',
                 'What thematic tags apply to this solution? Tag 5':
↪'thematic_tag_5'}
```

[10]:
```
# Let's rename then
data.rename(columns=new_col_names, inplace=True)

# test
data.columns
```

[10]:
```
Index(['contribution_date', 'new_date', 'id', 'energy_source', 'clean_cooking',
       'title', 'mapper', 'contributor', 'purp_prob_sol_description)',
       'solution_link', 'sol_open_source', 'sol_Intellectual_Property',
       'sol_replication_training', 'total_sol_unit_cost', 'prototype',
       'product', 'product_availability', 'product_advance_order',
       'solution_trl', 'solution_diffused', 'end-user_feedback',
       'efficiency_benchmarks', 'bottlenecks', 'sdg_tag_1', 'sdg_tag_2',
       'sdg_tag_3', 'sdg_tag_4', 'sdg_tag_5', 'thematic_tag_1',
       'thematic_tag_2', 'thematic_tag_3', 'thematic_tag_4', 'thematic_tag_5',
```

```
       'Latitude ', 'Longitude ', 'image_1', 'image_2', 'image_3', 'image_4',
       'image_5', 'image_6', 'image_7', 'image_8', 'image_9'],
      dtype='object')
```

[11]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 359 entries, 0 to 358
Data columns (total 44 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   contribution_date             357 non-null    object
 1   new_date                      357 non-null    object
 2   id                            359 non-null    int64
 3   energy_source                 355 non-null    object
 4   clean_cooking                 82 non-null     object
 5   title                         359 non-null    object
 6   mapper                        359 non-null    object
 7   contributor                   359 non-null    object
 8   purp_prob_sol_description)    347 non-null    object
 9   solution_link                 126 non-null    object
 10  sol_open_source               100 non-null    object
 11  sol_Intellectual_Property     41 non-null     object
 12  sol_replication_training      127 non-null    object
 13  total_sol_unit_cost           70 non-null     object
 14  prototype                     69 non-null     object
 15  product                       124 non-null    object
 16  product_availability          64 non-null     object
 17  product_advance_order         61 non-null     object
 18  solution_trl                  126 non-null    object
 19  solution_diffused             103 non-null    object
 20  end-user_feedback             27 non-null     object
 21  efficiency_benchmarks         58 non-null     object
 22  bottlenecks                   53 non-null     object
 23  sdg_tag_1                     325 non-null    float64
 24  sdg_tag_2                     237 non-null    float64
 25  sdg_tag_3                     178 non-null    float64
 26  sdg_tag_4                     75 non-null     float64
 27  sdg_tag_5                     18 non-null     float64
 28  thematic_tag_1                320 non-null    object
 29  thematic_tag_2                282 non-null    object
 30  thematic_tag_3                213 non-null    object
 31  thematic_tag_4                124 non-null    object
 32  thematic_tag_5                45 non-null     object
 33  Latitude                      359 non-null    object
 34  Longitude                     359 non-null    object
 35  image_1                       322 non-null    object
```

```
 36  image_2                    87 non-null     object
 37  image_3                    33 non-null     object
 38  image_4                    13 non-null     object
 39  image_5                    3 non-null      object
 40  image_6                    2 non-null      object
 41  image_7                    2 non-null      object
 42  image_8                    2 non-null      object
 43  image_9                    1 non-null      object
dtypes: float64(5), int64(1), object(38)
memory usage: 123.5+ KB
```

[12]:
```
df.head(10)
```

[12]:

	contribution_date	new_date	id	energy_source	clean_cooking	title	mapper
0	Sun May 30 2021 13:48:32 GMT+0000 (Coordinated…	Sun May 30 2021 13:48:32	3100	Thermal	NaN	Eco Char	AccLab Algeria
1	Mon Jun 28 2021 13:56:30 GMT+0000 (Coordinated…	Mon Jun 28 2021 13:56:30	3177	Wind	NaN	Wind power generator	AccLab Angola
2	Mon Jun 28 2021 13:32:36 GMT+0000 (Coordinated…	Mon Jun 28 2021 13:32:36	3176	Hydro	NaN	Hybrid Generator	AccLab Angola
3	Thu Nov 12 2020 06:03:43 GMT+0000 (Coordinated…	Thu Nov 12 2020 06:03:43	2261	Renewable general	NaN	Electric Power Microgeneration System	AccLab Angola
4	Wed Jul 21 2021 10:12:39 GMT+0000 (Coordinated…	Wed Jul 21 2021 10:12:39	3236	Household application	x	Solar Cooker	AccLab Angola
5	Thu Jul 22 2021 06:51:22 GMT+0000 (Coordinated…	Thu Jul 22 2021 06:51:22	3240	Thermal	NaN	Biogas production through a Biodigester	AccLab Angola
6	Wed Apr 06 2022 17:14:25 GMT+0000 (Coordinated…	Wed Apr 06 2022 17:14:25	4384	Solar	NaN	A circuit that provides high quality solar lig…	AccLab Argentina
7	Tue Apr 12 2022 17:16:15 GMT+0000 (Coordinated…	Tue Apr 12 2022 17:16:15	4509	Renewable general	NaN	Social plug-ins that provide hot showers: Suma…	AccLab Argentina
8	Tue Apr 12 2022 17:32:09 GMT+0000 (Coordinated…	Tue Apr 12 2022 17:32:09	4510	Solar	NaN	Hot water for showers and air heating systems:…	AccLab Argentina
9	Fri Apr 22 2022 15:06:22 GMT+0000 (Coordinated…	Fri Apr 22 2022 15:06:22	4546	Solar	NaN		

```
9  Solar Electric Mobility Prototype: EcoAndina F…  AccLab Argentina

      contributor                          purp_prob_sol_description)  \
0   Contributor 1  We upcycle wastes such as food organic wastes …
1   Contributor 2  The system to obtain electrical energy through…
2   Contributor 3  The production of fuel from water is done thro…
3   Contributor 4  The electric power microgeneration system is d…
4   Contributor 5   Solar Cooker\n\n\n\t\t\t\n\n\n\t\t\t\n\n\n\t\t\t
5   Contributor 6  Biogas is produced from cattle manure and orga…
6   Contributor 7  In many towns in Argentina, power lines become…
7   Contributor 8  The purpose of this project is to meet people'…
8   Contributor 9  This is a socio-environmental project which ob…
9  Contributor 10  The concept of electric solar mobility arises …

                                    solution_link sol_open_source  \
0                                             NaN             NaN
1                                             NaN             NaN
2                                             NaN             NaN
3                                             NaN             NaN
4                                             NaN             NaN
5                                             NaN             NaN
6                          http://proyectoluz.org               x
7       https://www.sumandoenergias.org/#what-we-do               x
8                   https://duchadesol5.webnode.com               x
9  https://www.ecoandina.org/proyectos/proyectos-…               x

  sol_Intellectual_Property sol_replication_training total_sol_unit_cost  \
0                       NaN                       NaN                 NaN
1                       NaN                       NaN                 NaN
2                       NaN                       NaN                 NaN
3                       NaN                       NaN                 NaN
4                       NaN                       NaN                 NaN
5                       NaN                       NaN                 NaN
6                       NaN                         x                 NaN
7                       NaN                         x                 NaN
8                       NaN                         x                 NaN
9                       NaN                         x                 NaN

  prototype product product_availability product_advance_order  \
0       NaN     NaN                  NaN                   NaN
1       NaN     NaN                  NaN                   NaN
2       NaN     NaN                  NaN                   NaN
3       NaN     NaN                  NaN                   NaN
4       NaN     NaN                  NaN                   NaN
5       NaN     NaN                  NaN                   NaN
6         x     NaN                  NaN                   NaN
7         x     NaN                  NaN                   NaN
```

```
8         x     NaN                  NaN                   NaN
9         x     NaN                  NaN                   NaN

       solution_trl                                  solution_diffused  \
0               NaN                                                NaN
1               NaN                                                NaN
2               NaN                                                NaN
3               NaN                                                NaN
4               NaN                                                NaN
5               NaN                                                NaN
6  Prototype system  Liter of Light has installed more than 350,000…
7  Prototype system  So far, over one hundred solar water heaters a…
8  Prototype system  The project has reached over 500 homes directl…
9  Prototype system   More than 500 people, including decision make…

                                 end-user_feedback  \
0                                              NaN
1                                              NaN
2                                              NaN
3                                              NaN
4                                              NaN
5                                              NaN
6       https://www.youtube.com/watch?v=o-Fpsw_yYPg
7  https://www.youtube.com/embed/yqc5vT8CjIE&amp;…
8         https://www.youtube.com/embed/uLfx8mAgnaM
9                                              NaN

                             efficiency_benchmarks bottlenecks  sdg_tag_1  \
0                                              NaN         NaN        1.0
1                                              NaN         NaN        1.0
2                                              NaN         NaN       10.0
3                                              NaN         NaN        1.0
4                                              NaN         NaN        7.0
5                                              NaN         NaN        7.0
6  The lithium phosphate battery gives 12-16 hour…         NaN        7.0
7  80% of the year, the family has free hot water…         NaN        7.0
8  With this solar water heater, 70% of the fuel …         NaN        7.0
9  People who work in the field and teachers woul…         NaN        7.0

   sdg_tag_2  sdg_tag_3  sdg_tag_4  sdg_tag_5         thematic_tag_1  \
0        6.0       13.0        NaN        NaN  food waste management
1        7.0       13.0        NaN        NaN     alternative energy
2       12.0       13.0        NaN        NaN                    NaN
3        7.0        9.0       10.0       11.0           clean energy
4       12.0       13.0        NaN        NaN             innovation
5       13.0        NaN        NaN        NaN     alternative energy
6        9.0       11.0       12.0       13.0      affordable energy
```

```
7        9.0       10.0       11.0        NaN          accessibility
8        9.0       10.0       11.0        NaN          accessibility
9        9.0       10.0       11.0        NaN           construction

          thematic_tag_2         thematic_tag_3  \
0                  youth                 coffee
1            clean energy         climate change
2     alternative energy            electricity
3  community empowerment  rural electrification
4     polution reduction           solar energy
5                 biogas   environment friendly
6     alternative energy     sustainable energy
7              inclusion     solar water heater
8     solar water heater     sustainable energy
9              inclusion              movilidad

                             thematic_tag_4  \
0                                   olives
1                   community empowerment
2                      polution reduction
3                          social justice
4                                     NaN
5                                     NaN
6  sustainable manufacturing, cooperativism
7                       sustainable energy
8     the vulnerable members of our society
9                        renewable energy

                          thematic_tag_5   Latitude   Longitude   \
0                                    NaN  36.7607349   3.0261856
1                                    NaN  -12.833226  13.6010742
2                                    NaN  -8.5158356  16.0817871
3                                welfare  -12.776115   15.687688
4                                    NaN   -12.86536  13.8098145
5                                    NaN  -12.910466  14.0356608
6  the vulnerable members of our society  -34.996496  -64.967282
7  the vulnerable members of our society  -34.996496  -64.967282
8                                    NaN  -34.787093  -68.438187
9                sustainability strategy  -34.996496  -64.967282

         image_1        image_2 image_3 image_4 image_5 image_6 image_7  \
0            NaN            NaN     NaN     NaN     NaN     NaN     NaN
1   file: img-10            NaN     NaN     NaN     NaN     NaN     NaN
2  file: img-121            NaN     NaN     NaN     NaN     NaN     NaN
3  file: img-230            NaN     NaN     NaN     NaN     NaN     NaN
4  file: img-305            NaN     NaN     NaN     NaN     NaN     NaN
5  file: img-324            NaN     NaN     NaN     NaN     NaN     NaN
```

```
6  file: img-525  file: img-526     NaN     NaN     NaN     NaN     NaN
7  file: img-357  file: img-358     NaN     NaN     NaN     NaN     NaN
8  file: img-214  file: img-215     NaN     NaN     NaN     NaN     NaN
9   file: img-51            NaN     NaN     NaN     NaN     NaN     NaN

  image_8 image_9
0     NaN     NaN
1     NaN     NaN
2     NaN     NaN
3     NaN     NaN
4     NaN     NaN
5     NaN     NaN
6     NaN     NaN
7     NaN     NaN
8     NaN     NaN
9     NaN     NaN
```

When looking at regional distribution of solutions, please note that UNDP does not apply a geographic clustering of countries, but a political clustering. Countires are hence grouped via Regional Bureau.

Let's define Regional Bureau.

