Monitor Deloitte.

Attn: NEDO Thailand

Study on Policy Recommendation for Biofuel in Indonesia Phase 2

Final report

Deloitte Consulting Southeast Asia

08 March 2024

Agenda

1	Executive summary
2	a. Policy framework study
3	b. Estimate of the cost of building a supply chain
4	c. Production feasibility estimates for alternative raw materials
5	Additional research/follow-up

Executive summary

It’s challenging to implement bioethanol introduction while "maintaining an acceptable price of bioethanol" without impacting the selling price of gasoline even with subsidies that can be expected from potential sources

a. Policy Framework Study (1/3) : Simulation result

Raising financial resources for subsidies		• Comparing the sources of subsidies in each country, there are two main types of subsidies: those which is using taxes as the sources and those which is imposing obligations on oil-related companies to secure the financial sources. • Middle-income and developing countries such as Brazil, Thailand, and Indonesia have secured financial resources for subsidies mainly through tax revenue
Simulation	Step1 Estimation of Subsidy Needed	• Using the amount of bioethanol demand estimation in Phase 1, the total amount of subsidies needed to achieve a price level based on fuel efficiency (66% of the gasoline market price) is estimated.
	Step2 Estimation of Subsidy Sources	• Referring to examples from middle-income and developing countries, we estimated the amount of subsidy funding from the following two direct sources: 1. Funded by export levy on bioethanol 2. Funded by shifting the existing gasoline subsidy resources to bioethanol.
	Step3 Subsidy gap	• It is difficult to generate enough subsidy to cover the total subsidy required, even if it is sourced from the export levy and from shifting the same amount of subsidy from the existing subsidy for gasoline as the blending ratio • Even considering the reduction in imports of crude oil due to the introduction of bioethanol, the subsidy gap is still not filled.
Calculation results		• **It is difficult to realize the introduction of bioethanol while maintaining an acceptable price of bioethanol without affecting the selling price of gasoline only** with the subsidies that can be expected from the above potential sources.

As long as the price gap between bioethanol and gasoline is huge, it will be difficult to achieve a market-acceptable price with potential subsidy sources, and it is essential to consider measures to increase the demand and supply to reduce the cost

a. Policy Framework Study (2/3) : Proposal of what to aim for

Mission

Achieving carbon neutrality by 2060

Goal

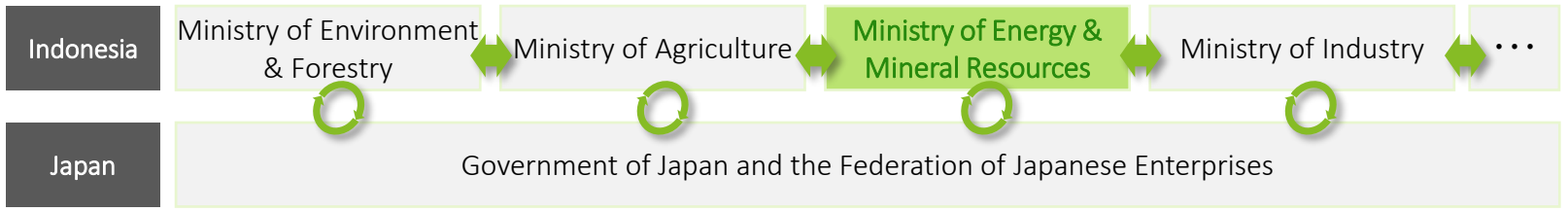
Market penetration of bioethanol by achieving reasonable market prices

Counter measures direction

Towards stable supply		Towards increasing demand	
Ensuring sufficient raw materials	Building a low-cost supply chain	Expansion of ethanol use	Expansion into high value-added products
• Establish technologies for 2G bioethanol commercialization • Maximizing supply by using EFB as well as other residues	• Leveraging supply chains used by the existing palm oil industry, such as CPO, to achieve a low-cost supply chain	• Maximize demand by introducing FFV • Secure further subsidy resources by curbing oil imports	• Development of high value-added products such as SAF, solid fuels and bioplastics on the basis of ethanol, and price pass-on schemes

Scale the business from both Supply & Demand sides to achieve equilibrium price in line with market principle

Key player



It is important to promote those measures as national strategies, involving not only the MEMR but also relevant ministries and agencies

In order to increase both the demand and supply, study the feasibility of introducing FFV and the potential of value-added products, and study the latest trends in 2G technology and the potential for 2G adaptation of residues other than EFB

a. Policy Framework Study (3/3) : Next Steps* (tentative)

Next Steps* (tentative)	(1) Demand increase • FFV introduction to advanced countries trend survey • Research on directions and challenges for the introduction of FFV to the market • Verification of synergies by developing into value-added products such as SAF (2) Supply increase • Detailed Trend Survey of 2G Technology • Feasibility studies on non-EFB residues • Supply chain concept for 2G ethanol using palm oil residues *The details of the investigation in the next phase will be decided in consultation with NEDO.

Countries that have successfully introduced bioethanol have dealt with the challenges faced when introducing it through government intervention and policy measures

Reference: a. Policy Framework Study

Country	Type of Challenges				
	Lack of Price Control	Lack of Infrastructure	Lack of Supply Availability	Lack of Ethanol-fuelled Vehicle Penetration	
				Manufacturer	End-user
United States	• **RVO-RIN Mechanism**	**Obligation to install ethanol fuel pump** for fuel retailers Provided cost-sharing funds to **ethanol fuel infrastructure**	• Volumetric Ethanol Excise **Tax credit for ethanol blenders**	N/A or Not an essential policy	
Brazil	• **Guaranteed ethanol fuel maximum price**	N/A or Not an essential policy	• **Tax relief on ethanol production**	• **Tax breaks for FFV manufacturer** • **Sales & licensing tax breaks** for ethanol-fuelled vehicle	• **Tax reduction for FFV purchase** • **Exemption for the Tax on Manufactured Goods** • **Reduction on Flat Road Tax**
Philippines	• **Fuel discount** program		**Monitoring fee** for each fuel ethanol produced for **R&D** • **Zero VAT on ethanol fuel sales and machine purchase** • **Zero import fee** on equipment	N/A or Not an essential policy	
Thailand	• **State Oil Fund subsidy for E20 and E85**		• **Zero tax on imported equipment** • **Zero income tax** for ethanol producer	• Zero import duties of foreign auto parts for FFV • **Production excise tax reduction** for FFV	• **Vehicle tax reduction** for ethanol fuelled-vehicle
India	• **Administered cheaper ethanol price** due to tax gap with fossil • Differential ethanol price based on raw material	• **Financial assistance program** to expand ethanol infrastructure	• **GST reduction** on ethanol transaction to OMCs • **Free on Basic Excise Duty, RIC, SAED, AIDC** in E10 for blender	N/A or Not an essential policy	
Indonesia (Biodiesel)	• **Export levy** of palm oil (and its derivatives) is used to **subsidize Biodiesel price**	N/A or Not an essential policy	• **Mandated blend ratio** and **give sanction** if not comply with the rules for fame producer and fuel blender		

: Tax control (reduce state income) : Financial assistance (coming from state-budget) : Obligation/stipulation

A supply structure to meet demand based on the Government's market expansion policy is likely to require significant investment to increase bioethanol production capacity

b. Estimation of 1G Supply Chain Construction Costs*

Previous Study	• The Indonesian government and Pertamina have already set a policy to expand the market bioethanol up to 2030 • Estimate of demand based on the market expansion policy has already been calculated. • Estimated supply of feedstock (sugarcane molasses) to cover the market expansion policy has already been calculated
Discussion Point	**Is there enough bioethanol production capacity to support the market expansion policy? If no, how much capital investment will be required in the future?**
Demand Assumptions	Direction for 2030 (based on Presidential Regulation 40/2023) • Blending ratio ... 2023~: 5% (E5) → 2026~: 10% (E10) • Regions ... 2023~: DKI Jakarta and Surabaya provinces → 2026~: All of Java Island • Octane value ... 2023~: RON95 → 2026~: RON92

Estimate of additional capital investment required

Calculation Results	It is assumed that an additional 9 plants in normal case or 2 plants in minimum case will be required on Java Island to cover the market expansion policy. • Max 9 plants (normal case) = 543 to 564 million USD • Min2 plant (min. case) = 121 to 125 million USD

**Depending on the target area of the additional 700K Ha of sugarcane farmland which currently under investigation, we plan to conduct additional calculations such as the cost of transporting molasses to Java*

Palm oil gasoline is a potential alternative for 2G bioethanol, but food competition is inevitable and not sustainable to meet all demand for palm oil gasoline production

c. Estimation of the feasibility for alternative raw materials production

Palm Oil Gasoline (Green gasoline)	**Possibility of alternative:** Yes (it is difficult to use it as the main resource due to food competition) **Outline of the Survey** • Although the government has set a target for the introduction of palm oil gasoline and is promoting several national priority programs, the target scale is not considered large • In order to cover the current demand for gasoline, it is necessary to raise about 5% of the current CPO production, but since CPO is used for food and other daily necessities, it is practically difficult to shift the amount of 5% utilization.
Used Cooking Oil (UCO)	**Possible alternative:** None (available for biodiesel) **Outline of the Survey** • If all the potential UCO supply is collected and utilized, 750 million liters of biodiesel could be produced, equivalent to 2.6% of total biodiesel consumption in 2022.
Sorghum	**Possibility of alternative:** Yes (it can be an alternative raw material if the plantation area increases significantly in the future) **Outline of the Survey** • The amount of bioethanol that could be produced from current sorghum plantation is only equivalent to 0.6% of total gasoline consumption in 2022 • As part of the government's policy to improve the food self-sufficiency rate, the government is expanding sorghum plantation in 2023 and 2024, but even if this has been considered, it will only be equivalent to 5.0% of total gasoline consumption in 2022

Initial simulations confirmed that it would be difficult to secure palm oil supplies by developing new plantations, but that sufficient supplies to meet domestic demand could be expected, even taking expansion constraints into account.

Additional research: oil palm plantation expansion feasibility study

Background

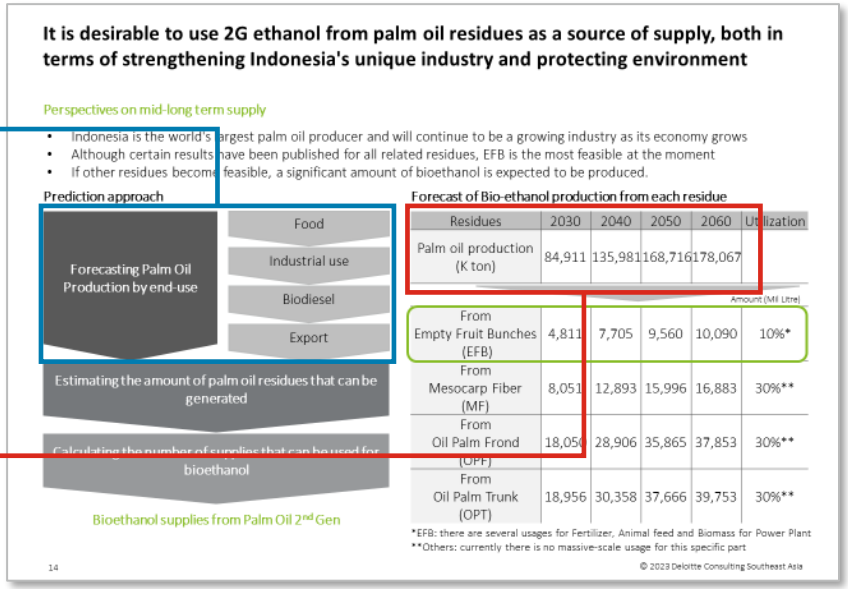
- In discussions with JJC in December 2023, concerns were expressed about the 2G supply simulation, which assumes significant growth in palm-related products.
- Due to climate change discussions and concerns about palm production, the Indonesian Government has basically refrained from expanding plantations. In this regard, the participants requested that the estimates be based on these realities.

Assumptions for the estimation

- Forecasts for each use in the palm oil industry
- Considering population growth and GDP growth, it is basically projected to be basically a growth market in the future.
- As a result, it is estimated that palm oil production in 2060 will be almost double that of 2060

Matters pointed out

- Considering the Indonesian government's reaction from the recent international public opinion, palm oil production is not likely to grow so simply
- On the assumption that agricultural area will not increase, is this production forecast reasonable?



It is desirable to use 2G ethanol from palm oil residues as a source of supply, both in terms of strengthening Indonesia's unique industry and protecting environment

Perspectives on mid-long term supply

- Indonesia is the world's largest palm oil producer and will continue to be a growing industry as its economy grows
- Although certain results have been published for all related residues, EFB is the most feasible at the moment
- If other residues become feasible, a significant amount of bioethanol is expected to be produced.

Prediction approach

Forecast of Bio-ethanol production from each residue

Residues	2030	2040	2050	2060	Utilization
Palm oil production (K ton)	84,911	135,981	168,716	178,067	
Amount (Mil Litre)					
From Empty Fruit Bunches (EFB)	4,811	7,705	9,560	10,090	10%*
From Mesocarp Fiber (MF)	8,051	12,893	15,996	16,883	30%**
From Oil Palm Frond (OPF)	18,056	28,906	35,865	37,853	30%**
From Oil Palm Trunk (OPT)	18,956	30,358	37,666	39,753	30%**

*EFB: there are several usages for Fertilizer, Animal feed and Biomass for Power Plant
**Others: currently there is no massive-scale usage for this specific part

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Summary of Study Results

- Indonesian govt. has tightened the approval process for new farmland development and basically limit the farmland expansion.
- On the other hand, they are implementing a program to improve productivity (yield rate) by actively supporting producers, such as improving existing farmland, providing financial support, educating new technologies, and etc.
- Taking into account the above program, a new supply estimate is to be conducted based on the palm oil production projected in the Indonesia Oil Palm Roadmap (2045) established by the government and research institutes.
  - ➢ ***Confirmed that depending on the utilization rate of EFB (as the raw material), there is a possibility that domestic demand can be sufficiently covered.***

Next Step* Study of international certification schemes, etc. to determine whether there is scope for new oil palm farmland development

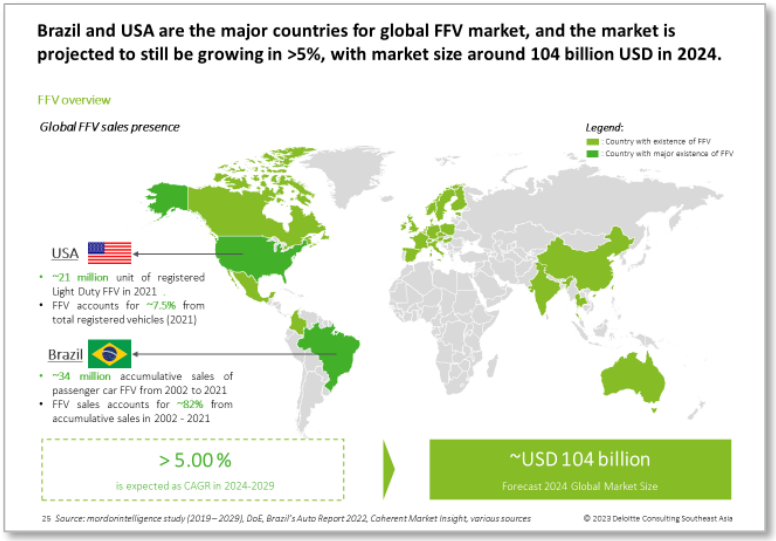
 **The contents of the next phase of the investigation will be determined in consultation with NEDO*

While the feasibility of the shift to EVs is unclear in Indonesia, the introduction of FFVs which is following the example of other countries can be one option for promoting decarbonization

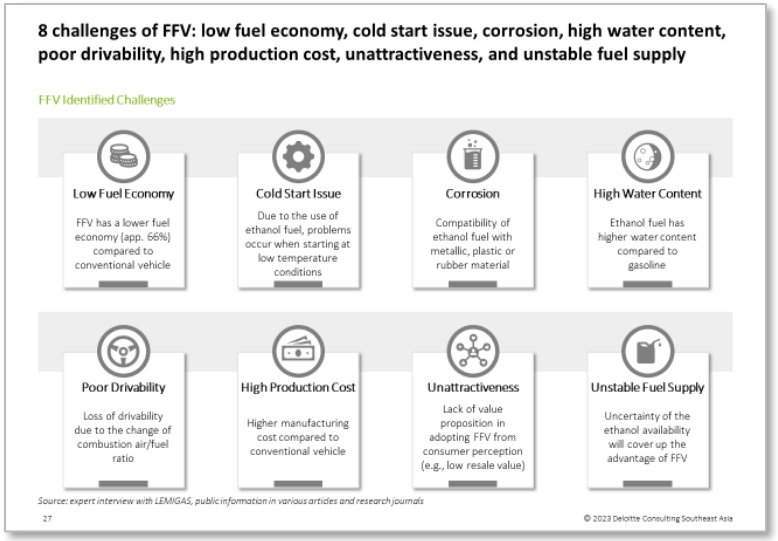
Additional study: consideration of FFV (Flex-Fuel Vehicle) introduction

Investigation Background	• During the discussion with JJC, we received an opinion that if bioethanol is to be introduced as part of decarbonization measures, the possibility of introducing FFV should also be considered • On the other hand, even if we look at the international market, there are not many markets where FFV has penetrated. There are certain barriers and hurdles to the introduction of FFV, so it is necessary to first unravel the successful cases of FFV introduction, investigate where the problems are, and how it was solved and make a success establishment in the market

Brazil has the most established FFV market



Referring to various articles, there are eight major issues



How did Brazil establish its market?

Summary of Investigation Results	• The Brazilian government maintains reasonable ethanol prices through subsidies funded mainly by gasoline taxes • Tax incentives were also offered to consumers and FFV manufacturers to create demand • OEM companies overcome problems with various technologies ➢ ***Assuming that the technical issues are no longer critical, there is a possibility that it will be widely used in Indonesia depending on the government's policy***
Next Step*	In order to spread FFV in Indonesia, benchmarking to other countries, identifying issues, and organizing direction are needed

The contents of the next phase of the investigation will be determined in consultation with NEDO

In addition to the expected effects already calculated in Phase 1, estimates of the volume and value of crude oil import reductions as well as socio-economic impact to Indonesia were carried out

Additional Survey: Calculation of Expected Effects

	Expected effect	Summary of Calculations	Scenario 2 : Moderate case (2031-2060 cumulative)	
			Quantity Impact	Amount Impact
Phase1 Calculated	GHG Emissions reduction	Estimation of expected GHG reductions and assumed carbon price based on a comparison of the continued use of 100% petrol and the reduced use of petrol blended with ethanol in the Tank to Wheel estimation	GHG Reduction 579 Million tCO2e	Assumed Carbon Credits 23,167 Million USD
Phase1 Calculated	Foreign Currency Earning	Estimation of the exportable volume and the amount of unexpected foreign exchange earned when exporting bioethanol that exceeds domestic demand	Exportable volume 29 Billion Litre	Amount of foreign currency earned 370 Trillion IDR 23 Billion USD
Phase2 Additional Calculations	Crude oil Import Reduction	Estimation of crude oil imports that are expected to be curtailed by producing bioethanol in Indonesia and using it as a substitute for gasoline	Amount of import reduction 186.4 Billion Litre	Amount of import reduction 1,650 Trillion IDR 104.4 Billion USD
Phase2 Additional Calculations	Socio-Economic Impact	Estimation of socio-economic impact comprise of economy output, gdp contribution, household (HH) income, and job creation derive from the increase of bioethanol demand in the future	Direct Jobs Creation = 21,442 Indirect Jobs Creation = 34,911	Amount of economy contribution Economy output = 166 Trillion IDR GDP Contribution = 94 Trillion IDR HH Income = 18 Trillion IDR

Next Step* (Tentative)	Investigating tariff barriers in exporting ethanol within the region in order to earn foreign currency by exporting bioethanol to neighboring countries such as the Philippines

The contents of the next phase of the investigation will be determined in consultation with NEDO

Based on the findings of this phase, the following actions should be taken in the next and subsequent phases

Next step (Draft)

#	Next step (Draft)	Original study
1	Detailed 2G technology trend study	▪ Policy framework study
2	Verification of synergies from expansion into SAF and other value-added products	▪ Policy framework study
3	Supply chain concept for 2G ethanol from palm oil residues	▪ Policy framework study
4	Feasibility study of non-EFB residues	▪ Policy framework study
5	Survey of trends in developed countries introducing FFV	▪ Policy framework study ▪ Consideration of FFV (Flex-Fuel Vehicle) introduction
6	Organizing issues and directions for the introduction of FFV to the market	▪ Policy framework study ▪ Consideration of FFV (Flex-Fuel Vehicle) introduction
7	Survey on international certification schemes and other relevant international certification schemes related to new oil palm farmland development	▪ Oil palm plantation expansion feasibility study
8	Intra-regional Export Tariff Barriers Survey	▪ Calculation of Expected Effects

Policy Framework Study

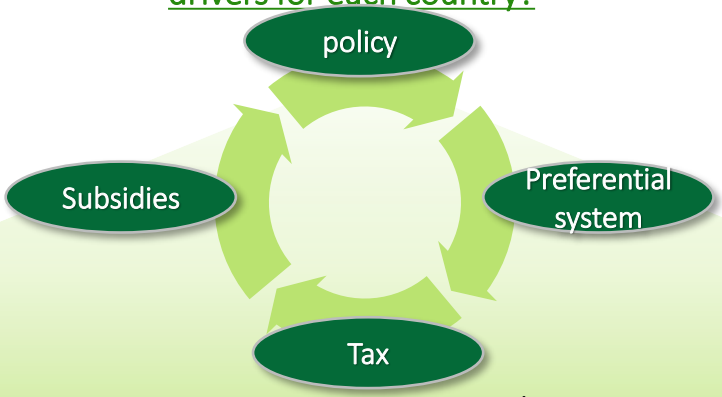
In researching policy frameworks, not only the information available on the surface, but also the true causes behind them and what the drivers were that led to their success, are unpacked and summarized

a. Specific image of the policy framework survey/study (benchmark of bioethanol introduction countries)

country	Mixing rate	Obligation to implement	Dissemination Support Measures
United States	E10 (for all cars) E15 (for 2001~) E85 (FFV)	• RFS2 obliges fuel suppliers to use biofuels.	• Tax deductions for gasoline blends • Subsidies and financing for small-scale ethanol production projects
Brazil	Gasoline C (A18-E27) Hydrous Ethanol (E94-E100)	• Mandatory blending rate of bioethanol into gasoline	• Reduction of federal industrial and local taxes for private and flexible vehicles
Philippines	E10 (for all cars)	• The Biofuel Law requires the inclusion of biofuels in liquid fuels used in automobiles	• N/A
Thailand	E10 Octane 91 = 22.9% E10 Octane 95 = 53.1% E20 Octane 95 = 18% E85 Octane 95 = 2.7%	• There is no mandate, and the introduction of ethanol blends is promoted by fuel tax exemption and subsidies for E20 and E85	• Excise tax exemption for ethanol • Subsidies for E10 production • Corporate tax exemption for new entrants to the ethanol industry

What are the key success factors (KSFs) and growth drivers for each country?

- What are the incentives for the supply side (raw material production and ethanol production)?
- What kind of mechanisms do you use to keep producers motivated?



- How is a stable selling price for consumers acheived?
- What kind of system was used to deal with vehicles that did not support bioethanol?

Raw material production → Bioethanol production → Transportation, Mixing and Storage → distribution → sale

USA

Currently, US fuel market share has been dominated by E10 fuel (average of 10.13%), with corn as the main raw material

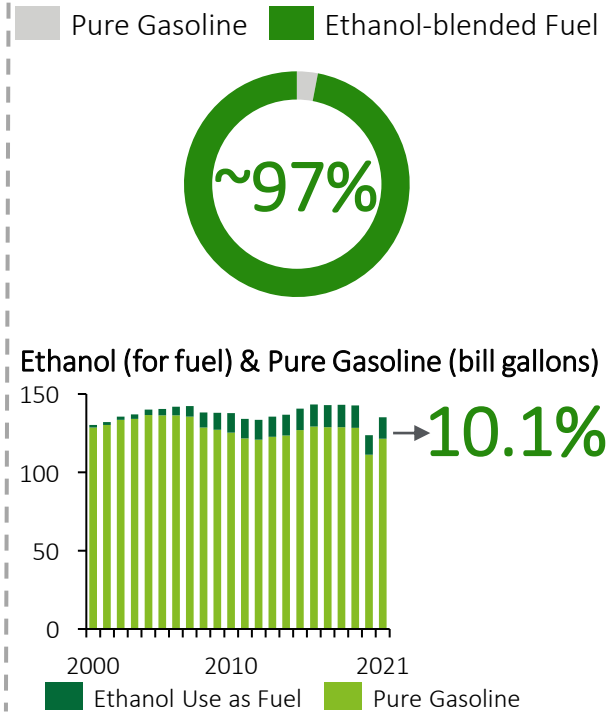
Current Condition

Feedstock for Ethanol	Ethanol Fuel Share	Ethanol Blending Ratio
Corn and sorghum	**Ethanol-blended fuel accounts for about 97%** of the total fuel shares with **10.1%** overall **blending ratio**	By Octane Rating • Regular (~ 87) • Mid-Grade (~ 89-90) • Premium (~ 91-94) By Blend Ratio • E10 • E15 • E85

Corn

Sorghum

	% in Feedstock	% in Ethanol
Corn	>99% 129.5 m ton (2021)	>99% *53.1 b Ltr (2021)
Sorghum	<1% 91.4 k ton (2021)	<1% *37.5 m Ltr (2021)

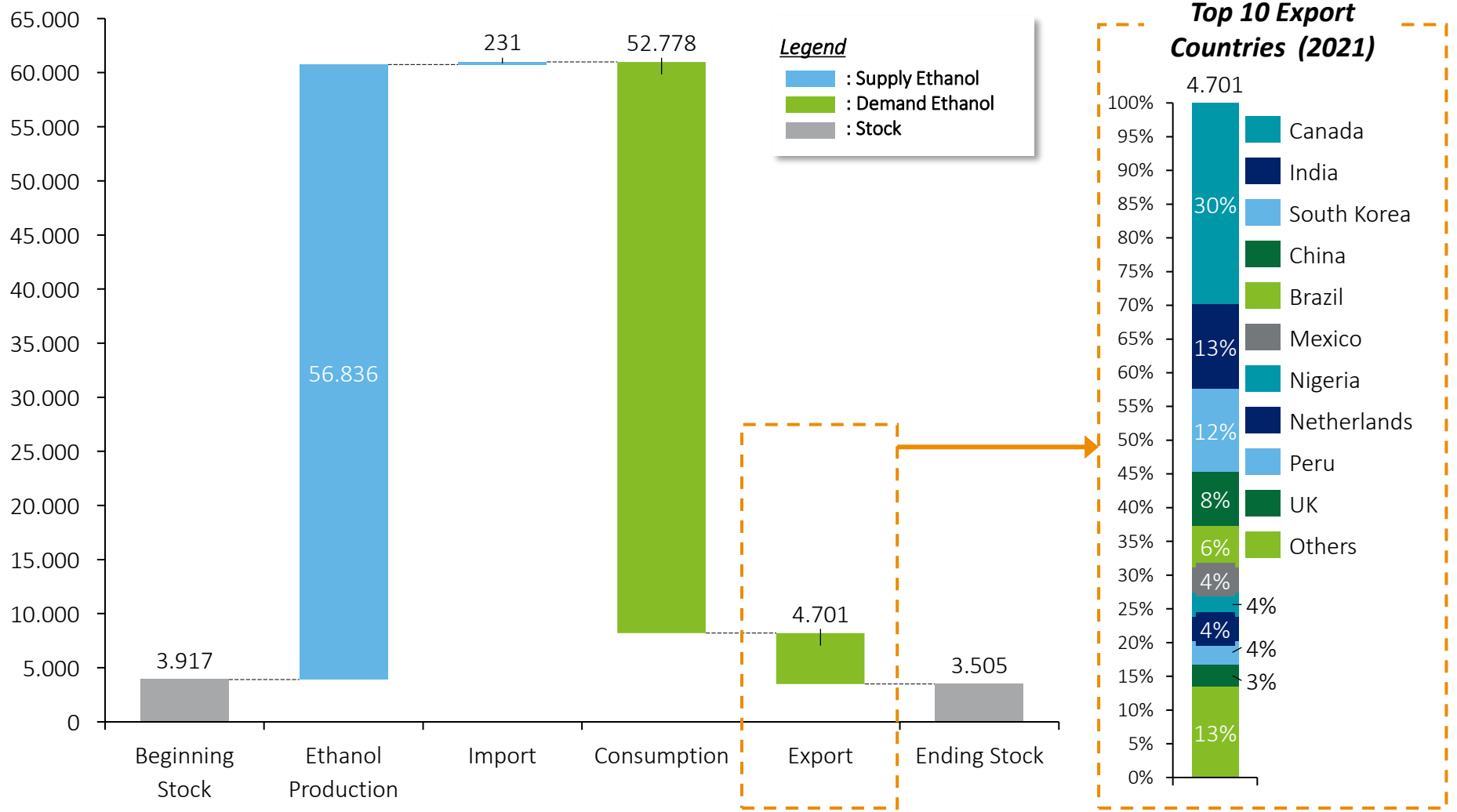


No Available Information Found

** : Deloitte's Calculation*
Source: U.S Bioenergy Statistics

US is a net exporter of ethanol; 55% of its total exports go to Canada, India and South Korea

2021 Ethanol Balance (million liter)



Source: Bioenergy Statistic 2022-USDA, US Ethanol Export & Import 2021-RFA

Tax exemption, infrastructure enhancement and RVO & RIN Mechanism have been addressed as three major growth factors from the government

Overview: USA's Key Success Factor (KSF)

Challenges

Before the introduction of Ethanol Fuel
Energy crisis in 1970 and OPEC embargo led to energy security issue

During the implementation of Ethanol Fuel
Unstable Oil & Bioethanol Price
Low adoption rate of E85 and FFV

Government Intervention

Industries	Ethanol Fuel	Ethanol-Fueled Vehicle	
PoV	[1]Producer	Manufacturer	End-User
Drivers	• Financial assistance for farmers or agriculture practitioners • Agricultural Risk Coverage program (ARC) - payments from the government when actual crop revenue is below a guarantee for a crop year (<86%) • **Tax exemption for each ethanol being produced** • Renewable Fuel Standard set targets for blending ethanol in gasoline • Volumetric Ethanol Excise Tax – tax credit for ethanol blenders • Import ethanol tariff – strengthen ethanol domestic market • Obligation to adopt FFV and use E85 for federal vehicle • **RVO & RIN - ease in complying with standards for higher ethanol blends producer** • **Direct funding on the infrastructure and/or gas station to adopt ethanol**	• Corporate Average Fuel Economy (CAFE)- ease of compliance for FFV producer with special fuel economy standards.	• Clean School Bus Program Replacement
Key Growth Factors	**Tax Exemption**	**RVO & RIN Mechanism**	**Support in Infrastructure**

[1] : *Raw material producer and ethanol fuel producer*

Government intervened in the ethanol raw material sector to guarantee the availability of ethanol by incentivizing and funding the producer

Government Incentive in Ethanol Product

	1981 - 2005	2006 - 2010	2011 - 2022
Raw Material Supplier	• Not found	• **(~2008)** Direct payments were calculated based on the farm's base acreage, which reflects the historical area planted to corn and an average yield. ($0.28 / bushel – 2008) • **(2010)** Qualified advanced biofuel feedstock producers are eligible for a reimbursement of 50% of the cost of establishing biomass feedstock crop (5-15 years) • **(2010)** BCAP (Biomass Crop Assistance Program) provides matching payments for the collection, harvest, storage, and transportation of their crops to advanced biofuel production facilities for two years ($1 for each $1 per dry ton paid by a qualified advanced biofuel production facility)	• **(2014)** Agricultural Risk Coverage program (ARC), ARC payments are determined by county and activated when actual crop revenue is below a guarantee for a crop year (<86% of the county benchmark revenue) • **(2019)** $12.0 billion in financial assistance as part of a trade aid package for certain agricultural goods producers, including corn (32 cents per bushel)

Source: Alternative Fuel Data Center-DOE, EIA, various sources

Many incentives have been implemented to encourage the development of the ethanol industry especially for ethanol players

Government Incentive in Ethanol Product

	1981 - 2005	2006 - 2010	2011 - 2022
Ethanol Producer	• **(1978)** 40-cent tax exemption per gallon of ethanol being produced • **(1980)** Federal excise tax exemption for E10 low ethanol blends ($0.45/gallon) • **(1980)** Income tax credit for blender • **(1980)** Provide over $1 billion, for the construction of ethanol plant facilities • **(1990)** Clean Air Act Amendments establish reformulated and oxygenated gasoline programs for metro areas with air quality issues • **(2005)** Renewable Fuel Standard set targets for blending ethanol in gasoline • **(2005)** Volumetric Ethanol Excise Tax credit for ethanol blenders of 45 cents for every gallon of pure ethanol they blend with gasoline • **(2005)** *Ad-valorem* tariff and specific-rate tariff has been imposed to the imported ethanol • **(2005)** Energy Policy Act 2005 mandated that all federal FFVs must use E85	• **(2007)** Companies that refine, import, or blend fossil fuels are required to meet Renewable Volume Obligations-RVO by producing a certain quantity of biofuel or paying the Renewable Identification Numbers-RIN (tradable credits) • **(2007)** The Energy Independence and Security Act of 2007 required that every federal fueling center must install a renewable-fuel pump. • **(2008)** The Biorefinery Assistance Program provides loan guarantees for the development, construction of commercial-scale biorefineries that produce advanced biofuels (max. 250m USD and/or 50% of project cost) • **(2009)** The American Recovery and Reinvestment Act provided $300 million toward alternative fuels and advanced vehicle projects, some of which funded 67 FFV refueling stations	• **(2011)** The Environmental Protection Agency (EPA) approves blends of 15% ethanol in gasoline (E15) for use in model year 2001 and newer passenger cars and light trucks • **(2015)** Provided $82 million in cost-sharing funds to install E15 and/or E85 infrastructure at retail stations
End-user	• Not Found		

Source: Alternative Fuel Data Center-DOE, EIA, Environmental Protection Agency's articles, Renewable Fuel Association, and various sources

Several incentives has been established aiming to incentivize FFV adoption, but the effectivity remains uncertain

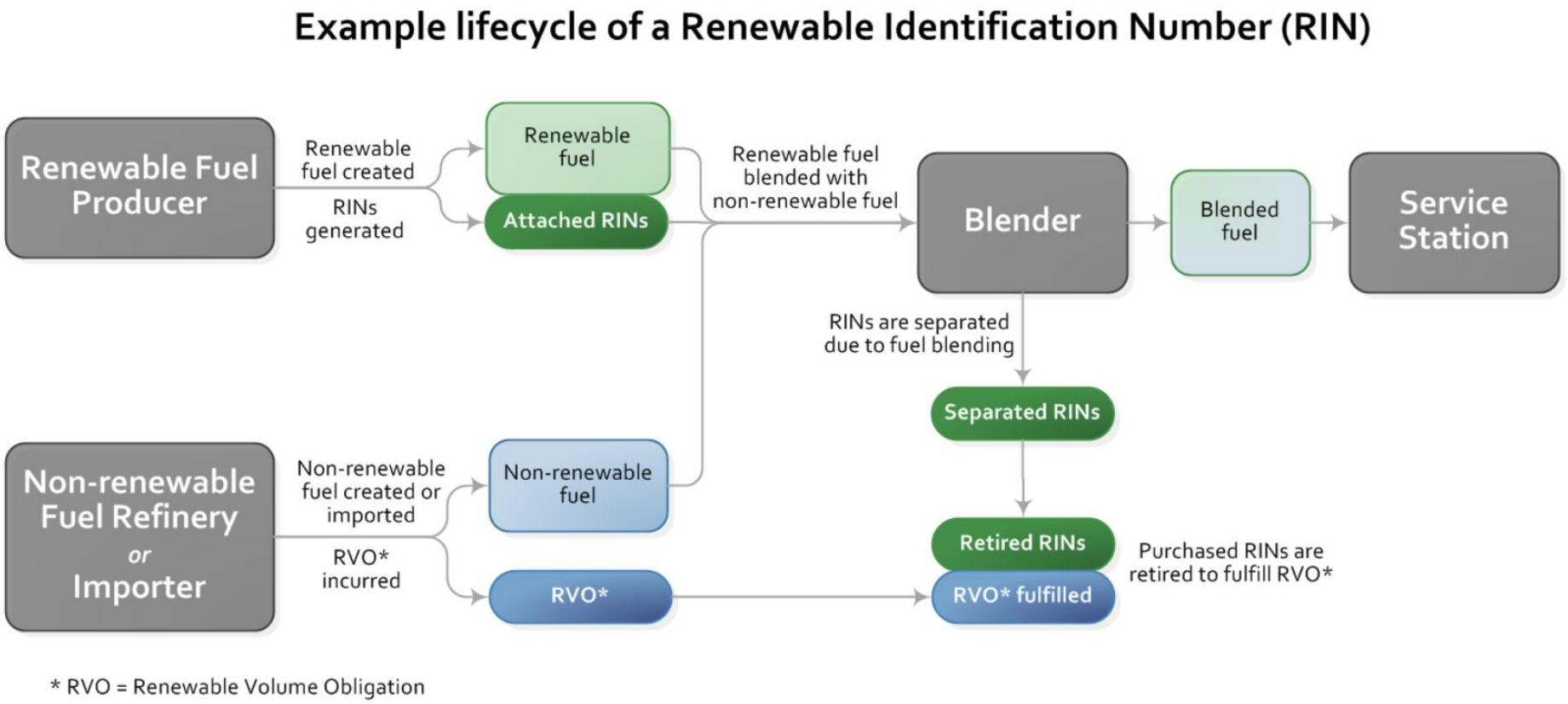
Government Incentive in Ethanol-Fueled Vehicle

	1981 - 2005	2006 - 2010	2011 - 2022
Events	**(1996)** U.S. automakers begin mass production of flex-fuel vehicles capable of running on up to E85. **(2005)** Federal government's vehicles required to start using FFV	**(2007)** There are around 5 million flex fuel vehicles (FFV) on the road	**(2015)** EPA approved for E15 use in LDVs and trucks model year 2001 and newer (97% of vehicles on the road – 2022) **(2018)** Renewable Fuel Association custom E85 motorcycle **(2022)** Renewable Fuels Association start to develop eFlexFuel (combination of PHEV and FFV)
Vehicle Manufacturer	• **(1988)** Corporate Average Fuel Economy (CAFE) credit incentive for vehicle manufacturer that use alcohol, enables to sell less fuel-efficient vehicles while still meeting the standard	• Not found	• Not found
End-User	• **(1992)** Energy Policy Act of 1992 required the federal agencies to at least have 75% of their LDVs in metropolitan areas to be alternative fuel vehicles (AFVs) Government	• **(2007)** The Energy Independence and Security Act of 2007 prohibited government for the acquisition of vehicles that are not low GHG-emitting vehicles Government	• (2022) Clean School Bus program provides funding to eligible applicants for the replacement of existing school buses with alternative fuel school buses or zero-emission school buses (up to 100% replacement cost) Public

Source: AFDC-DOE, Renewable Fuel Association, and various sources

The Renewable Volume Obligation (RVO) and Renewable Identification Number (RIN) implementation cycle to comply with the Renewable Fuel Standard (RFS)

Reference: Lifecycle of Renewable Identification Number (RIN)



Source: Environmental Protection Agency - EPA

RFS is implemented by EPA, and it obligates the refiners or importers of gasoline or diesel fuel to comply with the standard (RVO)

Renewable Fuel Standard (RFS)

Why

Congress created this program to **reduce GHG emissions** and **expand renewable fuels sector** while **reducing reliance on imported oil**

What

The RFS program is a national policy that **requires a certain volume of renewable fuel to replace or reduce the quantity of petroleum-based** transportation fuel, heating oil or jet fuel

When

2005, The Renewable Fuel Standard (RFS) program was created under the Energy Policy Act of 2005 (EPAct)

Who

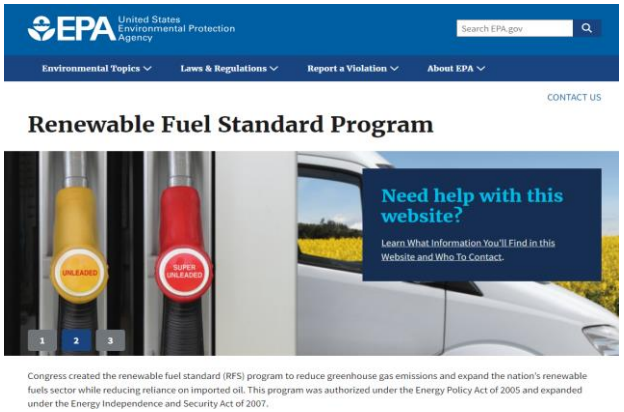
EPA implements the program in consultation with **U.S. Department of Agriculture and the Department of Energy**

How

- **Compliance is achieved by blending renewable fuels into transportation fuel, or by obtaining credits** (called "Renewable Identification Numbers", or RINs) to meet an EPA-specified Renewable Volume Obligation (RVO)
- Obligated parties under the RFS program are **refiners or importers of gasoline or diesel fuel**
- At the end of the compliance year, **obligated parties use RINs to demonstrate compliance**

Reference

- EPA



RIN credit mechanism became one of the drivers of the lower price of E85 fuel compared to other blends fuel

Price Control and Source of Funds

Raw Material of Ethanol	• **(~2008)** Counter-cyclical payments were made to farmers whenever the price of corn (including the direct payments) falls below a predetermined value. • **(2014)** Price Loss Coverage program (PLC), farmers receive payments if the average US price falls below a certain reference point (corn: $3.70 per bushel)
Ethanol Fuel	• No direct subsidy/intervention in ethanol fuel price, *Generally, E85 Price is 30-40% lower than other blends (2022) – *will be explained in the next page*

Findings

In June 2022, the price of E-85 is ~40% cheaper than unleaded gasoline (pure gasoline).

The image beside was found at a gas station in Iowa (right-side) and Washington City (left-side), but generally this price trends occurs in various gas station in the US.

Source: Alternative Fuel Data Center-DOE, EIA, X application, various sources

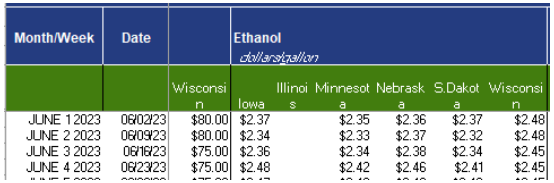
Normally, high ethanol-blends fuel is more expensive than gasoline; But, using the RIN mechanism, E85 can be cheaper than pure gasoline

Simulation Test (June 2022)

Pre-condition

- This simulation test is only to **provide recognition to the influence of the RIN mechanism on fuel prices**
- Cost of ethanol is referred from ethanol price from USDA
- Cost of Pure Gasoline (Crude Oil) is referred from EIA
- RIN price used a median RIN D6 price from EPA
- Profit margin is assumed 20%

	E85 (85% ethanol - 15% Gasoline)	**E10** (10% ethanol - 90% Gasoline)	**Unleaded** (100% Gasoline)
Pre condition			
Cost of Ethanol - before blends ($/gal) - Jun 2022	2.7	2.7	2.7
Cost of Pure Gasoline - before blends ($/gal) - Jun 2022	2.7	2.7	2.7
Simulation			
Total Blended Fuel (gal)	100	100	100
% renewable fuel	85%	10%	0%
% non-renewable fuel	15%	90%	100%
Total Ethanol Fuel (gal)	85	10	0
Total Pure Gasoline (gal)	15	90	100
Cost of Raw Material ($)	270	270	270
RINs Generation (number of RIN)	85	10	0
Median RIN D6 Price ($/gal) -2020	1.5	1.5	1.5
Percentage standard of RVO (gal)	11.59	11.59	11.59
The excess or lack of RVO (gal)	73.41	-1.59	-11.59
Additional Income from RINs sales ($)	110.12	0	0
Additional Cost to buy RIN ($)	0.00	-2.385	-17.385
Cost of Raw Material - Aftter consider RINs trade ($)	159.89	272.39	287.39
Profit Margin (assumption)	20%	20%	20%
Target Revenue ($)	199.86	340.48	359.23
Price ($/gal) - *only considering Cost of Raw Material*	2.00	3.40	3.59
Cost other than Raw Material ($/gal) *i.e., Production, Logistic, etc.*	~1	~1	~1
Price ($/gal) - *with considering "other" cost*	~3	~4.4	~4.59



Month/Week	Date	Ethanol dollars/gallon					
		Wisconsin	Iowa	Illinois	Minnesota	Nebraska	S.Dakota	Wisconsin
JUNE 1 2023	06/02/23	$80.00	$2.37		$2.35	$2.36	$2.37	$2.48
JUNE 2 2023	06/09/23	$80.00	$2.34		$2.33	$2.37	$2.32	$2.48
JUNE 3 2023	06/16/23	$75.00	$2.36		$2.34	$2.38	$2.34	$2.45
JUNE 4 2023	06/23/23	$75.00	$2.48		$2.42	$2.46	$2.41	$2.45

Source: Agricultural Marketing Service - USDA

U.S. Crude Oil First Purchase Price (Dollars per Barrel)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020	56.55	49.66	31.01	15.18	18.02	33.81	37.44	39.37	36.82	36.39	38.25	43.92
2021	49.47	56.44	60.43	59.87	62.80	68.58	70.12	65.68	69.09	78.51	76.45	70.56
2022	80.33	89.41	107.07	103.34	108.29	113.77	100.84	93.76	84.62	86.61	84.43	76.45
2023	75.71	74.32	72.09	77.22	70.14	68.58	74.05	79.78	87.96			

Source: US Crude Oil - EIA

- **Any RINs with transfer date after December 31, 2019**
  - D3 RIN Price – Min. Price: $0.05 & Max. Price: $3.50
  - D4 RIN Price – Min. Price: $0.05 & Max. Price: $3.00
  - D5 RIN Price – Min. Price: $0.05 & Max. Price: $3.00
  - D6 RIN Price – Min. Price: $0.05 & Max. Price: $3.00

Source: RIN Trades and Price Information - EPA

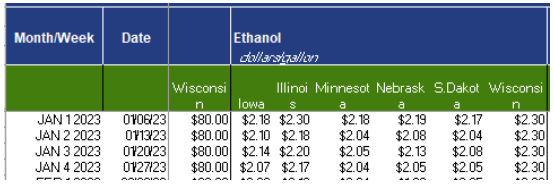
In other case, in January 2022, the price of crude oil raw materials is cheaper than ethanol, this reduce the price gap between E85 and pure gasoline.

Simulation Test (January 2022)

Pre-condition

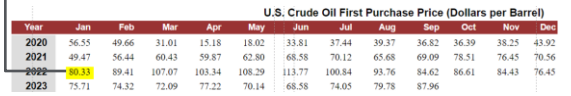
- This simulation test is only to **provide recognition to the influence of the RIN mechanism on fuel prices**
- Cost of ethanol is referred from ethanol price from USDA
- Cost of Pure Gasoline (Crude Oil) is referred from EIA
- RIN price used a median RIN D6 price from EPA
- Profit margin is assumed 20%

	E85 (85% ethanol - 15% Gasoline)	**E10** (10% ethanol - 90% Gasoline)	**Unleaded** (100% Gasoline)
Pre condition			
Cost of Ethanol - before blends ($/gal) - Jan 2022	2.15	2.15	2.15
Cost of Pure Gasoline - before blends ($/gal) - Jan 2022	1.9	1.9	1.9
Simulation			
Total Blended Fuel (gal)	100	100	100
% renewable fuel	85%	10%	0%
% non-renewable fuel	15%	90%	100%
Total Ethanol Fuel (gal)	85	10	0
Total Pure Gasoline (gal)	15	90	100
Cost of Raw Material ($)	211.25	192.5	190
RINs Generation (number of RIN)	85	10	0
Median RIN D6 Price ($/gal) -2020	1.5	1.5	1.5
Percentage standard of RVO (gal)	11.59	11.59	11.59
The excess or lack of RVO (gal)	73.41	-1.59	-11.59
Additional Income from RINs sales ($)	110.12	0	0
Additional Cost to buy RIN ($)	0.00	-2.385	-17.385
Cost of Raw Material - Aftter consider RINs trade ($)	101.14	194.89	207.39
Profit Margin (assumption)	20%	20%	20%
Target Revenue ($)	126.42	243.61	259.23
Price ($/gal) - *only considering Cost of Raw Material*	1.26	2.44	2.59
Cost other than Raw Material ($/gal) *i.e., Production, Logistic, etc.*	~1	~1	~1
Price ($/gal) - *with considering "other" cost*	~2.26	~3.44	~3.59



Month/Week	Date	Ethanol dollars/gallon						
		Wisconsin	Iowa	Illinois	Minnesota	Nebraska	S.Dakota	Wisconsin
JAN 1 2023	01/06/23	$80.00	$2.18	$2.30	$2.18	$2.19	$2.17	$2.30
JAN 2 2023	01/13/23	$80.00	$2.10	$2.18	$2.04	$2.08	$2.04	$2.30
JAN 3 2023	01/20/23	$80.00	$2.14	$2.20	$2.05	$2.13	$2.08	$2.30
JAN 4 2023	01/27/23	$80.00	$2.07	$2.17	$2.04	$2.05	$2.05	$2.30

Source: Agricultural Marketing Service - USDA



U.S. Crude Oil First Purchase Price (Dollars per Barrel)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020	56.55	49.66	31.01	15.18	18.02	33.81	37.44	39.37	36.82	36.39	38.25	43.92
2021	49.47	56.44	60.43	59.87	62.80	68.58	70.12	65.68	69.09	78.51	76.45	70.56
2022	80.33	89.41	107.07	103.34	108.29	113.77	100.84	93.76	84.62	86.61	84.43	76.45
2023	75.71	74.32	72.09	77.22	70.14	68.58	74.05	79.78	87.96			

Source: US Crude Oil - EIA

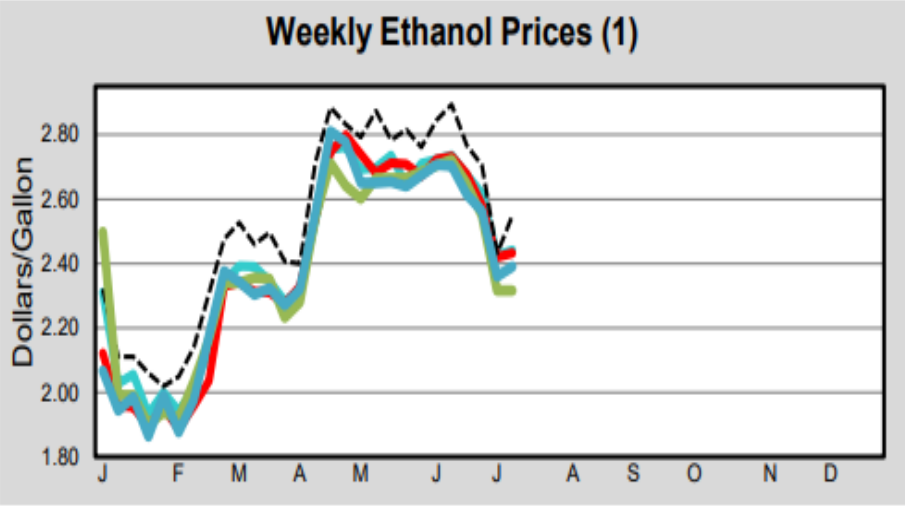
- **Any RINs with transfer date after December 31, 2019**
  - D3 RIN Price – Min. Price: $0.05 & Max. Price: $3.50
  - D4 RIN Price – Min. Price: $0.05 & Max. Price: $3.00
  - D5 RIN Price – Min. Price: $0.05 & Max. Price: $3.00
  - D6 RIN Price – Min. Price: $0.05 & Max. Price: $3.00

Source: RIN Trades and Price Information - EPA

The characteristics of ethanol and crude oil prices are very volatile, and dependent on the time period being used

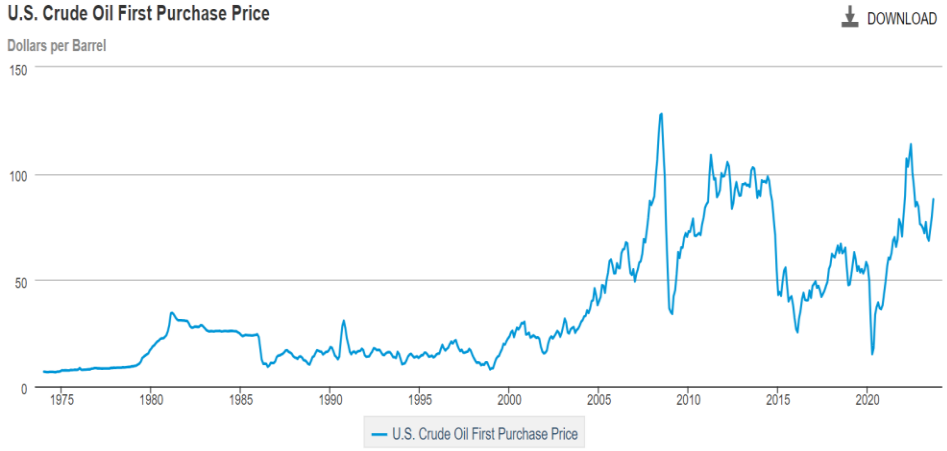
Reference: Ethanol & Crude Oil Price

Ethanol Price (2023)



Source: Daily Ethanol Report - USDA

Crude Oil Price (1975 - 2023)



Source: US Crude Oil - EIA

Development of 2G ethanol in the US is still continuing, even though government has provided support through various incentives, no significant success has been seen

Current 2nd Gen Condition in US

Share of 2G

<0.1%

Share of Cellulosic Ethanol among total production[1]

Challenge

High Cost

(Enzymes and Equipment)

is the main reason for low ethanol production

Govt. support

$250M/entity

Loan guarantee for 2G Construction Incentives[2]

Usage of 2G

Ethanol Fuel

is the main usage for 2G ethanol

Raw Material

Corn Stover

is the main raw material for cellulosic ethanol

Player(s)

Shut Down

POET DSM Advanced Biofuels

ABENGOA

DUPONT

QUAD COUNTY CORN PROCESSORS

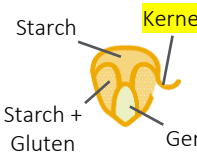
Home of KFT

is one of the cellulosic ethanol (1.5G) producer

[1] *as of 2019 data*
[2] *as of 2008 data*

Brief description about cellulosic ethanol (2G & 1.5G) plants in US; Until now, there are no 2G cellulosic ethanol plant has survived

2nd Gen plants in US

	POET DSM Advanced Biofuels	ABENGOA	DUPONT	Quad County Corn Processors – Home of KFT
Reference	US' DOE Challenges	• US' DOE	• US' DOE	• Iowa Government
Area	Iowa, US	Kansas, US	Iowa, US	Iowa, US
Tech	(2G)	(2G) Abengoa's enzymatic hydrolysis	(2G)	(1.5[1]) Syngenta's 1.5 gen technology
Capacity	Processed raw material: 285,000 dry tons stover/year Production Capacity: 25 mill gallons ethanol fuel/year	Processed raw material: 325,000 tons residue/year Production Capacity: 25 mill gallons ethanol fuel/year	Processed raw material: 375,000 tons residue/year Production Capacity: 30 mill gallons ethanol fuel/year	Production Capacity: 12,000 ton ethanol fuel/year
Feedstock Use	Corn Stover (cobs, husks, leaves, stalks)	corn stalks, stems and leaves	• Corn Stover (cobs, stalks, leaves)	 Corn kernel fiber
Status	(2014 – 2019) Shut down	(2013 – 2015) Shut down	(2015 – 2017) Shut down	• (2014 – Now)
Challenge	• Operational inefficiency in feedstock pretreatment, netwrap removal, biomass collection, interdependence of unit operations	• Financial difficulties • Front end process challenges	No longer fits with strategic plan due to the economic aspect	Controversy - The raw material is still considered as edible part of the corn

[1]1.5G bioethanol is ethanol produced from the peel (also called corn fiber) that covers the surface of corn kernels when ethanol is produced from corn starch.

Brazil

Nowadays, almost all of the gasoline in Brazil is blended-ethanol gasoline, mostly made from sugarcane, with Gasoline C dominating 70% of the market

Current Condition

Feedstock for Ethanol	Ethanol Fuel Share	Ethanol Blending Ratio
Sugarcane, Corn, Bagasse	**Almost no pure gasoline was sold** in Brazil, it is only used for blending with anhydrous ethanol	• Gasoline C = E18-E27 *(mixed of anhydrous ethanol & pure gasoline)* • Hydrous Ethanol = E94-E100

Sugarcane

% in Feedstock: ~97% — 333,050 k MT (2021)

% in Ethanol: ~87% — *23.3 b Ltr (2021)

Corn

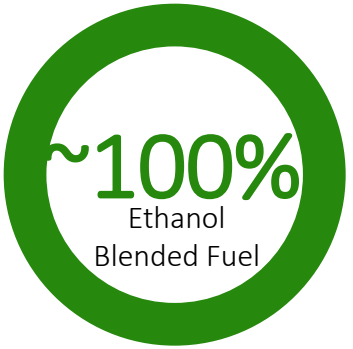
% in Feedstock: ~2% — 7,904 k MT (2021)

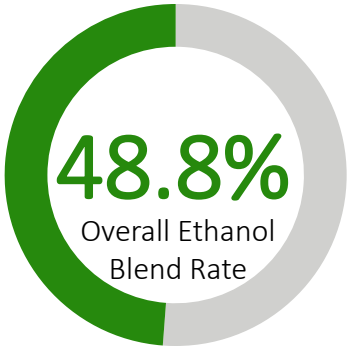
% in Ethanol: ~12% — *3.2 b Ltr (2021)

Bagasse

% in Feedstock: ~<1% — 0.222 k MT (2021)

% in Ethanol: ~<1% — *32 m Ltr (2021)





Anhydrous Ethanol (10,616 mill ltr - 2021) + Pure Gasoline

Gasoline C

~70% — 39,317 mil ltr (2021)

Hydrous Ethanol

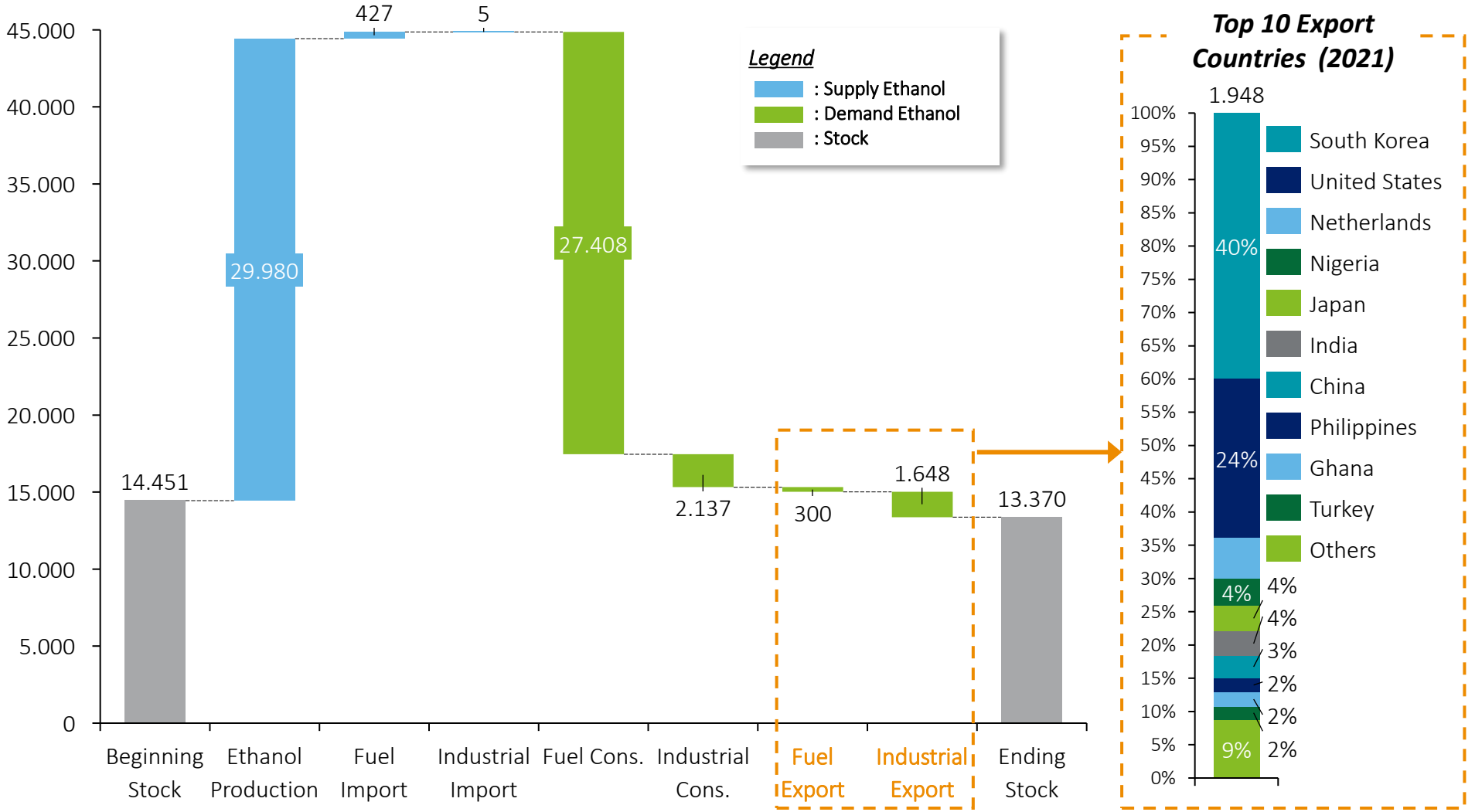
~30% — 16,792 mil ltr (2021)

** : Deloitte's Calculation*

Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELLA, Brazil's Biofuel Annual Report-USDA

Even though it still has some imports, Brazil is currently a net exporter of ethanol, 64% of its total exports go to South Korea and US

2021 Ethanol Balance (million liter)



Source: Brazil's Biofuel Annual Report-USDA

Tax reduction for supplier & user, promotion in FFV production and subsidy of ethanol price are the key growth factors for ethanol fuel in Brazil

Overview: Brazil's Key Success Factor (KSF)

Challenges

Before the introduction of Ethanol Fuel
Brazil was lacking domestic crude oil production and was relying on imported fuel (80% was imported fuel in 1980).

