Project Last Mile

LCO_2 SUPPLY FEASIBILITY ASSESSMENT

WEBINAR

11 MARCH 2021

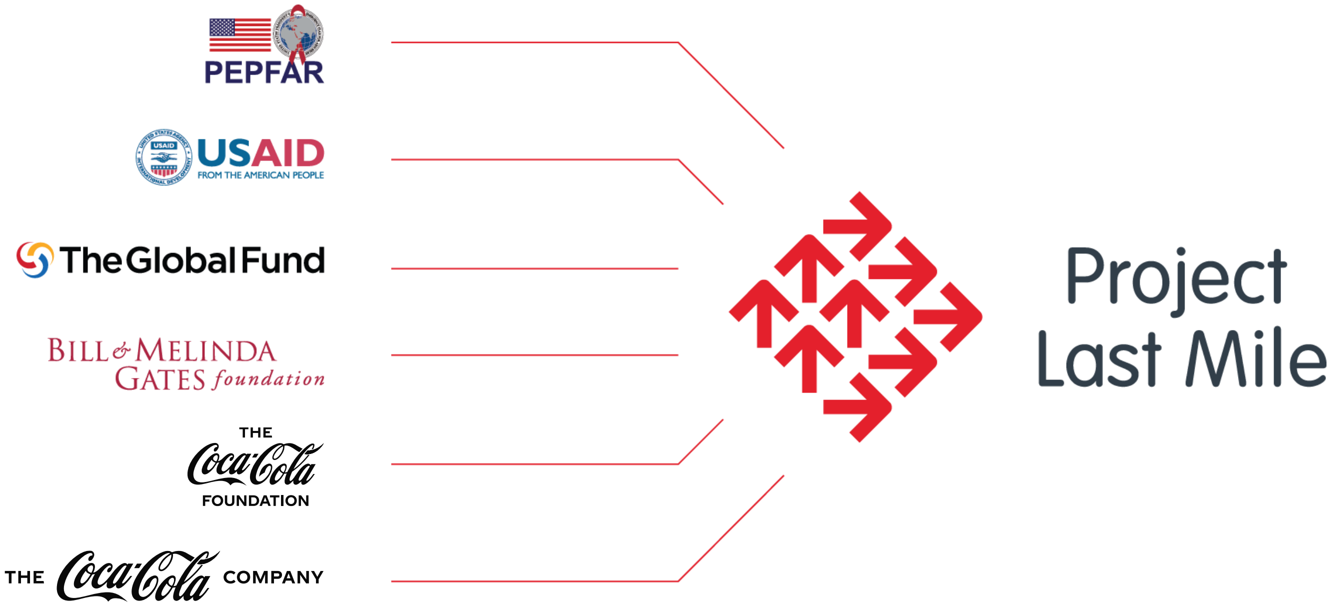
Global partners:

PEPFAR | USAID FROM THE AMERICAN PEOPLE | The Global Fund | BILL & MELINDA GATES foundation | THE Coca-Cola FOUNDATION | THE Coca-Cola COMPANY

INTRODUCTION TO PROJECT LAST MILE

WHAT IS PROJECT LAST MILE?

Project Last Mile is a pioneering partnership which aims to improve the availability of life-saving medicines and the uptake of health services by leveraging and sharing the expertise of the Coca-Cola system.



HOW DO WE WORK TOGETHER?

Funding

PEPFAR	USAID FROM THE AMERICAN PEOPLE	The Global Fund	Bill & Melinda Gates foundation	The Coca-Cola Foundation	The Coca-Cola Company

Technical input (networks with best practices, processes, ideas, technology, data)

The Coca-Cola Company	Coca-Cola Bottlers	Coca-Cola Vendors and system partners	Coca-Cola systems alumni and social intrapreneurs

Monitoring and evaluation

Yale Global Health Leadership Initiative	Ipsos

Management facilitating knowledge transfer, customizing solutions and dedicated project resources

Project Last Mile: Project management and Office Country Leads

In-country partners

Ministries of Health	Local non-governmental and community-based organizations

HOW DOES THE PARTNERSHIP MODEL WORK?

Donor partners invest billions of dollars to countries to improve health systems. Project Last Mile brings private sector technical expertise to support government departments with the effective implementation of key aspects of these grants related to distribution or demand creation challenges.

