



SELCO Foundation | 23rd April 2020

# Sustainable Energy Access for COVID-19 Testing

## GLOSSARY

<b>COVID-19</b>	: Coronavirus Diseases-2019
<b>SARS-CoV-2</b>	: Severe Acute Respiratory Syndrome Coronavirus 2
<b>2019-nCoV</b>	: Novel Coronavirus
<b>RT-PCR</b>	: Reverse Transcription Polymerase Chain Reaction
<b>POC PCR</b>	: Point-of-Care Polymerase Chain Reaction
<b>PCR Machine</b>	: Polymerase Chain Reaction Machine
<b>ICMR</b>	: Indian Council of Medical Research
<b>NIV</b>	: National Institute of Virology
<b>RNA</b>	: Ribonucleic Acid
<b>DNA</b>	: Deoxyribonucleic Acid
<b>PPE</b>	: Personal Protective Equipment

## TABLE OF CONTENTS

Introduction | COVID-19 Pathway to Recovery

Introduction | Testing Process

Sample Collection

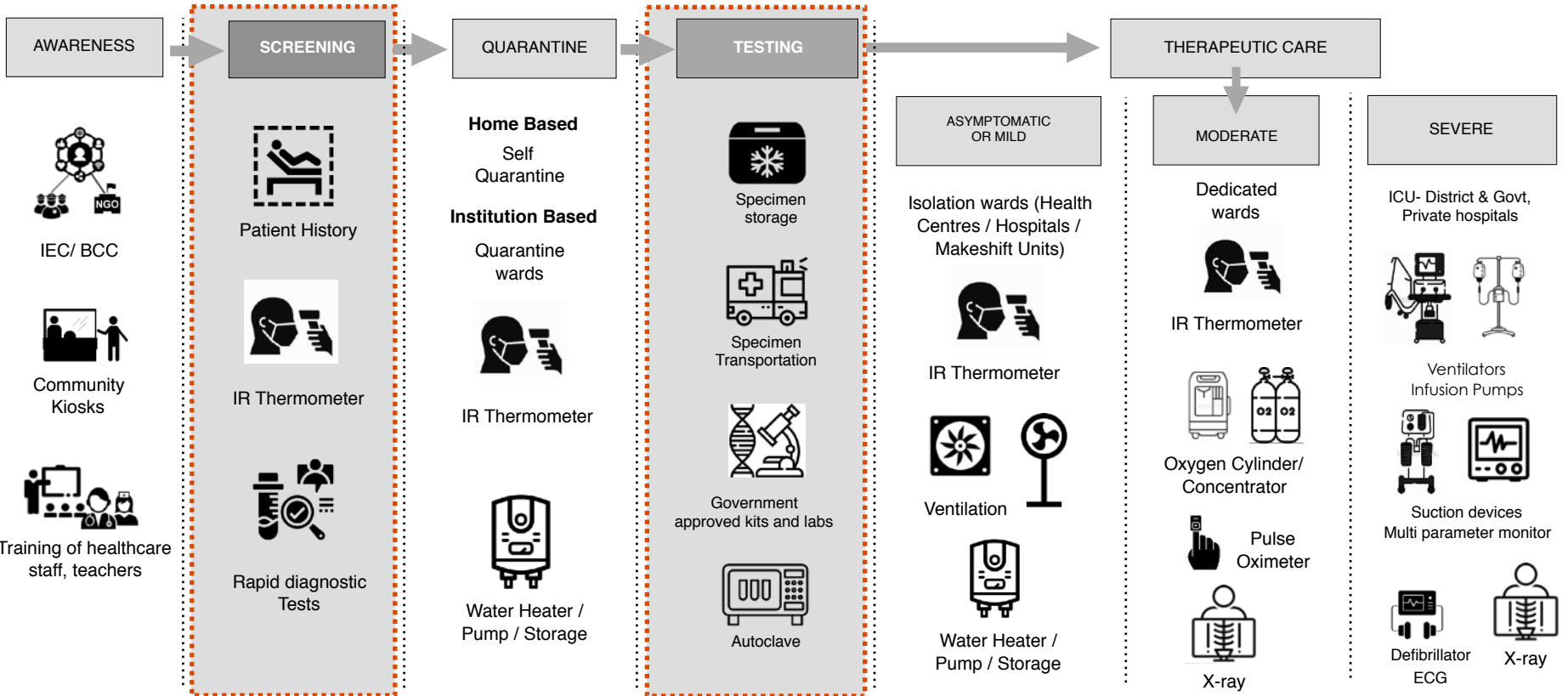
Sample Testing

References

# Sustainable Energy Access for COVID-19 Testing



## PATHWAY TO RECOVERY



# Sustainable Energy Access for COVID-19 Testing

## TESTING PROCESS

### Sample Collection



### Specimen Collection Details

Specifications on storage for specimen mentioned in the table below:

Specimen type	Collection materials	Transport to Laboratory	Storage till Testing
Nasopharyngeal and oropharyngeal swab	Dacron or polyester flocked swabs*	2 - 8 °C	≤5 days: 2 - 8°C >5 days: -70 °C
Bronchoalveolar lavage	sterile container*	2 - 8 °C	≤48 hours: 2 - 8°C >48 hours: -70 °C
Tracheal aspirate, nasopharyngeal aspirate or nasal wash	sterile container*	2 - 8 °C	≤48 hours: 2 - 8°C >48 hours: -70 °C
Sputum	sterile container	2 - 8 °C	≤48 hours: 2 - 8°C >48 hours: -70 °C
Tissue from biopsy or autopsy including from lung	sterile container with saline	2 - 8 °C	≤24 hours: 2 - 8°C >24 hours: -70 °C
Serum (2 samples – acute and convalescent)	Serum separator tubes (adults: collect 3-5 ml whole blood)	2 - 8 °C	≤5 days: 4 °C >5 days: -70 °C