During the implementation of Ethanol Fuel
Unstable Oil and Ethanol Price

Government Intervention

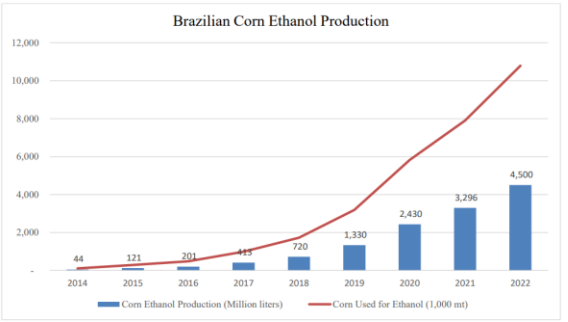
Industries	Ethanol Fuel		Ethanol-Fueled Vehicle		Others	
PoV	[1]Producer	End-user	Manufacturer	End-User	Price Control	Natural Advantage
Drivers	• Credits and loans for sugarcane industry • Guarantee purchase of the sugar & ethanol • Mandatory Blending Ratio & Tax credit for ethanol player	• Subsidy to cap ethanol fuel price not **exceed 66% of the gasoline price**	• Tax breaks for car manufacturer (ethanol-fueled vehicle including FFV)	• Tax reduction for vehicle purchase and licensing • Exemption of tax for ethanol-fueled commercial transport • Flat Road Tax reduction	• Flexibly set ethanol-sugar price parity • Subsidy to limit ethanol price not to exceed gasoline price	• Canes harvested in Brazil have high sugar content compared to others (cultural practice, variety, and climate) • Ample hydrologic water from Amazon Forest
Key Growth Factors	**Tax reduction for Supplier and User**		**Promotion in FFV**		**Subsidy of Ethanol Price**	

[1] : *Raw material producer and ethanol fuel producer*

Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELLA, Brazil's Biofuel Annual Report-USDA

The government's involvement in kick-starting and managing the ethanol industry was absolutely fundamental, a lot of intervention has been done in the industry

Government Incentive in Ethanol Product

	1975 - 2000	2001 - 2013	2014 - 2022
Raw Material Supplier	• **(1975)** 'soft' agricultural and industrial loans to revive the idle productive capacity of mills and distilleries (due to international market saturation in 1975) • **(1975)** Guaranteed purchase of their product through the Sugar and Ethanol Institute (Instituto do Açúcar e do Álcool - IAA)	• **(2010)** Direct funding for family farming through the National Family Farming Program, from around R$2 billion in 2003 to R$16 billion in 2010/2011 & R$100 billion invested in rural credit for corporate farming • **(2013)** Reduction in the annual interest rate of credits for sugarcane production from 9.5% to 5.5%	• **(2014)** Subsidy that allows farmer to receive compensation for selling their corn below the government's minimum price (PEPRO)  Source: FAS Brazil chart based on data from UNEM and UNICA. 2022 1/ figure is an estimate.
Ethanol Producer	• **(1975)** The blending ratio of Gasoline C is determined by the government, and the number will depend on the domestic sugarcane feedstock condition. • **(1979)** Significantly increase the mandatory of blending ratio for Gasoline C in all gas station (25%)	• **(2013)** Tax relief on ethanol production by up to US$0.05/ltr • **(2013)** Cut in the annual interest rate for investments in ethanol storage from 10% to 7.7%	• **(2019)** Under RenovaBio program, applied carbon credit (CBio) for fuel player, ranged from R$27 to R$60/mt of carbon • **(2022)** Cash-transfer program through a tax credit of R$ 3.8 billion to be split amongst states according to the hydrous ethanol consumption (ethanol tax: 12-30%, gasoline: 54%)

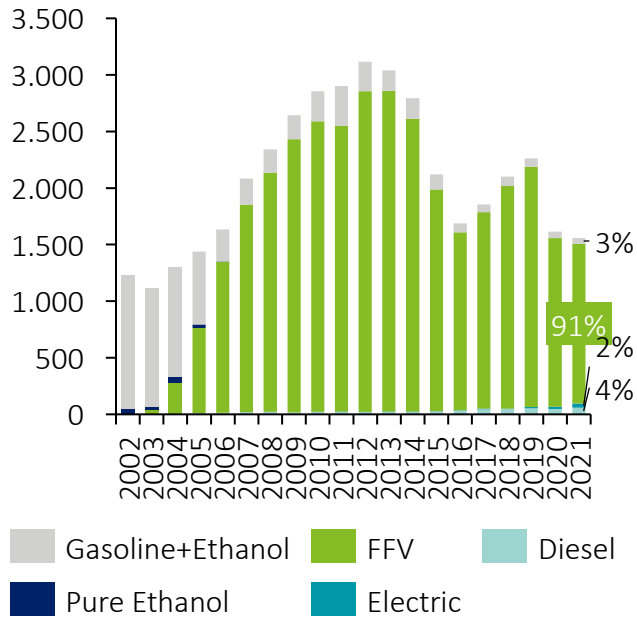
Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELLA, Brazil's Biofuel Annual Report-USDA

Several incentives also have been launched to promote ethanol-fueled vehicle and FFV became the solution of the fuel price fluctuation

Government Incentive in Ethanol-Fueled Vehicle

	1975 - 2000	2001 - 2013	2014 - 2022
Events	(1975) Production of E20-powered Cars by the automobile industry (1980) Cars powered exclusively by hydrated ethanol (pure ethanol driven engine) launched on the Brazilian market	(2002-2009) Development of flex fuel engines	(2019) FFV accounts for 90% shares of the total car market in Brazil
Vehicle Manufacturer	• (1980-1986) Tax Breaks for Car Manufacturer in ethanol-fueled car production	• (2003) Tax Breaks for Car Manufacturer in FFV Production	
End-User	• (1975) Tax reduction on Industrialized Product (IPI) for ethanol-fueled vehicle/FFV purchase • (1980) Exemption for ethanol-fueled taxis from the Tax on Manufactured Goods • (1980) 50% price reduction on the Flat Road Tax for those using ethanol-fueled vehicles Public	• (2001) Reduction in sales & licensing tax for ethanol-fueled vehicle from 16% to 14% Public	

Registration of new car by fuel type (k unit)



Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELLA, Brazil's Biofuel Annual Report-USDA, Brazilian Automotive Industry Report

Tax difference on Industrialized product (IPI) between gasoline-fueled vehicles and ethanol-fueled vehicles

Reference on the IPI Tax

Taxes Applied to Ethanol, Flex-Fuel and Gasoline Vehicles (Percentage)						
Year	Taxes	1000 cc	1001-2000 cc		Over 2000 cc	
		Gasoline/ Ethanol/ Flex	Gasoline	Ethanol / Flex	Gasoline	Ethanol/ Flex
2013	IPI	2	8	7	25	18
	ICMS	12	12	12	12	12
	PIS/COFINS	11.6	11.6	11.6	11.6	11.6
	% of Avg MSRP	23.6	27.4	26.8	36.4	33.1
2014	IPI	3	10	9	25	18
	ICMS	12	12	12	12	12
	PIS/COFINS	11.6	11.6	11.6	11.6	11.6
	% of Avg MSRP	24.4	28.6	28	36.4	33.1
2015/ thru 2021	IPI	7	13	11	25	18
	ICMS	12	12	12	12	12
	PIS/COFINS	11.6	11.6	11.6	11.6	11.6
	% of Avg MSRP	27.1	30.4	29.2	36.4	33.1
Source: National Association of Motor Vehicle Manufacturers (ANFAVEA)						
MSRP = Manufacturer Suggested Retail Price. The aggregation of the individual taxes does not necessarily add up to the Average Retail Price (fourth row) percentage because each tax applies to different steps of the production chain and not to the final retail price. During 2013, the Brazilian government offered temporary tax breaks to some categories.						

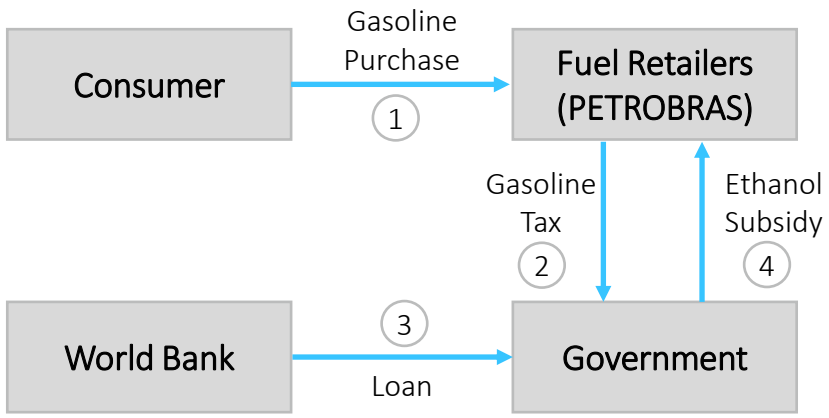
Source: Brazil's Biofuel Annual Report-USDA

The government also interfere in the price setting for both sugarcane and ethanol, and also encourages the production of crops and ethanol

Price Control and Source of Funds

Raw Material of Ethanol	• **(1975)** Flexibly set ethanol-sugar price parity so that producers would have clarity to manufacturing sugar or ethanol from the same raw material, sugarcane (44 ltr of ethanol for every 60 kg of sugar)
Ethanol Fuel	• **(1979)** Guaranteed ethanol fuel maximum selling price which was lower than the price of gasoline (66% of the gasoline price), where sales of ethanol are made through Petrobras (the state-owned oil and gas company, held >90% share of the oil and gas market)

Funding Sources of Ethanol Price Subsidy



1. **Consumer will pay higher tax (54%) for gasoline purchase** compared to ethanol purchase (12-30% tax)
2. **Tax will be then collected by the government as part of the source to subsidize ethanol fuel price**
3. **As a complement, the Government of Brazil also taking a loan from World Bank** to fund several ethanol's initiatives
4. Using Gasoline Taxes and loans from World Bank to **control ethanol price not exceed 66% of the gasoline price**

Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELLA, Brazil's Biofuel Annual Report-USDA

There is no support from the government, however the 2G ethanol industry in Brazil has been running for years and currently is on the rise

Current 2nd Gen Condition in Brazil

Share of 2G

~<1%

Share of Cellulosic Ethanol among total production[1]

Challenge

Initial Stage

Brazil's 2G is still in its infancy compared to the maturity of 1G

Govt. support

No Incentives/ Subsidy

related to 2G cellulosic ethanol

Usage of 2G

Ethanol Fuel

is the main usage for 2G ethanol

Raw Material

Bagasse & Corn Stover

are the main raw material for cellulosic ethanol

Player(s)

GranBio enabling NET ZERO™ & raízen

Are the two cellulosic ethanol (2G) producer

[1]*as of 2022 data, estimated 55 million ltr of cellulosic ethanol had been produced*

Raizen and Granbio are the two major players in 2G ethanol, and currently Raizen is in partnership with big oil company to expand its market

2nd Gen plants in Brazil

	GranBio (enabling NET ZERO)	raizen		in collaboration with..
Reference	• GranBio • BiofuelDigest	• Iogen • BiofuelDigest	• EthanolProducer	
Area	Alagoas, Brazil	Piracicaba, Sao Paulo, Brazil	Guariba, Sao Paulo, Brazil	
Tech	(2G) AVAP technology	(2G) Iogen Energy's advanced cellulosic biofuel technology	(2G) Iogen Energy's advanced cellulosic biofuel technology	
Capacity	Processed raw material: 400,000 tons /year Production Capacity: 82 mill ltr ethanol fuel/year	Processed raw material: 400,000 tons /year Production Capacity: 40 mill ltr ethanol fuel/year	Production Capacity: 82 mill ltr ethanol fuel/year	
Feedstock Use	• Corn Stover • Bagasse	• Sugarcane Straw • Bagasse	• Sugarcane Straw • Bagasse	
Status	(2014 – Now)	(2014 – Now)	(2023 – Now)	
Challenge	No Available Information Found			

Shell

In a long-term contract until 2037, to buy a total of

3.25 billion liter
cellulosic ethanol

and to build 3 cellulosic ethanol plants together with Shell

Source: Spglobal's articles, biofuelsdigest's articles, ethanolproducer's articles, and various public articles

Philippines

Although the mandate of E10 had been established, in reality the average of ethanol-use still below the mandatory ratio (9.1%)

Current Condition

Feedstock for Ethanol	Ethanol Fuel Share	Ethanol Blending Ratio
Molasses, Sugarcane Juice	**Target - Min. E10 in all gasoline types** (depends on the availability of the feedstock)	• E10 octane 91 • E10 octane 95 • E10 octane 97

Molasses

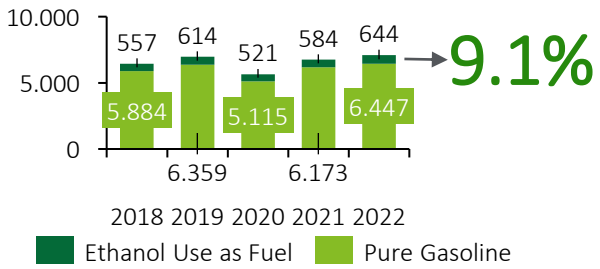
% in Feedstock	% in Ethanol
~71%	~88%
1,344 k MT (2022)	*331 m Ltr (2022)

Sugarcane

% in Feedstock	% in Ethanol
~29%	~12%
547 k MT (2022)	*44 m Ltr (2022)

Ethanol Blended Fuel

Ethanol Use (Fuel) and Pure Gasoline (mill ltr)

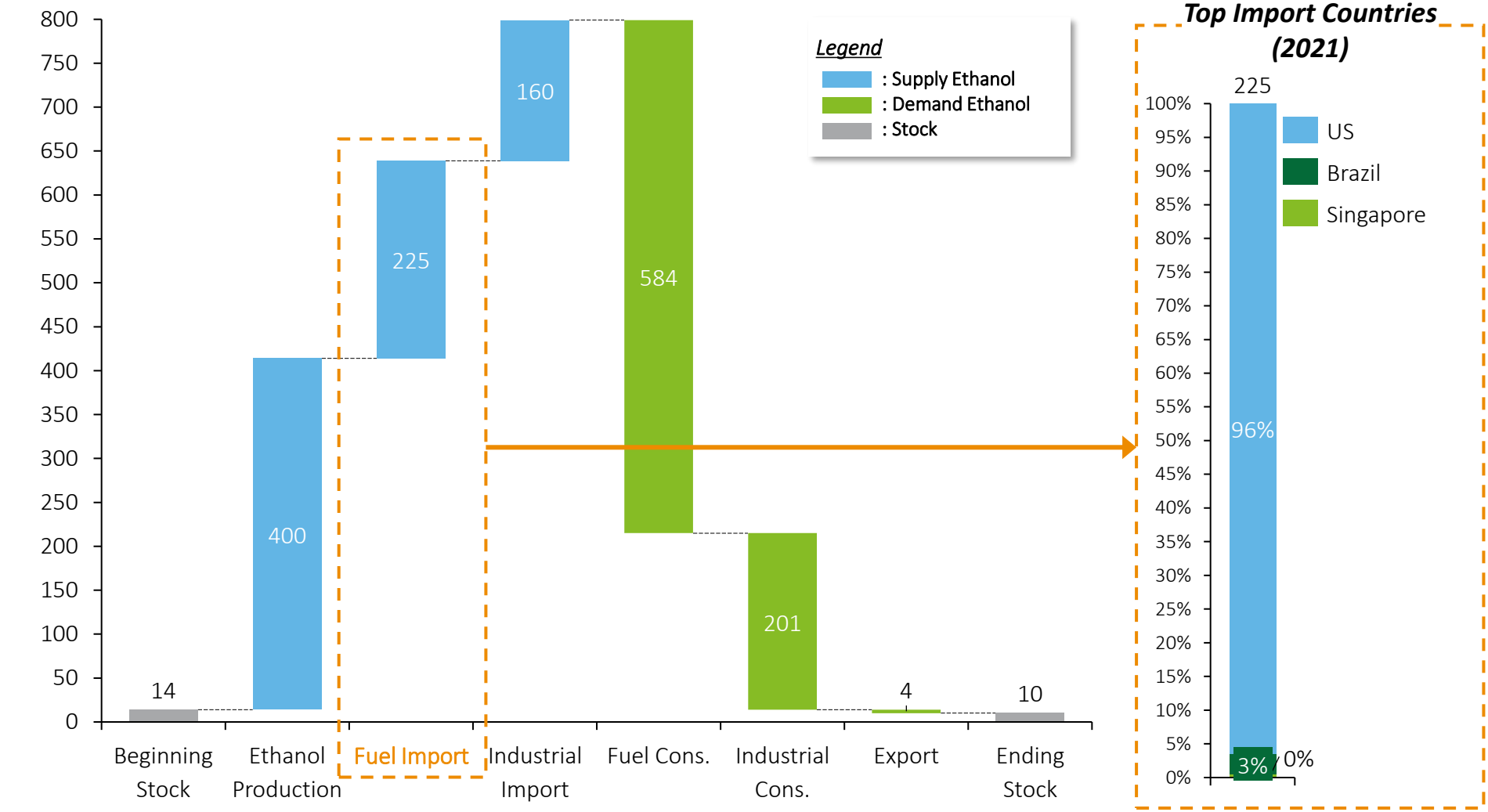


No Available Information Found

** : Deloitte's Calculation based on USDA conversion ratio*
Source: Philippine's Biofuel Annual Report-USDA

Philippines still depends on ethanol imports, around 50% of its total use comes from abroad, with US as the main supplier

2021 Ethanol Balance (million liter)



Source: Philippines's Biofuel Annual Report-USDA

In the midst of bioethanol development, currently Philippines is still struggling with limited feedstock to cover nation fuel demand

Overview: Philippine's Key Success Factor (KSF)

Challenges

Before the introduction of Ethanol Fuel

PH want to reduce their dependency in imported fuel (>50% of total imported oil -2006) and increase rural employment and income

During the implementation of Ethanol Fuel

- *Unstable Oil & Bioethanol Price*
- *Limited Feedstock (can only supply around 50% of the domestic demand)*

Government Intervention

Industries: Ethanol Fuel

PoV	[1]Producer	End-user	R&D
Drivers	• Zero-VAT Rating to the sale of biofuel and the raw materials • Mandated an ethanol blending ratio in Annual Total Volume of Gasoline • Income Tax Breaks • Duty-free importation of equipment & machinery • Exemptions from wastewater charges in biofuel production	• The fuel subsidy program when the Dubai price per barrel exceeds US$80 for three months	• Monitoring fee of fuel ethanol produced for Bioethanol Research, Development and Extension (BRDE)
Key Growth Factors	**Tax support for Bioethanol Producers**	**Fuel Subsidy Program**	**Support to Bioethanol Research**

[1] : *Raw material producer and ethanol fuel producer*

Source: Philippine's Biofuel Annual Report-USDA

Philippines is very aggressive in providing assistance to bioethanol players as producers, at the same time some amount of fee is collected for further research

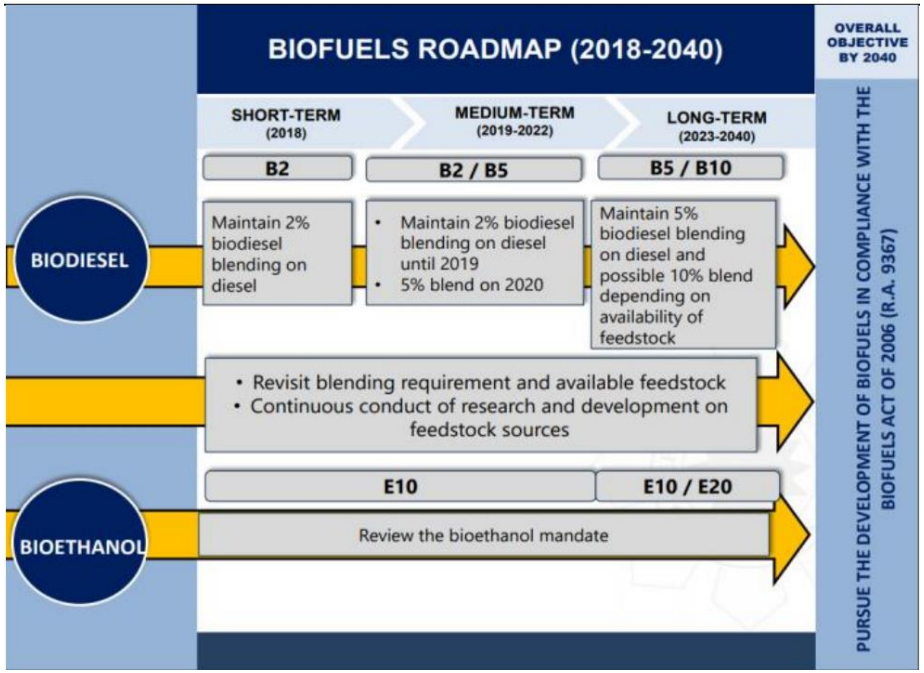
Government Incentives

		2001 - 2010	2010 - 2022
Ethanol Fuel	Raw Material Supplier	• **(2006)** zero-VAT Rating to the sale of raw materials used in biofuels production	• **(2021)** Qualified workers can take advantage of assistance, e.g., training, education, social protection and welfare, etc. • **(2022)** Limitation on the raw sugar importation
	Ethanol Producer	• **(2006)** Exemptions from wastewater charges • **(2008)** Income tax breaks for the first 7 years of operation • **(2008)** Special realty tax rates on equipment & machinery • **(2008)** Duty-free importation of equipment & machinery • **(2008)** Zero- VAT on purchases of goods and equipment • **(2008)** Zero VAT rate on sale of bioethanol fuel • **(2009)** Mandated a E5 in Annual Total Volume of Gasoline	• **(2011)** Mandated a E10 in Annual Total Volume of Gasoline
	End-user	• Not found	• **(2018)** In 2022, $10 Million (PhP500 Million) was appropriated for the fuel discount program
	R & D	• Not found	• **(2016)** The collection of a monitoring fee of PhP0.05 per liter of fuel ethanol produced for Bioethanol Research, Development and Extension (BRDE)
Ethanol-fueled Vehicle	Vehicle Manufacturer	• Not found	• Not found
	End-User	• Not found	• Not found

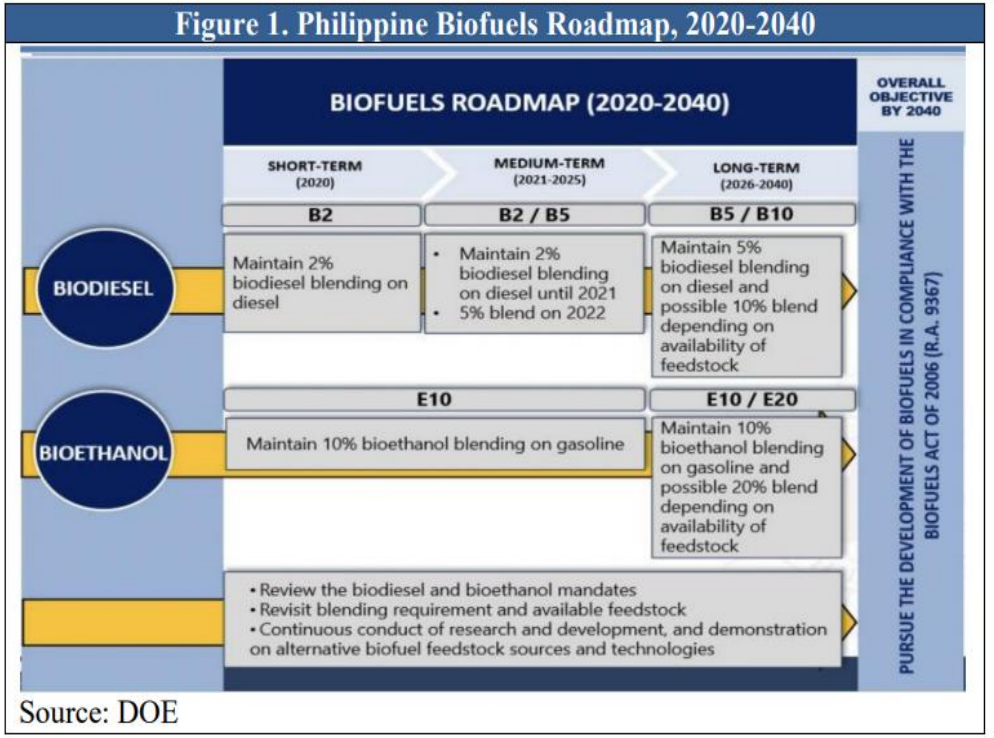
Source: Philippine's Biofuel Annual Report-USDA, DOE's articles

The plan to established beyond E10 fuel has not been confirmed yet due to the availability of the feedstock

Reference: Philippine's Biofuels Roadmap (2021 vs 2022)



Posted in 2021



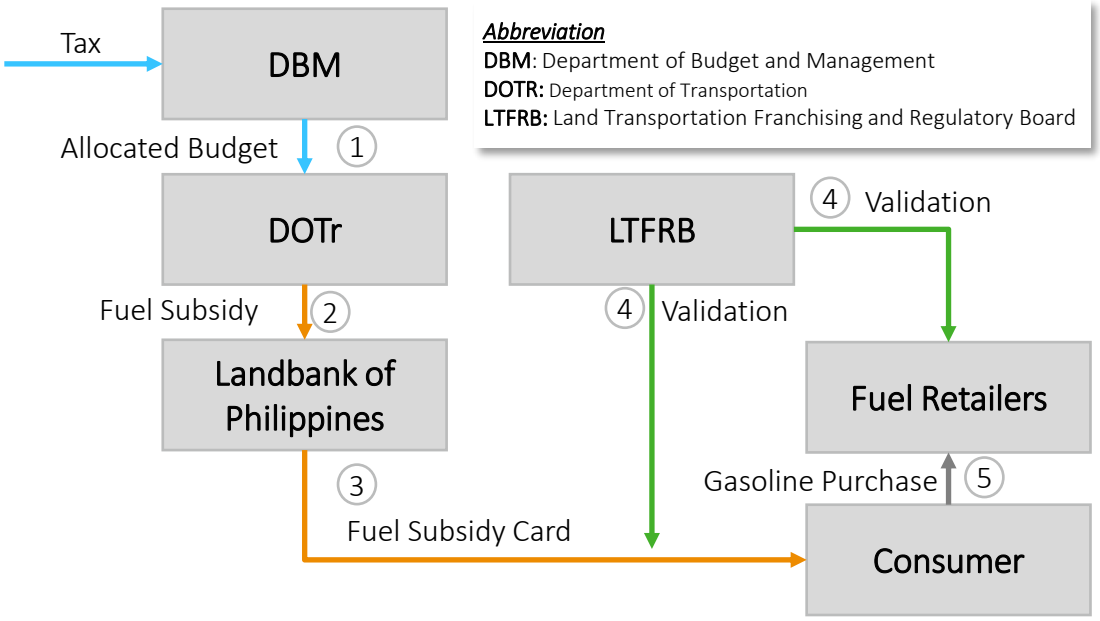
Posted in 2022

There is no specific subsidy both for ethanol price and raw material, however Fuel (ethanol-blended fuel) Subsidy for transportation had been launched in 2018

Price Control and Source of Funds

Raw Material of Ethanol	• Not Found
Ethanol Fuel	• **(2018-now)** In 2022, $10 Million (PhP500 Million) was appropriated for the fuel discount program *When the Dubai price per barrel exceeds US$80 for three months, this will trigger for the provision of subsidies **Various schemes depend on the fuel retailers (details on the next page)

Fuel Subsidy Program



1. DBM allocated some budget for fuel subsidy from collected tax
2. DOTR gives fuel subsidy to Landbank of Philippines (LBP) and the contracted fuel retailers
3. LDB will deliver the subsidy in form of Fuel Subsidy Card
4. LTFRB will validate the registered fuel retailers and the selected beneficiaries
5. Using fuel subsidy card, the selected beneficiaries can buy fuel in registered fuel retailers

Source: LTFRB's articles, DOE's articles, and various sources

Different discount schemes for each oil company applied for consumers

Reference: Fuel Subsidy Program**

Oil Company	Name of the fuel discount program	Period of effectivity	Availment Mechanisms	Amount of Fuel Discount/Promo
Total Philippines Corporation	Extreme Gas Pabigas Promo	October 1, 2023 to Januar 31, 2024; DTI Fair Trade Permit No. FTEB-173731 Series of 2023	E-raffle ticket for every Php 100 purchase, chance to win fuel and rice vouchers	Not applicable
SEAOIL Philippines Inc.	Lubricants Promo	On-going until further notice	Can be availed nationwide	DISCOUNT Lubricant: Php 3.00
SEAOIL Philippines Inc.	Happy Hour Promo	On-going until further notice	Can be availed nationwide	DISCOUNT Gasoline: Php 5.00/li Diesel: Php 1.00/li
SEAOIL Philippines Inc.	Pricelocq App	On-going until further notice	Must use Pricelocq App to buy fuel and redeem (Nationwide)	DISCOUNT Gasoline: Php 5.00/li Diesel: Php 5.00/li
SEAOIL Philippines Inc.	VIP Payday Promo	On-going until further notice	Can be availed every 15th and 30th of the Month-Payday (Nationwide)	DISCOUNT Gasoline: Php 5.00/li Diesel: Php 1.00/li Lubricant: Php 5.00
SEAOIL Philippines Inc.	Ka-Panda Gasolinahan	On-going until further notice	Food Panda Riders	DISCOUNT Gasoline: Php 9.00/li
SEAOIL Philippines Inc.	Security Bank x Pricelocq Promo	On-going until further notice	SecurityBank Card Holders	DISCOUNT Gasoline: Php 7.00/li Diesel: Php 7.00/li
SEAOIL Philippines Inc.	Tsuper Duper Discounts	On-going	Can be availed by PUV Drivers	DISCOUNT Diesel: Php 3.00/li
Pilipinas Shell Petroleum Corp.	TNVS (Transport Network Vehicle Service) Discount	On-going	Offered to all Drivers/Riders that are operating under TNVS applications	DISCOUNT Gasoline: Php 0.50/li Diesel: Php 0.50/li
Pilipinas Shell Petroleum Corp.	Shell Discount Lane for PUVs and TODAs	On-going	On-site discounting for PUVs (e.g. tricycle, jeepneys)	DISCOUNT IS SITE SPECIFIC Gasoline: Php 0.20/li Diesel: Php 0.20/li
Chevron Philippines Inc.	Caltex PUJ Discounts	On-going	PUJ discounts to 4 sites in Benguet Area	DISCOUNT Diesel: Php 2.00/li
Total Philippines Corporation	Local Promotion/Discounting including PUVs	Varies per station/area	Discount applicable to specified products for each station	DISCOUNT FOR ALL PRODUCTS Php 0.50-2.00/li
JETTI PETROLEUM, INC.	PUV/PUJ Discount	On-going until further notice. Subject to management's review and evaluation every 3 months.	Discount applied to all PUV/PUJ-outright pump discounts/rebate, applicable to all pumps unless specified with participating station	DISCOUNT FOR ALL PRODUCTS Php 2.00/li
PTT Pilipinas Corp.	PUV/PUJ Discount	Full Month of October 2023	Available to PUJ and PUV	DISCOUNT Gasoline: Php 2.00/li Diesel: Php 1.00/li

Source: DOE's Fuel Subsidy Program

Government of Philippines keep supporting research of 2G ethanol, although the realization is still in its absence (0% market share)

Current 2nd Gen Condition in Philippines

Share of 2G

~0%

Share of Cellulosic Ethanol among total production[1]

Challenge

Immature of Technology

is one of the reason why 2G still has not been penetrated

Govt. support

DEPARTMENT OF SCIENCE AND TECHNOLOGY

X

UNIVERSITY OF THE PHILIPPINES LOS BAÑOS 1908

DOST & UPLB collaborate to develop 2G Tech.

Usage of 2G

[3]Ethanol Fuel

will be the main usage for 2G ethanol

Raw Material

[3]Herbaceous

are the considered main raw material for 2G ethanol

Player(s)

NIPPON STEEL ENGINEERING

has started to develop a 2G biomass facility

[1]*as of 2022 data*
[2]*as in Alternative Energy Development Plan (AEDP) 2022*

[3]*based on NSE's case*

DOST: Department of Science and Technology
UPLB: University of the Philippines Los Banos

Thailand

Even though the government has provided various supports for E20 and E85, the proportion of both is still quite low

Current Condition

Feedstock for Ethanol	Ethanol Fuel Share	Ethanol Blending Ratio
Molasses, Cassava, Sugarcane	(2022) Ethanol-blended fuel accounts for **about 96.7%** of the total fuel shares with **12.6%** overall **blending ratio**	• E10 Octane 91 • E10 Octane 95 • E20 Octane 95 • E85 Octane 95

Molasses

% in Feedstock	% in Ethanol
~46%	~59%
3,454 k MT (2022)	*829 m Ltr (2022)

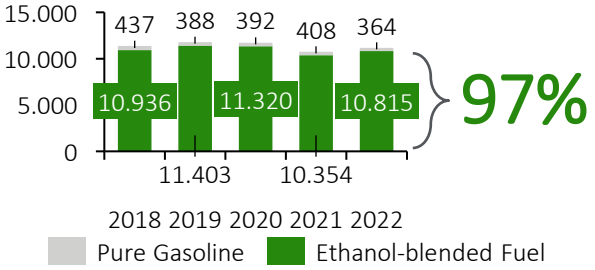
Cassava

% in Feedstock	% in Ethanol
~44%	~37%
3,317 k MT (2022)	*530 m Ltr (2022)

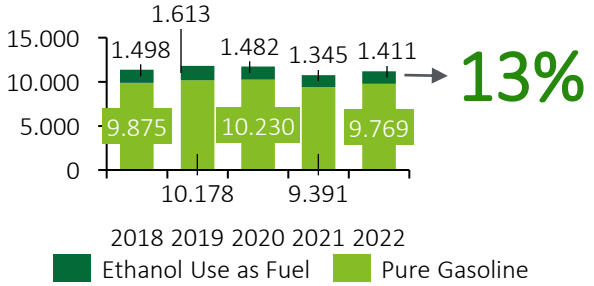
Sugarcane

% in Feedstock	% in Ethanol
~10%	~4%
768 k MT (2022)	*58 m Ltr (2022)

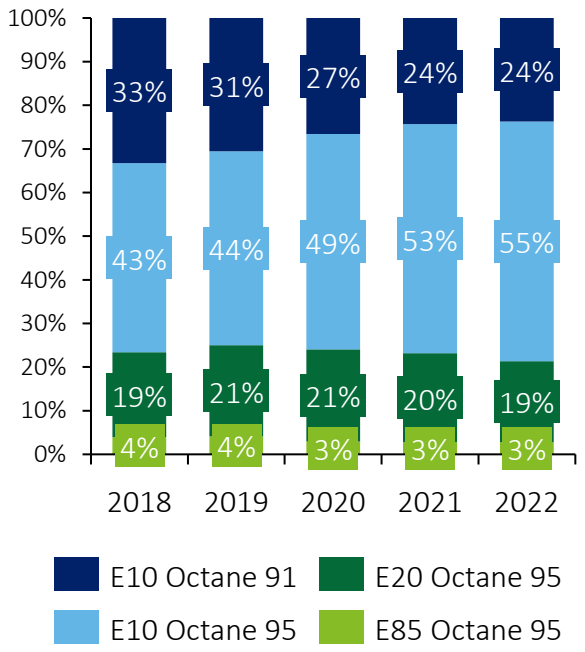
Gasoline and Gasohol Consumption (mill ltr)



Ethanol Use (Fuel) and Pure Gasoline (mill ltr)



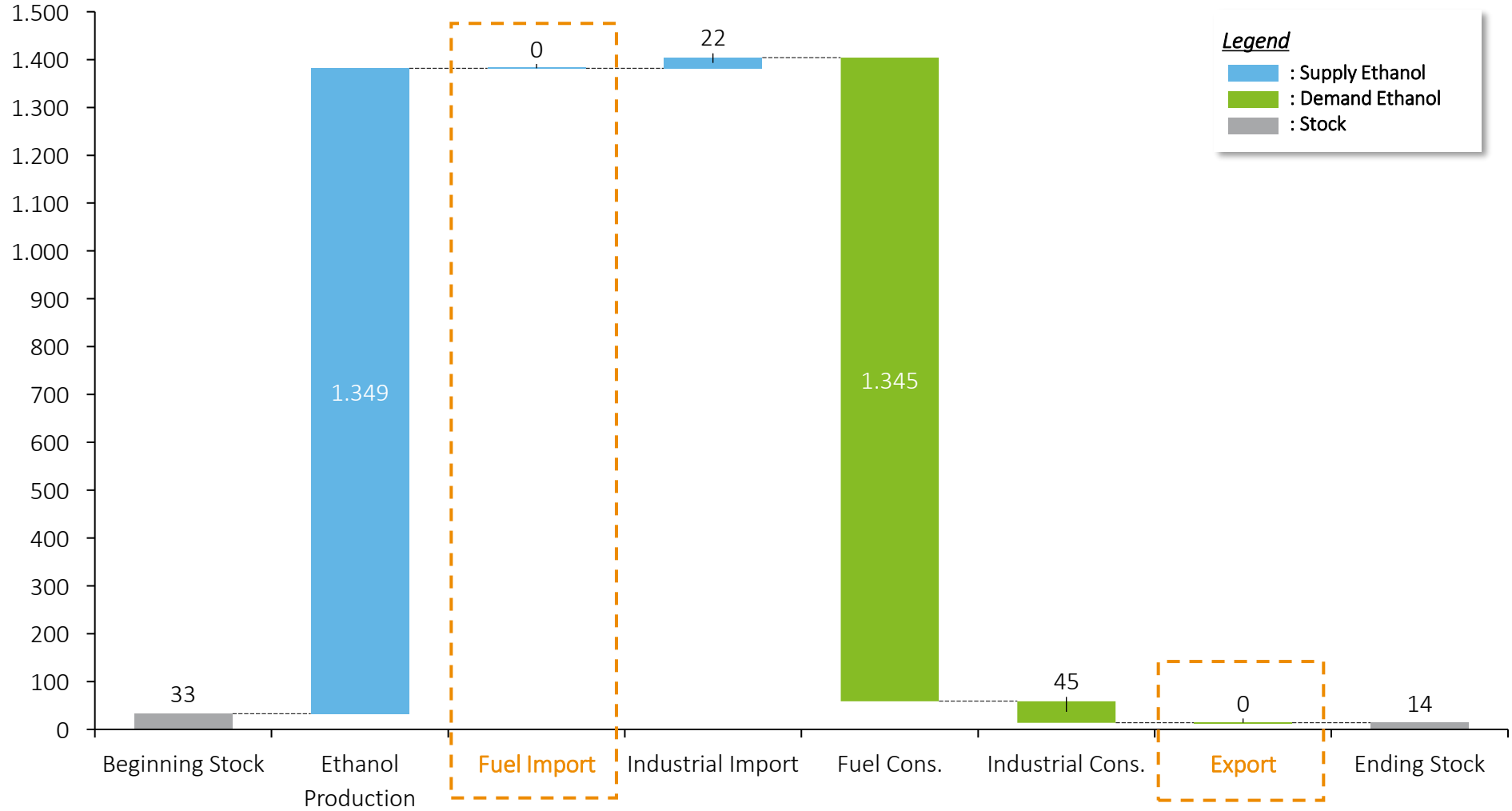
Gasohol Proportion per Type of Fuel



** : Deloitte's Calculation based on USDA conversion ratio*
Source: Thailand's Biofuel Annual Report 2023-USDA

In Thailand, there are efforts to ensure self-sufficient domestic ethanol circulation, indicated by the absence of ethanol imports and exports ethanol fuel

2021 Ethanol Balance (million liter)



Source: Thailand's Biofuel Annual Report-USDA

Tax reduction, state oil fund and incentives for ethanol-fueled vehicles became key growth factor of Thailand's ethanol industry

Overview: Thailand's Key Success Factor (KSF)

Challenges

Before the introduction of Ethanol Fuel
Thailand was relying on imported oil due to the scarcity of fossil energy resources and want lower the dependencies of imported fuel (> 60% in 2015)

During the implementation of Ethanol Fuel
Unstable Oil & Bioethanol Price

Government Intervention

Industries	Ethanol Fuel		Ethanol-Fueled Vehicle	
PoV	[1]Producer	End-user	Manufacturer	End-User
Drivers	• Zero income tax for 8 years • Zero import tax for machinery and equipment for 8 years	• Subsidy for gasohol price (E20 and E85) through state oil fund • Marketing subsidy for gasohol price (E20 and E85)	• Import tax exemption for machinery and equipment • Excise tax reduction	• Vehicle tax reduction for E20 and E85 compatible vehicle
Key Growth Factors	Tax reduction for Producer and User	State Oil Fund for Gasohol Price Subsidy	Incentives for E20 & E85 vehicles	

[1] : *Raw material producer and ethanol fuel producer*

Source: Status & Potential for The Development of Biofuels and Rural Renewable Energy in Thailand-ADB & Ministry of Energy, Thailand Biofuel Annual Report-USDA, and various sources

Several incentives has been launched to accelerate the adoption of fuel ethanol, however, currently, the government plans to phase out ethanol and focus on EVs

Government Incentives

		2001 - 2010	2010 - 2022
Ethanol Fuel	Raw Material Supplier	• **(2006)** The policy of the MOAC is to maintain the same cultivated area and increase production through the use of better varieties and more efficient farm management practices	• Not found
	Ethanol Producer	• Not found	• **(2012)** The Board of Investment Promotion provides privileges to producers of ethanol in the form of **zero taxes on imported equipment and machinery** for 8 years • **(2012)** For producer of ethanol will be given **zero income tax** for 8 years
	End-user	• **(2004 - 2021)** State Oil Fund subsidy for E20 (2.28 Baht/ltr) & E85 (7.13 Baht/ltr) reduced gasohol price in the retailers' level • **(2016)** Marketing subsidies to gasoline stations (5 baht/liter) to persuade them to increase sales of E85	
Ethanol -fueled Vehicle	Vehicle Manufacturer	• **(2008)** The Ministry of Finance is offering 3-year exemptions on import duties of foreign auto parts used to make vehicles E85-ready • **(2009)** Reduction to 3% in excise tax for the production of flex fuel cars which use E85	• Not found
	End-User	• Not found	• **(2011)** Vehicle tax reduction for cars compatible with E20 & E85 gasohol to 22, 27 and 32% depending on engine

Public

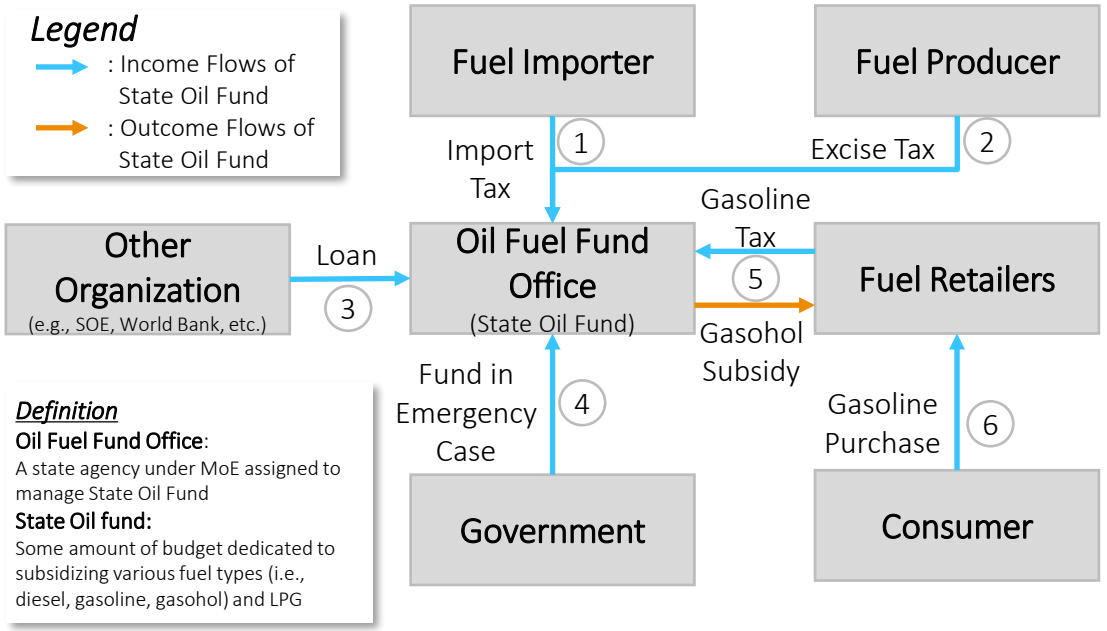
Source: Status & Potential for The Development of Biofuels and Rural Renewable Energy in Thailand-ADB & Ministry of Energy, Thailand Biofuel Annual Report-USDA, and various sources

Intervention on the pricing has been provided by using cross-subsidy mechanism to neutralize state oil funds, but still, loans are needed

Price Control and Source of Funds

Raw Material of Ethanol	• **Subsidy in form of Pledging Scheme to assist farmer when the crops price was low**, the government give Thai farmers the opportunity to pledge and then provide an unlimited supply of their crops to the government at a higher price for their crops
Ethanol Fuel	• **(2021)** State Oil Fund subsidy for E20 (2.28 Baht/ltr) and E85 (7.13 Baht/ltr) fuel that reduce gasohol price in the retailers' level • **(2016)** Marketing subsidies to gasoline stations (5 baht/ltr) to persuade them to increase sales of E85

State Oil Fund Sources for Gasohol Price Subsidy



1. **Pay import tax of fuel product**, this will be then transferred as State Oil Fund
2. **Pay excise tax for the fuel production activities**, this will be then transferred as State Oil Fund
3. If the state oil fund doesn't have sufficient balance, **loans are permitted without exceeding certain limits**
4. **Direct cash which the government may provide** in urgent and necessary case
5. **Fuel Retailers pay the gasoline tax** and in return **get the gasohol subsidy**
6. **Consumer purchase gasoline with some amount of gasoline tax** within the price

Source: Oil Fuel Fund Act B.E. 2562 (2019), Ethanol Policy Overview-U.S Grains Council and various sources

State Oil Fund's bank deposit was getting lower along with time, thus limitation of the subsidy and shifting to EV are a strategical move made by the government

Reference: State Oil Fund Income-Expense Report

In Million Baht

*Oil: Consist of various type of oil fuel (e.g., diesel, gasoline, gasohol) **LPG: Liquefied Petroleum Gas, a natural gas use as fuel		As of 1 Dec 2019			As of 27 Dec 2020		
		*Oil	**LPG	Total	*Oil	**LPG	Total
Bank Deposit		50,459		50,459	4,013		4,013
Deposit at the comptroller General Dept. MoF					51,870		51,870
Accrued Income	Money transferred to Oil Fund account	3,481		3,481	3,086		3,086
	Accrued income from oil traders	320		320	530		530
	Income from LPG Refineries and separation plants		27	27		143	143
	Accrued income from LPG Distributor		217	217		245	245
Total Assets		54,260	244	54,504	59,499	388	59,887
Debt	Money transferred from Oil Fund account		3,481	3,481		3,086	3,086
	Compensation for the price of LPG produced by the plants		771	771		2,574	2,574
	Compensation for the price of LPG used as fuel		1,011	1,011		3,835	3,835
	Compensation for various types of fuel	10,636		10,636	22,848		22,848
	Compensation according to reduce the oil retail price	7		7	7		7
	Management budget and project support	37		37	56		56
Total Debt		10,680	5,263	15,943	22,911	9,495	32,406
Net Fund		43,580	-5,019	38,561	36,588	-9,107	27,481

Source: *Oil Fuel Fund Office (OFFO) report*

The plan on phasing out biofuels by 2037 in AEDP has led to slow penetration of 2G in Thailand, on the other hand the private sector is still trying to develop 2G feasibility

Current 2nd Gen Condition in Thailand

Share of 2G

~0%

Share of Cellulosic Ethanol among total production[1]

Challenge

Began to reduce the use of biofuel in 2037[2]

is one of the reason why 2G development has stalled

Govt. support

No Incentives/ Subsidy

related to 2G cellulosic ethanol

Usage of 2G

Ethanol Fuel[3]

will be the main usage for 2G ethanol

Raw Material

Cassava & Sugarcane Waste[3]

are the considered main raw material for 2G ethanol

Player(s)

Sumitomo Corporation

X

GGC GLOBAL GREEN CHEMICALS

Signed a MoU to develop 2G ethanol (2022)

[1]*as of 2022 data*
[2]*as in Alternative Energy Development Plan (AEDP) 2022*

[3]*based on collaboration between Sumitomo and GGC*

Global Green Chemicals (GGC), a subsidiary of Thai petrochemical group PTT Global Chemical.

India

India is mainly using molasses, sugarcane juice, damaged food grains and rice for ethanol fuel feedstock with ~10.2% ethanol overall blend ratio

Current Condition

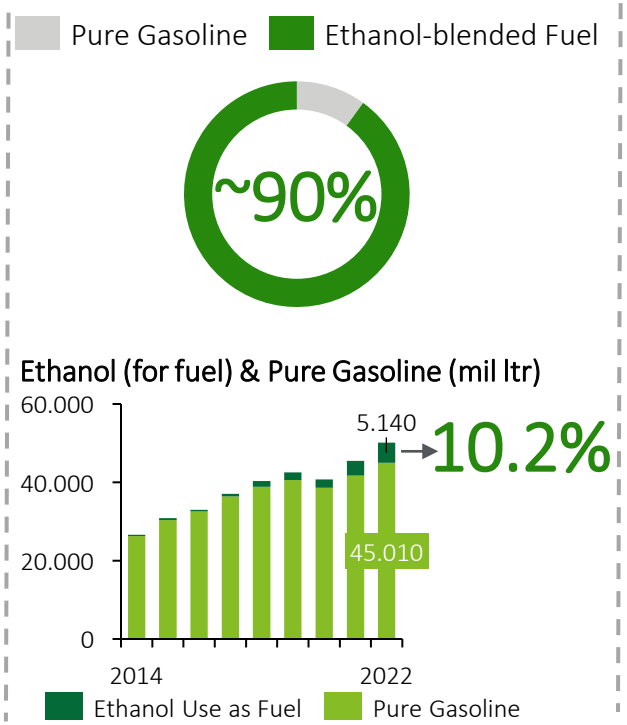
Feedstock for Ethanol

Sugarcane juice, molasses, damaged food grains, rice (broken)

	% in Feedstock	% in Ethanol
Sugarcane Juice	51.6% 14,274 k MT (2022)	21% *1.08 b Ltr (2022)
Molasses	35.4% 9,800 k MT (2022)	56% *2.87 b Ltr (2022)
Damaged Food Grains[1]	7.2% 2,000 k MT (2022)	10% *500 m Ltr (2022)
Rice	5.8% 1,610 k MT (2022)	13% *684.2 m Ltr (2022)

Ethanol Fuel Share

Most state-owned OMCs are selling ethanol blended fuel with various ratio (90% shares-2022), while private players mostly sell unblended fuel. (source: Economic Times)



Ethanol Blending Ratio

No Available Information Found

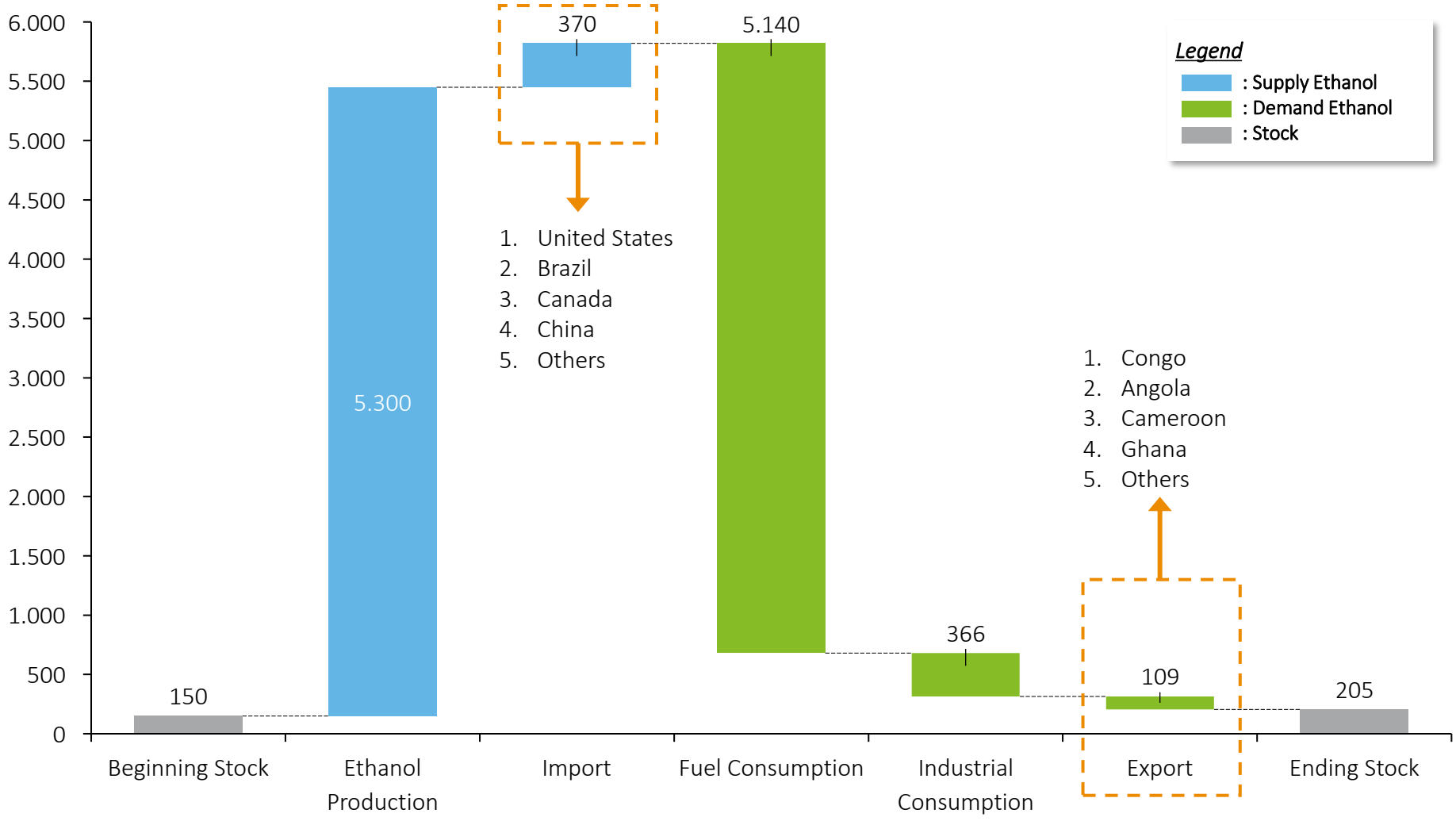
[1] = *food grains (majorly from maize) which is unfit for human consumption*

* = *Deloitte's calculation based on USDA conversion ratio*

Source: India Biofuel Report 2023 – USDA, Economic Times' publication

India is a net ethanol importer, mainly coming from the US and Brazil, where the ethanol is predominantly used for petroleum blends

2022 Ethanol Balance (million liter)



Source: India Biofuel Report 2023 - USDA

Government's focus is to provide support to the ethanol fuel supplier sides by providing financial assistance, administering differential ethanol price and tax reduction even tax exemption

Overview: India's Key Success Factor (KSF)

Challenges

Before the introduction of Ethanol Fuel
Dependence on oil import (97% of total oil consumption comes from import in 2011)

During the implementation of Ethanol Fuel
Unstable Oil & Bioethanol Price
Lack of Ethanol availability in some States

Government Intervention

Industries: Ethanol Fuel

PoV: [1]**Producer**

Drivers

- Mandated an ethanol blending ratio in gasoline progressively
- Increased the attractiveness of tenders for ethanol suppliers by OMCs
- Allowing several type of raw material to be used for ethanol production
- Financial assistance program to sugar mills or ethanol producer in form of loan interest subvention
- Differential ethanol price based on raw material utilized for ethanol production
- Reduction in Goods & Service Tax (GST) on ethanol supplied to OMCs from 18% to 5%
- Exemption on Basic Excise Duty, Road and Infrastructure Cess (RIC), Special Additional Excise Duty (SAED) and Agricultural and Infrastructure and Development Cess (AIDC) in E10 – E15 gasoline for fuel blender

Key Growth Policies

- **Financial Assistance Program**
- **Differential Ethanol Price by the Govt.**
- **Tax Reduction and Exemption**

[1] : *Raw material producer and ethanol fuel producer*

Government has mandated ethanol blended fuel use, however most of the support found is only for the ethanol supplier

Government Incentives

		<2019	2020 - 2023
Ethanol Fuel	Raw Material Supplier	• Not found	• **(2020)** Allowing surplus rice from FCI (Food Corporation of India) to be used for ethanol production with a fixed rates of Rs. 2250 /quintal of rice
	Ethanol Producer	• **(2002)** Mandated a 5% of ethanol blends rate in gasoline • **(2014)** Increased the attractiveness of tenders for ethanol suppliers by OMCs - Multiple EOI (expression of interest) and fixed transportation rates. • **(2018)** Set targets for the average ethanol blend rates in gasoline of 10% (E-10) by 2022 and 20% (E-20) by 2025 • **(2018)** Ethanol producer can have a long-term agreements (5 years) to sell ethanol to the OMCs (India's Oil Marketing Companies) at fixed rates • **(2018)** Allowing raw material aside from C-Heavy molasses to be used for ethanol production i.e., B-heavy molasses, sugarcane juice, damaged food grains • **(2018)** Financial assistance program to sugar mills or ethanol producer for ethanol infrastructure expansion	• **(2020)** Differential ethanol price based on raw material utilized for ethanol production • **(2020)** Allowing maize to be utilized for ethanol production • **(2021) Reduction in Goods & Service Tax (GST) on ethanol supplied to OMCs from 18% to 5%** • **(2021)** Exemption on **Basic Excise Duty**, **Road and Infrastructure Cess** (RIC), **Special Additional Excise Duty** (SAED) and **Agricultural and Infrastructure and Development Cess** (AIDC) **in E10 for fuel blenders** • **(2022)** Expanded the tax exemption for E12 - E15 • **(2023)** Financial assistance program to sugar mills or ethanol producer for ethanol infrastructure expansion increased by 54% ($48.38 million) from the previous year
	End-user	• Not found	• Not found
	R & D	• Not found	• Not found
Ethanol-fueled Vehicle	Vehicle Manufacturer	• Not found	• Not found
	End-User	• Not found	• Not found

Source: India's Biofuel Report – USDA, Ministry of Petroleum and Gas public release, Central Board of Indirect Taxes and Customs (CBIC)

Financial assistance pays loan interest if business players want to enter the ethanol industry or increase capacity for the existing ethanol player with a cap of 6%/annum or 50% of rate of interest charged by bank

Financial assistance program to sugar mills

442888/2021/US(Dte of Suger and Veg Oil)

[भाग II—खण्ड 3(ii)] भारत का राजपत्र : असाधारण 5

MINISTRY OF CONSUMER AFFAIRS, FOOD AND PUBLIC DISTRIBUTION

(Department of Food and Public Distribution)

NOTIFICATION

New Delhi, the 19th July, 2018

S.O. 3523(E).—The Central Government, with a view to increase production of ethanol and its supply under Ethanol Blended with Petrol (EBP) Programme, specially in the surplus seasons and thereby to improve the liquidity position of the sugar mills enabling them to clear cane price arrears of the farmers, hereby notifies the following scheme namely - "Scheme for extending financial assistance to sugar mills for enhancement and augmentation of ethanol production capacity" -

(1) Objective of the Scheme – Assistance under the scheme will be utilized by the sugar mills;

(i) For increasing ethanol production by enhancing the number of working days of existing distilleries in a year on installation of new incineration boilers.