PARTNER

Build on donor partner initiatives and investments by acting as a technical advisory partner.

INNOVATE

Integrate innovative Coca-Cola ecosystem approaches to medicine availability and health service challenges, assisting and equipping Ministry partners in achieving their objectives.

MOBILIZE

Mobilize a team, which can be a combination of Coca-Cola system volunteer and vendors, together with dedicated Project Last Mile Subject Matter Experts/Coca-Cola alumni to create and sustain solutions.

MONITOR

Monitor and evaluate progress and impact to ensure sustainable models.

LCO_2 SUPPLY FEASIBILITY ASSESSMENT FINDINGS

BACKGROUND

COVAX currently anticipates 1.2 million doses of the Pfizer-BioNTech vaccine will be available to the COVAX Facility in Q1 2021, subject to the completion of additional agreements, and will be complemented by the larger volumes of the AstraZeneca/Oxford vaccine available to the Facility during the same time period. **Additional volumes of doses of the Pfizer-BioNTech vaccine will be available in the second quarter and beyond, per the signed advance purchase agreement between Gavi and Pfizer-BioNTech for up to 40 million doses.**

Interim Distribution Forecast
The COVAX Facility 3 February 2021

BACKGROUND

Ultra-cold chain distribution of vaccines in low- and middle-income countries (LMIC) will be a critical component in the response to the COVID-19 pandemic.

Vaccines requiring ultra-cold chain distribution at **temperatures of -70C** will be an important contribution to fighting COVID in LMIC

Supporting infrastructure is lacking for ultra-cold chain distribution in LMIC countries

Packing of vaccines in **dry ice to manage storage and transport at -70C is an option** where ultra-cold chain freezers are not available

Liquid CO_2 is required to produce dry ice with 2-3KG of liquid CO_2 required for 1KG of dry ice

The **Coca-Cola Company bottler network** were identified as a **large-scale user** of liquid CO_2 and a **potential source for supply**

Project Last Mile (PLM) engaged to **evaluate the feasibility of sourcing sufficient dry ice and liquid CO_2** to support an ultra-cold chain distribution model in LMIC

OBJECTIVES

Project Last Mile was engaged by the Bill and Melinda Gates Foundation to conduct an analysis and feasibility assessment of existing CO_2 capabilities within the Coca-Cola Eco-system in 20 African countries selected by the donor and partners to make dry ice to support ultra-cold chain vaccine distribution.

The Scope

In markets where excess CO_2 production capacity exists, a deeper dive analysis of CO2 production capacity will be completed. Indication of unit cost of CO2 by country and, where appropriate, recommendations on investments required to meet demand projected by Bill and Melinda Gates Foundation partners will be developed.

APPROACH

Through this activity, PLM reached into their network of bottlers to determine the pre-feasibility of sourcing CO_2 through them or their suppliers that will be required for dry ice manufacturing

Map out TCCS and other reliable CO_2 supplier production and storage capacities in each country and indicate capacity available at each site.

Determine liquid CO_2 tank filling capabilities and capacities if available in the TCCS and/or suppliers in the selected countries.

Identify where bottling partners may have unused internal capacity and CO_2 suppliers have unused external capacity to produce/share CO_2 and **the estimated quantity of spare capacity.**

Determine what role Coca-Cola bottler procurement teams could play in assisting with the procurement of liquid CO_2 from their longstanding suppliers where no internal capacity is available.

Where current internal and external CO_2 capacity is insufficient if a new or decommissioned CO_2 plant is to be brought online, **determine how long it would take to make CO_2 available** and what it would cost.

Analyze unit cost of procuring and supplying CO_2, both for that supplied by the Coca-Cola system and procured from its core suppliers.

Establish the storage capacity of CO_2 at each point of supply ahead of transportation to regional hubs and evaluate additional storage capacity where required.

APPROACH

The scope was expanded to include 47 countries in Africa, 10 countries in Latin America and a further 10 countries in the Pacific Islands leading to 70 countries in total being assessed including all COVAX countries in these regions.

Africa:	COVAX x44 and Other x3
Latin America:	COVAX x10 and Other x3
Pacific Islands:	COVAX x10

Distribution model

Import Arrival
UCC Freezers (5,000 Doses)

First Mile Transport
Pellet Shippers (5,000 Doses)

Administration Storage
UCC Freezers (5,000 Doses)

Last Mile Transport
4x4 Vehicles
Transport Boxes (160 Doses)
4 Days Travel / 1 Day Vaccinating

Vaccination Points
Arktek (5.4L)

Patients
2 Doses Each

DEMAND

The demand model was provided to PLM to determine the expected supporting infrastructure, LCO_2 and dry ice capacities required by country to support the ultra-cold chain distribution model.

