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International Renewable Energy Agency

Canada

IRENA INNOVATION DAY

23-24 March 2022 • Canada

IRENA INNOVATION DAY

DAY 1
Opening session

WEDNESDAY, 23 MARCH 2022 • 9:00 – 9:15 EDT/14:00 – 14:15 CET

IRENA International Renewable Energy Agency

Canada

Opening remarks – IRENA

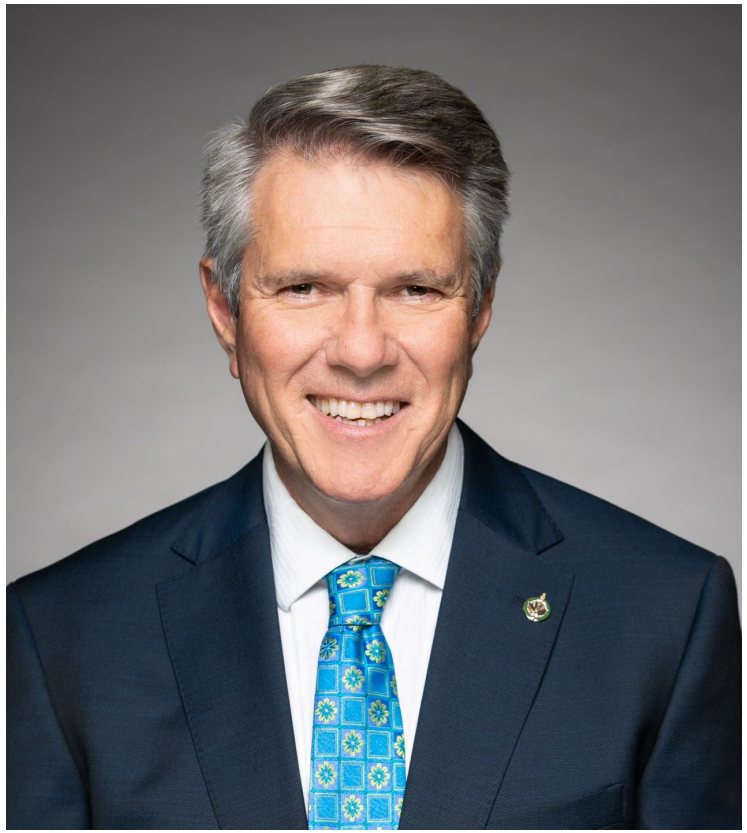
Francesco La Camera

Director General
IRENA

Opening remarks – Natural Resources Canada

John Aldag

Chair of Standing Committee
Natural Resources Canada



IRENA INNOVATION DAY

DAY 1
Focus on the power sector

WEDNESDAY, 23 MARCH 2022 • 9:00 – 9:15 EDT/14:00 – 14:15 CET

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Agenda Day 1

TIME (EDT)	SESSION
09:00 – 09:15	**Opening addresses** by IRENA and Natural Resources Canada
09:15 – 10:30	**Session 1: Mini-grids of the future** The session will explore innovative solutions in off-grid, remote areas and islands, including interconnecting mini-grids together or with the main grid to increase resilience and reliability, and allow the integration of higher shares of renewable electricity and in turn decrease costs. Central to the discussions will be the changing roles of energy actors, digitalisation, emerging challenges and opportunities, and the potential to enable Indigenous Reconciliation and economic development.
10:30 – 11:00	**Break**
11:00 – 12:15	**Session 2: Innovative hydropower solutions for a clean, reliable and flexible grid** The session will explore innovative solutions in hydropower and pumped hydro storage to maximize its contribution to the grid, integrate, and balance higher shares of variable renewables by offering a unique range of system services including provision of inertia, operation reserves, load following and time shifting to long-duration storage. The discussion will also explore the role of digitalisation.
12:15 – 12:30	**Wrap up of DAY 1** by IRENA and Natural Resources Canada.

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Session 1:
Mini-grids of the Future

WEDNESDAY, 23 MARCH 2022 • 9:15 – 10:30 EDT / 14:15 – 15:30 CET

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Session 1:
Scene setting

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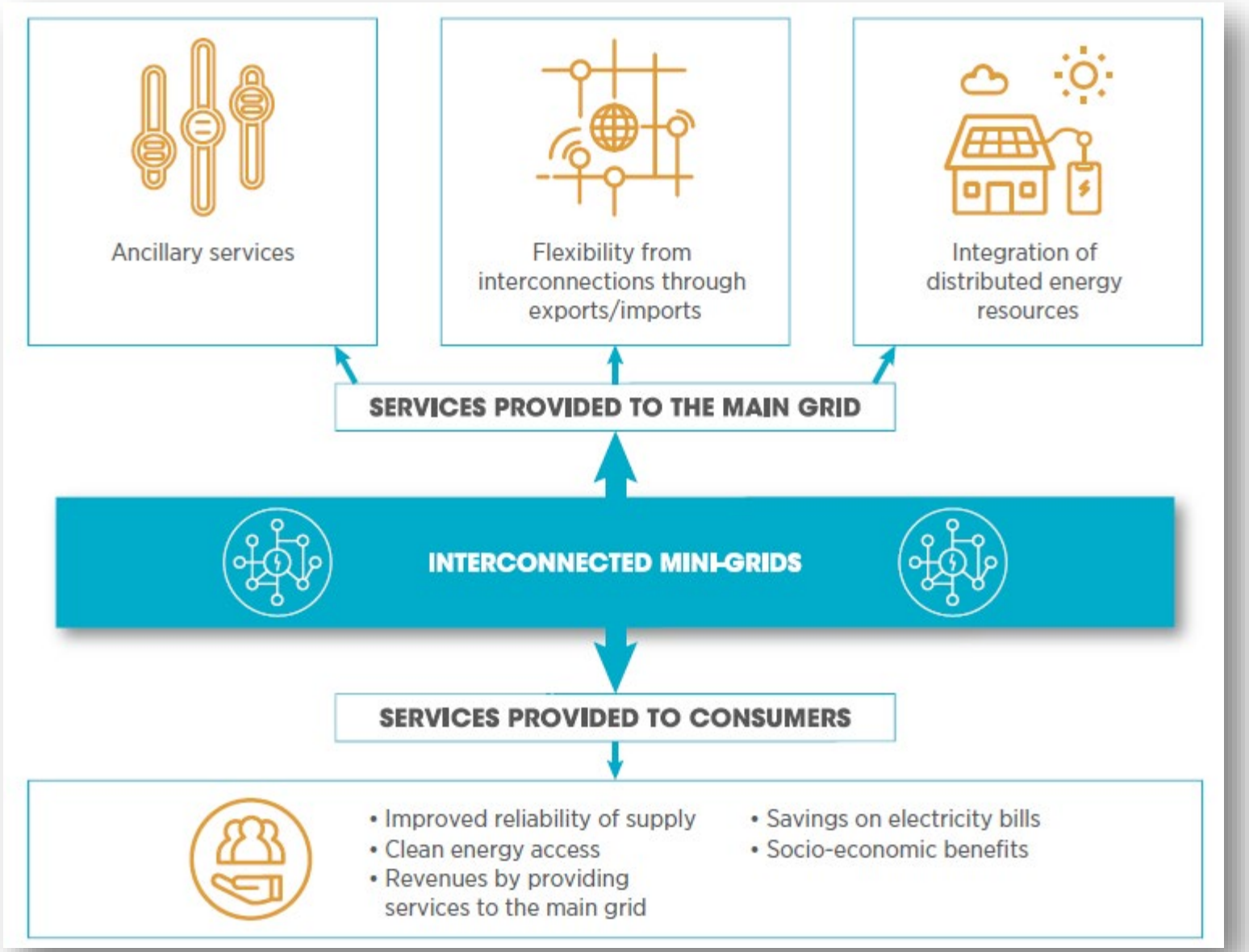
Global perspective

