

# Hydrogen Data Collection

**Joint EGNRET58/EGEDA34 meeting**

**Honolulu, Hawaii, USA**

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# Definition of terms

## □ What is **Hydrogen**?

- Hydrogen is the simplest element on earth—it consists of only one proton and one electron—and **it is an energy carrier**, not an energy source. Hydrogen can store and deliver usable energy, but it **doesn't typically exist by itself in nature** and **must be produced from compounds that contain it**.
- **Ammonia (NH<sub>3</sub>)**- Ammonia is a colourless, reactive gas that is lighter than air (approximately half as heavy) which dissolves readily in water. It represents one of the most promising potential solutions as energy vector and hydrogen carrier, having a higher potential to transport energy than hydrogen itself in a pressurized form.

# Definition of terms

## □ e-fuels

- **Electrofuels**, also known as **e-fuels** or **synthetic fuels**, are a type of replacement fuel. They are manufactured using captured carbon dioxide or carbon monoxide and hydrogen obtained from sustainable electricity sources such as wind, solar and nuclear power.
- After processing in refineries, **e-fuels** can replace gasoline, diesel, heating oil, kerosene, gas and can completely replace conventional fuels.

# Hydrogen production (1)

- **Thermal processes**

- Involve steam reforming, a high-temperature process in which steam reacts with a hydrocarbon fuel to produce hydrogen
  - ▶ Natural gas reforming
  - ▶ Petroleum products reforming
  - ▶ Coal gasification
  - ▶ Biomass gasification
  - ▶ Biofuels reforming

# Hydrogen production (2)

- **Electrolytic processes**

- Electrolysis is the process of using electricity to split water into hydrogen and oxygen.

- Other processes

- **Solar driven processes** – use sunlight as the agent for hydrogen production including photobiological, photoelectromechanical and solar thermochemical.
- **Biological processes** - use microbes such as bacteria and microalgae and can produce hydrogen through biological reactions.
- **Others**

# Hydrogen transformation

- ❑ **Hydrogen liquefaction** is the process of liquefying Hydrogen to reduce the volume by cooling it to below  $-253^{\circ}\text{C}$ .
- ❑ **Liquefied hydrogen regasification** is the process of regasifying liquefied hydrogen.
- ❑ **Hydrogen compound production** is the process of combining hydrogen with other elements to produce compound like ammonia, e-fuels and other products to facilitate safe transportation.
- ❑ **Hydrogen reconversion** is the process of separating hydrogen from compounds such as ammonia, e-fuels and other compounds.

# IEA Energy Statistics Development Group (ESDG) Meeting, Paris, France; 9-10 November 2022



- One of the purposes to participate in IEA's ESGD meeting is to present EGEDA/APERC's work on hydrogen data collection.
- Participants of this meeting :Canada, Belgium, Austria, Australia, APERC, EUROSTAT and IEA.

# IEA Energy Statistics Development Group (ESDG) Meeting, Paris, France; 9-10 November 2022

## Pilot hydrogen data collection in APEC member economies in 2022-2023: Proposed trial data collection format

### APEC format for annual Hydrogen data

Table 3. Final Energy Consumption

Unit: Terajoules

		Hydrogen	Ammonia	Methyl-cyclohexane	e-fuels	Total
		A	B	C	D	E
<b>FINAL ENERGY CONSUMPTION</b>	1	0	0	0	0	0
<b>TOTAL INDUSTRY SECTOR</b>	2	0	0	0	0	0
Iron and steel	3					
Chemical and petrochemical	4					
Non-ferrous metals	5					
Non-metallic minerals	6					
Transport equipment	7					
Machinery	8					
Mining and quarrying	9					
Food, beverages and tobacco	10					
Pulp, paper and print	11					
Wood and wood products	12					
Construction	13					
Textile and leather	14					
Not elsewhere specified	15					
<b>TOTAL TRANSPORT SECTOR</b>	16	0	0	0	0	0
Domestic air transport	18					
Road	19					
Rail	20					
Inland waterways	21					
Pipeline transport	22					
Not elsewhere specified	23					
<b>TOTAL OTHER SECTOR</b>	24	0	0	0	0	0
Commercial and public services	25					
Residential	26					
Agriculture	27					
Fishing	28					
Not elsewhere specified	29					