(ii) For augmentation of ethanol production capacity by setting up of new distilleries attached with their sugar mills.

(2) Eligibility:

(i) Existing distilleries attached with the sugar mills are eligible for assistance to install new incineration boilers.

(ii) All the sugar mills are eligible for assistance to set up new distilleries. Preference will be given to sugar mills which do not have existing distillery.

(3) Assistance under the Scheme :

(i) Interest subvention @ 6% per annum or 50% of rate of interest charged by banks, whichever is lower, on the loans to be extended by banks, shall be borne by the Central Government for five years.

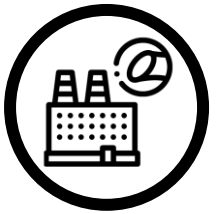
(ii) Interest subvention under the scheme in respect of 2(i) above shall be provided on the maximum loan amount of Rs. 20 crore or the actual loan amount, whichever is less, and in respect of 2(ii), it shall be provided on the loan amount of Rs. 80 crore or actual loan amount, whichever is less.

(iii) The total interest subvention under the scheme will be limited to total loan amount of Rs.2200 crore for installation of incineration boilers and Rs.2240 crore for establishment of new distilleries.

Eligible Party

Ethanol Producer

**for expanding the capacity*

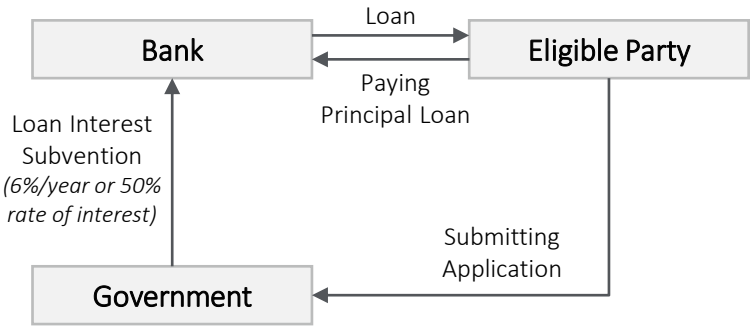


Sugar Mills

**for adding new ethanol distilleries*

Financial Assistance Scheme

Pre-condition =
Eligible party borrow funds for ethanol plant development



Source: MINISTRY OF CONSUMER AFFAIRS, FOOD AND PUBLIC DISTRIBUTION

Government started to administer ethanol price in 2014 and using different ethanol price based on raw material started from 2020

Differential ethanol price based on raw materials

Administered Price of Ethanol by Government (2020-2021)

Table 5.1: Administered Price of Ethanol by Source

Raw material Source	Ex-mill Ethanol Price (Rs./litre)
B-Heavy	57.61
C-Heavy molasses	45.69
Sugar/Sugar Syrup	62.65
Damaged Food Grains/ Maize	51.55
Surplus Rice (FCI)	56.87

Sources: *Roadmap for Ethanol Blending in India 2020 - 2025*

Administered Price of Ethanol by Government (2021 - 2022)

Cabinet approves mechanism for procurement of ethanol by Public Sector Oil Marketing Companies under Ethanol Blended Petrol programme revised - ethanol price for supply to Public Sector OMCs for Ethanol Supply Year 2021-22

The Cabinet Committee on Economic Affairs chaired by Prime Minister, Shri Narendra Modi, has given its approval for fixing higher ethanol price derived from different sugarcane based raw materials under the EBP Programme for the forthcoming sugar season 2021-22 during ESY 2021-22 from 1st December 2021 to 30th November 2022.

Approval is also given for the following:

(i) The Price of ethanol from C heavy molasses route be increased from Rs. 45.69 per litre to Rs. 46.66 per litre,

(ii) The price of ethanol from B heavy molasses route be increased from Rs. 57.61 per litre to Rs. 59.08 per litre,

(iii) The price of ethanol from sugarcane juice, sugar / sugar syrup route be increased from Rs. 62.65 per litre to Rs. 63.45 per litre,

(iv) Additionally, GST and transportation charges will also be payable.

(v) Government has decided that Oil PSEs should be given the freedom to decide the pricing for 2G ethanol as this would help in setting up advanced biofuel refineries in the country. It is important to note that grain-based ethanol prices are currently being decided by Oil Marketing Companies (OMCs) only.

Sources: *MoP&G*

Administered Price of Ethanol by Government (2022-2023)

Cabinet approves Mechanism for procurement of ethanol by Public Sector Oil Marketing Companies (OMCs) under Ethanol Blended Petrol (EBP) Programme - Revision of ethanol price for supply to Public Sector QMCs for Ethanol Supply Year (ESY) 2022-23

Posted On: 02 NOV 2022 3:25PM by PIB Delhi

The Cabinet Committee on Economic Affairs chaired by Hon'ble Prime Minister Shri Narendra Modi has approved higher ethanol price derived from different sugarcane based raw materials under the EBP Programme for the forthcoming sugar season 2022-23 during ESY 2022-23 from 1st December 2022 to 31st October, 2023:

(i) The price of ethanol from C heavy molasses route be increased from Rs.46.66 per litre to Rs.49.41 per litre,

(ii) The price of ethanol from B heavy molasses route be increased from Rs.59.08 per litre to Rs.60.73 per litre,

(iii) The price of ethanol from sugarcane juice/sugar/sugar syrup route be increased from Rs.63.45 per litre to Rs.65.61 per litre,

(iv) Additionally, GST and transportation charges will also be payable.

Sources: *MoP&G*

Feedstock	ESY 22-23 Basic Rate for Ethanol (₹ Per Ltr)	ESY 21-22 Basic Rate for Ethanol (₹ Per Ltr*)
Sugarcane Juice/Sugar/ Sugar Syrup based Ethanol	65.61	63.45
B-Heavy Molasses based Ethanol	60.73	59.08
C-Heavy Molasses based Ethanol	49.41	46.66
Damaged Food Grain based Ethanol	55.54	52.92
Maize based Ethanol	56.35	53.45
Surplus Rice based Ethanol (Sourced from FCI)	58.50	56.87

* ESY 21-22 Basic Rates do not include relief amount

Sources: *Indian Ethanol Report by Triveni*

Government is presence on controlling the raw material (sugarcane) and pure ethanol (for fuel) price, but no intervention has been found on the ethanol-blended fuel price

Price Control and Source of Funds

Raw Material of Ethanol	• **(2022)** Fair and Remunerative Price (FRP) for sugarcane for of INR 305 per quintal (USD $3.72/quintal) **FRP shall be applicable for purchase of sugarcane from the farmers by sugar mills based on sugar yield ratio*
Ethanol Fuel	• **Ethanol Price - (2014)** The government administered the ethanol price for supply to the Public Sector Oil Marketing Companies • **Ethanol Fuel Price – Not Found**

No Available Information Found

Source: Alternative Fuel Data Center-DOE, EIA, X application, various sources

The presence of 2nd gen ethanol in India has just started in 2022 by Indian Oil Corporation Limited for fuel blends with rice straw as the raw material

Current 2nd Gen Condition in India

Share of 2G

<0.01%[1]

2G is still almost nonexistent in the ethanol fuel market

Challenge

High Production Cost

the presence of 2G tech is still emergent

Govt. support

Viability Gap Funding[2]

Will be provided for 12 commercial and 10 demonstration 2G project

Usage of 2G

Ethanol Fuel

is the main usage for 2G ethanol

Raw Material

Rice Straw

is the main raw material used by Indian Oil Corporation

Player(s)

Operating[3]

IndianOil

Upcoming

Bharat Petroleum energising lives

HP

NRL NUMALIGARH REFINERY LIMITED

1 existing, and 3 upcoming of 2G commercial plants

[1]by an approximate number

[2](2019) 20% of the project cost or Rs 50 mil for every 1 mil liter of 2G ethanol being produced, total budget for financial support from 2020 – 2024: Rs 1,969.5 crore

[3]Indian Oil Corporation Limited (IOCL) using Praj's Tech. built the first 2G refinery in 2022 with 30 mil capacity[3]

EU

Pure gasoline has been phased out in EU, with overall blend ratio of 6.3%, dominated by a 5% blends ratio; However, in some countries E10 is the main blend ratio

Current Condition

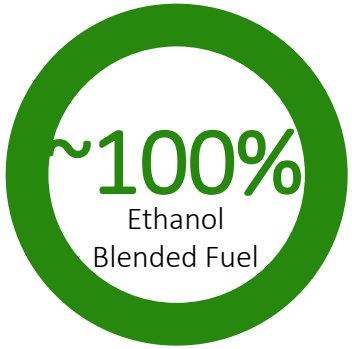
Feedstock for Ethanol

Wheat, corn, barley, rye, triticale, sugar beets, cellulosic biomass

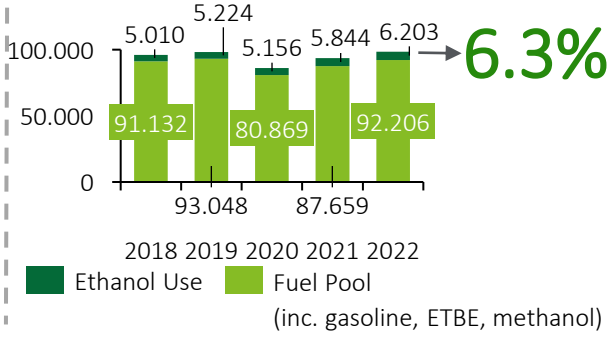
Year = 2022		Feedstock
Wheat	%	18.7
	Mass/Vol	3,579 kton
Corn	%	36.4
	Mass/Vol	6,970 kton
Barley	%	2.5
	Mass/Vol	482 kton
Rye	%	2.2
	Mass/Vol	421 kton
Triticale	%	3.5
	Mass/Vol	675 kton
Sugar Beets	%	35.2
	Mass/Vol	6,750 kton
Cellulosic Biomass	%	1.5
	Mass/Vol	280 kton

Ethanol Fuel Share

Pure gasoline almost completely phased out from the EU-27 petrol market (with the latest information of market share only 0.3% in 2020)

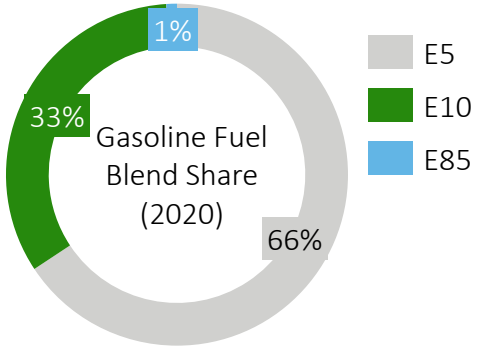


Ethanol Use (Fuel) and Fuel Pool (mill ltr)

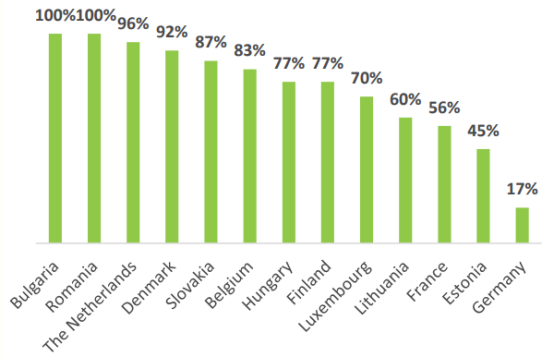


Ethanol Blending Ratio

- E5
- E10
- E85



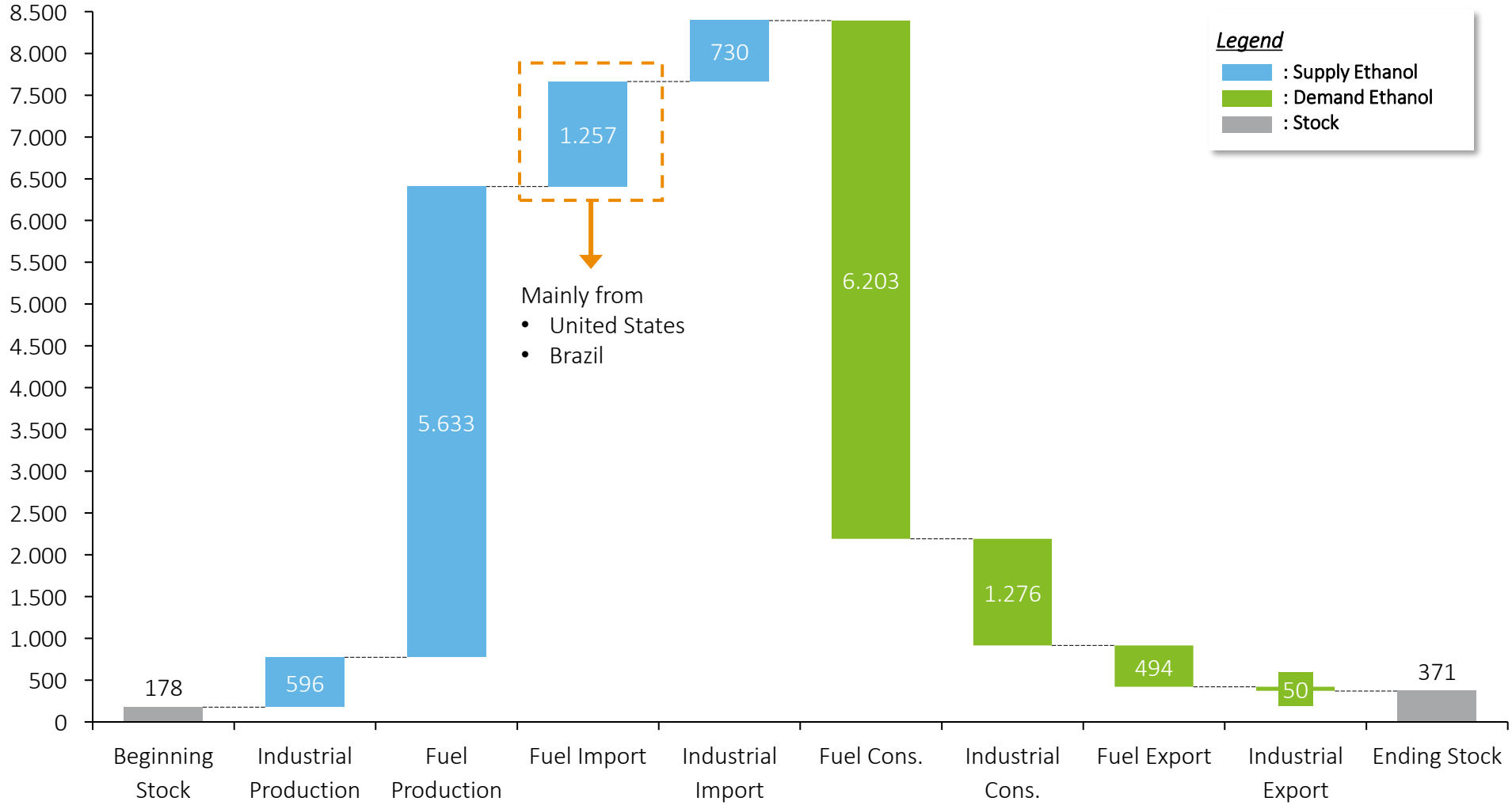
E10 market share in selected countries (2020)



Source: EU's Biofuel Annual Report-USDA, Overview of biofuels policies and markets across the EU - ePure

In general, EU is still relying on the ethanol import which mainly coming from Brazil and US as the main use is transportation fuel

2022 Ethanol Balance (million liter)



Source: Brazil's Biofuel Annual Report-USDA

The advanced biofuels sector is just emerging and the number of commercial plants is still quite small but is predicted to grow as the obligation increase and R&D improves

Current 2nd Gen Condition in EU

Share of 2G

~1.2%

Share of Cellulosic Ethanol among total ethanol-fuel production[1]

Challenge

High Capital & Unstable Feedstock

are the main challenges on penetrating advanced biofuel in the market

Govt. support

Penalties & Incentives

mechanism are found to propel 2G use in transportation fuel

Usage of 2G

Ethanol Fuel

is the main usage for 2G ethanol

Raw Material

Wood-based residue

are the main raw material for cellulosic ethanol

Player(s)

CLARIANT

versalis

RYAM

austrocel hallein

st1

Are the cellulosic ethanol (2G) producer

[1]*as of 2022 data, estimated 70 million ltr of cellulosic ethanol had been produced*

Several companies have succeeded in keeping cellulosic ethanol plants operating; This could be a benchmark for other countries, although they are still relatively new

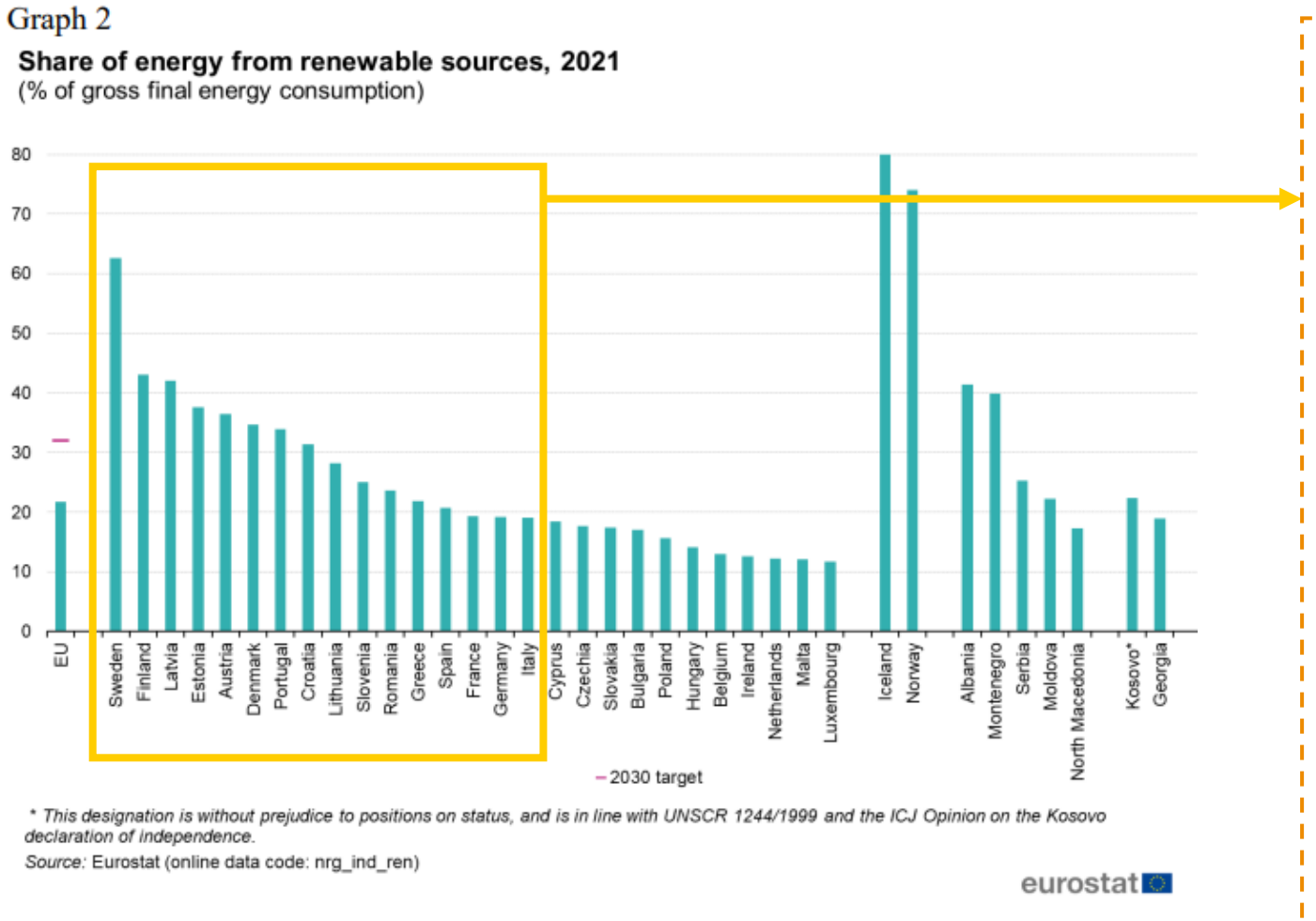
2nd Gen plants in EU

	RYAM	versalis	austrocel hallein	st1
Reference	• RYAM • Ethanolproducer	• Versalis	• Austrocel	• st1
Area	Tartas, Les Landes, France	Crescentino, Italy	Hallein, Austria	South Finland
Tech	(2G) Anomera™	(2G) Proesa™	GreenPower (GP)+ and AVAP	Etanolix®, Bionolix® and Cellunolix®
Capacity	Production Capacity: 21 mill ltr ethanol fuel/year	Processed raw material: 200,000 tons straw/year Production Capacity: 25,000 ton ethanol/year	Production Capacity: 30 mill ltr ethanol/year	Production Capacity: 115 mill ltr ethanol/year
Feedstock Use	• Wood-based Feedstock	• Wheat Straw • Rice Straw • Arundo Donax	• Waste materials from pulp production • Spruce, residual wood from the sawmill industry	• Sawdust • Food Industry Process Waste and Residue
Status	(2023 – Now)	(2020 – Now)	(2020 – Now)	• (2018 – Now)
Challenge				

Source: Spglobal's articles, biofuelsdigest's articles, ethanolproducer's articles, and various public articles

Narrowing down the top 16 countries in EU based on the percentage share of renewable energy from final energy consumption

EU Countries Prioritization Approach



Top 16 EU Countries

- Sweden
- Finland
- Latvia
- Estonia
- Austria
- Denmark
- Portugal
- Croatia
- Lithuania
- Slovenia
- Romania
- Greece
- Spain
- France
- Germany
- Italy

Source: EU's Biofuel Annual Report - USDA

EU countries have set targets for biofuel use, and some countries operate with obligations and penalties for blenders/suppliers to meet advanced fuel targets

Summary of EU's Biofuel Target and Penalty

Country	Biofuel Target			Incentive/Penalties Scheme			Incentive Scheme
	Overall	Advanced	GHG Reduction[1]	Overall Biofuel	Advanced	GHG Reduction	
Sweden	✗	✗	●	✗	✗	●	●
Finland	●	●	✗	●	●	✗	●
Latvia	●	●	✗	✗	✗	✗	●
Estonia	●	●	✗	●	●	✗	✗
Austria	●	●	●	●	✗	●	●
Denmark	✗	●	●	✗	✗	●	●
Portugal	●	●	✗	●	✗	✗	✗
Croatia	●	●	●	●	✗	●	●
Lithuania	●	●	✗	✗	✗	✗	✗
Slovenia	●	●	✗	✗	✗	✗	●
Romania	●	●	✗	●	✗	✗	✗
Greece	●	✗	✗	●	✗	✗	✗
Spain	●	●	✗	●	●	✗	✗
France	●	●	✗	●	●	✗	●
G7 Germany	✗	●	●	✗	●	●	✗
Italy	●	●	✗	●	●	✗	✗

[1]GHG reduction is calculated by comparing to the hypothetical GHG emissions that would occur due to the exclusive use of fossil fuels

In the Renewable Energy Directive (RED) II, advanced biofuel has been defined in two different type of feedstock, with an emphasis on feedstock development in part A

Advanced Biofuel Definition

Table 1. Advanced Biofuel Sources, Part A and Part B of Annex IX in RED II	
Part A	**Part B**
• Algae if cultivated on land in ponds or photobioreactors • Biomass fraction of mixed municipal waste • Biowaste from private households subject to separate collection • Biomass fraction of industrial waste not fit for use in the food or feed chain • Straw • Animal manure and sewage sludge • Palm oil mill effluent and empty palm fruit bunches • Crude glycerin • Bagasse • Grape marcs and wine lees • Nut shells • Husks • Cobs cleaned of kernels of corn • Biomass fraction of wastes and residues from forestry and forest-based industries • Other non-food cellulosic material • Other ligno-cellulosic material except saw logs and veneer logs	• Used cooking oil (UCO) • Some categories of animal fats

Source: Biofuel Mandates in the EU by Member State 2023 - USDA

Appendix

Sweden Biofuel Target and Penalty

Sweden	GHG Reduction Target through biofuel-blends		Penalties Scheme		Incentive Scheme
	Overall	Advanced	GHG Reduction	Advanced	
Gasoline	2024 = 12.5% 2025 = 15.5% 2026 = 19% 2027 = 22% 2028 = 24% 2029 = 26% 2030 = 28%		• Fuel suppliers failing to fulfill their GHG obligations must pay a penalty per kgCO2eq of €0.48 • Suppliers selling fossil fuels with no biofuel content must pay a fee of €0.038/l of petrol		Blended biofuels (Ethanol part in E85 and ED95; FAME in high blending; HVO or biodiesel in high blending) are exempted from energy and CO2 tax
Diesel	2024 = 40% 2025 = 45% 2026 = 50% 2027 = 54% 2028 = 58% 2029 = 62% 2030 = 66%		• Fuel suppliers failing to fulfill their GHG obligations must pay a penalty per kgCO2eq of €0.39 • Suppliers selling fossil fuels with no biofuel content must pay a fee of €0.26/l of diesel		

Appendix

Finland Biofuel Target and Penalty

Finland	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline & Diesel	2024 = 28% 2025 = 29% 2026 = 29% 2027 = 30% 2028 = 31% 2029 = 32% 2030 = 34%	2024 = 4% 2025 = 4% 2026 = 6% 2027 = 6% 2028 = 8% 2029 = 9% 2030 = 10%	Fuel supplier need to pay €0.04 per MJ (≈€1,675/toe) of missing biofuel	Fuel supplier need to pay €0.03 per MJ (≈€1,260/toe) of missing advanced biofuel	If a fuel supplier exceeds their overall blending obligation on a given year, they may be entitled to carry over the excess amount up to 30% of said obligation to comply with the obligation for the following year

Appendix

Latvia Biofuel Target and Penalty

Latvia	Biofuel Target (% volume)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline	5% for 98-octane fuel 9.5% for 95-octane fuel	2022 = 0.2% 2025 = 1% 2030 = 3.5%			E85 and B100 have lower excise tax than petrol and diesel. Unleaded petrol blend containing 70%-85% ethanol is taxed at 30% of the normal rate of €509/1,000l and biodiesel and paraffinized diesel obtained from biomass are taxed at the EU minimum gas oil rate: €330/1,000l
Diesel	6.5% for all diesel				

Appendix

Estonia Biofuel Target and Penalty

Estonia	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline & Diesel	2024 - 2027 = 7.5% 2028 = 8.5%	2024 – 2030 = 0.5%	Fuel supplier which failure to comply with the obligation concerning the share of biofuel released for consumption can be fined with: • Up to €1,200 if committed by natural person • Up to €10,000,000 if committed by entity/legal person		

Appendix

Austria Biofuel Target and Penalty

Austria	Biofuel Target (% cal)		GHG Reduction Target (for transport fuel)	Penalties Scheme		Incentive Scheme
	Overall	Advanced		Overall Biofuel	GHG Reduction	
Gasoline	2024 – 2030 = 3.4%	2024 = 0.2% 2025 - 2029 = 1% 2030 = 3.5%	2024 = 7% 2025 = 7.5% 2026 = 8% 2027 = 9% 2028 = 10% 2029 = 11% 2030 = 13%	A penalty of 43€/GJ (about 1,400€/toe) of gasoline should be paid by fuel suppliers failing to meet their blending obligations	€600 per MT CO2 eq of un-met GHG reduction target	For gasoline with a min. content of biofuel of 4.6% in volume, the reduced mineral oil tax is 482€/1,000l (regular tax = 515€) For diesel with a min. content of biofuel of 6.6% in volume, the reduced mineral oil tax is 397€/1,000l (regular tax = 425€) Pure biofuels in transportation are fully exempt from the mineral oil tax.
Diesel	2024 – 2030 = 6.3%			A penalty of 1,600€/toe of diesel should be paid by fuel suppliers failing to meet their blending obligations		

Appendix

Denmark Biofuel Target and Penalty

Denmark	Biofuel Target (% cal)		GHG Reduction Target (for transport fuel)	Penalties Scheme		Incentive Scheme
	Overall	Advanced		Overall Biofuel	GHG Reduction	
Gasoline		2024 = 0.2% 2025 - 2029 = 1% 2030 = 3.5%	2024 = 3.4% 2025 - 2027 = 5.2% 2028 - 2029 = 6% 2030 = 7%		Fuel suppliers failing to fulfil the GHG reduction may be fined and imposed criminal liability	The CO2 tax is lower for fuels containing biofuels: • For petrol with a biofuel content above 4.8%: 41.5 øre/l (3.6€/l) • For petrol with a biofuel content above 9.8%: 39.3 øre/l (3.5€/l) • For diesel with a biofuel content above 6.8%: 44.9 øre/l (3.9€/l)
Diesel						

Appendix

Portugal Biofuel Target and Penalty

Portugal	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline & Diesel	2024 = 11.5% 2025 – 2026 = 13% 2027 - 2028 = 14% 2029 - 2030 = 16%	2024 = 0.7% 2025 – 2026 = 2% 2027 - 2028 = 4% 2029 - 2030 = 7%	Fuel suppliers failing to meet their blending obligations must pay €2,000 per missing TdB		

Appendix

Croatia Biofuel Target and Penalty

Croatia	Biofuel Target (% cal)		GHG Reduction Target (for transport fuel)	Penalties Scheme		Incentive Scheme
	Overall	Advanced		Overall Biofuel	GHG Reduction	
Gasoline	2024 – 2029 = 1%	2024 = 0.6% 2025 = 1% 2026 = 1.3% 2027 = 1.7% 2028 = 2.1% 2029 = 2.7% 2030 = 3.5%	6% target, compared to the fossil reference of 94.1 gCO2eq/MJ	Fuel suppliers failing to fulfil their blending obligations are liable to pay a penalty calculated based on the quantity missing (€0.001327 /MJ under supplied)	Fuel suppliers failing to reduce emissions are liable to pay a penalty calculated based on the quantity missing (€0.001327/kgCO 2 under allocated)	Biofuels for transport purposes are exempted from excise duty
Diesel	2024 – 2029 = 7.49%					

Appendix

Lithuania Biofuel Target and Penalty

Lithuania	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline & Diesel	2024 = 7.8% 2025 = 8.6% 2026 = 9.8% 2027 = 11.3% 2028 = 12.9% 2029 = 14.7% 2030 = 16.8%	2024 = 0.7% 2025 = 1% 2026 = 1.4% 2027 = 1.8% 2028 = 2.2% 2029 = 2.7% 2030 = 3.5%			

Appendix

Slovenia Biofuel Target and Penalty

Slovenia	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline & Diesel	2024 = 10.6% 2025 = 11.2% 2026 = 13.8% 2027 = 15.8% 2028 = 18.3% 2029 - 2030 = 20.8%	2022 = 0.2% 2025 = 1% 2030 = 3.5%			The excise duty rate is set at 0% for ethanol, bio-ETBE, biodiesel, biogas, bio-dimethyl ether, and bio-methanol

Appendix

Romania Biofuel Target and Penalty

Romania	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline	8%	2022 = 0.2% 2025 = 1% 2030 = 3.5%	A fine of RON 70,000-100,000 (about €14,500-20,700) must be paid by fuel suppliers failing to meet their blending requirements		
Diesel	6.5%				

Appendix

Greece Biofuel Target and Penalty

Greece	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline	3.3%		Penalties for fuel suppliers failing to fulfil their quota: from €5,000 to €1,500,000		
Diesel	7%				

Appendix

Spain Biofuel Target and Penalty

Spain	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline & Diesel	2024 = 11% 2025 = 11.5% 2026 – 2029 = 12% 2030 = 14%	2024 = 0.5% 2025 = 1% 2026 – 2029 = 1.2% 2030 = 3.5%	Penalties for fuel suppliers failing to fulfil their quota €1,623 per Ktoe.		

Appendix

France Biofuel Target and Penalty

France	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline	9.5%	2023 – 2027 = 1.2% 2028 – 2030 = 3.8%	If the operators fail to meet its blending obligations, the tax rates of 140€/hl for petrol and diesel will be applied, otherwise the tax will be zero		A special energy tax rate is applicable to higher biofuel blends: • Ethanol-Diesel ED95 (12.11€/MWh), • Diesel B100 (12.9€/MWh), • Super-ethanol E85 (17.89€/MWh)
Diesel	8.6%	2023 – 2027 = 0.4% 2028 – 2030 = 2.8%			

Appendix

Germany Biofuel Target and Penalty

Germany	Biofuel Target (% cal)		GHG Reduction Target through biofuel-blends	Penalties Scheme		Incentive Scheme
	Overall	Advanced		Advanced Biofuel	GHG Reduction	
Gasoline & Diesel		2024 = 0.4% 2025 = 0.7% 2026 = 1% 2027 = 1% 2028 = 1.7% 2029 = 1.7% 2030 = 2.6%	2024 = 9.25% 2025 = 10.5% 2026 = 12% 2027 = 14.5% 2028 = 17.5% 2029 = 21% 2030 = 25%	Penalties for fuel suppliers failing to fulfil the advanced biofuel obligation: 43€/GJ under allocated	Penalties for fuel suppliers failing to fulfil the GHG reduction quota obligation: 600 €/tCO2eq reduction missing.	

Appendix

Italy Biofuel Target and Penalty

Italy	Biofuel Target (% cal)		Penalties Scheme		Incentive Scheme
	Overall	Advanced	Overall	Advanced	
Gasoline	2024 = 10% 2025 = 10.8% 2026 = 11.7% 2027 = 12.6% 2028 = 14.3% 2029 = 15.2% 2030 = 16%	2024 = 4.2% 2025 = 4.9% 2026 = 5.5% 2027 = 6.1% 2028 = 6.7% 2029 = 7.4% 2030 = 8%	Fuels suppliers not complying with at least 95 percent of the renewable mandates have to pay a penalty of €750 per missing toe		
Diesel					

Policy Framework for biodiesel in Indonesia

94.5% of all diesel fuel in Indonesia has been blended with FAME (derived from palm oil) to become biodiesel, with an overall blending ratio of 29.4% in 2022

Current Condition

Feedstock for Biodiesel	Biodiesel Fuel Share	Biodiesel Blending Ratio
Palm Oil	(2022) Biodiesel accounts for **94.5%** of the total Diesel Fuel shares, with **29.4%** overall **blending ratio**	There is only 1 type of Biodiesel. Started in 1st Feb 2023, the govt. has increased the blending ratio to 35% from 30% before • (2023) Biosolar or Biodiesel = B35

Palm Oil

% in Feedstock

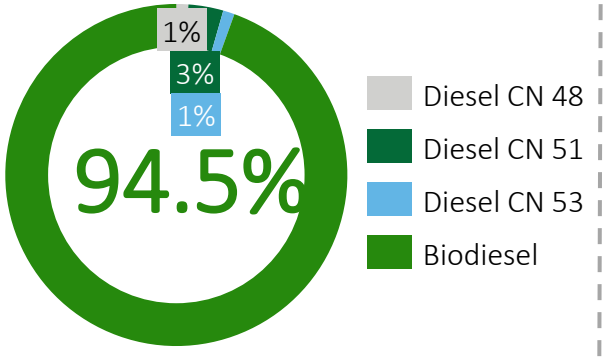
100%

10.063 k MT (2022)

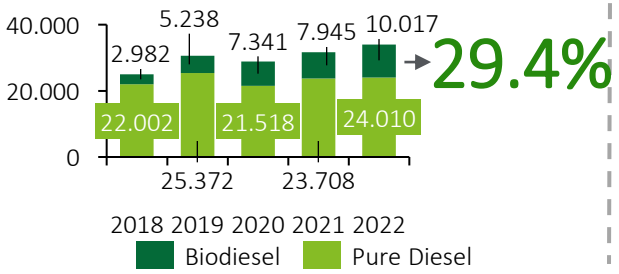
% in Biodiesel

100%

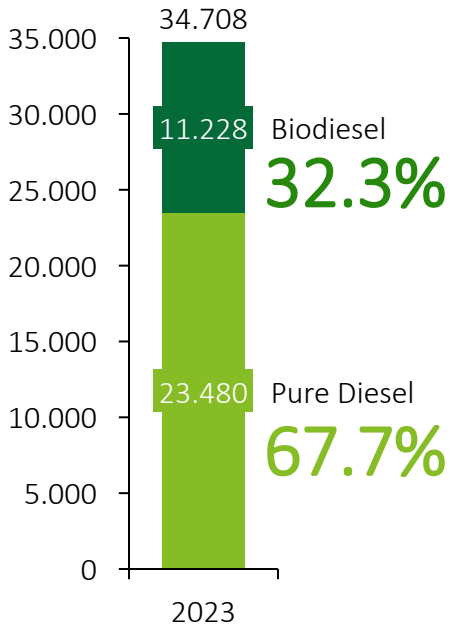
10.9 b Ltr (2022)



Biodiesel use and Pure Diesel (mill ltr)



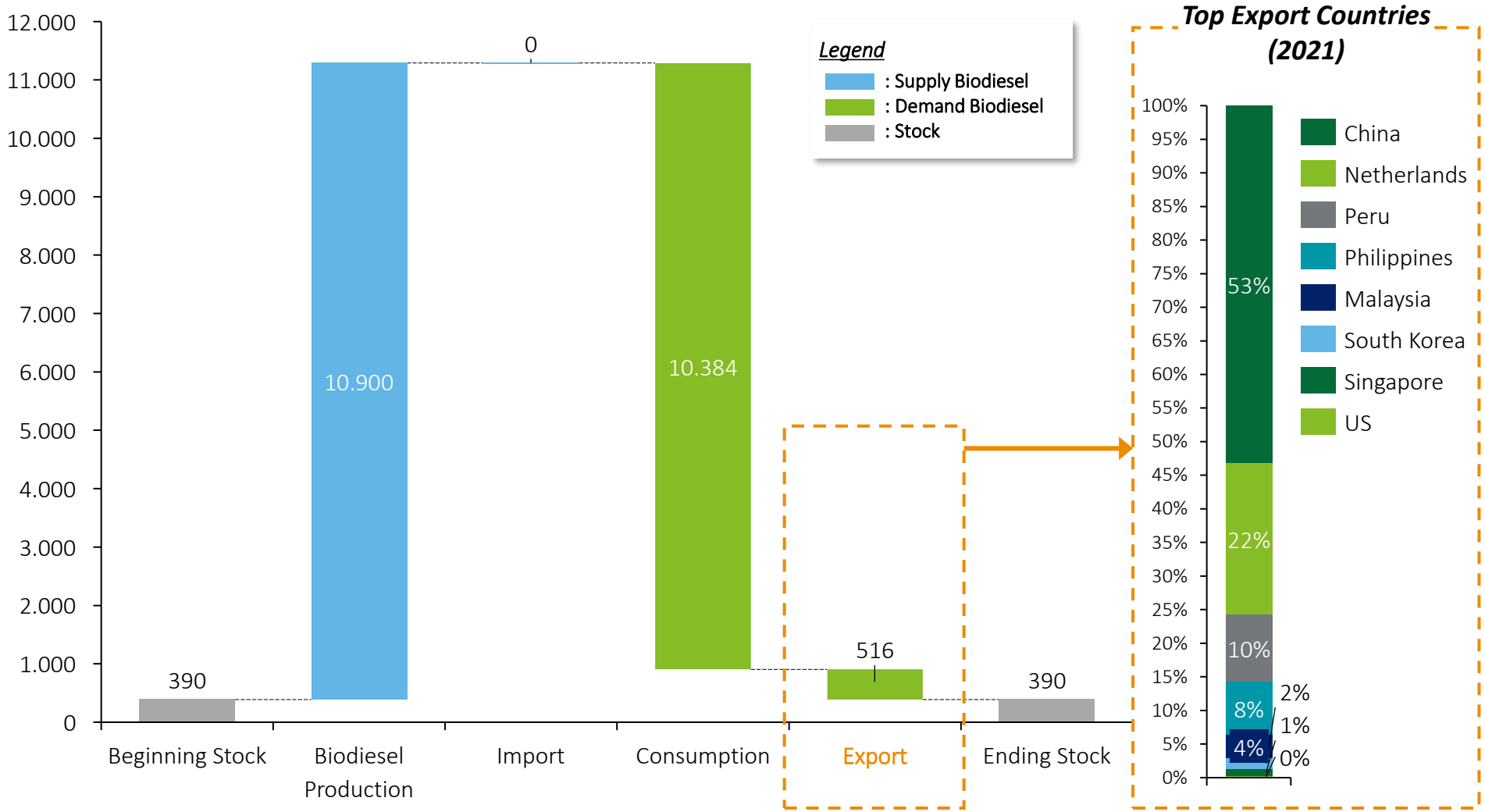
Forecast of Biodiesel use and Pure Diesel (mill ltr)



Source: Indonesia's Biofuel Annual Report-USDA, Handbook of Energy and Economic Statistics of Indonesia - MEMR

Indonesia is already a net exporter of Biodiesel, most of the (~53%) Biodiesel are being exported to China; From this export levy, will be used for subsidize Biodiesel

2022 Biodiesel Balance (million liter)



Source: Indonesia's Biofuel Annual Report-USDA, Export Trade Statistic 2022 - BPS

Aggressive mandatory blend ratio, sanction system, and subsidy of Biodiesel price are the key growth factors for Biodiesel in Indonesia

Overview: Indonesia Biodiesel's Key Success Factor (KSF)

Challenges

Before the introduction of Biodiesel Fuel
Indonesia was dependent on diesel import (52% of diesel consumption comes from imports - 2005)

During the implementation of Biodiesel Fuel
Non-compliance with mandate of blend ratio from fuel blenders
Non-compliance with allocated volume target from FAME Producer

Government Intervention

Industries: Ethanol Fuel

PoV	[1]Producer	End-user	R & D
Drivers	• Fertilizer price subsidy • CPO Funds to rejuvenate oil palm plantation & farmer's well-being • Mandated to use FAME in certain blending ratio amount progressively • Sanction system for fuel blender & FAME producer	• Subsidy Biodiesel price from state budget • Subsidy Biodiesel price from export levy of CPO and its derivatives	• CPO Funds to support research of Biodiesel
Key Growth Factors	**Aggressive Mandatory**	**Sanction system**	**Subsidy of Biodiesel price from Export Levy**

[1] : Raw material producer and ethanol fuel producer
Source: Indonesia's Biofuel Annual Report - USDA

Aside from the Biodiesel price subsidy, government's aggressiveness in increasing the blend ratio is shown by three times amendments, and sanction system for parties who not comply with the mandate

Government Incentives

		2003 - 2014	2015 - 2023
Biodiesel Fuel	Raw Material Supplier	• **(2003)** Government subsidize fertilizer price in the agricultural sector (33 Trillion Rupiah in average per year) • **(2015)** CPO Fund collected by BPDPKS will be used for the growers to rejuvenate plantation and to build infrastructure (IDR 60m/Ha, max 4 Ha/capita)	• Not Found
	Biodiesel Producer	• **(2008)** Mandated B2.5 use in industrial and commercial and B1 in transportation (Public Service Obligation – PSO) • **(2013)** 1st amendment of Biodiesel blend ratio target • **(2014)** Mandated B20 use in electricity generation and B10 in other sector (incl. transportation) – 2nd amendment • **(2015)** Mandated B25 use in electricity generation and B15 in other sector (incl. transportation) – 3rd amendment	• **(2016)** Mandated B30 use in electricity generation and B20 in another sector (excluding transportation non-PSO) • **(2018)** Expanded the mandatory of B20 in non-PSO • **(2018)** Sanction for Fuel Blender & FAME producers who don't follow the target blend ratio and volume obligation • **(2020)** Mandated B30 in all sectors • **(2023)** Mandated B35 in all sectors
	End-user	• **(2009)** Government allocate some portion in the state budget to subsidize biodiesel price • **(2015)** The transition period from state budget biodiesel subsidy to the incentive of BPDPKS from export levy	• Not Found
	R & D	• **(2015)** CPO Fund collected by BPDPKS will be used for R&D of Biodiesel	• Not Found
Biodiesel-fueled Vehicle	Vehicle Manufacturer	• Not Found	• Not Found
	End-User	• Not Found	• Not Found

Source: Indonesia's Biofuel Annual Report-USDA, DOE's articles

The following is the progress of mandatory program changes from year to year

Reference: Biodiesel Mandatory Program

2008

Jenis Sektor	Oktober 2008 s.d. Desember 2008	Januari 2009	Januari 2010	Januari 2015**	Januari 2020**	Januari 2025**	Keterangan
Rumah Tangga	-	-	-	-	-	-	Saat ini tidak ditentukan
Transportasi PSO	1% (*existing*)	1%	2.5%	5%	10%	20%	Terhadap kebutuhan total
Transportasi Non PSO	-	1%	3%	7%	10%	20%	
Industri dan Komersial	2.5%	2.5%	5%	10%	15%	20%	Terhadap kebutuhan total
Pembangkit Listrik	0.1%	0.25%	1%	10%	15%	20%	Terhadap kebutuhan total

** Spesifikasi disesuaikan dengan spesifikasi global dan kepentingan domestik

2013

Jenis Sektor	September 2013	Januari 2014	Januari 2015	Januari 2016	Januari 2020	Januari 2025	Keterangan
Rumah Tangga	-	-	-	-	-	-	Saat ini tidak ditentukan
Transportasi PSO	10%	10%	10%	20%	20%	25%	Terhadap kebutuhan total
Transportasi Non PSO	3%	10%	10%	20%	20%	25%	Terhadap kebutuhan total
Industri dan Komersial	5%	10%	10%	20%	20%	25%	Terhadap kebutuhan total
Pembangkit Listrik	7,5%	20%	25%	30%	30%	30%	Terhadap kebutuhan total

2014

Jenis Sektor	Juli 2014	Januari 2015	Januari 2016	Januari 2020	Januari 2025	Keterangan
Rumah Tangga	-	-	-	-	-	Saat ini tidak ditentukan
Usaha Mikro, Usaha Perikanan, Usaha Pertanian, Transportasi, dan Pelayanan Umum (PSO)	10%	10%	20%	30%	30%	Terhadap kebutuhan total
Transportasi Non PSO	10%	10%	20%	30%	30%	Terhadap kebutuhan total
Industri dan Komersial	10%	10%	20%	30%	30%	Terhadap kebutuhan total
Pembangkit Listrik	20%	25%	30%	30%	30%	Terhadap kebutuhan total

2015

Sektor	April 2015	Januari 2016	Januari 2020	Januari 2025
Usaha Mikro, Perikanan, Pertanian, Transportasi dan PSO	15%	20%	30%	30%
Transportasi non PSO	15%	20%	30%	30%
Pembangkit Listrik	25%	30%	30%	30%
Industri dan Komersial	15%	20%	30%	30%

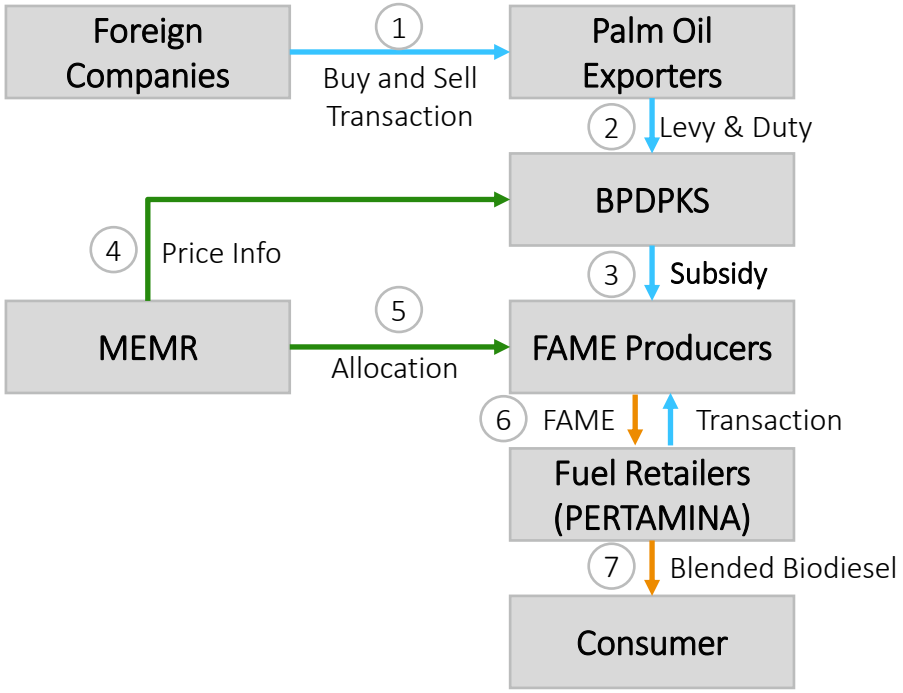
Source: Book of "BIODIESEL, a long struggle journey" 2021 by MEMR, P3tek, APROBI

Biodiesel subsidy managed by public service agency named BPDPKS to collect funds from export levy of CPO and its derivatives

Price Control and Source of Funds

Raw Material of Biodiesel	• Not Found
Biodiesel Fuel	• **(2009)** Government allocated some portion in the state-budget for subsidize Biodiesel price • **(2015)** The transition period from state budget (APBN) subsidy to the incentive of BPDPKS from export levy

Funding Sources of Biodiesel Price Subsidy



1. **Foreign exchange** from export activities of palm oil-related products **contribute to the inflow of money into Indonesia**
2. Export activities will be imposed of export levy and export duty as **CPO Supporting Fund (CSF), collected by BPDPKS**
3. **CSF will be used to overcome the price gap difference between biodiesel and crude oil price**
4. **MEMR will provide price index** (Biodiesel and CPO) that will **influence the export levy structure**
5. **MEMR will arrange the allocation of biodiesel (FAME) volume** for each producer company
6. **Producer will sell FAME to PERTAMINA** with an agreed price
7. **PERTAMINA will distribute biodiesel** fuel across all gas stations **to the end-user**

Source: USDA, Indonesia: Biofuels Annual 2021

A sanction system is being applied both for FAME Producer and Fuel Blender which don't comply to the decree and mandatory program

Sanction Mechanism

Type of Sanction

- Administrative Fines
- Revocation of Business Permit

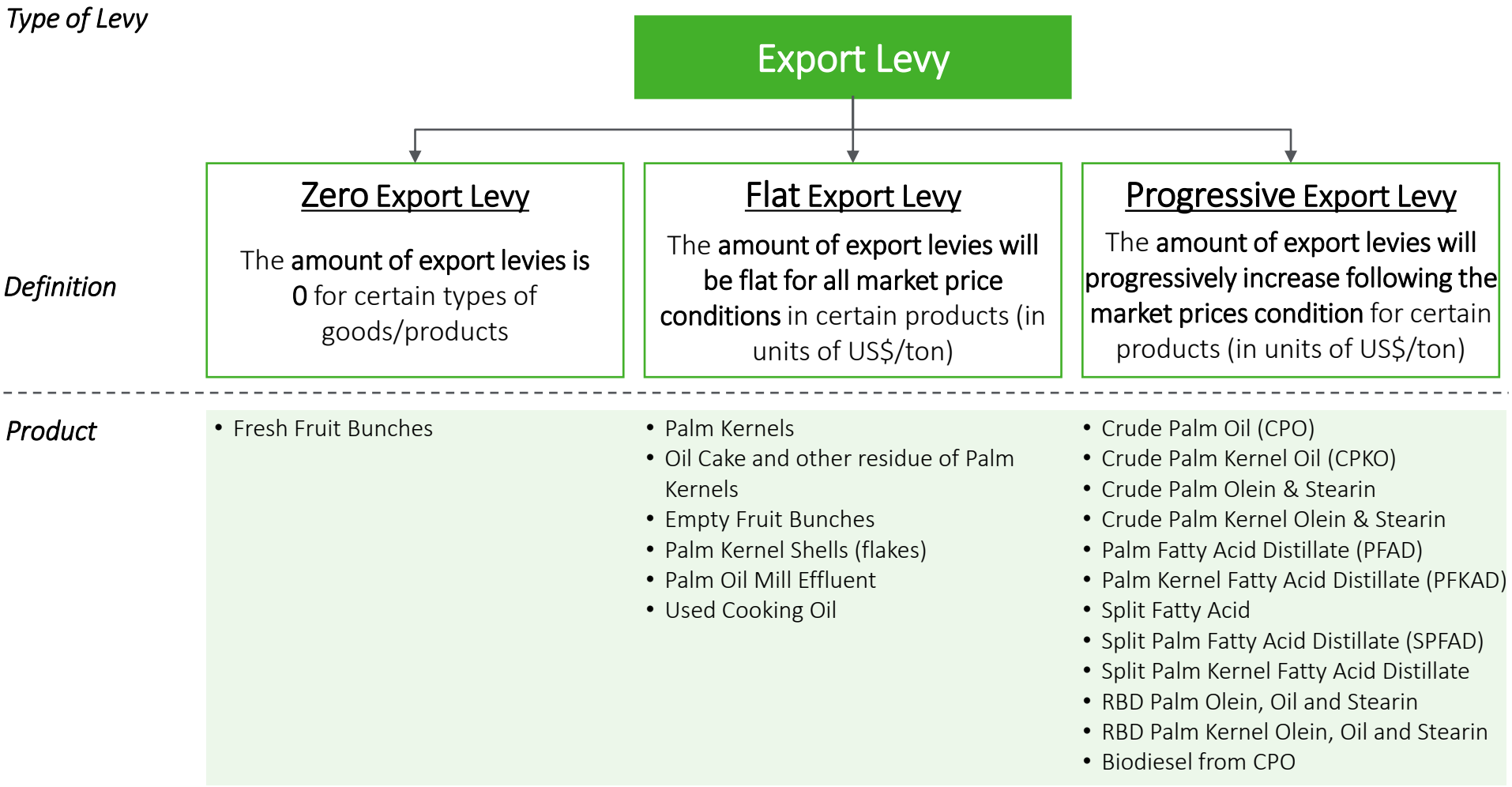
Applied for

	FAME Producer	Fuel Blender
Obligation	Obliged to supply a certain volume of FAME for fuel based on allocated volume in the recent decree	Obliged to blend a certain percentage of FAME with diesel based on the recent mandatory program
Fine Amount	Fine of **6,000 IDR/liter** for **each volume gap of FAME** which must be distributed based on the targets in the Decree	Fine of **6,000 IDR/liter** for **each percentage gap of FAME blend ratio** which must be mixed based on total diesel-fuel sales

Source: MEMR Decree No.41 2018, MEMR Decree No.24 2021

Export levy is imposed by BPDPKS to the exporter on various oil palm products and its derivatives with three mechanisms: Zero, Flat and Progressive

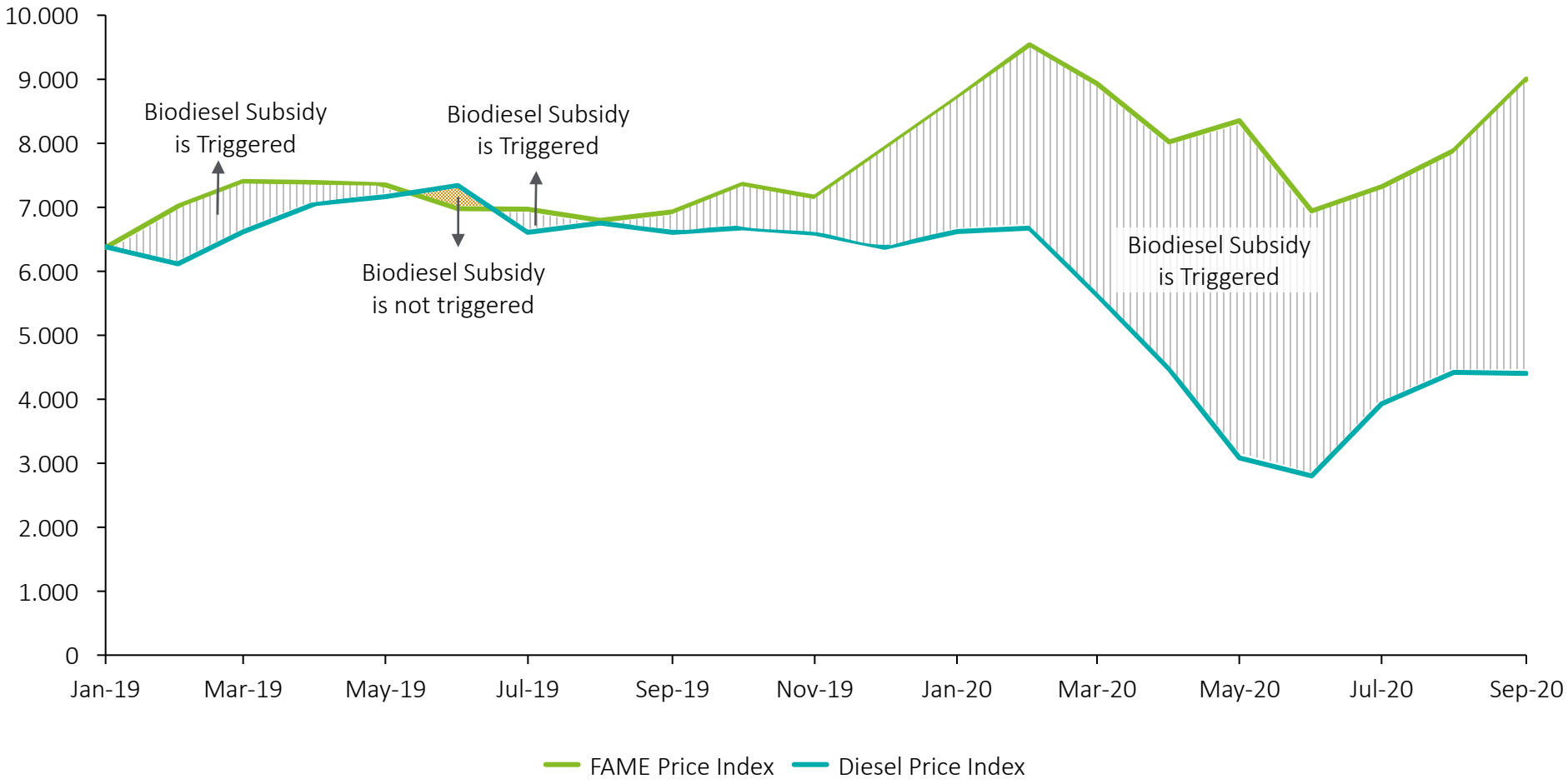
Export Levy Mechanism



Source: MoF Decree no. 115/PMK.05/2022

The fund will be used to fill the gap of FAME and Diesel Price Index, pulling FAME price to the same level as Diesel price when it's triggered

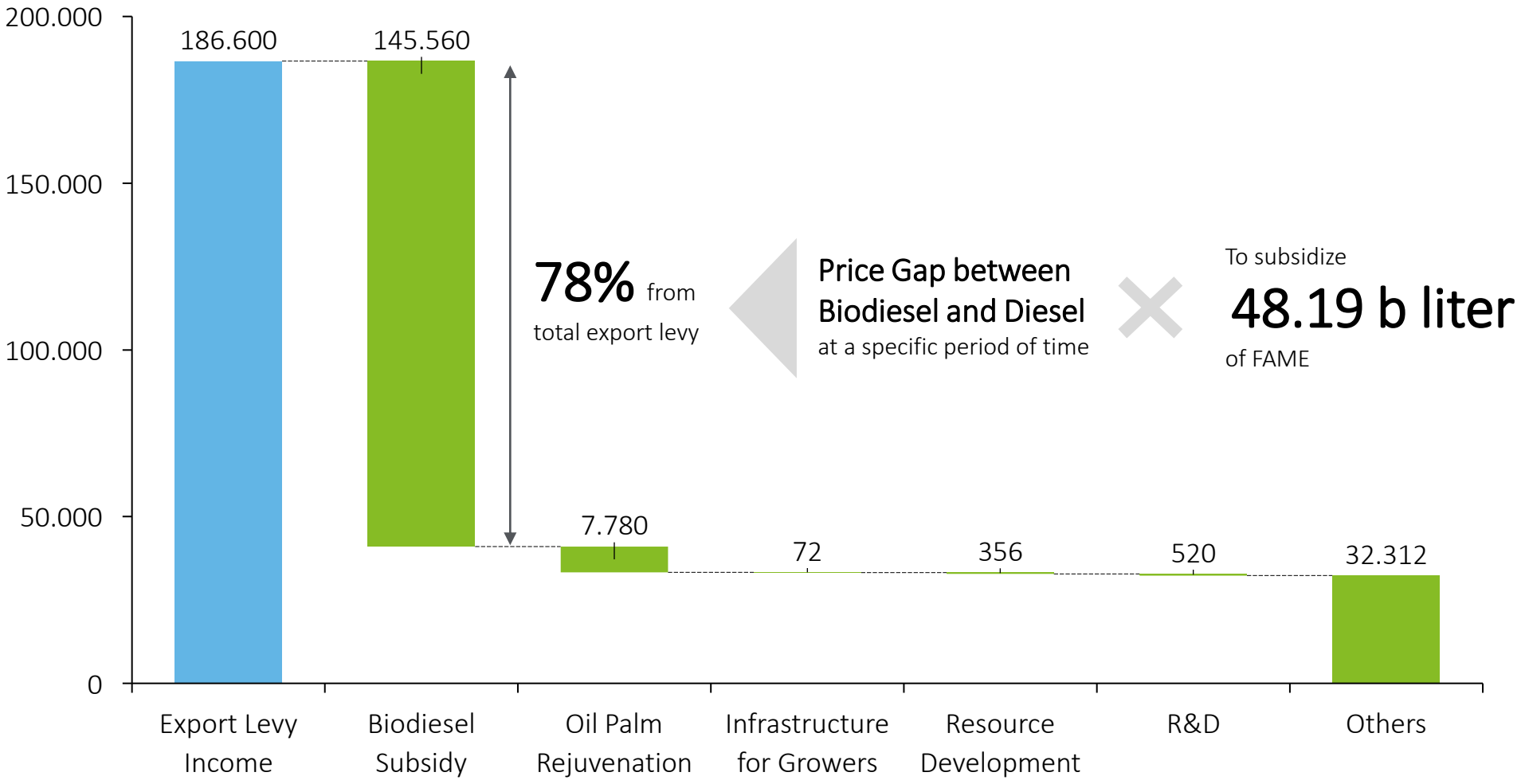
Reference : FAME & Diesel Price Index of 2019 – Sept 2020 (Rupiah/liter)



