Solar farms and Biodiversity: from country-level smart sitting areas to local scale effects

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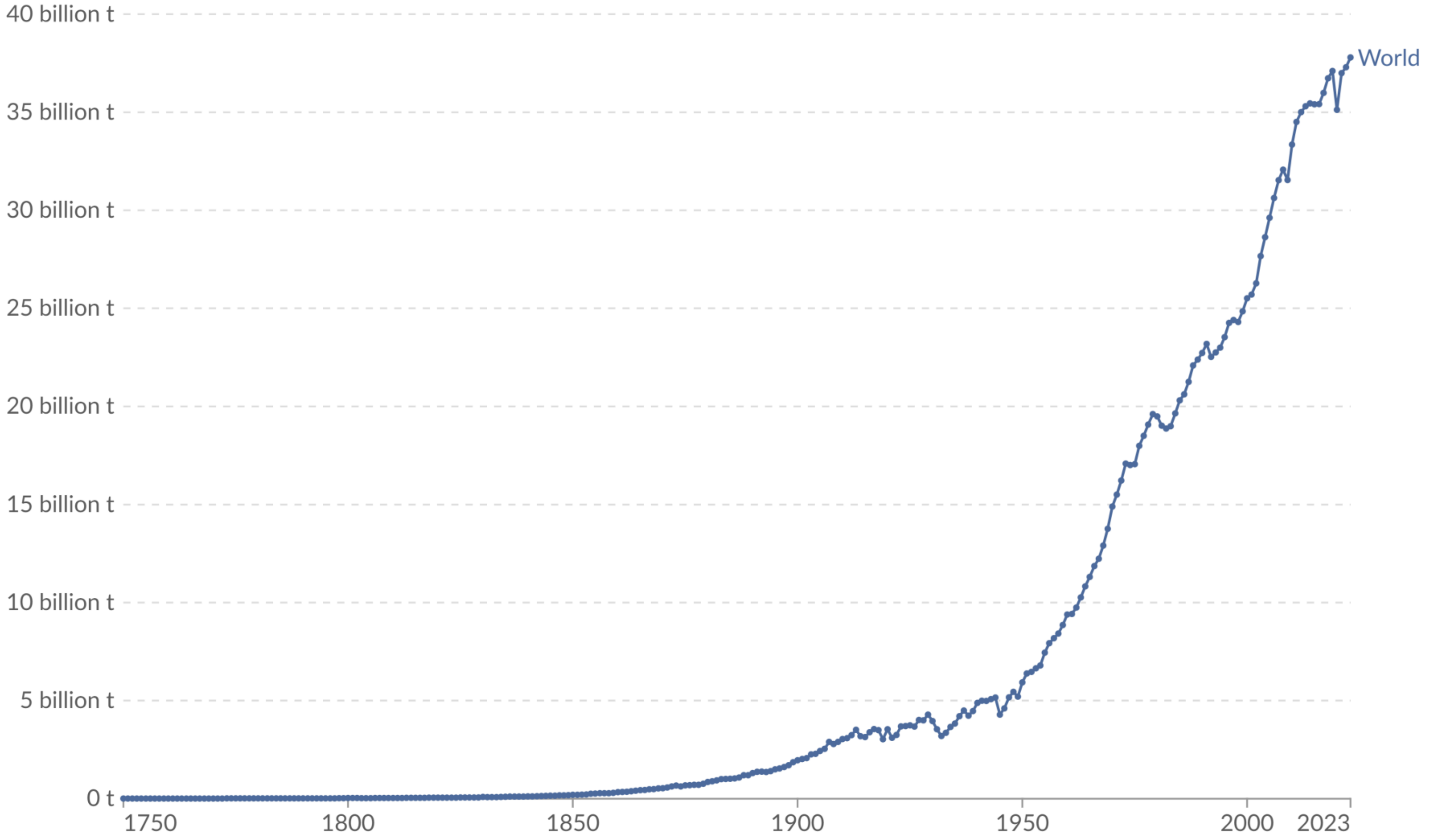
CHANGE Global Change and Sustainability Institute


Phasing down or phasing up?
Top fossil fuel producers plan even more extraction despite climate promises
SEI Stockholm Environment Institute
IISD
ODI
E3G
UN environment programme
Production Gap Report 2023

Annual CO_2 emissions

Carbon dioxide (CO_2) emissions from fossil fuels and industry[1]. Land-use change is not included.