Aakarshan Vaid

Associate Programme Officer
Power System Flexibility
IRENA

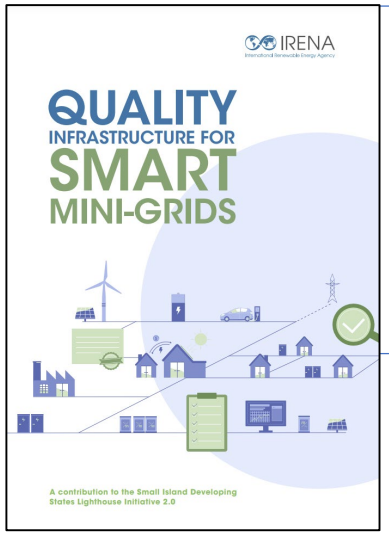
Innovation in mini-grids connected to the main grid



- In the Netherlands, pilot projects with renewable mini-grids provide balancing service to the main grid
- In Tanzania, mini-grids achieve 98% reliability, compared with 47% for the national grid
- Global installed capacity for off-grid renewable mini-grids is about 4.2 GW, with high potential for grid connection

Source: IRENA (2019), Innovation landscape brief: Renewable mini-grids

Mini-Grids with assured quality = resilient energy systems for small islands



Puerto Rico Regulation for Mini-grids

After hurricane Maria in 2017, Puerto Rico looked to implement more resilient energy systems in their communities.

The 2018 regulation defines 'renewable microgrids' as those that can generate 75 % of their energy from renewables. It identifies the applicable codes and standards.

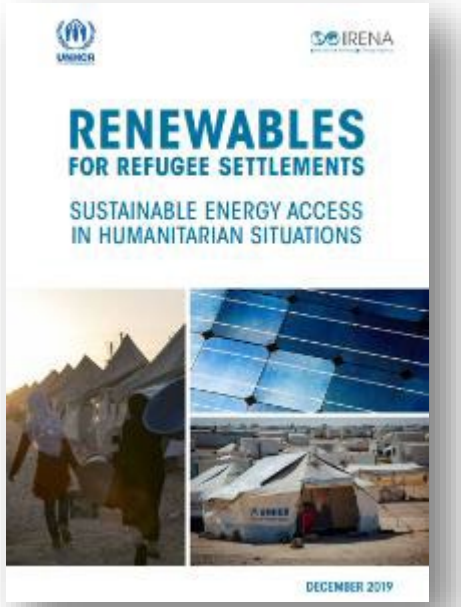
Below, the Commission establishes the list of Codes and Standards with which all microgrids must comply. It remains the responsibility of each microgrid owner and operator to ensure that its microgrid system is in compliance with any and all Codes and Standards that may be applicable to it.

1. Latest National Electrical Code;
2. Latest National Electrical Safety Code;
3. IEEE Standard 1547-2014;
4. IEEE P2030.2, P2030.7;
5. IEC 61850-7-420; Power Utility Automation
6. IEC/TS 62898-1 and 62898-2; Guidelines for microgrid projects planning and specification

Source: NFPA, 2018; CEPR, 2018, WRI 2017, Magnaray International, African enterprise investor

Renewables for refugee settlements - Background

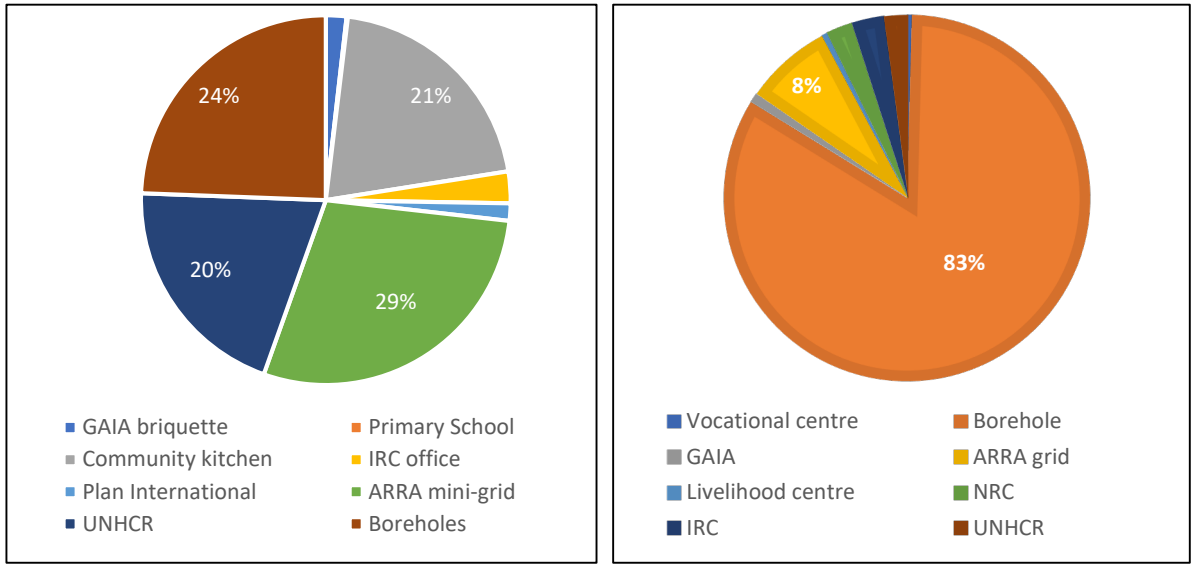
- 70.8 million displaced people
  (25.9 million refugees and over half < 18 years of age)
- Most refugees depend on unsustainable energy resources that pose risks to their security and safety
- Access to clean and sustainable energy can deliver quick returns
- IRENA and UNHCR entered into an MoU
- Under this framework, IRENA – jointly with UNHCR – released a study at the Global Refugee Forum in December 2019 to assess energy usage in four refugee camps in Iraq and Ethiopia
- Missions to the camps in Ethiopia and Iraq took place in September 2019