Note: The above recommendation as per WHO. It also recommends the use of VTM (Viral Transport Medium) containing anti fungal and antibiotic supplements for transport of samples. Avoid repeated freezing and thawing of specimens.

# Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION

## SAMPLE COLLECTION Collecting virus samples by nasopharyngeal (NP) swab, oropharyngeal (OP) swab method

### Requirements for Clinical Sample Collection

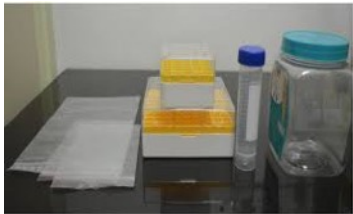
1. Sample vials and Virus Transport Medium (VTM)



2. Adsorbent material (cotton, tissue paper), paraffin, seizer, cello tape



3. A leak-proof secondary container (e.g., ziplock pouch, cryobox, 50 mL centrifuge tube, plastic container)



4. A suitable container (e.g., thermocol box, ice-box, hard-board box) (minimum dimensions: 10 x 10 x 10 cm)



### Different Methods of Sample Collection

1. COVID WISK



2. LABORATORY



3. MOBILE COVID 19 TESTING VAN



4. DRIVE IN COVID 19 SAMPLE COLLECTION



## COVID WALK-IN SAMPLE KIOSKS (WISK)

A WISK (Walk-in Sample Kiosk) is a mobile cubicle with a sealed glass front, and have extended gloves attached in the front, through which a medical practitioner standing in the cubicle can collect samples.

Even a swab can be collected without direct exposure and contact. After the swab collection, the gloves can be sanitised from outside.

**The Kiosk can be used to for any type of test.**

### Medical consumables

- Viral Transport Medium (VTM)
- Flocked Dacron swabs (2 swabs/ sample collection from 1 patient)
- Disinfectant

### Materials required for infrastructure

- Aluminium fabrication with multi wood
- Glass (8 mm thickness) with Gloves
- Magnetic door - 2 nos.