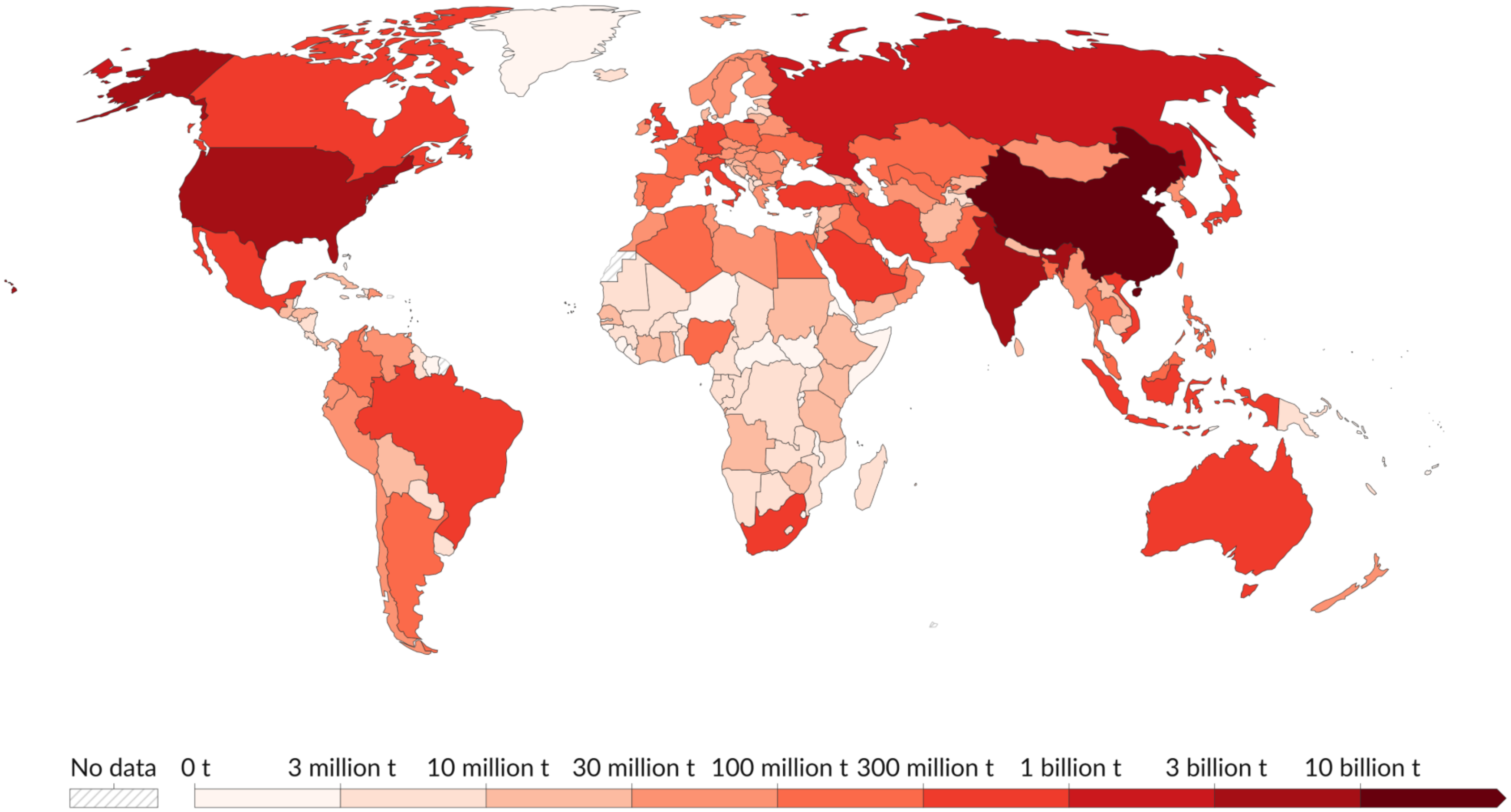


Data source: Global Carbon Budget (2024)

1. **Fossil emissions**: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Annual CO_2 emissions, 2023

Carbon dioxide (CO_2) emissions from fossil fuels and industry[1]. Land-use change is not included.



Data source: Global Carbon Budget (2024)