Renewables for refugee settlements - Overview of camps

- **Darashakran, Iraq**
  - 40km north of Erbil (Kurdish region of Iraq)
  - 2013, largest settlement in Erbil region (≈ 11,608)
- **Domiz 1 & 2, Iraq**
  - Adjacent to each other, 10 km outside Duhok (Kurdish region of Iraq)
  - 2012, combined population of 44,000 (largest in Iraq)
- **Sherkole, Ethiopia**
  - 42 km north of Assosa on the border with Sudan
  - 1997, currently hosts ≈10,619 refugees
- **Tsore, Ethiopia**
  - 20 km north of Assosa on the border with Sudan
  - 2015, currently hosts ≈14,153 refugees

UNHCR refugee settlements in Iraq



Pie charts of the electricity use in Sherkole (left) and in Tsore (right)

Renewables for refugee settlements - Technology options for electricity

- **Solar lighting kits**

Solar lanterns charging at a school in Chuuk, Federated States of Micronesia

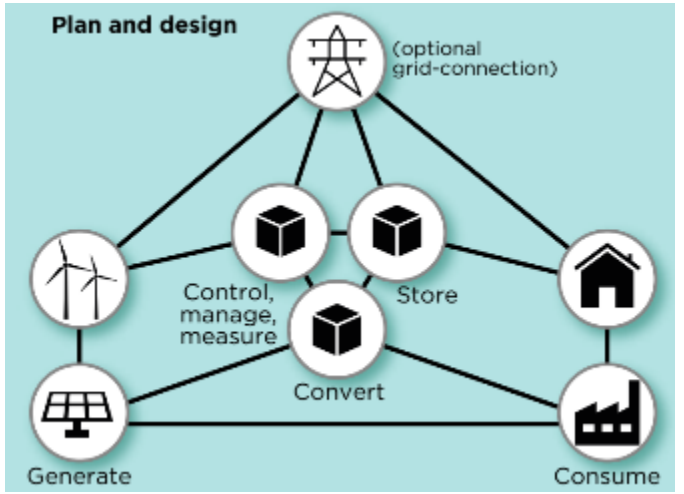
- **Standalone solutions /SHS**

School in Chuuk using standalone solar PV with battery storage

- **Solar water pumping**

A solar plant installed at a borehole in Darashakran refugee camp (Iraq)

- **Mini-grids**

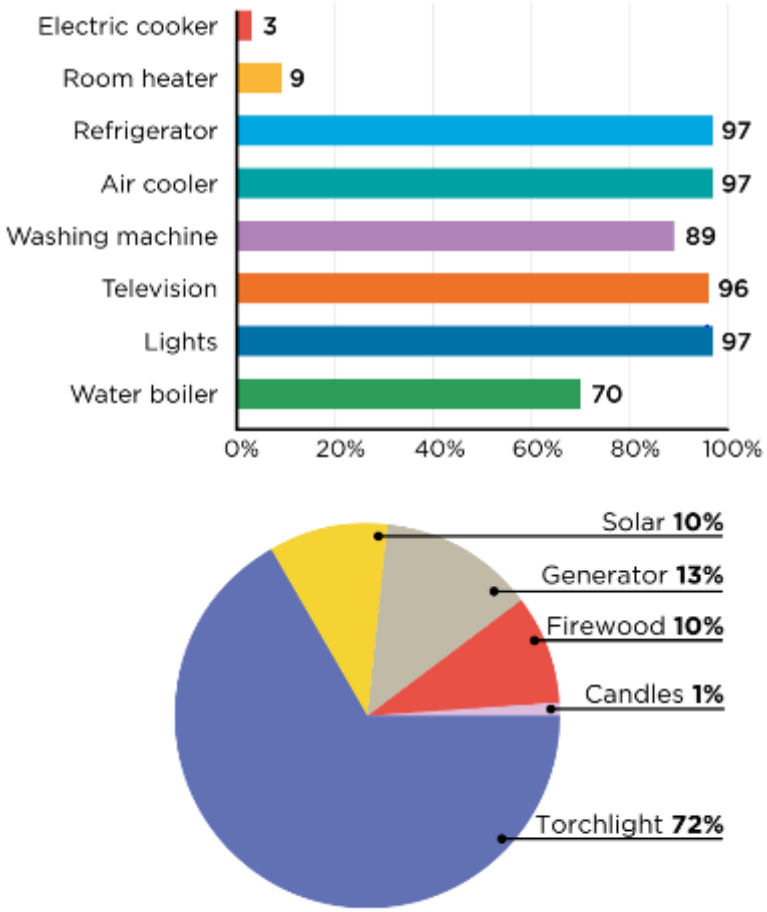


Source: Based on IRENA (2016) Innovation Outlook: Renewable Mini-Grids

- **Grid connected renewables**

Renewables for refugee settlements – Key findings

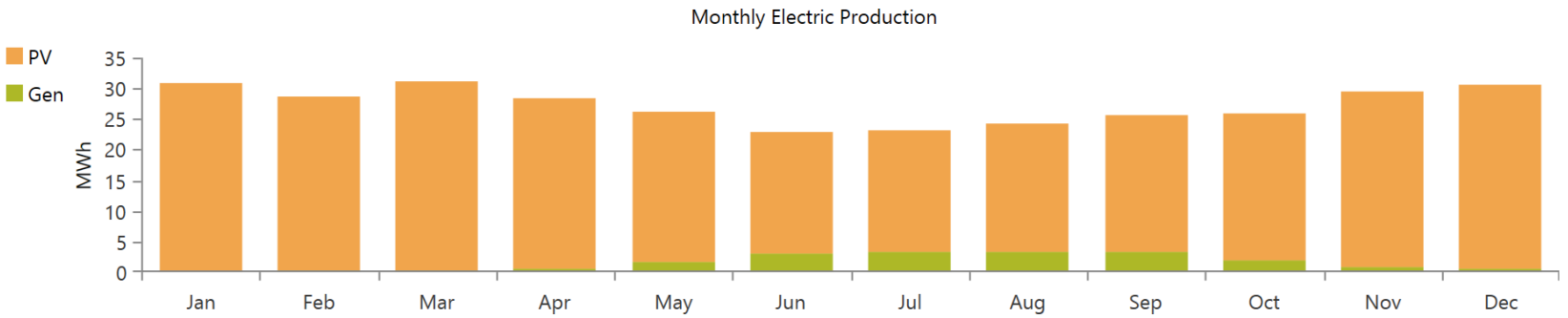
1. The energy situation for refugees reflects the development level of the host community
2. Brownouts and blackouts lead to over-reliance on expensive backup diesel generators in Iraq
3. The lack of access to energy for cooking for refugees poses a risk for conflict with host community in Ethiopia
4. Large potential benefits arise from increasing the use of renewable energy in refugee settings
5. The lack of data limits the efficiency of electricity supply and is a barrier for moving to renewables