### APEC format for annual Hydrogen data

Table 4. Production Capacity

Unit: Terajoules/year

		Hydrogen	Ammonia	Methyl-cyclohexane	e-fuels	Total	Electricity generation capacity (MW)
		A	B	C	D	E	F
<b>PRODUCTION</b>	1	0	0	0	0	0	0
<b>Thermal process</b>	2	0	0	0	0	0	
Natural gas reforming	3						
Petroleum products reforming	4						
Coal gasification	5						
Biomass gasification	6						
Biofuels reforming	7						
<b>Electrolytic processes</b>	8	0	0	0	0	0	0
Electricity exclusively from renewables	9						
Electricity exclusively from nuclear energy	10						
Electricity exclusively from fossil fuels	11						
<b>Other processes</b>	13	0	0	0	0	0	
Solar-driven processes	14						
Biological processes	15						

# Next Steps and feedback from ESDG Meeting



## Pilot Hydrogen data collection

Collect data at the same time as the other 5 annual energy questionnaires, energy prices and CO<sub>2</sub> emission

All questionnaires will be sent to EGEDA focal points before **end of December 2022**

Deadline for submission of data would be **March 31, 2023**



## Data processing

Currently, hydrogen used in oil refining is reported under “**Other hydrocarbons**”, which is a primary product

Consumption of hydrogen is currently reported under “**Other sources**”

Continue the same approach until an energy product called Hydrogen is added in the Standard International Energy Classification (SIEC) of UNSD

**The feedback from Canada and Australia ⇒ all the data needed in the planned pilot data collection by the EGEDA secretariat may not be available in 2022.**

**⇒EGEDA had better postpone data collection to have a harmonized data collection with IEA.**

# APERC-EUROSTAT-IEA H2 data trilateral meeting on 22 November 2022

- The main purpose of this meeting is to harmonize APERC's data collection considering that APEC and IEA have 8 common members so, both should not collect different data from these members.
- APERC prepared the format considering the amount of Carbon captured and stored (CCS) in tonnes and distinguishing between the amount of hydrogen production with or without CCS.
- After the meeting, we decided to add the revised "hydrogen compound production" and "hydrogen reconversion" to make them clearer. Further refinements on the wordings would still be needed.

# APERC-EUROSTAT-IEA H2 data trilateral meeting on 1 December 2022

- The APERC draft revised at the meeting held on 22 November 2022 was much closer with the Eurostat/IEA draft.
- However, APERC, EUROSTAT, and IEA had to talk because differences remained.
- e.g., production by input product vs production by process, transformation/backflows, blending, carbon emissions ((hydrogen produced with/without CCS vs tonnes of carbon produced)) and level of details in the energy sector).
- As a result of this meeting, we revised our data collection format.

# Proposed data collection format

## APEC format for annual Hydrogen data

Table 1a. Production and supply

Unit: Terajoules (Gross calorific values)

		Energy input		Energy Output			
		Product	Quantity	Hydrogen	Ammonia	e-fuels	Total
		A	B	C	D	E	F
<b>PRODUCTION</b>	1		0	0	0	0	0
<b>Thermal process</b>	2		0	0	0	0	0
Natural gas reforming	3	Natural gas					
Petroleum products reforming	4	Petroleum products					
Coal gasification	5	Coal					
Biomass gasification	6	Biomass					
Biofuels reforming	7	Biofuels					
<b>Electrolytic processes</b>	8		0	0	0	0	0
Electricity exclusively from renewables	9	Electricity					
<i>Geothermal</i>	10	Electricity					
<i>Solar (Thermal)</i>	11	Electricity					
<i>Solar (PV)</i>	12	Electricity					
<i>Wind</i>	13	Electricity					
<i>Hydro</i>	14	Electricity					
<i>Biomass</i>	15	Electricity					
<i>Others</i>	16	Electricity					
Electricity exclusively from nuclear energy	17	Electricity					
Electricity exclusively from fossil fuels	18	Electricity					
Electricity from grid	19	Electricity					
<b>Other processes</b>	20		0	0	0	0	0
Solar-driven processes	21	Solar energy					
Biological processes	22	Other energy (specify)					
Others	23	Other energy (specify)					
Imports	24						
Exports	25						
International marine bunkers	26						
International aviation bunkers	27						
Stock change (opening-closing)	28			0	0	0	0
Gross inland deliveries (calculated)	29			0	0	0	0
Statistical difference (+ or -) (11 minus 13)	30			0	0	0	0
Gross inland deliveries (observed)	31			0	0	0	0
<b>Stocks</b>							
Total stocks in national territory- opening	32						
Total stocks in national territory- closing	33						

