

RAISING AMBITION

ZERO CARBON SCENARIOS FROM ACROSS THE GLOBE



Centre for Alternative Technology
Canolfan y Dechnoleg Amgen



INFORSE-EUROPE
International Network for Sustainable Energy

EXECUTIVE SUMMARY

There is no shortage of evidence that humanity is entering a very serious place. Both data and real-life stories from the ever-increasing global catalogue of extreme weather events clearly shows we are heading into a climate emergency. There is growing recognition that we must act on climate.

Raising Ambition: Zero Carbon Scenarios from Across the Globe collects and highlights the work of hundreds of people around the world to develop snapshots and deep visions of possible futures at the global, regional, national and sub-national scales. From Tanzania to Los Angeles, South Asia to the

Baltic, we take an in-depth look at 18 case studies of scenarios. These are drawn from 130 scenarios that model net zero, deep decarbonisation, and using up to 100% renewable energy.

Why zero carbon?

Levels of ambition for action must reflect what climate science is telling us. To stabilise the climate system and stay below the internationally agreed limit of keeping global temperature rise well below 2°C above pre-industrial levels, and to pursue efforts to limit the increase to 1.5°C, humanity must move rapidly beyond fossil-fuel-based

energy systems and sequester any remaining man-made greenhouse gas emissions.

Global society needs to be collectively on a path to achieving net zero greenhouse gas emissions as far in advance of the Paris Agreement's target date of 2050 as possible. The

earlier this is achieved, the greater the chance of limiting global temperature rise to near 1.5°C, minimising the risk of severe runaway climate impacts and protecting the most vulnerable countries. There is, therefore, an urgent need to integrate accelerated short-term action with enhanced ambition in longer-term planning from all nations.

What do we mean by zero?

All emissions that can go to zero must go to zero – as rapidly as possible.

Not just in electricity, but also in heat, transport, industry and land-use.

Whilst researching all potential climate solutions is informative, we must resist the temptation to justify the continued burning of fossil fuels by relying on the promise of future technologies that are not yet proven at scale. These put an

added burden on future generations to recapture the massive amounts of greenhouse gases caused by our lack of ambition today.

We can revitalise natural systems that offer sustainable 'net negative processes', for example by restoring forests, peatlands and soils. These can absorb and sequester the unavoidable

residual greenhouse gases from the atmosphere, to achieve an overall balance, whilst also regenerating and protecting natural systems. Even with a zero emissions end-goal, the science still requires a clearly defined trajectory so that the total cumulative greenhouse gas emissions released over a specific timeframe work within the agreed total carbon budget. Early action is vital.

| WHERE | WHAT | WHO | WHEN | SCENARIO SUMMARY |
|---|--|--|------|---|
|  | Global Energy System Based on 100% Renewable Energy – Power Sector | Lappeenranta University of Technology and Energy watchgroup | 2017 |    |
| | Energy transition within 1.5°C – A disruptive approach to 100% decarbonisation of the global energy system by 2050 | ECOFYS | 2018 |    |
| | 10 Steps: The Ten Most Important Short-term Steps to Limit Warming To 1.5°C | Climate Action Tracker: Climate Analytics, Ecofys, New Economy Institute | 2016 |    |

REGIONAL CASE STUDIES

| | | | | |
|---|--|--|----------------------|---|
|  | Power Sector Vision: Towards 100% Renewable Electricity by 2050 Greater Mekong Area: Cambodia, Laos, Myanmar, Thailand, Vietnam | WWF, Intelligent Energy Systems and Mekong Economics Ltd | 2016 |    |
|  | 100% renewable energy based electricity systems by 2030 and 2050 The Baltic Sea Region North-East Asia Southeast Asia and the Pacific Rim region South and Central America | Lappeenranta University of Technology | 2016 2017 2018 |    |
|  | Nordic Energy Technology Perspectives 2016 – Cities, flexibility and pathways to carbon-neutrality Denmark, Finland, Iceland, Norway and Sweden | Nordic Energy Research & International Energy Agency | 2016 |    |