Distribution of appliances in Domiz, Iraq (top) and main lighting source in Sherkole, Ethiopia (bottom)

Renewables for refugee settlements – Examples of proposed solutions

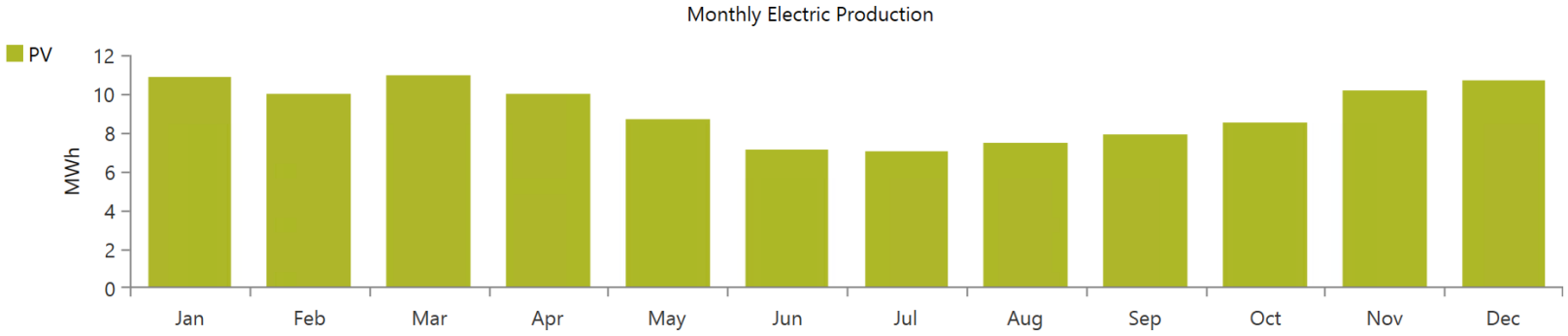
Sherkole settlement mini-grid



Monthly electricity generation of proposed mini-grid in Sherkole settlement, Ethiopia

PV: 183kW
Storage: 433kWh
Diesel: 80kVA
COE: 0.16 USD/kWh
RE Share: 91%
Investment: 480,000-550,000 USD

Tsore settlement mini-grid



Monthly electricity generation of proposed mini-grid in Tsore settlement, Ethiopia

PV: 65kW
Storage: 108kWh
Diesel: None
COE: 0.2 USD/kWh
RE Share: 100%
Investment: 160,000 USD

Renewables for refugee settlements - Conclusions

- More data needs to be collected
- Energy loggers are crucial to properly measure and size appropriate renewable energy systems
- In Iraq, transitioning to a meter-based payment system for HH in the settlements could improve the availability and quality of electricity supply
- In Ethiopia, collecting data on HH income would be central in moving towards market-based cash assistance
- Considerable synergies can be gained from collaboration between humanitarian organisations (e.g. UNHCR) and specialised RE agencies (e.g. IRENA)

Renewables are key for affordable, reliable, climate-safe access to modern energy services

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Thank you!

Aakarshan Vaid
IRENA International Technology Centre
IRENA

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Canadian perspective

Kathleen Lombardi

Science & Technology Advisor
NRCan

IRENA International Renewable Energy Agency
Canada

Indigenous Climate Leadership in Remote Communities in Canada

Remote Communities in Canada

292 remote communities and industrial sites across Canada not connected to the North American grid

