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Phase-out of diesel-based electricity generation

A CALL DIRECTED AT THE FIRST JUST TRANSITION AWAY FROM FOSSIL FUEL CONFERENCE, ORGANIZED BY COLOMBIA & THE NETHERLANDS.

THIS IS A CALL TO FOCUS ON QUICK AND IMPACTFUL WINS IN THE PHASE OUT OF FOSSIL FUELS.

Submission for the -Just Transition Away from Fossil Fuels- conference

This document is submitted by Charged Islands as input to the 1st -Just Transition Away from Fossil Fuels- conference organized by Colombia and the Netherlands, taking place on April 28th and 29th 2026 in Santa Marta, Colombia.

1st -Just Transition Away from Fossil Fuels- conference objective:
The Conference is designed as a space for countries, subnational governments and other stakeholders that recognize the need to implement a transition away from fossil fuels in a just, orderly and equitable manner, in line with climate goals and the best available science.

Our submission calls for:
We call for stronger facilitation and support of the phase-out of diesel based electricity generation. This measure constitutes a quick win in the energy transition, as well as a just one as it strongly improves the energy cost & supply situation of remote communities (islands and remote inland communities).

Authors:
This document was created by Daniel Avila & Willem de Vries (Charged Islands). The document builds on the findings that Charged Islands published in its white paper in January 2026 (link)

Dated 14-03-2026

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Executive Summary

We call for increased focus on the phase out of diesel as a fuel for grey electricity generation

Diesel based electricity generation: Expensive and detrimental

Diesel is by far the most expensive way to produce electricity and as a consequence, it has a strong detrimental impact on the communities that rely on it, as for example islands. Yet, CO_2 mitigation efforts normally focus on larger generation modalities (as coal and natural gas). Due to recent developments, diesel based electricity generation is the first grey electricity generation modality that can economically be replaced by baseload renewables.

The solution: Baseload Renewable Energy Systems

Baseload Renewable Energy Systems (BRES) stand for electricity supply setups that provide baseload or near baseload power from renewables, combining renewables & storage for 95%+ of the energy demand. Although technically feasible for longer already, Baseload Renewables have reached and passed an inflexion point after which they are economically more attractive than diesel based electricity generation. Baseload Renewables can provide 30-40% cheaper power to affected communities, whilst improving the additional reliability to the local grid and meaningfully reduce CO2 emissions. In the longer run and with proper facilitation, Baseload Renewables will start to replace other grey electricity generation modalities on basis of economic arguments.

Leading by example in the Colombian 'Zonas no Interconectadas'

We want to encourage Colombia and the Netherlands to lead by example and initiate a program that aims to replace the diesel based electricity generation in Colombia's 'Zonas no Interconectadas' (ZNI). Charged Islands has identified a potential for deployment of large scale Baseload Renewables with a total investment value of approximately 1B-USD, directly reducing the cost of electricity in the affected regions and yearly reducing emissions by 750 kiloton of CO_2.

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The negative role of diesel based electricity generation

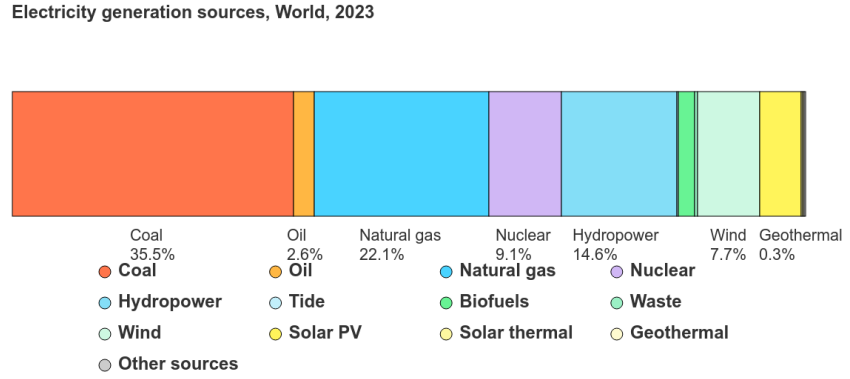
Diesel based electricity generation

- **Small share, large impact:** Diesel based electricity generation is the most expensive method to generate electricity and one of the most polluting methods to do so as well. Although diesel based electricity generation only constitutes 3% of the provided electricity in the world (IEA, 2023), it is responsible for more than 6% of the electricity related CO_2 emissions (approximately 650 million tons of CO_2). Diesel based electricity generation constituted 780 TWh in 2023, or approximately 90GW of continuous load.

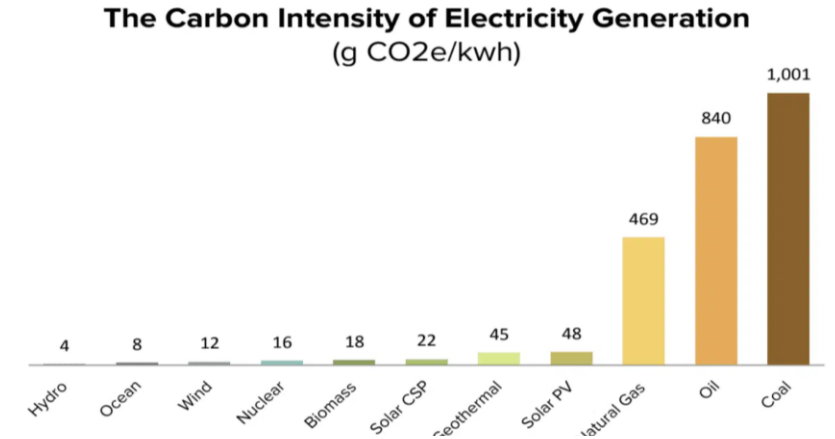
- **Measure of last resort:** Due to its high costs, diesel based electricity generation is a measure of last resort and only used if coal or natural gas based generation is not feasible or available. This misfortune typically befalls remote communities who's electricity grids do not reach a critical mass to allow for electricity generation on basis of coal or natural gas.

- **Islands & remote inland communities:** Islands are the prime example of remote communities that are 'stuck' to diesel-based electricity generation due to their limited grid size. Remote inland communities face the same challenges (and can be considered 'electric' islands of sorts).