Item	Assumption
Vaccine Volume per dose (secondary packaging)	3 cm3
Vaccine Doses per Vial	5
Max. time vaccine can spend outside UCC (e.g., at 2C-8C)	1 Day
Number of Doses per person	2
Arktek Capacity	5.40L
Volume of PCM in Arktek	8.20L
Dry Ice Transport Box Capacity	2.36L
Dry Ice Weight Needed per Dry Ice Transport Box	7.20KG
Dry Ice Transport Box Holdover time	3 Days
Max. Number of Vaccinator Teams per vehicle	2
Max. Number of People that can be vaccinated by a vaccination team in 1 day	160
Capacity of a UCC Freezer - Large	550L
Capacity of a UCC Freezer - Small	120L
Dry Ice "Shipper" - Capacity (doses)	5,000 Doses
Dry Ice "Shipper" - Per Tray Capacity (doses)	1,000 Doses
Dry Ice "Shipper" Holdover time	10 Days
Dry Ice Weight Needed per Dry Ice "Shipper"	23.00KG
Number of re-icings needed	2

DEMAND

The demand for dry ice and LCO_2 increases at a reduced rate as the number of vaccinated increases. Significant investment in supporting infrastructure is required.

Example: Mozambique		
Population to be Vaccinated	**1%**	10%
Vaccinated	**312,554**	3,125,544
Doses	**625,108**	6,246,088
Number of Vaccination Delivery Sites	**1,579**	1,579
Days	**30**	180
UCC Freezers	**18**	8
Shippers	**140**	232
Dry Ice Boxes	**540**	281
Vaccinator Teams	**1,001**	1,160
LCO2 per Day KG	**3,236**	2,477
Dry Ice per Day KG	**1,079**	826