Source: MEMR price index

In general, the export levy will be used for several purposes, but it's allocated mainly for biodiesel subsidies which will be paid to FAME producers

Reference: BPDPKS Finance (Billion Rupiah) 2015 – May 2023



Source: Special Dialogue Events 2023 – Eddy Abdurrachman, President Director BPDPKS

HVO is an emerging biofuel and has been initiated by KPI under Pertamina; However, high investment and lack of government support still pose bottlenecks

Current HVO (HDRD/D100) Condition in Indonesia

Share of HVO

~0.2%

Share of HVO among total Biodiesel + HVO production[1]

Challenge

High Investment
High Production Cost

are the reason why HVO hasn't penetrated the market

Govt. support

No Incentives/ Subsidy

related to HVO

Usage of HVO

Renewable/Green Diesel

which is the main usage for HVO will be exported internationally

Raw Material

RBD Palm Oil

Is the main raw material for HDRD

Player(s)

PERTAMINA

is the HVO producer with two operating plants in Cilacap & Dumai

(Total cap. : 165 m ltr/year)

[1] = *based on 2022 data*

RBD Palm Oil : CPO that has been Refined, Bleached, Deodorized

HVO : Hydrotreated Vegetable Oil

HDRD : Hydrogenation-derived renewable diesel

The challenges of controlling production costs and addressing consumer appeal in order to create a stable and sustainable biodiesel market

Challenges

Current Challenge			Issues
Lv.3	**Lv.2**	**Lv.1**	
Use of low-quality seeds by local farmers	Unstable Production Amount of CPO	High Production Cost（Budget Squeeze of Subsidy）	Production Cost Containment
Insufficient Agricultural Infrastructure			
Limited Access to the CPO refinery by Local Farmers			
Uncertainty of feedstock Procurement due to multiple use of palm			
Lack of Catalysis material）	High price of catalysis material		
Additional Cost of Producer（Due to Increase in Blending Ration）	Additional Maintenance Cost		
Additional Cost of Consumer（i.e. High Fuel consumption、Additional Maintenance Cost）	Decline in Production Competitiveness	Decline in Biodiesel Demand	Enhancement of Appealing to Consumer
Additional Investment on Car Manufacturer（i.e. Maintaining Engine）	Limited Choice in Car Type		
Deforestation Issues relating to Palm Plant	Negative Opinion to Palm Oil		
Wildfire Issues caused by Palm			
Harassment to Labor			
Inequality for Small-scale Farmers in Contrast with Enterprise			

Source: Book of "BIODIESEL, a long struggle journey" 2021 by MEMR, P3tek, APROBI

The government has addressed some issues, but not cover all of it; some solutions have not been effective in dealing with challenges until its truly resolved

What have been done

Current Challenge Lv.1	Issue	Countermeasures implemented by Government
High Production Cost （Budget Squeeze of Subsidy）	Production Cost Containment	• Part of the funds from the BPDPKS is used to develop small-scale local farmers and their infrastructure to raise the level of local farmers and increase the payback of their production (stable procurement). • MEMR determines biodiesel quotas for each CPO producing company every year to ensure stable procurement of biodiesel.
Decline in Biodiesel Demand	Enhancement of Appealing to Consumer	• In 2011, MoA launched the Indonesian Sustainable Palm Oil (ISPO) and certification system, which is mandatory for enterprises and voluntary for small farmers • In 2019, President Jokowi issued Presidential Decree (INPRES) 2019-2024 National Action Plan for Sustainable Oil Palm Plantations (NAP SPO)

Source: Book of "BIODIESEL, a long struggle journey" 2021 by MEMR, P3tek, APROBI

Subsidy Simulation

Each of the countries have controlled ethanol-fuel prices to become lower than fossil fuel price with various system and sources; BR, PH, TH and Indonesia applied financial assistance mechanism to control the price

Comparison of price control policy

Country	Price Control Policy	Current Price Condition	Causes of price gaps	Source of the fund	Fund Manager
United States	• **RVO-RIN Mechanism**	Price of ethanol-blended fuel is cheaper than price of the fossil fuel	RVO-RIN mechanism **gave advantages for ethanol producer** and **additional costs** to **fossil fuel producers**	N/A	N/A
Brazil	• **Guaranteed ethanol fuel maximum price**		**Government subsidize ethanol price**	• **Gasoline tax** • **Loan from World Bank** *(in special case)*	**MoE**
Philippines	• **Fuel discount** program		**Government subsidize ethanol price**	**General tax**	**Department of Transportation and Landbank of Philippines** *(state–owned Bank)*
Thailand	• **State Oil Fund subsidy for E20 and E85**		**Government subsidize ethanol price**	• Fuel **Import and Excise tax** • **Loan** from other organization • **Fund** from the government *(in special case)*	**Oil Fuel Fund Office** *(state agency under MoE)*
India	• **Administered cheaper ethanol price** due to tax gap with fossil • Differential ethanol price based on raw material		Government controlled **higher tax for gasoline and lower tax for ethanol**	N/A	N/A
Indonesia (Biodiesel)	• **Export levy** of palm oil (and its derivatives) is used to **subsidize Biodiesel price**		**Government subsidize biodiesel price**	**Export Levy from Palm Oil and its derivatives product**	**BPDPKS** *(state agency under MoE)*

: Tax control (reduce state income) : Financial assistance (coming from state-budget) : Obligation/stipulation

3 main steps have been addressed to better known the capabilities of Indonesia in subsidizing ethanol price

Ethanol subsidy simulation for Indonesia

Step 1 Subsidy Needed

Define the amount of subsidy required based on the acceptable price of ethanol and current ethanol price

- Set the targeted/acceptable ethanol price at ~66% of the average gasoline price
  - ➢ Compare the targeted ethanol price with the current ethanol price to find the price gap
    - Calculate subsidy needed by multiplying price gap with gasoline consumption volume

Step 2 Subsidy Sources

Design and calculate potential subsidy sources from two sources:

- Estimate potential income from **export levy** of excess bioethanol fuel grade
- Estimate the **shifting gasoline subsidy** due to the swap of gasoline-use with ethanol-use in fuel

Step 3 Subsidy Gap

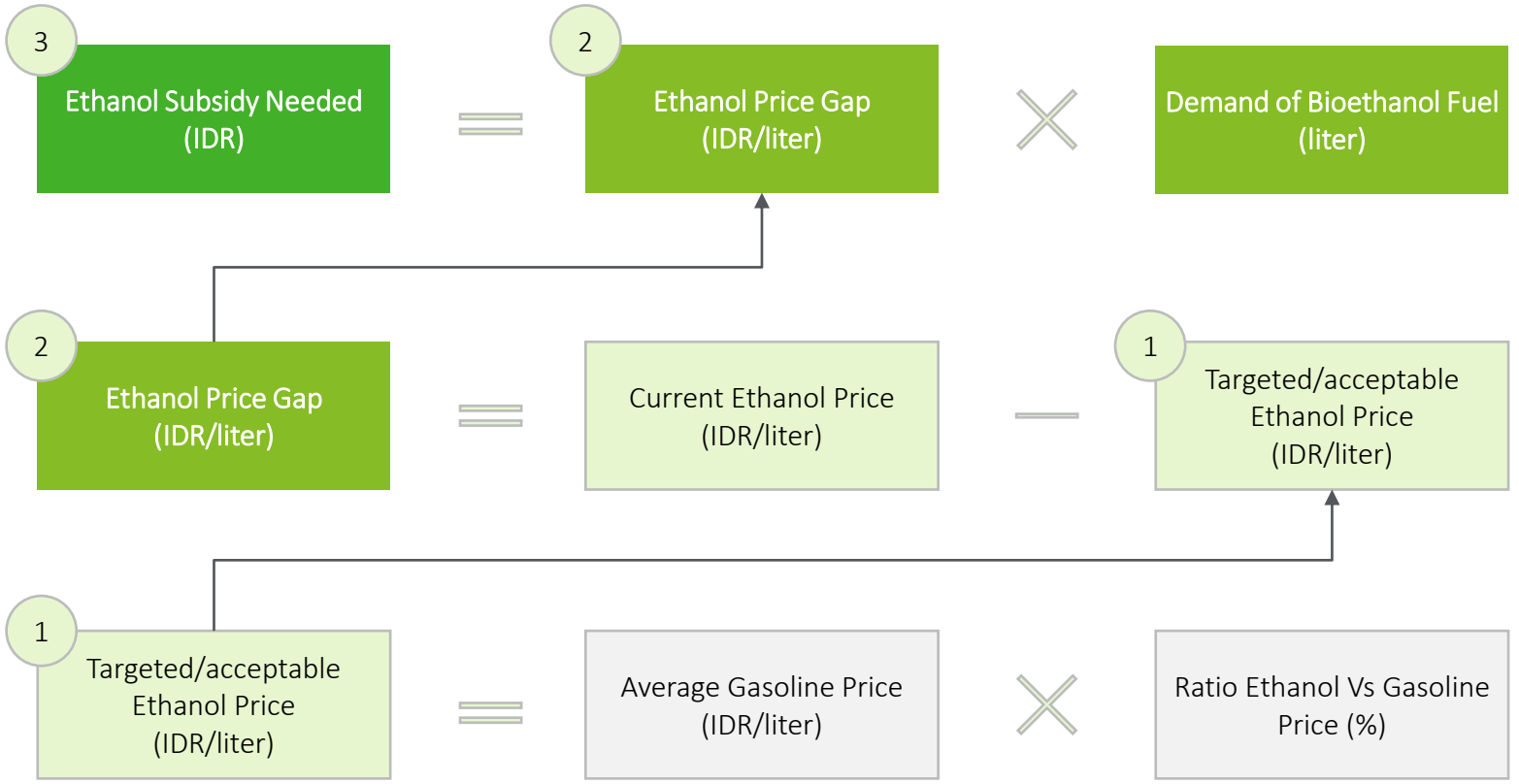
Summarize and compare the amount of subsidy needed and the potential subsidy sources that have been estimated

- Design and develop several scenario(s) to bridge the gap
  - ➢ Calculate fuel import reduction as an alternative subsidy source

Subsidy Needed

The formula to define the amount of ethanol subsidy needed is as below

Ethanol Subsidy Needed



Using average gasoline price and 66% ratio as the targeted ethanol price, the targeted ethanol price is ~6,940 IDR/liter

①Targeted/acceptable Ethanol Price

Average Gasoline Price (IDR/liter)

	Unit	Gasoline RON 90	Gasoline RON 92	Gasoline RON 92 above
Price Reference *Refer to Pertamina as of Jan 2024* *Source: CNBC*	IDR/liter	10,000 *represented by Pertalite price*	12,950 *represented by Pertamax price*	~14,400 *represented by Pertamax Turbo price*
Consumption Volume *Source: MEMR Handbook Energy Outlook 2022*	Mil liter	29,685	5,773	319

- **Weightage average fuel price across all RONs** *by taking into account the consumption volume in 2022*: **10,515 IDR/liter**

×

Ratio Ethanol Vs Gasoline Price (%)

- Ethanol price is **referred from Brazil's case at 66%** of the gasoline price

**note: 66% is based on the energy level degradation for ethanol compared to fossil fuel*

Lesson learns from Brazil's

4 Using Gasoline Taxes and loans from World Bank to **control ethanol price not exceed 66% of the gasoline price**

*Brazil controls the ethanol price by **maintaining the price not to exceed 66% of the gasoline price**; this will then give more favor to the consumer and increase ethanol fuel attractiveness*

=

Targeted/acceptable Ethanol Price (IDR/liter)

- As a result, the targeted or acceptable ethanol price (subsidized price) in below:

$$\max 66\% \; x \; 10{,}515 \; IDR/liter <= 6{,}940 \; IDR/liter$$

The current ethanol price is ~14,741 IDR/liter; therefore, there would be a price gap of 7,801 IDR/liter. This will be a targeted ethanol subsidy per liter by the government

②Ethanol Price Gap

Current Ethanol Price (IDR/liter)

- Ethanol price is referred from MEMR biofuel market price index for bioethanol that will be released every month
- **Bioethanol fuel grade price** *(in January 2024)* : **14,741 IDR/liter**

Source: Biofuel Price Index by MEMR

Targeted/acceptable Ethanol Price (IDR/liter)

- Targeted or acceptable ethanol price (subsidized price) is <= $\mathbf{6,940\ IDR/liter}$

Ethanol Price Gap (IDR/liter)

- Ethanol price gap *(between current ethanol price Vs targeted ethanol price)*:

$$14{,}741\ IDR/liter - 6{,}940\ \text{IDR/liter} = \mathbf{7{,}801\ IDR/liter}$$

- This gap will later be a **targeted subsidy per liter needed** to control the price of ethanol by the government

The price gap is multiplied by the volume of bioethanol fuel demand to get the amount of ethanol subsidy needed, as shown in the figure on the last row

③Ethanol Subsidy Needed

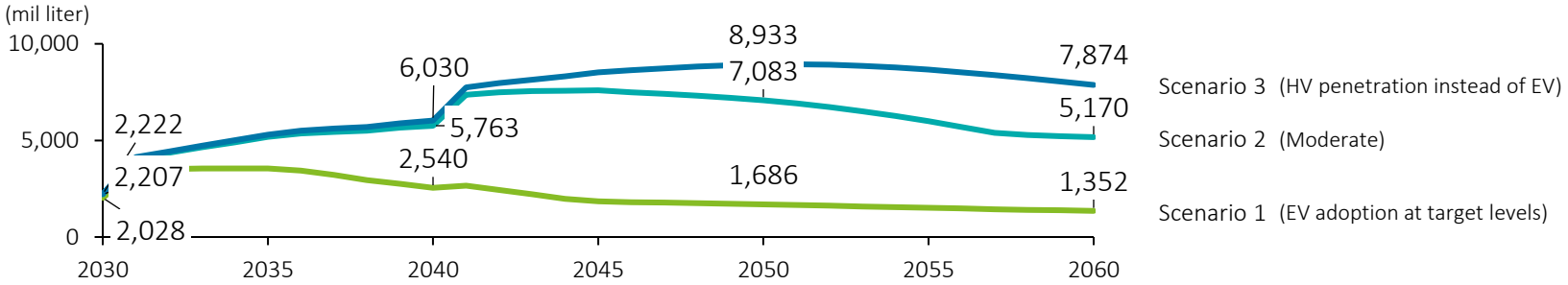
Ethanol Price Gap (IDR/liter)

- Ethanol price gap *(between current ethanol price Vs targeted ethanol price)*: **7,801 IDR/liter**

×

Demand of Bioethanol Fuel (liter)

- Total bioethanol demand including all 4W and 2W refer to Phase 1 calculation



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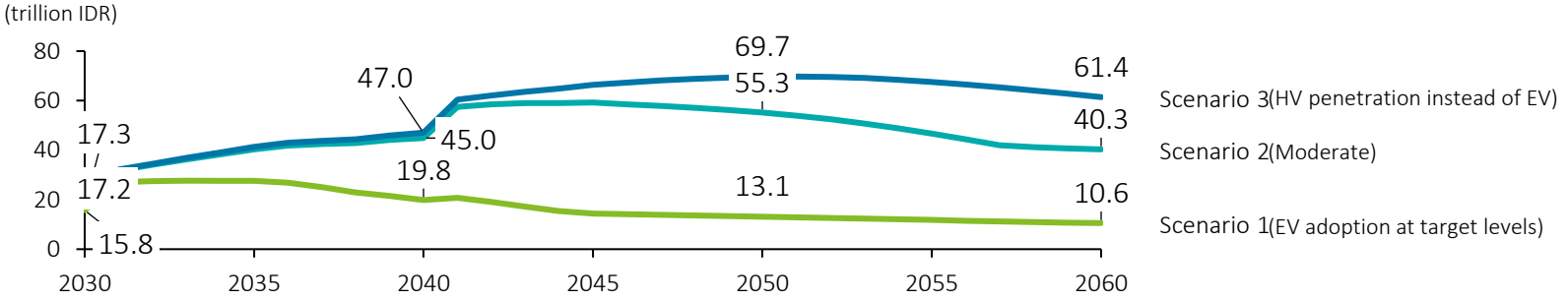
Ethanol Subsidy Needed (IDR)

- Ethanol subsidy needed from 2030 to 2060

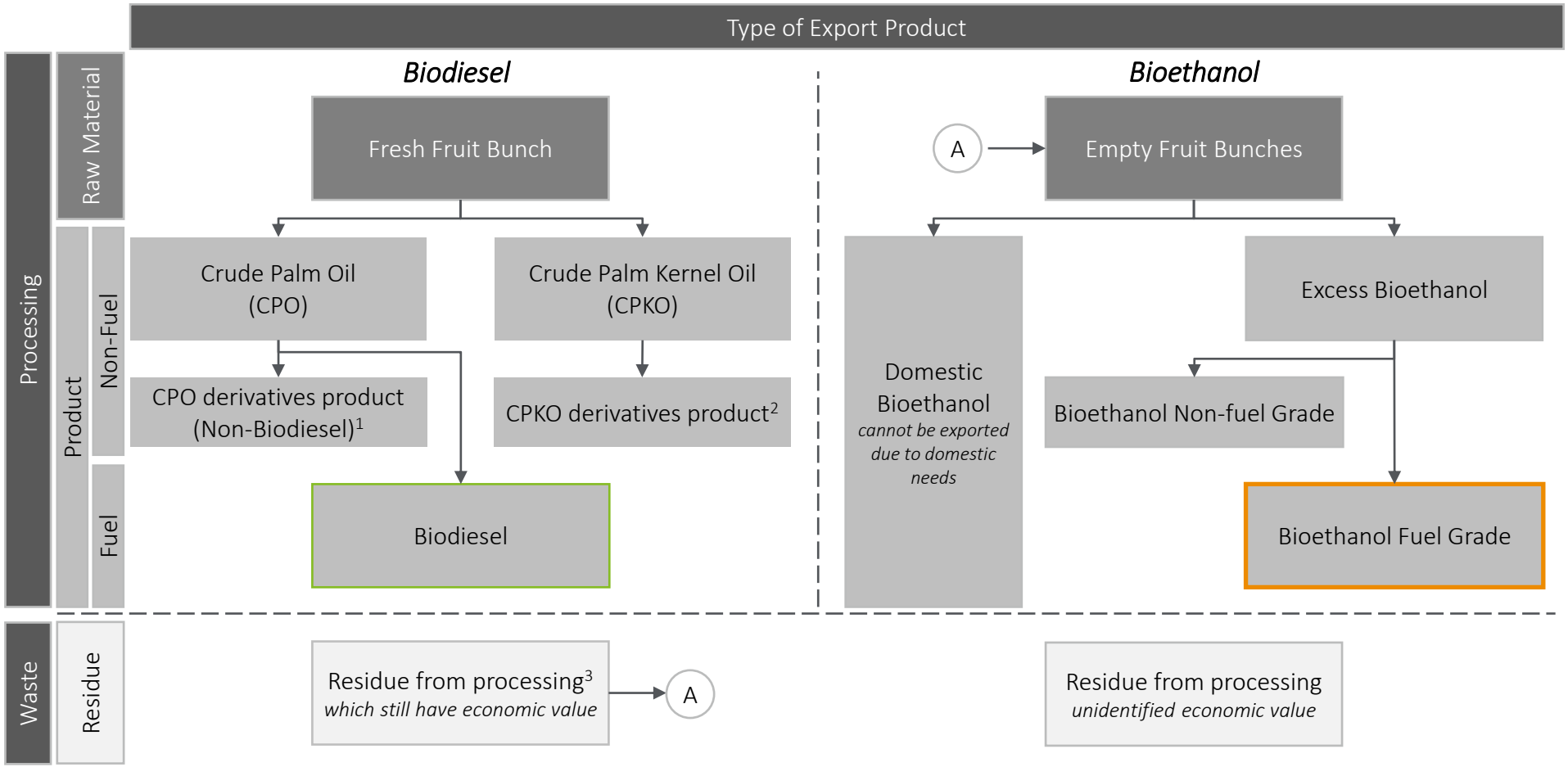


Subsidy Sources

Subsidy Sources – Export Levy

To find the equivalent export levy mechanism in bioethanol case, benchmarking biodiesel is being done to get the equivalent type of product and type of export levy

Type of export product comparison between Bioethanol and Biodiesel case



[1]*CPO derivatives product (Non-Biodiesel)* : *RBDP oil, RBDP olein, RBDP stearin,* Palm Fatty Acid Distillate (PFAD), Split Palm Fatty Acid Distillate (SPFAD)
[2]*CPKO derivatives product* : *RBDPK oil, RBDPK olein, RBDPK stearin,* Palm Kernel Fatty Acid Distillate (PFKAD), Split Palm Kernel Fatty Acid Distillate (SPKFAD)
[3]*CPO process residue* : *empty fruit bunches, palm oil mill effluent*
[3]*CPKO process residue* : *palm kernels, oil cake, palm kernel shells (flakes)*

 Source: MoF Decree no. 115/PMK.05/2022 : Charged by progressive export levy : Potential charges by export levy

Simulation used the same mechanism, similar ratio and parameter in biodiesel to be adopted by bioethanol; Average export levy fee for bioethanol is ~1,096 IDR/liter

Equivalent export levy mechanism in Bioethanol fuel grade refer from Biodiesel case

Export Levy Mechanism

Export Levy

Existing — Biodiesel

- Type of Levy : **Progressive Export Levy**
- Parameter of progressivity : **Crude Palm Oil Price** *by MoT*
- Level of sensitivity : **every 50$/ton** (~3-6% of the CPO price)
- Parameter of CPO Price
  - Lowest : 750 USD/ton
  - Highest : 1,500 USD/ton

CPO Price		<=750	<=800	<=850	<=-900	<=-950	<=1000	<=1050	<=1100	<=1150	<=1200	<=1250	<=1300	<=1350	<=1400	<=1450	<=1500	>1500
Export Levy	USD/ton	25	35	45	55	60	65	70	75	80	85	90	107	124	141	158	176	194
Ratio	%	3.3%	4.4%	5.3%	6.1%	6.3%	6.5%	6.7%	6.8%	7%	7.1%	7.2%	8.2%	9.2%	10.1%	10.9%	11.7%	12.5%
Avg. Ratio	%	7.6%																

Simulation — Bioethanol Fuel Grade

- Type of Levy : **Progressive Export Levy**
- Parameter of progressivity : **Bioethanol Price** by MEMR
- Level of sensitivity : **~ 500 IDR/liter** (~3-4% of the Bioethanol price)
- Parameter of Bioethanol Price *(Sept 2023 – Feb 2024)*
  - Lowest : 12,725 IDR/liter ~ 0.8 USD/liter
  - Highest : 14,539 IDR/liter ~ 0.92 USD/liter

Average Bioethanol Price Fuel Grade *(Sept 2023 – Feb 2024)*	IDR/liter	13,536 ~ 0.86 USD
Moderate Export Levy (avg. 7.6%)		1,029 ~ 0.07 USD
High Export Levy (12.5%)		1,692 ~ 0.11 USD

Exchange rate = 1 USD ~ 15,800 IDR

Source: MoF Decree no. 115/PMK.05/2022

Then, using the excess supply of bioethanol as the export product, the income estimation from export levy fee is calculated across all demand scenario(s)

Subsidy Source(s) from Export Levy Calculation

Formula

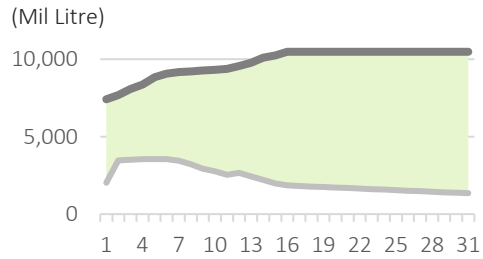
Excess Bioethanol (liter) × Average Export Levy (IDR/liter) = Potential Subsidy Source from Export Levy (IDR)

Estimation

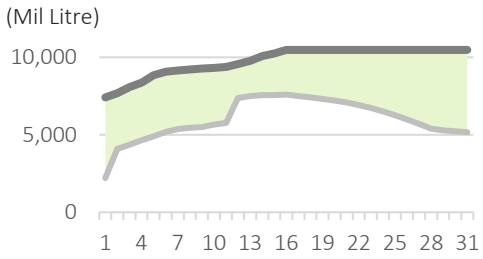
Excess Bioethanol (liter)

- Excess bioethanol is the gap between new supply calculation with 20% EFB utilization rate and demand

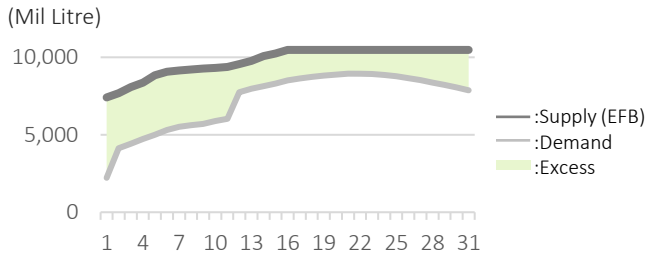
Scenario1: EV adoption at target levels



Scenario2: Moderate



Scenario3: HV penetration instead of EV



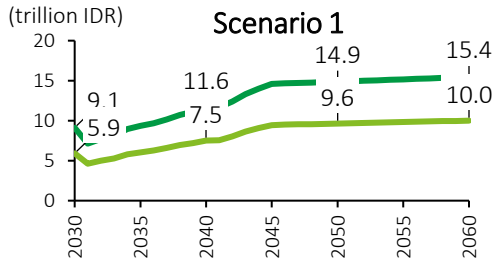
× Avg.Export Levy (IDR/liter)

- **Moderate export levy** for bioethanol fuel grade export = **1,096 IDR/liter**
- **High export levy** for bioethanol fuel grade export = **1,692 IDR/liter**

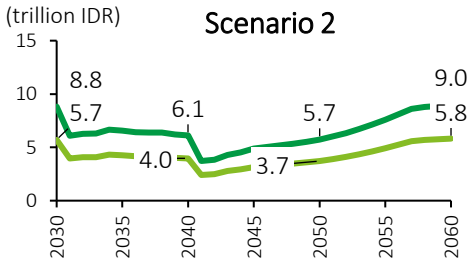
= Potential Subsidy Source from Export Levy (IDR)

- Potential subsidy from export levy of excess bioethanol fuel grade is shown as below:

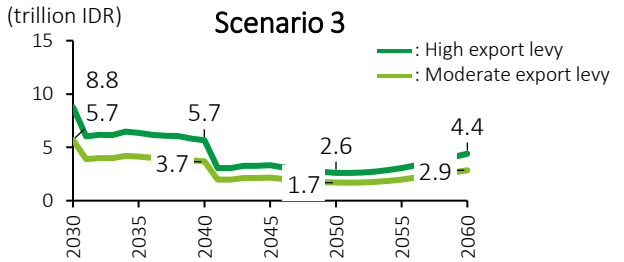
Scenario 1



Scenario 2



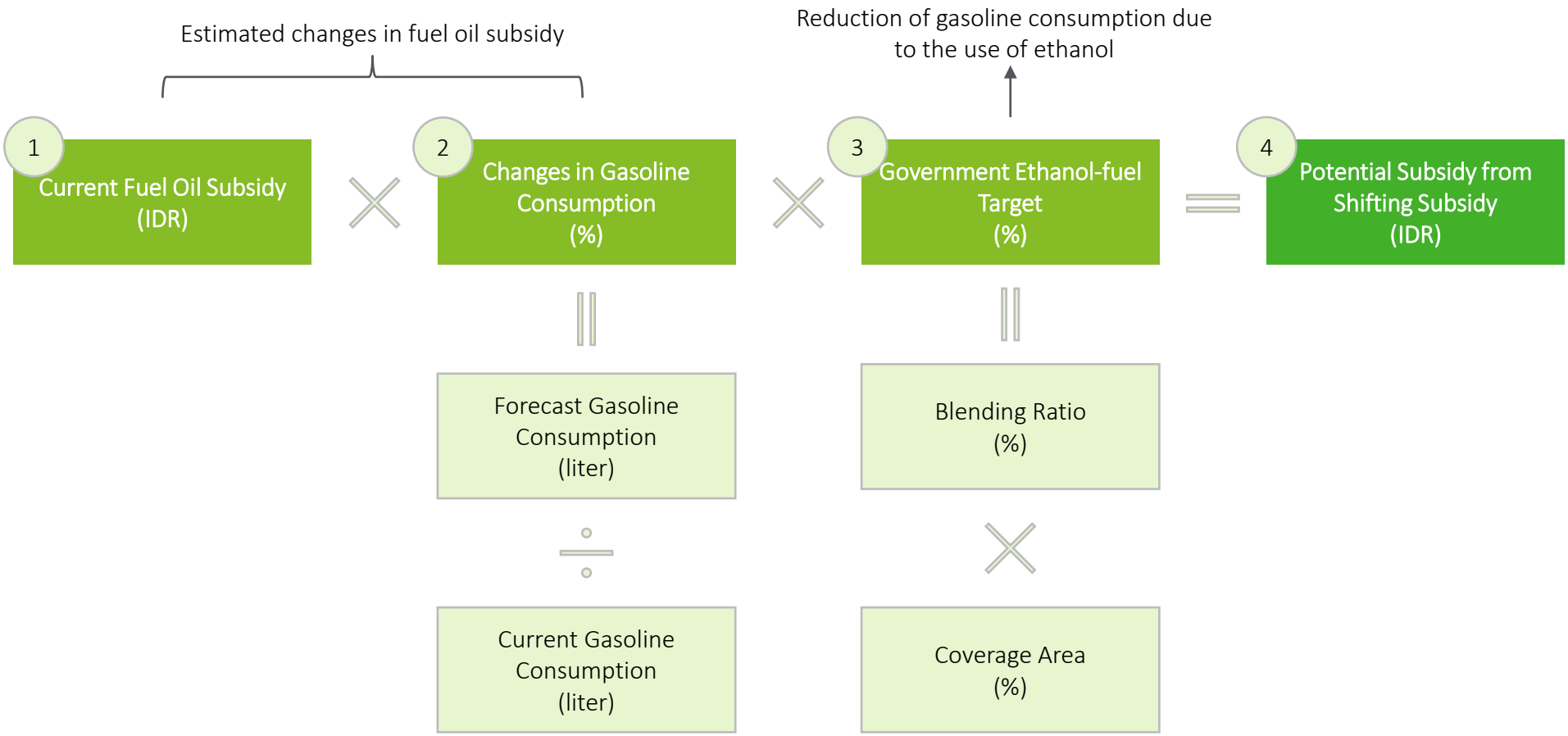
Scenario 3



Subsidy Sources – Shifting Subsidy

The formula to calculate the amount of subsidy sources from shifting subsidy is as below

Subsidy Source(s) – Shift from current gasoline subsidy (2)



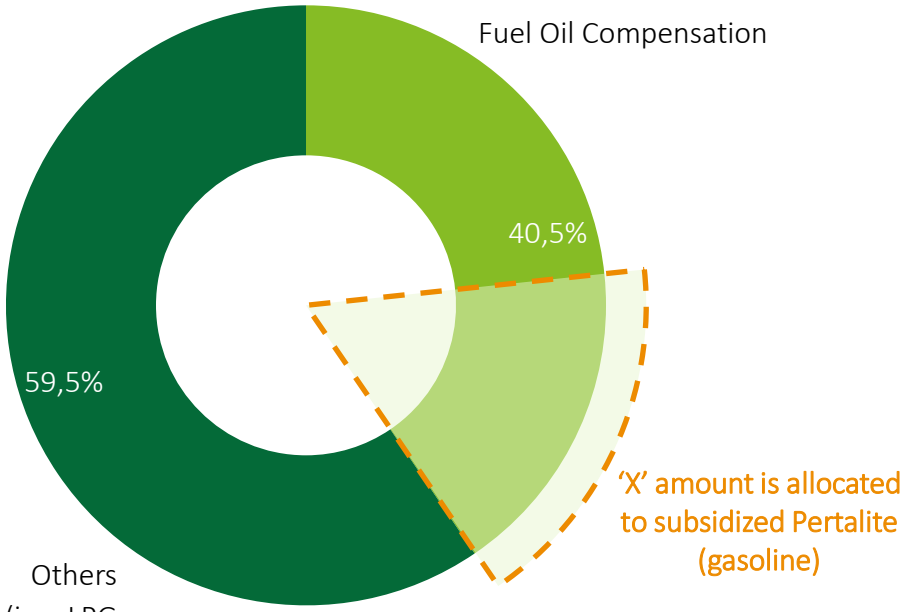
Other alternative subsidy sources coming from the existing gasoline subsidy, the government allocated state budget to subsidize Pertalite (RON 90)

①Gasoline subsidy overview

Gasoline Subsidy Budget & Source

Energy Subsidy & Compensation

based on state revenue and expenditure budget 2022



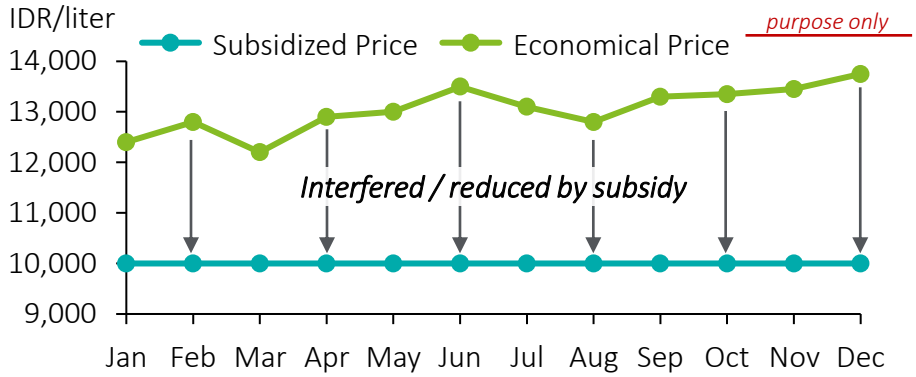
Source: MPR, MoE, CNBC

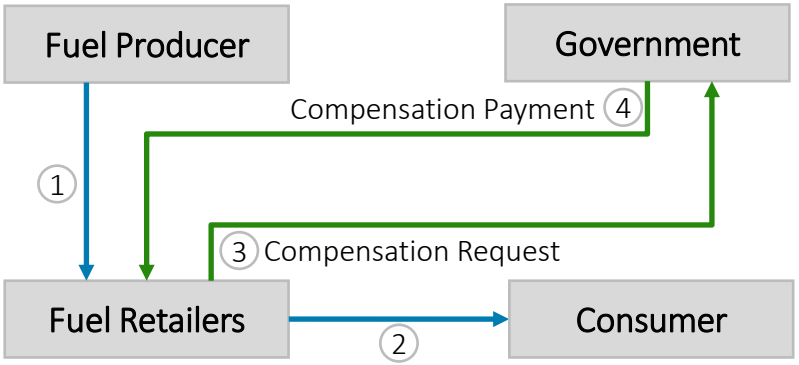
Source of the funds:

- **Tax**
- **Customs and excise**
- **State income** (exclude tax) e.g., administrative fee, dividend

Compensation Mechanism

For illustration purpose only





Legends

: Flows of Goods

: Flows of Subsidy

1. **Buy and sell transaction of gasoline** (fuel import or domestic production)
2. **Selling to the end-user at subsidized price level**
3. **Recap and request of the profit compensation** due to the controlled selling price (subsidy)
4. **Compensation payment** from state budget

The estimated gasoline (Pertalite) subsidy in 2022 is ~159.9 trillion IDR, and in 2023 is ~60.1 trillion IDR; increase in subsidized gasoline price is the key differentiator

① Pertalite's subsidy estimation

Gasoline (<RON 95) Retail Price Formula

$$Economical\ Price = Basic\ Price + VAT + MFVT$$

$$Basic\ Price = Price\ Index + 1{,}800 + 10\%\ margin$$

$$Subsidy = [Basic\ Price\ - Subsidized\ Retail\ Price]\ x\ volume$$

Notes

Economical Price : An economical prices which should be applied to the consumer that has been imposed by tax for the government (IDR/liter)
Basic Price : Reference production cost that has included supply chain cost & profits (IDR/liter)
Price Index : Average price of MOPS or Argus last month (USD/barrel)
Conversion to IDR/liter:
a) Average of exchange rate (middle rate) in Bank Indonesia last month
b) 1 barrel ~ 159 liter
1,800 : Constant number represent the supply chain cost (IDR/liter)
10% margin : 10% from Price Index (IDR/liter) + 1,800 IDR/liter
VAT : Value added tax levied by central government (11% as of Apr 22)
MFVT : Motor Fuel Vehicle Tax levied by local government (vary among each area) (5%)
Subsidy : Later can be called compensation, is the amount of fund that will be paid by the government in order to stabilize gasoline price

Source: Minister of Energy and Mineral Resources Decree Number 245.K/MG.01/MEM.M/2022, House of Representative journal

Parameter	Unit	Amount
Year of 2022		
Compensation	IDR/liter	5,386
Pertalite Volume	Billion liter	29.7
Estimated Pertalite Subsidy	Trillion IDR	**159.9**
Year of 2023 *(additional)*		
Compensation	IDR/liter	2,001
Pertalite Volume	Billion liter	30
Estimated Pertalite Subsidy	Trillion IDR	**60.1**

Assumption used:

-Price Index of MOPS or Argus is adopted from Indonesia Crude Price due to limited information
-Compensation (subsidy) is calculated based on the gap between average economical price and average subsidized price

Disclaimer:
The information above is based on conditions at a certain time period when creating a simulation by considering calculation and/or project requirements. The calculations carried out are not based on actual live conditions, where the data used is average actual data. This calculation was made to provide an overview/estimation of the Indonesian government's ability to provide gasoline subsidies which could potentially later be shifted to ethanol subsidies

The subsidized gasoline price was changing in September 2022 by ~130%, this majorly reduce the subsidy amount for gasoline (Pertalite)

Gasoline subsidized price

2022

Pertalite (29.7 billion liter)
Estimated average economical price:
13,830 IDR/liter

Approximate avg. gap
5,386 IDR/liter
(**~40%** from the economical price)

Compensation
Borne by State Budget

Subsidized Price
7,650 IDR/liter – 10,000 IDR/liter

	Month(s) in 2022 (1 = January, 2 = February, etc.)											
	1	2	3	4	5	6	7	8	9	10	11	12
Subsidized Price	7,650 IDR/ltr								10,000 IDR/ltr			

The government **decided to increase the subsidized price, effective from 3 September 2022**
Source: Presidential press conference on September 3, 2022

Reasoning behind the increase of subsidized price for Pertalite

- **Higher crude oil price**
  - (2022) Crude oil price reach it's peak at ~ 113 USD/barrel in May 2022 or ~160% increment compared to Dec 2021
- **Weaker exchange rate of IDR to USD**
  - Rupiah exchange rate weakens against dollar by ~5% in August 2022 compared to Dec 2021
- **Pertalite consumption increase**
  - Pertalite consumption increase ~27% in 2022 compared to 2021

2023

Pertalite (30 billion liter)
Estimated average economical price:
12,001 IDR/liter

Approximate gap
2,001 IDR/liter
(**~17%** from the economical price)

Compensation
Borne by State Budget

Subsidized Price
10,000 IDR/liter

	Month(s) in 2023 (1 = January, 2 = February, etc.)											
	1	2	3	4	5	6	7	8	9	10	11	12
Subsidized Price	10,000 IDR/ltr											

Appendix

Details Estimated Subsidy Calculation for 2022

Year of 2022

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Price Index ICP (USD/barrel)	85.9	95.7	113.5	102.5	109.6	117.6	106.7	94.2	86.1	89.1	87.5	76.7
Exchange Rate (IDR/USD)	14,342	14,308	14,352	14,348	14,357	14,556	14,645	14,951	14,884	14,902	15,317	15,636
Price Index ICP (IDR/liter)	7,747	8,613	10,245	9,250	9,897	10,768	9,831	8,855	8,057	8,350	8,429	7,539
VAT (%)	10	10	10	11	11	11	11	11	11	11	11	11
MFVT (%)	5	5	5	5	5	5	5	5	5	5	5	5
Basic Price IDR/liter)	10,608	11,570	13,383	12,278	12,997	13,964	12,923	11,839	10,952	11,278	11,366	10,376
Economical Price (IDR/liter)	12,176	13,281	15,362	14,216	15,048	16,169	14,963	13,708	12,681	13,059	13,159	12,014
Avg. Economical Price (IDR/liter)	13,830											
Subsidized Price Pertalite (IDR/liter)	7,650	7,650	7,650	7,650	7,650	7,650	7,650	7,650	10,000	10,000	10,000	10,000
Avg. Subsidized Price Pertalite (IDR/liter)	8,433											
Compensation (IDR/liter)	5,386											
Pertalite Volume (bil liter)	29.7											
Estimated Pertalite Subsidy (tril IDR)	159.9											

 Source: Deloitte's research and analysis from various sources

Appendix

Details Estimated Subsidy Calculation for 2023

Year of 2023

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Price Index ICP (USD/barrel)	78.5	79.5	74.6	79.3	70.1	69.4	75.1	82.6	90.2	86.7	79.6	75.5
Exchange Rate (IDR/USD)	15,618	15,463	15,080	15,344	14,953	14,777	14,929	15,039	15,191	15,317	15,645	15,703
Price Index ICP (IDR/liter)	7,715	7,730	7,074	7,657	6,595	6,446	7,048	7,812	8,615	8,354	7,835	7,457
VAT (%)	11	11	11	11	11	11	11	11	11	11	11	11
MFVT (%)	5	5	5	5	5	5	5	5	5	5	5	5
Basic Price IDR/liter)	10,572	10,588	9,860	10,507	9,327	9,162	9,831	10,680	11,572	11,282	10,706	10,286
Economical Price (IDR/liter)	12,241	12,260	11,417	12,166	10,799	10,608	11,382	12,366	13,399	13,063	12,396	11,910
Avg. Economical Price (IDR/liter)	12,001											
Subsidized Price Pertalite (IDR/liter)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Avg. Subsidized Price Pertalite (IDR/liter)	10,000											
Compensation (IDR/liter)	2,001											
Pertalite Volume (bil liter)	30											
Estimated Pertalite Subsidy (tril IDR)	60.1											

 Source: Deloitte's research and analysis from various sources

Using current and forecast gasoline consumption in all demand scenario, the changes in gasoline consumption are calculated in order to estimate future fuel oil subsidy

② Changes in Gasoline Consumption

Forecast Gasoline Consumption (liter)

Formula

Registered Vehicle Volume Forecast (units) × Yearly Distance Travelled (km) × Gasoline Consumption (Liter/km)

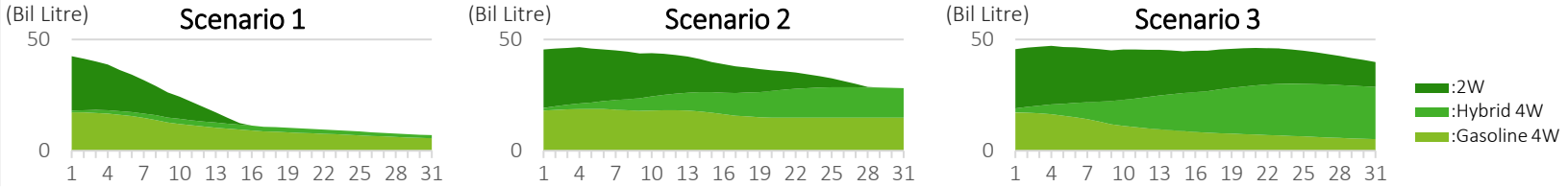
*will repeat for **each vehicle type** (4W Gasoline, Hybrid, and 2W) and **each demand scenario(s)***

Reference

Registered vehicle volume forecast, yearly distance travelled, and gasoline consumption **are referred and use the same assumption as final report in Phase 1**

Result

- Forecast gasoline consumption in 3 scenario(s) based on each type of vehicle

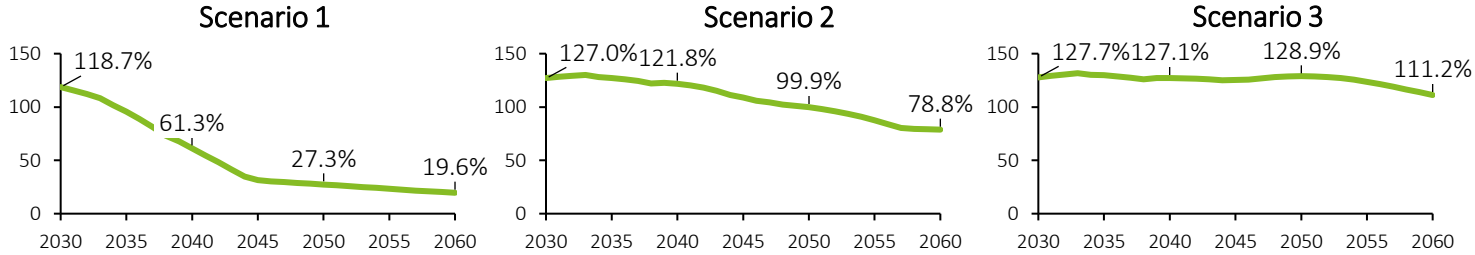


Current Gasoline Consumption (liter)

- Refer to 2022 fuel consumption data as a baseline anchor
- Total gasoline consumption in 2022: **35,795 million liter**

(source: MEMR Handbook Energy Outlook 2022)

Changes in Gasoline Consumption (%)



The use of ethanol fuel is assumed could replace the use of subsidized fuel; Thus, the shifting subsidy from the current gasoline subsidy can be another potential sources

③ Potential Transferable Subsidy to Ethanol-fuel

Government Plan on Ethanol Fuel

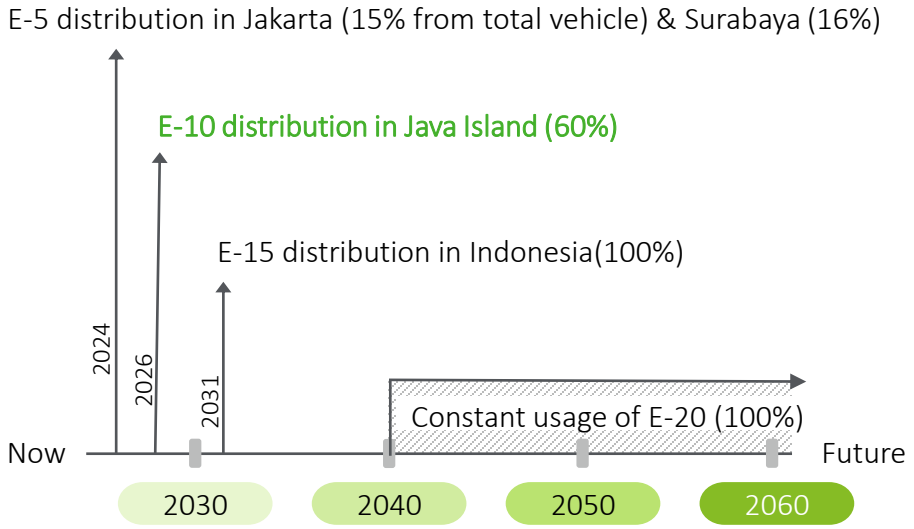
(now - 2030)

Based on Indonesia Bioethanol Roadmap by the government, at least Indonesia plan to implement E10 which is **using 10% ethanol blending**

Assumed scenario of Ethanol Blend Ratio

(2031 - 2060)

Refer to Phase 1 Final Report



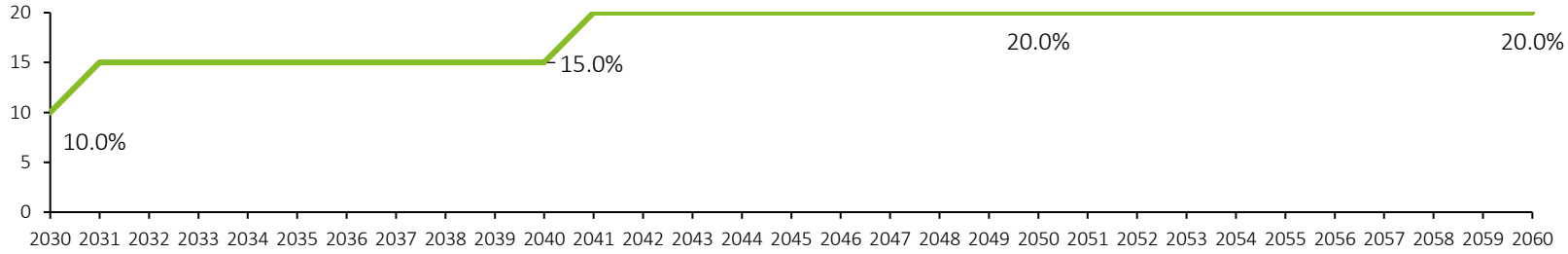
- Using the assumed scenario of ethanol blending ratio (refer to figure above), the exact same amount of fuel oil volume is expected to be replaced by ethanol
  - 2030 = 10%
  - 2031 – 2040 = 15%
  - 2041 – 2060 = 20%
- Since certain volume of gasoline (Pertalite) has been replaced by ethanol, **the current subsidy for the missing Pertalite volume can be transferred to ethanol**

Also taking into account the targeted ethanol utilization among all gasoline consumption refers to government's direction

③Government Ethanol-fuel Target

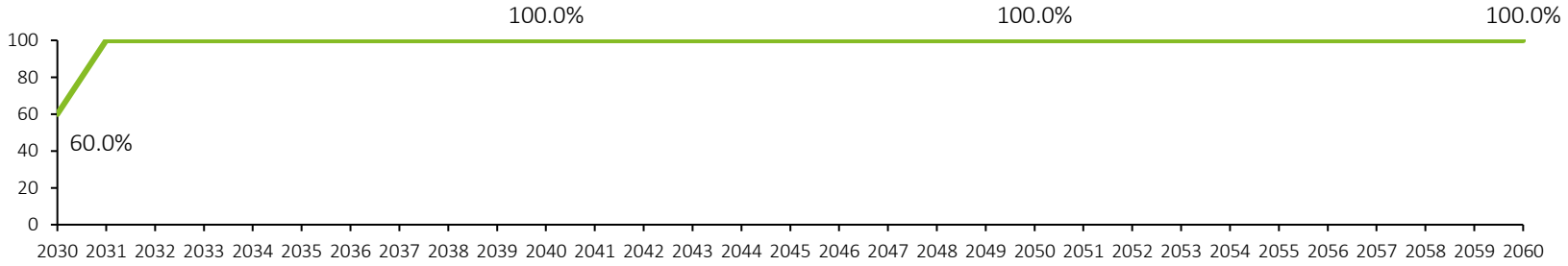
Blending Ratio (%)

- Blending ratio is referred and use the same assumption as final report in Phase 1



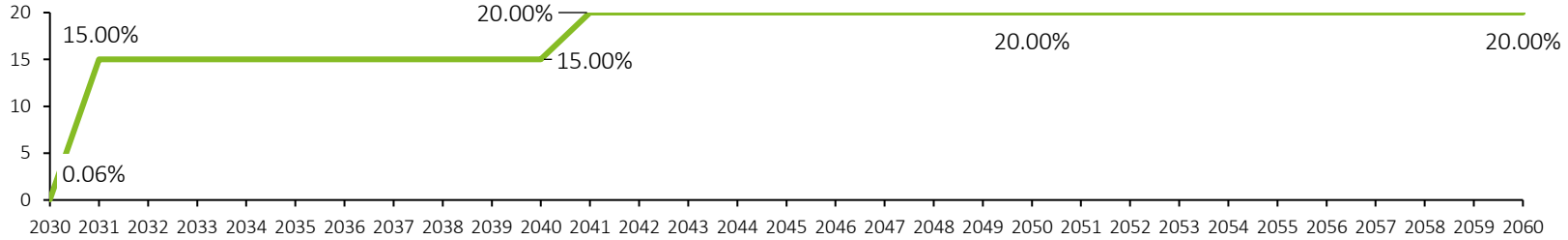
Coverage Area (%)

- Coverage area is referred and use the same assumption as final report in Phase 1



Government Ethanol-fuel Target (%)

- Below is the forecast amount of ethanol fuel percentage compared to total gasoline consumption



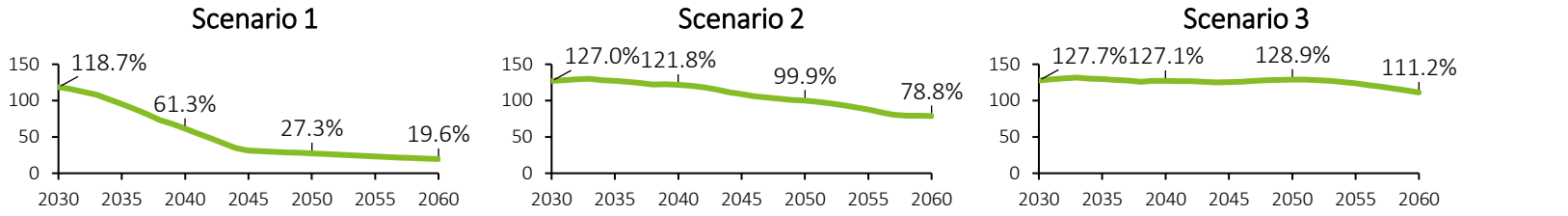
Using the formula, the estimated amount of shifting subsidy caused by the exchange of gasoline with ethanol-use can be calculated, shown in the figure at the last row

④Potential Subsidy from Shifting Subsidy

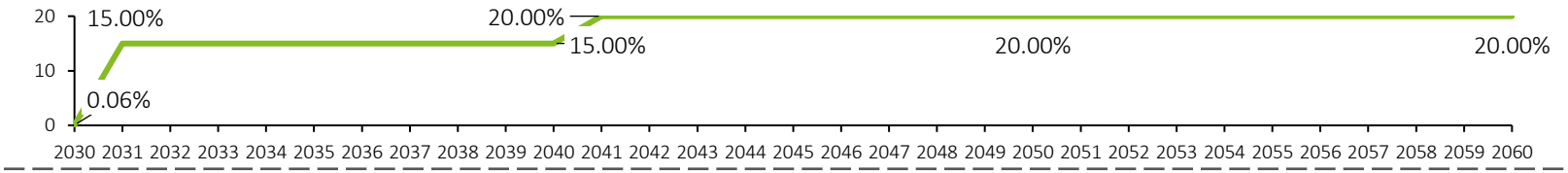
Current Fuel Oil Subsidy (IDR)

- An estimated gasoline (Pertalite) subsidy in 2022 is ~ **159.9 Trillion IDR**
- An estimated gasoline (Pertalite) subsidy in 2023 is ~ **60.1 Trillion IDR**

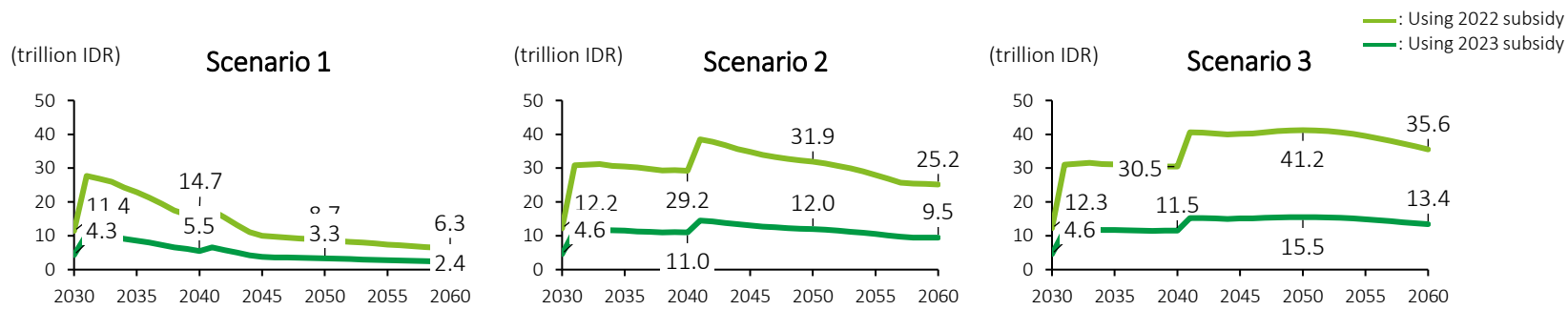
Changes in Gasoline Consumption (%)



Government Ethanol-fuel Target (%)



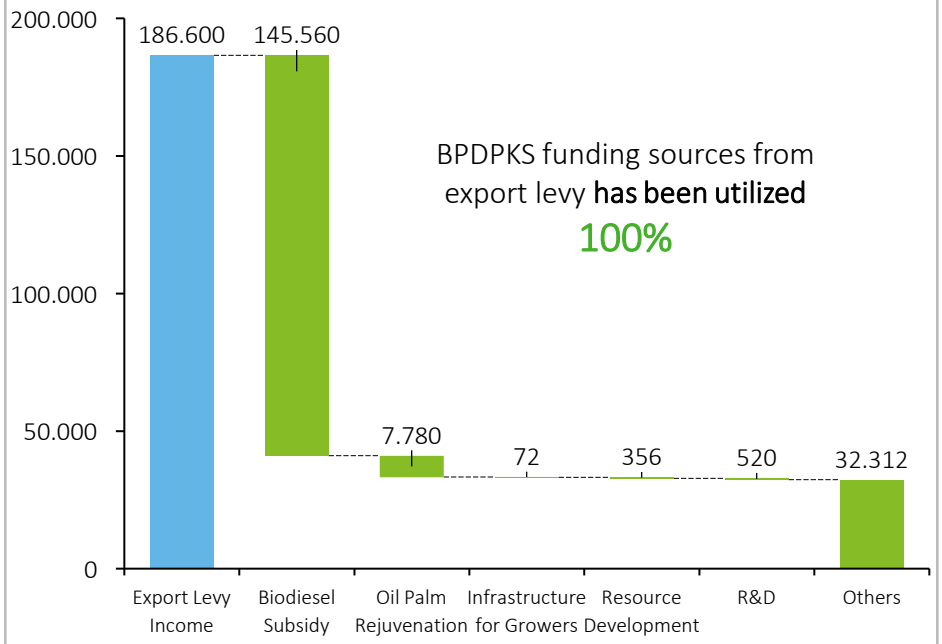
Potential Subsidy from Shifting Subsidy (IDR)



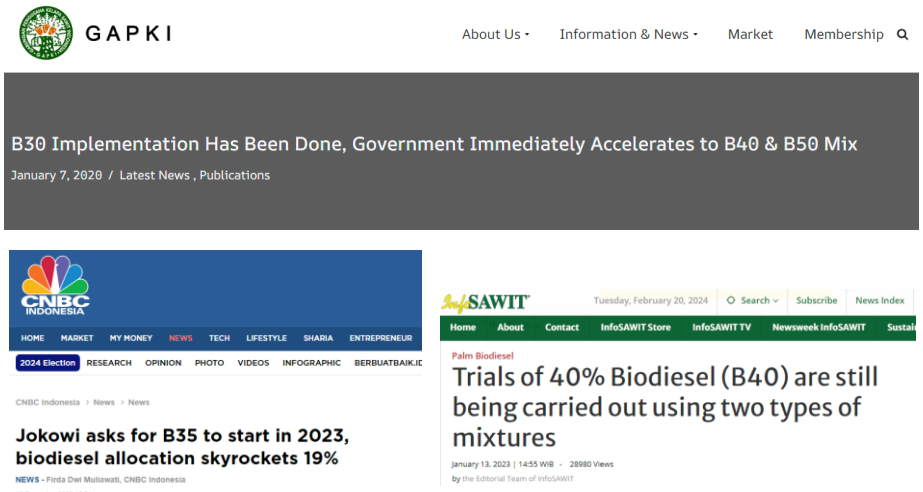
Indonesia can't use the same fund sources as Biodiesel due to the limited sources and plan to increase biodiesel blend ratio, which will increase subsidy need

Current biodiesel subsidy sources in Indonesia

Current Utilization of Biodiesel Funding Sources



Plan to Increase Biodiesel Blend Ratio



Currently, Indonesia has just started with B35, aside from that trials of B40 has already begun. Based on past behavior, the **Indonesian government tends to** keep increasing the biodiesel blend ratio.