Worldwide electricity generation split according to generation modes & carbon intensity of said modes.



Source: International Energy Agency. Licence: CC BY 4.0



Source: Adapted from IPCC special Report on Renewable Energy Sources and Climate Change Mitigation.

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The need for increased focus on diesel based electricity generation

Why more focus on diesel generation?

- **A just transition also requires focus on social impact of grey electricity generation**
  - For communities that rely on diesel based electricity generation, there are significant drawbacks. In the case of islands for example, the share of GDP spent on electricity generation is typically between 10 and 15% (IEA, 2024). Having 100% or 200% higher electricity prices as compared to the mainland seriously hampers economic competitiveness and socio-economic development.
  - Additional detrimental aspects of diesel based electricity generation is the high dependency on imports, exposure to price fluctuations and relative instability of small grids as the diesel generators typically provide very little inertia.

- **A complete shift towards renewable energy supply is now economically feasible for diesel-reliant grids**
  - As of recent, remote communities have a cheaper method at their disposal to generate electricity: Baseload Renewable Energy Systems. Where in the past local solar or wind projects typically would endanger the stability of a small grid and not reduce electricity costs noticeably, intermittent renewables combined with batteries (in the shape of 'Baseload Renewable Energy Systems') can now reliably assume full electricity provision whilst providing significantly cheaper power. **Where there was no real alternative to diesel generation, there is now.**

IEA, 2024: https://www.iea.org/commentaries/islands-need-resilient-power-systems-more-than-ever-clean-energy-can-deliver

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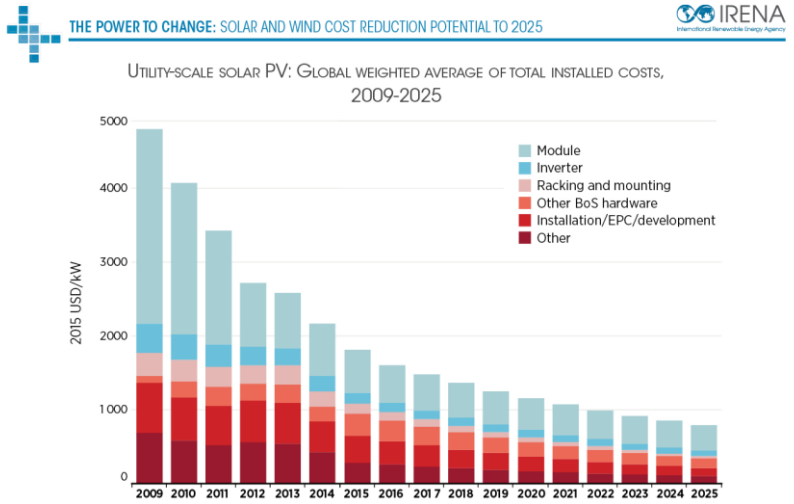
What are baseload renewables

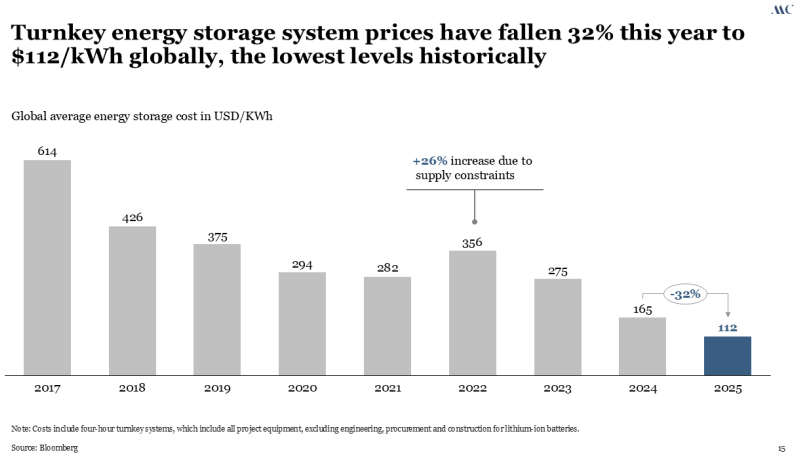
The arrival of Baseload Renewables

- **Moving from intermittent renewable generators to baseload renewables**
  - Renewables have been deployed worldwide in large quantities, but predominantly incorporated in larger grids. For small grids, these renewables posed a problem; the intermittent nature impacted the stability of the microgrid (sometimes leading to black-outs).
  - Colocation of renewables and storage is increasingly popular, also in mature and larger grids. In large grids storage predominantly provides ancillary services. In smaller grids without a fully developed energy market, collocated systems are managed in a more rigorous 'per MWh' manner.

- **A complete shift towards renewable is now economically feasible for diesel-reliant grids**
  - A combined storage & renewable system can be scaled such that it can provide (almost) baseload or dispatchable power.
  - Until recent, the resulting cost of electricity was still higher than that of diesel generators, making them an unfeasible alternative for full replacement.
  - Intermittent renewables combined with batteries can now reliably assume full electricity provision whilst providing significantly cheaper power. **Where there was no real alternative to diesel generation, there is now.**

Enabling Baseload Renewables: Spectacular decline in deployment costs of renewables & storage.





Charged Islands, 2026: White paper on the emergence of baseload renewables https://chargedislands.com/papers

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Finetuning is key to bring prices down with Baseload Renewables

How to keep baseload renewable pricings low

- **Project sizing:** As the solution concerns remote areas, logistics often represents a huge challenge. For smaller projects, the added logistical costs are almost unbearable, increasing deployment costs by several times. It is therefore imperative that projects are larger than 5MW baseload, and preferably around 10MW baseload. Baseload renewables require serious oversizing, having as a consequence that every MW of baseload requires various MW of intermittent renewables and tens of MWh of storage.