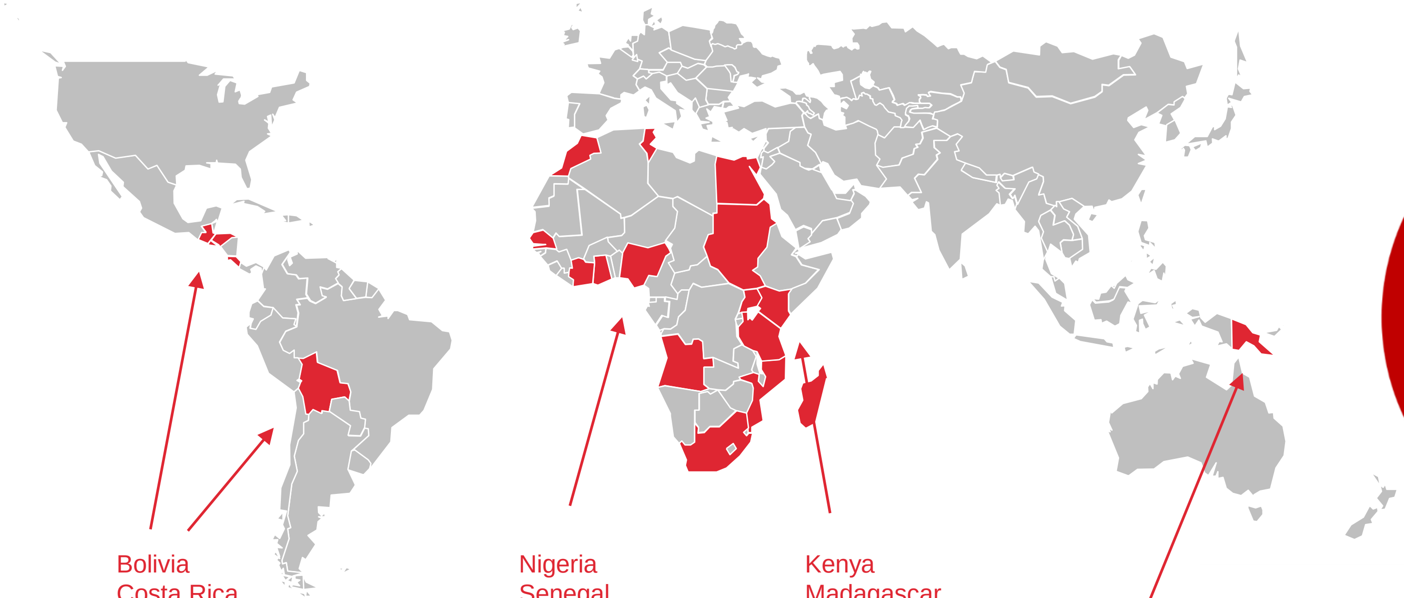
OUTPUT

There is an abundant supply of liquid CO_2 to meet the demand for dry ice across all 3 regions. There are potential additional sources of liquid CO_2 supply outside the regions including Europe and the Mid-East.

Region	LCO_2 KG for 30 Days		
	Capacity	Required	Balance
Africa	19,942,973	7,055,107	12,887,866
Latin America	2,467,693	919,207	1,548,486
Pacific Islands	113,148	104,172	8,977
Total	22,523,814	8,078,485	14,445,329

OUTPUT

Initial mapping of dry ice demand versus local supply capacity reveals
23 countries as self-sufficient with significant excess supply capacity available.



Bolivia
Costa Rica
El Salvador
Guatemala
Honduras
Trinidad and Tobago

Nigeria
Senegal
Tunisia
Angola
Cote D'Ivoire
Ghana
Morocco

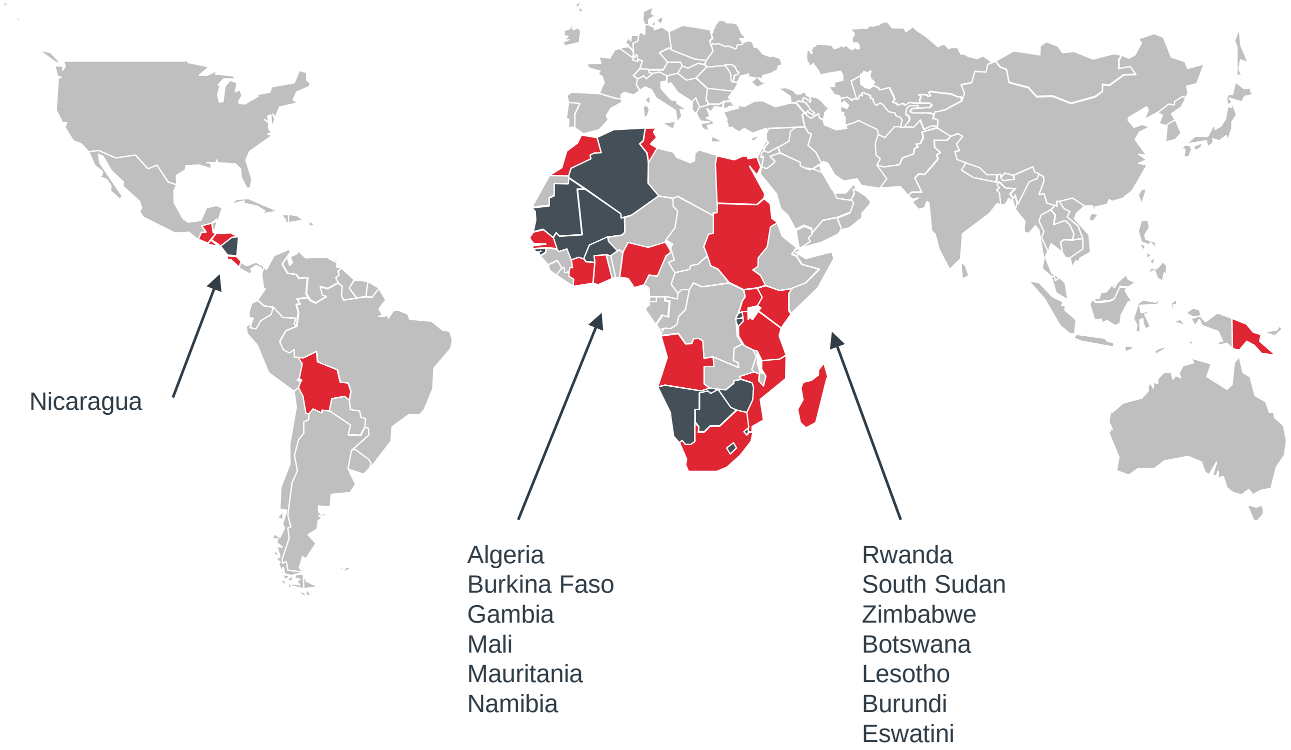
Kenya
Madagascar
Egypt
Tanzania
Uganda
South Africa
Sudan
Mozambique