OurWorldinData.org/co2-and-greenhouse-gas-emissions | CC BY

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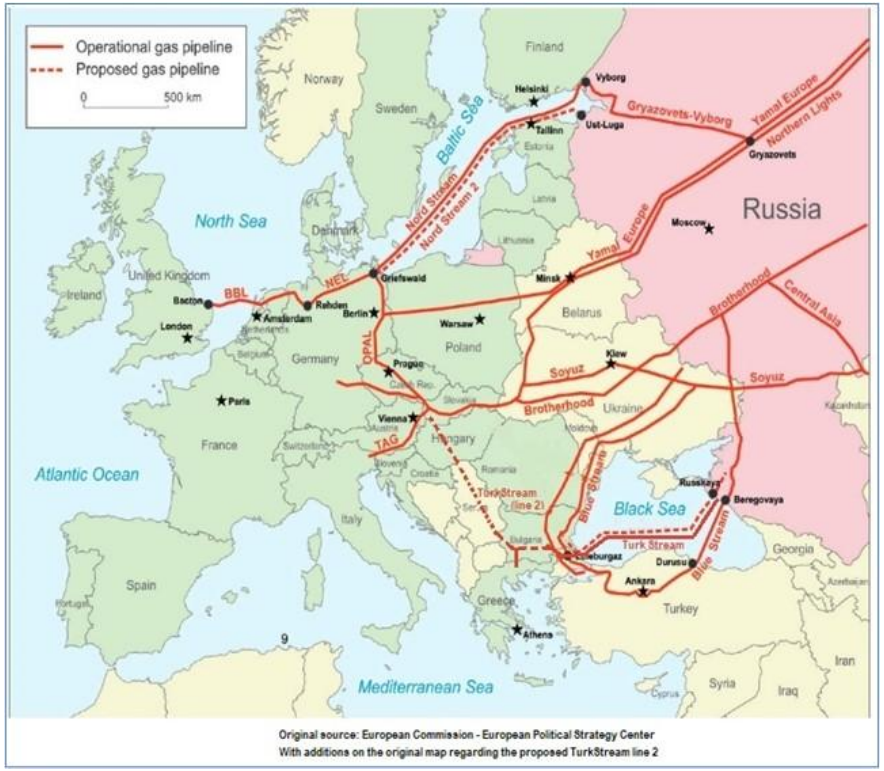