- **Pure or Hybrid:** Baseload renewables can be set up in their 'pure' version, or 'hybrid' with a small diesel. Modelling shows that allowing for 1-5% of energy provision by diesels in these grids takes out the requirement of the system having to be scaled to account for the worst weather event of the year. Although pure baseload renewables already outcompetes diesel generation on LCOE, the hybrid baseload renewable system achieves 40% cost reduction (and after the initial 10y of economic lifetime, costs go even further down). **As part of a just transition, hybrid baseload renewable energy systems are the most attractive solution.**

- **Financing conditions**
  - Financing of baseload renewable energy projects is perhaps the most impactful factor for the resulting LCOE, more so even than the absolute quality of the renewables. As these projects are extremely 'CAPEX heavy', the cost of financing has a huge impact on the final LCOE. For example, on a 10y repayment period, decreasing the WACC by 2% can result in 10% lower LCOE.
  - Financing costs are typically defined by country risk and offtaker risk. The first is slow and difficult to change, but can be mitigated by instruments as export credit guarantees of other nations or concessional loans. Offtaker risk needs to be addressed in country and requires an independent and well managed utility company that can act as a long term PPA holder or as a lessee of the installation.

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What can host countries do

How to achieve the lowest price of electricity from baseload renewables

- **Policy measures by host countries**
  - Power supply (IPP) tenders should accommodate for baseload renewables: a power supply tender cannot be designed such that it can fairly let baseload renewables compete with diesel generation. Where the former has a massive advantage in pricing, the latter does not require long development periods. Tenders therefore need to orientate at the renewables.
  - Enable and empower local utilities to close long term energy supply contracts, collect their own revenues and be managed in an apolitical manner. In addition, guarantees for the contracts from a national government can be contemplated to further improve the financing conditions.
  - Noting that most of the renewable deployment will concern solar and that some of the applicable regions might be burdened with high population-, nature- or agricultural land use density, active regulation on the deployment of roof-based solar or other solar deployment methods as AgriPV or floating solar can be contemplated.
  - Private capital needs to be attracted to facilitate large scale deployment of Baseload Renewables, which is maximally facilitated by a stable policy environment.

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What can institutions and international partners do

How to achieve the lowest price of electricity from baseload renewables

- **Measures by international institutions & partner countries**
  - Financing instruments of development finance institutions (DFI) should be tailored to facilitate long tenors for this type of projects and bridge the perceived country risk for specific jurisdictions. These instruments can be both concessional loans as well as tailored guarantees for lenders.
  - Projects can be derisked by upfront execution of the feasibility stage of a baseload renewable energy project. International institutions can provide funds to affected countries (for example SIDS and countries with large remote inland communities). Land allocation, sizing and ensuring permit eligibility for example could be part of such feasibility studies. Further execution & investment can then be tendered or distributed otherwise to private entities.
  - Non-affected countries can incentivize their private sector to become active in the development of baseload renewables in partner countries, providing subsidies, securities and other instruments to remove hurdles.

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Introduction to Colombia's ‘Zonas no Interconectadas’

Colombia & the Netherlands have a unique opportunity to kick-start the baseload renewable energy transition

- **Colombia’s ‘Zonas no Interconectadas’**
  - Colombia counts with vast areas that rely on diesel generation. These non-interconnected areas (Zonas no Interconectadas, ZNI) as they are called, represent approximately 50% of the Colombian territory and house 4% of its population. Some 250MW of accounted for diesel generation capacity provides inhabitants with power, albeit often for only a couple of hours per day. The ZNI constitute of:
    - The island archipelago of San Andres & Providencia
    - Inland areas as the Amazonas & Vaupes.
    - Coastal regions as Choco
  - Power generation is organized in various manners, sometimes by small private initiatives and more often by governmental bodies as municipalities and small utilities.
  - Charged Islands estimates that approximately 50% of the mentioned capacity is concentrated in larger nuclei (>5MW generation centres). The other 50% is dispersed over smaller generation units. Generation centres of 5MW or more can be replaced by non-recourse financed projects, the smaller centres require a more diverse approach.

A map of the Zonas no Interconectadas in Colombia (IPSE)

Please find more information on the Colombian energy system & the ‘Zonas no Interconectadas’ in the Annex

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Replacing the larger generation centres

The larger nuclei can be replaced by non-recourse financed projects

➢ Defining the opportunity

- Charged Islands estimates that the larger generation nuclei (>5MW) can be replaced by non-recourse financed Baseload Renewable Energy projects, if provided with favourable conditions. Replacing these larger diesel generating nuclei with baseload renewables represents a 1 billion USD investment (mostly solar & battery storage).
- Approximately 100.000 inhabitants would benefit from the cleaner and cheaper power supply. Also the Colombian national government could benefit due to reduced subsidy necessity for the provision of energy in these regions.

➢ Building a roadmap for the larger nuclei

- A roadmap for the Zonas no Interconectadas should be devised, taking stock of (amongst other things):
  - The exact demand of each ‘nucleus’, resulting in an approximated size (land-use & investment) of each project
  - Technical hurdles as land availability and logistics
  - Required policy changes to maximally facilitate and encourage the development of Baseload Renewables
- A joint Colombian – the Netherlands taskforce should be set up that is tasked with the creation (and execution) of this roadmap. The Dutch government and Dutch companies can support in both the development of the roadmap as in the execution of resulting projects, providing financing, technology & project development capabilities.

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Replacing the smaller generation centres

The smaller nuclei can be replaced by non-recourse financed projects

- **Defining the opportunity**
  - Charged Islands estimates that the smaller generation nuclei (<5MW, and often in the kW range) will require a larger width of solutions, ranging from state-sponsored small baseload renewable energy projects to standardized battery-solar units.
  - As there will often be no centralized counterparts (aside of some municipalities in some cases), projects will have direct exposure to customers and will have to find innovative methods to streamline payments.
  - Creating portfolios of installations/projects will help reduce the payment risks and cover for the large CAPEX investments.
  - Approximately 100.000 inhabitants would benefit from the cleaner and cheaper power supply, and often from a prolonged power supply period.

- **Building a roadmap for the larger nuclei**
  - A roadmap for the Zonas no Interconectadas should be devised, providing solutions for various generation sizes and financing solutions thereof.
  - Policy changes and possibly the creation of new governmental bodies will have to be investigated to facilitate these projects.
  - A joint Colombian – the Netherlands taskforce should be set up that is tasked with the creation (and execution) of this roadmap. Charged Islands and other Dutch companies can be instrumental in the development and execution of this roadmap, in cooperation with Colombian public and private sector.