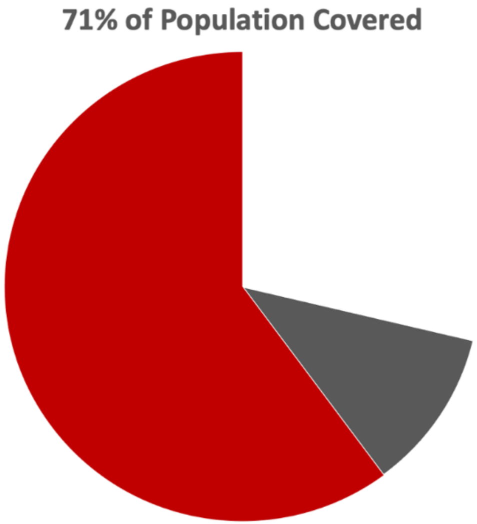
Papua New Guinea
Vanuatu

23 countries represent 60% of the population of the 70 countries across the 3 regions evaluated

OUTPUT

Excess local dry ice supply capacity in **23 countries can transport excess capacity by road to 14 neighboring countries within 24 hours travel time**.





14 countries represent 11% of the population of the 70 countries across the 3 regions evaluated

OUTPUT

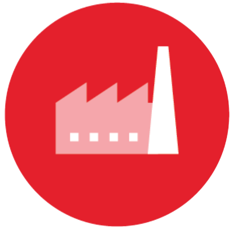
Remaining 33 countries with insufficient local dry ice supply are too remote from source for effective road transport of dry ice. **PLM therefore identified 3 options to fill local gap in dry ice supply.**

Option 1:

Transport excess dry ice capacity by air

Option 2:

Rental of mobile dry ice production hubs with sequenced deployment



Option 3:

Installation of new dry ice plants with transport of excess capacity to neighboring countries by road

Benin
Central African Republic
Comoros
Djibouti
Eritrea
Guinea
Liberia
Niger
Somalia
Zambia
Dominica
Grenada
Guyana
Haiti
St. Lucia
St. Vincent
Fiji
Kiribati
Marshall Islands
Micronesia
Samoa
Solomon Islands
Tonga
Tuvalu

OUTPUT: OPTION 1

Sufficient dry ice supply capacity across all 3 regions to meet demand for dry ice immediately using air transport from 3 regional hubs to 47 countries where local dry ice capacity is insufficient.

Operating Model

- Current dry ice suppliers will use existing dry ice plants and LCO2 supply to manufacture dry ice
- Where daily capacity exceeds local demand in country of manufacture **excess dry ice capacity is transported by air to countries where supply is insufficient** or no manufacturing capacity in place
- **Maximum time of 24 hours for transportation** of the dry ice from point of manufacture to central vaccine administration area in the neighboring country
- Dry ice is loaded in to insulated transportation boxes “shippers” which are designed to minimize sublimation losses during transportation
- Custom clearance processes coordinated between local governments enabling relatively frictionless movement across borders between countries

Analysis

- 23 countries have sufficient local dry ice capacity to meet demand
- **31 of the remaining 47 countries require less than 50% of the daily dry ice manufacturing capacity** of 1,100KG of the smallest ice plant (ASCO A55P)
- **South Africa, Kenya, Cote D’Ivoire, New Zealand and Trinidad and Tobago** are regional air transport hubs that have excess dry ice capacity that is sufficient to meet demand for the remaining 47 countries
- **Additional relatively low-cost dry ice supply capacity is in place in Belgium** close to an international air transport hub
- Although a maximum of 200 KG of dry ice can be transported in insulated dry ice containers per passenger flight, this restriction does not apply for commercial cargo flights

Implications

- Immediate dry ice supply is available across all 70 countries
- 23 countries are self-sufficient with local capacity exceeding local demand for dry ice
- For remaining 47 countries there are 3 potential hubs that can support the dry ice needs across all regions simplifying the supply process:
    - **32 countries in Africa supplied from Belgium**
    - **8 countries in Pacific Islands supplied from New Zealand**
    - **7 countries in Latin America supplied from Trinidad and Tobago**

OUTPUT: OPTION 2

Rental of mobile Dry Ice Production Hubs is a potential option to meet dry ice demand in countries where local supply is insufficient and air transport is not preferred.