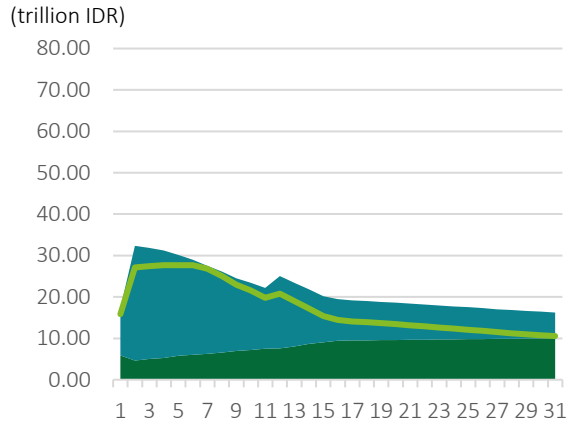
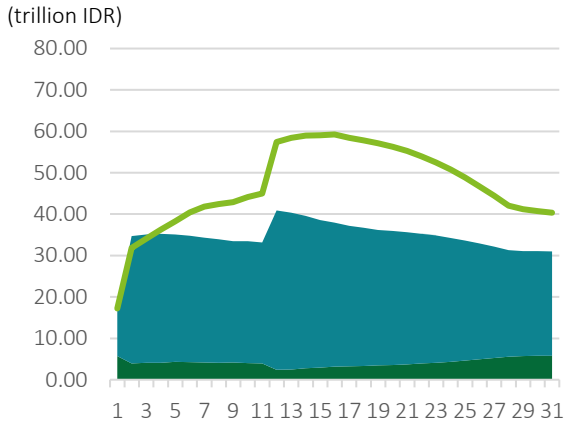
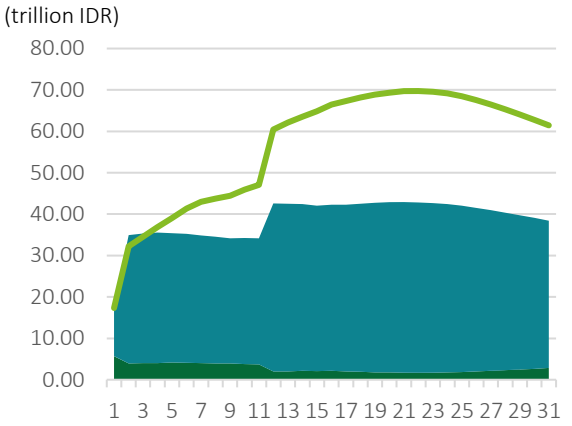
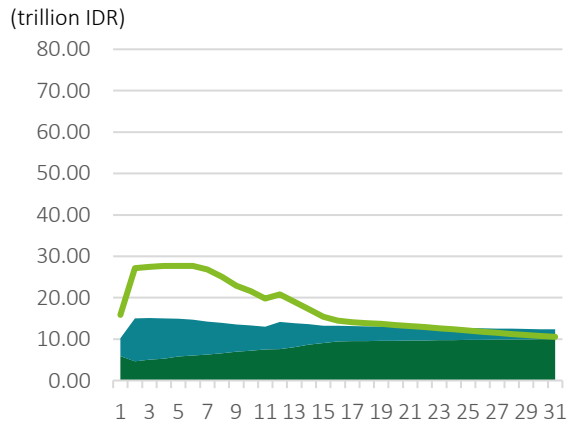
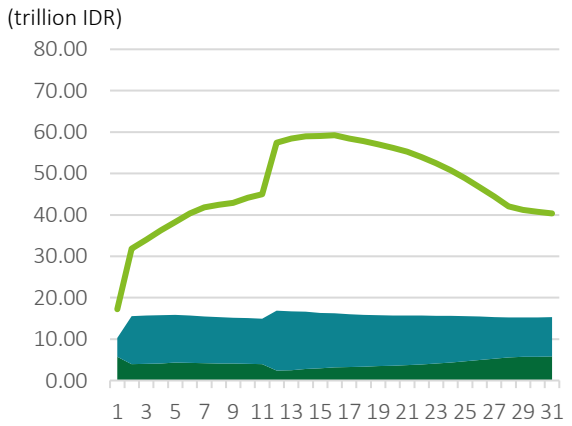
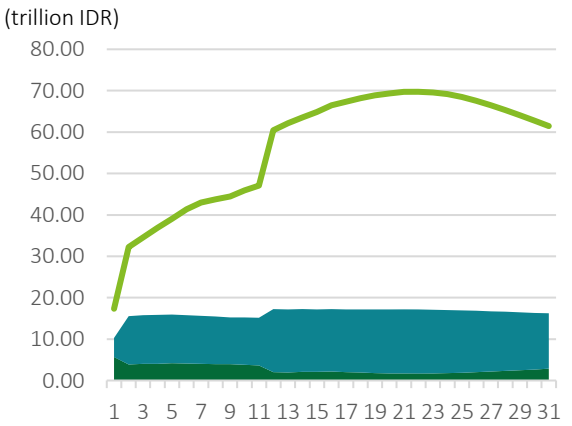
Therefore, Indonesia need to seek another potential funding sources to be used to assist ethanol price stability

Source: ***Special Dialogue Events 2023 – Eddy Abdurrachman, President Director BPDPKS*** *, GAPKI, CNBC, InfoSawit*

Subsidy Gap

Most of the minimum scenario(s) can't fulfill the required ethanol subsidy except Scenario 1 that use 2022 budget as a baseline anchor; otherwise, additional incomes are needed

Subsidy Gap (Minimum Scenario)

	Scenario1: EV adoption at target levels	Scenario2: Moderate	Scenario3: HV penetration instead of EV
Using 2022 Budget			
Using 2023 Budget			

Will be analyzed further

Under BAU (later called the minimum scenario), it's difficult to meet the subsidy needed; therefore, two scenarios have been designed for analysis purposes

Subsidy source(s) scenario

Minimum Scenario

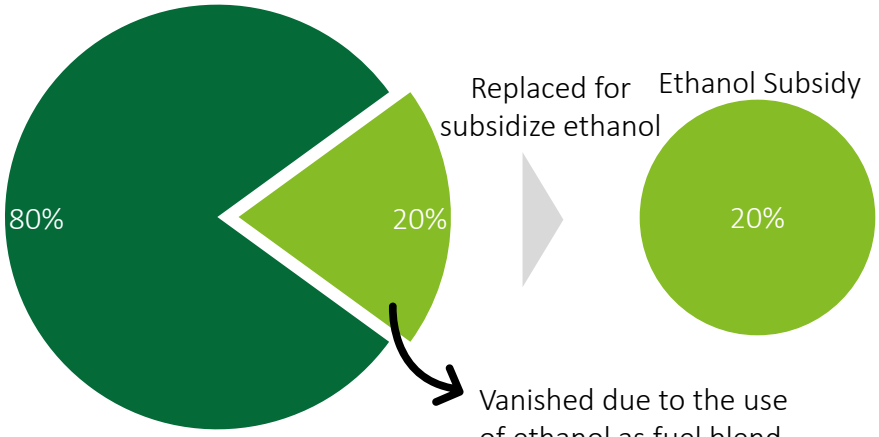
Definition

- Business as usual (BAU) scenario without any additional interference or extra budget needed
- Relatively easy to implement as there will be no drastic changes

Subsidy

For illustration purpose only

Partial shifting subsidy



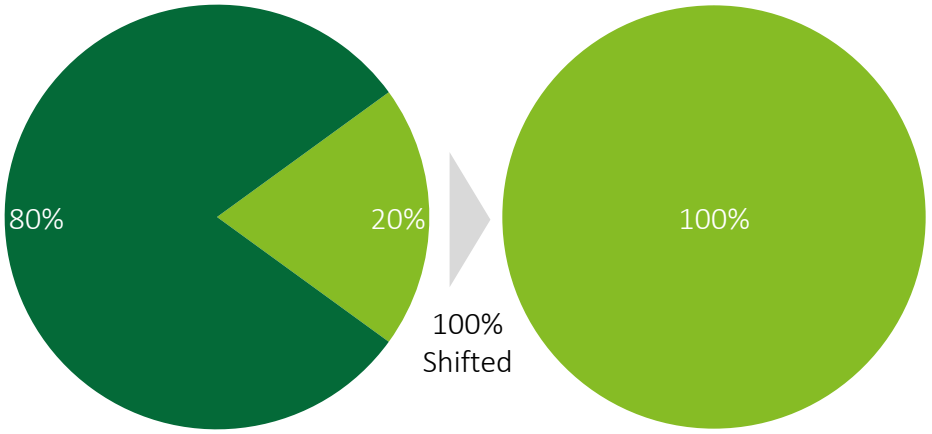
Export Levy

Moderate export levy for bioethanol fuel grade (1,029 IDR/liter)

Maximum Scenario

- Aggressive scenario with additional interference from the government needed to apply drastic changes
- As it will cause major changes, it is needed to consider the implementation roadmap and its potential impact strategically

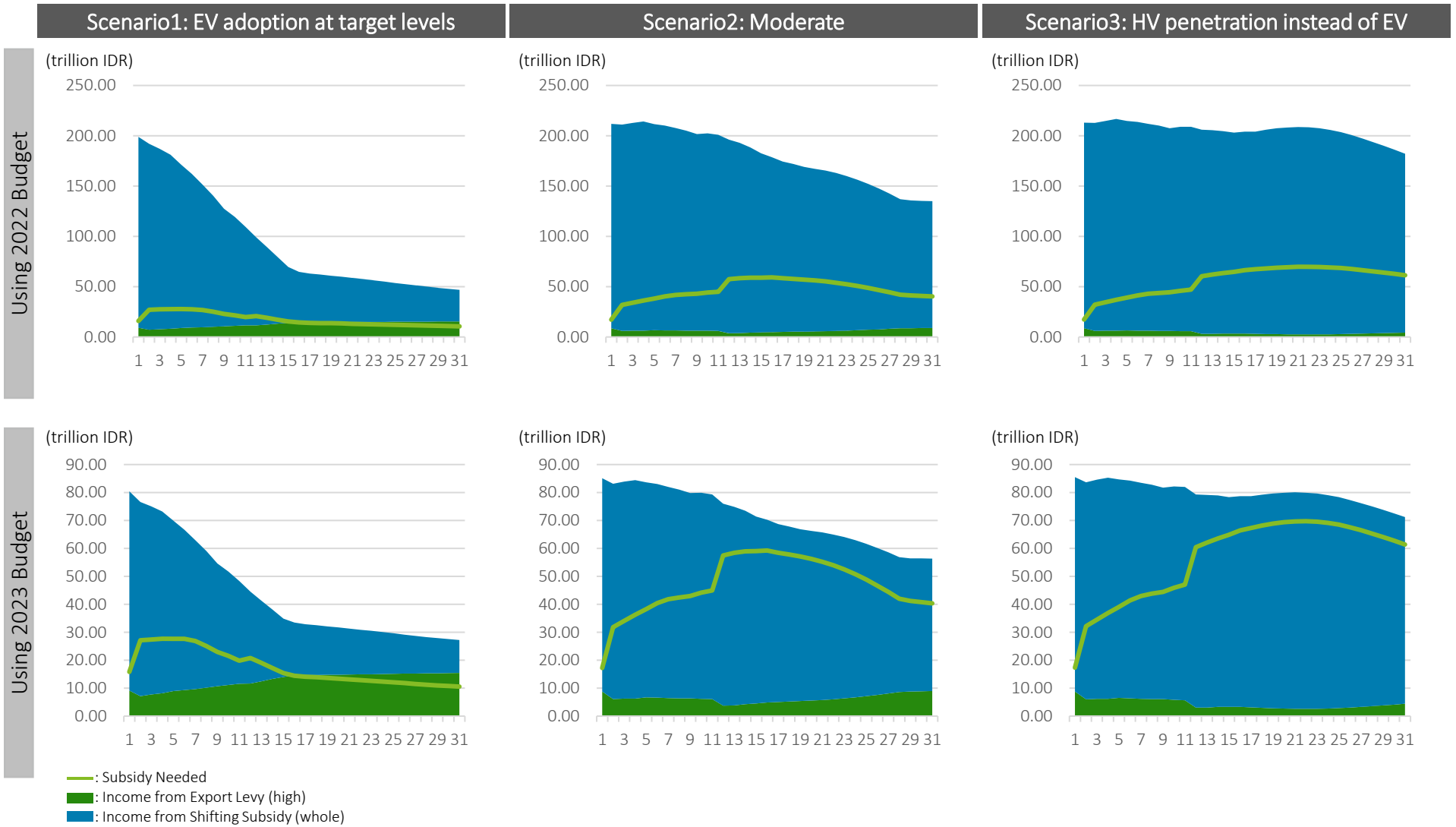
Whole shifting subsidy



High export levy for bioethanol fuel grade (1,692 IDR/liter)

On other hand, maximum scenario(s) offer great alteration to achieve the required ethanol subsidy, even under the most pessimistic condition

Subsidy Gap (Maximum Scenario)



For further analysis in minimum scenario (using 2023 budget), the remaining gasoline subsidy is assumed to be used to close the subsidy gap; However, this could have an impact on changes in the price of the Pertalite subsidy

Further analysis to close the gap

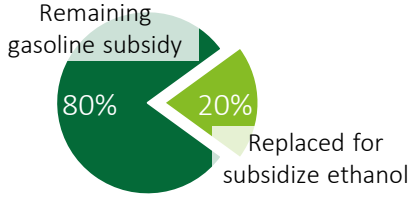
For illustration purpose only

Base Logic

Partial shifting subsidy (*old*)

With the use of ethanol, certain portion of the gasoline subsidy is transferred to subsidized ethanol

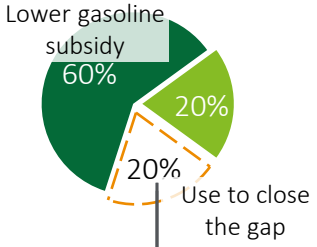
Pertalite Subsidy Distribution



Partial shifting subsidy (*new*)

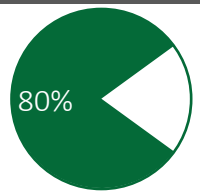
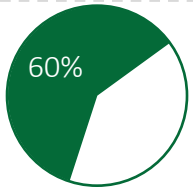
The remaining gasoline subsidy is used to close the gap

Pertalite Subsidy Distribution

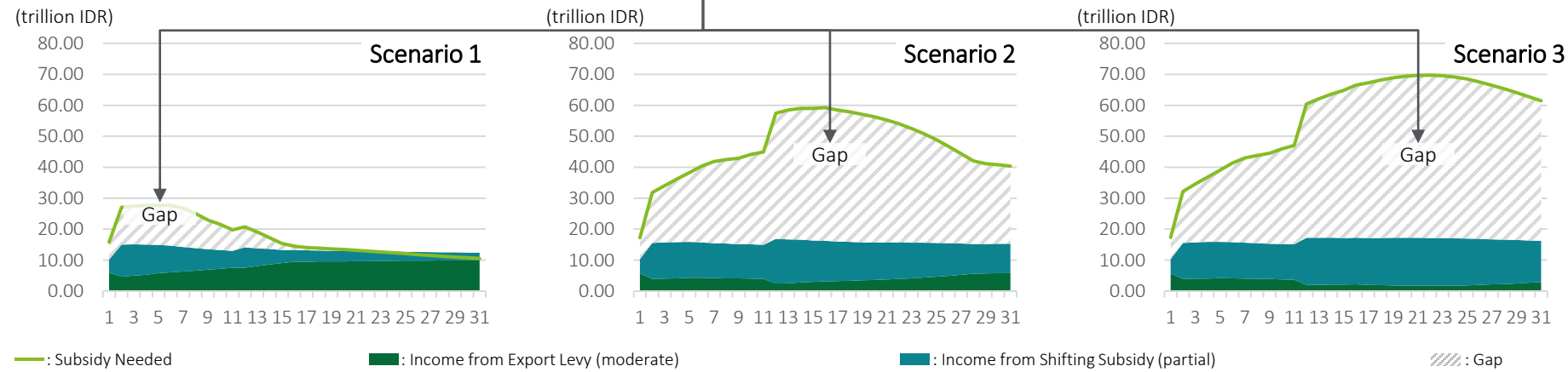


Impact on Subsidized Price Level for Pertalite

"The lower gasoline subsidy will affect the subsidized price level"

Remaining Subsidy Changes	Subsidized Fuel Volume	Subsidized Fuel Price
	Same amount of Pertalite volume	10,000 IDR/liter
		*?? IDR/liter* *Will be estimated in the next pages*

Min. scenario(s) using 2023 Budget



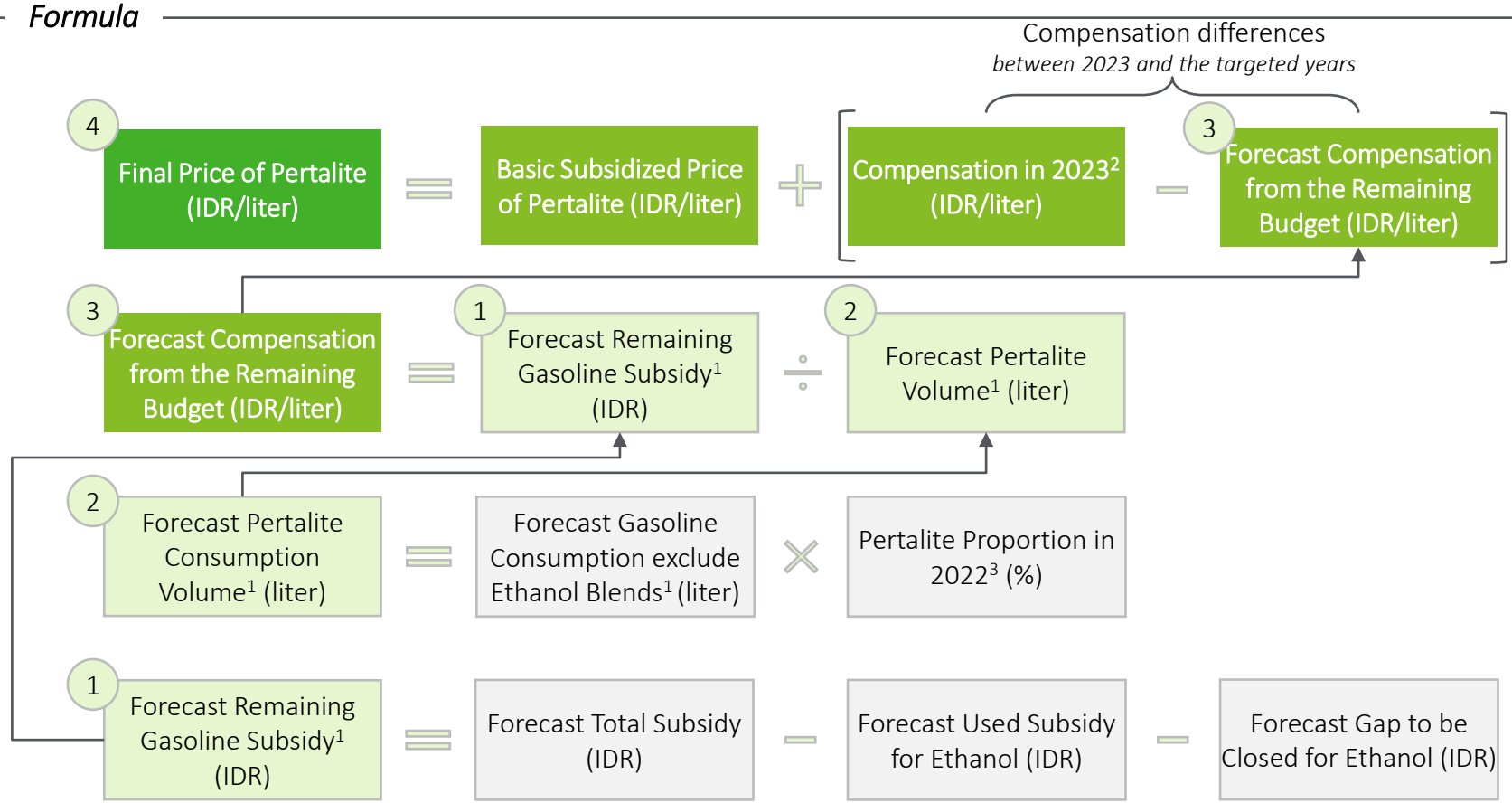
The pre-conditions and the formula to calculate the impact on subsidized price level are as below

Impact on Subsidized Price Level Calculation

Pre-condition

- [1]Assumed there will be no fluctuation of oil price, inflation and economic growth
- [2]All situation and condition are referred from 2023 case (amount of compensation, oil price, subsidy, subsidized gasoline volume, etc.)
- [3]Gasoline type by RON proportion are assumed to be the same with 2022 case

Formula



The details calculation on part ① is as below

①Forecast Remaining Gasoline Subsidy

Forecast Total Subsidy (IDR)

Current Fuel Oil Subsidy (IDR) ×

Changes in Gasoline Consumption (%)

- Using the previous calculation in subsidy source - shifting gasoline - ①
- An estimated gasoline (Pertalite) subsidy in 2023 is ~ **60.1 Trillion IDR**

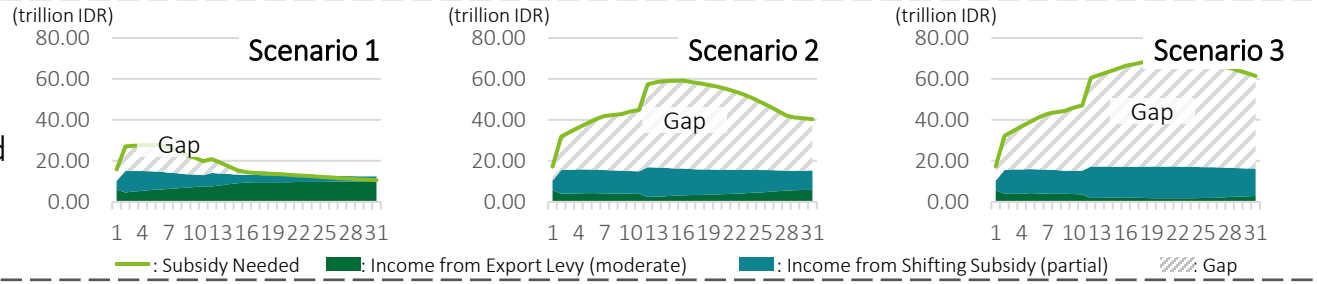
Using the previous calculation in subsidy source - shifting gasoline - ② - Changes in Gasoline Consumption (%)

Forecast Used Subsidy for Ethanol (IDR)

Using the previous calculation in subsidy source - shifting gasoline - ④ - Potential Subsidy from Shifting Subsidy (IDR)

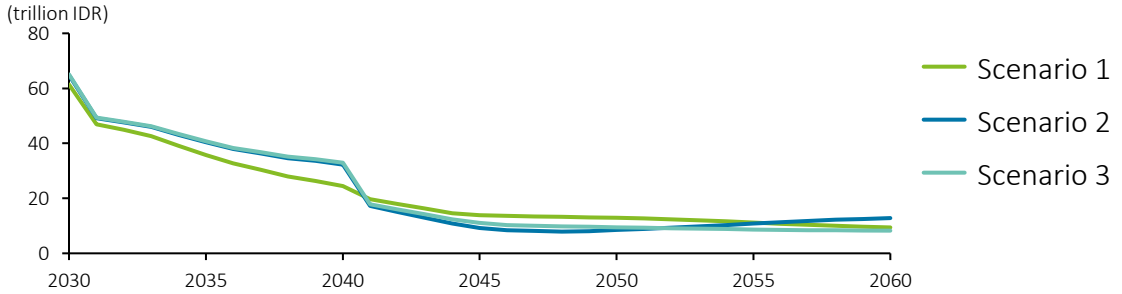
Forecast Gap to be Closed for Ethanol (IDR)

Using the gap from previous calculation between subsidy needed vs subsidy sources



Forecast Remaining Gasoline Subsidy (IDR)

This is the amount of remaining gasoline subsidy after being used to subsidized ethanol completely



The details calculation on part ② is as below

②Forecast Pertalite Volume

Forecast Gasoline Consumption exclude Ethanol Blends (liter)

× (1 − Government Ethanol-fuel Target (%))

Forecast Gasoline Consumption[1] (liter)

Using the previous calculation in subsidy source - shifting gasoline - ② - Forecast Gasoline Consumption (liter)

Using the previous calculation in subsidy source - shifting gasoline - ③ - Government Ethanol-fuel Target (%)

Pertalite proportion in 2022 (%)

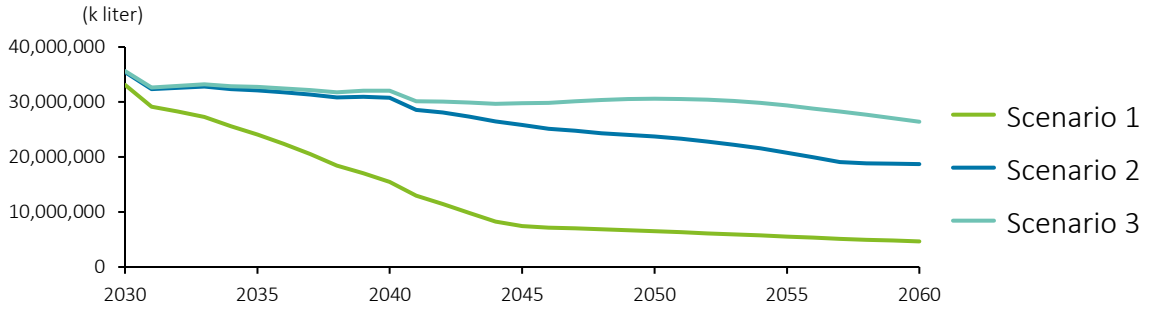
For future calculation the fuel proportion will be referred from 2022 case

TYPES OF OIL FUEL (2022)	Consumption (kL)	% composition
Gasoline RON 88	18,298	0.05%
Gasoline RON 92	5,773,457	16.13%
Gasoline RON 95 + 98 + 100	318,770	0.89%
Gasoline RON 90	29,684,964	82.93%

Source: MEMR Handbook Energy Outlook 2022

Forecast Pertalite Consumption Volume (liter)

Forecast of Pertalite volume using 2022 fuel proportion



The details calculation on part ③ is as below

③Forecast Compensation from the Remaining Budget

Forecast Remaining Gasoline Subsidy (IDR)

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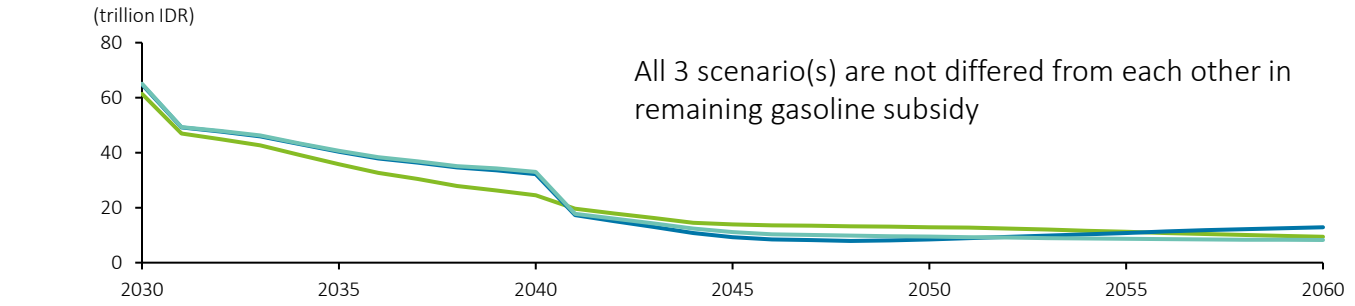

Forecast Pertalite Consumption Volume (liter)

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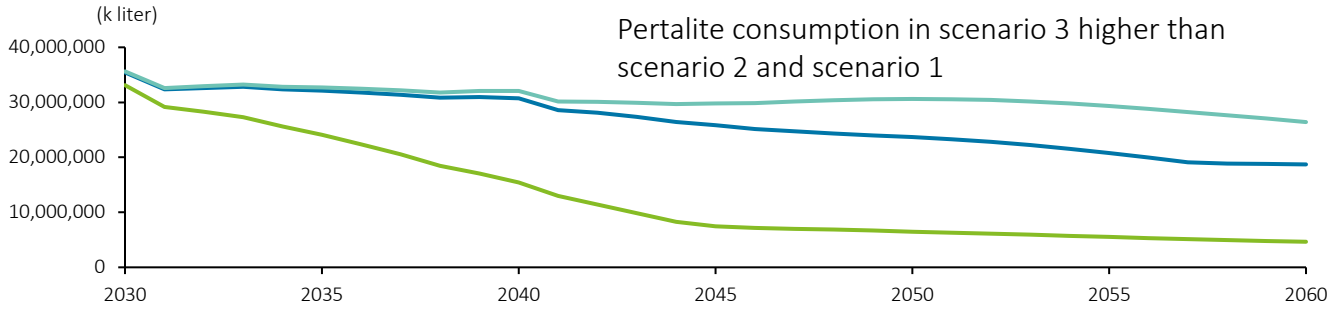
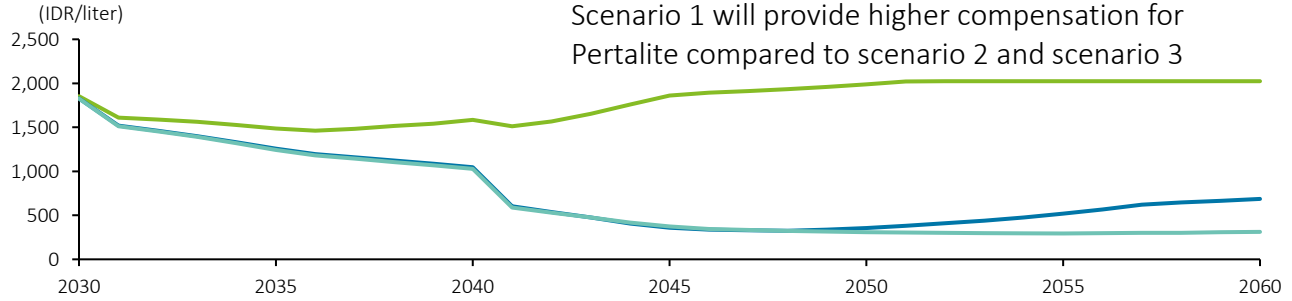


Forecast Compensation from the Remaining Budget (IDR/liter)



The details calculation on part ④ is as below

④ Final Price of Pertalite

Basic Subsidized Price of Pertalite (IDR/liter)

As per current condition, subsidized price of Pertalite is set at **10,000 IDR/liter**

+

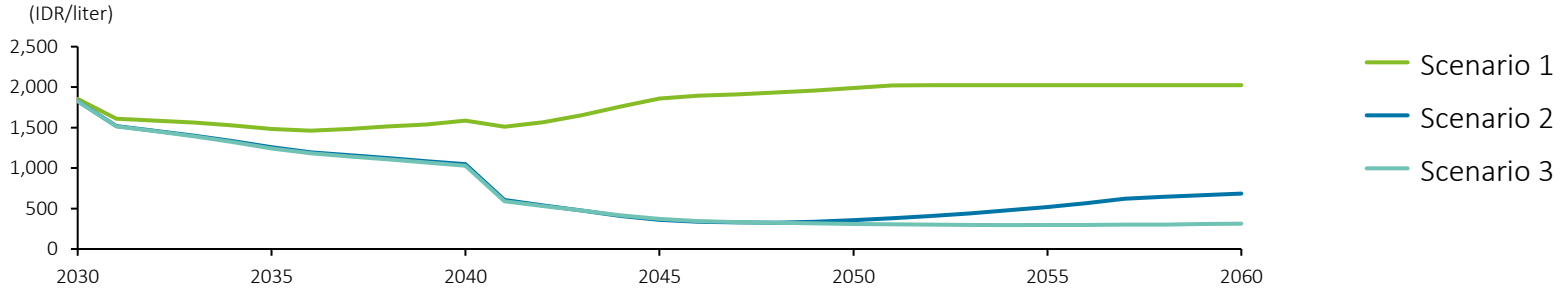
Compensation in 2023[2] (IDR/liter)

- Using the previous calculation in subsidy source - shifting gasoline - ① - Compensation in 2023
- Compensation in 2023 is estimated **~ 2,001 IDR/liter**

−

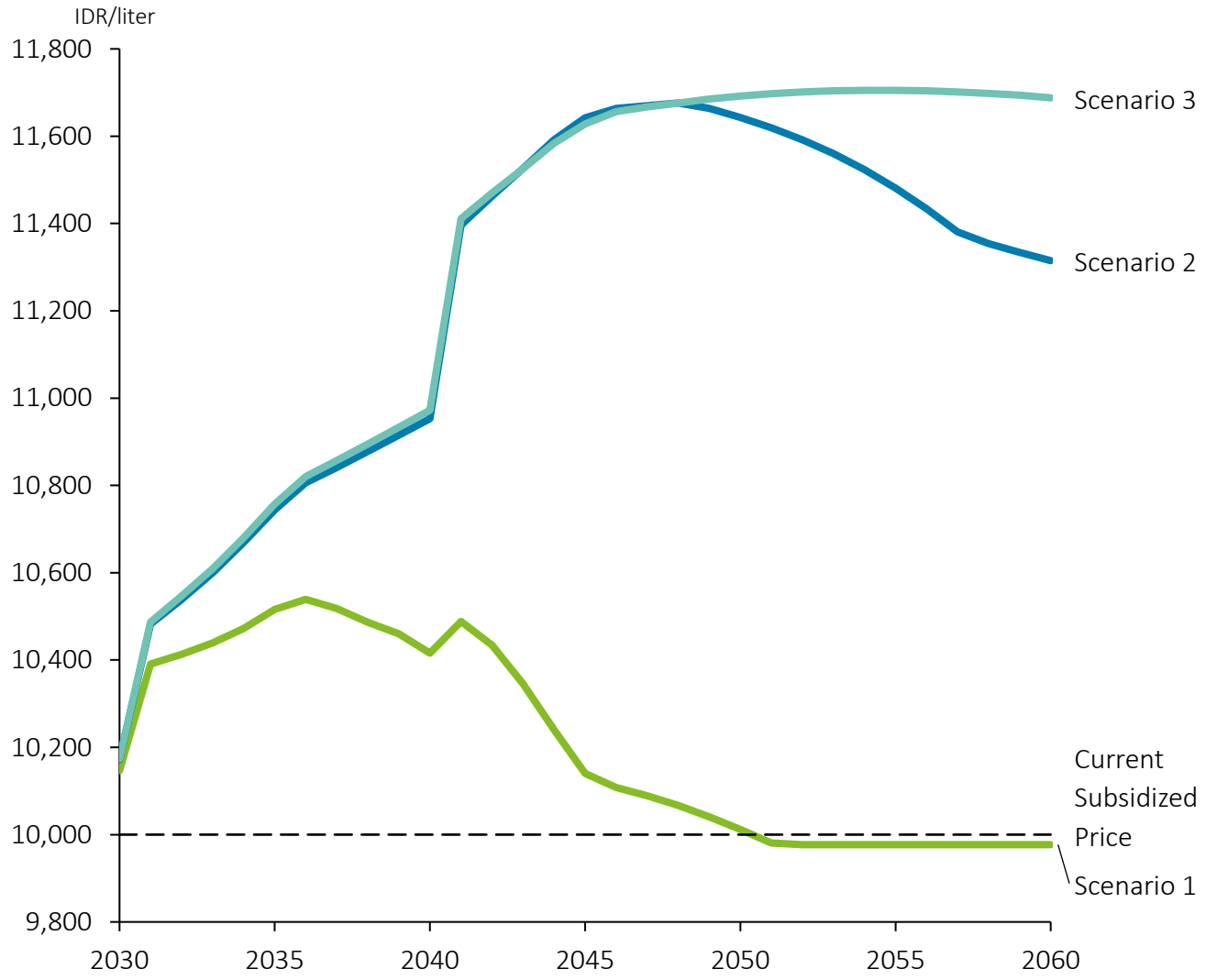
Forecast Compensation from the Remaining Budget (IDR/liter)

Referred from calculation ③



As a result, the estimated impact on the level of subsidized pertalite prices in scenario 1 can be considered low (~2%), whereas in scenario 3, the change could reach ~17%

④ Final Price of Pertalite (IDR/liter)



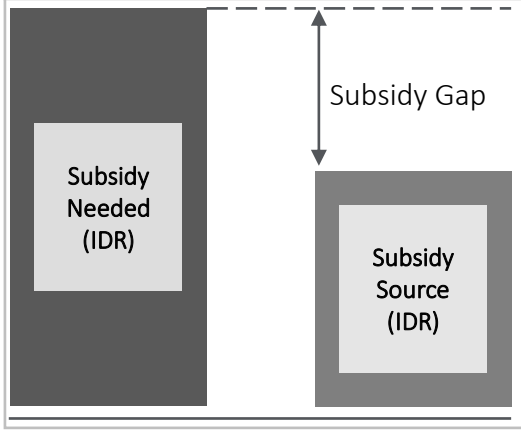
	Subsidized Price Level (IDR/liter)	Ratio of Change (%)
Scenario 3		
2030-2040	10,174 – 10,972	~1-10
2041-2050	11,411 – 11,692	~14-17
2051-2060	11,697 – 11,688	~17
Scenario 2		
2030-2040	10,172 – 10,953	~1-10
2041-2050	11,396 – 11,643	~14-16
2051-2060	11,619 – 11,315	~13-17
Scenario 1		
2030-2040	10,147 – 10,416	~1-4
2041-2050	10,488 – 10,012	~0-5
2051-2060	9,981 – 9,977	0

Subsidy Gap – Potential subsidy source

Leveraging fund from crude oil import reduction due to the use of ethanol can be one potential option to bridge the subsidy gap

Crude oil import reduction as alternative subsidy source

Subsidy Gap

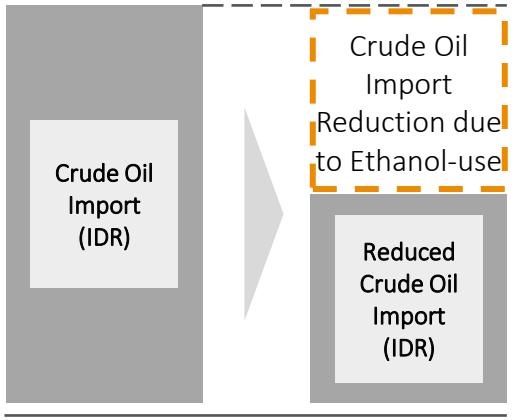


Description:

As per current calculation, some **missing fund (gap) of the subsidy still exist** and **reflected in almost all minimum / realistic scenario** except Scenario 1 using 2022 budget

+

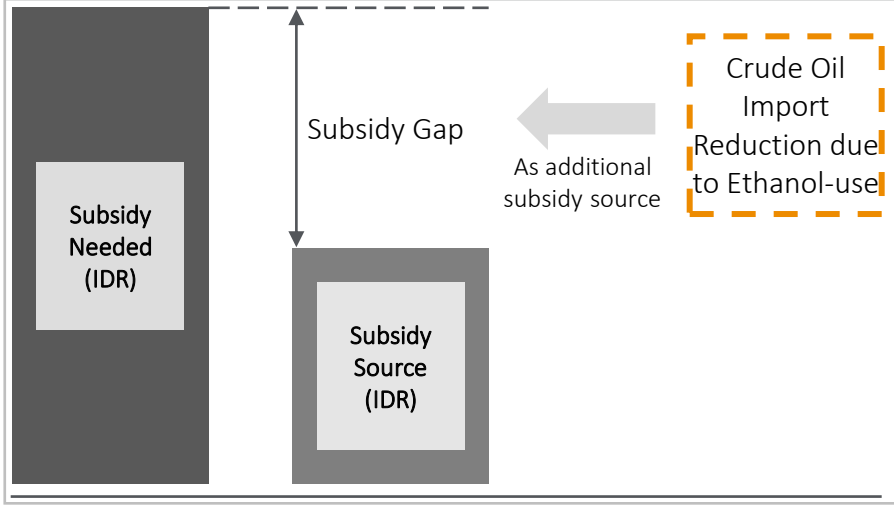
Potential Subsidy Source



Description:

A **potential crude oil import reduction** as a benefit of using ethanol as fuel blend **can be an alternative way to act as an additional fund to subsidize ethanol**

Crude Oil Imports Reduction will **Help Bridge the Subsidy Gap**



Description:

The monetary amount of crude oil import reduction will be *one potential option* for filling the subsidy gap

Notes

Crude oil import in this context, *consist of crude oil and it's finished fuel product import.*

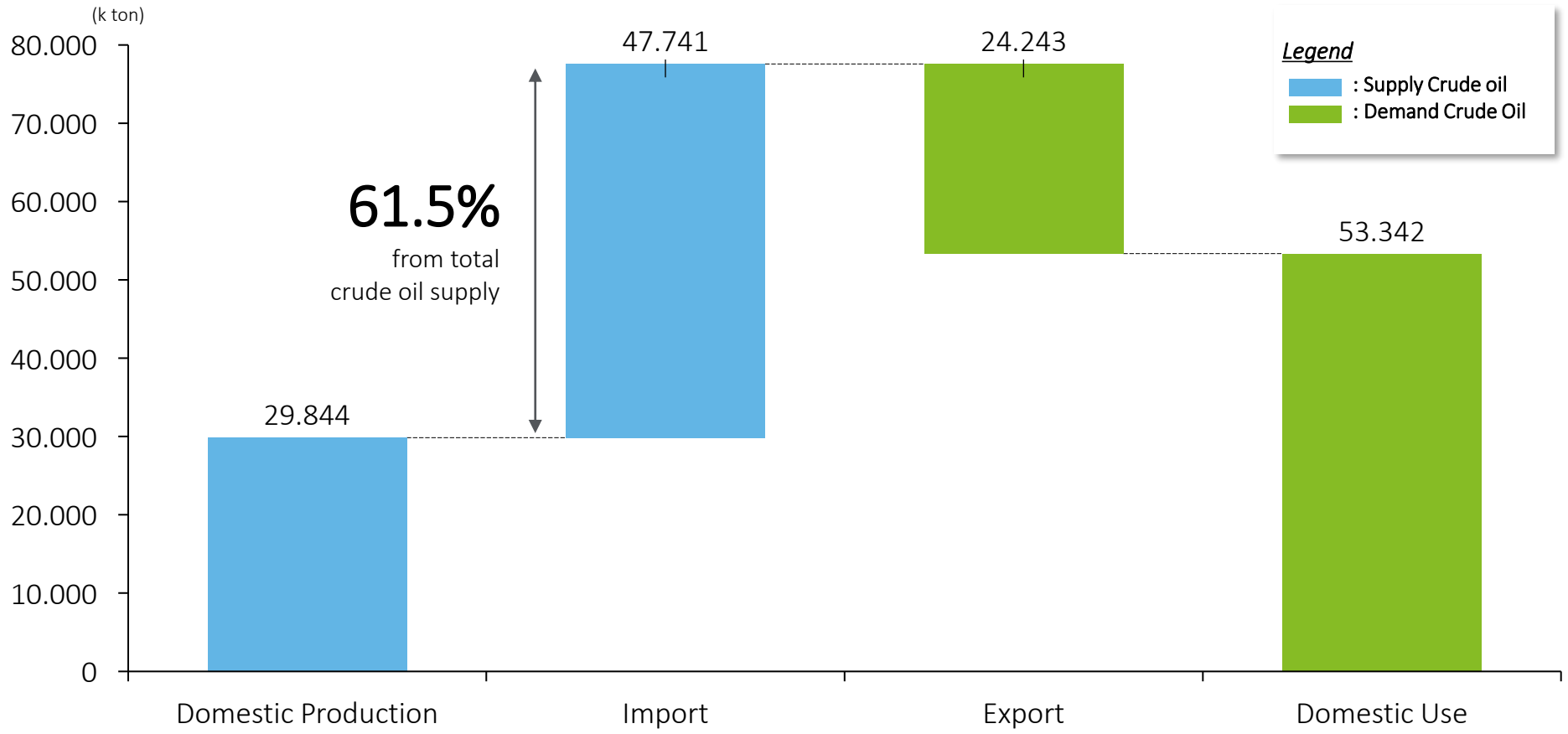
Fuel supply in Indonesia generally comes from 3 sources, *domestic crude oil processing, imported crude oil processing, and fuel product imports.*

In the case of processing, oil refinery use crude oil as a raw material to produce several fuel type and ratings, e.g., Gasoline RON 92, Diesel CN 51, Avtur, Kerosene, etc.

 Note: Box size of each part of the bar does not reflect true value - for illustration purpose only

Although Indonesia has produced oil domestically, essentially Indonesia is still relying heavily on crude oil import

2022 crude oil[1] balance



Notes

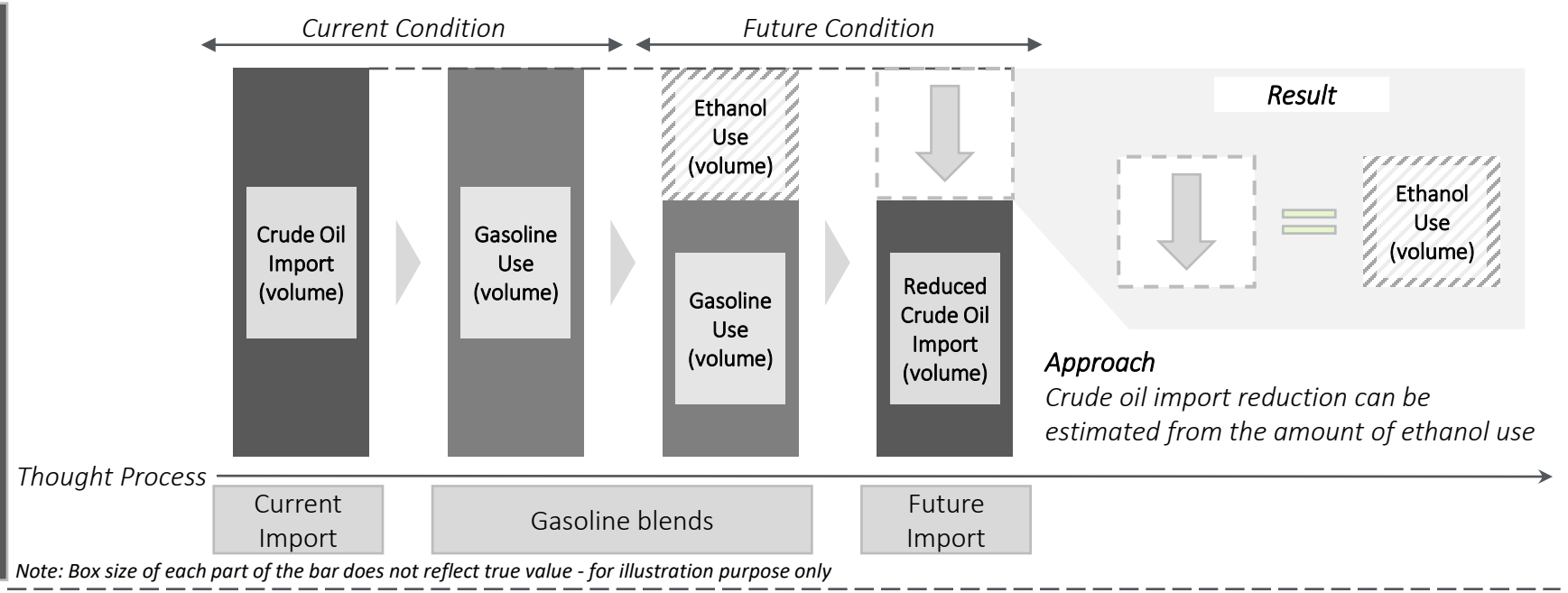
"Domestic Production", "Import", and "Export" is referred from BPS (Central Statistic Agency)
"Domestic use" is estimated from the calculation logic as follow: (Domestic Production + Import) - Export

[1] = crude oil include its derivatives product

As an approach, crude oil import reduction is adopted from total ethanol-fuel use and the calculation is using the formula below

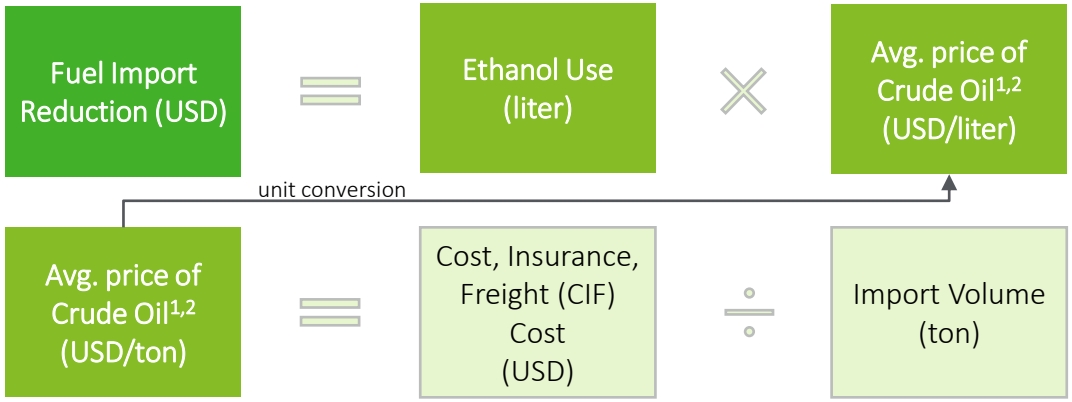
How to determine crude oil import reduction

Base Logic and Assumption



Note: Box size of each part of the bar does not reflect true value - for illustration purpose only

Calculation Logic

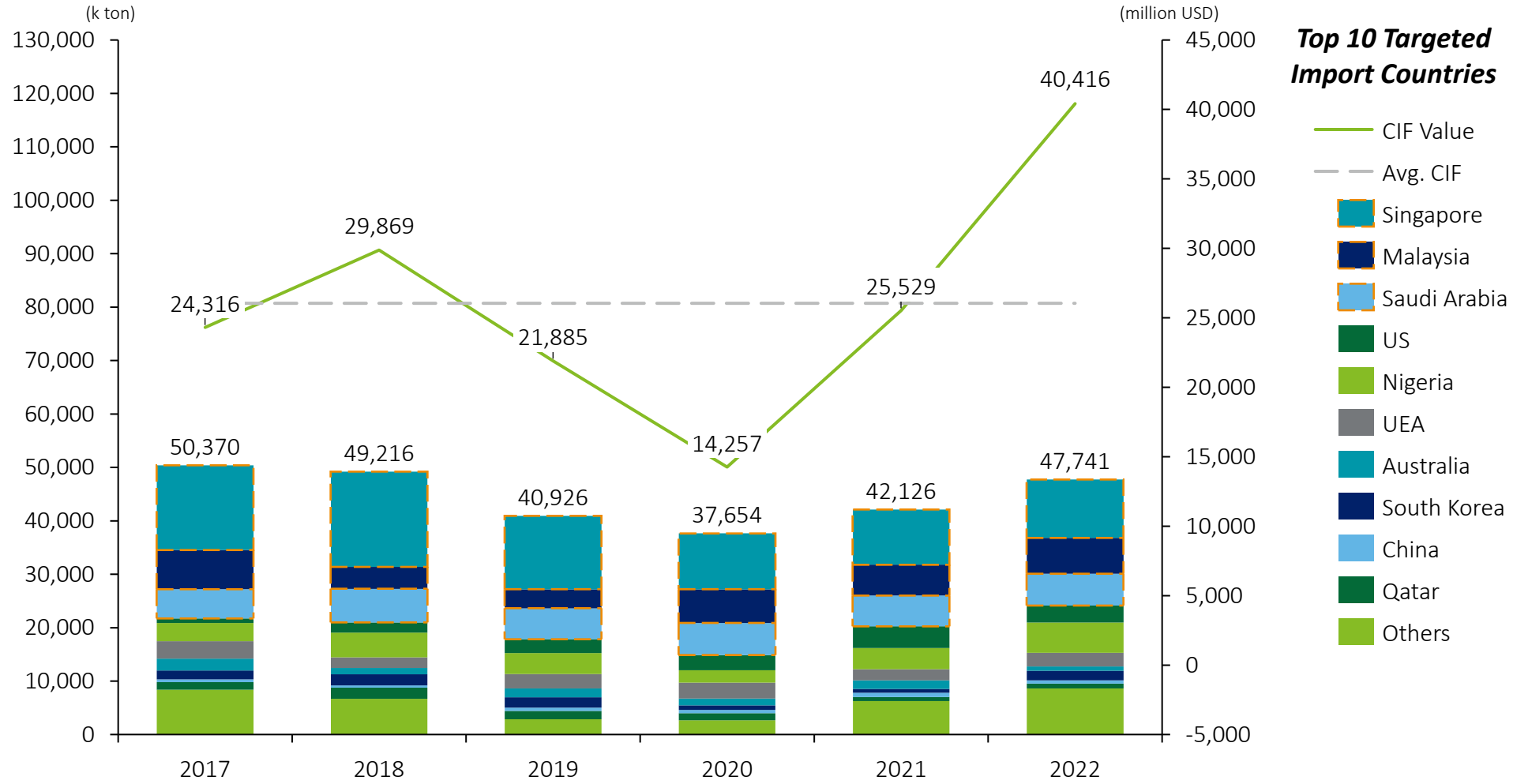


[1] = crude oil include its derivatives product

[2] = average between 2017-2022 datapoints

The datapoints below is used to estimate the average price of crude oil, and later will be used to estimate the reduction in foreign gasoline purchases (import)

Current crude oil (and its derivatives) import (2017-2022)

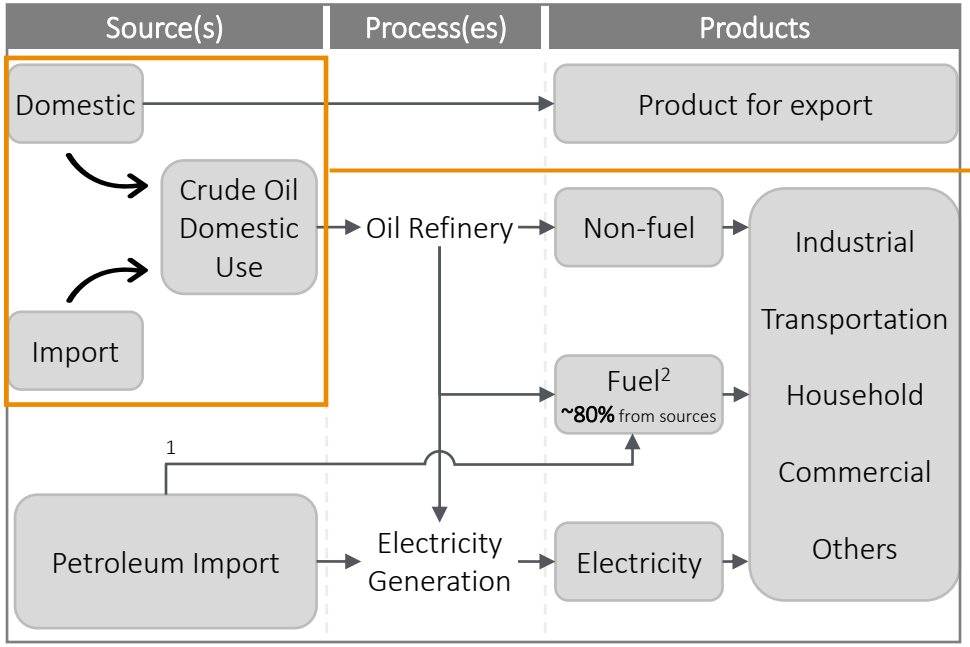


Source: *Badan Pusat Statistik (Central Statistic Agency)*

To determine the crude oil import reduction, crude oil import forecast from National General Energy Plan (RUEN) is used as a baseline scenario before the use of ethanol

Crude oil import forecast

Crude oil product diagram flow

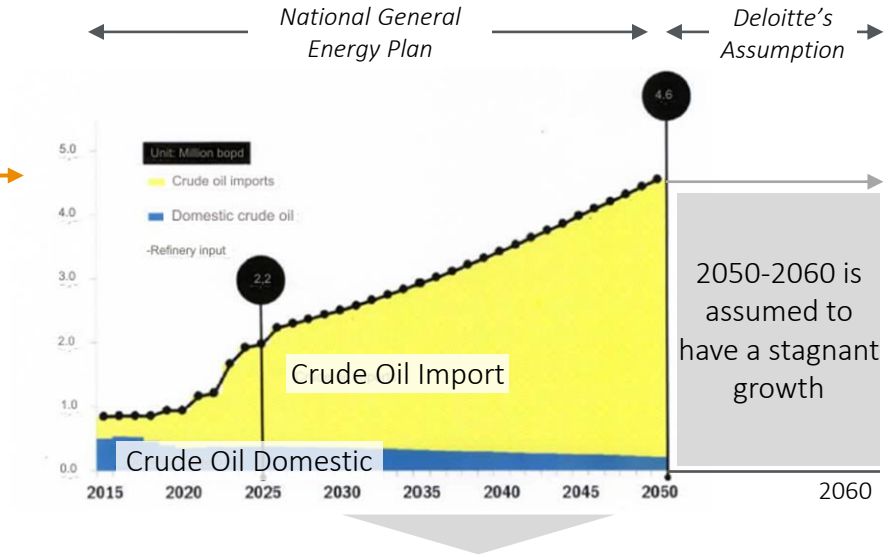


Source: National General Energy Plan (RUEN) by President Regulation no.22/2017

Notes

- [1]In National Energy Council Cabinet Meeting 2020-2050, President sets the target to phase out petroleum import for fuel by 2030
- [2]Domestic fuel supply will then derive from domestic production and crude oil import in 2030 onwards

Crude Oil Supply Forecast (in million BOPD)



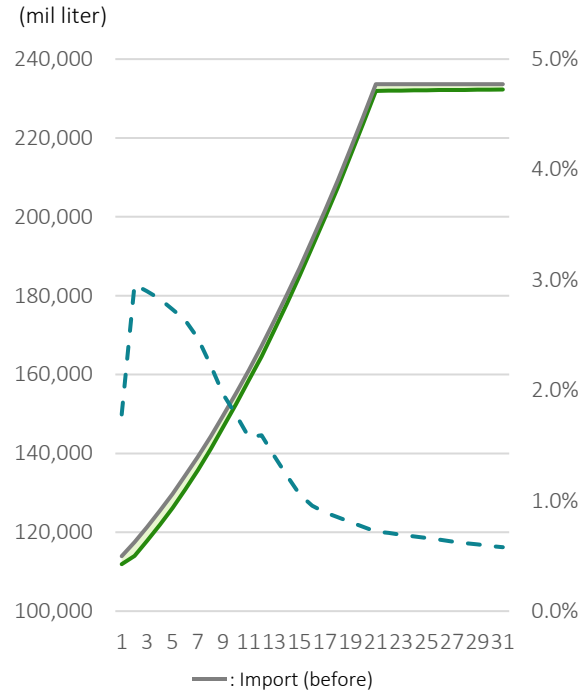
(in million BOPD)	2030	2040	2050	2060
Crude Oil Domestic	575.1	695.3	594	594
Crude Oil Import	1,963.2	2,775.9	4,025.9	4,025.9

BOPD : Barrel Oil per Day
Source: National General Energy Plan (RUEN) by President Regulation no.22/2017

The use of ethanol will reduce the use of fossil fuels which majorly derive from import; this will give a potential cost cut to purchase foreign fossil fuel

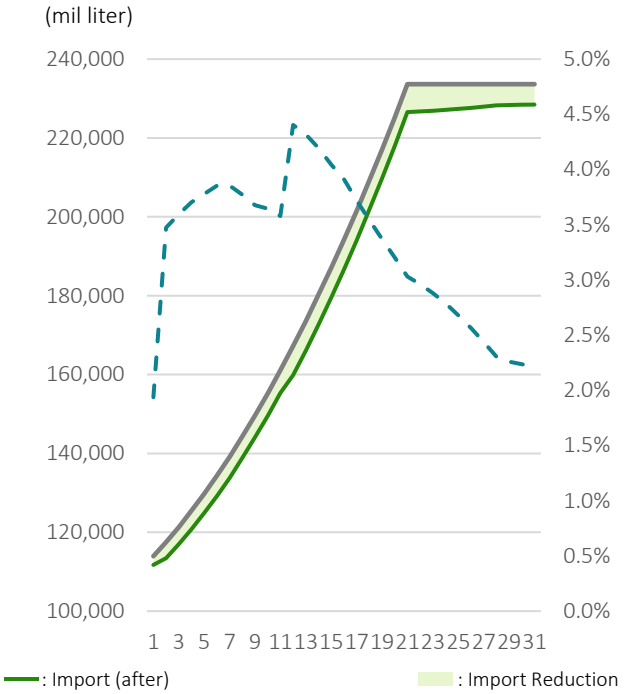
Potential crude oil import reduction

Scenario1: EV adoption at target levels



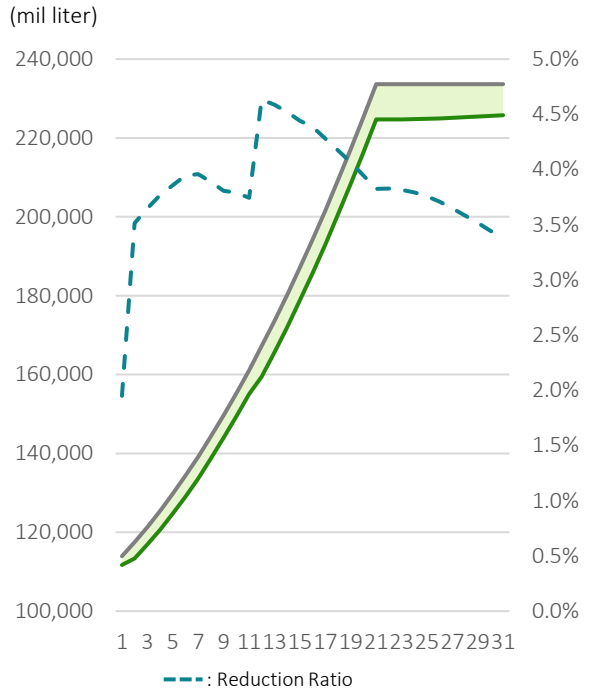
Accumulative Volume Reduction	69.4 Billion Litre
Accumulative Cost Reduction	614 Trillion IDR 38.9 Billion USD

Scenario2: Moderate



Accumulative Volume Reduction	186.4 Billion Litre
Accumulative Cost Reduction	1,650 Trillion IDR 104.4 Billion USD

Scenario3: HV penetration instead of EV

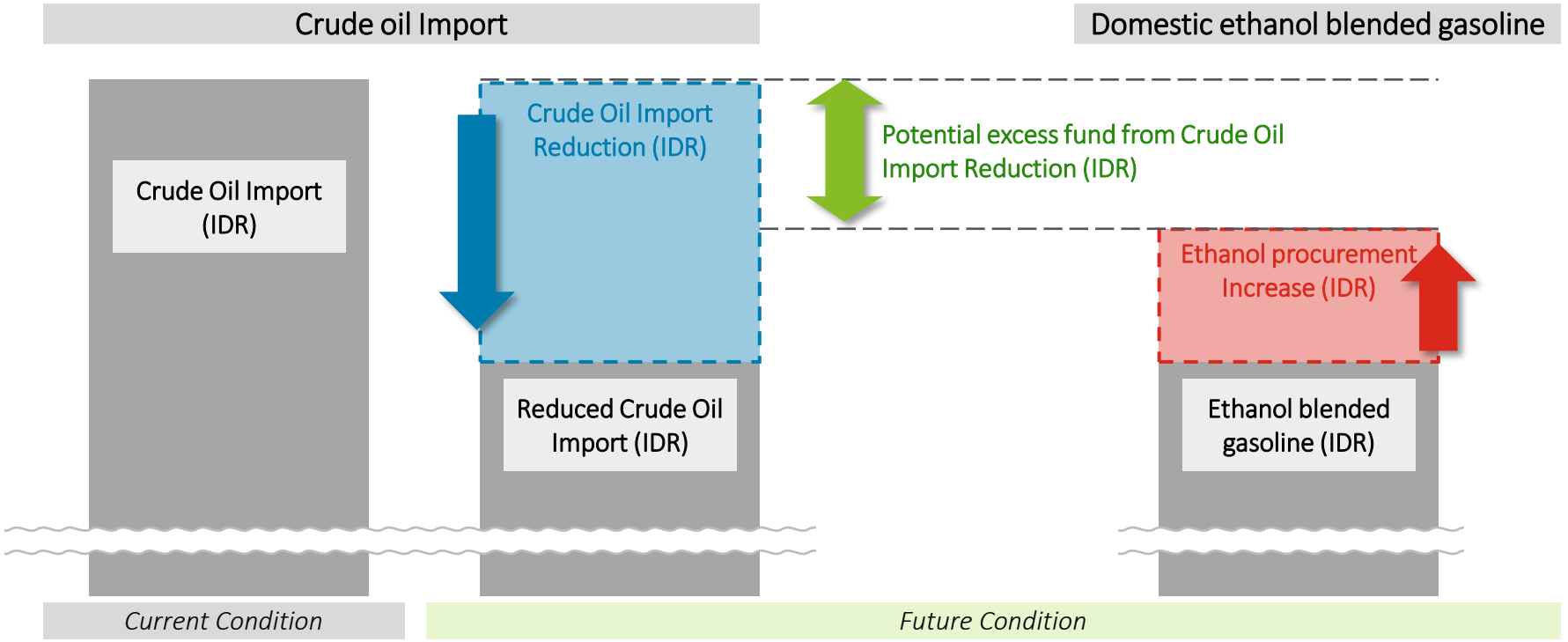


Accumulative Volume Reduction	224.4 Billion Litre
Accumulative Cost Reduction	1,987 Trillion IDR 125.8 Billion USD

Exchange rate = 1 USD ~ 15,800 IDR

The cost reduction from the reduced crude oil import will be used partially to buy ethanol as a product substitution; thus, it is necessary to deduct the cost of ethanol

Analogy of Crude Oil Import Reduction Impact



Structure of Crude oil import cost

CIF (Cost, Insurance, Freight) Value

Product Cost + Insurance Cost + Freight Cost

Structure of Ethanol purchase cost

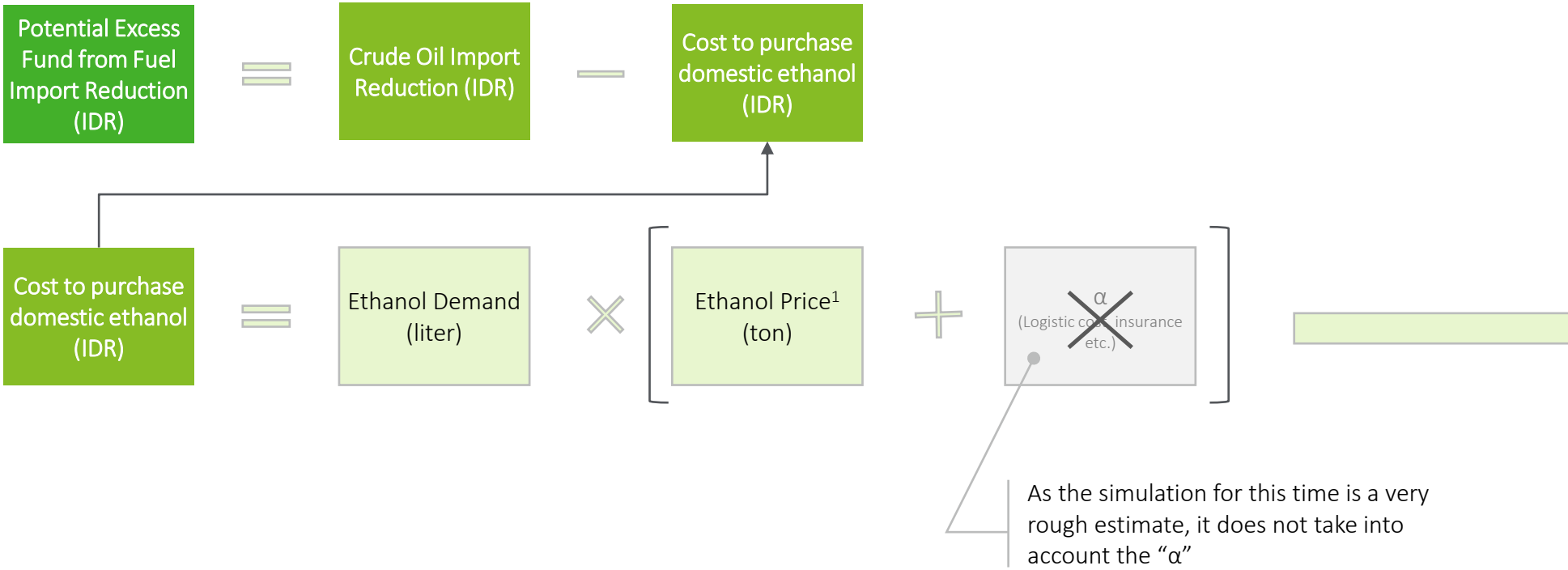
Domestic Procurement Value

Ethanol price (Product Cost) + α*

* : e.g. Logistic cost, insurance etc.