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End of Main Document

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Annexes

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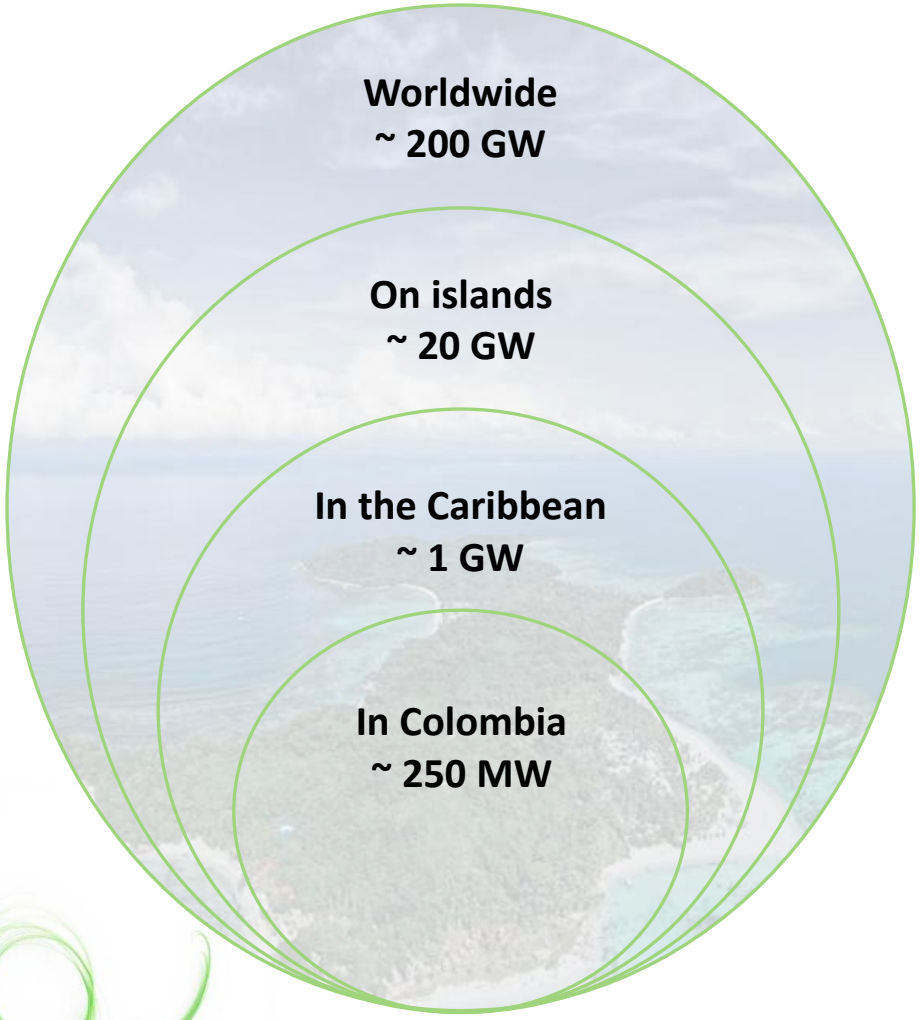
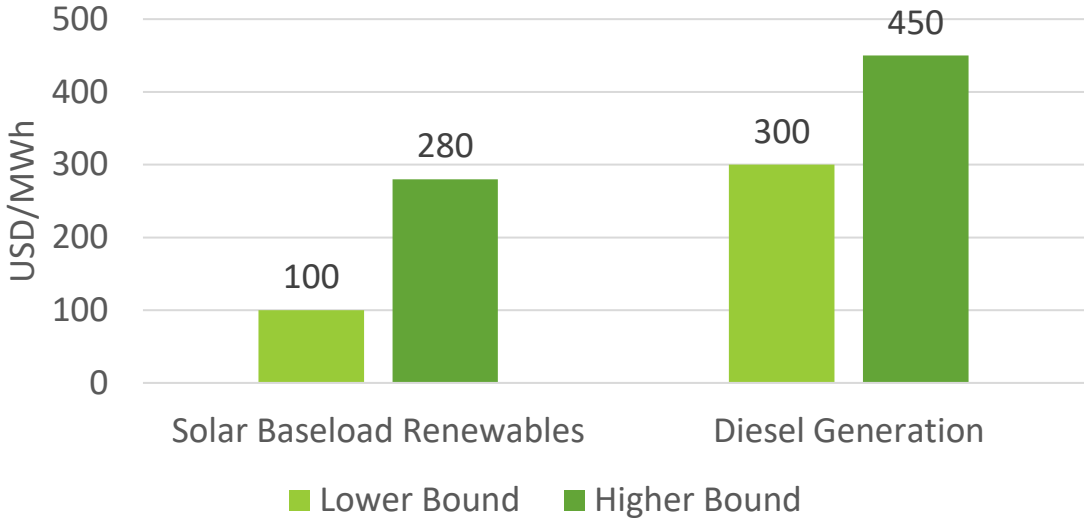
~200 GW of diesel generation capacity operational around the world

Total operational capacity



Baseload Renewables beat diesel generation



Solar BRES ideal region

Macro trends enabling the BRES-replacement of diesel

Baseload Renewable Energy Systems price

- The price of Baseload Renewable Energy depends almost entirely on the CAPEX price of its renewables & BESS.
- Charged Islands takes a view on pure solar & BESS (excluding wind), for the **LCOE, deployment speed & simplicity**.