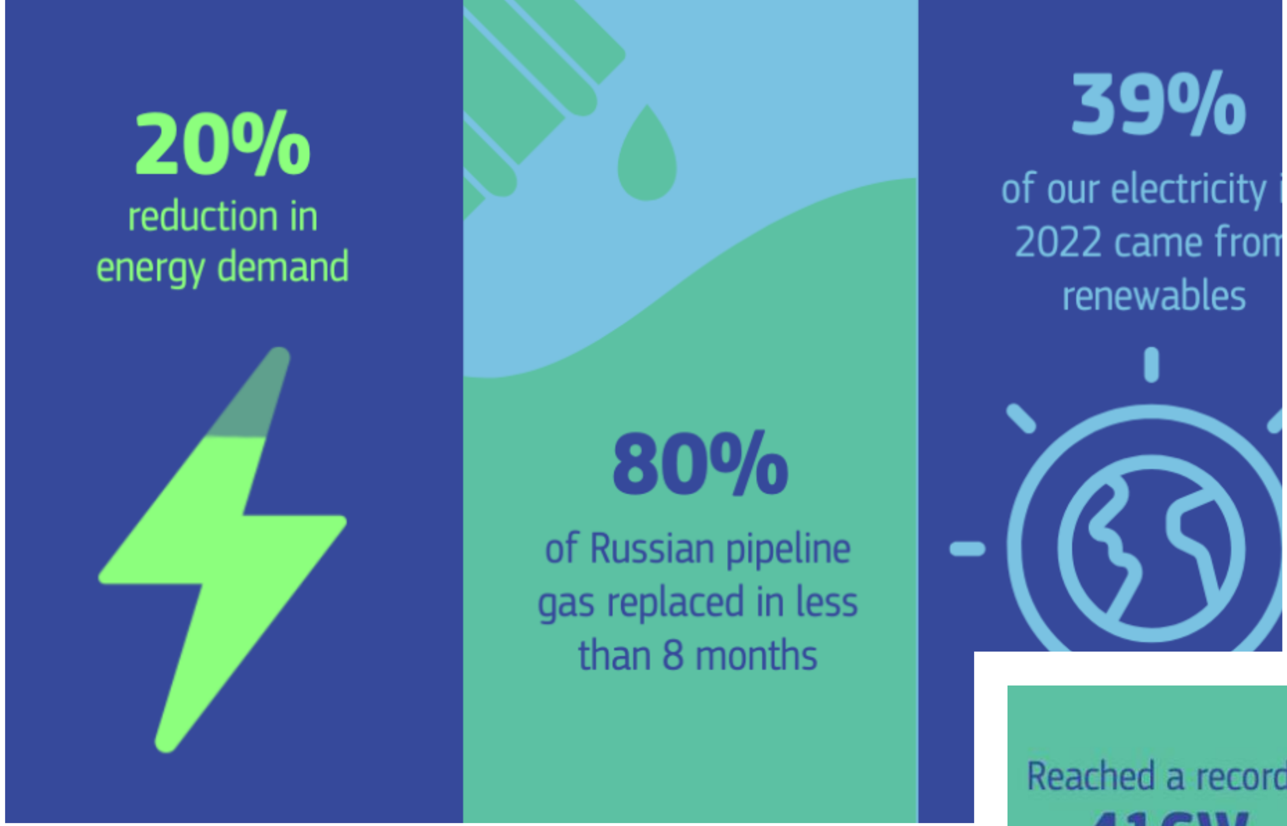
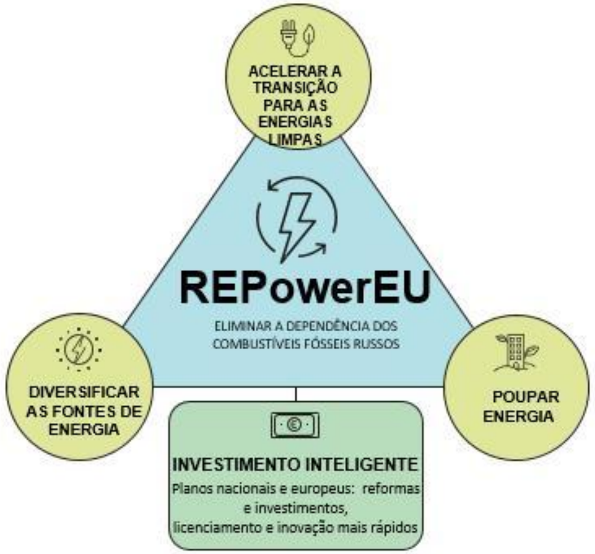
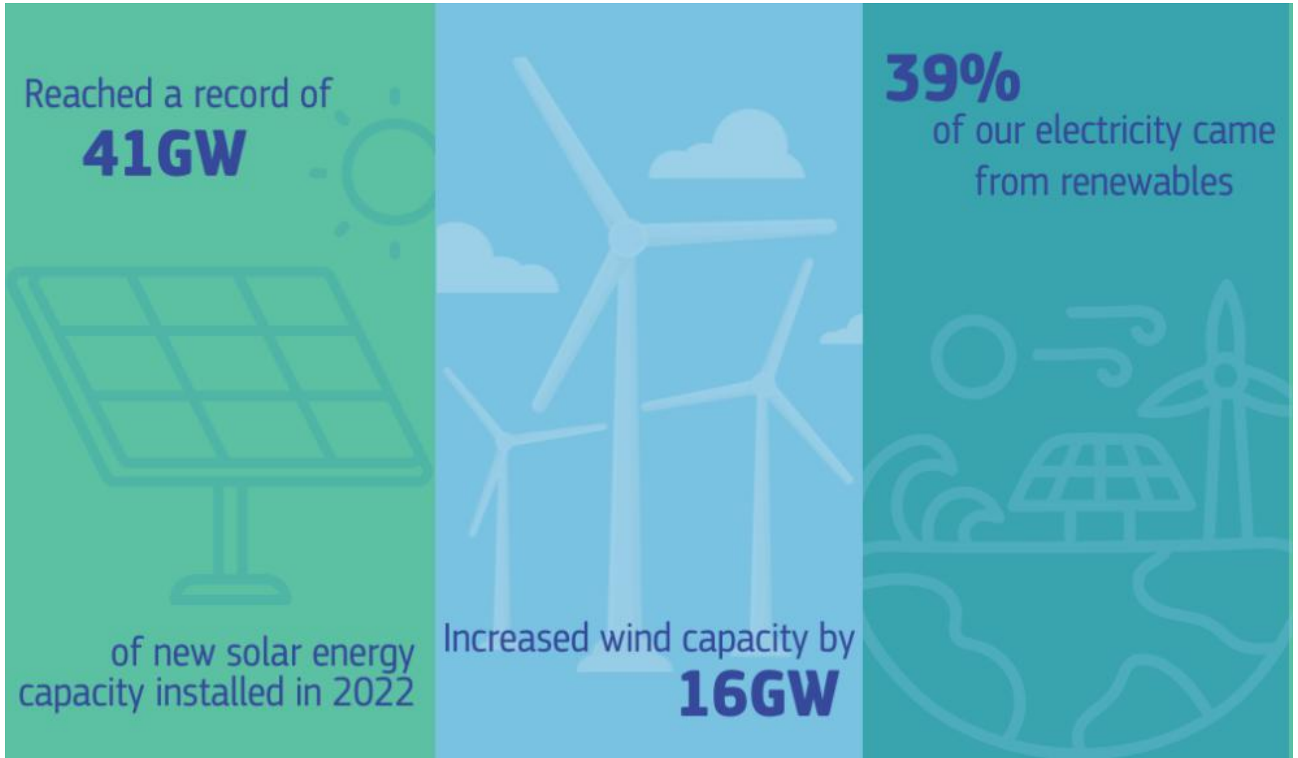