The calculation logic below is used to determine the excess fund from crude oil import reduction

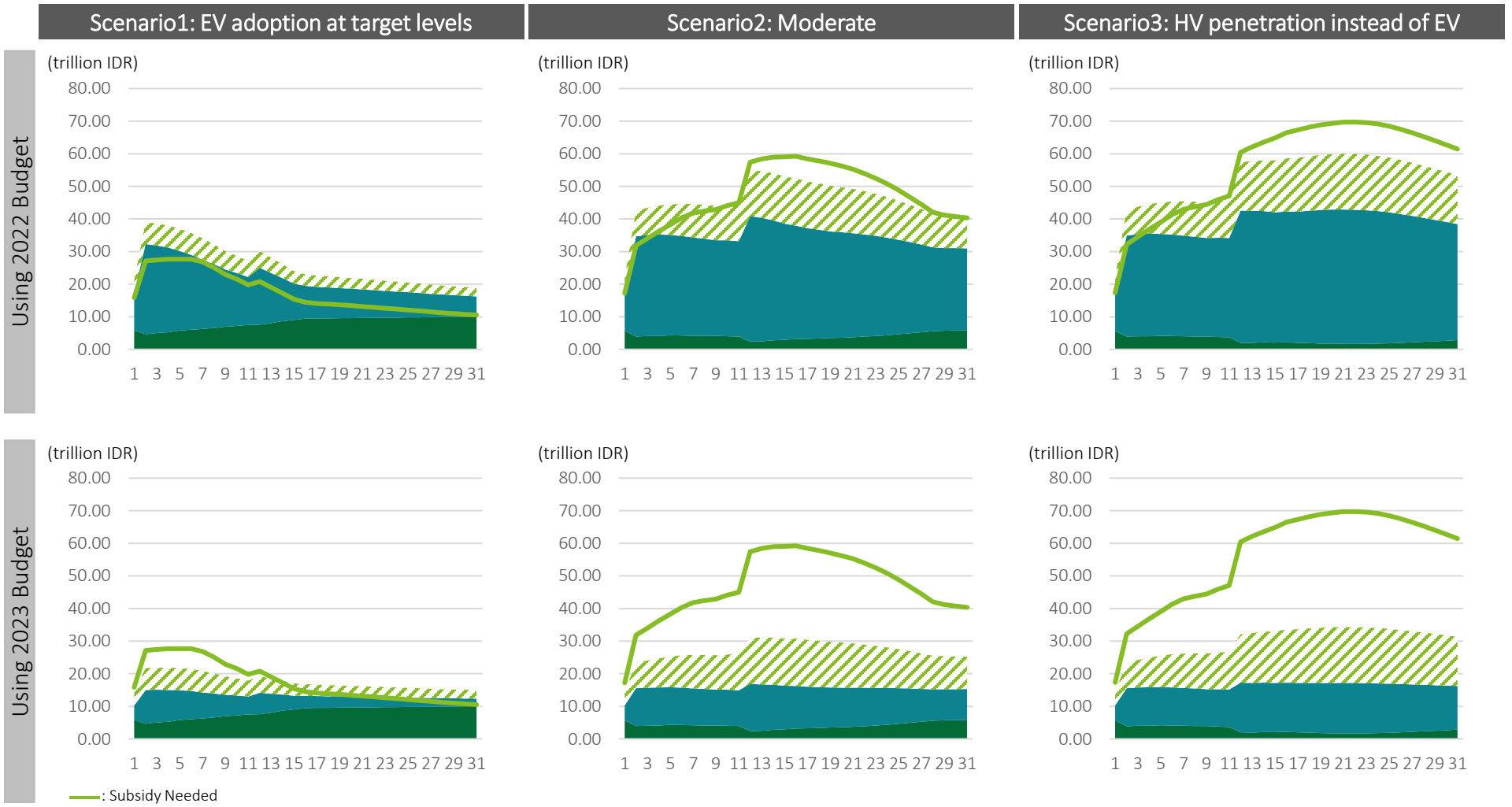
Calculation Logic for Excess Fund from Fuel Import Reduction



[1] = *Ethanol price is the subsidized price of ethanol (due to the price gap between ethanol and fossil fuels has been covered by subsidies)*

As a result, the shift of crude oil import reduction cost to subsidize ethanol can give positive contribution to fill the subsidy needed

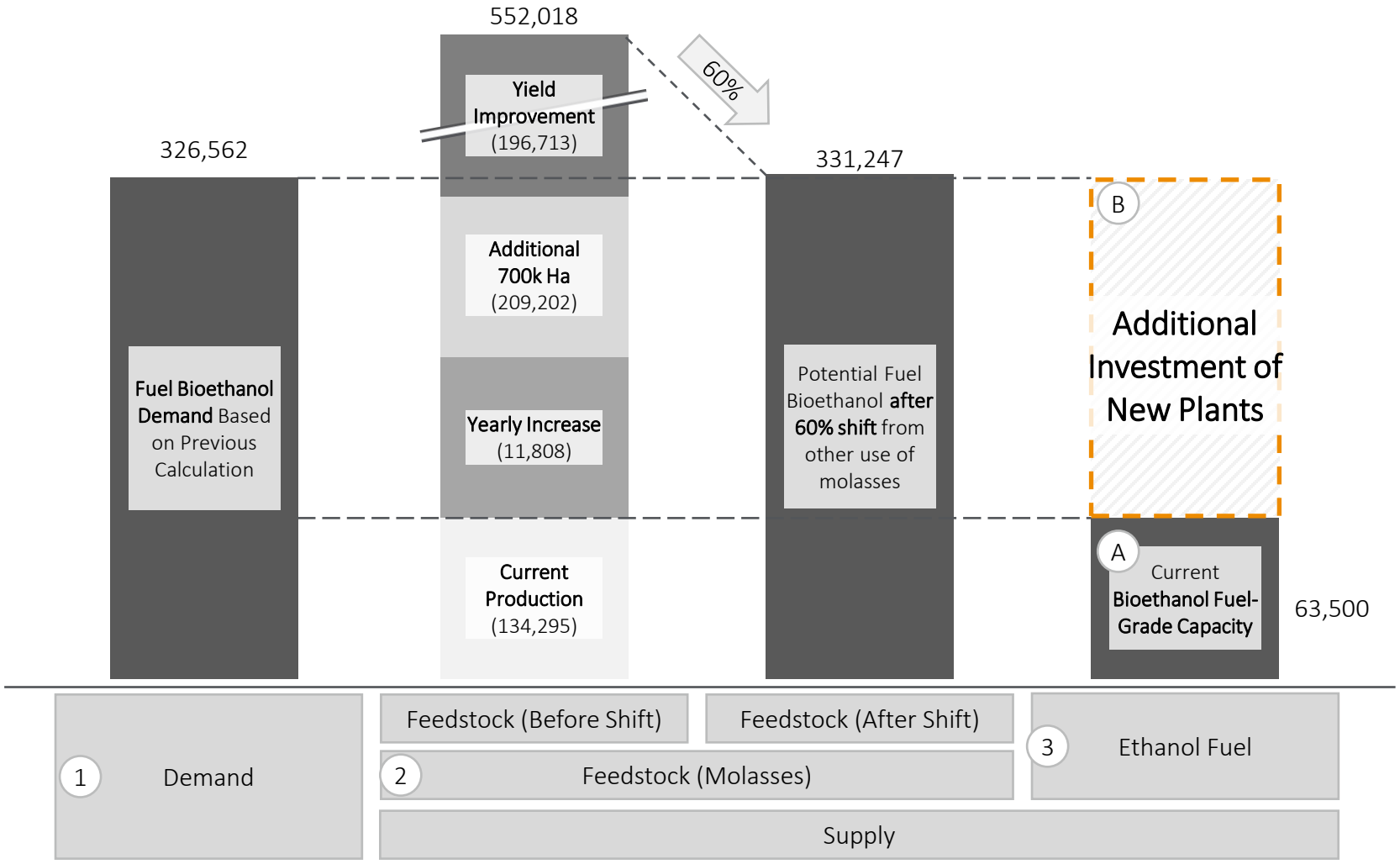
Subsidy Gap After Incorporating the Crude Oil Import Reduction Benefits (Minimum Scenario)



b. Estimate of the cost of building 1G supply chain

Feedstock is sufficient to cover 2030 bioethanol fuel demand with assumption of 60% shift; However, there is still lack of fuel grade bioethanol production capacity

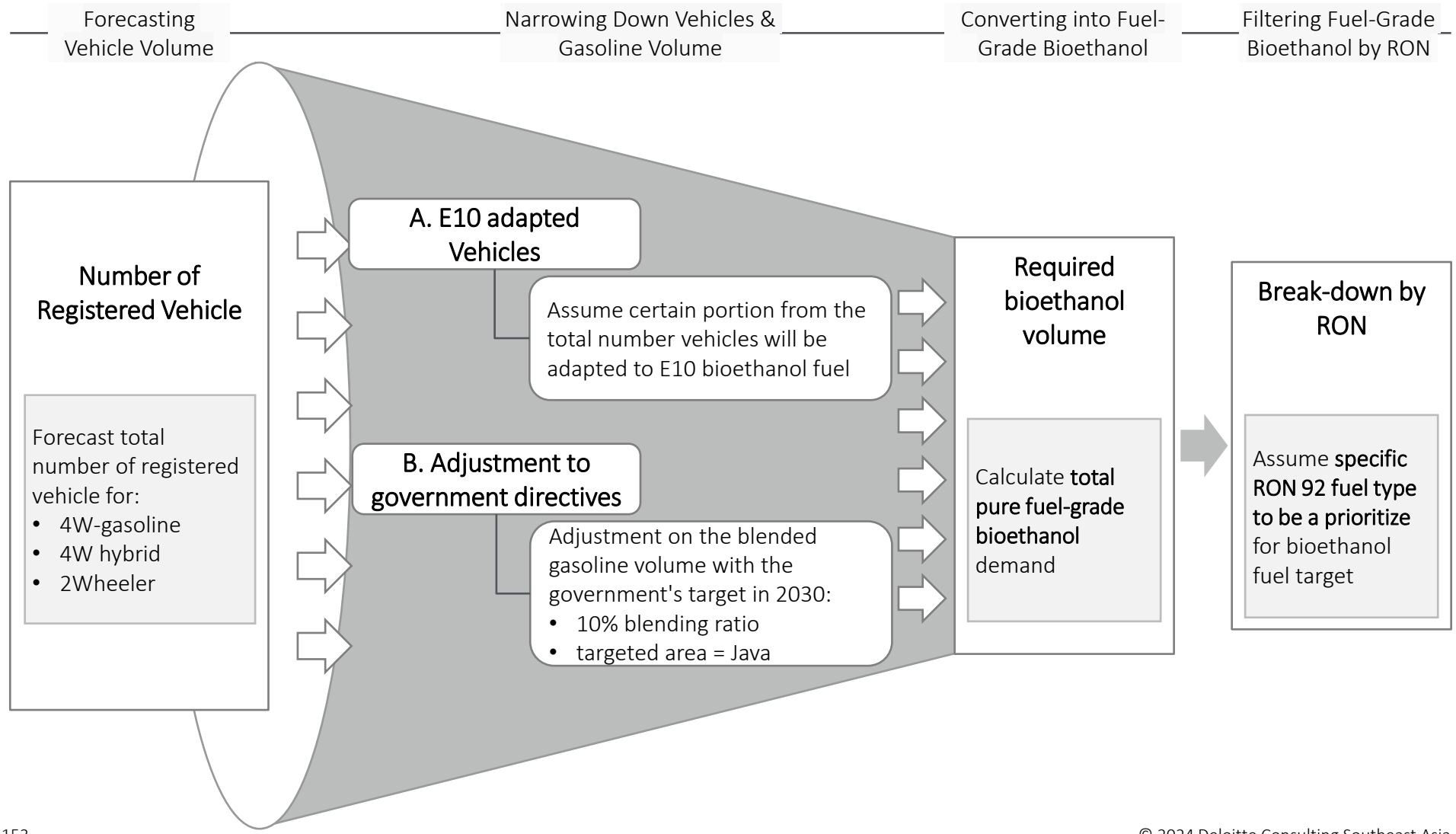
Fuel Grade Bioethanol Supply & Demand Balance Sheet in 2030 (kL)



Note: Box size of each part of the bar does not reflect true value - for illustration purpose only

The following are the steps in calculating fuel-grade bioethanol demand which refer to the calculation process in the previous study

Calculation Step Summary – 1. Fuel Grade Bioethanol Demand



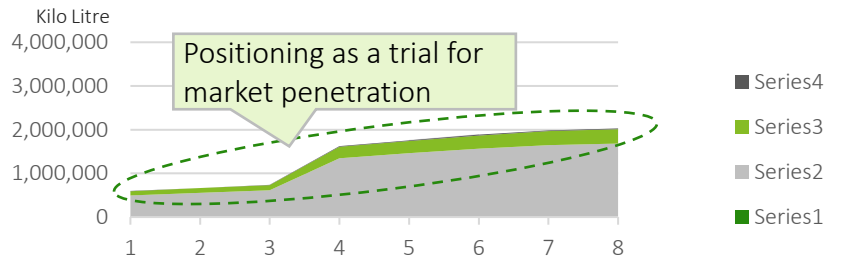
Based on the calculation and assumption that had been made, in 2030 there will be a demand of 326,562 kL fuel-grade bioethanol, focusing on RON 92 fuel type

1. Fuel Grade Bioethanol Demand

Short-term (~2030) direction (Presidential Regulation 40/2023)

- Blending ratio : 5% (E5) → 10% (E10)
- Region : Provinces of DKI Jakarta and Surabaya → Java
- Octane rating : RON95 → RON92

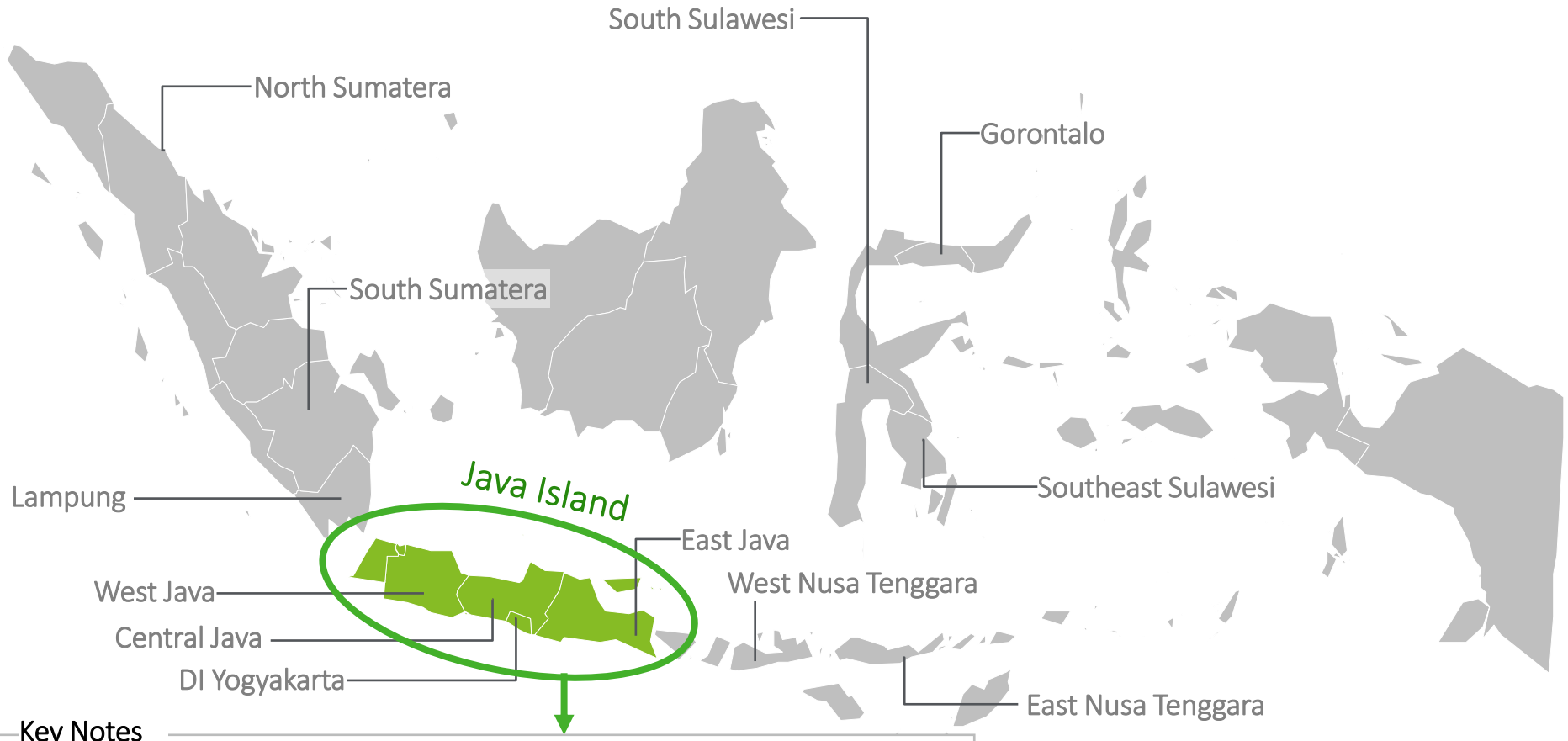
Short term Bioethanol demand prediction



			2023	2024	2025	2026	2027	2028	2029	2030
Registered vehicles (K unit)	Gasoline		16,077	16,731	17,390	18,030	18,614	19,082	19,323	19,295
	Hybrid		58	137	241	379	563	809	1,134	1,565
	2W		125,542	125,817	126,093	126,367	126,638	126,906	127,168	127,425
E10 adapted Vehicles (K unit)	Gasoline		11,623	12,842	14,094	15,355	16,588	17,733	18,679	19,246
	Hybrid		58	137	241	379	563	809	1,134	1,565
	2W		44,421	50,205	55,924	61,474	66,656	71,083	74,012	74,012
Government Direction	Blending ratio		5%			10%				
	Region		DKI Jakarta and Surabaya			Java (60% of market)				
Required bioethanol volume			596,259	667,129	738,924	1,620,837	1,759,146	1,885,079	1,983,850	2,028,337
										Kilo Litre
Break-down by RON	RON 92	16%*	95,998	107,408	118,967	260,955	283,223	303,498	319,400	326,562
	Others	84%*	500,261	559,721	619,957	1,359,882	1,475,923	1,581,581	1,664,450	1,701,775

A centralized supply chain network in Java is sufficient, knowing that the market penetration at initial stage is expected within Java Island

Targeted market



Key Notes

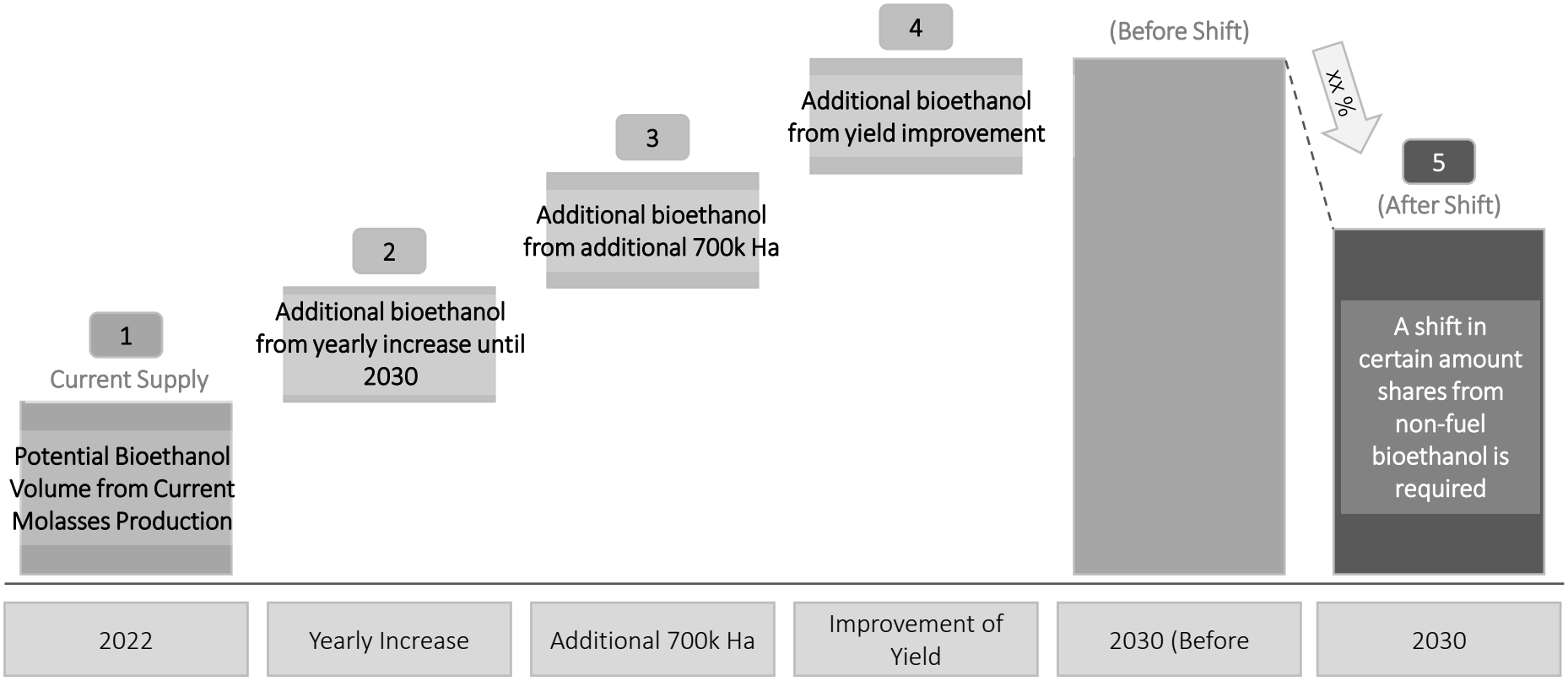
- Java become the priority region for the distribution of bioethanol fuel at least until 2030
- Java accounts for ~60% of the national fuel consumption
- Assumed that bioethanol penetration will be focused on RON 92 gasoline first
- Bioethanol will be blended in gasoline with 10% ratio (E10)

On the supply side, the prediction of fuel-grade bioethanol based on feedstock production had also been made using the steps as follows

Calculation Step Summary – 2. Fuel Grade Bioethanol Supply (Feedstock)

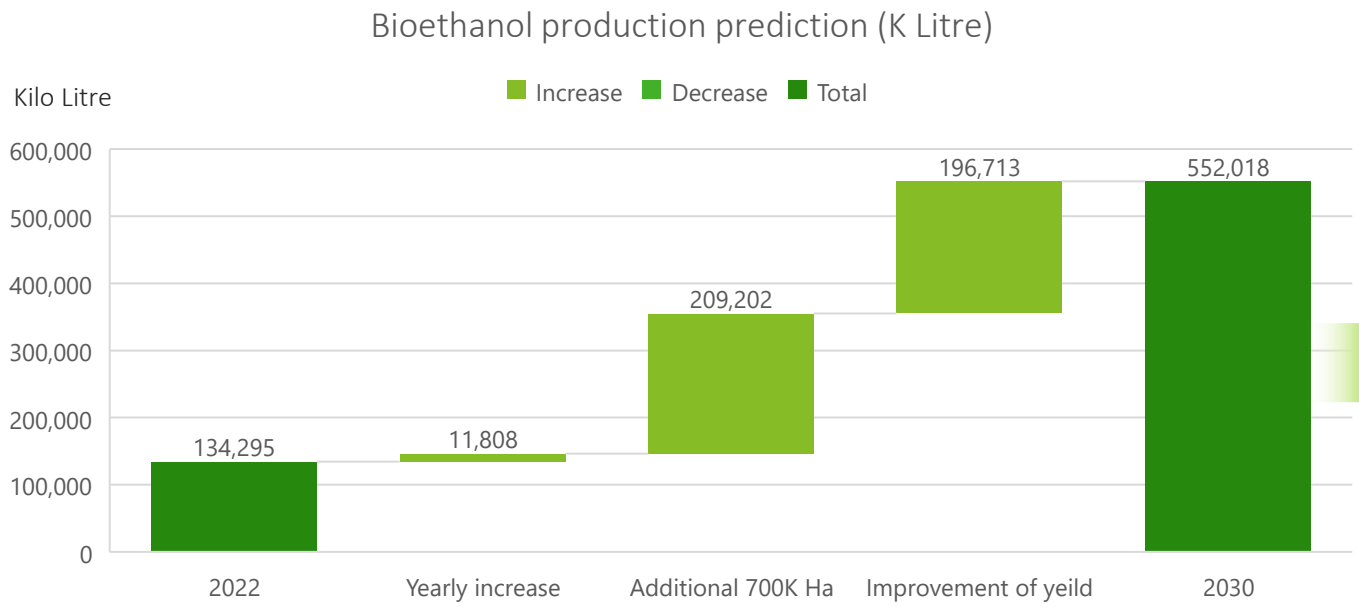
(Before shift) : >99% non-fuel- Bioethanol + **<1%** fuel bioethanol

(After shift) : <99% non-fuel Bioethanol + **>1%** fuel bioethanol



If all hypotheses occur according to assumptions and targets, the amount of feedstock will be sufficient to cover fuel grade bioethanol specific for RON 92

2. Fuel Grade Bioethanol Supply (Feedstock)



Bioethanol production is divided into **fuel** and **non-fuel** grades, now only 60K (0.04%) for fuel grade due to low demand

The key point on the supply will be how much can be shifted to fuel grade

To cover the demand in 2030, around 60% shift will be expected at least

Measures	Description	Change
Yearly increase	Assumes comparable historical growth rates in sugarcane production	101% average annual growth
Additional 700K Ha	Expected amount of bioethanol from government-prepared land for sugar self-sufficiency	Approx. 450 K Ha → 1,150 K Ha
Improvement of yield	Government is trying to increase sugarcane yields to 130 t/ha	67 t/Ha → 130 t/Ha

Still on the supply side, it also needed to know the capabilities of ethanol fuel production; the following are the steps to calculate the amount of investment needed

Calculation Step Summary – 3. Fuel Grade Bioethanol Supply (Ethanol Fuel)

3. A

Current Bioethanol Fuel-Grade Capabilities

3. B

Additional Investment of New Plants

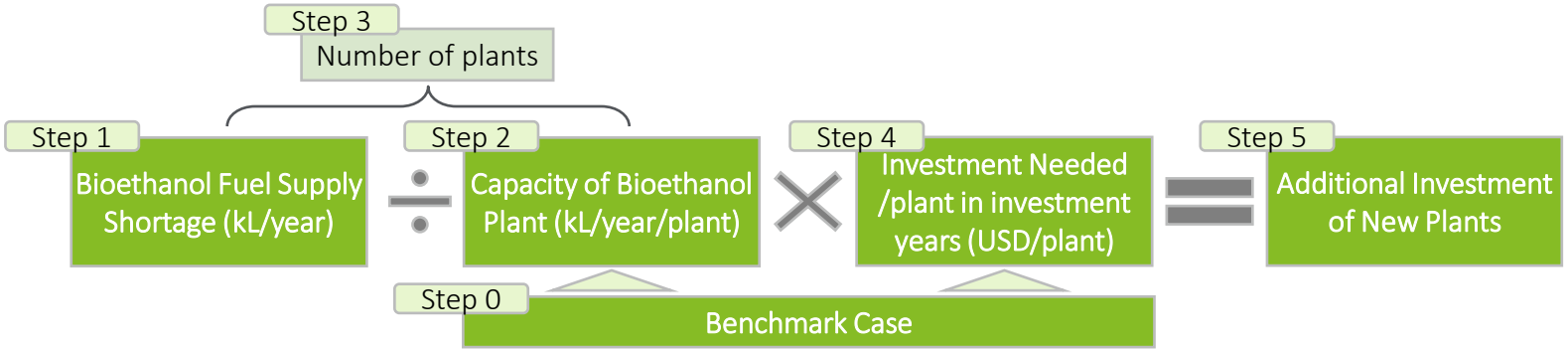
Map out current capabilities

Sum up the current bioethanol plants that ready to produce fuel-grade bioethanol

Company Candidates

Source: Data from APSENDO

- PT Energi Argo Nusantara (ENERO)
- PT Indonesia Ethanol Industry
- PT Madusari Murni Indah (Molindo)
- PT Madu Baru



Step 0 Benchmark Cases

Collect historical cases in Indonesia regarding Bioethanol plants investment

Step 1 Bioethanol Fuel Supply Shortage

Find the gap between fuel-grade bioethanol demand vs supply volume

Step 2 Ideal Plant's Capacity

Determine the ideal bioethanol plant's capacity based on benchmark

Step 3 Additional New Plants Needed

Calculate number of plant(s) needed in order to cover the fuel bioethanol demand

Step 4 Investment per Plant

Consider inflation rate to define investment amount in the targeted year (2030)

Step 5 Additional Investment

Totalize plant's investment in 2030 based on the number of plants needed

As per current condition, 4 bioethanol companies in Indonesia has already had the capabilities to produce bioethanol fuel grade with a total capacity of 63,500 kL

3.A Bioethanol Fuel Supply – Current Bioethanol Fuel-Grade Capacity

Pre-condition

- Company that are currently ready to produce fuel-grade bioethanol are assumed will **produce 100% of it's current fuel-grade bioethanol capacity in the future**
- **Madu Baru's current fuel-grade bioethanol capacity is assumed to be 50% of it's total bioethanol capacity**

Bioethanol companies that are ready to produce bioethanol fuel grade

Company Name	Production Capacity *(kL/year)*	Location	Raw Material	Pre-Condition	
				Current Fuel-grade Bioethanol Capacity (kL/year)	Percentage of Fuel-Grade Capacity
Energi Agro Nusantara (Enero)	30,000	East Java	Molasses	30,000	100%
Molindo Raya	80,000	East Java & Lampung	Molasses & Corn	10,000	12.5%
Indonesia Ethanol Industry	35,000	Lampung	Molasses & Corn	20,000	57%
Madu Baru	7,000	Yogyakarta	Molasses	3,500	50%
Total				63,500	

Total of 63,500 kL/year contribution from Current Bioethanol Companies that are ready to produce fuel-grade bioethanol

Source : Paper titled "Bioethanol prospect from agricultural crops and its biomass in Indonesia", APSENDO's interview, journals

Some benchmark cases have been found as a reference with 30,000 kL/year/plant ideal capacity and investment ranging from 30.3 - 34.5 million USD

3.B Bioethanol Fuel Supply – Additional Investment of New Plants - Benchmark Case(s)

Case 1

Data Reference	PTPN X and NEDO built bioethanol plant
Year	2012
Production Capacity	30 million liters / year
Investment Needed	461,210 m IDR ≒ 30.3 m USD[1]

Case 2

Data Reference	PTPN X built bioethanol plant in East Java
Year	2015
Production Capacity	30 million liters / year
Investment Needed	525,000 m IDR ≒ 34.5 m USD[1]

Key takeaways

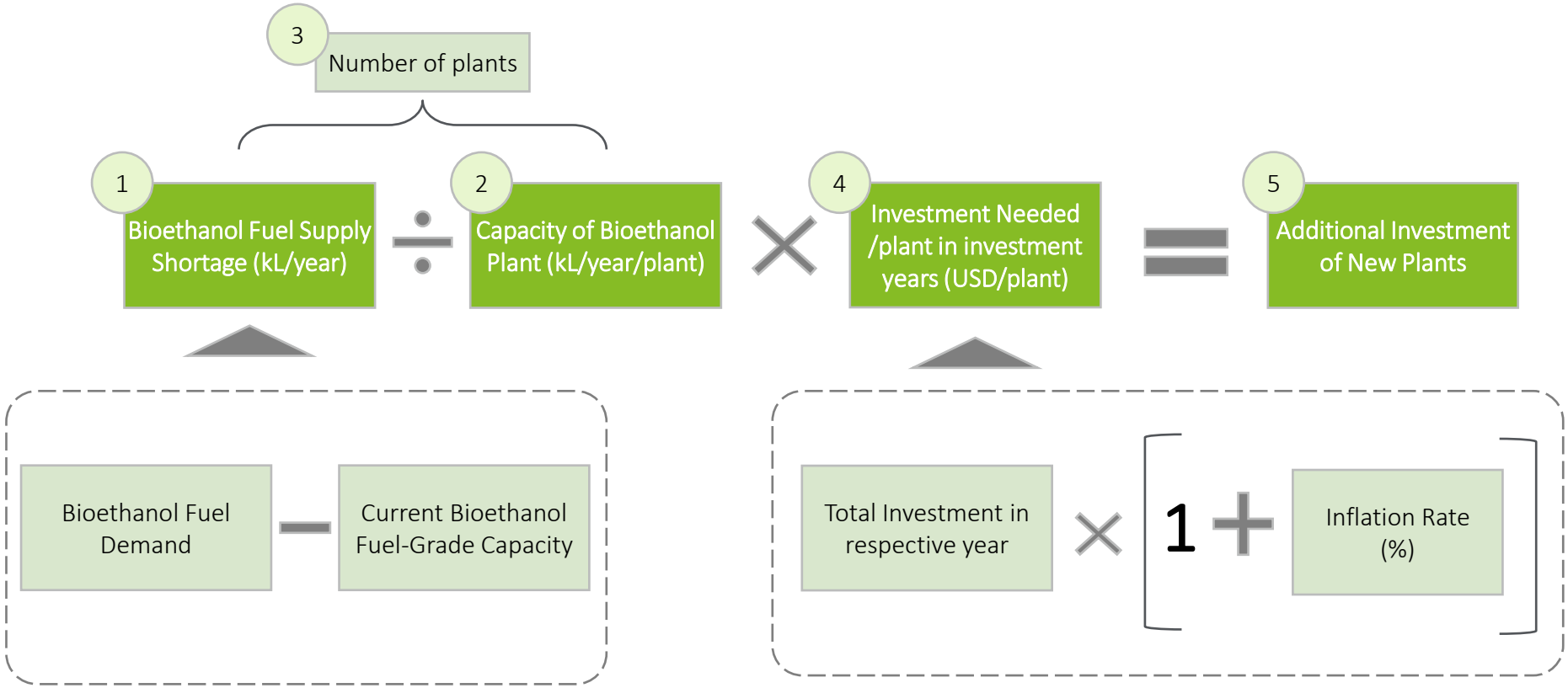
- Ideal capacity to build a fuel-grade bioethanol plant is 30,000 kL/year
- Investment needed to build a 30,000 kL/year fuel-grade bioethanol plant ranges from 30.3 million USD – 34.5 million USD in respective year

[1] = 1 USD ~ 15,200 IDR

Source : Communication and Information Division of East Java Local government

The following calculation logic are used to calculate additional investment of new plants and will be explained in the next following pages

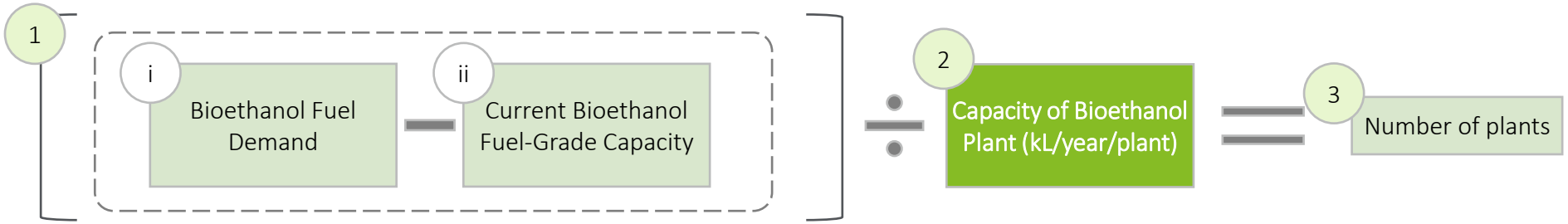
3.B Bioethanol Fuel Supply – Additional Investment of New Plants – Calculation Logic



* = *Interval years between the targeted year and the investment year*

Using the given information regarding bioethanol fuel demand, current supply capacity and ideal capacity per plant, it was calculated that it would take 9 plants to cover 2030 demand

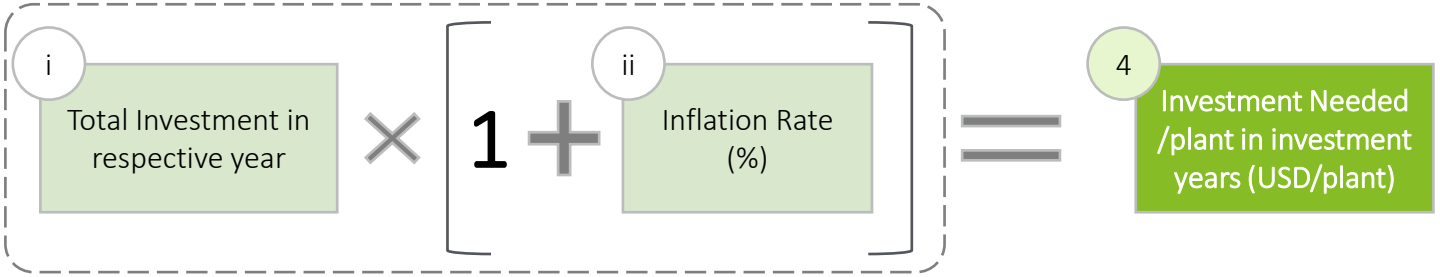
3.B Additional Investment of New Plants – ① ② ③



Description		Calculation Result	
i	In this simulation we only **use scenario 1 vehicles volume (EV Target)** to proceed to the calculation	Bioethanol Fuel Demand	326,562 kL/year
ii	Total of **63,500 kL/year** contribution from Current Bioethanol Companies (ENERO, Molindo, Madu Baru) that can produce fuel-grade bioethanol	Current Bioethanol Fuel-Grade Capacity	63,500 kL/year
1	The number on the side is the amount of **additional capacity needed (new plants) to cover 2030 bioethanol fuel demand**	Bioethanol Fuel Supply Shortage	326,562 kL/year − 63,500 kL/year = **263,062 kL/year**
2	Ideal capacity per 1 plant from benchmark case = **30,000 kL/year/plant**	3 Number of Plants	$= \frac{263{,}062\ kL/year}{30{,}000\ kL/year}$ $= 8.8 \approx \mathbf{9\ plants}$

In order to project investment amount in the targeted years (2030); Incorporation of inflation rate has been made to get more precise investment cost

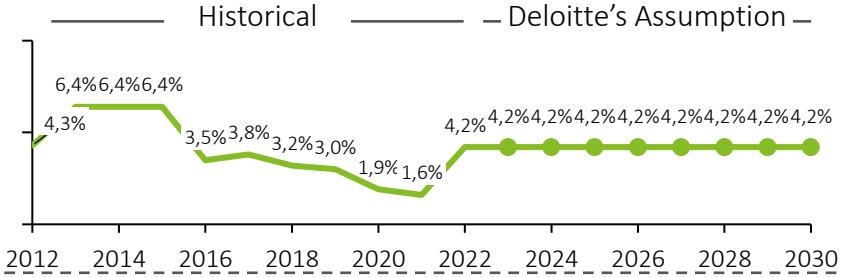
3.B Additional Investment of New Plants – ④



Description	
i	• Refer to the information in benchmark case(s)
ii	• On the side is Indonesia's Inflation Rate graph • The calculation in 2012–2022 is using historical data • Inflation rate in 2023 – 2030 is assumed to be constant at 4.2% • Source: Worldbank
4	The number on the side is the amount of **investment needed per plant in 2030** (after considering inflation rate)

Calculation Result

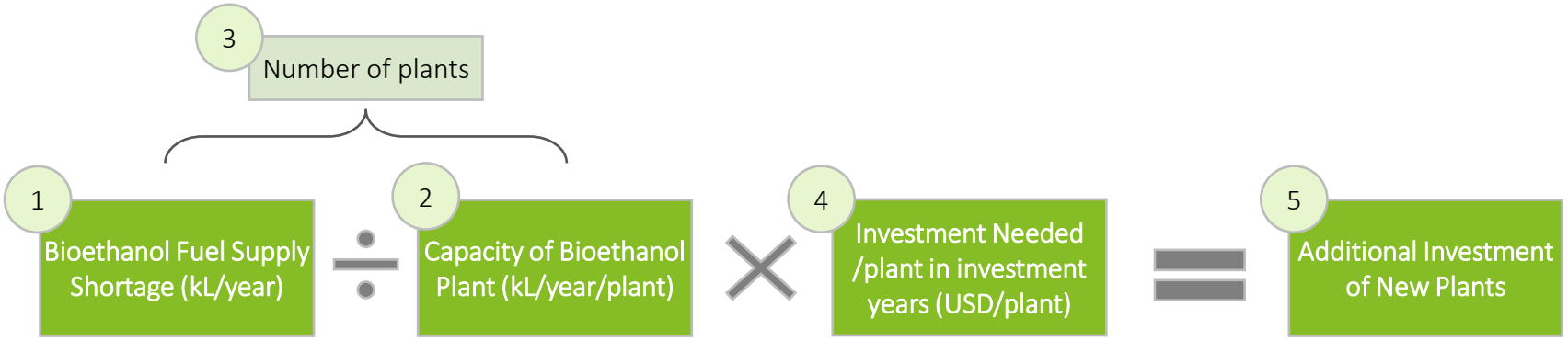
	PTPN X (Case 1)	PTPN X (Case 2)
Year of Establishment	2012	2015
Investment Cost (m USD)	30.3	34.5



		2030
Case 1	Investment in 2030 (m USD/plant)	62.62
Case 2	Investment in 2030 (m USD/plant)	60.38

As a summary, a 543–564 million USD additional investment are needed to build 9 new bioethanol plants with capacity of 30,000 kL/year per plant

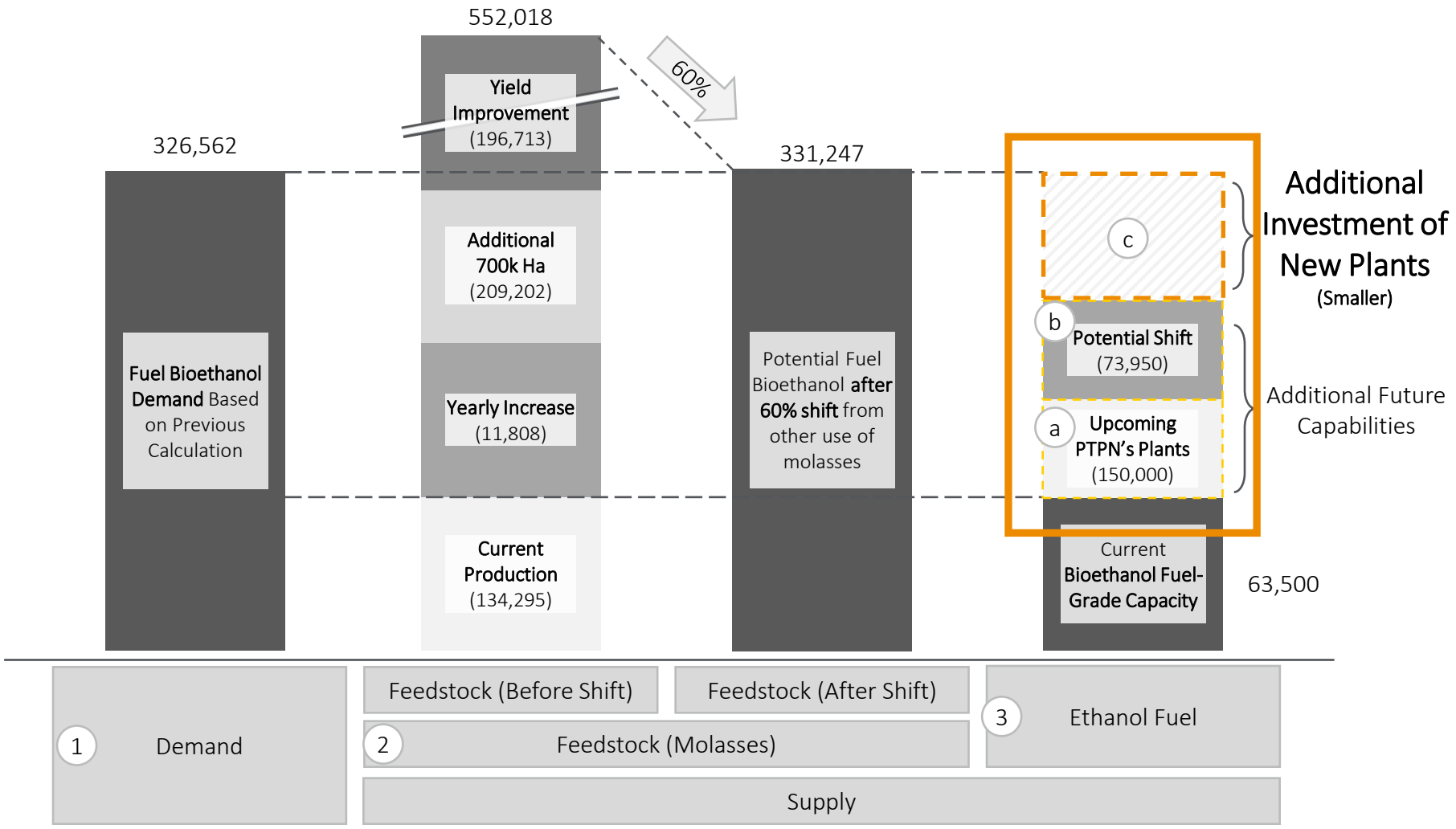
3.B Additional Investment of New Plants – ⑤



	Component	Calculation Result
1	Bioethanol Fuel Supply Shortage	263,062 kL/year
2	Ideal capacity per 1 plant from benchmark case	30,000 kL/year/plant
3	Number of Plants Needed	9 plants
4	Case 1 Investment in 2030 (m USD/plant)	62.62
	Case 2 Investment in 2030 (m USD/plant)	60.38
3	Additional Investment of New Plants (m USD) – range from Case 1 to Case 2	543 - 564

However, we see opportunities to reduce investment amount needed by considering potential future capabilities from upcoming PTPN's plants and potential shift of non-fuel grade bioethanol production

Fuel Grade Bioethanol Balance Sheet (kL) – Additional Future Capabilities (Min. case)



Note: Box size of each part of the bar does not reflect true value - for illustration purpose only

In collaboration with Pertamina, PTPN are currently reviewing their plans to build another 4 bioethanol plants with total capacity of 150,000 kL/year by 2028

a. Upcoming PTPN's Plants

Press Release from PTPN's subsidiary, named SGN in 2023

SINERGI GULA NUSANTARA | About Us | Governance | Work unit | Production | Publication | Office

SGN Projects Bioethanol Production in 2024 to Reach 34,500 KL/Year

2023-10-18

SURABAYA - PT Sinergi Gula Nusantara (SGN) or *Sugar Co* , Sugar Sub Holding PTPN III (Persero) Holding Perkebunan Nusantara projects that it can produce bioethanol reaching 34,500 kiloliters (KL) per year in line with the sugar production target of 965,000 tons next year. SGN President Director, Aris Toharisman said that SGN continues to strive to support the government's efforts to develop bioethanol production as stated in Presidential Decree 40/2023. "Currently PTPN is also reviewing plans to build 4 bioethanol plants in collaboration with Pertamina which are projected to produce 500 KL per day or 150,000 KL per year," explained Aris, Tuesday (17/10/2023).

Currently, he continued, bioethanol production by PT Energi Agro Nusantara (Enero), a subsidiary of PTPN According to Aris, the factors that are a big challenge in developing bioethanol production as a fuel substitute are the problem of availability of development land and increasing sugar cane productivity. "If both are resolved, the amount of sugar and molasses for ethanol raw materials will increase," he said. The sugar industry and its derivative products, added Aris, currently need support for expanding sugarcane land areas, access to cheap funding sources, and a conducive trading system.

Currently, SGN is making efforts to restructure the sugar business and business transformation in the *off-farm sugarcane processing sector, on-farm* plantation cultivation partnerships , improving the welfare of smallholder sugarcane farmers and their supporting units in order to improve the company's performance and productivity. Separately, the Director of PT Enero, Puji Setiyawan, said that currently Enero is preparing 1,900 kl of bioethanol fuel grade for the Pertamax Green mixture. "Enero has a capacity of 100 *Kilo Liters Per Day* (KLPD), then we optimize 50% of the factory capacity to produce *fuel grade* , the rest we use for ENA Grade production," explained Puji. The plan is that in 2024, 70% - 80% of Enero's capacity will be used for *fuel grade* production . The increase in production will be carried out in line with the large absorption of bioethanol from Pertamina. "Currently, Pertamina has only taken 60 KL for Pertamax Green needs, as a trial at several gas stations in Surabaya and Jakarta. "We hope that the extraction of *fuel grade* bioethanol can be carried out in stages and continuously, so that Pertamax Green can be applied immediately," he said. Puji explained that the mixing of bioethanol in vehicle fuel has been tested for safety, so it will not damage the vehicle engine. The successful application of bioethanol in fuel has been carried out in several countries such as Brazil and Thailand. "The bioethanol produced by Enero comes from sugar cane molasses produced by sugar factories, where 4 kg of molasses can produce 1 liter of bioethanol," he added. He is optimistic that bioethanol products from Enero have promising prospects in the future, because the government will plan to build four bioethanol factories in Sumatra and Java until 2028.

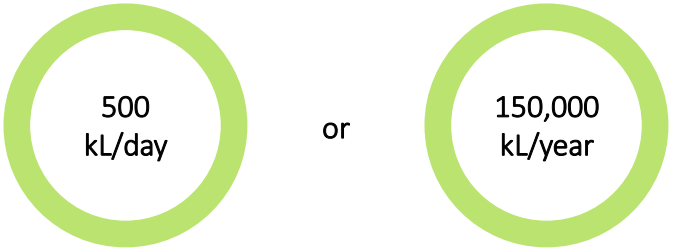
Source: Sinergi Gula Nusantara (SGN)

PTPN's plans for Bioethanol Plants

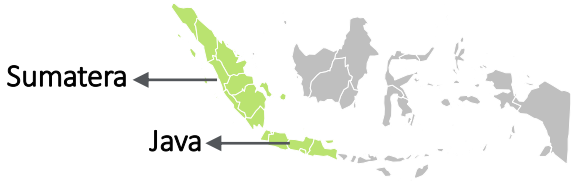
To build...

4 fuel-grade bioethanol plants by 2028

With a total capacity of....



Will be located around.....