Price Diesel Generated Power

- Diesel generated power has a marginal (fuel) cost of **>230 USD/MWh**.
- Typical transaction (PPA) price of electricity generated by diesel gensets is **> 300 USD/MWh, rising all the way up to 450 USD/MWh*.**

Baseload Renewables beat Diesel

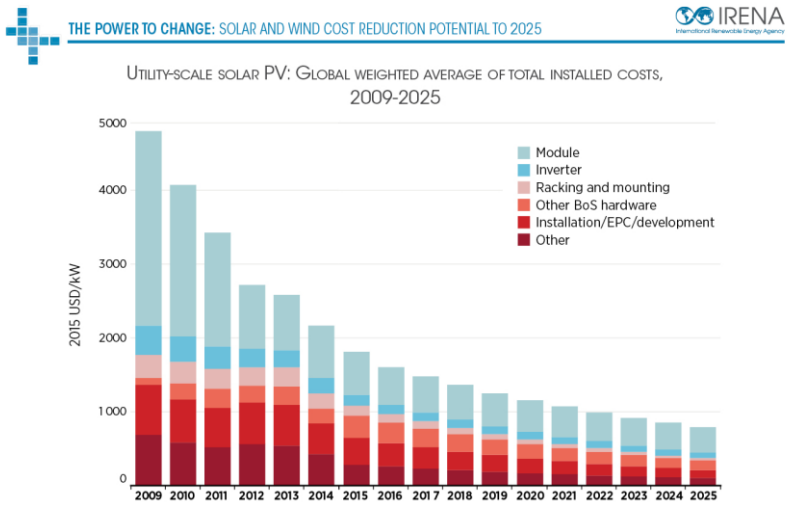
- In optimal conditions, PV & BESS can today generate baseload electricity price as low as **140 USD/MWh**.**.**
- In more realistic conditions, prices between **200 and 250 USD/MWh** can be reached, outcompeting diesel.

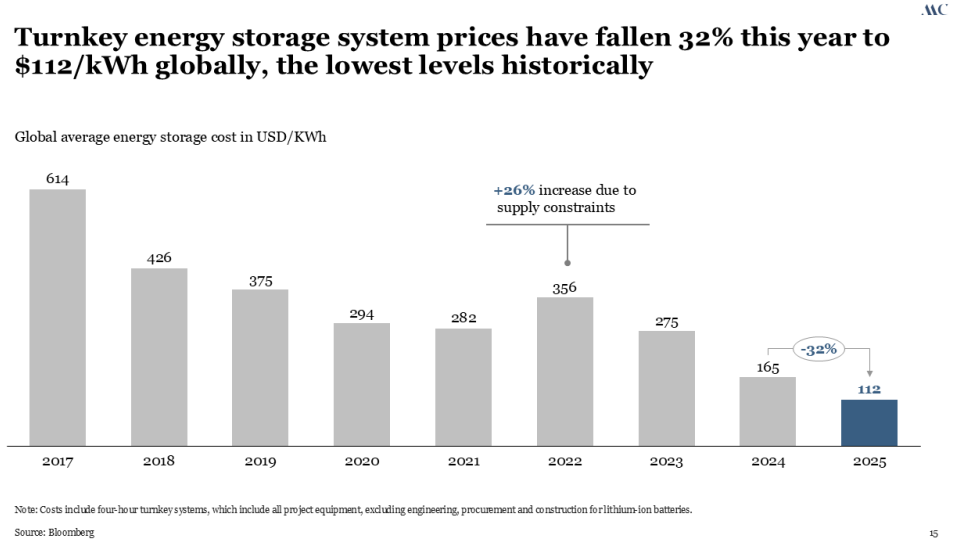
Marcro trend PV & BESS

The cost for utility scale deployment of

- ✓ Solar power generators
- ✓ Battery energy storage systems (BESS)

have plummeted over the course of the last decade.

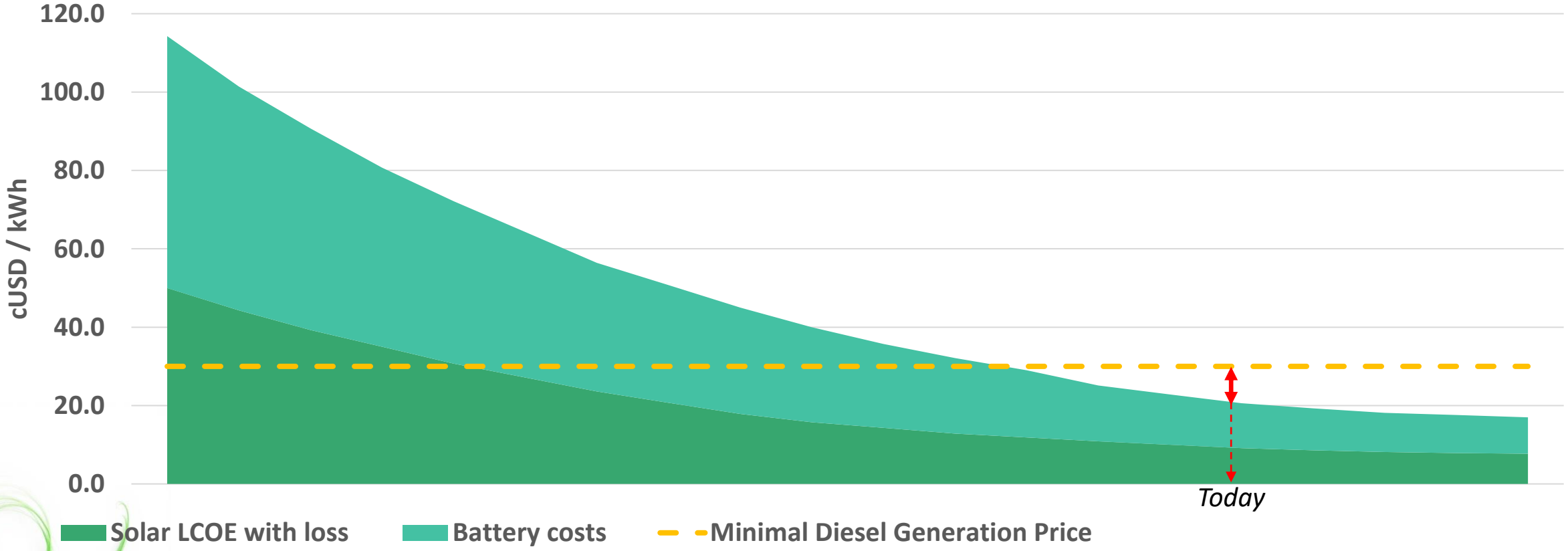




** A recent study used by the IEA shows that some islands spend 13% of their GDP on fuel imports, often resulting in prices up to or even above 450 USD/MWh (link 1, link 2).*
*** A study performed by Ember claims that baseload electricity supply (97%) as low as 100 USD/MWh is possible (link). Charged Islands has found that 140 USD/MWh is possible for 100% time coverage, for example in the Atacama desert & assuming utility rate project finance conditions (20y project lifetime, 7% WACC).*