NATIONAL CASE STUDIES

| | | | | |
|---|--|--|------|---|
|  | Energy Report for Uganda: A 100% Renewable Energy Future by 2050 | WWF Uganda, IVL Swedish Environmental Research Institute, African Solar Design and KTH Royal Institute of Technology | 2015 |    |
|  | Net-Zero in New Zealand – Scenarios to achieve domestic emissions neutrality in the second half of the century | Vivid Economics for GLOBE-NZ: a cross-party group of 35 members of the New Zealand Parliament | 2017 |    |
|  | 100% Renewable Energy for Tanzania: Access to renewable energy for all within one generation | Institute for Sustainable Futures - University of Technology Sydney, Bread for the World, Climate Action Network Tanzania and World Future Council | 2017 |    |
|  | France can reach 100% renewable energy by 2050 while phasing-out nuclear | négaWatt | 2017 |    |
|  | Zero Carbon Britain: Rethinking the Future | Centre for Alternative Technology | 2013 |    |

SUB-NATIONAL CASE STUDIES

| | | | | |
|---|---|--|------|---|
|  | Carbon neutral archipelago – 100% renewable energy supply for the Canary Islands | DLR - German Aerospace Center | 2017 |    |
|  | Swansea Bay City Region: A Renewable Energy Future – Energy system vision for 2035 | IWA - Institute for Welsh Affairs | 2018 |    |
|  | Clean Energy for Los Angeles – An analysis of a pathway for 100 percent renewable energy in Los Angeles by 2030 | Prepared for Food & Water Watch by Synapse Energy Economics | 2018 |    |
|  | Climate Change Strategy of the Basque Country to 2050 | Administration of the Basque Country Autonomous Community and the Department of Environment and Territorial Policy | 2015 |   |

KEY GUIDE



Net-zero emissions scenario for at least one sector



Deep decarbonisation scenario for at least one sector



Scenario uses 100% renewable energy



Scenario uses 50% renewable energy or more



Governmental author



Non-governmental author

Key findings

Net zero is achievable

This report outlines scenarios at global, regional, national and sub-national scales that illustrate how the Paris Agreement targets could be met. Our conclusions are drawn from analysis of over 130 scenarios that demonstrate how deep decarbonisation or net-zero greenhouse gas emissions can be

achieved before the second half of the century using existing technology, whilst also supporting social or economic development.

Changing how billions of people live on Planet Earth is a very special kind of problem because the forces that shape our lives exist on many different

levels. However, the depth and detail of these scenarios clearly demonstrate that we already have all the tools and technologies we need to achieve the Paris targets. Rather than an unresolved technical challenge, what is actually holding us back is a mix of economic, cultural and psychological barriers.

Scenarios can help overcome carbon lock-in

The historical technical, cultural and institutional co-evolution of the relationship between fossil fuels and the ways we deliver energy, housing, transport, food and agriculture has created persistent forces that are hugely resistant to change.

This 'carbon lock-in' exerts a powerful influence, shaping the choices that define our lives. Changing institutional culture isn't easy, but lessons from across the globe show that it can be done. By developing evidence-based scenarios and unleashing practical

projects, particularly at a local scale where there is flexibility to experiment and innovate, we can begin to normalise new and better relationships with transport, buildings, food and energy.

Every country should have a zero carbon scenario

There are still too many countries that have not yet prepared scenarios that align their short-term actions and long-term plans with the levels of ambition required by the Paris Agreement. Focusing on individual countries*, we found that only 32 out of 199 have deep decarbonisation, 100% renewable energy or net zero scenarios. That's a mere 16%.

All countries – developed and developing, large and small – must be supported to prepare full net-zero greenhouse gas scenarios for 2050 to inform their policy and industrial strategies. This will ensure that each country's development pathway aligns with the climate actions required, and creates trusted investment frameworks whilst helping develop social licence.