### Electrical appliances required

- Exhaust fan (to maintain the temp)
- LED Tube light
- Cold Carrier box



[Click here for drawing](#)

# Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION

## Solar System Designs for COVID19 WALK\_IN SAMPLE KIOSKS (WISK)

Option 1 - 80 - 100 samples/day Collection & Transportation

Load Type	Wattage (W)	No of Appliances	Hours of Usage	Energy Consumed (Units/Day)
DC Wall Fan	14	1	12	0.48
DC LED Light	5	1	8	0.048
Mobile Charging	20	1	3	0.06
Cold Carrier Box	36	4	4	0.576

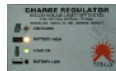
Max Load that can be Connected	183 W
Max Units of Energy (kWh) Usage per day	0.85 kWh
System Voltage	24 V
Cost	INR 62,000*



Solar Panel 400 Wp  
(200 Wp, 24 V x 2 nos)



Solar Battery 360 Ah, 24 V  
(180 Ah, 12 V x 2 nos)



Charge Controller  
15 A, 24 V

Option 2 - 40 - 50 samples/day Collection & Transportation

Load Type	Wattage (W)	No of Appliances	Hours of Usage	Energy Consumed (Units/Day)
DC Wall Fan	14	1	12	0.48
DC LED Light	5	1	8	0.048
Mobile Charging	20	1	3	0.06
Cold Carrier Box	36	2	4	0.288

Max Load that can be Connected	111 W
Max Units of Energy (kWh) Usage per day	0.56 kWh
System Voltage	12 V
Cost	INR 45,000*



Solar Panel 200 Wp  
(100 Wp, 12 V x 2 nos)



Solar Battery 200 Ah, 12 V  
(200 Ah, 12 V x 1 nos)



Charge Controller  
15 A, 12 V

\*The cost does not include the cost of the Cold Carrier Box (Suggested technology- Black Frog)



# Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION

## MOBILE COVID19 TESTING VAN

This is to collect the samples from potential coronavirus patients at their doorstep. This would save time and energy of both patients and lab technicians as the vehicle can be taken to any remote art, especially in contaminated zones, without much difficulty.



## DRIVE-IN COVID19 SAMPLE COLLECTION

This is to collect the sample from patient who can arrive in their car at the location. During the process first, you never need to leave your vehicle as the test can be conducted through the vehicle's window itself. The test would be conducted by trained medical staff who would use the maximum amount of safety equipment with masks, gloves medical scrub suits, and face protective equipment.



## Solar System Designs for Mobile Testing Solutions

50 samples/day Collection & Transportation

Load Type	Wattage (W)	No of Appliances	Hours of Usage	Energy Consumed (Units/Day)
DC LED Light	5	2	8	0.04
Mobile Charging	20	1	3	0.06
Cold Carrier Box	72	1	4	0.29

Max Load that can be Connected	97 W
Max Units of Energy (kWh) Usage per day	0.39 kWh
System Voltage	12 V
Cost	INR 35,000*



Solar Panel  
150 Wp



Solar Battery  
150 Ah, 12 V



Charge Controller  
15 A, 12 V

\*The cost does not include the cost of the Cold Carrier Box (Suggested technology- Black Frog)

# Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION



## DISTRICT SURVEILLANCE OFFICE To store the samples collected from different PHC, CHC & Private Hospitals

Option 1: 100 Litres DC Fridge - 500 - 900 Samples



Solar Panel  
300 Wp



Solar Battery  
200 Ah, 12 V

**Cost: INR 68,000\***

Option 2: 150 Litres DC Fridge - 1,100 - 1,400 Samples



Solar Panel  
400 Wp



Solar Battery  
360 Ah, 12 V

**Cost: INR 86,000\***

Option 3: 200 Litres DC Fridge - 1,400 - 1,700 Samples



Solar Panel  
450 Wp



Solar Battery  
400 Ah, 12 V

**Cost: INR 98,000\***

Option 4: 268 Litres DC Fridge - 1,900 - 2,200 Samples



Solar Panel  
900 Wp



Solar Battery  
300 Ah, 24 V

**Cost: INR 127,000\***

*\*The cost is inclusive of the cost of the fridge*

## TYPES OF TESTING

Parameters	Viral Detection (Based on virus detection technology)	Rapid RT-PCR Tests (Based on virus detection technology)	Antibody Test/ Rapid Tests (Based on antibody detection technology)
<b>About</b>	To determine whether a nasopharyngeal sample is positive for coronavirus. Reverse Transcriptase Polymerase Chain Reaction (RT - PCR) is the technique used.	COVID-19 Rapid Diagnostics Test (RDT) identifies body's response to coronavirus after the onset of infection and gives a qualitative result. Implementing rapid screening for COVID-19 helps in controlling the spread of the virus by identifying infection rapidly and accurately. There are two types of COVID-19 rapid tests currently in use or in development: direct SARS-CoV-2 antigen detection and indirect antibody detection tests.	The antibody test known as serological test uses a few drops of blood drawn from vein and dropped into the device containing a small strip, similar to the combination of a blood glucose test and home pregnancy kit. The test identifies antibodies to the Coronavirus in a patient's bloodstream to determine whether that person previously had COVID - 19 and possibly recovered.
<b>List of administrators</b> (As per ICMR guideline of 16/4/2020)	<u>Govt Laboratories reporting to ICMR</u> <u>Private Laboratories</u>	<u>Rapid diagnostics</u>	<u>Antibody test kits for Covid 19</u>
<b>Approved by</b>	India Council of Medical Research (ICMR)	India Council of Medical Research (ICMR)	NIV Pune
<b>Time required to get results</b>	5 - 6 hours	2.5 hours - 3 hours	30 min - 1 hour
<b>Electrical equipments required</b> As per ICMR guideline of 13/4/2020	RT-PCR, Deep Freezer (-20 degree C & -80 degree C), Refrigerator (4 degree C), Microcentrifuge / Refrigerated Centrifuge, Vortex Mixer, Microspin, Autoclave	RT-PCR, Deep Freezer (-20 degree C & -80 degree C), Refrigerator (4 degree C), Microcentrifuge / Refrigerated Centrifuge, Vortex Mixer, Microspin, Autoclave	Does not require electricity supply as the device contains a small strip

## ELECTRICAL EQUIPMENT DETAIL

### Real Time PCR (RT - PCR)

A real-time RT-PCR test intended for the qualitative detection of nucleic acid from the 2019-nCoV in upper and lower respiratory specimens. Real-time PCR machine calibrated for the fluorophore dyes which are present on the probes.



<b>Power consumption</b>	300 W
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<b>Voltage</b>	220 - 240 Vac
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### Vortex Mixer

A vortex mixer is used to mix small vials of liquids in a quickly oscillating circular motion. When the motion of the rubber cup holder on the mixer is transmitted to the liquid sample, a vortex is created



<b>Power consumption</b>	30 W
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<b>Voltage</b>	220 - 240 Vac
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### Cold centrifuge/Microfuge

A microcentrifuge, also called a microfuge, is used to spin small (2 ml or less) liquid samples at high speeds. Refrigerated centrifuges protect sensitive samples from heat degeneration, protect the sample's integrity. Also important are safety features, ergonomic adaptations and ease of use.



<b>Power consumption</b>	60 - 72 W
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<b>Voltage</b>	220 - 240 Vac
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### Microspin

Microspin is used for extracting RNA/DNA samples, sedimentation of biological components, biochemical and chemical analysis of microsamples



<b>Power consumption</b>	60 W
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<b>Voltage</b>	220 - 240 Vac
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## ELECTRICAL EQUIPMENT DETAIL

### Deep Freezer

A deep freezer is required to store reagents & samples. A  $20^{\circ}\text{C}$  -  $80^{\circ}\text{C}$  deep freezer are required to store reagents (primers/ probes/positive controls) & aliquoted samples/ viral RNA in Cryovials respectively.



<b>Power consumption</b>	120 W
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<b>Voltage</b>	220 - 240 Vac
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### Refrigerator

A refrigerator is required to store viral transport medium, and for short term storage of samples and extracted RNA). It should maintain at a temp  $4^{\circ}\text{C}$



<b>Power consumption</b>	100 - 130 W
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<b>Voltage</b>	220 - 240 Vac
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### Autoclave

Autoclave can sterilize solids, liquids, hollows, and instruments of various shapes and sizes. A very basic autoclave is similar to a pressure cooker; both use the power of steam to kill bacteria, spores and germs resistant to boiling water and powerful detergents.