[13]:
```
rba = ('Guinea',
'Guinea-Bissau',
'Mauritania',
'Mozambique',
'Nigeria',
'Senegal',
'Cameroon',
'Mauritius (& Seychelles)',
'Angola',
'Benin',
'Burkina Faso',
'Cape Verde',
'Chad',
'Congo',
'Democratic Republic Congo',
"Cote d'Ivoire",
'Eswatini',
'Ethiopia',
'Ghana',
'Kenya',
'Lesotho',
'Malawi',
'Mali',
'Namibia',
'Niger',
```

```
'Rwanda',
'Sierra Leone',
'South Africa',
'South Sudan',
'Tanzania',
'The Gambia',
'Togo',
'Uganda',
'Zambia',
'Zimbabwe')

rba_dict = {elt: 'rb_africa' for elt in rba}
```

[14]:
```
rbap = ('Bhutan',
'Indonesia',
'Maldives',
'Mongolia',
'Myanmar',
'Thailand',
'Samoa (& Cook Islands, Niue, Tokelau)',
'Bangladesh',
'Cambodia',
'India',
'Lao PDR',
'Lao',
'Malaysia',
'Nepal',
'Pacific-Fiji',
'Pacific',
'Pakistan',
'Philippines',
'Timor Leste',
'Vietnam')
rbap_dict = {elt: 'rb_asia_pacific' for elt in rbap}
```

[15]:
```
rbas = ('Egypt',
'Syria',
'Saudi Arabia (self starter)',
'Somalia',
'Algeria',
'Iraq',
'Jordan',
'Lebanon',
'Libya',
'Morocco',
'Palestine',
'Sudan',
```

```
'Tunisia')
rbas_dict = {elt: 'rb_arab_states' for elt in rbas}
```

[16]:
```
rbec = ('Belarus, Republic of',
'Georgia, Republic of',
'Kazakhstan',
'Kyrgyzstan',
'North Macedonia',
'Azerbaijan',
'Bosnia & Herzegovina',
'Serbia',
'Turkey',
'Ukraine',
'Uzbekistan')
rbec_dict = {elt: 'rb_europe_cis' for elt in rbec}
```

[17]:
```
rblac = ('Bolivia',
'El Salvador',
'Guatemala',
'Haiti',
'Trinidad & Tobago',
'Guyana & Suriname',
'Peru',
'Panama',
'Uruguay (self starter)',
'Uruguay',
'Argentina',
'Barbados',
'Colombia',
'Dominican Republic',
'Ecuador',
'Mexico',
'Paraguay')
rblac_dict = {elt: 'rb_latin_america' for elt in rblac}
```

[18]:
```
# Let's create a master regional bureau dict
rb_master = rba_dict | rbap_dict | rbas_dict | rbec_dict | rblac_dict
```

[19]:
```
# Creation of the country variable
df['country'] = df['mapper'].str.replace('(', '').str.replace(')', '').str.
 ↪replace('AccLab ', '').str.replace('Honey Bee Network ', '').str.strip()
```

```
C:\Users\FOZING\AppData\Local\Temp\ipykernel_241272\1411820144.py:2:
FutureWarning: The default value of regex will change from True to False in a
future version. In addition, single character regular expressions will *not* be
treated as literal strings when regex=True.
  df['country'] = df['mapper'].str.replace('(', '').str.replace(')',
```

```
'').str.replace('AccLab ', '').str.replace('Honey Bee Network ', '').str.strip()
```

[20]:
```
# Creation of the regional bureau variable
df['regional_bureau'] = df['country'].apply(lambda value: rb_master[value])
```

[21]:
```
df.head()
```

[21]:

	contribution_date	new_date	id	energy_source	clean_cooking	title	mapper	contributor	purp_prob_sol_description)	solution_link	sol_open_source	sol_Intellectual_Property	sol_replication_training	total_sol_unit_cost	prototype	product	product_availability
0	Sun May 30 2021 13:48:32 GMT+0000 (Coordinated…	Sun May 30 2021 13:48:32	3100	Thermal	NaN	Eco Char	AccLab Algeria	Contributor 1	We upcycle wastes such as food organic wastes …	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	Mon Jun 28 2021 13:56:30 GMT+0000 (Coordinated…	Mon Jun 28 2021 13:56:30	3177	Wind	NaN	Wind power generator	AccLab Angola	Contributor 2	The system to obtain electrical energy through…	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2	Mon Jun 28 2021 13:32:36 GMT+0000 (Coordinated…	Mon Jun 28 2021 13:32:36	3176	Hydro	NaN	Hybrid Generator	AccLab Angola	Contributor 3	The production of fuel from water is done thro…	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
3	Thu Nov 12 2020 06:03:43 GMT+0000 (Coordinated…	Thu Nov 12 2020 06:03:43	2261	Renewable general	NaN	Electric Power Microgeneration System	AccLab Angola	Contributor 4	The electric power microgeneration system is d…	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	Wed Jul 21 2021 10:12:39 GMT+0000 (Coordinated…	Wed Jul 21 2021 10:12:39	3236	Household application	x	Solar Cooker	AccLab Angola	Contributor 5	Solar Cooker\n\n\n\t\t\t\n\n\n\t\t\t\n\n\n\t\t\t	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

```
4                 NaN       NaN     NaN                   NaN

  product_advance_order solution_trl solution_diffused end-user_feedback  \
0                   NaN          NaN               NaN               NaN
1                   NaN          NaN               NaN               NaN
2                   NaN          NaN               NaN               NaN
3                   NaN          NaN               NaN               NaN
4                   NaN          NaN               NaN               NaN

  efficiency_benchmarks  … sdg_tag_2  sdg_tag_3  sdg_tag_4  sdg_tag_5  \
0                   NaN  …       6.0       13.0        NaN        NaN
1                   NaN  …       7.0       13.0        NaN        NaN
2                   NaN  …      12.0       13.0        NaN        NaN
3                   NaN  …       7.0        9.0       10.0       11.0
4                   NaN  …      12.0       13.0        NaN        NaN

         thematic_tag_1         thematic_tag_2         thematic_tag_3  \
0  food waste management                  youth                 coffee
1     alternative energy           clean energy         climate change
2                    NaN     alternative energy            electricity
3           clean energy  community empowerment  rural electrification
4             innovation     polution reduction           solar energy

         thematic_tag_4 thematic_tag_5   Latitude   Longitude   \
0                olives            NaN  36.7607349   3.0261856
1  community empowerment            NaN  -12.833226  13.6010742
2     polution reduction            NaN  -8.5158356  16.0817871
3         social justice        welfare  -12.776115   15.687688
4                    NaN            NaN   -12.86536  13.8098145

        image_1 image_2 image_3 image_4 image_5 image_6 image_7 image_8  \
0           NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
1   file: img-10     NaN     NaN     NaN     NaN     NaN     NaN     NaN
2  file: img-121     NaN     NaN     NaN     NaN     NaN     NaN     NaN
3  file: img-230     NaN     NaN     NaN     NaN     NaN     NaN     NaN
4  file: img-305     NaN     NaN     NaN     NaN     NaN     NaN     NaN

  image_9  country regional_bureau
0     NaN  Algeria  rb_arab_states
1     NaN   Angola       rb_africa
2     NaN   Angola       rb_africa
3     NaN   Angola       rb_africa
4     NaN   Angola       rb_africa

[5 rows x 46 columns]
```

The 17 sustainable development goals (SDGs) to transform our world: GOAL 1: No Poverty

GOAL 2: Zero Hunger

GOAL 3: Good Health and Well-being

GOAL 4: Quality Education

GOAL 5: Gender Equality

GOAL 6: Clean Water and Sanitation

GOAL 7: Affordable and Clean Energy

GOAL 8: Decent Work and Economic Growth

GOAL 9: Industry, Innovation and Infrastructure

GOAL 10: Reduced Inequality

GOAL 11: Sustainable Cities and Communities

GOAL 12: Responsible Consumption and Production

GOAL 13: Climate Action

GOAL 14: Life Below Water

GOAL 15: Life on Land

GOAL 16: Peace and Justice Strong Institutions

GOAL 17: Partnerships to achieve the Goal

[22]:
```
sdg_dict = {1: 'No Poverty',
2: 'Zero Hunger',
3: 'Good Health and Well-being',
4: 'Quality Education',
5: 'Gender Equality',
6: 'Clean Water and Sanitation',
7: 'Affordable and Clean Energy',
8: 'Decent Work and Economic Growth',
9: 'Industry, Innovation and Infrastructure',
10: 'Reduced Inequality',
11: 'Sustainable Cities and Communities',
12: 'Responsible Consumption and Production',
13: 'Climate Action',
14: 'Life Below Water',
15: 'Life on Land',
16: 'Peace and Justice Strong Institutions',
17: 'Partnerships to achieve the Goal'}
```

df[[‘sdg_tag_1’, ‘sdg_tag_2’, ‘sdg_tag_3’, ‘sdg_tag_4’, ‘sdg_tag_5’]].to_numpy().reshape(1, 1795)[0]

More about Technology_readiness_level

TRL

Current NASA usage[4]

European Union[5]

1

Basic principles observed and reported

Basic principles observed

2

Technology concept and/or application formulated

Technology concept formulated

3

Analytical and experimental critical function and/or characteristic proof-of concept

Experimental proof of concept

4

Component and/or breadboard validation in laboratory environment

Technology validated in lab

5

Component and/or breadboard validation in relevant environment

Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)

6

System/subsystem model or prototype demonstration in a relevant environment (ground or space)

Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)

7

System prototype demonstration in a space environment

System prototype demonstration in operational environment

8

Actual system completed and "flight qualified" through test and demonstration (ground or space)

System complete and qualified

9

Actual system "flight proven" through successful mission operations

Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

[23]:
```
# Let's check about unique TRL values
df['solution_trl'].unique()
```

[23]:
```
array([nan, 'Prototype system', 'Full commercial application',
       'Prototype System', 'Fully ready', 'Ready',
       'Deployable - product is available for sale/scaling.',
       'Proof of concept developed.',
       '8. Systeme reel complet qualifie a travers des tests et des
demonstrations',
       '9. Systeme reel prouve a travers des operations / missions reussies',
       'TRL 7', 'TRL 4 - TRL 5', 'TRL7', 'TRL4', 'Between TRL 5 to TRL 7',
       'TRL 5- TRL 6', 'TRL 6',
       'Technical and economic feasibilities both positive. All materials of
construction are readily available in most villages. TRL 7-TRL8',
       'Technical and economic feasibilities both positive. All materials of
construction are readily available in most villages. However the heat exchanger
pipe that heats water and also acts as chimney has to be sourced in big cities',
       'In practice',
       'Applied research (analytical studies and tests only at the laboratory
level) Prototype in a simulated environment (Validation of a prototype, whether
full-scale or not, that has the ability to function in conditions similar to its
final application, corroborating the results obtained; but its operability is
still at the laboratory or simulation level).',
       'Tested at laboratory context\n',
       'The start up has been running for almost 5 years',
       'Tested product',
       'It is currently at testing phase and has been used by the user for about
5 years now with success',
       'This solutions has been in use since the early 2000s and has been tested
widely',
       'A business model ready for implementation/ won already 8k USD recently
by the UNDP RET (rural energy technology project), which has recently phased
out',
       'The technology is readily available in high source of solar energy area
9Somali region of Ethiopia. This enterprise generate solar energy from installed
solar energy generators and supply batteries based on prepaid schemes',
       'Market viable product', 'scale up',
       'Ready for production based on order', 'ready', 'Tested',
       'Scale up', 'Available any time', 'ready for production',
       'ready for production up on request', 'Mediana', 'Alta', 'RTL9',
       'TRL 8', 'TRL9', '8 or 9', 8, '3\n', 9,
       datetime.datetime(2022, 9, 8, 0, 0),
       'Proven implementation of product, service or process at scale',
       'Proven implementationof product, serviceor process at scale',
       'Not focused in technology, but models',
       'TRL 5, Technology development.',
       'Prototype Demonstration in operation Environment', 'Prototype.',
```

```
       '(TRL.6), the solution has a functional prototype.', 5, 6, 7,
       'fully ready', 'The Solution is ready',
       'The Solution has already been tested and proved to be in the category of
clean cooking solutions'],
      dtype=object)
```