# Proposed data collection format

**Table 1b. Carbon captured, utilized and stored**  
**Unit: Tonnes of Carbon**

		Hydrogen	Ammonia	e-fuels	Total
		A	B	C	D
	1	0	0	0	0
<b>Thermal process</b>	2	0	0	0	0
Natural gas reforming	3				
Petroleum products reforming	4				
Coal gasification	5				
Biomass gasification	6				
Biofuels reforming	7				
<b>Electrolytic processes</b>	8	0	0	0	0
Electricity exclusively from renewables	9				
<i>Geothermal</i>	10				
<i>Solar (Thermal)</i>	11				
<i>Solar (PV)</i>	12				
<i>Wind</i>	13				
<i>Hydro</i>	14				
<i>Biomass</i>	15				
<i>Others</i>	16				
Electricity exclusively from nuclear energy	17				
Electricity exclusively from fossil fuels	18				
Electricity from grid	19				
<b>Other processes</b>	20	0	0	0	0
Solar-driven processes	21				
Biological processes	22				
Others	23				

# Proposed data collection format

## APEC format for annual Hydrogen data

Table 2. Consumption in the transformation and energy sectors

Unit: Terajoules

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
<b>TOTAL TRANSFORMATION SECTOR</b>	1	0	0	0	0
Main activity producer	2	0	0	0	0
Electricity plants	3				
CHP	4				
Heat plants	5				
District cooling plants	6				
Autoproducer	7	0	0	0	0
Electricity plants	8				
CHP	9				
Heat plants	10				
District cooling plants	11				
Natural gas blending plants	12				
Gas works plants	13				
Coke ovens	14				
Blast furnaces	15				
Natural gas liquefaction	16				
LNG regasification	17				
Gas-to-liquid plants	18				
Oil refineries	19				
Petrochemical industry	20				
Hydrogen compound production (hydrogen to ammonia)	21				
Hydrogen reconversion (ammonia to hydrogen)	22				
e-fuels production (hydrogen to e-fuels)	23				
Other transformation	24				

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
<b>TOTAL ENERGY SECTOR</b>	25	0	0	0	0
Coal mines	26				
Oil and gas extraction	27				
Oil refineries	28				
Coke ovens	29				
Gas works	30				
Electricity, CHP and heat plants	31				
Natural gas liquefaction plants	32				
LNG regasification	33				
Natural gas blending plants	34				
Gas-to-liquid plants	35				
Oil refineries	36				
Hydrogen production	37				
Hydrogen compound production (hydrogen to ammonia)	38				
Hydrogen reconversion (ammonia to hydrogen)	39				
Hydrogen liquefaction	40				
Liquefied hydrogen regasification	41				
e-fuels production (hydrogen to e-fuels)	42				
Other energy sector	43				
Losses	44	0	0	0	0
Distribution	45				
Transmission	46				

# Proposed data collection format

## APEC format for annual Hydrogen data

Table 3. Final Energy Consumption

Unit: Terajoules

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
<b>FINAL ENERGY CONSUMPTION</b>	1	0	0	0	0
<b>TOTAL INDUSTRY SECTOR</b>	2	0	0	0	0
Iron and steel	3				
Chemical and petrochemical	4				
Non-ferrous metals	5				
Non-metallic minerals	6				
Transport equipment	7				
Machinery	8				
Mining and quarrying	9				
Food, beverages and tobacco	10				
Pulp, paper and print	11				
Wood and wood products	12				
Construction	13				
Textile and leather	14				
Not elsewhere specified	15				
<b>TOTAL TRANSPORT SECTOR</b>	16	0	0	0	0
Domestic air transport	18				
Road	19				
Rail	20				
Inland waterways	21				
Pipeline transport	22				
Not elsewhere specified	23				
<b>TOTAL OTHER SECTOR</b>	24	0	0	0	0
Commercial and public services	25				
Residential	26				
Agriculture	27				
Fishing	28				
Not elsewhere specified	29				

# Proposed data collection format

Table 4. Non-energy consumption

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
<b>TOTAL NON-ENERGY CONSUMPTION</b>	1	0	0	0	0
Fertilizer production	2				
Manufacture of vegetable oil	3				
Manufacture of organic compounds	4				
Manufacture of hydrogen chloride	5				
Mettalurgy	6				
Other non-energy uses	7				

# Proposed data collection format

## APEC format for annual Hydrogen data

Table 4. Production Capacity

Unit: Terajoules/year

		Hydrogen	Ammonia	e-fuels	Total	Electricity generation capacity (MW)	Electricity consumption (MWh)
		A	B	D	E	F	F
<b>PRODUCTION</b>	1	0	0	0	0	0	0
<b>Thermal process</b>	2	0	0	0	0		
Natural gas reforming	3						
Petroleum products reforming	4						
Coal gasification	5						
Biomass gasification	6						
Biofuels reforming	7						
<b>Electrolytic processes</b>	8	0	0	0	0	0	0
Electricity exclusively from renewables	9						
<i>Geothermal</i>	10						
<i>Solar (Thermal)</i>	11						
<i>Solar (PV)</i>	12						
<i>Wind</i>	13						
<i>Hydro</i>	14						
<i>Biomass</i>	15						
<i>Others</i>	16						
Electricity exclusively from nuclear energy	17						
Electricity exclusively from fossil fuels	18						
Electricity from grid	19						
<b>Other processes</b>	20	0	0	0	0		
Solar-driven processes	21						
Biological processes	22						
Others	23						