Diesel generating station in KUUJJUARAAPIK, Nunavik, Québec

200 rely completely on diesel for heat and electricity

2/3 are Indigenous

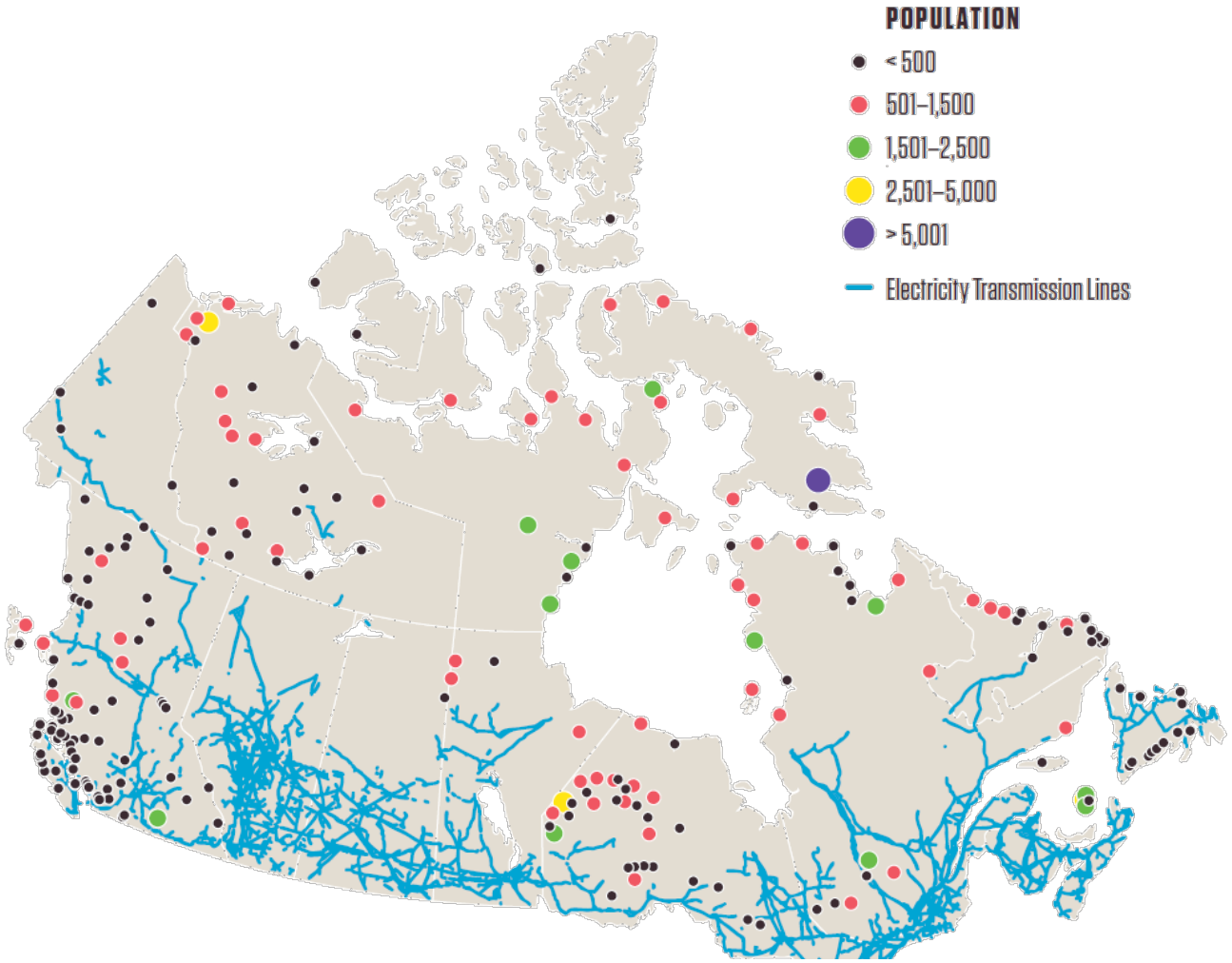

Image source: Waterloo Global Science Initiative. (2017). OpenAccess Energy Blueprint.

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Remote Communities in Canada

292 remote communities and industrial sites across Canada not connected to the North American grid

Diesel generating station in KUUJJUARAAPIK, Nunavik, Québec

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Image source: Inuit Tapiriit Kanatami

Energy Actors

Communities

- Land caretakers
- Project leaders
- Businesses
- Customers
- People – *students, Elders, employees*

Utilities

- Provide reliable power
- Own and operate most diesel generating equipment and micro-grids
- Purchase power

Regulators

- Set energy policy for *most* regions
- Protect consumer interest
- Oversee energy pricing

Provincial, Territorial, & Regional Governments

- Directly manages most natural resources and energy
- Funding programs

Federal Government

- National energy policy
- Funding programs
- Science and technology R&D

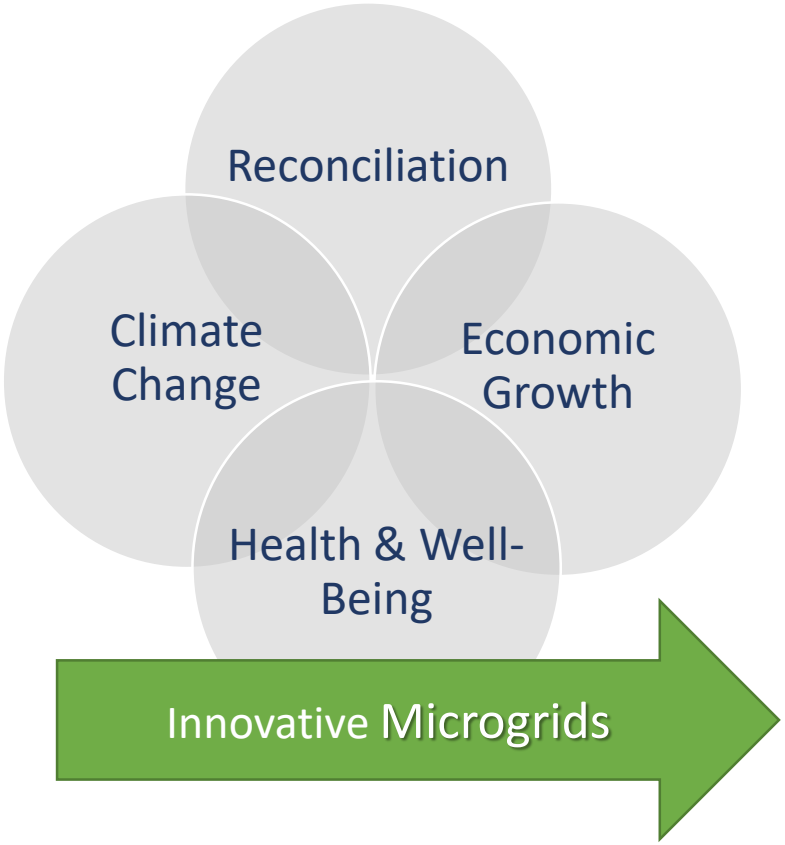
Others

- Manufacturers
- Development corporations
- Operation and maintenance staff
- Interested stakeholders

Project Development

Innovative Concepts

- **Integrating renewables:** Proven reliability in cold climates with limited internet; equipment, controls, and operating strategies for variable & grid-forming generation
- **Holistic approach:** Integrating clean energy projects with transportation, agriculture, economics, health, and other sectors
- **Policy:** Commercial, institutional, and independent power production programs
- **Business:** Power purchase agreements *beyond* the avoided cost of fuel; valuing health, reliability, avoided contamination
- **Ownership:** Communities own assets, generating long-term economic benefits through revenue and employment



Indigenous Leadership in Clean Energy Microgrids

Communities are geographically dispersed, with varying needs and resources, no one size fits all solution.

The Government of Canada has committed to support the transition of Indigenous communities from reliance on diesel to clean, renewable and reliable energy by 2030.

The key to successful, innovative ownership and business models for clean energy projects:

community leadership

ATLIN HYDRO EXPANSION PROJECT
Photo source: www.thelp.ca

WHAPMAGOOSTUI-KUUJJUARAAPIK HYBRID POWER PLANT PROJECT
Photo credit: www.tugliq.com

SREE VYAH OLD CROW SOLAR PROJECT
Photo credit: GBP Creative

Conclusions

INDIGENOUS CLIMATE LEADERSHIP

Significant and meaningful Indigenous participation in project and policy development decisions and governance through Indigenous agency, voice, and resources to lead self-determined clean energy action

Canada's innovative microgrids include clean energy projects which create socio-economic and health benefits for communities.

Community ownership of renewable energy assets promotes economic reconciliation and energy sovereignty.

Multiple federal departments (NRCan, CIRNAC, ISC, ECCC, INFC, RDAs) have direct or indirect role in supporting Indigenous clean energy projects.