Let's create a dictionary to map all this text to corresponding TRL numbers

[24]:
```
trl_dict = {'Prototype system': 7,
            'nan':np.nan,
            'Full commercial application':9 ,
            'Prototype System':7,
            'Fully ready':9,
            'Ready':9,
            'Deployable - product is available for sale/scaling.':9,
            'Proof of concept developed.':3,
            '8. Systeme reel complet qualifie a travers des tests et des␣
 ↪demonstrations':8,
            '9. Systeme reel prouve a travers des operations / missions␣
 ↪reussies':9,
            'TRL 7':7,
            'TRL 4 - TRL 5':5,
            'TRL7':7,
            'TRL4':4,
            'Between TRL 5 to TRL 7':7,
            'TRL 5- TRL 6':6,
            'TRL 6':6,
            'Technical and economic feasibilities both positive. All materials␣
 ↪of construction are readily available in most villages. TRL 7-TRL8':8,
            'Technical and economic feasibilities both positive. All materials␣
 ↪of construction are readily available in most villages. However the heat␣
 ↪exchanger pipe that heats water and also acts as chimney has to be sourced␣
 ↪in big cities':8,
            'In practice':9,
            'Applied research (analytical studies and tests only at the␣
 ↪laboratory level) Prototype in a simulated environment (Validation of a␣
 ↪prototype, whether full-scale or not, that has the ability to function in␣
 ↪conditions similar to its final application, corroborating the results␣
 ↪obtained; but its operability is still at the laboratory or simulation␣
 ↪level).':4,
      'Tested at laboratory context\n':4,
      'The start up has been running for almost 5 years':9,
      'Tested product':8,
      'It is currently at testing phase and has been used by the user for␣
 ↪about 5 years now with success':8,
      'This solutions has been in use since the early 2000s and has been␣
 ↪tested widely':9,
```

```
      'A business model ready for implementation/ won already 8k USD recently␣
↪by the UNDP RET (rural energy technology project), which has recently phased␣
↪out':9,
      'The technology is readily available in high source of solar energy area␣
↪9Somali region of Ethiopia. This enterprise generate solar energy from␣
↪installed solar energy generators and supply batteries based on prepaid␣
↪schemes':9,
      'Market viable product':9,
           'scale up':9,
      'Ready for production based on order':9,
           'ready':9,
           'Tested':8,
      'Scale up':9,
           'Available any time':9,
           'ready for production':9,
      'ready for production up on request':9,
           'Mediana':5,
           'Alta':9,
           'RTL9':9,
      'TRL 8':8,
           'TRL9':9,
           '8 or 9':9,
           8:8,
           '3\n':3,
           9:9,
      'Proven implementation of product, service or process at scale':9,
      'Proven implementationof product, serviceor process at scale':9,
      'Not focused in technology, but models':6,
      'TRL 5, Technology development.':5,
      'Prototype Demonstration in operation Environment':6,
           'Prototype.':6,
      '(TRL.6), the solution has a functional prototype.':6,
           5:5,
           6:6,
           7:7,
      'fully ready':9,
           'The Solution is ready':9,
      'The Solution has already been tested and proved to be in the category␣
↪of clean cooking solutions':8}
```

[25]:
```
trl_val = {1:'TRL_1', 2:'TRL_2', 3:'TRL_3', 4:'TRL_4', 5:'TRL_5', 6:'TRL_6', 7:
↪'TRL_7', 8:'TRL_8', 9:'TRL_9'}
```

[26]:
```
df['trl_level'] = df['solution_trl'].apply(lambda value: trl_dict[value] if␣
↪value in list(trl_dict.keys()) else np.nan).apply(lambda value:␣
↪trl_val[value] if value in list(trl_val.keys()) else np.nan)
```

[27]:
```
# Let's convert trl_level to a CategoricalDtype
classes = ['TRL_1', 'TRL_2', 'TRL_3', 'TRL_4', 'TRL_5', 'TRL_6', 'TRL_7',␣
 ↪'TRL_8', 'TRL_9']
# Creating Category
cat_classes = pd.api.types.CategoricalDtype(categories=classes, ordered=True)
# Converting to CategoricalDtype
df['trl_level'] = df['trl_level'].astype(cat_classes)
# Testing
df['trl_level'].info()
```

```
<class 'pandas.core.series.Series'>
RangeIndex: 359 entries, 0 to 358
Series name: trl_level
Non-Null Count  Dtype
--------------  -----
125 non-null    category
dtypes: category(1)
memory usage: 859.0 bytes
```

list(df[‘trl_level’])

[28]:
```
def proto_prodo(val):
    if (val[0]=='x'):
        return 'prototype'
    elif (val[1]=='x'):
        return 'product'
    else:
        return np.nan
```

Let’s create one colum ‘sol_type’

df[[‘prototype’, ‘product’]].to_numpy().tolist()

[proto_prodo(val) for val in df[[‘prototype’, ‘product’]].to_numpy().tolist()]

[29]:
```
df['sol_type'] = [proto_prodo(val) for val in df[['prototype', 'product']].
 ↪to_numpy().tolist()]
```

[ ]:
```
```

[30]:
```
def open_proper(val):
    if (val[0]=='x'):
        return 'open_source'
    elif (val[1]=='x'):
        return 'intellectual_property'
    else:
        return np.nan
```

[31]:
```
df['sol_protection'] = [open_proper(val) for val in df[['sol_open_source',␣
↪'sol_Intellectual_Property']].to_numpy().tolist()]
```

[32]:
```
df.columns
```

[32]:
```
Index(['contribution_date', 'new_date', 'id', 'energy_source', 'clean_cooking',
       'title', 'mapper', 'contributor', 'purp_prob_sol_description)',
       'solution_link', 'sol_open_source', 'sol_Intellectual_Property',
       'sol_replication_training', 'total_sol_unit_cost', 'prototype',
       'product', 'product_availability', 'product_advance_order',
       'solution_trl', 'solution_diffused', 'end-user_feedback',
       'efficiency_benchmarks', 'bottlenecks', 'sdg_tag_1', 'sdg_tag_2',
       'sdg_tag_3', 'sdg_tag_4', 'sdg_tag_5', 'thematic_tag_1',
       'thematic_tag_2', 'thematic_tag_3', 'thematic_tag_4', 'thematic_tag_5',
       'Latitude ', 'Longitude ', 'image_1', 'image_2', 'image_3', 'image_4',
       'image_5', 'image_6', 'image_7', 'image_8', 'image_9', 'country',
       'regional_bureau', 'trl_level', 'sol_type', 'sol_protection'],
      dtype='object')
```

[33]:
```
df['total_sol_unit_cost'].unique()
```

[33]:
```
array([nan, '1200 BDT per unit',
       'Initial investment: BDT 1.7 million. Pricing: BDT 20-30 per HH/month',
       'Unsure.', '3420 $ US', '298 $ US', '3670 $ US', '2414 $ US', 150,
       '574 $ US', '161 $ US', '563 $ US', '2415 $ US', '1450 $ US',
       '51501 $ US', '$22',
       'After economic analysis, our ASAAB cooker is sold between 15000 FCFA and
25000 FCFA or between 23 ¬£ and 39 ¬£ about 33 US$ and 56 US$. On the other
hand, the price of other thermal cookers already marketed is about 90 US$ and
more or more than 40,500 FCFA.',
       'being a product which is not yet in the market, we plan on fixing the
unit cost of the solution at 130 000 frs Cfa payable in 3 instalment.',
       '$400', '800 Dollars',
       'We sell a kilogram at 150cfa compared to that of wood whose prices vary
from 300cfa to 500frs sometimes. The wood in the city of Maroua is sold in a
small pile of about 03 twigs which is up to 100frs and can not make a meal',
       '100$',
       'The unit cost if 45,000 Frs with no maintenance costs. However if massed
produced with a small iron smelting plant the cost could get down to 25000 frs.
Important to state that we recommend sheet metal thickness of 3mm which is quite
expensive now in the market but very durable.',
       'The unit cost if 250,000 Frs CFA with no maintenance costs. However if
massed produced with a small iron smelting plant the cost could get down to
200000 frs CFA.',
       'Improve led light so that it has a greater scope of spectrum and
illumination',
       '2500 EGP', '450 euros per month (36 months)', '45000EGP',
```

```
       'the costs can range between $1000 and $1200',
       'approximately $500',
       'The business model requires1 million ETB (~19000 USD) for
implementation',
       'USD 1000', '20 USD', '2500 Birr', '0.6 USD/kg',
       'it is made of burned clay, 3 to 4 cylindrical enclosures, no pot-rests,
developed by the Government in 2002, can be found in Amhara, Oromia, Tigray and
Southern regions, price from 1 to 2 USD, cheapest Injera baking ICS stove in
Ethiopia), stove-test by the Ministry of Water and Energy',
       '0.13 USD', '1400 USD', 'No se tiene esa info',
       'To be updated soon', 'From sefl evaluation probably 20 USD.',
       '1000000 GNF / 100 USD', '20 000 000 GNF', 'Maximum 7 USD.',
       'Undefined', 'Not defined', '25,000 USD',
       '35, 000 VUV (Vanuatu Vatu)', '16000 VUV/peanut cooker',
       '200, 000VUV/unit', 'No', '1,450 - 1,750 quetzales',
       '110 - 810 quetzales', '7,390 - 10,599 quetzales',
       '50,000 FRW/KW equivalent to 52$',
       'The prices are affordable but still under discussion.',
       '20$ per stove', '500,000 FRW equivalent to 515$.',
       '500,000 FRW / 515$', '1500$',
       'Green house building and installation costs 3000$, (in Syria it is more
expensive due to scarcity of inputs, and due to economic sanctions)\nComposting
heating distribution unite costs: 1200$',
       'the cost depends on the availability of materials in Syria. But
approximately between 1500$ to 2000%',
       1500, '1200 $', 1700, 'Depends on the quantity',
       '100 TRY per solar cooker', '1,750,000 Ugandan Shillings'],
      dtype=object)
```

We will convert everything to USD

1 TRY = 0.054 USD

1 Ugandan Shillings = 0.00026 USD

1 GNF = 0.00012 USD

1 XAF = 0.0015 USD

1 BDT = 0.0099 USD

1 EGP 0,051

1 EUR

1 BIRR

1 quetzales

1 VUV

[34]:
```
convert_dict = {'TRY': 0.054, 'Ugandan Shillings':0.00026, 'GNF': 0.00012,␣
↪'XAF': 0.0015, 'BDT': 0.0099, 'USD': 1, 'EGP': 0.051, 'EUR':0.97, 'BIRR':0.
↪019, 'quetzales':0.13, 'VUV':0.00814599}
```

[35]:
```
cost_dict = {'nan':np.nan,
             '1200 BDT per unit': 1200 * convert_dict['BDT'] ,
      'Initial investment: BDT 1.7 million. Pricing: BDT 20-30 per HH/month':␣
↪1700000 * convert_dict['BDT'],
      'Unsure.':np.nan,
            '3420 $ US':3420 * convert_dict['USD'] ,
            '298 $ US':298 * convert_dict['USD'],
            '3670 $ US':3670 * convert_dict['USD'],
            '2414 $ US':2414 * convert_dict['USD'],
            150:150 * convert_dict['USD'],
      '574 $ US':574 * convert_dict['USD'],
            '161 $ US':161 * convert_dict['USD'],
            '563 $ US':563 * convert_dict['USD'],
            '2415 $ US':2415 * convert_dict['USD'],
            '1450 $ US':1450 * convert_dict['USD'],
      '51501 $ US':51501 * convert_dict['USD'],
            '$22':22 * convert_dict['USD'],
      'After economic analysis, our ASAAB cooker is sold between 15000 FCFA␣
↪and 25000 FCFA or between 23 ¬£ and 39 ¬£ about 33 US$ and 56 US$. On the␣
↪other hand, the price of other thermal cookers already marketed is about 90␣
↪US$ and more or more than 40,500 FCFA.':56 * convert_dict['USD'],
      'being a product which is not yet in the market, we plan on fixing the␣
↪unit cost of the solution at 130 000 frs Cfa payable in 3 instalment.':
↪130000 * convert_dict['XAF'],
      '$400':400 * convert_dict['USD'],
            '800 Dollars':800 * convert_dict['USD'],
      'We sell a kilogram at 150cfa compared to that of wood whose prices vary␣
↪from 300cfa to 500frs sometimes. The wood in the city of Maroua is sold in a␣
↪small pile of about 03 twigs which is up to 100frs and can not make a meal':
↪500 * convert_dict['XAF'],
      '100$': 100 * convert_dict['USD'],
      'The unit cost if 45,000 Frs with no maintenance costs. However if␣
↪massed produced with a small iron smelting plant the cost could get down to␣
↪25000 frs. Important to state that we recommend sheet metal thickness of 3mm␣
↪which is quite expensive now in the market but very durable.':45000 *␣
↪convert_dict['XAF'],
      'The unit cost if 250,000 Frs CFA with no maintenance costs. However if␣
↪massed produced with a small iron smelting plant the cost could get down to␣
↪200000 frs CFA.':250000 * convert_dict['XAF'],
      'Improve led light so that it has a greater scope of spectrum and␣
↪illumination':np.nan,
      '2500 EGP':2500 * convert_dict['EGP'],
```

```
            '450 euros per month (36 months)': 450 * 36 * convert_dict['EUR'],
            '45000EGP':45000 * convert_dict['EGP'],
      'the costs can range between $1000 and $1200':1200 * convert_dict['USD'],
      'approximately $500':500 * convert_dict['USD'],
      'The business model requires1 million ETB (~19000 USD) for␣
↪implementation':19000 * convert_dict['USD'],
      'USD 1000':1000 * convert_dict['USD'],
            '20 USD':20 * convert_dict['USD'],
            '2500 Birr':2500 * convert_dict['BIRR'],
            '0.6 USD/kg':0.6 * convert_dict['USD'],
      'it is made of burned clay, 3 to 4 cylindrical enclosures, no pot-rests,␣
↪developed by the Government in 2002, can be found in Amhara, Oromia, Tigray␣
↪and Southern regions, price from 1 to 2 USD, cheapest Injera baking ICS␣
↪stove in Ethiopia), stove-test by the Ministry of Water and Energy':2 *␣
↪convert_dict['USD'],
      '0.13 USD':0.13 * convert_dict['USD'],
            '1400 USD':1400 * convert_dict['USD'],
            'No se tiene esa info':np.nan,
      'To be updated soon':np.nan,
            'From sefl evaluation probably 20 USD.':20 * convert_dict['USD'],
      '1000000 GNF / 100 USD':100 * convert_dict['USD'],
            '20 000 000 GNF':20000000 * convert_dict['GNF'],
            'Maximum 7 USD.':7 * convert_dict['USD'],
      'Undefined':np.nan,
            'Not defined':np.nan,
            '25,000 USD':25000 * convert_dict['USD'],
      '35, 000 VUV (Vanuatu Vatu)':35000 * convert_dict['VUV'],
            '16000 VUV/peanut cooker':16000 * convert_dict['VUV'],
      '200, 000VUV/unit':200000 * convert_dict['VUV'],
            'No':np.nan,
            '1,450 - 1,750 quetzales':1750 * convert_dict['quetzales'],
      '110 - 810 quetzales':810 * convert_dict['quetzales'],
            '7,390 - 10,599 quetzales':10599 * convert_dict['quetzales'],
      '50,000 FRW/KW equivalent to 52$':52 * convert_dict['USD'],
      'The prices are affordable but still under discussion.':np.nan,
      '20$ per stove':20 * convert_dict['USD'],
            '500,000 FRW equivalent to 515$.':515 * convert_dict['USD'],
      '500,000 FRW / 515$':51 * convert_dict['USD'],
            '1500$':1500 * convert_dict['USD'],
      'Green house building and installation costs 3000$, (in Syria it is more␣
↪expensive due to scarcity of inputs, and due to economic␣
↪sanctions)\nComposting heating distribution unite costs: 1200$':(3000 +␣
↪1200) * convert_dict['USD'],
      'the cost depends on the availability of materials in Syria. But␣
↪approximately between 1500$ to 2000%':2000 * convert_dict['USD'],
      1500:1500 * convert_dict['USD'],
            '1200 $':1200 * convert_dict['USD'],
```

```
            1700:1700 * convert_dict['USD'],
            'Depends on the quantity':np.nan,
      '100 TRY per solar cooker':100 * convert_dict['TRY'],
            '1,750,000 Ugandan Shillings':1750000 * convert_dict['Ugandan␣
 ↪Shillings']}
```