Operational gas pipeline
Proposed gas pipeline
0
500 km
Finland
Norway
Sweden
Baltic Sea
Helsinki
Vyborg
Tallinn
Ust-Luga
Gryazovets-Vyborg
Yamal Europe
Northern Lights
Gryazovets
Nord Stream
Nord Stream 2
Russia
Moscow
North Sea
United Kingdom
Ireland
Bacton
BBL
NEL
Griefswald
Rehden
Amsterdam
Berlin
London
Minsk
Yamal Europe
Warsaw
Poland
Belarus
Germany
OPAL
Prague
Kiew
Soyuz
Brotherhood
Central Asia
Paris
France
Vienna
TAG
Hungary
Ukraine
Atlantic Ocean
TurkStream (line 2)
Blue Stream
Black Sea
Russkaya
Beregovaya
Italy
Spain
Turk Stream
Luleburgaz
Durusu
Ankara
Georgia
Greece
Turkey
Athens
Iran
Mediterranean Sea
Syria
Iraq
Original source: European Commission - European Political Strategy Center
With additions on the original map regarding the proposed TurkStream line 2



20%
reduction in energy demand
80%
of Russian pipeline gas replaced in less than 8 months
39%
of our electricity
2022 came
renewables

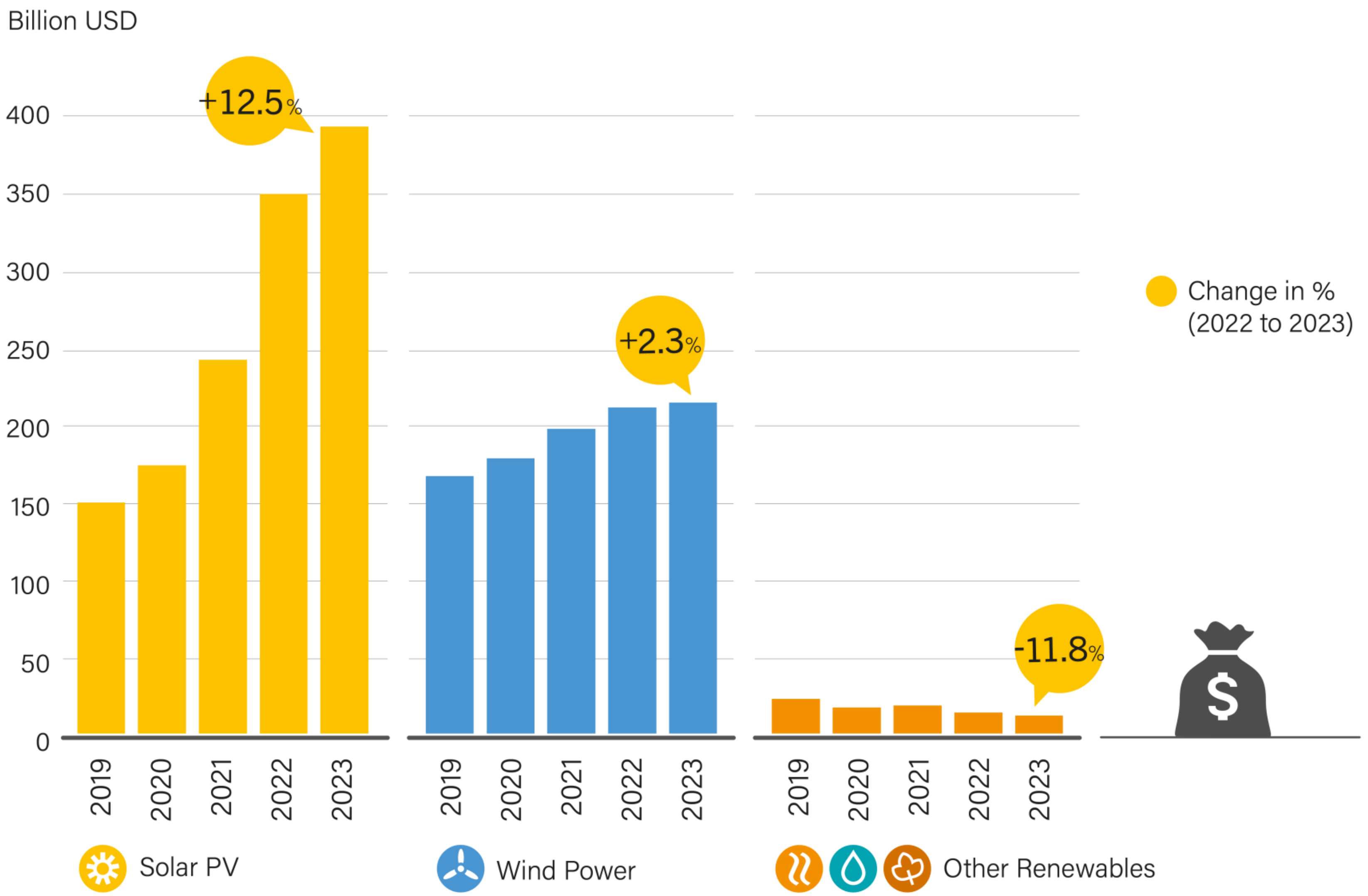


ACELERAR A TRANSIÇÃO PARA AS ENERGIAS LIMPAS
REPowerEU
ELIMINAR A DEPENDÊNCIA DOS COMBUSTÍVEIS FÓSSEIS RUSSOS
DIVERSIFICAR AS FONTES DE ENERGIA
POUPAR ENERGIA
INVESTIMENTO INTELIGENTE
Planos nacionais e europeus: reformas e investimentos, licenciamento e inovação mais rápidos