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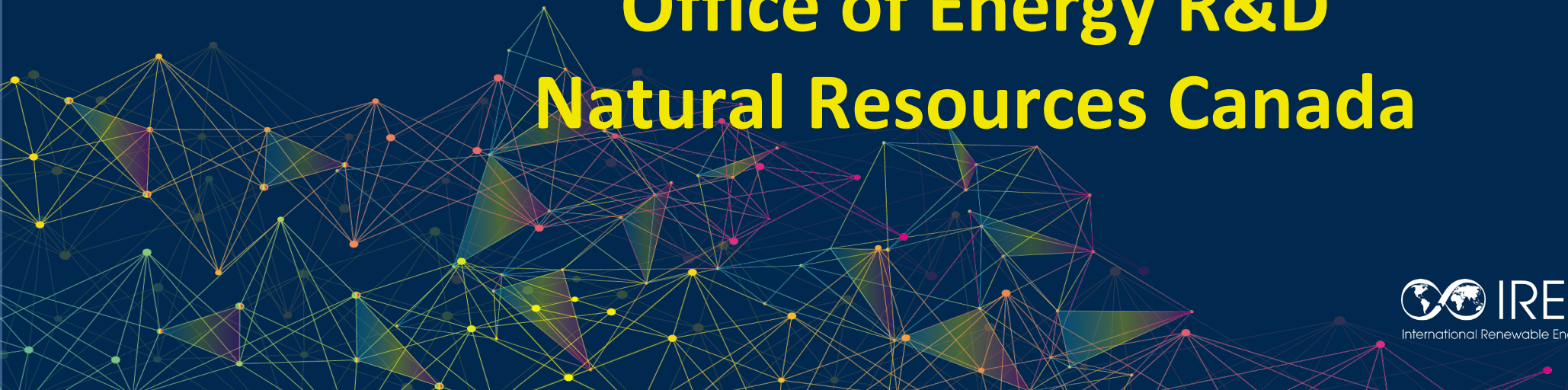
Kathleen Lombardi
Office of Energy R&D
Natural Resources Canada



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Session 1: Mini-grids of the Future - PANEL

Moderator

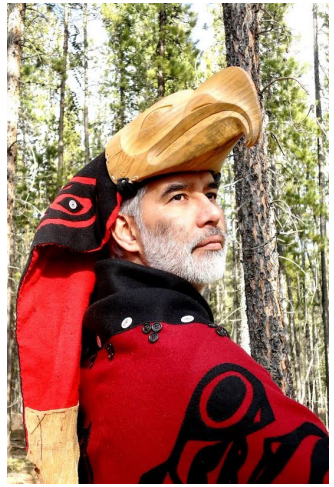
Emanuele Taibi

Analyst, Power Sector Transformation Strategies
IRENA

Panellists

Shane Andre

Director
Energy Branch
Yukon Government



Peter Kirby

President and CEO
Taku River Tlingit Corporations

Tammy Riel

Director
Three Nations Energy

Louise Mathu

Lead Consultant
Gennis Consulting

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Session 1: Mini-grids of the Future

Shane Andre

Director Energy Branch
Yukon Government

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The Yukon and its Electrical System

- Small jurisdiction in the north-west corner of Canada, Population of approximately 40,000 people
- 14 communities, none of which connected to the broader North American electrical grid
- 4 isolated “diesel” communities
- >90% of electricity supply comes from renewable sources

Independent Power Production Policy and Programs

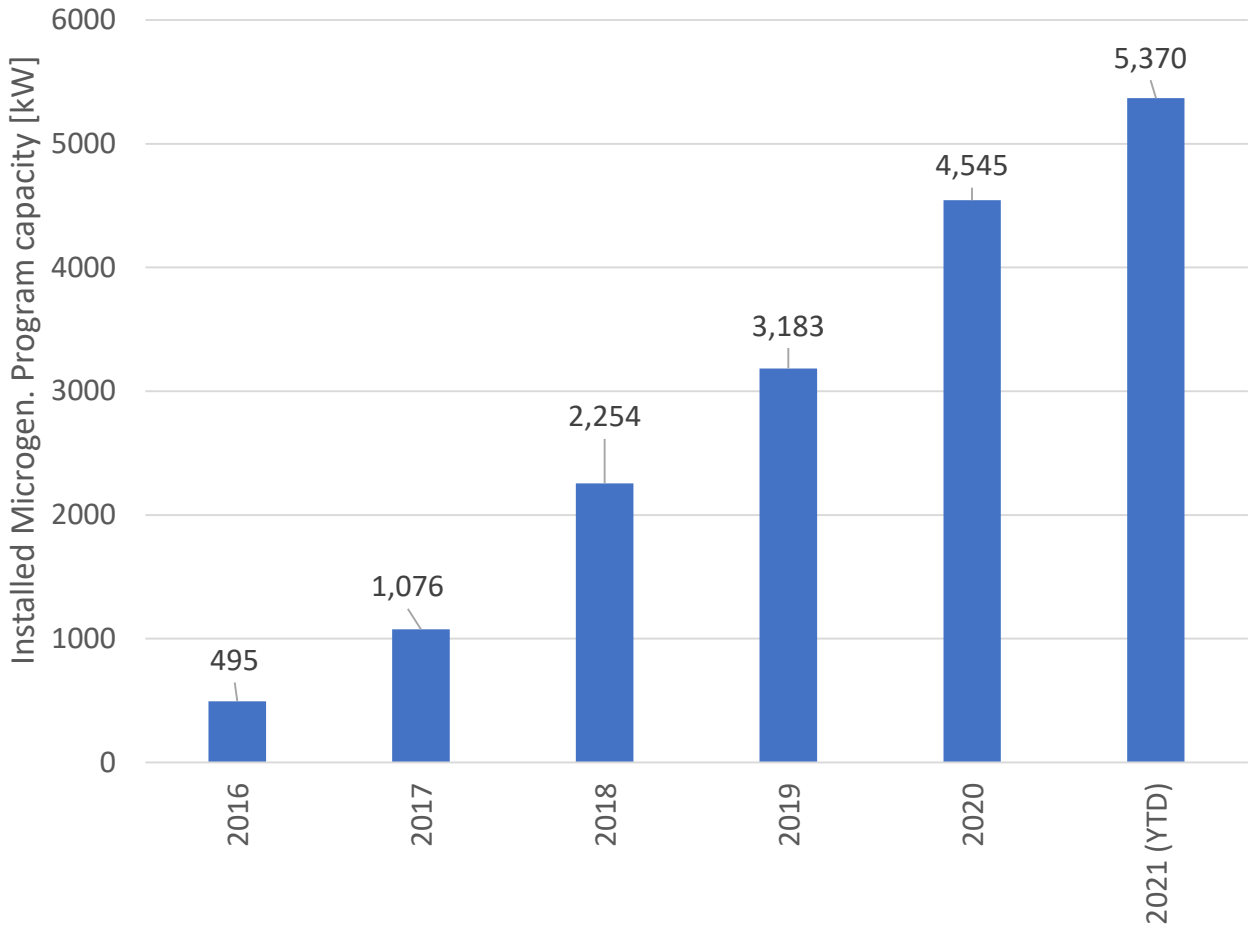
Vuntut Gwitchin Government Solar Project (Old Crow)