[36]:
```
df['sol_cost_usd'] = df['total_sol_unit_cost'].apply(lambda value:␣
 ↪cost_dict[value] if value in list(cost_dict.keys()) else np.nan)
```

[37]:
```
# Let's convert sol_type to a CategoricalDtype
classes = ['prototype', 'product']
# Creating Category
cat_classes = pd.api.types.CategoricalDtype(categories=classes, ordered=True)
# Converting to CategoricalDtype
df['sol_type'] = df['sol_type'].astype(cat_classes)
# Testing
df['sol_type'].info()
```

```
<class 'pandas.core.series.Series'>
RangeIndex: 359 entries, 0 to 358
Series name: sol_type
Non-Null Count  Dtype
--------------  -----
193 non-null    category
dtypes: category(1)
memory usage: 611.0 bytes
```

[38]:
```
# Let's convert trl_level to a CategoricalDtype
classes = ['intellectual_property', 'open_source']
# Creating Category
cat_classes = pd.api.types.CategoricalDtype(categories=classes, ordered=True)
# Converting to CategoricalDtype
df['sol_protection'] = df['sol_protection'].astype(cat_classes)
# Testing
df['sol_protection'].info()
```

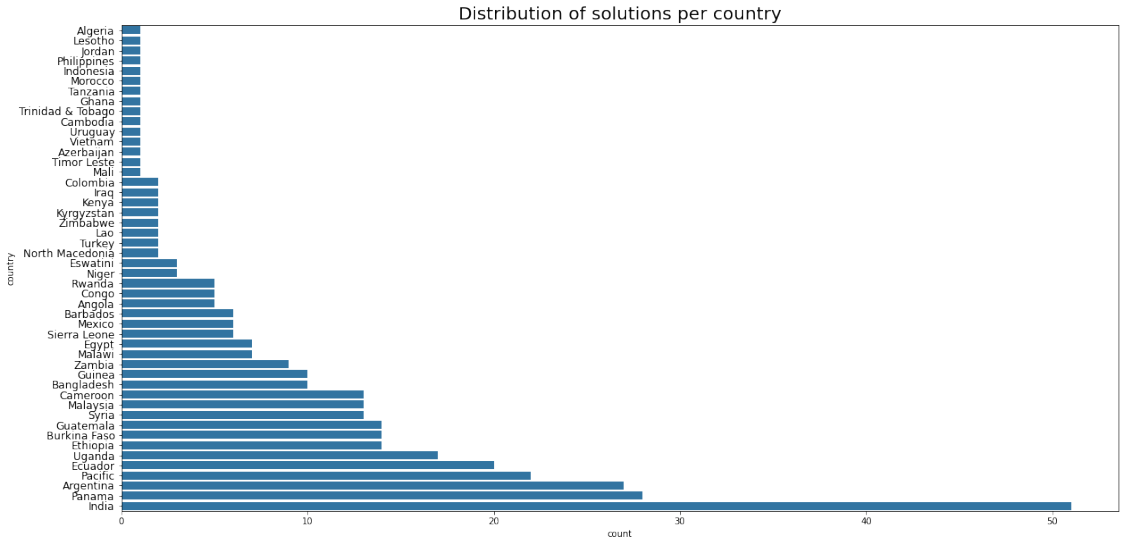
```
<class 'pandas.core.series.Series'>
RangeIndex: 359 entries, 0 to 358
Series name: sol_protection
Non-Null Count  Dtype
--------------  -----
140 non-null    category
dtypes: category(1)
memory usage: 611.0 bytes
```

[39]:
```
df['energy_source'] = df['energy_source'].str.strip()
```

[40]:
```
from os.path import exists
from os import mkdir
from shutil import rmtree
folder_name = 'viz_pictures'

if exists(folder_name):
    rmtree(folder_name)

if not exists(folder_name):
    mkdir(folder_name)

fig_ext = '.pdf'
fig_img = '.jpg'
fig_num = 0

def save_fig(fig_name, title=True):
    global fig_num
    fig_num+=1
    if title:
        plt.title(fig_name, fontdict={'fontsize': 20});
    plt.savefig(f'{folder_name}/{fig_num}_{fig_name}{fig_ext}',␣
 ↪bbox_inches='tight')
    plt.savefig(f'{folder_name}/{fig_num}_{fig_name}{fig_img}',␣
 ↪bbox_inches='tight')
```

1.0.1 Question : Where are the solutions coming from? What is their distribution per country?

[41]:
```
b = sns.countplot(data=df, y='country', order=df['country'].value_counts().
 ↪index[::-1] , color=sns.color_palette()[0])
b.set_yticklabels(b.get_yticklabels(), size = 12);
fig_name = 'Distribution of solutions per country'
save_fig(fig_name)
```

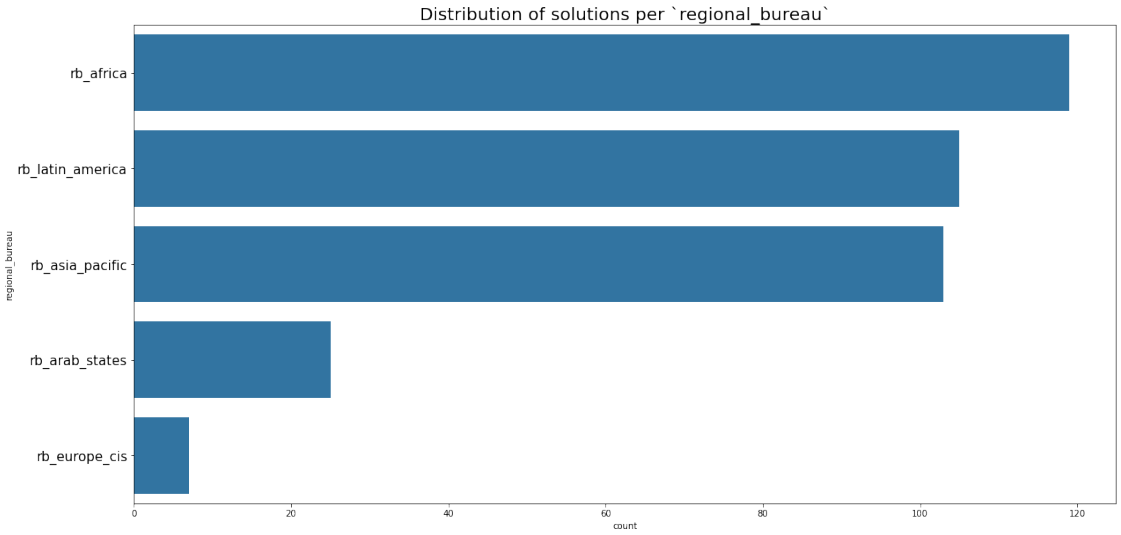


1.0.2 Question : Where are the solutions coming from? What is their distribution per country?

- `India` has the highest number of solutions
- `Panama` is the second best solutions provider
- `Argentina` is the third best solutions provider
- `Pacific` is the fourth best solutions provider
- `Ecuador` is the fifth best solutions provider

1.0.3 Question : Where are the solutions coming from? What is their distribution per region?

[42]:
```
b = sns.countplot(data=df, y='regional_bureau', order=df['regional_bureau'].
  ↪value_counts().index, color=sns.color_palette()[0])
b.set_yticklabels(b.get_yticklabels(), size = 15);
fig_name = 'Distribution of solutions per `regional_bureau`'
save_fig(fig_name)
```

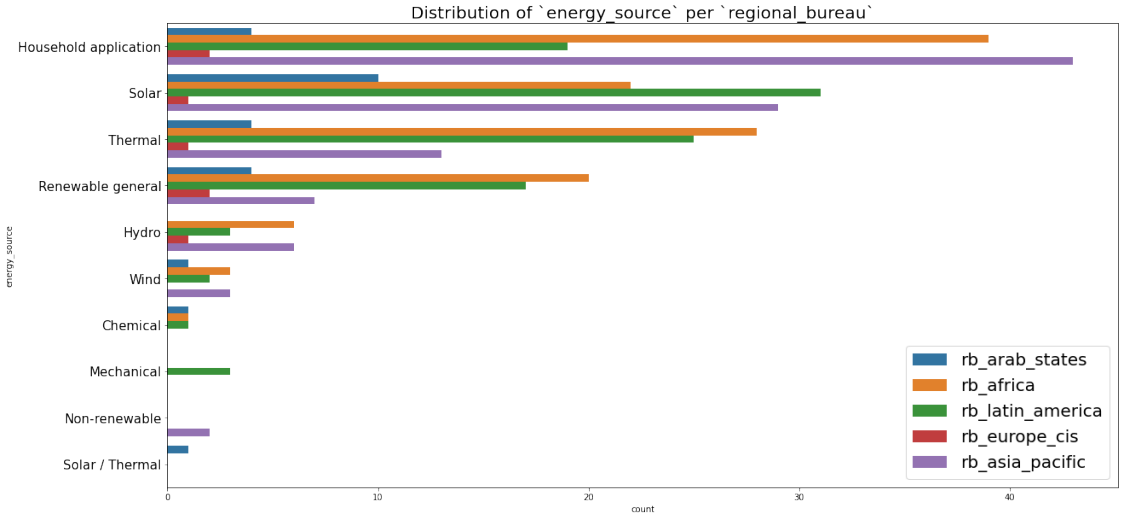


1.0.4 Question : Where are the solutions coming from? What is their distribution per region?

- `rb_africa` has the highest number of solutions
- `rb_latin_america` is the second best solutions provider
- `rb_asia_pacific` is the third best solutions provider

1.0.5 Question : What are global commonalities across solutions; what are typical applications & use cases for solutions? Are there patterns that emerge when looking at the distribution per country & per region?