Total of 150,000 kL/year contribution from Upcoming PTPN's Plants

Assumption of 30% shift from current non-fuel-grade bioethanol production has been made with the prioritization for plants that located in Java and using molasses as the raw material

b. Potential Shift from Non-fuel grade Bioethanol

Pre-condition

1	• Assumed there will be a shift of 30% from non-fuel bioethanol capacity to fuel-grade bioethanol • Assumed the capacity of the future fuel-grade bioethanol will be utilized 100%
2	• Since the government target in 2030 is to distribute bioethanol fuel focusing on Java island, the priority scale is based on the plant's location. **The plants which are located inside of Java will be prioritized in the next calculation** • Since this simulation is focusing on the 1G sugarcane capabilities, **thus molasses-based bioethanol will be prioritized**

Bioethanol companies which produce bioethanol non-fuel grade

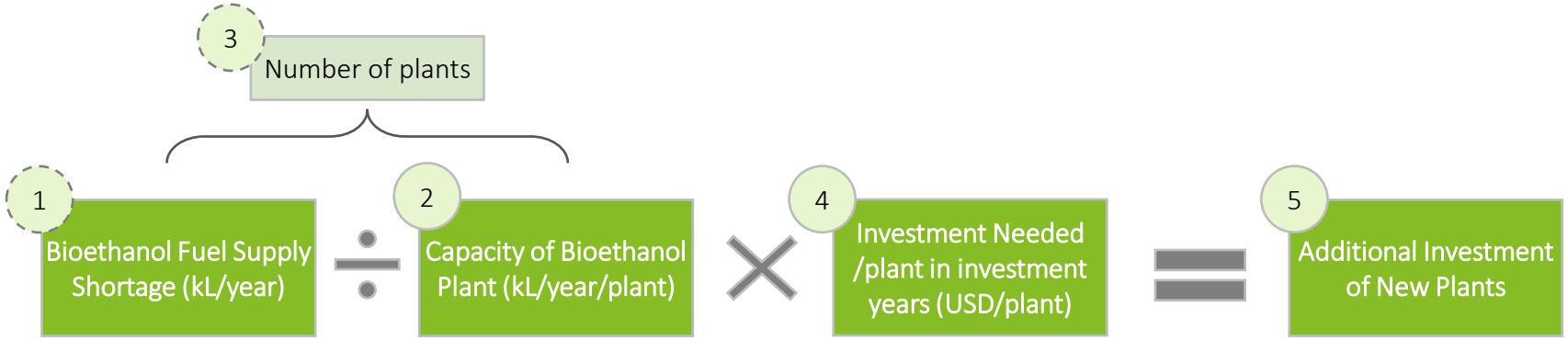
Company Name	Production Capacity *(kL/year)*	Location	Raw Material	Pre condition		
				1. Future Fuel-grade Bioethanol Capacity (kL/year)		2. Status
				% assumption	Amount	
Molindo Raya* *(capacity of non-fuel bioethanol)	70,000	East Java & Lampung	Molasses & Corn		21,000	Priority
Indolampung Distillery	30,000	Lampung	Molasses		27,000	Non-Priority
Indo Acidatama	45,000	Central Java	Molasses		13,500	Priority
Aneka Kimia	17,000	East Java	Molasses		5,100	Priority
PASA Djatiroto	7,500	East Java	Molasses		2,250	Priority
PSA Palimanan	7,000	West Java	Molasses	30%	2,100	Priority
Basis Indah	5,500	South Sulawesi	Molasses		1,650	Non-Priority
Permata Sakti	5,000	North Sumatera	Molasses		1,500	Non-Priority
Molasindo Alur Pratama	3,600	North Sumatera	Molasses		1,080	Non-Priority
PT. Medco Ethanol Indonesia	69,000	Lampung	Cassava		20,700	Non-Priority
Sampoerna Bio Energi	60,000	East Java/Central Java	Cassava		18,000	Non-Priority
RNI	100,000	East Java	Cassava/Molasses		30,000	Priority
Total					73,950	

Total of 73,950 kL/year contribution from the shift of non-fuel bioethanol

 Source : Paper titled "Bioethanol prospect from agricultural crops and its biomass in Indonesia", APSENDO's interview, journals

Using min. case scenario assumption, some adjustment in the calculation are needed; It was calculated that it would take 2 plants to cover 2030 demand

c. Additional Fuel-Grade Bioethanol Plants Needed (Min. case)

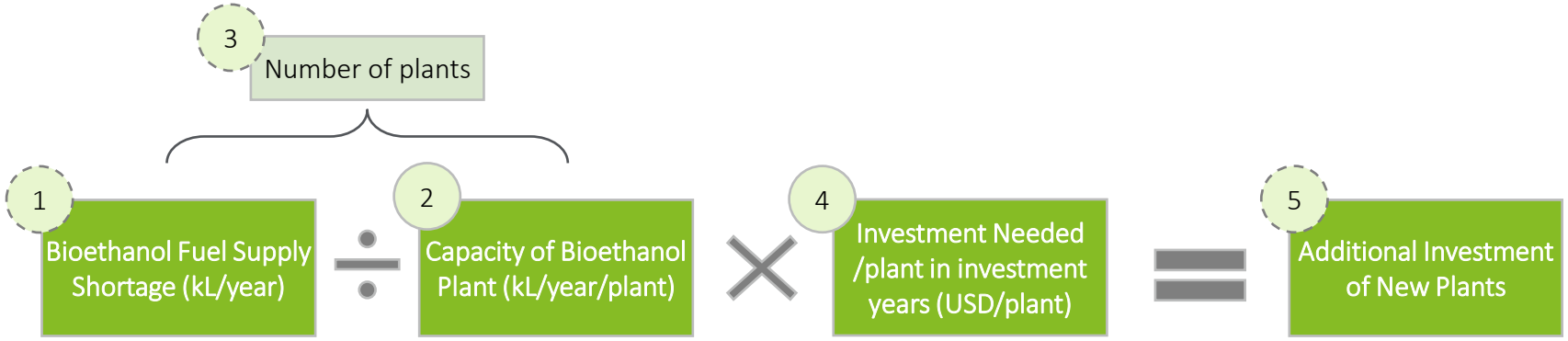


	Description	Calculation Result	
1	Taking into account the additional future capabilities from the **upcoming PTPN's plants** (total of 150,000 kL/year) and **potential shift from non-fuel bioethanol** (total of 73,950 kL/year)	Bioethanol Fuel Supply Shortage	326,562 kL/year – 63,500 kL/year – 150,000 kL/year – 73,950 kL/year = 39,112 kL/year
3	By increasing the potential supply from the scenario above, this reduces the bioethanol supply-demand volume gap and will **adjust the number of plants that need to be built**	Number of Plants Needed	$= \frac{39{,}112\ kL/year}{30{,}000\ kL/year}$ $= 1.3 \approx \mathbf{2}\ \boldsymbol{plants}$

- - - - : *adjustments in scenario 2*

In min. case scenario, investment is expected to be smaller, with only 121 – 125 total additional investment to build 2 new bioethanol plants

c. Additional Fuel-Grade Bioethanol Plants Needed (Min. case) – Final Calculation Result



	Component	Calculation Result
1	Bioethanol Fuel Supply Shortage	39,112 kL/year
2	Ideal capacity per 1 plant from benchmark case	30,000 kL/year/plant
3	Number of Plants Needed	2 plants
4	Case 1 Investment in 2030 (m USD/plant)	62.62
	Case 2 Investment in 2030 (m USD/plant)	60.38
5	Additional Investment of New Plants (m USD) – range from Case 1 to Case 2	121 - 125

- - - - : *adjustments in scenario 2*

c. Production feasibility estimates for alternative raw materials

Palm oil gasoline (Green gasoline) as alternative feedstock

Green gasoline, which was first introduced by Indonesia, has no need for engine adjustments due to the similarity of chemical structure to fossil fuels

Overview of Green Gasoline (1)

Description	• Green gasoline is a type of fuel (gasoline) that use Oil Palm as the main raw material, also known as BENSA (Bensin Sawit / Palm Oil Gasoline) • The case is different with ethanol fuel grade which has a different chemical structure with fossil fuel, **Green gasoline has a bio hydrocarbon chemical structure which is the same structure as in fossil fuel** • **Indonesia is the first country who introduce green gasoline**, also known as green gasoline
Raw Material	• **RBDPO** (Refined, Bleached, Deodorized, Palm Oil) • **IVO** (industrial vegetable oil) -> similar with RBDPO but without color bleaching process **RBDPO is CPO that has been purified from impurities in it such as sap, dirt, odor and taste*.
Current Usage of the Raw material	Export **Food** : Cooking Oil, Margarine, creamer, etc. **Oleochemical** : Soap, Cosmetics, etc.

MINISTRY OF ENERGY AND MINERAL RESOURCES
OF THE REPUBLIC OF INDONESIA

Source: MEMR

Co-processing is an option for a green-fuel production method through processing vegetable oil raw materials with petroleum simultaneously into green hydrocarbons (green-gasoline, green-diesel, or bioavtur). Green-fuel is a biohydrocarbon compound which generally has the same characteristics as fossil-based hydrocarbon compounds so it can be mixed at any percentage level without the need to adjust the vehicle engine. This green-fuel is a good choice to meet domestic liquid fuel needs to substitute for crude oil or fuel from domestic production, in addition to Biodiesel type BBN which is already running commercially up to 20% (B20) blending. In the end, green-fuel

RBDPO

IVO

Source : MEMR press conference, Pertamina website, MoI Oil Palm Balance Sheet

IVO has a shorter production process than RBDPO, this makes the price of IVO relatively cheaper than RBDPO

Reference: RBDPO & IVO Production Process

Production Process of RBDPO

Degumming	Degumming : The process of **binding gum and impurities** consists of the main components, namely phospholipids, phosphatides, resins, impurity fibers in CPO
Bleaching	Bleaching: The process of **bleaching the color of CPO and absorbing impurities** for the stability of the final product
Filtration	Filtration: The process of **filtering BPO (bleached palm oil) from gum** that has been bound with phosphoric acid (during the degumming process)
Deodorization	Deodorization: The process of **separating the aroma and odor from oil by distillation** and stripping agent removal in a vacuum and high temperature (>200 °C) condition

Production Process of IVO

Degumming	Degumming : The process of **binding gum and impurities** consists of the main components, namely phospholipids, phosphatides, resins, impurity fibers in CPO
Bleaching	ELIMINATED
Filtration	Filtration: The process of **filtering BPO (bleached palm oil) from gum** that has been bound with phosphoric acid (during the degumming process)
Deodorization	Deodorization: The process of **separating the aroma and odor from oil by distillation** and stripping agent removal in a vacuum and high temperature (>200 °C) condition

Source : MEMR press conference, ITB Presentation Material at GIIAS 2023

2 research developments have been started by ITB and Pertamina, but they are still not feasible to run commercially

Overview of Green Gasoline (2)

Current Research

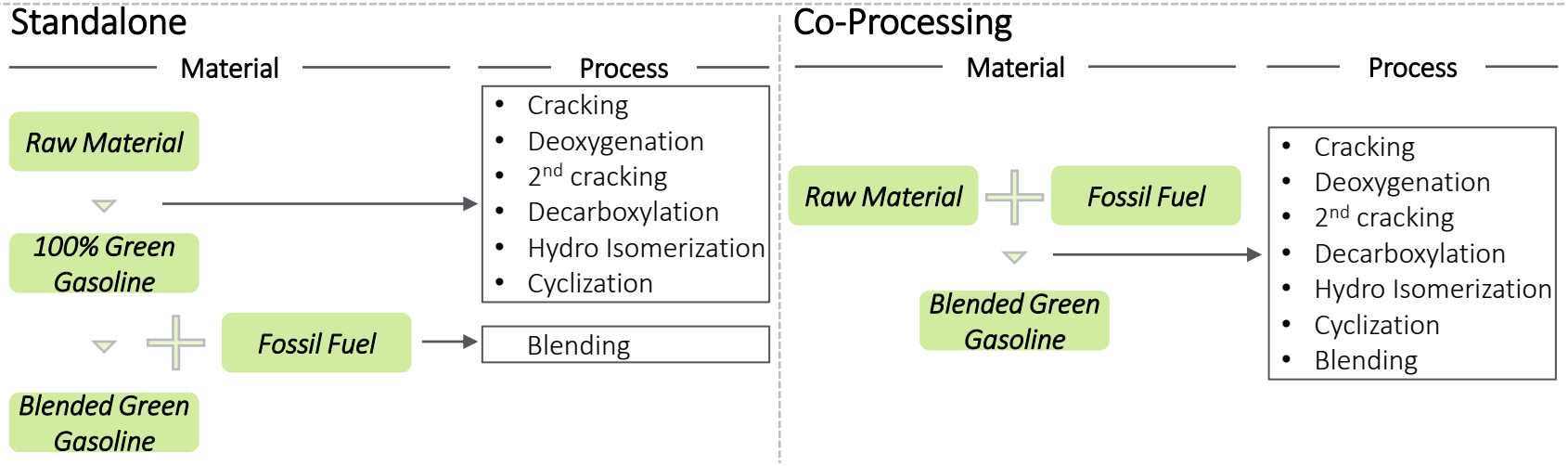
ITB's Research

- Process Type : Standalone (produce pure green gasoline and blended green gasoline separately)
- Location : South Sumatera
- Capacity : 1,000 L/day
- Raw Material : IVO (Industrial Vegetable Oil)
- Blend Ratio : 60% pure green gasoline (RON 105 – 110) + 40% NAFTA (RON 71)
- Product : Blended Green Gasoline RON 92 - 94

Pertamina's Research (as a baseline in the calculation)

- Process Type : Co-Processing (produce final green gasoline without any blending process)
- Location : South Sumatera
- Capacity : 64,500 kL/month
- Raw Material : RBDPO (Refined Bleached Deodorized Palm Oil)
- Blend Ratio : 7.5% RBDPO with fossil fuel
- Product : Blended Green Gasoline RON 91.3

Process Type Differences



 Source : MEMR press conference, ITB Presentation Material at GIIAS 2023

Government had a green gasoline target and put several project as national priority program; The immediate focus is developing community-based projects

Government Development Plan

BIOFUELS DEVELOPMENT PLAN (2021-2040)

Unit : Million KL	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Biodiesel	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.2	10.5	10.8	11.1	11.3	11.5	11.5	11.6	11.6	11.6	11.7	11.7
Co-processing Green Diesel	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Standalone Green Diesel	0.0	0.2	0.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Co-processing Green Gasoline	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Standalone Green Gasoline	0.0	0.0	0.1	0.3	0.5	0.8	1.1	1.4	1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Total Biofuels	9.2	9.7	10.0	11.3	11.6	12.0	12.4	12.8	13.4	14.0	14.3	14.6	14.8	15.0	15.0	15.1	15.1	15.1	15.2	15.2

Target of Green Gasoline

=

app. ~6% of Total Gasoline Consumption (2022)

PREPARATION FOR B40 IMPLEMENTATION

- B40 Technical Study And Test
- Launching Road Test
- Road Test

1. Fuel used in Road Test B40:
   - B30D10 >> 30% Biodiesel (B100*) + 10% Biodiesel/Biohydrocarbon Diesel/HVO (D100) + 60% Diesel (B0)
   - B40 >> 40% Biodiesel (B100*) + 60% Diesel (B0)
2. The road test distance is 50,000 km for ≤ 3.5 ton automotive and 40,000 km for > 3.5 ton automotive

B40 Road Test Activity Timeline

DES21 — JUN22 JUL22 — DES22 DES23

PREPARATION | ROAD TEST | REPORT

NATIONAL PRIORITY PROGRAM: GREEN FUELS – 1 "MERAH PUTIH" CATALYST FACTORY,WEST JAVA	NATIONAL PRIORITY PROGRAM: GREEN FUELS – 2 GREEN REFINERY PLAJU, SOUTH SULAWESI	NATIONAL PRIORITY PROGRAM: GREEN FUELS – 3 GREEN REFINERY CILACAP UNIT TDHT (REVAMPING)	NATIONAL PRIORITY PROGRAM: GREEN FUELS – 4 HIDROGENASI CPO AT RU IV CILACAP
IVO DEVELOPMENT DEMOPLANT AT MUSI BANYUASIN	**PALM OIL GASOLINE DEVELOPMENT** DEMOPLANT AT KUDUS, CENTRAL JAVA	**BIOAVTUR DEVELOPMENT** DEVELOPMENT OF BIOAVTUR J2,4	**UCO FOR GREENFUELS** MoU PERTAMINA AND APJETI

National Priority Program

1) **Since 2020, Mandatory B30 has been implemented in all sectors/users.**
2) **Development of Co-Processing Green Diesel** at Pertamina RU II Dumai is targeted to start commercial production in 2023.
3) **Development of Stand Alone Green Diesel** by PT Pertamina.
   Revamping phase I @ RU IV Cilacap in 2022; *Revamping phase* II @ RU IV Cilacap in 2023; RU III Plaju *standalone green refinery* in 2024.
4) **Green Gasoline Development**
   - **Non Pertamina stand alone green gasoline**
     1) Musi Banyuasin (development of community-based palm oil gasoline projects by involving cooperatives).
     2) Replicate the development of community-based palm oil gasoline projects in palm oil plantation in North Sumatera, Riau, South Sumatera, West Kalimantan, East Kalimantan Timur and Papua.
   - Co-processing green gasoline project at Pertamina RU III Plaju.
5) **Production of Merah Putih Catalyst.**

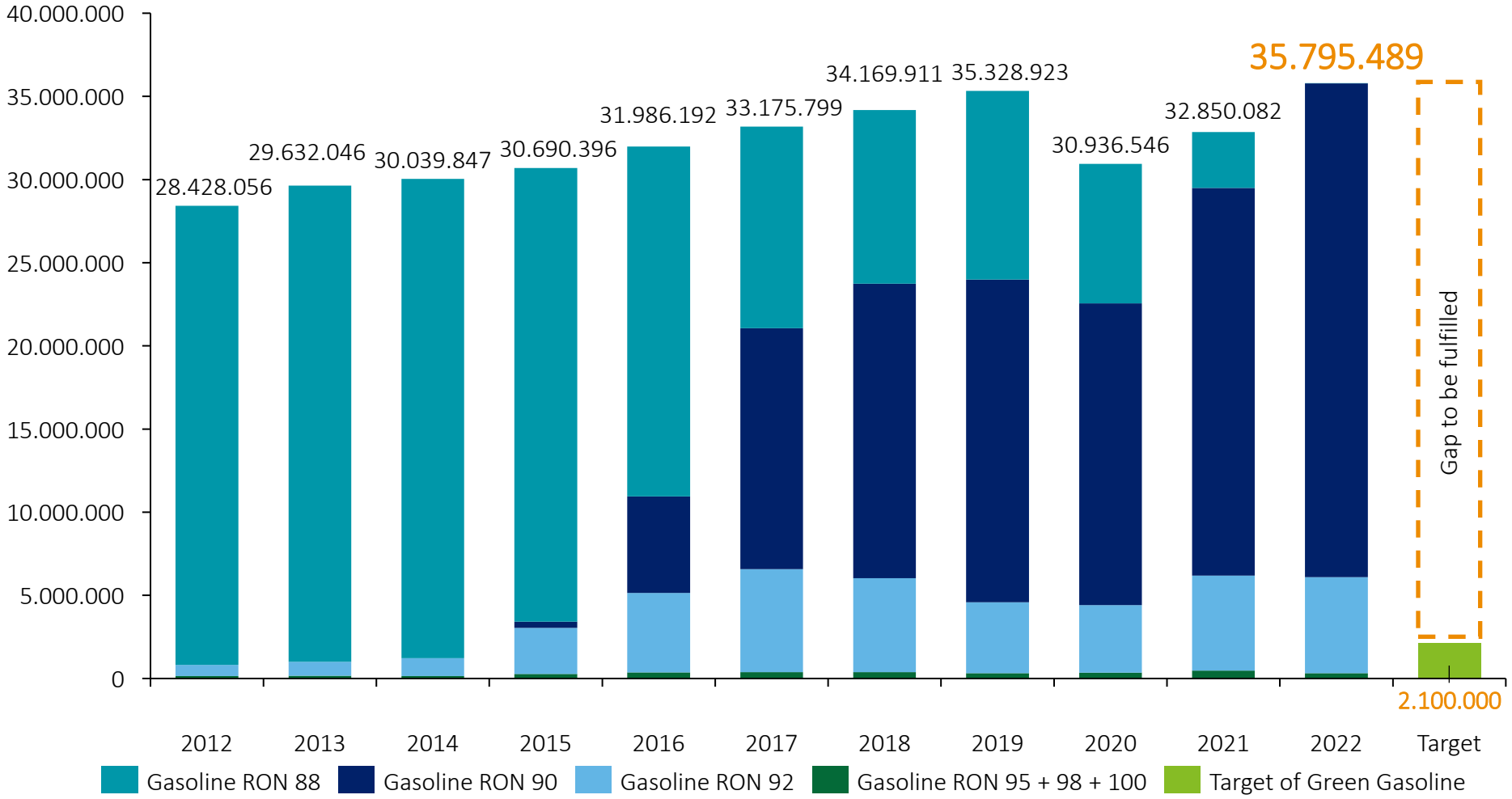
www.esdm.go.id

Plan to replicate on community-based (small) projects

Source : MEMR presentation material at GIIAS 2023

However, even if the target is achieved, it will only account for 6% of current gasoline consumption; There's still gap to be fulfilled

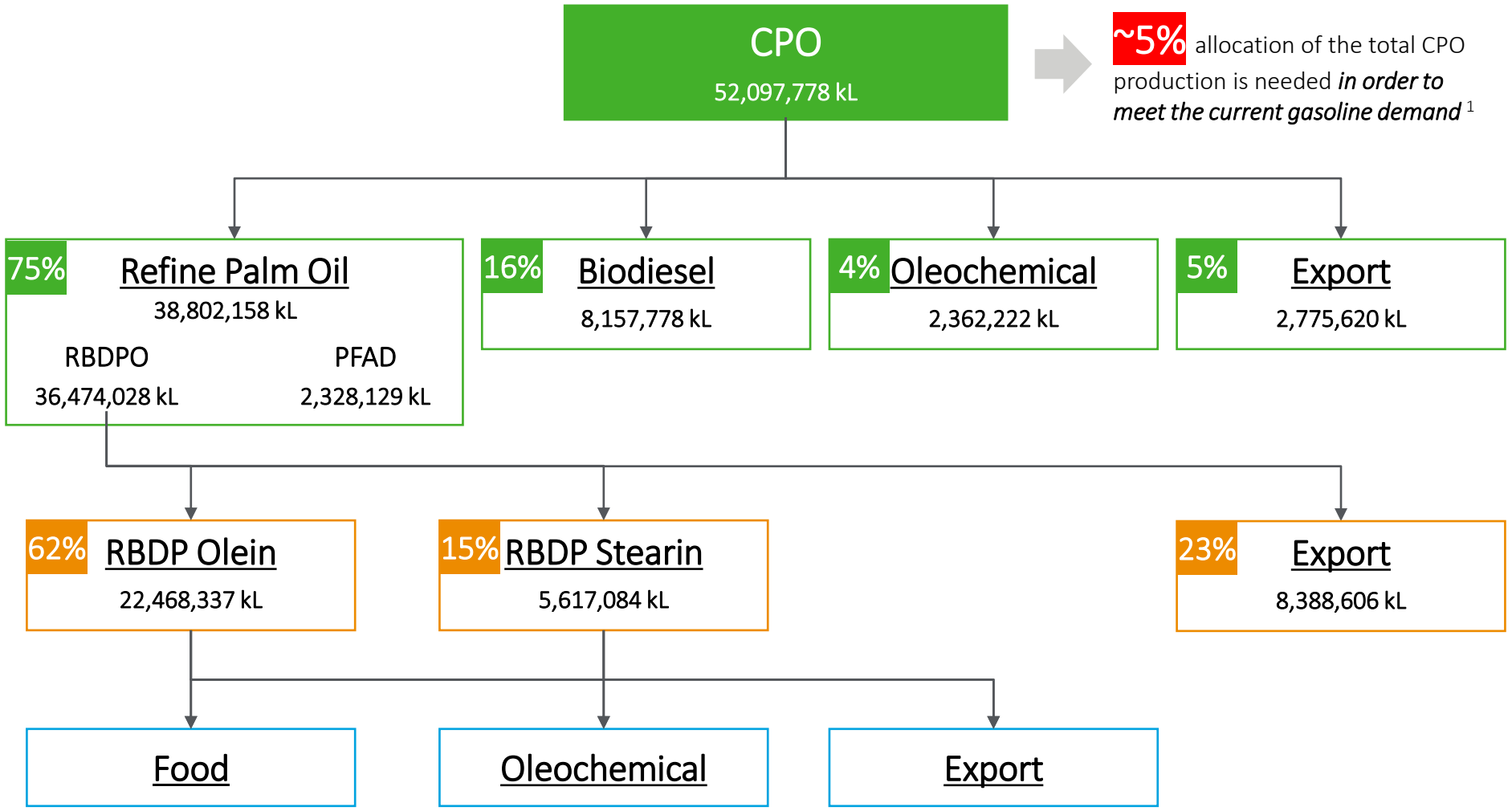
Gasoline Consumption Vs Green Gasoline Target (kilo liter)



Source : MEMR Handbook Energy Outlook 2022

One option to bridge this gap is to increase the ~5% allocation of CPO for green gasoline, which can be obtained from shifting of other-use

Potential Supply (as of 2021)



[1] = *Based on Deloitte's calculation in Appendix*

Source : MoI Oil Palm Product and Derivatives Balance Sheet 2021

In general, green gasoline has conflicts with other uses, land-use change, difficulty of obtaining raw material compared to 2nd Gen EFB

Comparison to 2nd Gen ethanol from EFB

		Green Gasoline / Palm Oil Gasoline / BENSA	2nd Gen EFB
Technological Readiness		X Not ready yet	X Not Ready yet
Green Wash Related	Competition of raw material use	X Compete with Food and Oleochemical Industry	○ No Conflicts
	Land-use Change	△ Potential Land Expansion Needed	○ No Land Expansion Needed
Availability of Raw Material	Ease of Obtaining Raw Material	X Use processed raw material	△ Use direct waste from Palm Oil Mills
	Raw Material Volume	△ The current utilization shares can be shifted to green gasoline use	○ Can cover future demand
Government Support		○ 2.1-billion-liter target in 2030, established several national priority program	X No specific target & support
Impact on the engine adjustment		○ Minimum adjustment needed	X Adjustment Needed

Reference

Calculation of CPO volume needed to fulfill current gasoline consumption

Data Gathered:

- 10 ton (100%) CPO can be processed into → 9.5 ton (95%) RBDPO and 0.4 ton (4%) PFAD
  - Source: Mass Balance of CPO from BPDPKS
  - CPO to RBDPO Conversion Rate 0.95 $\frac{ton\ of\ RBDPO}{ton\ of\ CPO}$
- Current Gasoline Consumption = 35.8 billion liter
- Current CPO Production = 52.1 billion liter

Calculation based on Pertamina's Research Case – Co-processing → 7.5% feedstock (Use of RBDPO)

- RBDPO needed (if using 7.5% feedstock) =

  $\frac{\%\ Feedstock}{100}\ x\ expected\ output\ needed$

  $\frac{7.5}{100} x\ 35.8\ bil\ ltr\ of\ current\ gasoline\ consumption$ = 2.685 billion liter RBDPO
- RBPO conversion to CPO needed =

  $RBDPO\ needed\ x\ \frac{1}{CPO\ to\ RBDPO\ Conversion\ Rate}$

  $2.685\ bil\ ltr\ x\ \frac{10}{9.5} = 2.826\ bil\ ltr$

  ~ equal to $\frac{2.826\ bil\ ltr\ of\ CPO\ needed\ for\ green\ gasoline}{52.1\ bil\ ltr\ of\ total\ CPO\ production}$ = ~5% of total CPO Production

UCO (Used Cooking Oil) as alternative feedstock

Currently, it's not feasible to produce ethanol from UCO; 80% of the UCO is being used for recycled cooking oil (65%) and Biodiesel (15%)

Overview of Biodiesel from Used Cooking Oil (UCO)

Description

- There are no journals or companies that develop ethanol, which is coming from UCO
- UCO is already being used as **Biodiesel feedstock**
- **Biodiesel from UCO is considered as more eco-friendly** due to minimum land-use change
- Conversion Ratio: 5 liter of UCO → 1 liter FAME (source: APROBI)

UCO

Source of Raw Material

53% of UCO coming from household waste in big city

47% of UCO coming from industrial waste

Current Usage of the UCO

Recycled Cooking Oil

Unused / Waste

Export

Biodiesel

Source : Tractionenergy.Asia, CNBC public news

Biodiesel from UCO has already been running by several players, nowadays the trend to produce green diesel (HVO) had just started by PT KPI under Pertamina

Some Identified Players of Biodiesel from Used Cooking Oil (UCO)

Current Players Examples

Private Players

- Name : CV Artha Metro Oil
- Status : Operational
- Location : Sidoarjo, East Java
- Capacity : Unknown
- Raw Material : UCO
- Product : FAME / Pure Biodiesel

Artha Metro Oil

- Name : PT. HIJAU DAUN ENERGI
- Status : Operational
- Location : Jakarta
- Capacity : Unknown
- Raw Material : UCO
- Product : FAME / Pure Biodiesel

PT Hijau Daun Energi

State Owned Enterprise

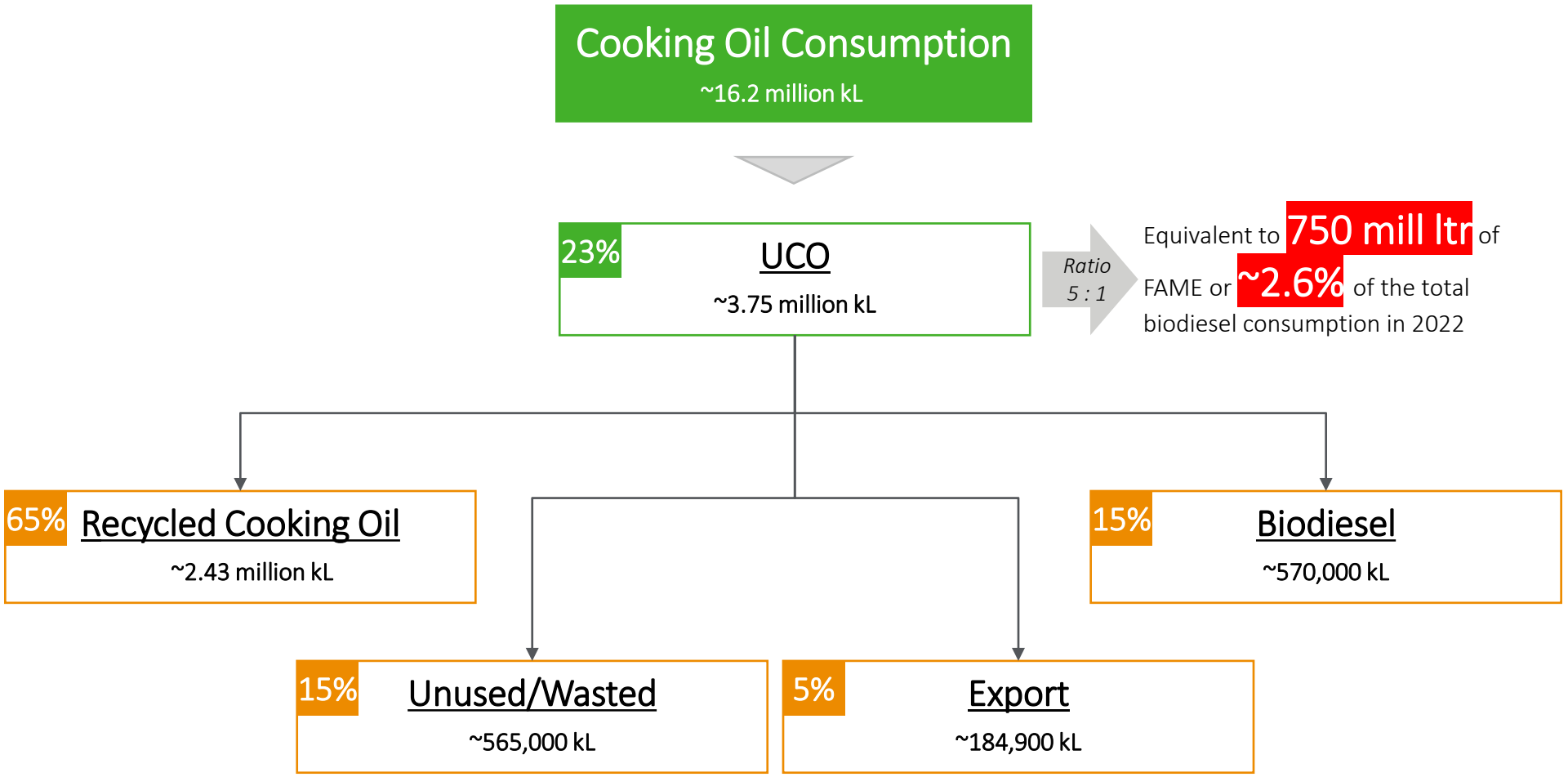
- Name : PT. KPI (Green Refinery Phase 2)
- Status : Planned
- Location : Cilacap, Central Java
- Capacity : 6 kBarrel/day
- Raw Material : UCO
- Product : Hydrotreated Vegetable Oil (HVO/Green Diesel)

PERTAMINA KILANG PERTAMINA INTERNASIONAL

Source : Tractionenergy.Asia, CNBC public news

If all potential UCO supply is leveraged, it will produce 750 million liter of biodiesel, or 2.6% from the total Biodiesel consumption in 2022

Potential Supply (as of 2019)



Source : APROBI's publication

Sorghum as alternative feedstock

Sorghum has already been used as for bioethanol in USA, Australia and China; However, in Indonesia, sorghum only used as food (grain) and animal feed (leaf)

Overview of Sorghum

Description

Sorghum in General

- **Sorghum is the 5th largest cereal product in the world** after wheat, corn, rice and barley
- **Sorghum has some advantages compared to sugarcane**

Shorter Harvest Time
3x harvest in a year

Higher Survivability
Resistance with waterlogging or dry weather

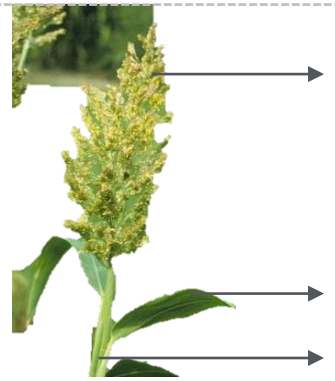
Sorghum as Bioethanol

- Parts of the Sorghum that can be used for bioethanol
  - **Starch from the grains**
  - **Juice from the stem**
  - **Bagasse from the stem**
- Countries that are using sorghum as bioethanol feedstock: **USA, Australia, and China**

United

In 2008, United Petroleum in Australia produced fuel grade bioethanol based on sorghum grain starch with a capacity of 76,000 kL/year

Current Usage of the Sorghum in Indonesia



Grains → **Food** (direct consumption) or processed food i.e., flour)

Leaf → **Animal Feed**

Stem → **Unused** / Wasted

Source : MEMR's publication

Sorghum ethanol is still in a demonstration test stage focusing on using sorghum stem juice as the raw material

Current Development Stage

Current Demonstration Test

MEMR's Research

- Status : Running
- Scale : Pilot Project
- Location : Yogyakarta (with UPN Veteran University) & East Lombok (with Mataram University)
- Capacity : Unknown
- Raw Material : Sorghum juice from stem
- Product : Bioethanol

Pertamina's Research

- Status : Planned
- Scale : Pilot Project
- Location : Dumai (with Badan Pengkajian Teknologi Pertanian – BPTP Riau)
- Capacity : Unknown
- Raw Material : Sorghum juice from stem
- Product : Bioethanol

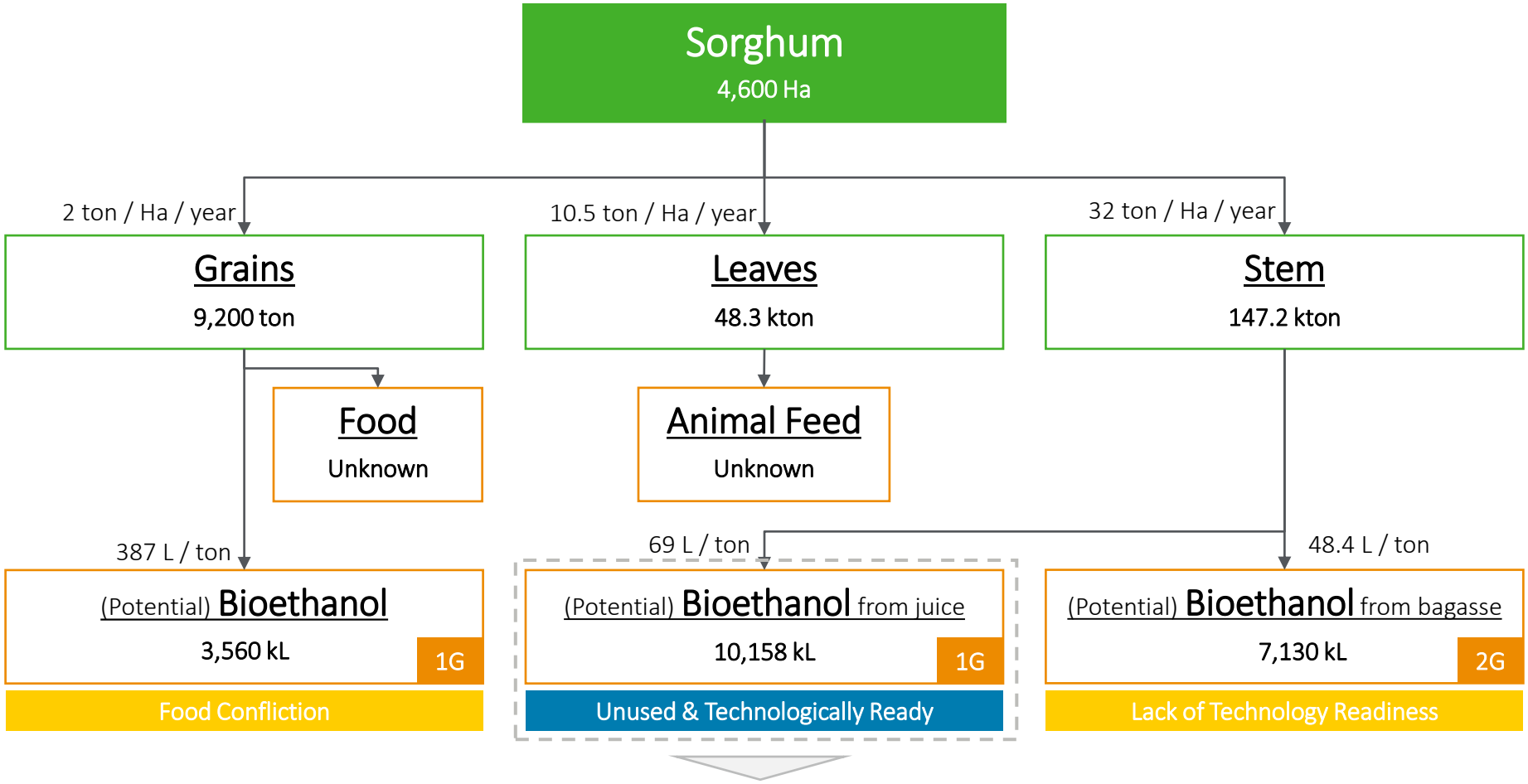
Process Flow

Grain Starch	Stem Juice	Stem Bagasse
Milling	*Fermentation*	*Pre-treatment*
Saccharification	*Distillation*	*Saccharification*
Fermentation	*Dehydration*	*Fermentation*
Distillation		*Distillation*
		Dehydration

 Source : MEMR's publication, METI's journal, international journals, various articles

Out of 3 potential bioethanol volume from different material, stem juice has the most feasibility with the potential production of 10,158 kL as of 2022 plantation condition

Potential Supply (as of 2022)



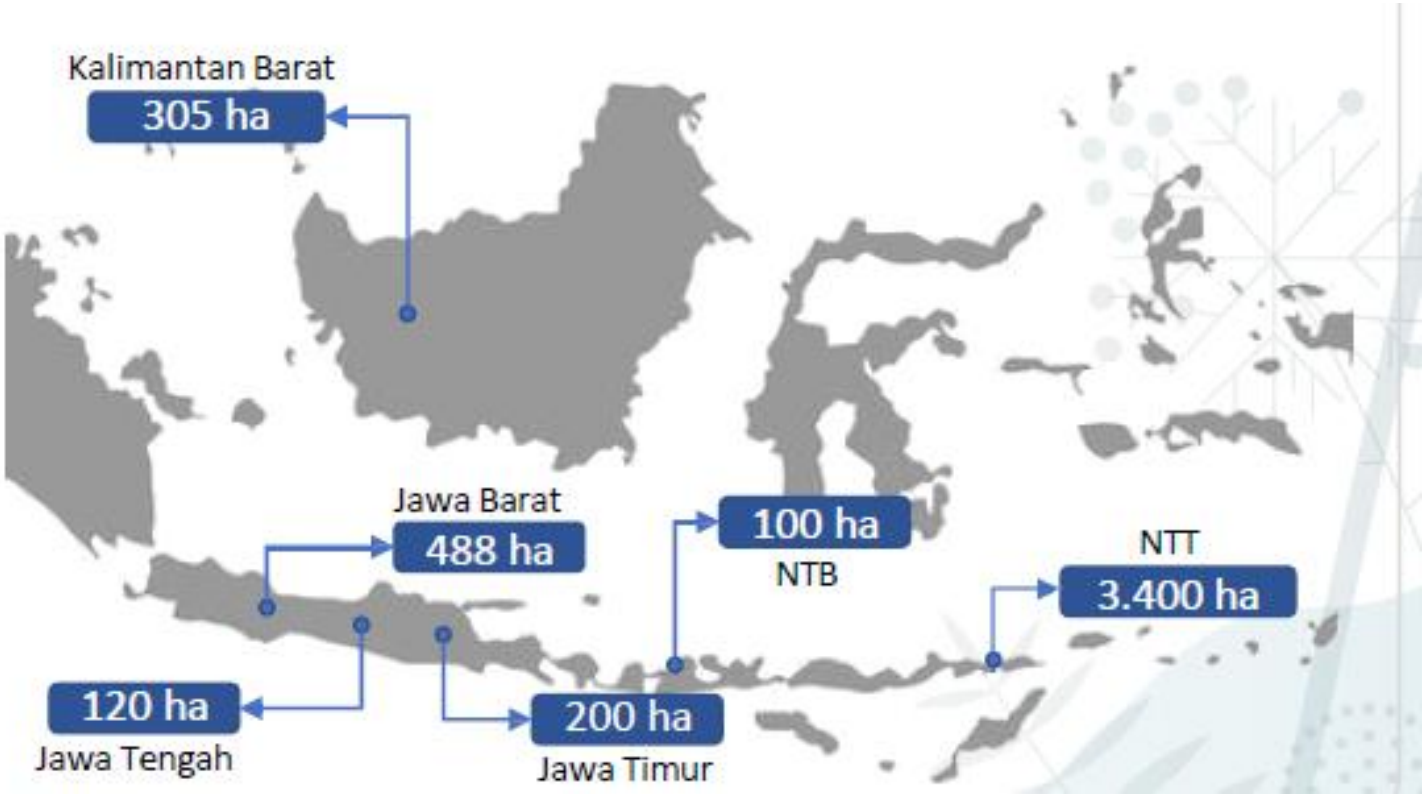
Total Potential pure Bioethanol = **10,158 kL** equal to ~ **0.6%** of total 2022 gasoline consumption[1]

[1]= *assumed 5% blend ratio*

Source : Pertamina's material at GIIAS 2023, METI's publication, BRIN's publication, international journals, MEMR Handbook Energy Outlook 2022

In Indonesia, sorghum's plantation is concentrated in Java and Nusa Tenggara Island; It becomes one of the consideration how to distribute across Indonesia's region

Distribution of Sorghum Plantation (2022)

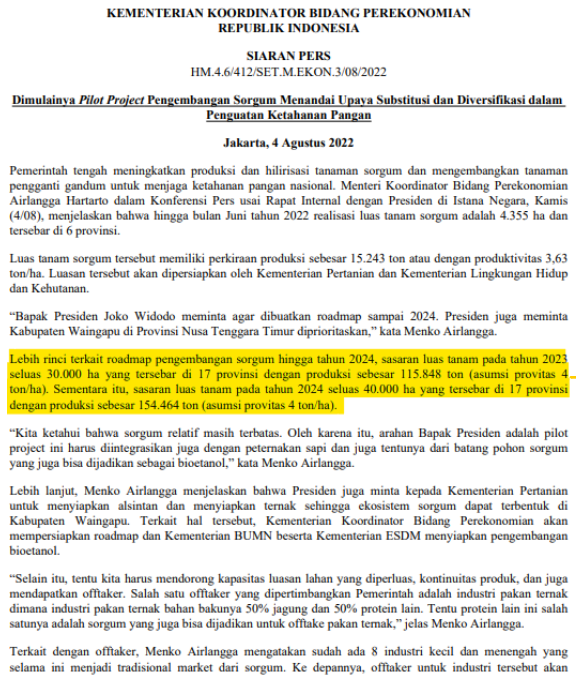


Source: *Pertamina's material at GIIAS 2023*

The government has established a target to expand sorghum plantation by 2023 and 2024, although the progress still no further information

Government Target

Press Release from Coordinating Ministry of Economic Affairs



KEMENTERIAN KOORDINATOR BIDANG PEREKONOMIAN
REPUBLIK INDONESIA

SIARAN PERS
HM.4.6/412/SET.M.EKON.3/08/2022

Dimulainya *Pilot Project* Pengembangan Sorgum Menandai Upaya Substitusi dan Diversifikasi dalam Penguatan Ketahanan Pangan

Jakarta, 4 Agustus 2022

Pemerintah tengah meningkatkan produksi dan hilirisasi tanaman sorgum dan mengembangkan tanaman pengganti gandum untuk menjaga ketahanan pangan nasional. Menteri Koordinator Bidang Perekonomian Airlangga Hartarto dalam Konferensi Pers usai Rapat Internal dengan Presiden di Istana Negara, Kamis (4/08), menjelaskan bahwa hingga bulan Juni tahun 2022 realisasi luas tanam sorgum adalah 4.355 ha dan tersebar di 6 provinsi.

Luas tanam sorgum tersebut memiliki perkiraan produksi sebesar 15.243 ton atau dengan produktivitas 3,63 ton/ha. Luasan tersebut akan dipersiapkan oleh Kementerian Pertanian dan Kementerian Lingkungan Hidup dan Kehutanan.

"Bapak Presiden Joko Widodo meminta agar dibuatkan roadmap sampai 2024. Presiden juga meminta Kabupaten Waingapu di Provinsi Nusa Tenggara Timur diprioritaskan," kata Menko Airlangga.

Lebih rinci terkait roadmap pengembangan sorgum hingga tahun 2024, sasaran luas tanam pada tahun 2023 seluas 30.000 ha yang tersebar di 17 provinsi dengan produksi sebesar 115.848 ton (asumsi provitas 4 ton/ha). Sementara itu, sasaran luas tanam pada tahun 2024 seluas 40.000 ha yang tersebar di 17 provinsi dengan produksi sebesar 154.464 ton (asumsi provitas 4 ton/ha).

"Kita ketahui bahwa sorgum relatif masih terbatas. Oleh karena itu, arahan Bapak Presiden adalah pilot project ini harus diintegrasikan juga dengan peternakan sapi dan juga tentunya dari batang pohon sorgum yang juga bisa dijadikan sebagai bioetanol," kata Menko Airlangga.

Lebih lanjut, Menko Airlangga menjelaskan bahwa Presiden juga minta kepada Kementerian Pertanian untuk menyiapkan alsintan dan menyiapkan ternak sehingga ekosistem sorgum dapat terbentuk di Kabupaten Waingapu. Terkait hal tersebut, Kementerian Koordinator Bidang Perekonomian akan mempersiapkan roadmap dan Kementerian BUMN beserta Kementerian ESDM menyiapkan pengembangan bioetanol.

"Selain itu, tentu kita harus mendorong kapasitas luasan lahan yang diperluas, kontinuitas produk, dan juga mendapatkan offtaker. Salah satu offtaker yang dipertimbangkan Pemerintah adalah industri pakan ternak dimana industri pakan ternak bahan bakunya 50% jagung dan 50% protein lain. Tentu protein lain ini salah satunya adalah sorgum yang juga bisa dijadikan untuk offtake pakan ternak," jelas Menko Airlangga.

Terkait dengan offtaker, Menko Airlangga mengatakan sudah ada 8 industri kecil dan menengah yang selama ini menjadi tradisional market dari sorgum. Ke depannya, offtaker untuk industri tersebut akan

Source: Coordinating Ministry of Economic Affairs

"… regarding the roadmap for sorghum development until 2024, the target planting area in 2023 is 30,000 ha spread across 17 provinces with production of 115,848 tons (assuming a yield of 4 tons/ha). Meanwhile, the target planting area in 2024 is 40,000 ha spread across 17 provinces with (assuming a yield of 4 tons/ha)…" production of 154,464 tons

2023 Target

30,000 Ha
Plantation Area of Sorghum

Distributed across **17** provinces

Total expected grain production is **115,848** ton[1]

2024 Target

40,000 Ha
Plantation Area of Sorghum

Distributed across **17** provinces

Total expected grain production is **154,464** ton[1]

Potentially can produce **88,330 kL of pure bioethanol** equal to ~ **5%** of total current gasoline consumption[2]

[1] = assumed 4 ton/Ha yield
[2] = assumed 5% blend ratio

Source : Coordinating Ministry of Economic Affairs' press release, MEMR Handbook Energy Outlook 2022

Additional research / Follow up

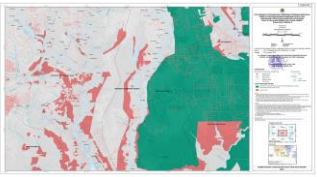
Feasibility Study on Oil Palm Farmland Development

Government encourage productivity improvement with no land expansion in order to increase palm oil production and establishes an evaluation system in granting permit

Government direction related to land expansion

Direction for General Plantation

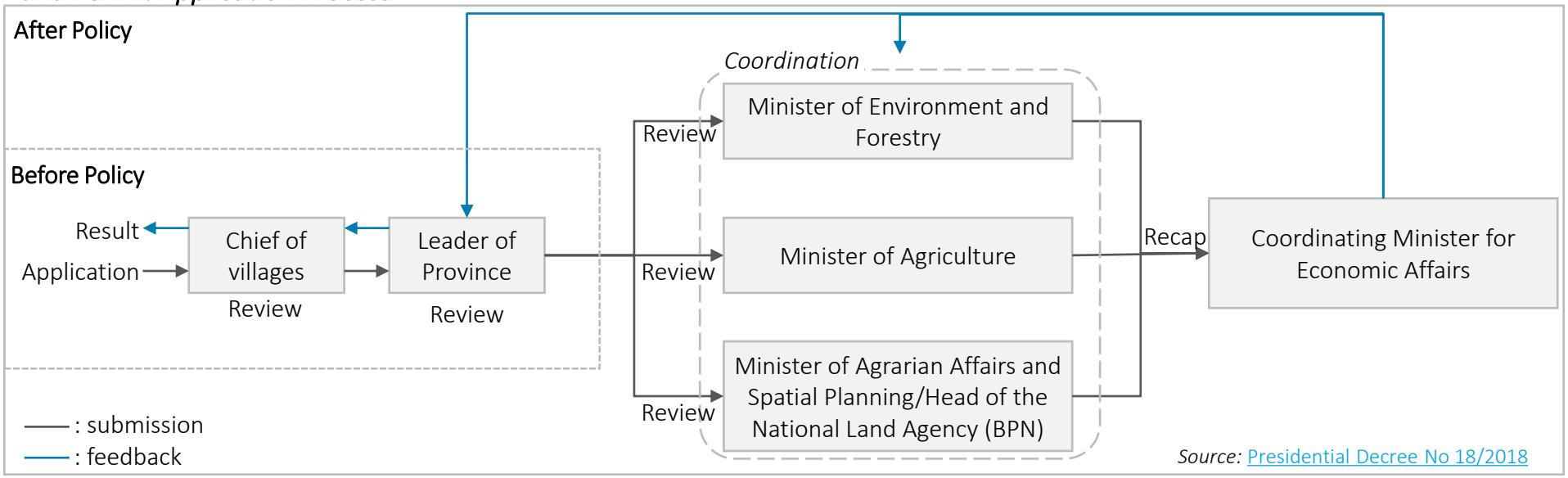
- Presidential Decree No 5/2019 about the Termination of the Granting of New Permits in **Primary Natural Forests** (in green) and **Peatlands** (in red)
  - The area is pictured spatially in the Indicative **Map for Delays in Granting New Permits (PIPPIB)** and will be revised every six months (source: https://sigap.menlhk.go.id/peta-cetak-detail/19)



Direction for Oil Palm Plantation

- Latest is Presidential Decree No 18/2018 about the delay and evaluation of palm plantation licensing and increasing palm plantation productivity
- **Land permit application had been changed** in the new regulation, make it more complex and have a comprehensive review from various stakeholders

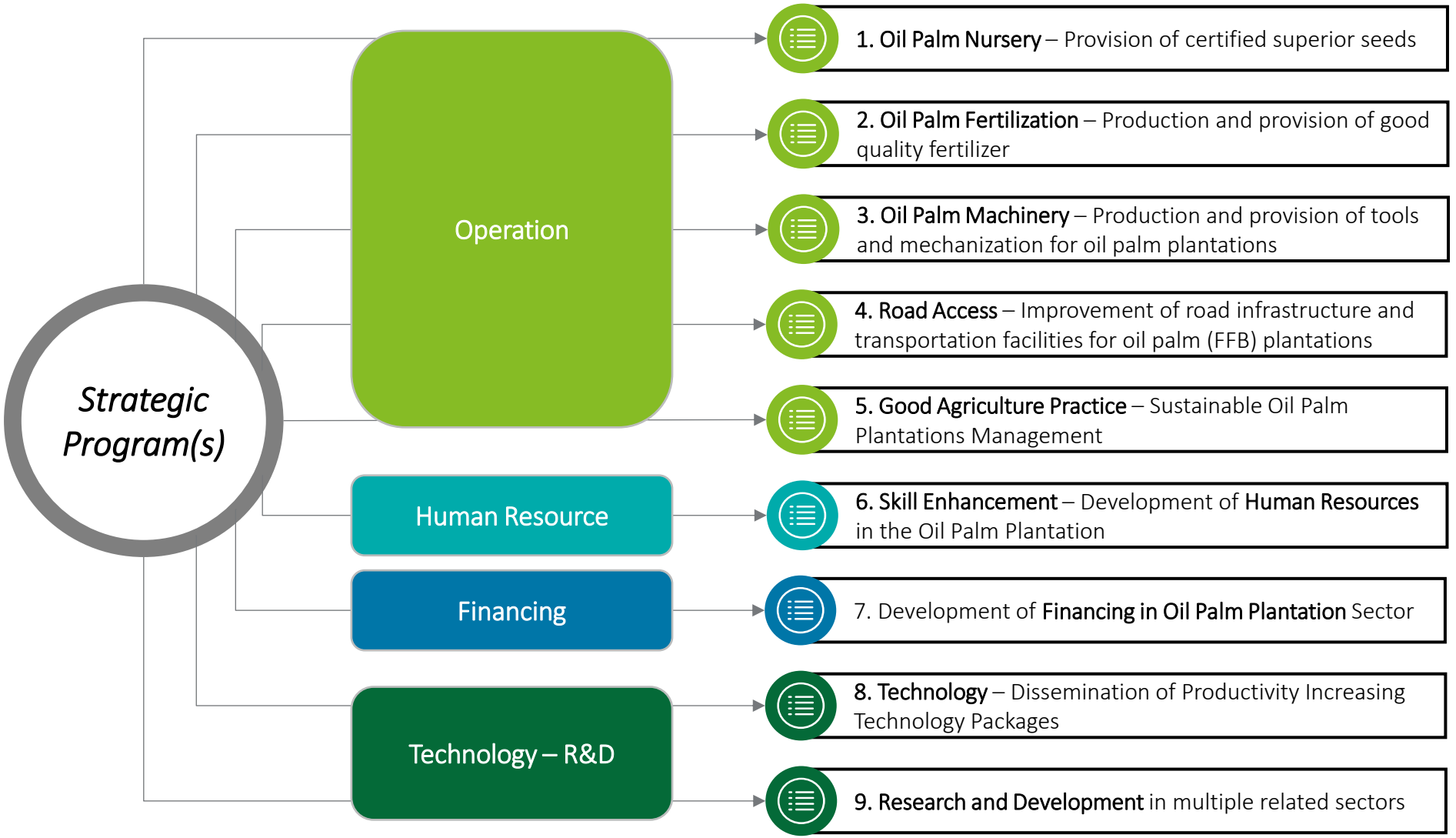
Land Permit Application Process



Source: Presidential Decree No 18/2018

To increase production, the government encourage improving oil palm productivity without any land expansion; Several programs were planned as follows

Strategic programs for productivity improvement



 Source: Indonesia Oil Palm Roadmap 2045 (created in 2020)

Appendix

Strategy for increasing the productivity

	Programs / Strategic Action	In Charge	Supporting Parties
1. Oil Palm Nursery – Provision of certified superior seeds			Operation
	Establishment of Gene Bank National of Oil Palm (Coconut Germplasm)	MoA	Seed Associations, R&D Agencies, Variety Protection Centers
	Provision of certified superior oil palm seeds for replanting of smallholder and corporate oil palm plantations every year	Seed Producer, *Oil Palm planter*[1]	Breeders, Provincial - Regency Plantation Services
2. Oil Palm Fertilization – Production and provision of good quality fertilizer			Operation
	Production & distribution of compound fertilizer for oil palm plantations based on land conditions	Fertilizer Producer, *Oil Palm Planter*[1]	MoA, R&D Agencies
	Expanding the use of palm biomass-based compost	*Oil Palm Planter*[1]	MoA, Plantation Service, Oil Palm Plantation Companies
3. Oil Palm Machinery – Production and provision of tools and mechanization for oil palm plantations			Operation
	Production & distribution of mechanization technology products for oil palm plantations in the market	Manufacturers of agricultural machinery, *Oil Palm Planter*[1]	Directorate General of Plantations, Ministry of CSME, Plantation Service, Research Institutes, Universities

[1] = Oil palm planter including community-based plantation, private plantation, and state plantation
Source: Indonesia Oil Palm Roadmap 2045 (created in 2020)

Appendix

Strategy for increasing the productivity

	Programs / Strategic Action	In Charge	Supporting Parties
4. Road Access – Improvement of road infrastructure and transportation facilities for oil palm (FFB) plantations			Operation
	Improvement of road access for oil palm plantations people	Provincial-Regency Plantation Service	Ministry of Public Works, Ministry of Agriculture, Provincial department
5. Good Agriculture Practice – Sustainable Oil Palm Plantations Management			Operation
	Realizing sustainable governance of peatland oil palm plantations	*Oil Palm Planter*[1]	Coordinating MoE, MoA, Peat Restoration Agency, Local Government
	Fulfillment of ISPO certification for all smallholder, state and private oil palm plantations	*ISPO Comission, Oil Palm Planter*[1]	MoA, Provincial-Regency Plantation Service, ISPO Auditor, Association
	Preparation of National Standards of ISPO to be recognized globally	*MoA*	National Standardization Agency, ISPO Comission
6. Development of Human Resources in the Oil Palm Plantation			Human Resource
	Increasing the technical, managerial and group dynamics (interpersonal skills) of smallholder oil palm growers, and capacity building for private and state-owned enterprises	*Oil Palm Planter*[1]	MoA, MoF, BPDPKS

[1] = *Oil palm planter including community-based plantation, private plantation, and state plantation*

Source: Indonesia Oil Palm Roadmap 2045 (created in 2020)

Appendix

Strategy for increasing the productivity

	Programs / Strategic Action	In Charge	Supporting Parties
7. Development of Plantation Sector Financing			Financing
	Establishment of a microfinance institution unit (one of the units within regional oil palm plantation institutions)	*MoA, MoE,* Ministry of CSME	Coordinating MoE, Ministry of Villages, Development of Disadvantaged Regions and Transmigration, and related village service
	Repair of facilities and infrastructure for smallholder oil palm plantations and Biohydrocarbon Oil Palm Plantation	*Community-based planter, BPDPKS, MoA*	*(same as above)*
	Establishment of Agricultural Bank	*MoA*	Coordinating MoE, MoF, Bank Indonesia, Financial Services Authority (OJK)
8. Technology – Dissemination of Productivity Increasing Technology Packages			Technology – R&D
	Acceleration of Oil Palm Rejuvenation Program for *Oil Palm Planter*[1]	*Oil Palm Planter*[1]	MoA, BPDPKS, MoE, Provincial-Regency Plantation Service
	Dissemination of Good Agriculture Practice Technology for *Oil Palm Planter*[1] Target in 2025 (ton CPO/Ha): 4.21 for Community, 4.89 for Private, 4.29 for State	*Oil Palm Planter*[1]	MoA, Provincial-Regency Plantation Service

[1] = *Oil palm planter including community-based plantation, private plantation, and state plantation*
Source: Indonesia Oil Palm Roadmap 2045 (created in 2020)

Appendix

Strategy for increasing the productivity

	Programs / Strategic Action	In Charge	Supporting Parties
9. Research and Development in multiple related sectors			Technology – R&D
	Plantation Cultivation Sector: molecular breeding, genetic engineering, etc.	*Palm Oil Research Center (PPKS)*	Ministry of Research and Technology, R&D Agency, Ministry's Research, Private Research Institute and Universities, BPDPKS
	Postharvest and Processing Sector: mobile application, rapid analysis method, etc.		
	Environment Sector: GHG emission reduction, carbon capture, etc.		
	Social, Economic and Business Sector: Competitiveness study, economic efficiencies study, etc.		
	Regulation/Policy Sector: partnership policy study, etc.		