Operating Model

- Where daily capacity exceeds local demand in country of manufacture **excess dry ice capacity is transported by refrigerated truck to countries where supply is insufficient** or no manufacturing capacity in place
- Existing pharmaceutical logistics partners with experience of efficient transporting of medical supplies across borders are to be used where available
- **Where travel time exceeds 24 hours local temporary dry ice capacity will be provided**
- Use of **mobile Dry Ice Production Hub (DIPH) which is a self-contained plant in transportable container** that can be easily transported by road
- Possible for LCO2 storage to be provided but this restricts the ease of mobility

Analysis

- DIPH supplied by Cold Jet is PR120H model with **dry ice manufacturing capacity of 2,400KG per day**
- Relatively rapid deployment possible of DIPH by air where connection to local liquid CO2 storage tanks is possible
- There are currently 9 DIPH available:
  - **4 located in the United Kingdom**
  - **2 in Singapore**
  - **1 each in Norway, Nigeria and United States.**
- Of the 47 countries with insufficient local dry ice supply capacity there are **45 where the DPIH has sufficient capacity to meet daily demand**
- For Ethiopia and DRC where daily demand exceeds the DIPH capacity multiple units can be deployed, or sequenced use of a single unit would meet demand

Implications

- Flexible dry ice supply option that can be rapidly deployed across 47 countries where local dry ice supply capacity is insufficient
- **Sequencing of dry ice supply would enable limited number of mobile DIPH to be deployed**
- Optimal use of mobility of DIPH requires connection to existing local liquid CO2 storage
- **Rental fees replace the need for purchasing new equipment thus there is little capital expenditure required**
- For neighboring countries with low daily demand for dry ice that are further than 24 hours from excess manufacturing capacity it is possible to transport excess dry ice from mobile DPIH thus reducing the frequency of redeployment and utilizing the DIPH capacity more effectively

OUTPUT: OPTION 3

Installation of new dry ice plants is a potential option to meet dry ice demand in countries where local supply is insufficient and air transport is not preferred.

Operating Model

- Current dry ice suppliers will use existing dry ice plants and LCO2 supply to manufacture dry ice
- Where daily capacity exceeds local demand in country of manufacture **excess dry ice capacity is transported by refrigerated truck to countries where supply is insufficient** or no manufacturing capacity in place
- Existing pharmaceutical logistics partners with experience of efficient transporting of medical supplies across borders are to be used where available
- **Where travel time exceeds 24 hours local new dry ice capacity will be installed**
- Preferably connected to existing LCO2 storage but if unavailable it is possible for LCO2 storage to be installed

Analysis

- **8 models of varying daily manufacturing capacities ranging from 1,100KG to 7,000KG supplied by 3 companies** – ASCO, Cold Jet and METSCO
- All models similar in technical specifications and robust enough for deployment in 3 regions
- **Smallest ASCO A55P can manufacture sufficient dry ice each day to meet the demand in 41 of the 47 countries** where local supply is insufficient
- **Lead-time for deployment is 12 weeks** from placement of order where new plant can be connected to existing local liquid CO2 storage with LCO2 storage tanks lead-time is an additional 10 weeks
- Dry ice plant manufacturing capacity for each of the 3 companies is 10 plants per month
- **ASCO offer the option to repurchase new dry ice plants up to 12 months after installation**

Implications

- **Extended lead-times for deployment will lead to relatively long delay in supply of dry ice** in countries where local dry ice supply is insufficient
- With need for purchasing new equipment there is **capital expenditure required**
- Capital expenditure burden is potentially reduced when ASCO repurchase option is triggered
- **Appropriate building locations need to be sourced to house the new dry ice plants** that are ideally close to existing liquid CO2 storage and with ease of access to compressed air supply and electricity
- Potential commercial use of excess dry ice supply capacity can mitigate operating expenses of supplying dry ice

OUTPUT

Supply of sufficient dry ice to meet the demand for 1% of the total population over a period of 30 days would cost between $1.04 to $1.15 per person vaccinated depending on the viability of transporting dry ice by air or truck.