[43]:
```
b = sns.countplot(data=df, y='energy_source', order=df['energy_source'].
↪value_counts().index, hue='regional_bureau')
b.set_yticklabels(b.get_yticklabels(), size = 15);
plt.legend(fontsize=20, loc='lower right');
fig_name = 'Distribution of `energy_source` per `regional_bureau`'
save_fig(fig_name)
```

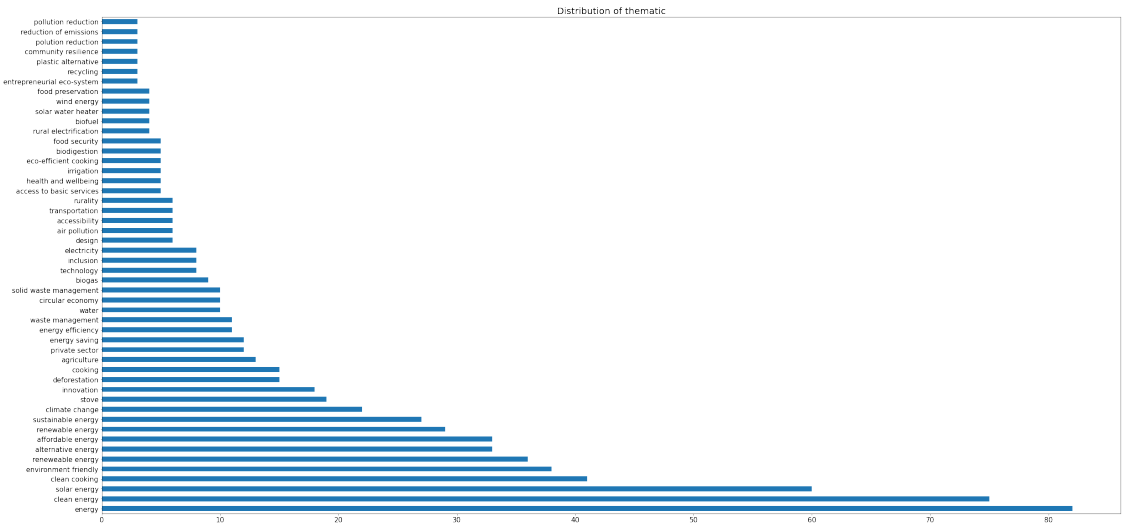


1.0.6 Question : What are global commonalities across solutions; what are typical applications & use cases for solutions? Are there patterns that emerge when looking at the distribution per country & per region?

- The most produced `energy_source` is `Household application` and this solution is more prevalent in the regional bureau `rb_asia_pacific`, then `rb_africa` and `rb_latin_america`. It can be relative to the proverty level, which is high in these locations.
- The second most produced `energy_source` is `Solar` and more prevalent in the regional bureau `rb_latin_america` then `rb_asia_pacific`, `rb_africa` and `rb_arab_states`. It can be relative to the poor developpement of other energy sources in the locations of the first three, and the desert with his high level of solar reception in the locations of the `rb_arab_states`.
- The third most produced `energy_source` is `Thermal` and more prevalent in the regional bureau `rb_africa`, `rb_latin_america` and `rb_asia_pacific`.
- Overall energy sources, the more prevalent locations are `rb_africa`, `rb_latin_america` and `rb_asia_pacific`, certainly because of the development level which is low in these locations. That said, we understand why there are not so many solutions in `rb_europe_cis` and `rb_arab_states`.

1.0.7 Question : What overall challenges are the solutions addressing or contributing to overcome?

[44]:
```
pd.Series(data = df[['thematic_tag_1', 'thematic_tag_2', 'thematic_tag_3',␣
 ↪'thematic_tag_4', 'thematic_tag_5']].to_numpy().reshape(1, 1795)[0]).
 ↪dropna(axis=0).reset_index(drop=True).value_counts().nlargest(50).
 ↪plot(kind='barh', figsize = (40, 20), fontsize=15);
fig_name = 'Distribution of thematic'
save_fig(fig_name)
```

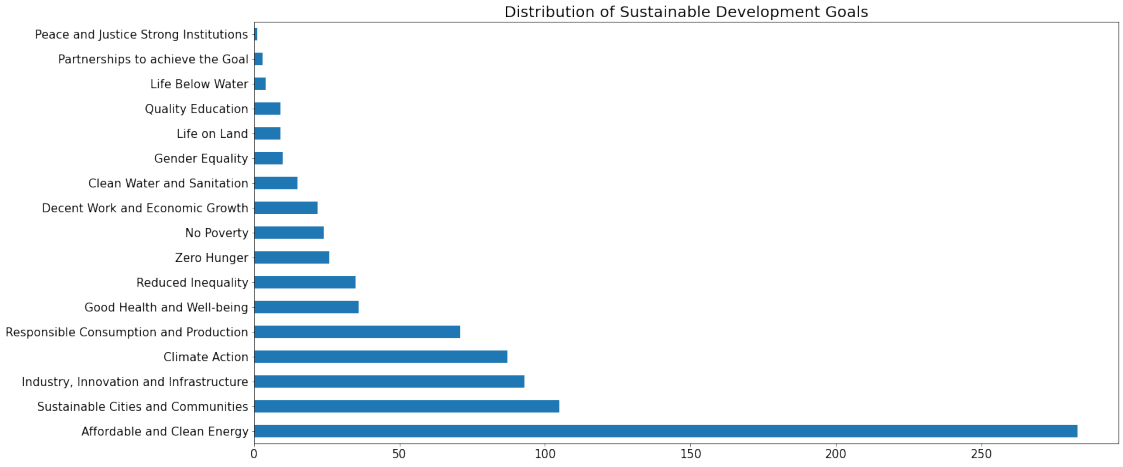


1.0.8 Question : What overall challenges are the solutions addressing or contributing to overcome?

- The most represented thematic is `Energy` (either `clean energy`, `solar energy`, `renewable energy`, `alternative energy`, `affordable energy`, `sustainable energy`)
- The second most represented thematic is `environment friendly`
- The third is `climate change`

1.0.9 Question : Which Sustainable Development Goals are the solutions advancing in particular, and how?

[45]:
```
# We create an array of the sdg tags, convert to numpy array, reshape to 1-d␣
↪array, drop NaN values, convert values to int, reset index, rename to␣
↪corresponding sdg goals, then plot the bar chart of the distribution.
pd.Series(data = df[['sdg_tag_1', 'sdg_tag_2', 'sdg_tag_3', 'sdg_tag_4',␣
↪'sdg_tag_5']].to_numpy().reshape(1, 1795)[0]).dropna(axis=0).astype(int).
↪reset_index(drop=True).value_counts().rename(lambda value: sdg_dict[value]␣
↪if value in list(sdg_dict.keys()) else np.nan).plot(kind='barh',␣
↪fontsize=15);
fig_name = 'Distribution of Sustainable Development Goals'
save_fig(fig_name)
```

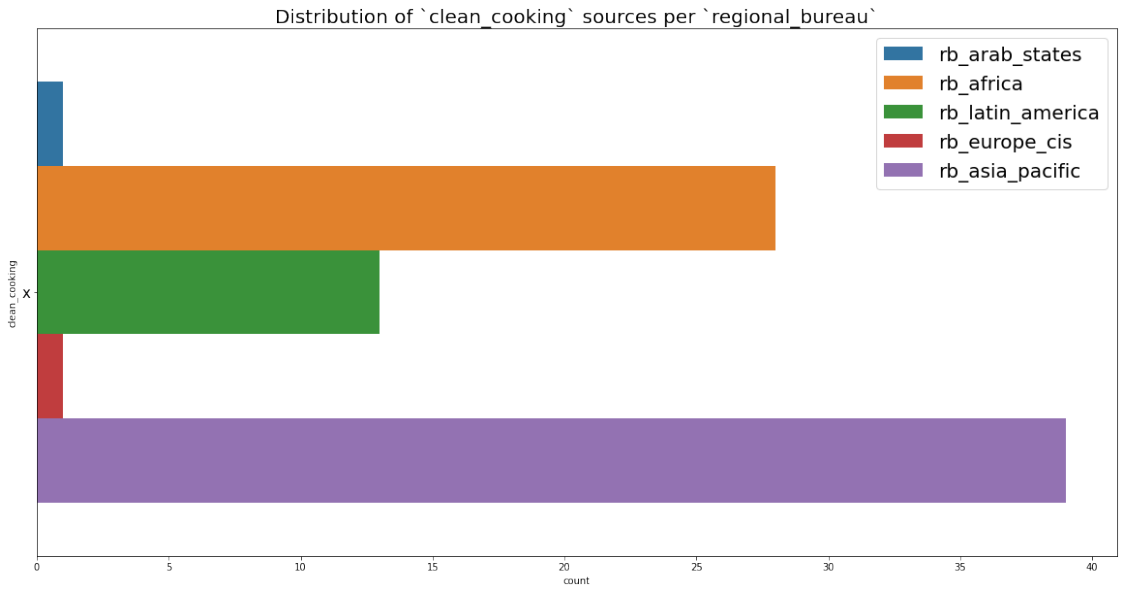


1.0.10 Question : Which Sustainable Development Goals are the solutions advancing in particular, and how?

- The most represented SDG is `Affordable and Clean Energy`
- The second is `Sustainable Cities and Communities`
- The third is `Industry, Innovation and Infrastructure`

1.0.11 Question : Looking at the use case of clean cooking solutions, what is their prevalence, distribution, and source of energy?

[46]:
```
b = sns.countplot(data=df, y='clean_cooking', order=df['clean_cooking'].
  ↪value_counts().index, hue='regional_bureau')
b.set_yticklabels(b.get_yticklabels(), size = 15);
plt.legend(fontsize=20, loc='upper right');
fig_name = 'Distribution of `clean_cooking` sources per `regional_bureau`'
save_fig(fig_name)
```

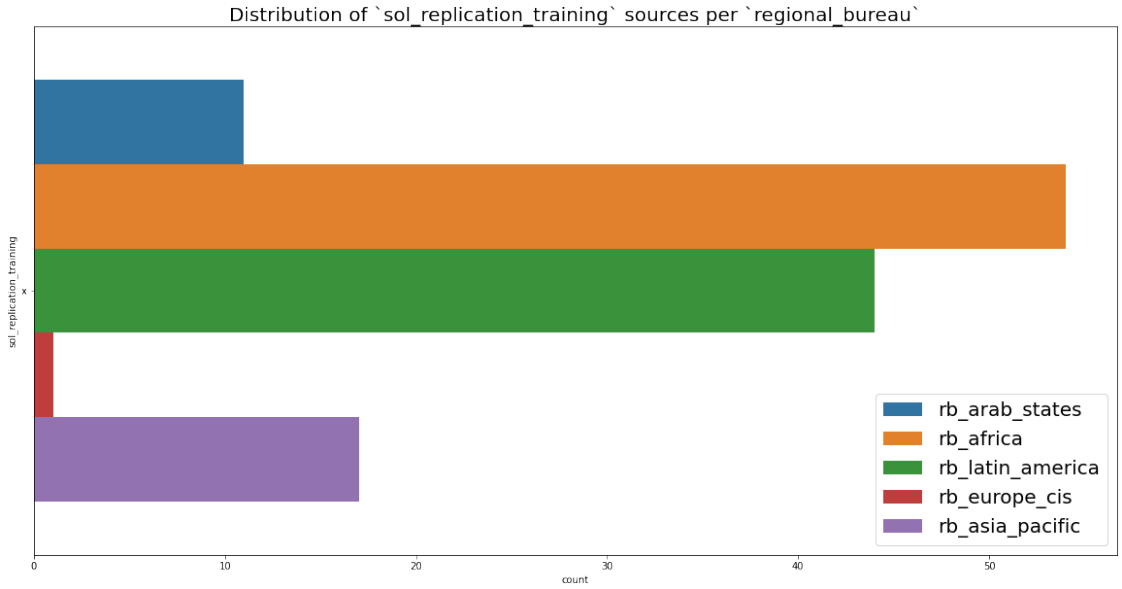


1.0.12 Question : Looking at the use case of clean cooking solutions, what is their prevalence, distribution, and source of energy?