Source: Indonesia Oil Palm Roadmap 2045 (created in 2020)

New calculation has been made in reference to the projection of palm oil production, which have also incorporated SDGs concern about avoiding land expansion

2nd Gen supply calculation (considering land-use change)

- **Reference:** Indonesia Oil Palm Roadmap (2045) by cross-ministerial team, institutions and associations
- Oil Palm Roadmap in the reference has been made by **incorporating Sustainable Development Goals (SDG) by UN**
- One of the **SDGs is to consider land-use changes as an action that should be avoided**

Prediction approach

Forecasting Palm Oil Production by end-use

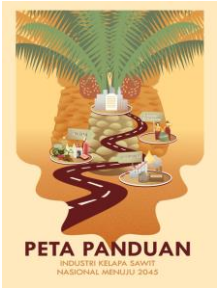
- Food
- Industrial use
- Biodiesel
- Export

Estimating the amount of palm oil residues that can be generated

Calculating the number of supplies that can be used for bioethanol

Bioethanol supplies from Palm Oil 2nd Gen

Indonesia Oil Palm Roadmap (2045)



Palm Oil Production Forecast is referred from Indonesia Oil Palm Roadmap (2045)

Estimating the amount of palm oil residues that can be generated

Calculating the number of supplies that can be used for bioethanol

Bioethanol supplies from Palm Oil 2nd Gen

 Source: Indonesia Oil Palm Roadmap (2045)

Extrapolation of forecast data is required, assuming no additional production; Next, two scenarios for EFB utilization rate were created to meet future needs (10% & 20%)

2nd Gen supply calculation (considering land-use change)

- **Palm oil production in 2030 & 2040 are referred directly** from the data points in Indonesia Oil Palm Roadmap (2045)
- **Palm oil production 2050 & 2060 are based on 2045 data**, which **assumed no additional production will occur after 2045**
- Assumed there will be **2 scenarios based on the EFB utilization rate, 10% and 20%**
- Assumed **utilization rate of MF, OPF and OPT is 30%**

Prediction approach

Palm Oil Production Forecast is referred from "Indonesia Oil Palm Roadmap (2045)"

Palm Oil Production by plantation ownership (mil. ton)

	2030	2040	2045
Community	25.13	30.42	34.59
State	2.86	3.56	3.98
Private	37.39	48.79	53.87
Total	65.39	82.77	92.45

Source: Indonesia Oil Palm Roadmap (2045)

Estimating the amount of palm oil residues that can be generated

Calculating the number of supplies that can be used for bioethanol

Bioethanol supplies from Palm Oil 2nd Gen

Data Points from the Report ← → Deloitte's Assumption

Residues		2030	2040	2050	2060
Palm oil production (K ton)		65,390	82,770	92,450	92,450
					Mil Litre
Empty Fruit Bunches (EFB)	10% util. rate	3,705	4,690	5,239	5,239
	20% util. rate	7,411	9,380	10,477	10,477
Mesocarp Fibre (MF) – 30% util. rate		6,200	7,848	8,765	8,765
Oil Palm Frond (OPF) – 30% util. rate		13,900	17,595	19,653	19,653
Oil Palm Trunk (OPT) – 30% util. rate		14,598	18,478	20,639	20,639

New calculation forecasts lower amounts of palm oil production, impacting on the smaller 2nd Gen bioethanol supplies

What we have changed in the calculation

Old Calculation

		2030	2040	2050	2060
Palm Oil Production (k ton)					
Palm Oil		80,943	109,826	133,077	156,829
Total Palm Oil Residue from All Palm Oil Production (kton)					
EFB		66,473	90,193	109,287	128,793
MF		37,898	51,422	62,308	73,429
OPF		269,273	365,358	442,709	521,725
OPT		74,089	100,527	121,809	143,550
Potential Palm Oil Residue for Bioethanol considering util. rate (kton)					
EFB	(10%)	6,647	9,019	10,929	12,879
	(20%)	13,295	18,039	21,857	25,759
MF (30%)		11,370	15,427	18,693	22,029
OPF (30%)		80,782	109,607	132,813	156,517
OPT (30%)		22,227	30,158	36,543	43,065
Bioethanol supplies from 2nd Gen supplies (mil. liter)					
EFB	(10%)	4,587	6,223	7,541	8,887
	(20%)	9,173	12,447	15,082	17,773
MF (30%)		7,674	10,413	12,617	14,869
OPF (30%)		17,207	23,346	28,289	33,338
OPT (30%)		18,070	24,518	29,709	35,012

New Calculation

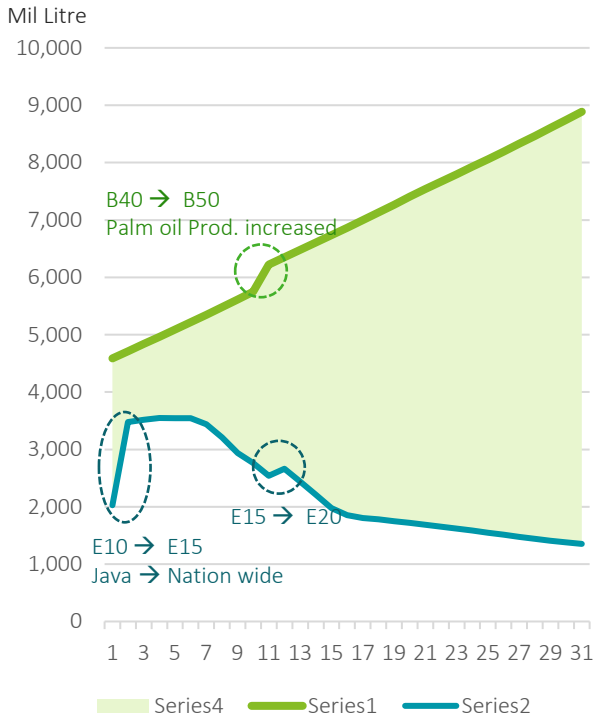
		2030	2040	2050	2060
Palm Oil Production (k ton)					
Palm Oil		65,390	82,770	92,450	92,450
Total Palm Oil Residue from All Palm Oil Production (kton)					
EFB		53,700	67,973	75,923	75,923
MF		30,616	38,754	43,286	43,286
OPF		217,533	275,351	307,554	307,554
OPT		59,853	75,762	84,622	84,622
Potential Palm Oil Residue for Bioethanol considering util. rate (kton)					
EFB	(10%)	5,370	6,797	7,592	7,592
	(20%)	10,740	13,595	15,185	15,185
MF (30%)		9,185	11,626	12,986	12,986
OPF (30%)		65,260	82,605	92,266	92,266
OPT (30%)		17,956	22,729	25,387	25,387
Bioethanol supplies from 2nd Gen supplies (mil. liter)					
EFB	(10%)	3,705	4,690	5,239	5,239
	(20%)	7,411	9,380	10,477	10,477
MF (30%)		6,200	7,848	8,765	8,765
OPF (30%)		13,900	17,595	19,653	19,653
OPT (30%)		14,598	18,478	20,639	20,639

Introduction of 2G bioethanol from palm oil residues is expected to supply more than domestic demand. Foreign currency can be earned by exporting the excess, which can be assumed to be used to generate funds for subsidies

Potential foreign currency acquisition (EFB Utilization 10%)

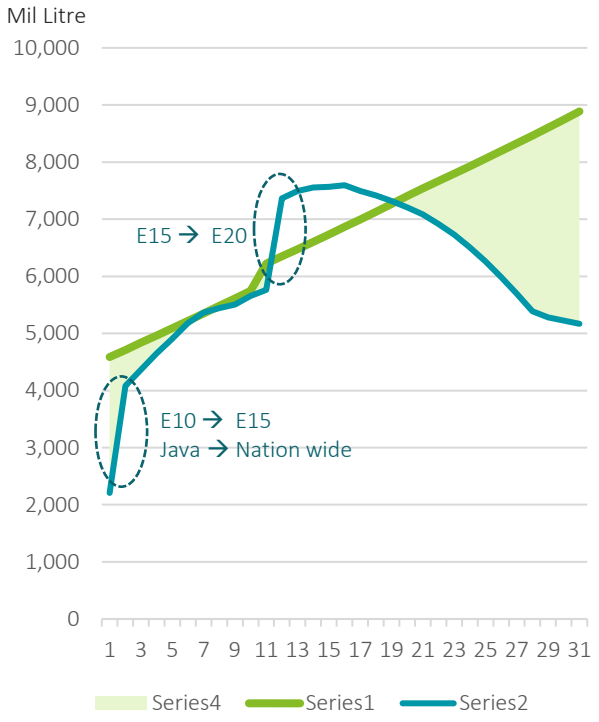
Condition: 12,825IDR based on MEMR Bioethanol price as of Oct.
Without taking into consideration customs duties, export taxes, etc.

Scenario1: EV adoption at target levels



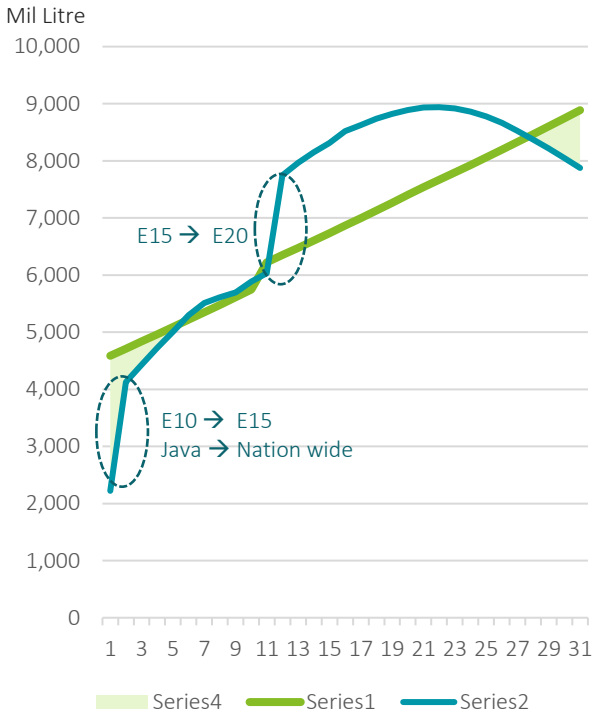
Excess Bioethanol	140 Billion Litre
Potential foreign currency acquisition	1,801 Trillion IDR 113 Billion USD

Scenario2: Moderate



Excess Bioethanol	29 Billion Litre
Potential foreign currency acquisition	370 Trillion IDR 23 Billion USD

Scenario3: HV penetration instead of EV



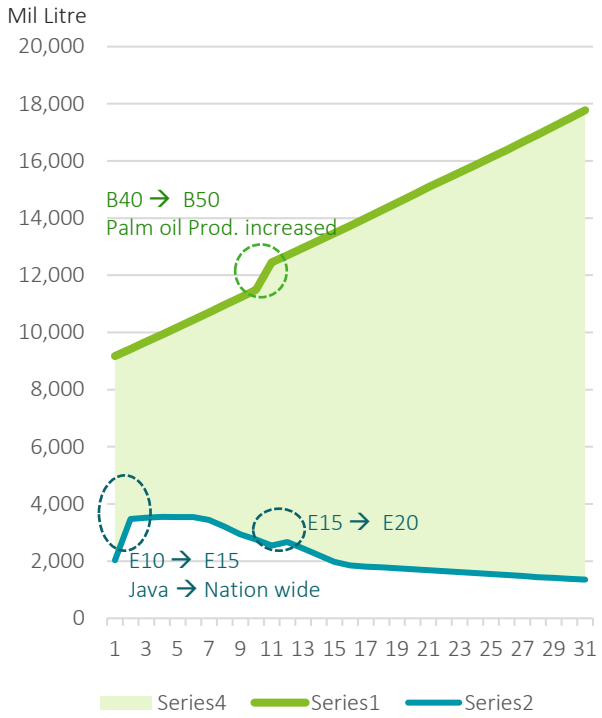
Excess Bioethanol	6 Billion Litre
Potential foreign currency acquisition	78 Trillion IDR 5 Billion USD

Taking into account the opinions of experts, a 10% usage rate is a bit conservative, so assuming that the EFB usage rate is increased to 20%, it is clear that it is sufficient to meet the requirements in scenarios 2 and 3.

Potential foreign currency acquisition (EFB Utilization 20%)

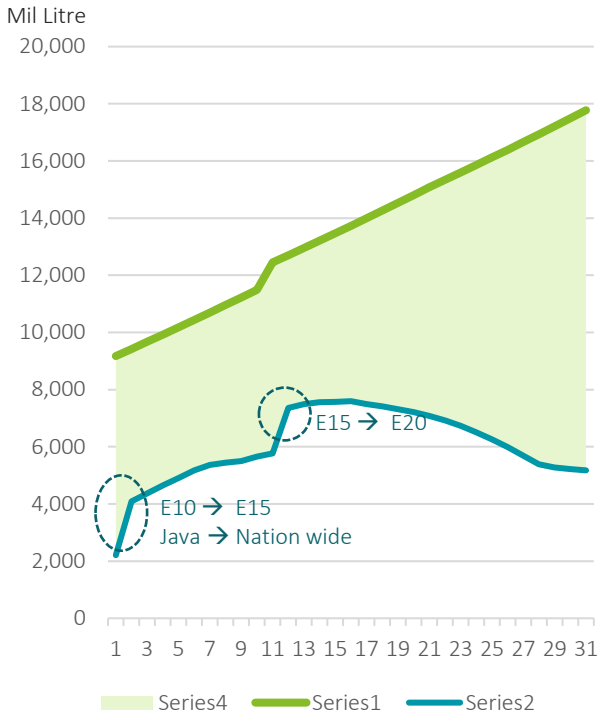
Condition: 12,825IDR based on MEMR Bioethanol price as of Oct.
Without taking into consideration customs duties, export taxes, etc.

Scenario1: EV adoption at target levels



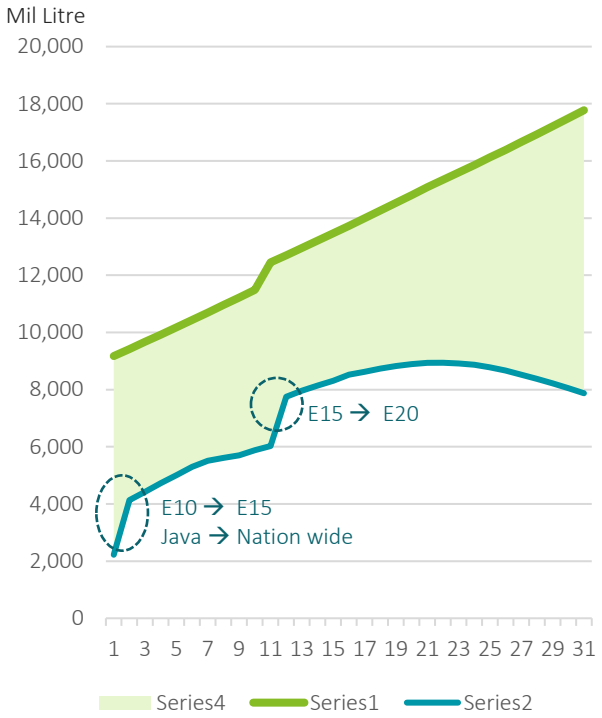
Excess Bioethanol	350 Billion Litre
Potential foreign currency acquisition	4,493 Trillion IDR 282 Billion USD

Scenario2: Moderate



Excess Bioethanol	233 Billion Litre
Potential foreign currency acquisition	2,992 Trillion IDR 188 Billion USD

Scenario3: HV penetration instead of EV



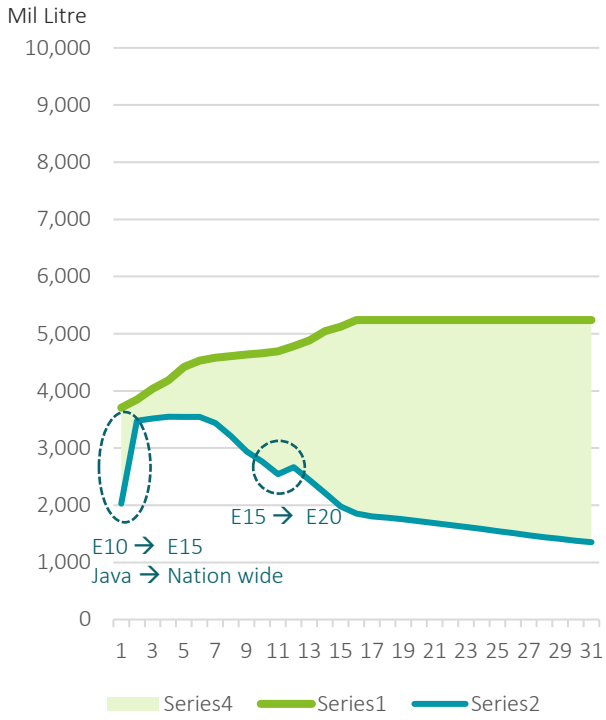
Excess Bioethanol	195 Billion Litre
Potential foreign currency acquisition	2,504 Trillion IDR 157 Billion USD

Based on supply with reference to the Indonesian Oil Palm Roadmap, 10% EFB utilization rate would mean that supply would be significantly lower than demand in Scenarios 2 and 3

Potential foreign currency acquisition (EFB Utilization 10%)

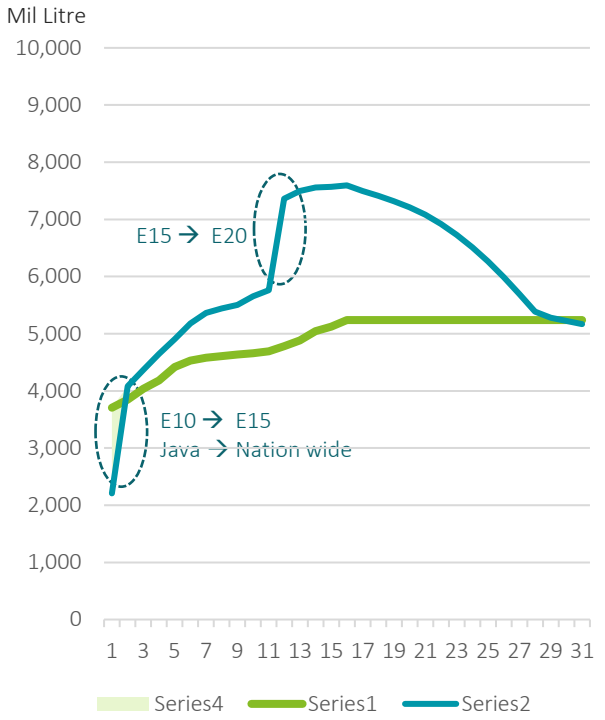
Condition: 12,825IDR based on MEMR Bioethanol price as of Oct.
Without taking into consideration customs duties, export taxes, etc.

Scenario1: EV adoption at target levels



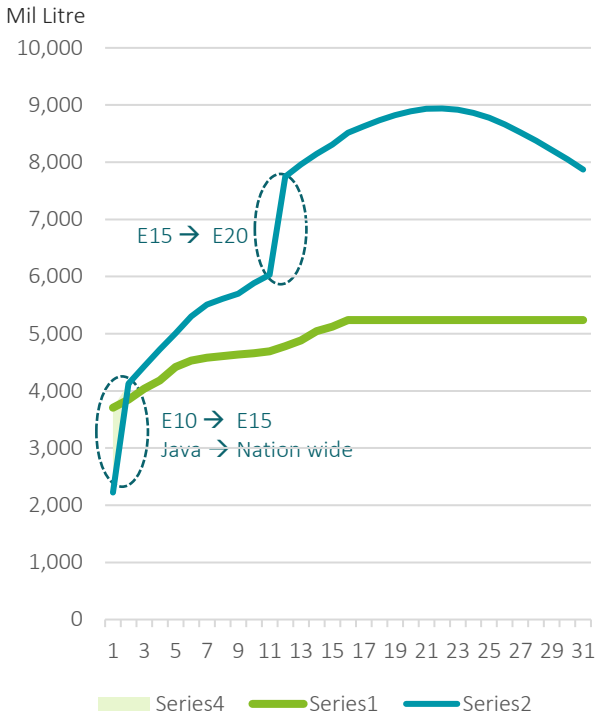
Excess Bioethanol	82 Billion Litre
Potential foreign currency acquisition	1,053 Trillion IDR 66 Billion USD

Scenario2: Moderate



Excess Bioethanol	2 Billion Litre
Potential foreign currency acquisition	20 Trillion IDR 1 Billion USD

Scenario3: HV penetration instead of EV



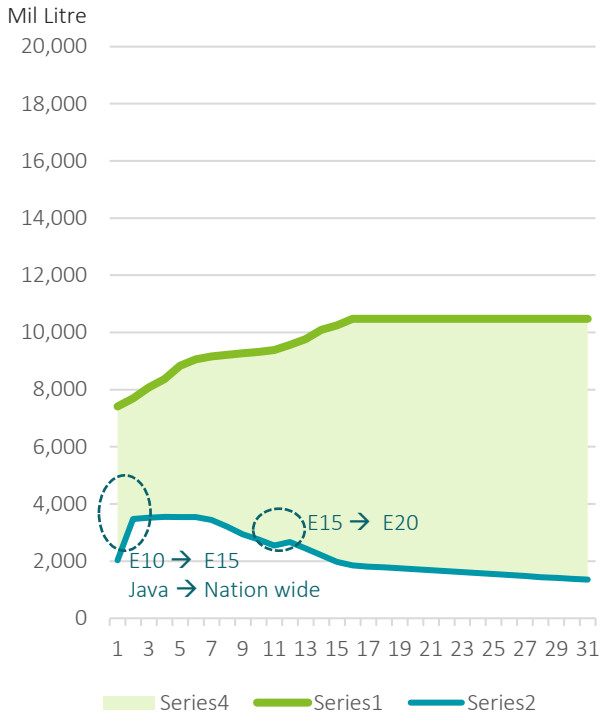
Excess Bioethanol	1 Billion Litre
Potential foreign currency acquisition	19 Trillion IDR 1 Billion USD

Even on the basis of supply with reference to the Indonesian Oil Palm Roadmap, if EFBs increase to a 20% utilization rate, supply will significantly exceed demand

Potential foreign currency acquisition (EFB Utilization 20%)

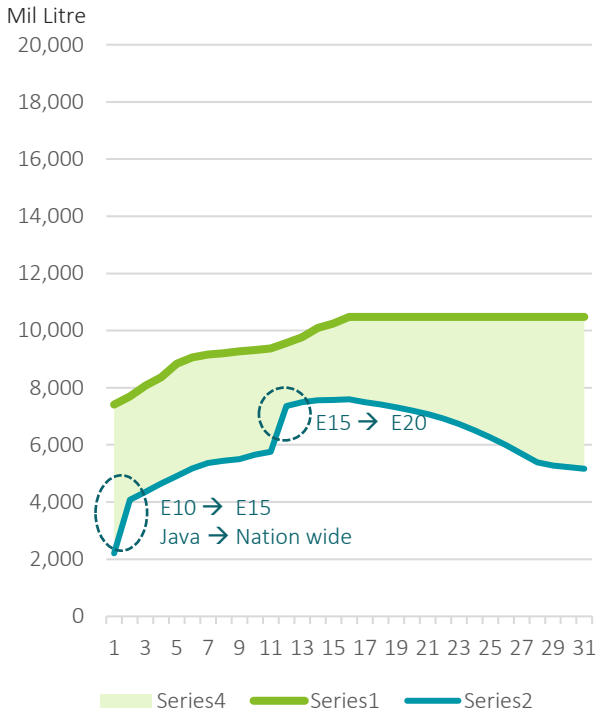
Condition: 12,825IDR based on MEMR Bioethanol price as of Oct.
Without taking into consideration customs duties, export taxes, etc.

Scenario1: EV adoption at target levels



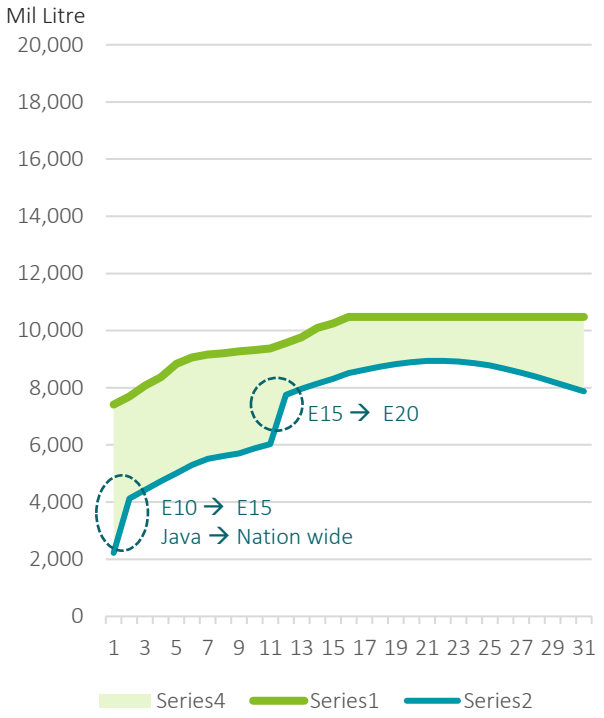
Excess Bioethanol	234 Billion Litre
Potential foreign currency acquisition	2,997 Trillion IDR 188 Billion USD

Scenario2: Moderate



Excess Bioethanol	117 Billion Litre
Potential foreign currency acquisition	1,497 Trillion IDR 94 Billion USD

Scenario3: HV penetration instead of EV



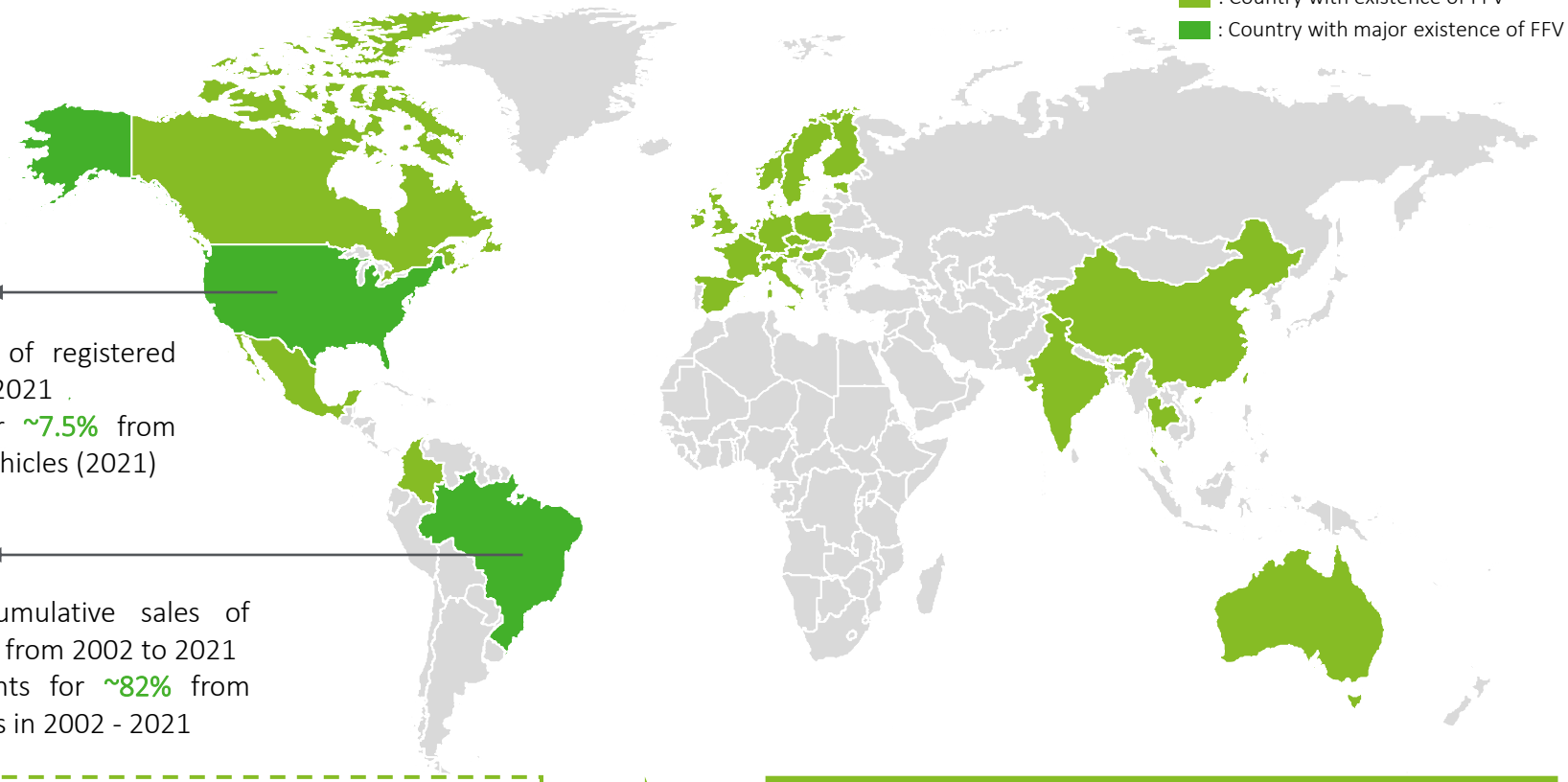
Excess Bioethanol	79 Billion Litre
Potential foreign currency acquisition	1,009 Trillion IDR 63 Billion USD

Study on FFV (Flex-Fuel Vehicle) Introduction

Brazil and USA are the major countries for global FFV market, and the market is projected to still be growing in >5%, with market size around 104 billion USD in 2024.

FFV overview

Global FFV sales presence



USA

- ~21 million unit of registered Light Duty FFV in 2021
- FFV accounts for ~7.5% from total registered vehicles (2021)

Brazil

- ~34 million accumulative sales of passenger car FFV from 2002 to 2021
- FFV sales accounts for ~82% from accumulative sales in 2002 - 2021

> 5.00 %

is expected as CAGR in 2024-2029

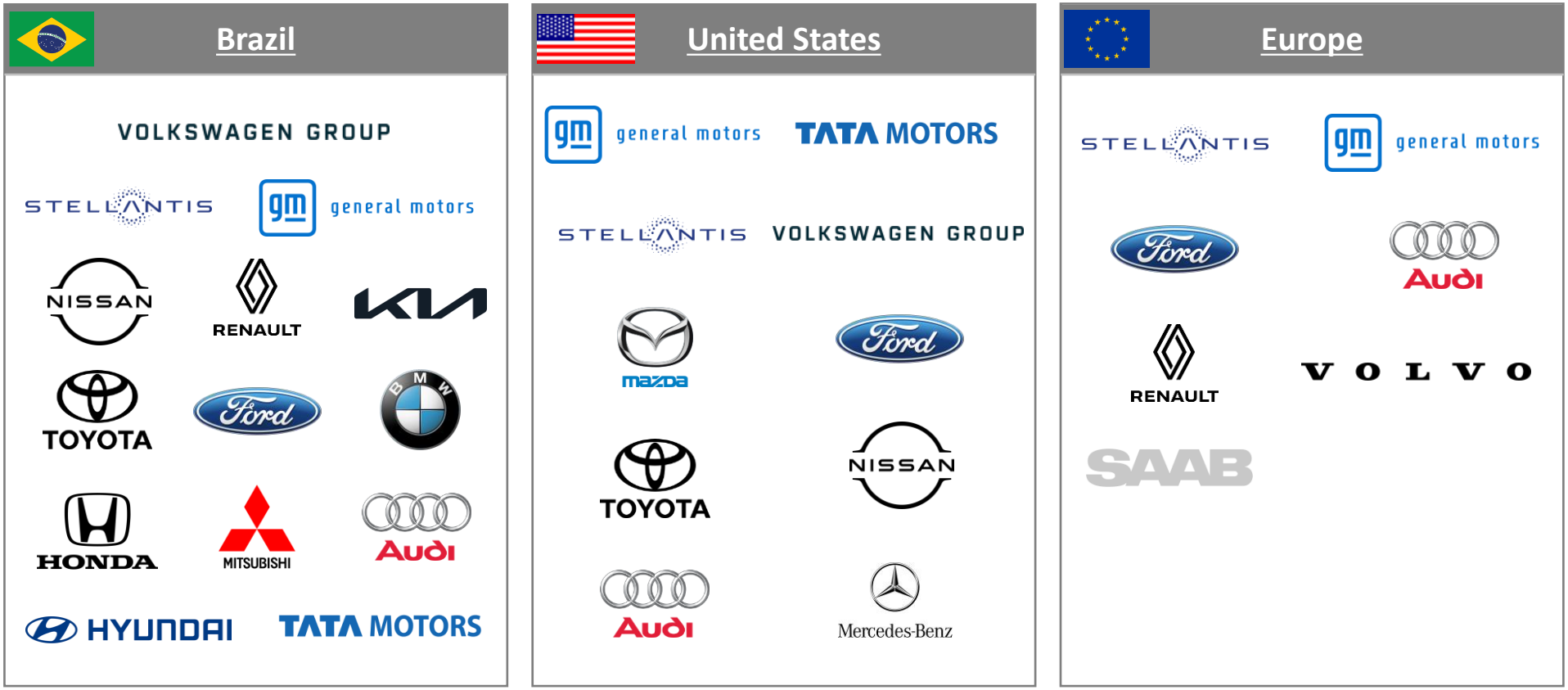
~USD 104 billion

Forecast 2024 Global Market Size

 Source: mordorintelligence study (2019 – 2029), DoE, Brazil's Auto Report 2022, Coherent Market Insight, various sources

Some key FFV players in Brazil, United States, and EU have been mapped out as follows

FFV key players (non-exhaustive)



Source: Flex Fuel Vehicles in Brazil - ANFAVEA

Source: fueleconomy.gov

Source: academic accelerator

Stellantis include but not limited to : *FIAT, Chrysler, Dodge, Jeep, Ram, Peugeot, Citroen*
Volkswagen Group include but not limited to : *Volkswagen, Porsche*
General Motors include but not limited to : *GMC, Cadillac, Buick, Chevrolet*
Ford Motor include but not limited to : *Ford, Lincoln, SAAB,*
Tata Motors include but not limited to : *Jaguar, Land Rover*
Renault include but not limited to : *Renault, Dacia*

*Not in a particular order

8 challenges of FFV: low fuel economy, cold start issue, corrosion, high water content, poor drivability, high production cost, unattractiveness, and unstable fuel supply

FFV Identified Challenges

Low Fuel Economy

FFV has a lower fuel economy (app. 66%) compared to conventional vehicle

Cold Start Issue

Due to the use of ethanol fuel, problems occur when starting at low temperature conditions

Corrosion

Compatibility of ethanol fuel with metallic, plastic or rubber material

High Water Content

Ethanol fuel has higher water content compared to gasoline

Poor Drivability

Loss of drivability due to the change of combustion air/fuel ratio

High Production Cost

Higher manufacturing cost compared to conventional vehicle

Unattractiveness

Lack of value proposition in adopting FFV from consumer perception (e.g., low resale value)

Unstable Fuel Supply

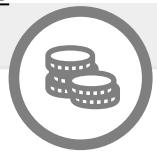
Uncertainty of the ethanol availability will cover up the advantage of FFV

Source: expert interview with LEMIGAS, public information in various articles and research journals

Brazil had taken follow-up actions in responding to overcome the challenges

Lesson Learns from Brazil (1)

Challenges



Low Fuel Economy

FFV has a lower fuel economy (app. 66%) compared to conventional vehicle

Cold Start Issue

Due to the use of ethanol fuel, problems occur when starting at low temperature conditions

Corrosion

Compatibility of ethanol fuel with metallic, plastic or rubber material

High Water Content

Ethanol fuel has higher water content compared to gasoline

Solutions

Cheaper ethanol price by controlling pump price for fossil fuel and imposing gasoline tax (54%, compared to ethanol 12-30%) to compensate lower energy density of ethanol fuel	**Introduce Electric cold start**, vehicle has an electrical heater that works integrated with the injectors and warms the ethanol (when it is necessary), assuring a perfect start of the engine even at low temperatures.	•**Motor**: Valves with new profile and protection against corrosion. •**Fuel supply:** All plastic & metallic parts must resist to Ethanol. •**Pressure regulator**: Protection for internal surface from corrosion •**Fuel injectors:** The fuel injectors must be protected to corrosion. •**Fuel pump**: Internal components must be protected to corrosion.	**Exhaust system:** Internal surface of pipes must be protected against oxidation. The dimension considers high water level inside the pipes.

Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELLA, globalbioenergy

Brazil had taken follow-up actions in responding to overcome the challenges

Lesson Learns from Brazil (2)

Challenges

Poor Drivability

Loss of drivability due to the change of combustion air/fuel ratio

High Production Cost

Higher manufacturing cost compared to conventional vehicle

Unattractiveness

Lack of value proposition in adopting FFV from consumer perception (e.g., low resale value)

Unstable Fuel Supply

Uncertainty of the ethanol availability will cover up the advantage of FFV

Solutions

- **Ignition system:** Different ignition timing for each fuel.
- **ECU and Software:** Additional functions to determine ratio in fuel and calculate fuel injection amount & ignition time.
- **Lambda sensor:** Determine the air/ fuel ratio for every possible mixture.

- **Tax Breaks for car manufacturer for producing FFV**

- **2% Sales Tax Reduction for end-user**
- **50% price reduction on the Flat Road Tax**
- **Exemption from the Tax on Manufactured Goods**
- **Tax reduction on Industrialized Product (IPI)** for FFV purchase (1-7% reduction)

- **Soft loans for sugarcane plantation** to boost ethanol production
- **Direct funding for family farming**
- **4% reduction in credit interest rate** for sugarcane production
- **Compensation for corn sold below the govt.'s minimum price (PEPRO)**
- **Tax exemption on the investment** for sugarcane companies
- **Mandates a minimum shares of ethanol in gasoline** at the pump

 Source: Government Intervention to Strengthen the Ethanol Sector-ELLA, The Story of Brazil's Ethanol Programme-ELL, globalbioenergy

While in Indonesia, only 1 policy has been addressed in relation to solve high production cost; The policy is more towards incentive for car manufacturer

FFV current state in Indonesia

FFV Definition by Ministry of Industry

Bagian Ketujuh

Flexy Engine

Pasal 10

Flexy Engine sebagaimana dimaksud dalam Pasal 3 huruf f harus memenuhi persyaratan sebagai berikut:

a. menggunakan atau mampu adaptif dengan bahan bakar nabati 100% (seratus persen);
b. memiliki peralatan atau sistem otomatisasi, baik mekanikal atau elektrikal, yang fleksibel dan mampu melakukan penyesuaian proses pembakaran mesin sendiri tanpa campur tangan dari pengemudi; dan
c. menggunakan logo teknologi *Flexy Engine*.

Source: MoI Decree No.36 / 2021

Flexy Engine as intended in Article 3 letter must meet the following requirements:

a. **Using or being able to adapt to 100% biofuel** (one hundred percent);
b. Have automation equipment or systems, whether mechanical or electrical, that are **flexible and capable of adjusting the engine's own combustion process without intervention from the driver;**
c. uses the **Flexy Engine technology logo**.

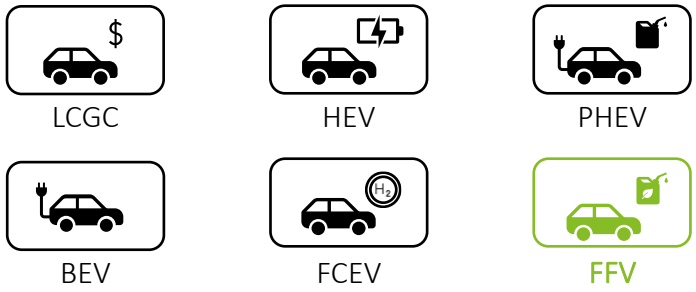
Source: MoI Decree No.36 / 2021, Government Regulation No.74/2021

Low Carbon Emission Vehicle Program

Among the challenges, Indonesia only has 1 policy related to the car manufacturer incentives, namely Low Carbon Emission Vehicle Program (LCEV)

LCEV is a **government program** to **encourage the production of low-carbon vehicles by providing incentives**

Applied for car manufacturer which produce following LCEV..



Specific for FFV, producer which has fulfilled the requirement[1] will get **special tax reduction** as follows:

8% for Luxury Good Sales Tax for FFV

15-70% luxury good sales tax for conventional vehicles

[1]= passed verification process, and have a letter of determination from the minister

Appendix

Luxury Good Sales Tax

	Conventional Vehicle									LCGC	HEV									PHEV	BEV & FCEV	FFV
											Full Hybrid			Mild Hybrid			Full/mild Hybrid					
Passenger Capacity	<10	<10	<10	<10	<10	<10	<10	<10	<10													
CC of cylinder (cm^3)	<3,000	<3,000	<3,000	<3,000	<4,000	<4,000	<4,000	<4,000	>4,000	<1,200	<3,000	<3,000	<3,000	<3,000	<3,000	<3,000	<4,000	<4,000	<4,000			
Fuel Consumption (km/liter)	>15.5	<15.5	<11.5	<9.3	>15.5	<15.5	<11.5	<9.3		>20	>23	<23	<18.4	>23	<23	<18.4	>23	<23	<18.4	>28		
Turning Radius (mm)										<4,600												
Ground Clearance (mm)										>150												
Selling Price (m IDR)										<135												
CO^2 emission (gr/km)	<150	<200	<250	>250	<150	<200	<250	>250		<120	<100	<125	<150	<100	<125	<150	<100	<125	<150	<100		
Battery Capacity (volt)											>60			<60								
Battery power travel dist. (km)																				>40		
Luxury Good Sales Tax[1]	15%	20%	25%	40%	40%	50%	60%	70%	95%	2-3%[2]	6%	7%	8%	8%	10%	12%	20%	25%	30%	5%	0%	8%

Notes:
Only including 4W vehicle
Double cabin vehicle or goods transport vehicle are excluded
Vehicle with capacity >10 passenger is excluded

= Highlighted Luxury Good Sales Tax compared across various type of vehicle
[1] = Percentage from selling price
[2] = 2% for Automatic Transmission, 3% for additional safety feature for passenger (i.e., safety belt, air bag, advanced brake system)

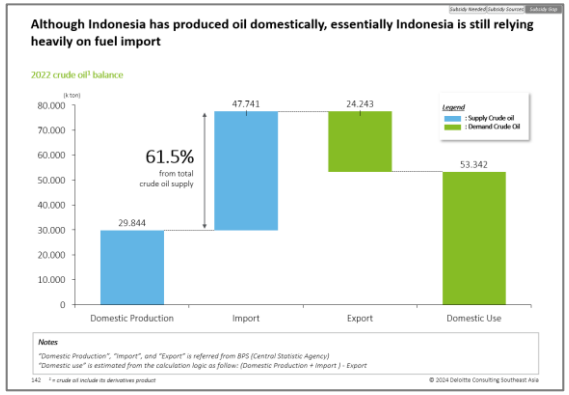
 Source: MoI Decree No.36 / 2021, Government Regulation No.74/2021, Government Regulation No.73/2019

Other additional effects - Crude oil import reduction

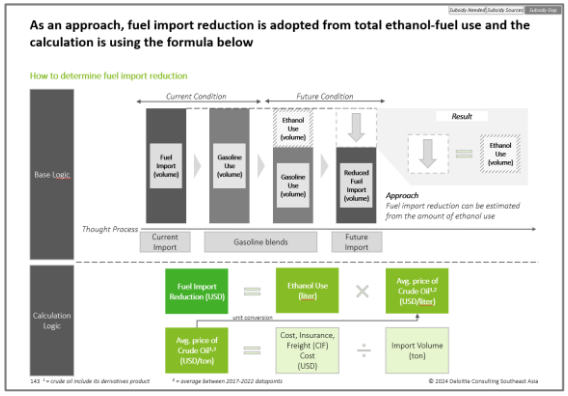
The calculation of crude oil import reduction is referring to the previous section in subsidy simulation section

Fuel Reduction Calculation Step

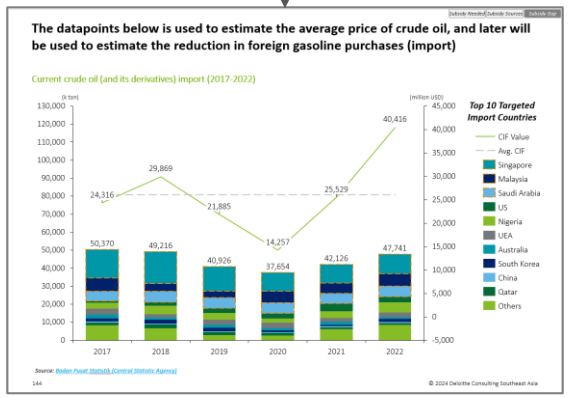
Refer to the previous section regarding crude oil import reduction as an potential subsidy source



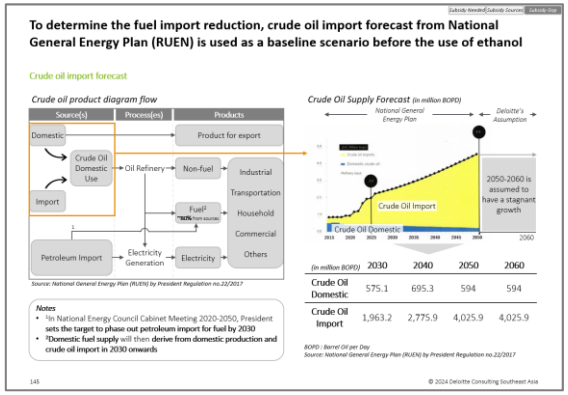
Crude Oil Balance
(Page 143)



Base Logic + Calculation Logic
(Page 144)



Historical Crude Oil Import
(Page 145)



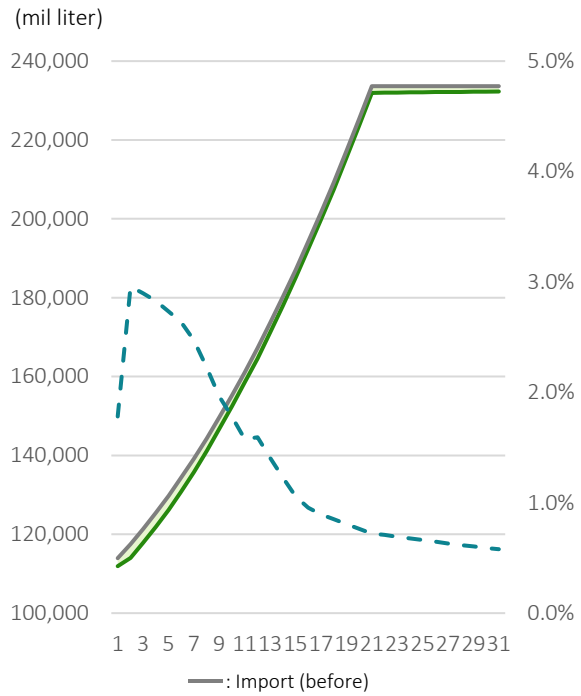
Crude Oil Import Forecast*
(Page 146)

Refer to Page 147

The use of ethanol will reduce the use of fossil fuels which majorly derive from import; this will give a potential cost cut to purchase foreign fossil fuel

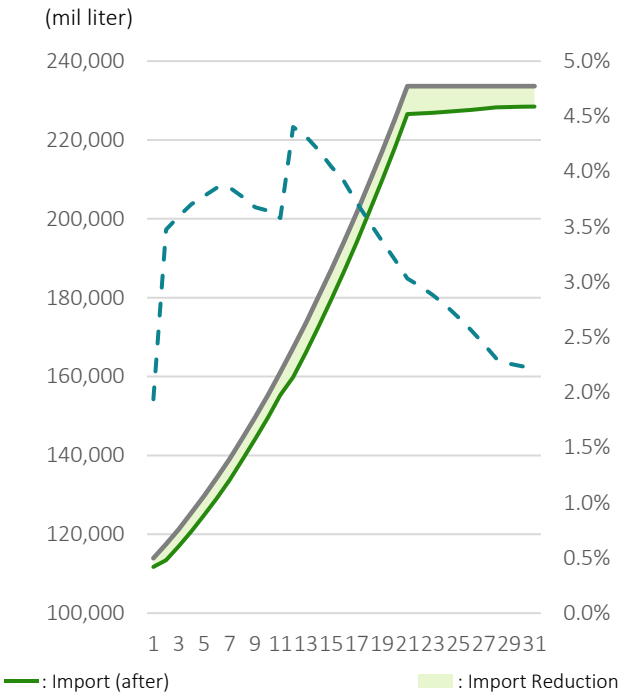
Potential crude oil import reduction

Scenario1: EV adoption at target levels



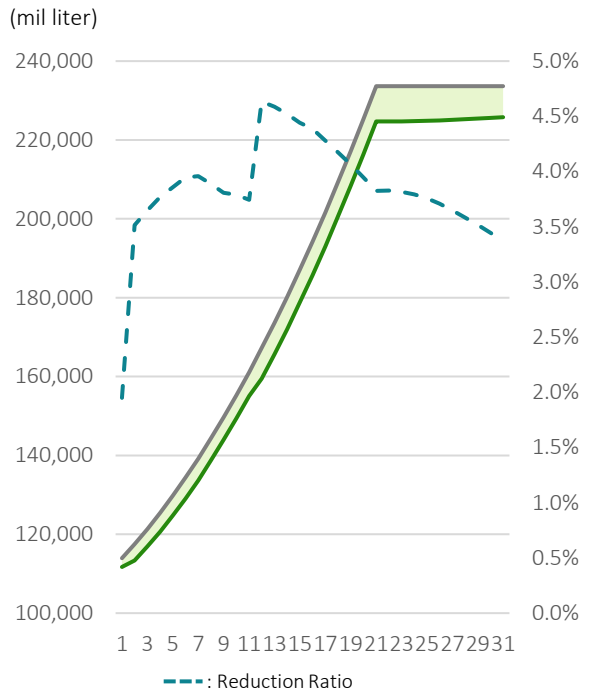
Accumulative Volume Reduction	69.4 Billion Litre
Accumulative Cost Reduction	614 Trillion IDR 38.9 Billion USD

Scenario2: Moderate



Accumulative Volume Reduction	186.4 Billion Litre
Accumulative Cost Reduction	1,650 Trillion IDR 104.4 Billion USD

Scenario3: HV penetration instead of EV



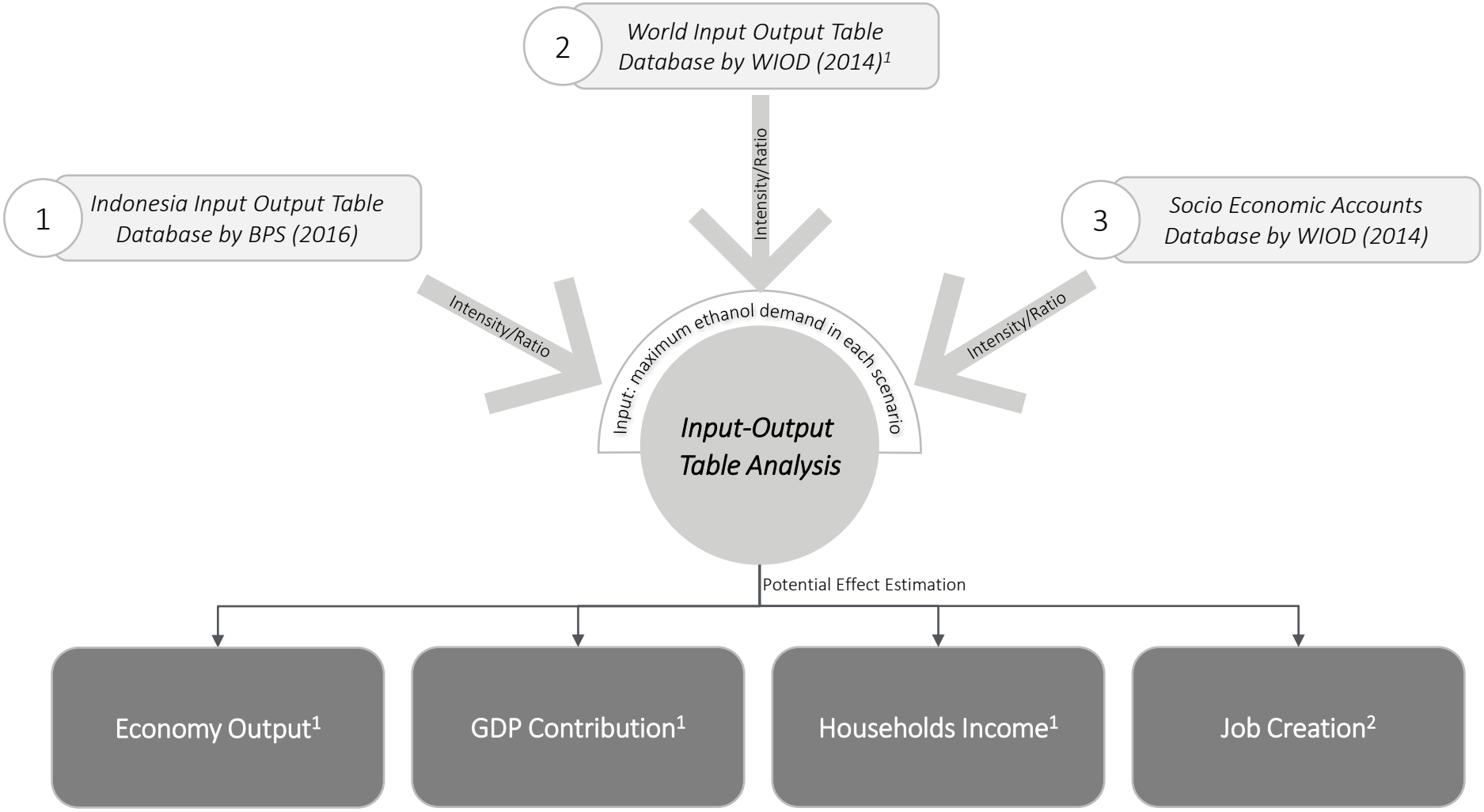
Accumulative Volume Reduction	224.4 Billion Litre
Accumulative Cost Reduction	1,987 Trillion IDR 125.8 Billion USD

Exchange rate = 1 USD ~ 15,800 IDR

Other additional effects - Socio Economy

Socio-economic impact is comprised of economy output, gdp contribution, household income & job creation that have been analyzed using input-output table methodology

Thought Process on Input Output Table Analysis



[1] = Analysis is based on 2016 data
[2] = Analysis is based on 2014 data

3 different domestic and global database are being used to conduct input-output table analysis

Database Reference

Database 1	Reference	• *Input Output Table Indonesia in 2016* *by* Central Statistic Agency (BPS) • Released in **2021** • Source: BPS
	Description	• Consist of transaction (input and output) between and for each **185 sectors in Indonesia** • Table is shown in monetary unit (**million Rupiah**) • Bioethanol industry is assumed belong to "Manufacture of Oil, Refined Oil, and Gas" sector (Code 95)
Database 2	Reference	• *World Input Output Table in 2014* *by World Input Output Database (WIOD)* • Released in **2018** • Source: WIOD
	Description	• Consist of transaction (input and output) between and for each **56 sectors in 43 countries** • Table is shown in monetary unit (**million USD**) • Exchange rate being used is **~15,800 IDR/USD** as per January 2024 Bioethanol industry is assumed belong to "Manufacture of Coke and Refined Petroleum Products" sector (Code 10)
Database 3	Reference	• *Socio Economic Accounts in 2014* *by World Input Output Database (WIOD)* • Released in 2018 • Source: WIOD
	Description	Consist of gross output, intermediate inputs, gross value added, employment & labor compensation, capital compensation and capital stocks for each 56 sectors in 43 countries

Image(s)

Kode	Deskripsi	001 Padi	002 Jagung	003 Ubi jalar	004 Ubi kayu	005 Umbi-umbia	006 Kacang tana	007 Kedelai
001	Padi	15045056	0	0	0	0	0	0
002	Jagung	0	2819433	0	0	0	0	0
003	Ubi jalar	0	0	524662	0	0	0	0
004	Ubi kayu	0	0	0	1096213	0	0	0
005	Umbi-umbian lainnya	0	0	0	0	74221	0	0
006	Kacang tanah	0	0	0	0	0	172878	0
007	Kedelai	0	0	0	0	0	0	181282
008	Kacang-kacangan Lainnya	0	0	0	0	0	0	0
009	Padi-padian dan Bahan Makanan Lainnya	0	0	0	0	0	0	0
010	Sayur-sayuran	0	0	0	0	0	0	0
011	Tanaman Hias	0	0	0	0	0	0	0
012	Tebu	0	0	0	0	0	0	0
013	Tembakau	0	0	0	0	0	0	0
014	Tanaman serat	0	0	0	0	0	0	0
015	Hasil Perkebunan Lainnya	0	0	0	0	0	0	0
016	Buah-buahan	0	0	0	0	0	0	0
017	Tanaman Biofarmaka	0	0	0	0	0	0	0
018	Karet	0	0	0	0	0	0	0
019	Kelapa	0	0	0	0	0	0	0
020	Kelapa Sawit	0	0	0	0	0	0	0
021	Kopi	0	0	0	0	0	0	0
022	Teh	0	0	0	0	0	0	0
023	Kakao	0	0	0	0	0	0	0
024	Cengkeh	0	0	0	0	0	0	0
025	Jambu Mete	0	0	0	0	0	0	0
026	Ternak dan Hasil-hasilnya kecuali Susu Segar	109816	39755	1141	45560	354	10445	5311
027	Susu segar	0	0	0	0	0	0	0
028	Unggas dan Hasil-hasilnya	237240	30085	1172	32771	2594	6905	2824

(industry-by-industry) (millions of US$)			A01 animal production, hunting and related service activities	A02 Forestry and logging	A03 Fishing and aquaculture	B Mining and quarrying	C10-C12 Manufacture of food products, beverages and tobacco products
			AUS	AUS	AUS	AUS	AUS
			c1	c2	c3	c4	c5
A01	imal production, hunting and related service activities	AUS r1	12,924	112	228	539	25,139
A02	Forestry and logging	AUS r2	83	201	0	17	3
A03	Fishing and aquaculture	AUS r3	19	0	19	4	316
B	Mining and quarrying	AUS r4	116	1	6	4,492	332
C10-C12	re of food products, beverages and tobacco products	AUS r6	1,591	1	43	203	10,852
C13-C15	:ture of textiles, wearing apparel and leather products	AUS r6	42	1	3	92	67
C16	manufacture of articles of straw and plaiting materials	AUS r7	23	0	1	32	11
C17	Manufacture of paper and paper products	AUS r8	28	0	0	51	652
C18	Printing and reproduction of recorded media	AUS r9	65	0	1	239	87
C19	Manufacture of coke and refined petroleum products	AUS r10	877	230	117	2,248	105
C20	Manufacture of chemicals and chemical products	AUS r11	772	0	2	565	141
C21	naceutical products and pharmaceutical preparations	AUS r12	667	0	1	197	42
C22	Manufacture of rubber and plastic products	AUS r13	86	1	8	248	366
C23	Manufacture of other non-metallic mineral products	AUS r14	29	0	1	138	248
C24	Manufacture of basic metals	AUS r16	44	0	2	628	48
C25	ted metal products, except machinery and equipment	AUS r16	151	1	22	2,053	321

country	variable	description	code	2014
AUS	CAP	Crop and animal production, hunting and related service	A01	20,525
AUS	CAP	Forestry and logging	A02	1,206
AUS	CAP	Fishing and aquaculture	A03	1,475
AUS	CAP	Mining and quarrying	B	79,601
AUS	CAP	Manufacture of food products, beverages and tobacco pr	C10-C12	9,928
AUS	CAP	Manufacture of textiles, wearing apparel and leather pro	C13-C15	553
AUS	CAP	Manufacture of wood and of products of wood and cork,	C16	1,180
AUS	CAP	Manufacture of paper and paper products	C17	1,080
AUS	CAP	Printing and reproduction of recorded media	C18	1,220
AUS	CAP	Manufacture of coke and refined petroleum products	C19	1,644
AUS	CAP	Manufacture of chemicals and chemical products	C20	2,218
AUS	CAP	Manufacture of basic pharmaceutical products and pharr	C21	1,473
AUS	CAP	Manufacture of rubber and plastic products	C22	1,783
AUS	CAP	Manufacture of other non-metallic mineral products	C23	2,279
AUS	CAP	Manufacture of basic metals	C24	1,880

As a result, Indonesia will achieve a positive impact to the socio-economic from the development of bioethanol in the future, the strongest effect occur in Scenario 3

Potential Effect to the Socio Economy

Socio Economy Effect in Scenario 1

Occurs when the maximum bioethanol demand is triggered in **2035**

Generate **78 trillion IDR** to Indonesia economy

Contribute to GDP by **44 trillion IDR**

Increase Household Income by **8 trillion IDR**

Create **10,006** direct jobs

Supplementarily, create **16,291** indirect/induced jobs

Socio Economy Effect in Scenario 2

Occurs when the maximum bioethanol demand is triggered in **2045**

Generate **166 trillion IDR** to Indonesia economy

Contribute to GDP by **94 trillion IDR**

Increase Household Income by **18 trillion IDR**

Create **21,442** direct jobs

Supplementarily, create **34,911** indirect/induced jobs

Socio Economy Effect in Scenario 3

Occurs when the maximum bioethanol demand is triggered in **2051**

Generate **196 trillion IDR** to Indonesia economy

Contribute to GDP by **111 trillion IDR**

Increase Household Income by **21 trillion IDR**

Create **25,238** direct jobs

Supplementarily, create **41,091** indirect/induced jobs

Green text = Effect to the economy aspect
Blue text = Effect to the socio aspect

Deloitte.

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