Baseload Renewables can outcompete diesel as of recent

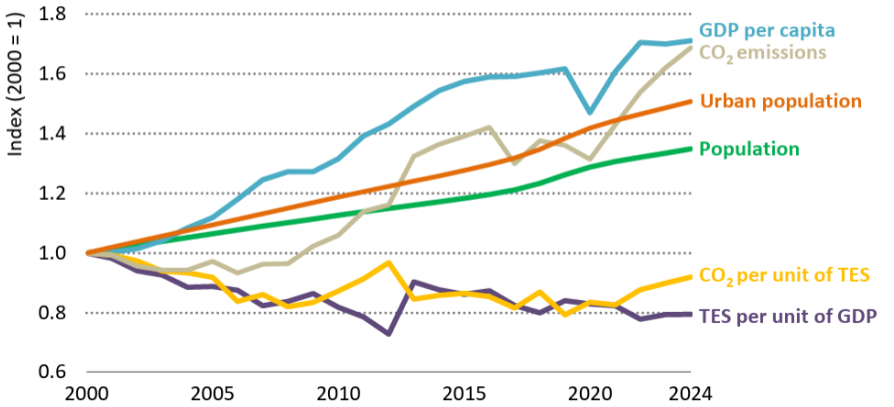
In order for baseload renewables to outcompete diesel generation, the cumulative cost of generating renewable electricity and storing it for a certain period of time needs to be cheaper than diesel generation. For large parts around the world this has become the case today, with the inflexion point being only 12 to 24 months behind us. Please note that this is a simplified explanation, but does capture the essence of the matter. Local demand profile, logistics and financing costs have a strong influence on the LCOE of baseload renewables. Outcomes will therefore be different per region/jurisdiction, either lower or higher than the projected costs hereunder.



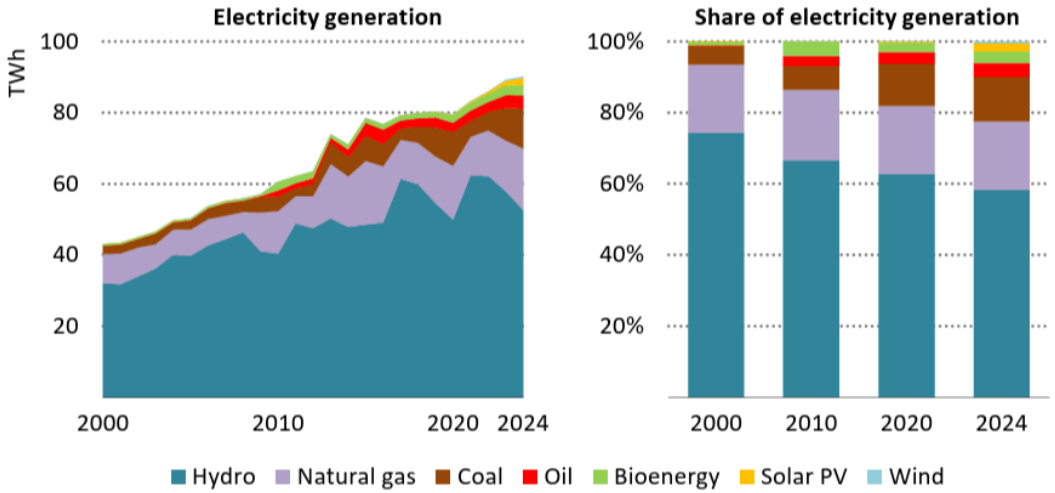
Colombia Energy Consumption – A Snapshot

Decreasing energy usage per unit of GDP, increasing emissions

Colombia has witnessed an almost 40% increase in its population over the course of the last 25 years, whilst undergoing an even stronger push to urbanization. Energy consumption and CO_2 emissions rise accordingly, only slowed down by reduced energy consumption & emissions per unit of GDP. The generation of electricity has witnessed an increase of all modes of electricity generation, although mostly coal, oil and renewables.



IEA. CC BY 4.0.



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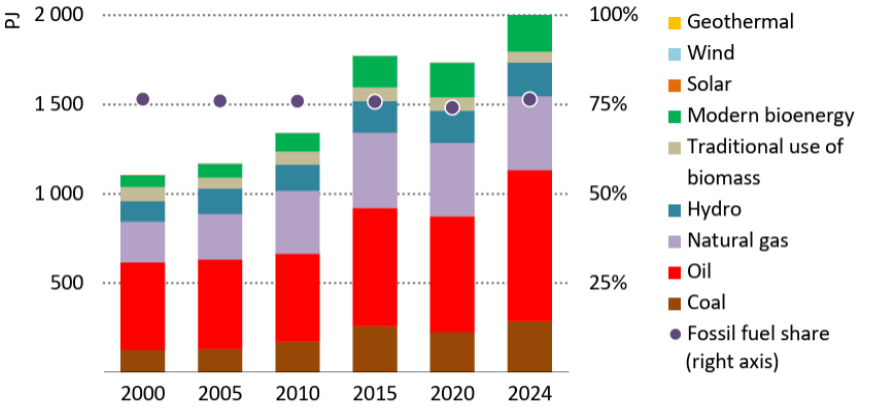
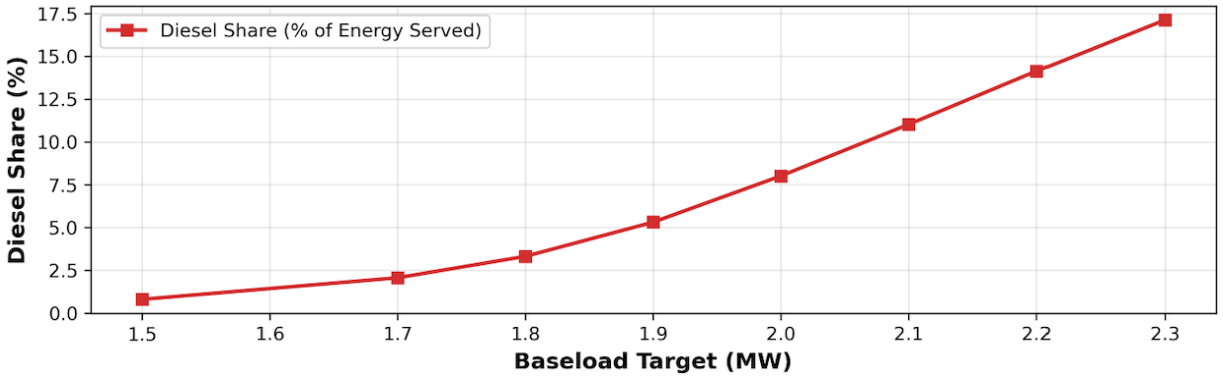