- More `clean_cooking` solutions are produced in `rb_asia_pacific`, `rb_africa` and `rb_latin_america`

1.0.13 Question : Distribution of `sol_replication_training` sources per `regional_bureau`

[47]:
```
sns.countplot(data=df, y='sol_replication_training',␣
 ↪order=df['sol_replication_training'].value_counts().index,␣
 ↪hue='regional_bureau')
plt.legend(fontsize=20, loc='lower right');
fig_name = 'Distribution of `sol_replication_training` sources per␣
 ↪`regional_bureau`'
save_fig(fig_name)
```

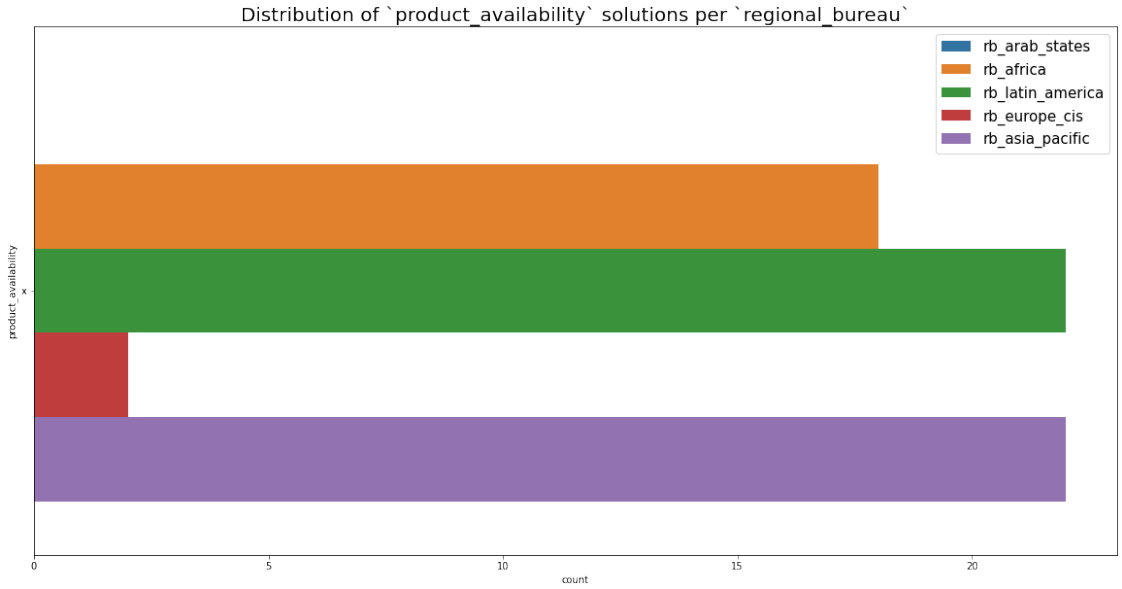


1.0.14 Question : Distribution of `sol_replication_training` sources per `regional_bureau`

- Many solutions are replicable elsewhere, and most of solutions are coming from `rb_africa` and `rb_latin_america`.

1.0.15 Question : Distribution of `product_availability` solutions per `regional_bureau`

[48]:
```
sns.countplot(data=df, y='product_availability',␣
 ↪order=df['product_availability'].value_counts().index, hue='regional_bureau')
plt.legend(fontsize=15, loc='upper right');
fig_name = 'Distribution of `product_availability` solutions per␣
 ↪`regional_bureau`'
save_fig(fig_name)
```

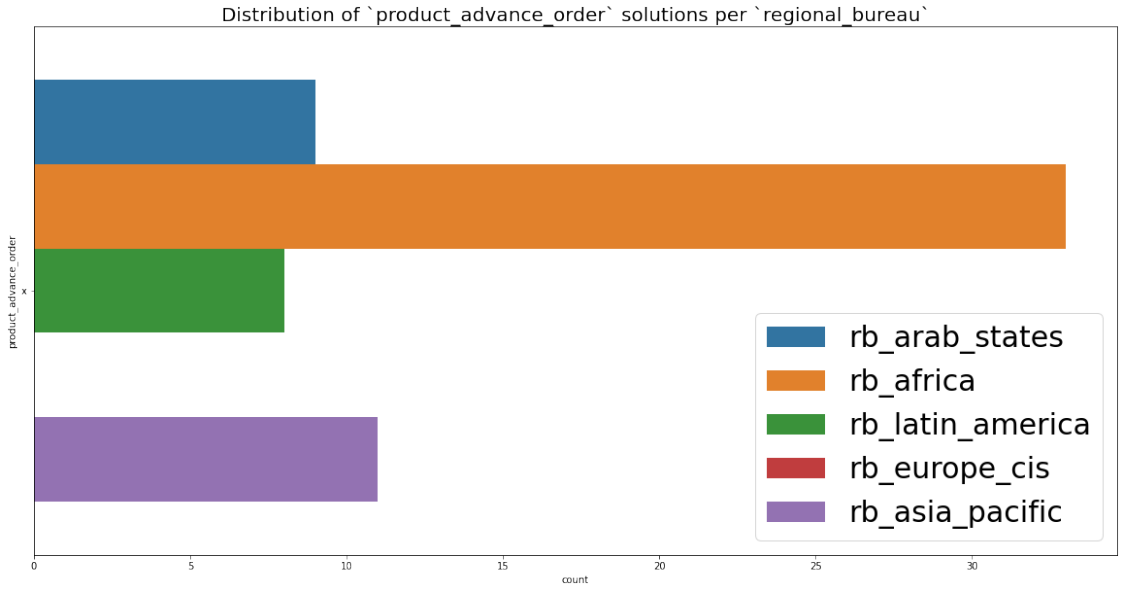


1.0.16 Question : Distribution of `product_availability` solutions per `regional_bureau`

- Many solutions are products already available and waiting for scaling in the `rb_africa`, `rb_asia_pacific` and `rb_latin_america`.

1.0.17 Question : Distribution of `product_advance_order` solutions per `regional_bureau`

[49]:
```
sns.countplot(data=df, y='product_advance_order',␣
 ↪order=df['product_advance_order'].value_counts().index,␣
 ↪hue='regional_bureau')
plt.legend(fontsize=30, loc='lower right');
fig_name = 'Distribution of `product_advance_order` solutions per␣
 ↪`regional_bureau`'
save_fig(fig_name)
```



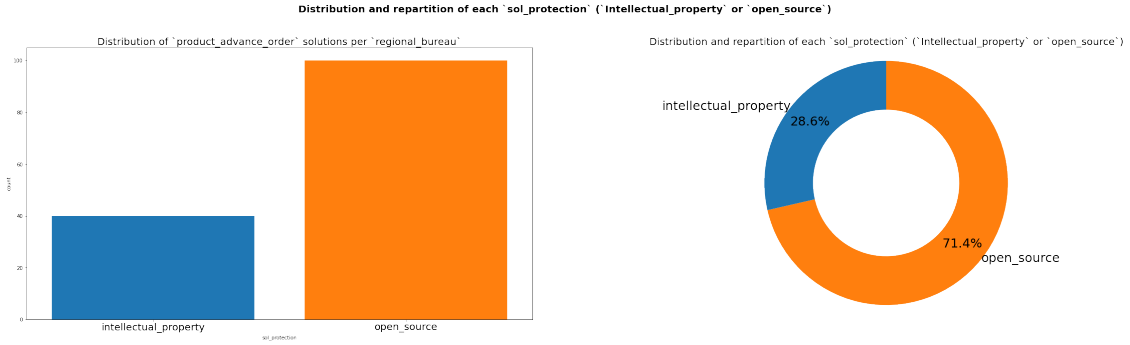
1.0.18 Question : Distribution of `product_advance_order` solutions per `regional_bureau`

- Many solutions have been already ordered, most from `rb_africa`.

1.0.19 Question : Distribution and repartition of each `sol_protection` (`Intellectual_property` or `open_source`)

[50]:
```
plt.figure(figsize = (40, 10));
fig_title = 'Distribution and repartition of each `sol_protection`␣
 ↪(`Intellectual_property` or `open_source`)'
plt.suptitle(fig_title, fontsize=20, fontweight='bold', x=0.5, y=1)

plt.subplot(1, 2, 1)
b = sns.countplot(data=df, x='sol_protection', palette=sns.color_palette()[:2],␣
 ↪saturation=1)
b.set_xticklabels(b.get_xticklabels(), size = 20);
save_fig(fig_name)

plt.subplot(1, 2, 2)
sorted_counts = df['sol_protection'].value_counts()
plt.pie(sorted_counts, labels = sorted_counts.index, startangle = 90,
        counterclock = False, wedgeprops = {'width' : 0.4}, colors=sns.
 ↪color_palette()[:2][::-1],
        textprops={'fontsize': 25}, autopct='%1.1f%%', pctdistance=0.8,␣
 ↪labeldistance=1);
plt.axis('square');
```

```
fig_name = 'Repartition of `sol_protection` (`Intellectual_property` or␣
 ↪`open_source`)'
save_fig(fig_name)

#saving the master image
save_fig(fig_title)
```

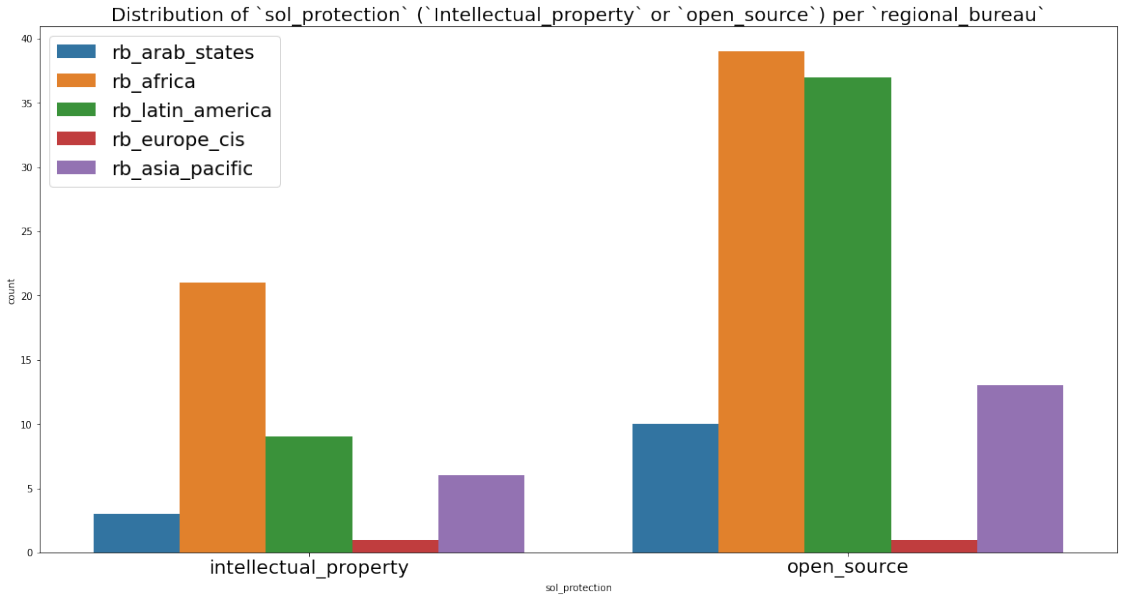


1.0.20 Question : Distribution and repartition of each sol_protection (Intellectual_property or open_source)

- Most of the solutions are open_source representing about 71.4% overall.

1.0.21 Question : Distribution of sol_protection (Intellectual_property or open_source) per regional_bureau

[51]:
```
b = sns.countplot(data=df, x='sol_protection', hue='regional_bureau')
b.set_xticklabels(b.get_xticklabels(), size = 20);
plt.legend(fontsize=20, loc='upper left');
fig_name = 'Distribution of `sol_protection` (`Intellectual_property` or␣
 ↪`open_source`) per `regional_bureau`'
save_fig(fig_name)
```

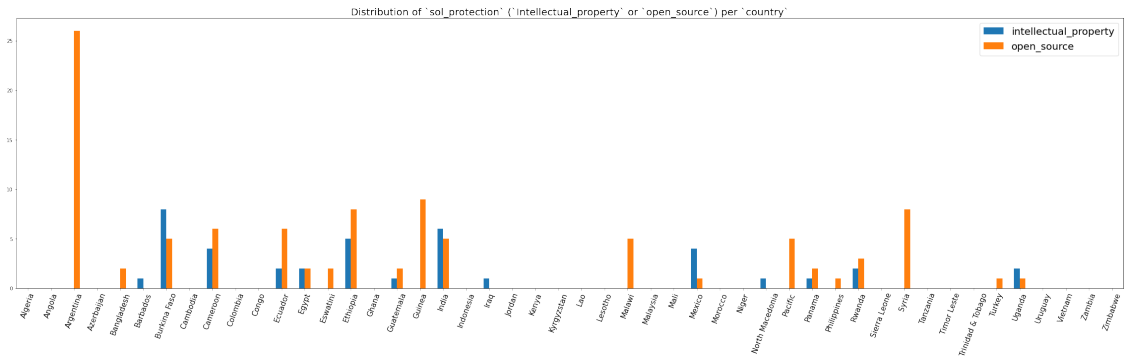


1.0.22 Question : Distribution of `sol_protection` (`Intellectual_property` or `open_source`) per `regional_bureau`

- Most `open_source` solutions are from `rb_africa` and `rb_latin_america`.