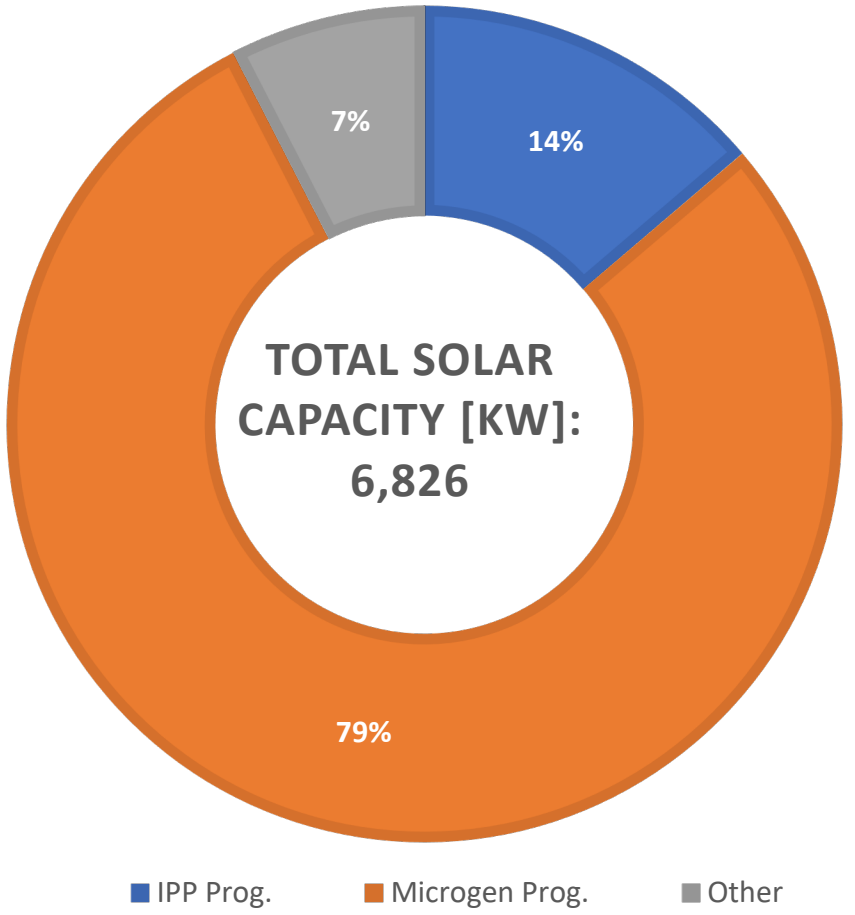
- Policy adopted in 2015
- Five signed Electricity Purchase Agreements
- First Nation government led renewable IPP project planned in every diesel community
- 40,000 MWh of planned IPP's in none diesel communities
- Taku River Tlingit First Nation majority owned, Atlin Hydro project.

N'Tsi Wind Project (Burwash Landing)

Kwanlin Dun First Nation 4 MW Wind Project (Whitehorse)

Micro-generation Program





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Thank you!

Shane Andre
Yukon Government

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Session 1: Mini-grids of the Future

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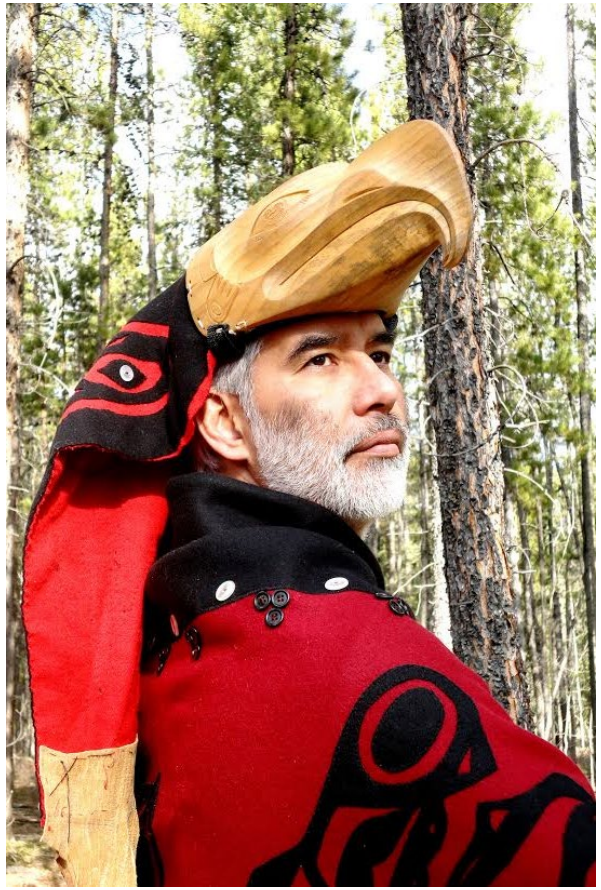
President and CEO
Taku River Tlingit Corporations



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Taku River Tlingit Territory

History of Diesel Consumption in Atlin

From 1978 to 2009 diesel generation powered Atlin.

Burned about 1.2 million litres of diesel per year.

Environmental risks of transporting/storing fuel.

Greenhouse gas emissions of about 4,400 tonnes per year, increasing as energy demand increased.

Over 120,000 tonnes of GHGs in 20-25 years

Generation For Generations

XEITL Limited Partnership

2.1MW hydro renewable energy microgrid project

COD 2009 – 25 EPA with BC Hydro

Unfettered revenue to Taku River Tlingit for 25 years

Freedom to choose how we allocate funds

Tlatsini Fund – LUP implementation G2G with BC

Language, Culture, investing in WHO WE ARE = TLINGITS

STEP – Skills Training Employment Program

Skills Training Employment Program

- Our Skills Training Employment Program
- This program meets people where they are in their personal development and aspirations – The Gift of Self Esteem
- Relationship is vital, trust is vital, WE do this ourselves
- We do this ourselves because we now have money to allow us to reconnect with who we are under our terms

Tlingit Homeland Energy LP Hydro Expansion

- 8.5MW project adjacent our first renewable energy microgrid
- TRTFN will export energy to Yukon and add to our economy
- Local Ownership has resulted in increase self sufficiency
- Improved/reliable long-term programming and economic development initiatives and investment
- Opportunities for skill development
- Pride (self-perception/cultivate personal development and thereby enhance pride and self-esteem)

Tlingit Projects: Renewable Energy Microgrid

Tlingit Projects are a Renewable Energy Microgrid (REM) approach for Off-Grid Diesel Communities & Local Grids

Our projects illustrate how renewable energy, through microgrid approaches that include storage and control systems result in deep diesel reduction penetration. We're connected closely to Indigenous Clean Energy (ICE), the Canadian hub for Indigenous clean energy participation, which is now also beginning to support REMs development for Indigenous communities globally

Taku River Tlingit First Nation Sustainable Development

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Peter Kirby
Taku River Tlingit Corporations

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Session 1: Mini-grids of the Future

Tammy Riel

Director
Three Nations Energy

Fort Chipewyan Solar Farm

March 23, 2022

IRENA Innovation Day
Panel Session

Three Nations ENERGY

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Three Nations Energy

www.3ne.ca

Living and working together in the hamlet of Fort Chipewyan

Fort Chip is
A Northern Remote Community

Fly – In
Limited Expensive River Barge Service in Summer
Limited and Challenging Winter Road Access – Ice Bridges !