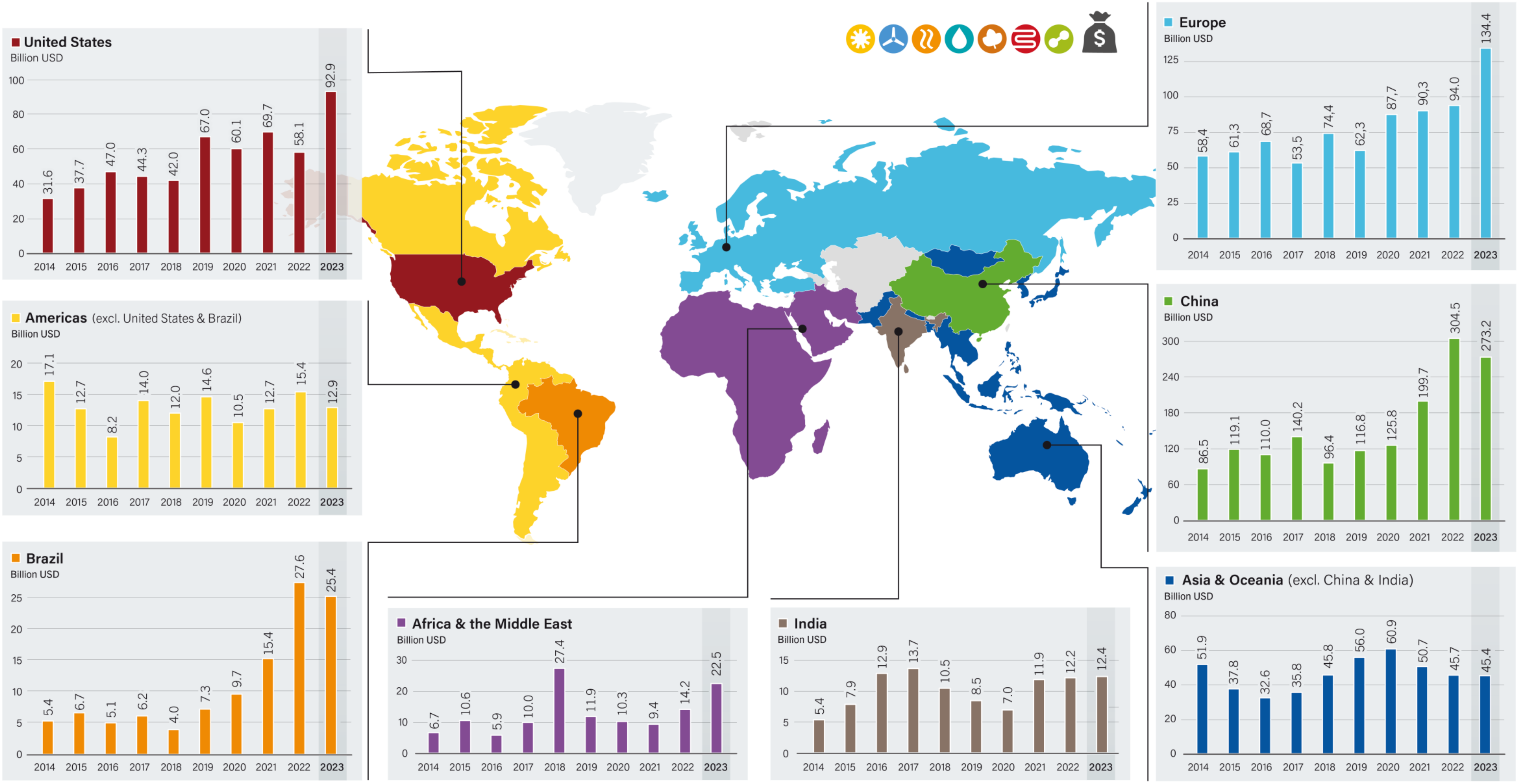


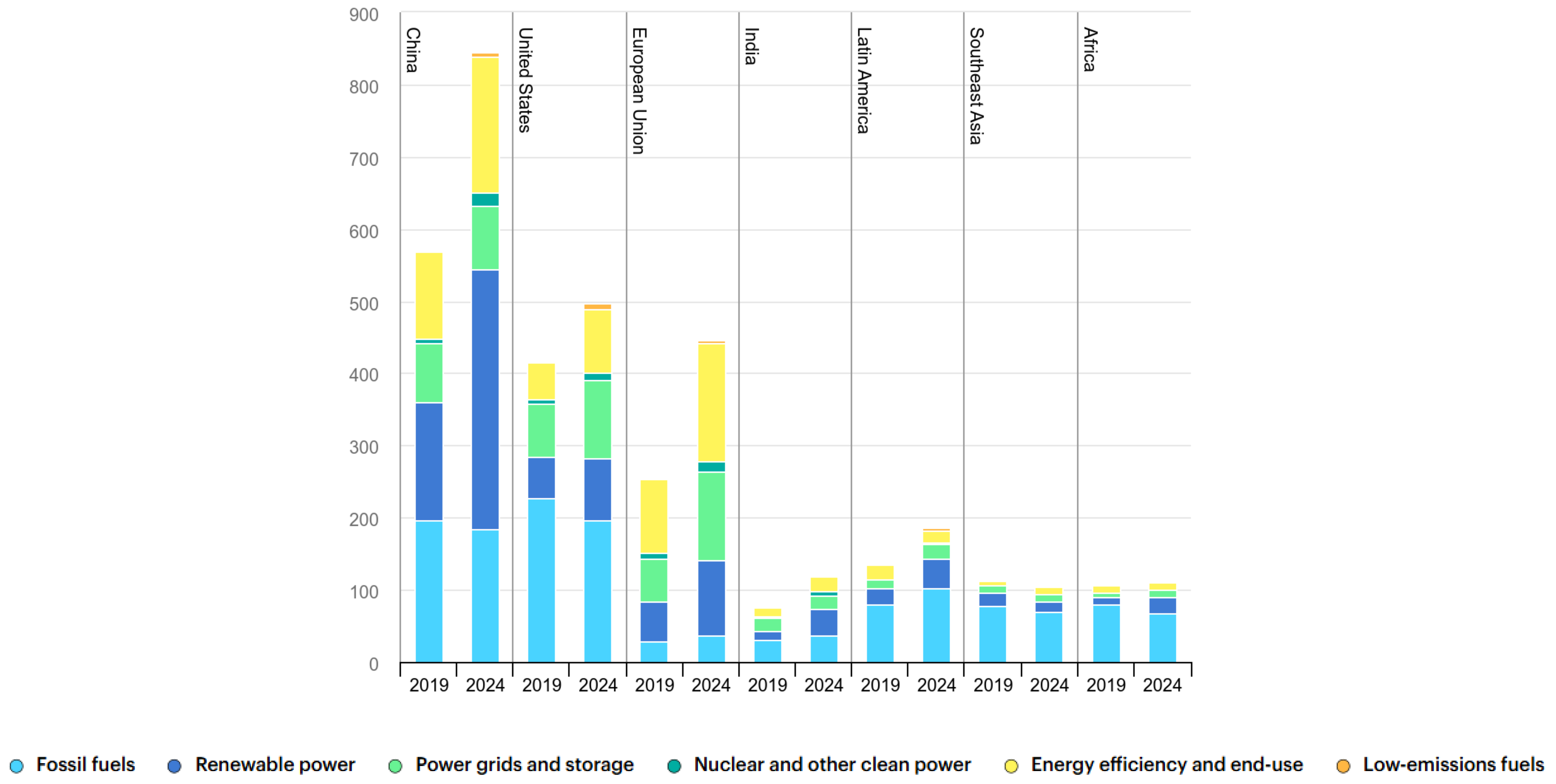
Reached a record of
41GW
of new solar energy capacity installed in 2022
Increased wind capacity by
16GW
39%
of our electricity came from renewables