<b>Power consumption</b>	1 - 2 kW
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<b>Voltage</b>	220 - 240 Vac
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# Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION

## Solar System Designs for Testing Labs

Govt approved RT PCR Viral detection - 20 samples in a day (8 hours)  
 Rapid RT - PCR - 40 samples- Since it gives test results in 2.5 hours, they can do 40 samples in a day

Load Type	Wattage (W)	No of Appliances	Hours of Usage	Energy Consumed (Units/Day)
RT-PCR	300	1	8	2.4
Deep Freezer (-20 degree C)	120	1	24	1.2
Deep Freezer (-80 degree C)	140	1	24	1.4
Refrigerator ( 4 degree C)	130	1	24	1.3
Microcentrifuge	72	1	4	0.288
Vortex Mixer	30	1	4	0.12
Microspin	60	1	4	0.24

- Note:
1. The usage of Autoclave is minimal here as the chemical disinfect is used
  2. All electrical equipment power consumption varies based on the labs

Max Load that can be Connected	852 W W
Max Units of Energy (kWh) Usage per day	6.95 kWh
System Voltage	96 V
Cost	INR 380,000*

\* The cost includes cost of the solar energy system only.



Solar Panel  
3.6 kWp



Solar Battery  
200 Ah 96 V



Solar Inverter  
5 kVA, 4 kW, 96 V

For the current design, it is assumed that the labs will be operating for 8 hrs/day. If the number of tests/day are increased, the operating hours for the equipments would increase. While the number of equipments per lab will remain the same, the solar energy system design would need to be altered accordingly.

## REFERENCES

[Prerequisites for establishing COVID-19 testing facility in Government and private Medical Colleges \(Date: 13/04/2020\)](#)

<https://www.ecdc.europa.eu/sites/default/files/documents/Overview-rapid-test-situation-for-COVID-19-diagnosis-EU-EEA.pdf>

<https://www.asianscientist.com/2020/04/features/covid-19-diagnostics-explained/>

<https://www.itg.be/E/Article/guidance-on-the-use-of-covid-19-rapid-diagnostic-tests>

<https://www.itg.be/Files/docs/COVID-19-Rapid-Diagnostic-Tests.pdf>

<https://economictimes.indiatimes.com/news/politics-and-nation/govt-issues-licences-to-import-antibody-kits-may-buy-more/articleshow/75019914.cms>

<https://www.mohfw.gov.in/pdf/NotificationofICMguidelinesforCOVID19testinginprivatelaboratoriesinIndia.pdf>

<https://www.jagranjosh.com/current-affairs/icmr-approves-antibody-tests-in-covid-19-hotspot-areas-1585911909-1>

<https://economictimes.indiatimes.com/industry/healthcare/biotech/healthcare/covid-19-icmr-invites-bids-for-antibody-kit-for-virus-diagnosis/articleshow/74818887.cms?from=mdr>

<https://www.businesstoday.in/sectors/pharma/coronavirus-icmr-floats-tender-for-rapid-diagnostic-kits-to-test-45-lakh-samples/story/400832.html>

<https://economictimes.indiatimes.com/news/politics-and-nation/karnataka-scales-up-covid-19-tests-5-times-to-1500-per-day/articleshow/75196068.cms>

<https://www.livemint.com/news/india/icmr-readies-plan-to-increase-testing-capacity-to-1-lakh-per-day-if-situation-worsens-11586178638274.html>

<https://www.deccanherald.com/city/bengaluru-labs-testing-covid-19-samples-are-overloaded-814125.html>

# Thank You!

Do get in touch for further  
information and assistance.

Write to us at:

[covid19@selcofoundation.org](mailto:covid19@selcofoundation.org)

SELCO Foundation COVID-19 Response Website:

[covid-19.selcofoundation.org](https://covid-19.selcofoundation.org)



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