2017 – Growing Power Loads

Government of Canada, and Alberta interest in:

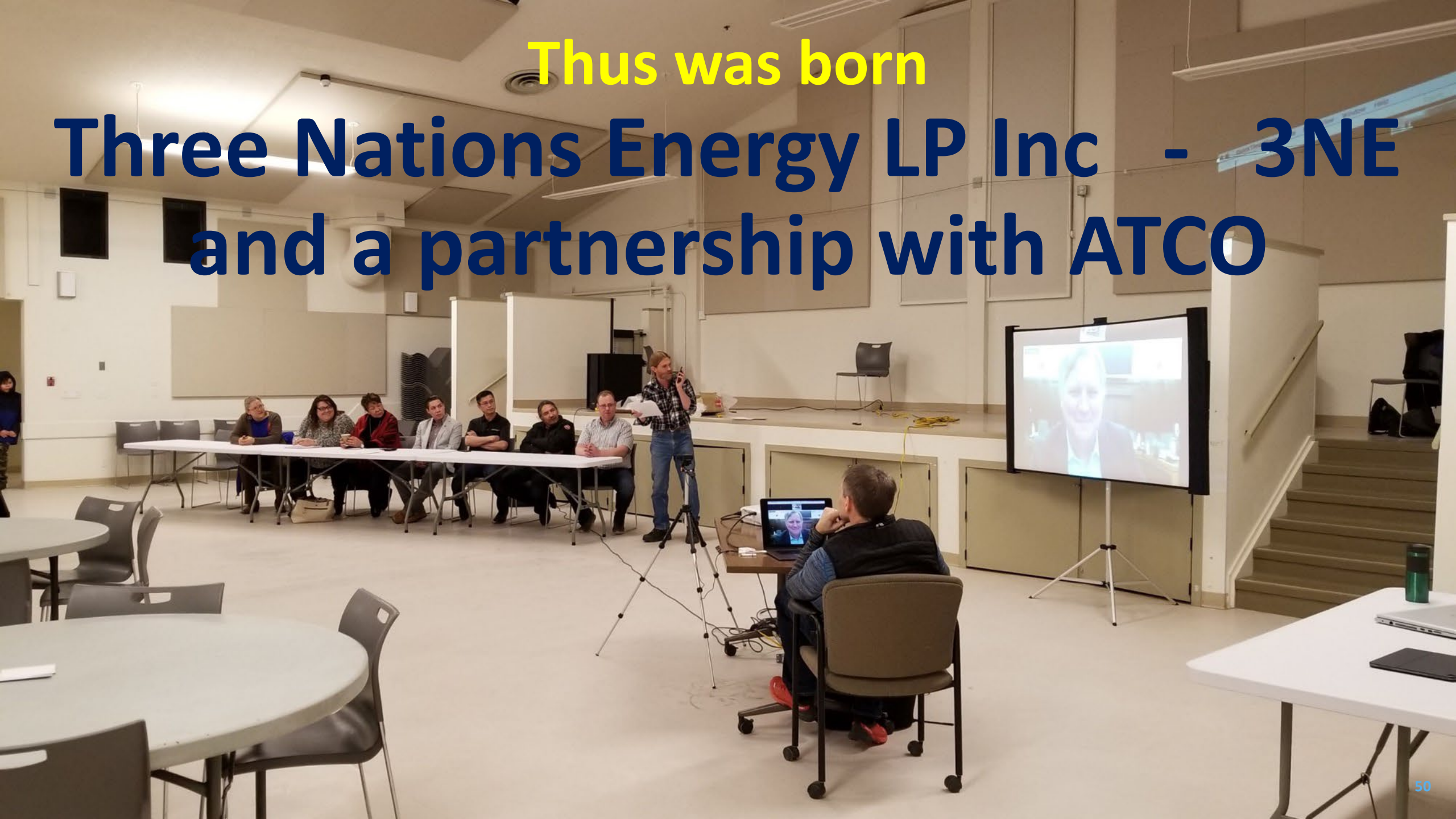
- Off-Diesel for Remote Northern Communities and in
- Indigenous Action on Climate Change

Power Generation – Before 2018

Isolated Grid

ATCO Third Lake Gen Station

- Four 1.4 MW Diesel Engines
- Over 3 million litres per year
- Limited Capacity to Store Fuel, and looking at options for storage or new supply to meet multiple challenges



Thus was born

Three Nations Energy LP Inc - 3NE and a partnership with ATCO

Power Generation: Today

Third Lake Gen Stn (ATCO)

Phase 2 – 2.35MW (3NE)

Phase 1 - 600kW (ATCO)

1.5MWh Battery + Microgrid Controls (ATCO)

- Allows renewable and diesel generation to work together

Immediate Impact

Operational since Jan. ’21

Reduced diesel consumption by more than 800,000 litres each year

GHG emissions reduced by more than 2,376 tCO_{2eq} each year

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Thank you!

Tammy Riel
Three Nations Energy

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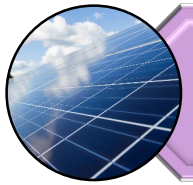
Session 1: Mini-grids of the Future – African Context

Louise Mathu

Lead Consultant
Gennis Consulting

Why Mini-Grids?

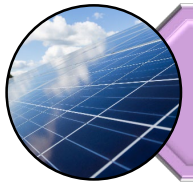
Lack of access to national grids



Remote communities

Displaced communities e.g. refugees

Opportunities to harness Renewable Energy



Productive use of energy

Country Examples

Kenya: 158 minigrids planned under K-OSAP (public sector). By end of 2022, approx. 280 minigrids expected to be completed.

Nigeria: 59 projects – totaling approx. 2.8MW serving rural consumers (as at end 2019)

Ethiopia: The National Eletrification Program (NEP) targets 35% of electrification from off-grid technologies. December 2020 – Minigrid Directive approved by the Ethiopian Energy Authority

Ghana: About 20 operational minigrids – 15 by private developers and 5 by the MoE. Renewable Energy Masterplan – 300 by 2030.

Technology and Innovation

Generation Technologies	Business Models	Smart Technologies	Data/ Digitalization	Productive Use Technologies
• Solar • Wind • Hybrid installations • Battery Storage	• Pay-as-you-go • Energy-as-a-service	• Energy efficiency • Prepayment	• Blockchain • Internet of Things • GIS	• Agricultural • Cooling/Drying • Light industries • Small scale manufacturing • E-mobility

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Thank you!

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Gennis Consulting

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