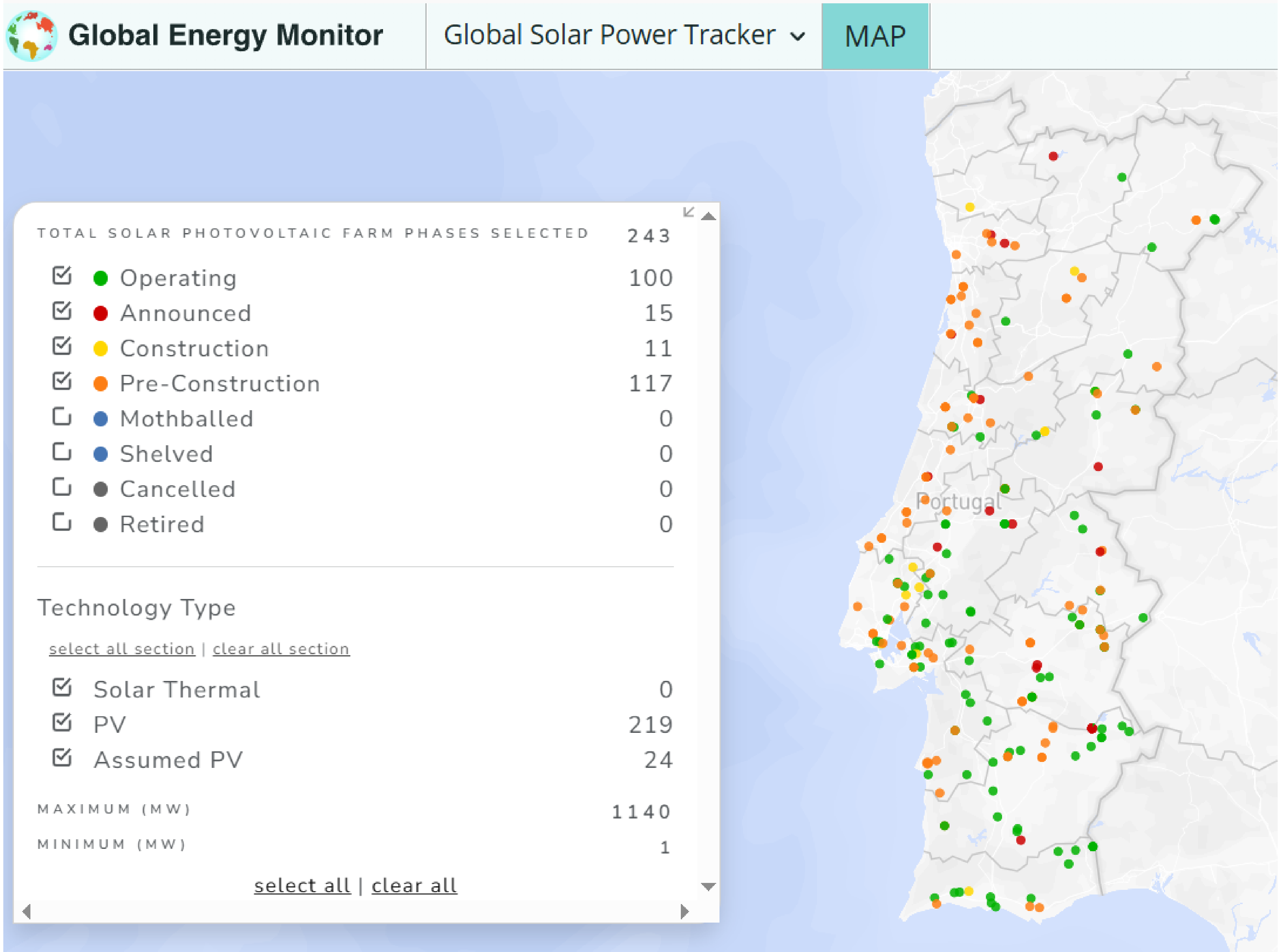
Global Investment in Renewable Power and Fuels, by Technology, 2019-2023