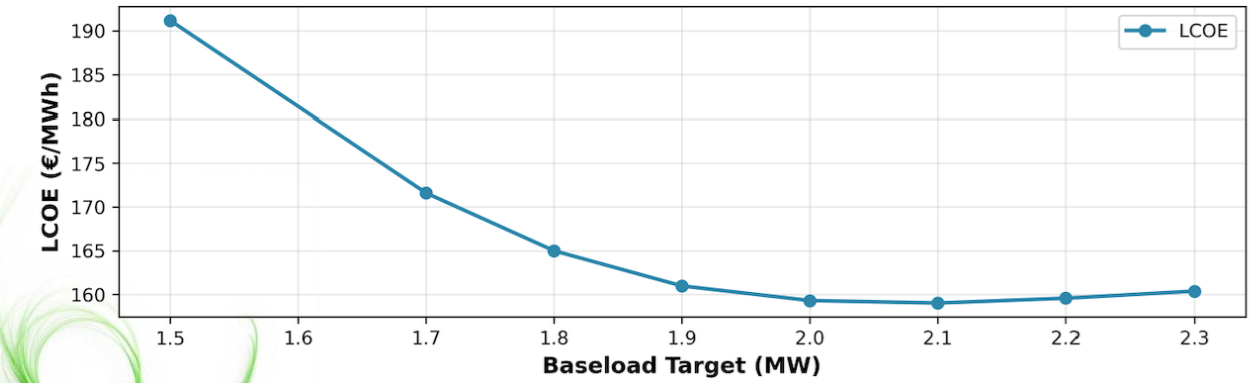
IEA. CC BY 4.0.

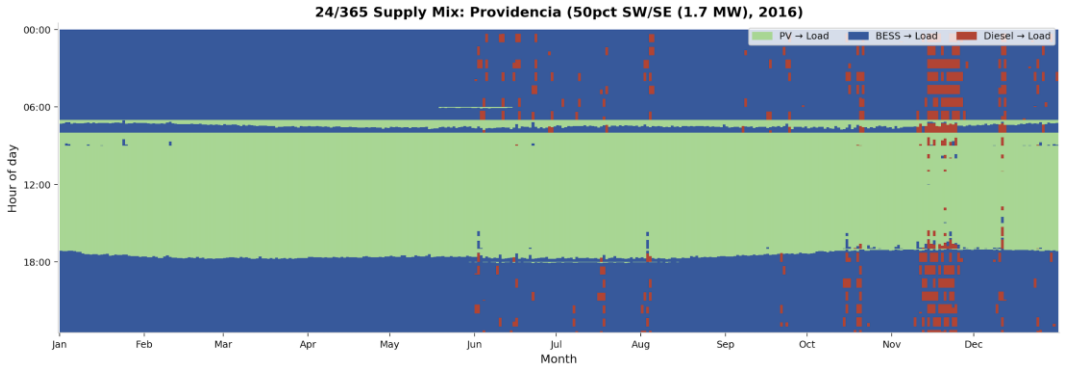
Demonstrating the possibilities: BRES in Providencia

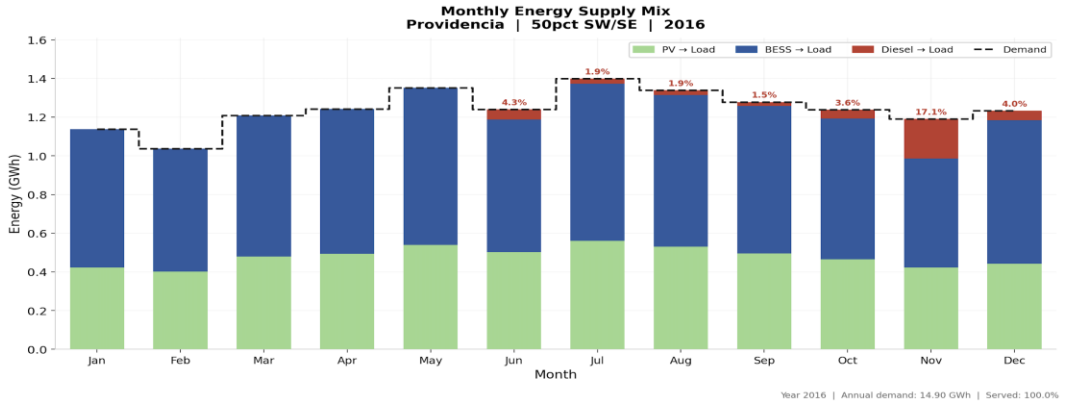
Charged Islands has taken the small island of Providencia as an example case and modelled its energy system as a Baseload Renewable Energy System (BRES).

The small island of Providencia (part of the San Andres-Providencia archipelago) depends on diesel based power generation for its electricity supply. The local cost of electricity generation are close to 36cUSD/kWh or 31cEUR/kWh. Charged Islands demonstrates that with a baseload renewable energy system, prices below 20cUSD/kWh can be achieved if set up properly. Although Providencia counts with very good renewable resources, also compared to other Colombian regions, this outcome can be taken as a vector for other regions.