	Option 1	Option 2	Option 3
Model Description	Transport excess dry ice capacity from regional hubs by air	Rental of mobile Dry Ice Production Hubs and transport excess dry ice capacity by refrigerated truck	Install new dry ice manufacturing capacity and transport excess dry ice capacity by refrigerated truck
Period of Supply	All 70 countries immediate	37 countries immediate 33 countries 12-22 weeks after dry ice plant order	37 countries immediate 33 countries 12-22 weeks after dry ice plant order
Expected Cost	$14.6m	$14.9m	$16.3m
Expected Cost per Person Vaccinated (2 doses over 21 days)	$1.04	$1.06	$1.15
Investment in Dry Ice Plants and LCO2 Storage	$0.0m	$0.0m	Up to $4.0m

Note:
ASCO offer a repurchase option for dry ice plants up to 12 months after installation hence a proportion of the investment funds can be recovered.
No LCO2 storage has been included for the rental mobile Dry Ice Production Hubs as this hinders the mobility. It is expected that connection will be made to existing LCO2 storage.
Investment excludes supporting infrastructure such as UCC freezers, Arktek, transport boxes and vehicles.

IMPLICATIONS

To vaccinate 1% of the total country population with COVID-19 vaccines (2 doses 21 days apart) there is sufficient LCO_2 and dry ice capacity in minimum 37 countries to begin immediately and potentially all 70 where air transport is possible.

In Africa, abundant LCO_2 capacity exists to support ultra-cold chain requirements for a COVID-19 vaccination program where up to 1% of the total country population is to be vaccinated

Installation of new dry ice supply capacity in 27 countries, with remaining countries supplied from excess local capacity using refrigerated trucks is an option. There is the possibility for supplier to repurchase the new dry ice plants after 12 months.

Estimated cost: up to $16.3m excluding LCO_2 transportation cost ($1.15 per person vaccinated) including investment of $4.0m.

23 countries have sufficient dry ice production capability to service 1% of total country population with vaccines (2 doses 21 days apart). The cost of procuring dry ice from existing suppliers just for these countries is $6.3m.

Rental of mobile Dry Ice Production Hubs for dry ice supply capacity in 27 countries, with remaining countries supplied from excess local capacity using refrigerated trucks is an option. Requires connection to existing local LCO_2 supply.

Estimated cost: up to $14.9m excluding LCO_2 transportation cost ($1.06 per person vaccinated).

Where air transport is feasible, dry ice capacity exists to meet needs of all 70 countries. Belgium, Trinidad & Tobago, New Zealand would be regional hubs with spare dry ice capacity to support remaining countries.

The suppliers have significant experience of bulk transport of dry ice by air. Estimated cost: $14.6m ($1.04 per person vaccinated).

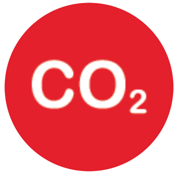
Air transport for dry ice is expected to be necessary for 15 remote small island nations. LCO_2 will have to be imported requiring new LCO_2 storage to be installed with lead times for shipping by boat being significantly longer than by air.

Note:

Further detailed feasibility assessments are recommended on the transportation of dry ice by air or refrigerated truck, the capacity of suppliers to manufacture and install new dry ice plants and whether mobile Dry Ice Production Hubs can be connected to existing sources of LCO2 through existing LCO2 suppliers.

IMPLICATIONS

How do these insights inform vaccine selection?



Abundant liquid **CO_2 supply can support the manufacture of sufficient dry ice each day to meet the demand** of an ultra-cold chain distribution model to support maintaining vaccines at -70C for vaccination of 1% of the population over 30-days

There is **sufficient dry ice manufacturing capacity across the regions to immediately supply all 70 countries** through a combination of local sourcing, road and air transport, mobile and installed capacity

Supply of dry ice will not be a constraining factor in allocating equitable access to vaccines across all geographies within the 70 countries accessed

The challenge for ultra-cold chain will be the effective management of the distribution model to deploy the vaccines at the required quantity to the target points of administration within the desired temperature range in order to minimise wastage

A flexible distribution model will be required to support both ultra- and regular-cold chain in order to effectively manage an evolving supply of vaccines over time and avoid inefficient parallel supply chains

Project Last Mile

THANK YOU

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