1.0.23 Question : Distribution of `sol_protection` (`Intellectual_property` or `open_source`) per `country`

[52]:
```
country_sol_type = df.groupby(['country', 'sol_protection']).size().
 ↪reset_index(name='count').pivot(index='country', columns='sol_protection',␣
 ↪values='count').reset_index().rename(columns={'sol_protection': 'index'})#.
 ↪plot(kind='bar')

country_sol_type.plot(kind='bar', figsize = (40, 10));
plt.xticks(country_sol_type.index, country_sol_type['country'], rotation=70,␣
 ↪fontsize=15);
plt.legend(fontsize=20, loc='upper right');
fig_name = 'Distribution of `sol_protection` (`Intellectual_property` or␣
 ↪`open_source`) per `country`'
save_fig(fig_name)
```

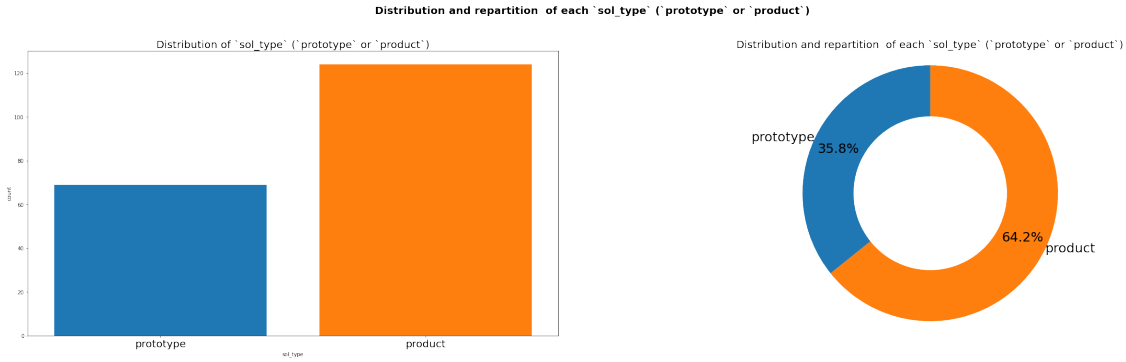


1.0.24 Question : Distribution of `sol_protection` (`Intellectual_property` or `open_source`) per `country`

- Many coutries have more `open_source` solutions than `intellectual_property` solutions, such as `Argentina`, `Guinea`, `Cameroon`, `Ethiopia` and `Syria`.

1.0.25 Question : Distribution and repartition of each `sol_type` (`prototype` or `product`)

[53]:
```
plt.figure(figsize = (40, 10));
fig_title = 'Distribution and repartition  of each `sol_type` (`prototype` or␣
 ↪`product`)'
plt.suptitle(fig_title, fontsize=20, fontweight='bold', x=0.5, y=1)

plt.subplot(1, 2, 1)
b = sns.countplot(data=df, x='sol_type', palette=sns.color_palette()[:2],␣
 ↪saturation=1)
b.set_xticklabels(b.get_xticklabels(), size = 20);
fig_name = 'Distribution of `sol_type` (`prototype` or `product`)'
save_fig(fig_name)

plt.subplot(1, 2, 2)
sorted_counts = df['sol_type'].value_counts()
plt.pie(sorted_counts, labels = sorted_counts.index, startangle = 90,
        counterclock = False, wedgeprops = {'width' : 0.4}, colors=sns.
 ↪color_palette()[:2][::-1],
        textprops={'fontsize': 25}, autopct='%1.1f%%', pctdistance=0.8,␣
 ↪labeldistance=1);
plt.axis('square');
fig_name = 'Repartition of `sol_type` (`prototype` or `product`)'
save_fig(fig_name)

#saving the master image
save_fig(fig_title)
```

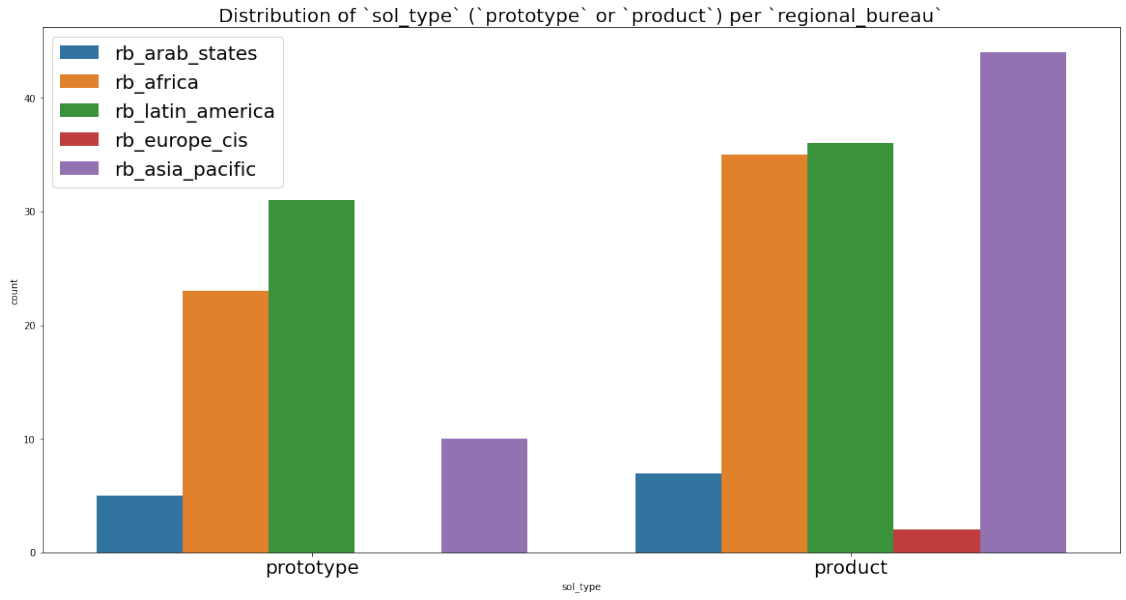


1.0.26 Question : Distribution and repartition of each `sol_type` (`prototype` or `product`)

- Most of the solutions are `product` (ready to scale) representing about `64.2%` overall.

1.0.27 Question : Distribution of `sol_type` (`prototype` or `product`) per `regional_bureau`

[54]:
```
b = sns.countplot(data=df, x='sol_type', hue='regional_bureau')
b.set_xticklabels(b.get_xticklabels(), size = 20);
plt.legend(fontsize=20, loc='upper left');
fig_name = 'Distribution of `sol_type` (`prototype` or `product`) per␣
 ↪`regional_bureau`'
save_fig(fig_name)
```

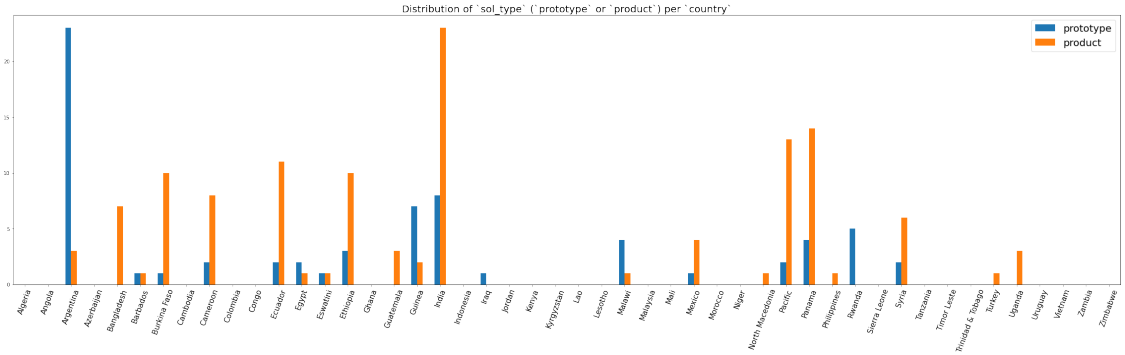


1.0.28 Question : Distribution of sol_type (prototype or product) per regional_bureau

- Most product solutions are from rb_africa, rb_asia_pacific and rb_latin_america.

1.0.29 Question : Distribution of sol_type (prototype or product) per country

[55]:
```
country_sol_type = df.groupby(['country', 'sol_type']).size().
 ↪reset_index(name='count').pivot(index='country', columns='sol_type',␣
 ↪values='count').reset_index().rename(columns={'sol_type': 'index'})#.
 ↪plot(kind='bar')

country_sol_type.plot(kind='bar', figsize = (40, 10))
plt.xticks(country_sol_type.index, country_sol_type['country'], rotation=70,␣
 ↪fontsize=15);
plt.legend(fontsize=20, loc='upper right');
fig_name = 'Distribution of `sol_type` (`prototype` or `product`) per `country`'
save_fig(fig_name)
```

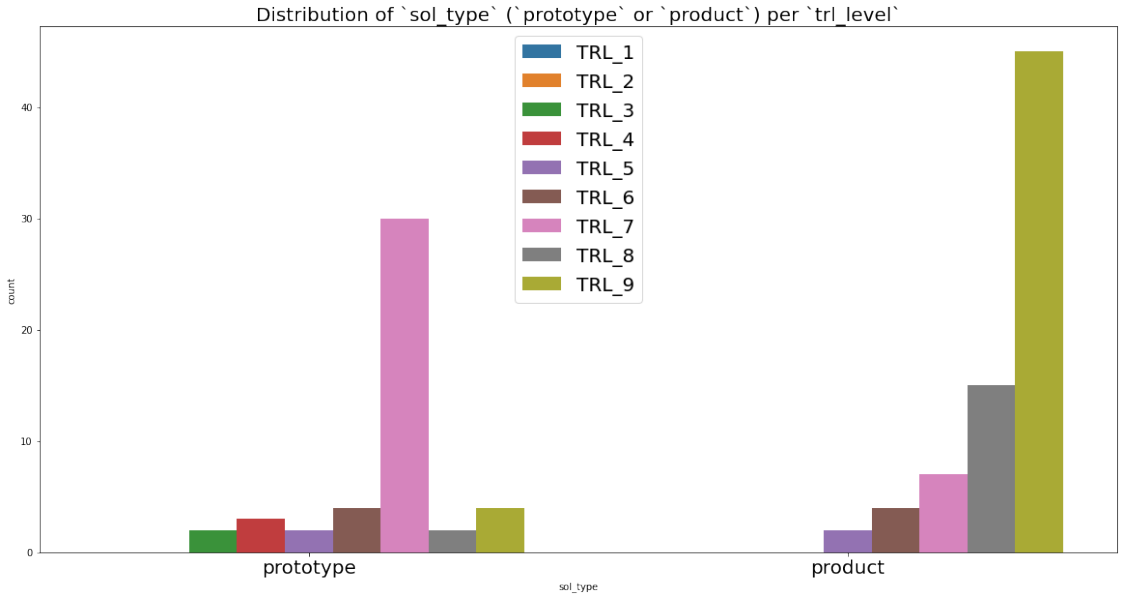


1.0.30 Question : Distribution of sol_type (prototype or product) per country

- Many coutries have more product solutions (ready to scale) than prototype solutions, such as India, Cameroon, Pacific, Panama, Ecuador, Burkina Faso and Ethiopia.

1.0.31 Question : Distribution of sol_type (prototype or product) per trl_level

[56]:
```
b = sns.countplot(data=df, x='sol_type', hue='trl_level')
b.set_xticklabels(b.get_xticklabels(), size = 20);
plt.legend(fontsize=20, loc='upper center');
fig_name = 'Distribution of `sol_type` (`prototype` or `product`) per␣
 ↪`trl_level`'
save_fig(fig_name)
```



1.0.32 Question : Distribution of `sol_type` (`prototype` or `product`) per `trl_level`

- Many product solutions have a TRL of 9 : Actual system proven in operational. They are ready to be scaled
- Many prototype solutions have a TRL of 7 : System prototype demonstration in operational environment.

https://stackoverflow.com/questions/42404154/increase-tick-label-font-size-in-seaborn

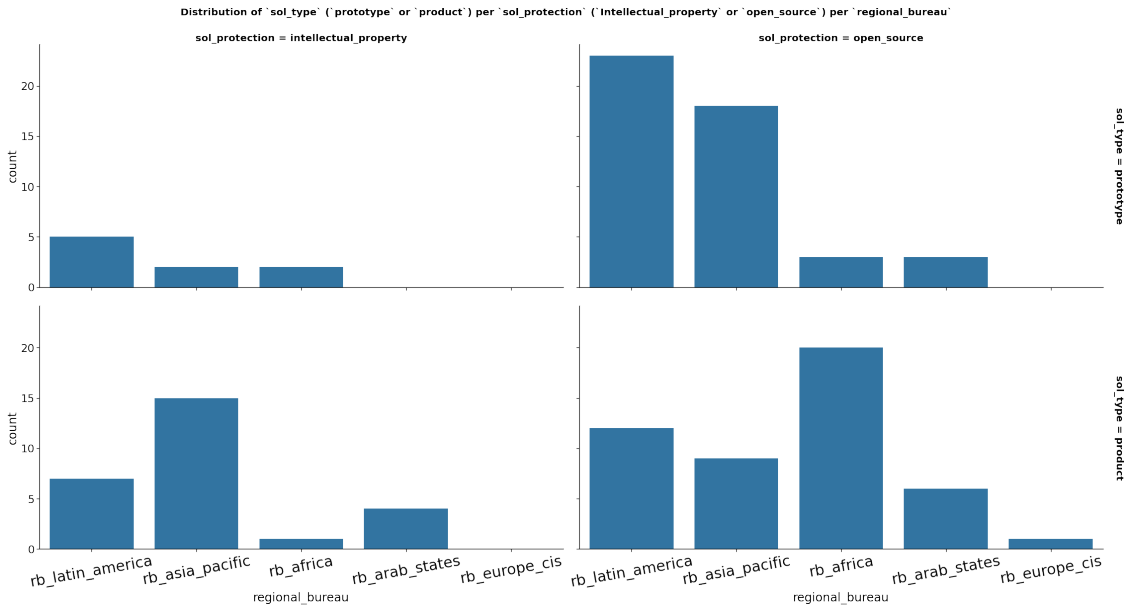
https://stackoverflow.com/questions/25328003/how-can-i-change-the-font-size-using-seaborn-facetgrid

https://stackoverflow.com/questions/25328003/how-can-i-change-the-font-size-using-seaborn-facetgrid