The numbers shown here are indicative and based on a number of financing & CAPEX assumptions. For example, a 10% WACC has been and a 10y project lifetime have been assumed. The real numbers can result higher.

Introducing the -Zonas no Interconectadas- of Colombia

Massive distances & abundant nature

Colombia is characterized by immense distances and dense natural rainforests. Colombia measures roughly 1800km from north to south, and 1300km from east to west. One consequence of these large distances is that it is not economically feasible to connect remote communities to the countries main infrastructure, be it roads, telecom or electricity. These remote communities are islands in all aspects but being surrounded by forest instead of water. Colombia calls these regions **'Zonas no Interconectadas'** (ZNI, in English: non-connected regions).

Key Facts

- ZNIs cover about **52% of Colombia's territory**.
- They include **27 municipal capitals** and **5 departmental capitals** (IPSE, 2019).
- Around **2 million people** live in ZNIs, representing approximately 4% of Colombia's total population (OECD, 2023).
- More than **half of the registered grid connections** in these ZNI receive power for a part of the day only (some of which even less than 6 hours per day).

A map of the Zonas no Interconectadas in Colombia (IPSE)

The consequences of providing electricity in a ZNI

Electricity supply in Zonas no Interconectadas (ZNI)

Power generation in ZNI relies on local, often isolated, diesel fueled generation systems. These zones are mostly found in the Amazon region, the Orinoco basin, the Pacific coast, and island territories, where extending the national grid is technically difficult and economically unfeasible. Generation of electricity in ZNI typically happens with diesel generators, sometimes organized by the local municipalities, cooperatives, privates or local utility companies. The latter therefore also constitute the largest generation centres.

Generation costs of electricity range from 35 all the way up to 50 cUSD/kWh, significantly higher than the 16 to 20 cUSD/kWh that is common in the connected zones of Colombia. The extreme examples are mostly caused by high logistical costs, as trucks need to drive long distances and through harsh terrain to bring the fuel to the destination.

Financial support of the Colombian government

The Colombian national government subsidizes the generation & distribution of electricity in the ZNI areas, in order to reduce the impact of the high generation costs. In the year 2023, these costs had already risen to 75 M-USD (OECD, 2025), and are expected to rise further as electrification continues and the consumption of electricity rises with increasing economic development. In the long run, this creates a problem for the Colombian government. In addition, the Colombian government actively subsidizes the expansion of the microgrids in the ZNI, to increase coverage.

Various governmental bodies & organizations are involved in the further electrification of ZNI and their switch to renewable energy generation methods, including but not limited to FAZNI & FENOGE.

OECD, 2025: https://www.oecd.org/content/dam/oecd/es/publications/reports/2023/05/distributed-renewable-energy-in-colombia_6bc6efb0/58322dd6-es.pdf

An overview of the electricity generation in the ZNI

Diverse field of players

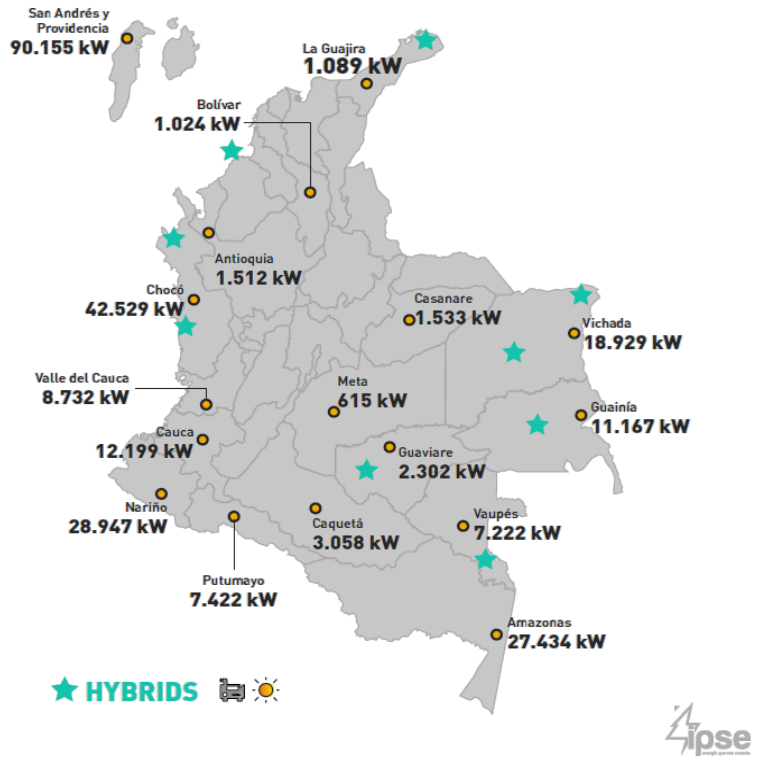
Power generation in the ZNI is organized by a large variety of players, amongst of which municipalities, cooperatives, local utilities and private entities. The largest generation centres are managed by a group of local utilities. The vast majority of the generation capacity is on basis of diesel generators, setting the tone with regards to the pricing.

Distribution of generation centres

Of the ~ 260MW of installed diesel capacity, roughly half of it is dispersed in small units over the country. The other half is concentrated in larger nuclei (San Andres & Providencia, Leticia, Capurganá, Puerto Carreño and Mitú). Half of this concentrated capacity can be found on the island of San Andres, which is a popular touristic destination.

Replacing these larger diesel generation nuclei with Baseload Renewable Energy Systems* would entail an **investment of approximately 1 billion USD**, spread over various separate projects. Although this is a sizeable investment, the simple-pay-back period is short, as the costs of generating electricity with the current diesel generators **are estimated between 250 and 350 million USD on a yearly basis**, for the mentioned ~130MW of larger nuclei.

A map providing the estimated generation capacity (diesel + others) present in each ZNI (IPSE).



Generation Type	Installed Capacity (MW)
Biomass & municipal waste based	5.5
Solar PV	8.4
Small hydropower	4.6
Diesel	262.2

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