# Proposed data collection format

## APEC format for Hydrogen data Imports by source

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
<b>APEC Economies</b>	1	0	0	0	0
Australia	2				0
Brunei Darussalam	3				0
Canada	4				0
Chile	5				0
China	6				0
Hong Kong, China	7				0
Indonesia	8				0
Japan	9				0
Republic of Korea	10				0
Malaysia	11				0
Mexico	12				0
New Zealand	13				0
Papua New Guinea	14				0
Peru	15				0
Philippines	16				0
Russian Federation	17				0
Singapore	18				0
Chinese Taipei	19				0
Thailand	20				0
United States of America	21				0
Viet Nam	22				0
<b>ASEAN (non-APEC) economies</b>	23	0	0	0	0
Myanmar	24				0
Lao P.D.R	25				0
Cambodia	26				0
<b>Rest of the World</b>	27	0	0	0	0

# Proposed data collection format

## APEC format for Hydrogen data Exports by destination

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
<b>APEC Economies</b>	1	0	0	0	0
Australia	2				0
Brunei Darussalam	3				0
Canada	4				0
Chile	5				0
China	6				0
Hong Kong, China	7				0
Indonesia	8				0
Japan	9				0
Republic of Korea	10				0
Malaysia	11				0
Mexico	12				0
New Zealand	13				0
Papua New Guinea	14				0
Peru	15				0
Philippines	16				0
Russian Federation	17				0
Singapore	18				0
Chinese Taipei	19				0
Thailand	20				0
United States of America	21				0
Viet Nam	22				0
<b>ASEAN (non-APEC) economies</b>	23	0	0	0	0
Myanmar	24				0
Lao P.D.R	25				0
Cambodia	26				0
<b>Rest of the World</b>	27	0	0	0	0

# Proposed trial data collection format

## Definition of products

### 1. Hydrogen (H<sub>2</sub>)

Hydrogen is the simplest element on earth—it consists of only one proton and one electron—and it is an energy carrier, not an energy source. Hydrogen can store and deliver usable energy, but it doesn't typically exist by itself in nature and must be produced from compounds that contain it.

### 2. Ammonia (NH<sub>3</sub>)

Ammonia is a colourless, reactive gas that is lighter than air (approximately half as heavy) which dissolves readily in water. It represents one of the most promising potential solutions as energy vector and hydrogen carrier, having a higher potential to transport energy than hydrogen itself in a pressurized form.

### 3. e-fuels

Electrofuels, also known as e-fuels or synthetic fuels, are a type of drop-in replacement fuel. They are manufactured using captured carbon dioxide or carbon monoxide, together with hydrogen obtained from sustainable electricity sources such as wind, solar and nuclear power. Examples of e-fuels are replacements for traditional jet fuel and diesel.

# Status of hydrogen production and consumption based on the last EGEDA33 meeting (the Philippines, 26-28 October 2022)

Economy	Status
Australia	Currently conducting surveys to get information on consumption data.
Brunei Darussalam	1-year demonstration project on hydrogen production and transportation.
Hong Kong, China	No hydrogen production and consumption data available at present.
Indonesia	Conducting Pre-Feasibility study on possible use of Hydrogen.
Korea	Trying to collect data but still needs to improve collection system.
Malaysia	Pilot project on ammonia co-firing in coal power plants.

Economy	Status
Papua New Guinea	Looking into studying renewable-hydrogen in the future.
The Philippines	Conducting further study on possible inclusion of Hydrogen in the energy mix.
Chinese Taipei	Conducting pilot project on green hydrogen and co-firing with hydrogen and ammonia.
Thailand	Conducting a study on the possibilities of hydrogen use in power generation, industry, transportation and others.
United States	Collects data on hydrogen disposition.
Viet Nam	Conducting the pilot study on Hydrogen production.

# Conclusions

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- If necessary, EGEDA Secretariat needs to talk with APEC member economies and IEA to improve our data collection format in the future.
- EGEDA Secretariat will send data format by the end of 2023.
- Data collected will be 2022 data.
- IEA will be collecting the same data by using their own format. OECD-APEC members can use IEA format for submitting data to EGEDA Secretariat.

**Thank you for your kind attention.**

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