1.0.33 Question : Distribution of `sol_type` (`prototype` or `product`) per `sol_protection` (`Intellectual_property` or `open_source`) per `regional_bureau`

[57]:
```
with sns.plotting_context("notebook", font_scale=2):
    g = sns.FacetGrid(data=df, col='sol_protection', row='sol_type',␣
 ↪margin_titles=True, height=8, aspect=2);
    g.map_dataframe(sns.countplot, x='regional_bureau', alpha=1);
    g.set_xticklabels(size = 30, rotation=10)
    g.set_titles(fontweight='bold', size=20)
    fig_title = 'Distribution of `sol_type` (`prototype` or `product`) per␣
 ↪`sol_protection` (`Intellectual_property` or `open_source`) per␣
 ↪`regional_bureau`'
    plt.suptitle(fig_title, fontsize=20, fontweight='bold', x=0.5, y=1.02)
```

```
    save_fig(fig_title, title=False)
```



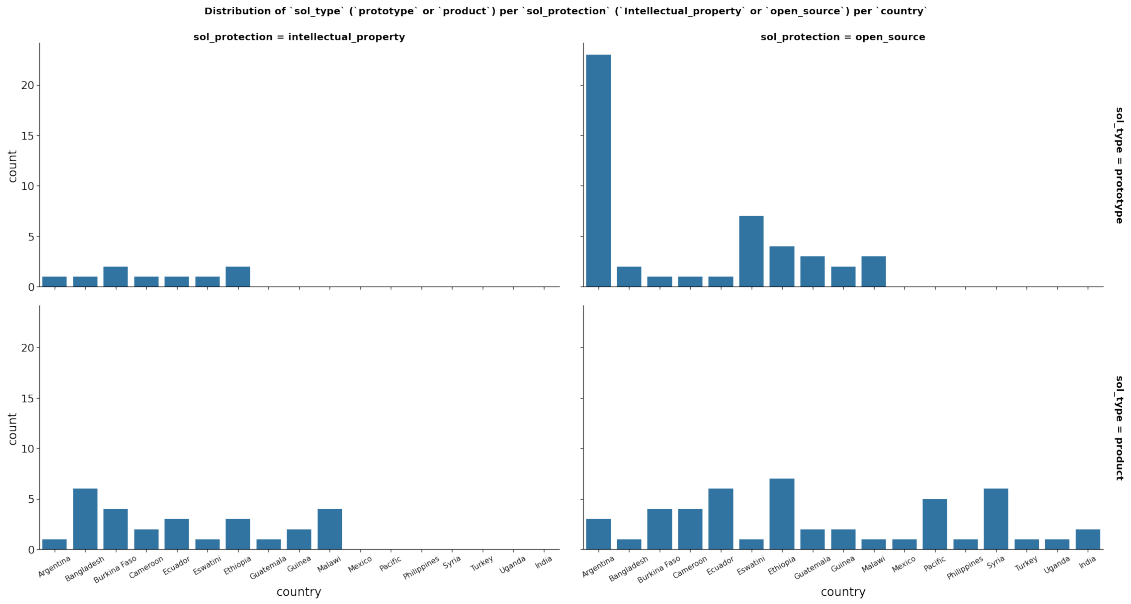
1.0.34 Question : Distribution of sol_type (prototype or product) per sol_protection (Intellectual_property or open_source) per regional_bureau

- rb_latin_america has more prototype open_source solutions than product open_source solutions.
- rb_asia_pacific has more prototype open_source solutions than product open_source solutions.
- rb_africa has more product open_source solutions than prototype open_source solutions.

1.0.35 Question : Distribution of sol_type (prototype or product) per sol_protection (Intellectual_property or open_source) per country

[58]:
```
with sns.plotting_context("notebook", font_scale=2):
    g = sns.FacetGrid(data=df, col='sol_protection', row='sol_type',␣
 ↪margin_titles=True, height=8, aspect=2);
    g.map_dataframe(sns.countplot, x='country', alpha=1);
    g.set_xticklabels(size = 15, rotation=30)
    g.set_titles(fontweight='bold', size=20)

    fig_title = 'Distribution of `sol_type` (`prototype` or `product`) per␣
 ↪`sol_protection` (`Intellectual_property` or `open_source`) per `country`'
    plt.suptitle(fig_title, fontsize=20, fontweight='bold', x=0.5, y=1.02)
```

```
    save_fig(fig_title, title=False)
```



1.0.36 Question : Distribution of `sol_type` (`prototype` or `product`) per `sol_protection` (`Intellectual_property` or `open_source`) per `country`

- Countries with more `prototype` `open_source` solutions than `product` `open_source` solutions: `Argentina`, `Eswatini`.
- Countries with more `product` `open_source` solutions than `prototype` `open_source` solutions: `Cameroon`, `Ecuador`, `Ethiopia`, `Burkina Faso`, `Pacific` and `Syria`.

1.0.37 Question : Distribution of `sol_cost_usd` in Dollar US

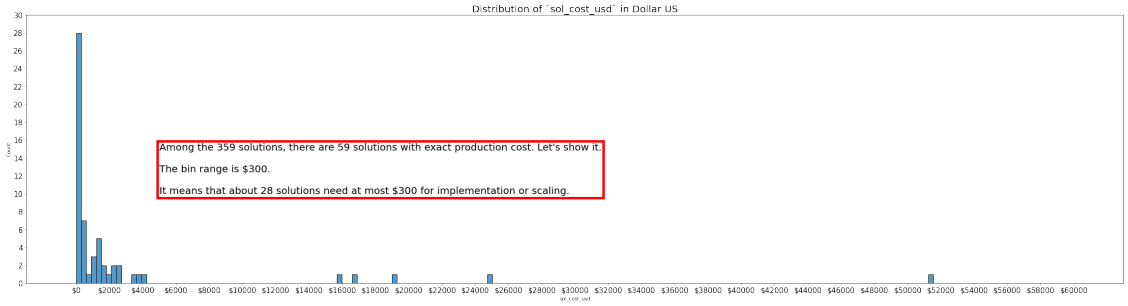
[59]:
```
df['sol_cost_usd'].info()
```

```
<class 'pandas.core.series.Series'>
RangeIndex: 359 entries, 0 to 358
Series name: sol_cost_usd
Non-Null Count  Dtype
--------------  -----
59 non-null     float64
dtypes: float64(1)
memory usage: 2.9 KB
```

There are 59 solutions with exact production cost. Let's show it.

[60]:
```
plt.figure(figsize = (40, 10));
bins = np.linspace(0, 60000, 200)
g = sns.histplot(data=df, x='sol_cost_usd', bins=bins);
```

```
text = 'Among the 359 solutions, there are 59 solutions with exact production␣
 ↪cost. Let\'s show it.\
\n\nThe bin range is $300. \n\nIt means that about 28 solutions need at most␣
 ↪$300 for implementation or scaling.'
plt.text(x=5000, y=10, s=text, fontsize=20, bbox=dict(fill=False,␣
 ↪edgecolor='red', linewidth=5));
xticks = np.arange(0, 60000 + 2000,2000)
labels = [f'${tick}' for tick in xticks]
g.set_xticks(ticks=xticks, labels=labels, fontsize=15)

xticks = np.arange(0, 30 + 2, 2)
labels = [f'{tick}' for tick in xticks]
g.set_yticks(ticks=xticks, labels=labels, fontsize=15)

fig_name = 'Distribution of `sol_cost_usd` in Dollar US'
save_fig(fig_name)
```



1.0.38 Question : Distribution of `sol_cost_usd` in Dollar US

Among the 359 solutions, there are 59 solutions with exact production cost.

The bin range is $300.

It means that about 28 solutions need at most $300 for implementation or scalin

[61]:
```
df.to_csv('Viz4SocialGood_submissionV1_cleaned.csv', index=False)
```

Conclusions

1.1 Conclusions 1/5

- `India` has the highest number of solutions
- `Panama` is the second best solutions provider
- `Argentina` is the third best solutions provider
- `Pacific` is the fourth best solutions provider

- Ecuador is the fifth best solutions provider
- rb_africa has the highest number of solutions
- rb_latin_america is the second best solutions provider
- rb_asia_pacific is the third best solutions provider
- The most produced energy_source is Household application and this solution is more prevalent in the regional bureau rb_asia_pacific, then rb_africa and rb_latin_america. It can be relative to the proverty level, which is high in these locations.

1.2 Conclusions 2/5

- The second most produced energy_source is Solar and more prevalent in the regional bureau rb_latin_america then rb_asia_pacific, rb_africa and rb_arab_states. It can be relative to the poor developpement of other energy sources in the locations of the first three, and the desert with his high level of solar reception in the locations of the rb_arab_states.
- The third most produced energy_source is Thermal and more prevalent in the regional bureau rb_africa, rb_latin_america and rb_asia_pacific.
- Overall energy sources, the more prevalent locations are rb_africa, rb_latin_america and rb_asia_pacific, certainly because of the development level which is low in these locations. That said, we understand why there are not so many solutions in rb_europe_cis and rb_arab_states.

1.3 Conclusions 3/5

- The most represented thematic is Energy (either clean energy, solar energy, renewable energy, alternative energy, affordable energy, sustainable energy)
- The second most represented thematic is environment friendly
- The third is climate change
- The most represented SDG is Affordable and Clean Energy
- The second is Sustainable Cities and Communities
- The third is Industry, Innovation and Infrastructure
- More clean_cooking solutions are produced in rb_asia_pacific, rb_africa and rb_latin_america
- Many solutions are replicable elsewhere, and most of solutions are coming from rb_africa and rb_latin_america.
- Many solutions have been already ordered, most from rb_africa.

1.4 Conclusions 4/5

- Most of the solutions are open_source representing about 71.4% overall.
- Most open_source solutions are from rb_africa and rb_latin_america.
- Most of the solutions are product (ready to scale) representing about 64.2% overall.

- Most `product` solutions are from `rb_africa`, `rb_asia_pacific` and `rb_latin_america`.
- Many coutries have more `open_source` solutions than `intellectual_property` solutions, such as `Argentina`, `Guinea`, `Cameroon`, `Ethiopia` and `Syria`.
- Many coutries have more `product` solutions (ready to scale) than `prototype` solutions, such as `India`, `Cameroon`, `Pacific`, `Panama`, `Ecuador`, `Burkina Faso` and `Ethiopia`.
- Many product solutions have a TRL of 9 : Actual system proven in operational. They are ready to be scaled.
- Many prototype solutions have a TRL of 7 : System prototype demonstration in operational environment.

1.5 Conclusions 5/5

- `rb_latin_america` has more `prototype open_source` solutions than `product open_source` solutions.
- `rb_asia_pacific` has more `prototype open_source` solutions than `product open_source` solutions.
- `rb_africa` has more `product open_source` solutions than `prototype open_source` solutions.
- Countries with more `prototype open_source` solutions than `product open_source` solutions: `Argentina`, `Eswatini`.
- Countries with more `product open_source` solutions than `prototype open_source` solutions: `Cameroon`, `Ecuador`, `Ethiopia`, `Burkina Faso`, `Pacific` and `Syria`.

Among the 359 solutions, there are 59 solutions with exact production cost.

The bin range is $300.

It means that about 28 solutions need at most $300 for implementation or scaling

1.6 Feedback

Thank you for paying attention to our team work. Please we need your review to improve ourselves.

- What do you notice about each visualization?
- What questions do you have about the data?
- What relationships do you notice?
- What do you think is the main takeaway from the report / presentation?
- Is there anything that you don't understand from the plots?

Kindly reach us: - Jozias Tema - LinkedIn : jozias-tema - GitHub : jozias-tema - Gmail : jozias-tema or temajozias@gmail.com - Yvvon Jemmy - GitHub : YvvonJemmy - Gmail : YvvonJemmy yvvon-jemymahmajala@gmail.com - Angie Bil - GitHub : AngieBil - Gmail : AngieBil kbilhah@gmail.com

Let's export to html and pdf

[62]:
```
from subprocess import call
call(['python', '-m', 'nbconvert', 'UNDP-Accelerator-Labs-Network.ipynb',␣
 ↪'--to', 'pdf'])
```

[62]: 0

[63]:
```
from subprocess import call
call(['python', '-m', 'nbconvert', 'UNDP-Accelerator-Labs-Network.ipynb',␣
 ↪'--to', 'html'])
```

[63]: 0