There is also a need for a common language, framework and shared assumptions, to make the comparisons and integration of modelling work easier across international borders.

* Including Taiwan, Wales, Northern Ireland, Scotland and England as individual countries

Game over for wasteful energy use

Current high-energy consumer lifestyles were designed before we understood the very serious nature of the climate challenge, and so compel us to use far more energy than we actually require to meet our needs.

This report offers many scenarios demonstrating how we can drastically reduce demand through the smart, efficient use of energy.

"As a result of strong energy efficiency improvements, it is possible to bring global energy use below current levels to 435 exajoules (EJ), a large contrast to business as usual growth to over 800 EJ."

Ecofys, global scenario

We have the tools to move beyond fossil fuels

Our mapping has revealed 100% renewable scenarios for a wide range of locations, including many of the world's largest emitters. It is exciting to see the diverse range of new scenarios that are now emerging. Hourly modelling from an increasing range of countries demonstrates that we can ensure that supply meets demand 24-hours a day, across all seasons.

There are experts working on scenarios for a diverse range of locations, with developing country experts coming through in greater numbers. The diversity of detailed, well-researched scenarios from around the world shows that we have all the tools and technologies we need to move beyond fossil fuels.

"Australia's solar resource is 10,000 times Australia's annual energy consumption. Australia also has the second largest offshore wind energy resource in the world after the Russian Federation and the wave energy resource from Geraldton to Tasmania alone would supply five times Australia's total energy requirements."

City of Sydney, city-level scenario

Land use is a key missing piece

Land use – whether in energy system modelling, government goal-setting or financial investment – is consistently underestimated or even ignored. We can become stewards of land not only for sustainable agriculture, healthy

diets and recreational uses, but also for carbon management. The scenarios that included land use demonstrated that it's a key part of how they will reach net zero; without it, they can reduce demand and decarbonise

up to a point, but without the sinks provided by natural climate solutions, such as forests and peatlands, net zero eludes them.

Thinking ahead pays off

As the cost of responding to climate impacts goes up each year, the price of inaction increases. Many of the 130 scenarios compared the costs of a 'business as usual' (BAU) trajectory for the energy system with a decarbonised or 100% renewables trajectory.

Most found a decarbonised energy system paid off in the long term compared to BAU. A major contributing factor was the falling price of electricity as renewables with low to zero fuel costs pay off their capital costs and take up more of the energy generation.

"Total levelised cost of electricity (LCOE) on a global average for 100% renewable electricity in 2050 is 52 €/MWh (including curtailment, storage and some grid costs), compared to 70 €/MWh in 2015."

Lappeenranta University of Technology, global scenario

Scenario building processes must reflect a fair and inclusive future

Fewer than five of the 130 scenarios assessed in this report were developed using a participatory, multi-stakeholder process. Although any finished report can be made available publicly, or sent out for consultation, this is not as powerful as creating it using a participatory process. Our collective capacity to multi-solve, break down silos, and integrate the findings into

our places of work and ways of life is increased by processes that create space for participation and reflection around scenarios from the outset.

It is an ethical imperative that all scenarios also embrace climate equity. How the remaining global carbon budget is distributed between nations is a complex and contested issue. The way we share this out must

embrace developing country needs to lift citizens out of poverty and to increase quality of life. This requires 'climate equity', or a 'fair contribution' by developed countries, which takes some account of the role of their historic emissions in causing climate change and allocates an adequate emissions budget to allow emerging and Global South countries to develop.

The benefits beyond emissions - multi-solving

We recommend that multi-solving should become a vital part of all zero carbon scenario development, acting as a tool to identify and optimise co-benefits, and helping build coalition across a range of sectors. The shift to

zero carbon holds the potential to be one of the most exciting opportunities in human history, offering potential to fundamentally transform current systems. Whilst there are clear challenges, there are also huge

opportunities to find models that offer solutions for adaptation, resilience, employment, health, wellbeing, economics and natural systems, as well as for achieving our agreed Sustainable Development Goals.

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