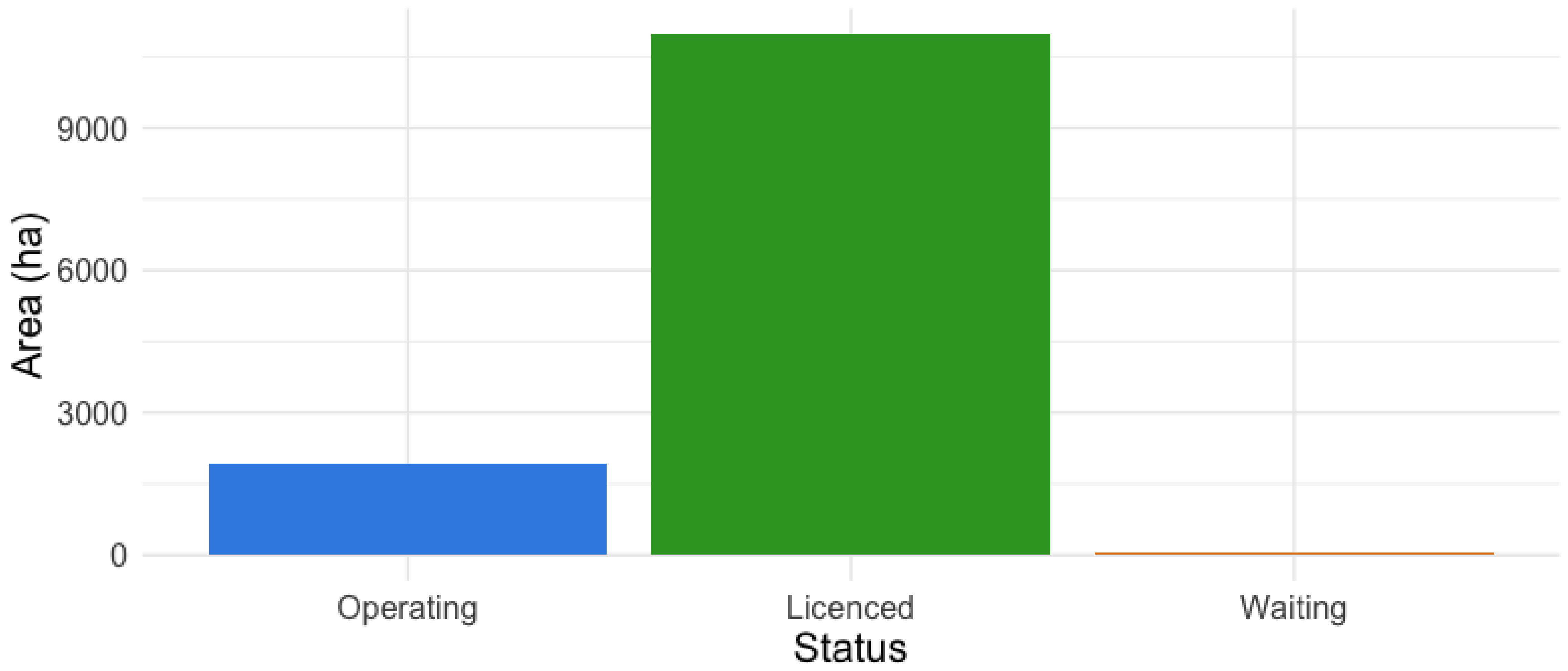


Global Investment in Renewable Power and Fuels, by Country and Region, 2014-2023




900
800
700
600
500
400
300
200
100
0
China
United States
European Union
India
Latin America
Southeast Asia
Africa
2019
2024
Fossil fuels
Renewable power
Power grids and storage
Nuclear and other clean power
Energy efficiency and end-use
Low-emissions fuels


Global Energy Monitor
Global Solar Power Tracker
MAP
TOTAL SOLAR PHOTOVOLTAIC FARM PHASES SELECTED 243
Operating 100
Announced 15
Construction 11
Pre-Construction 117
Mothballed 0
Shelved 0
Cancelled 0
Retired 0
Technology Type
select all section | clear all section
Solar Thermal 0
PV 219
Assumed PV 24
MAXIMUM (MW) 1140
MINIMUM (MW) 1
select all | clear all
Portugal



9000
6000
3000
0
Area (ha)
Operating
Licenced
Waiting
Status

Global Energy Monitor

Solar Farm Capacity by Country (MW)

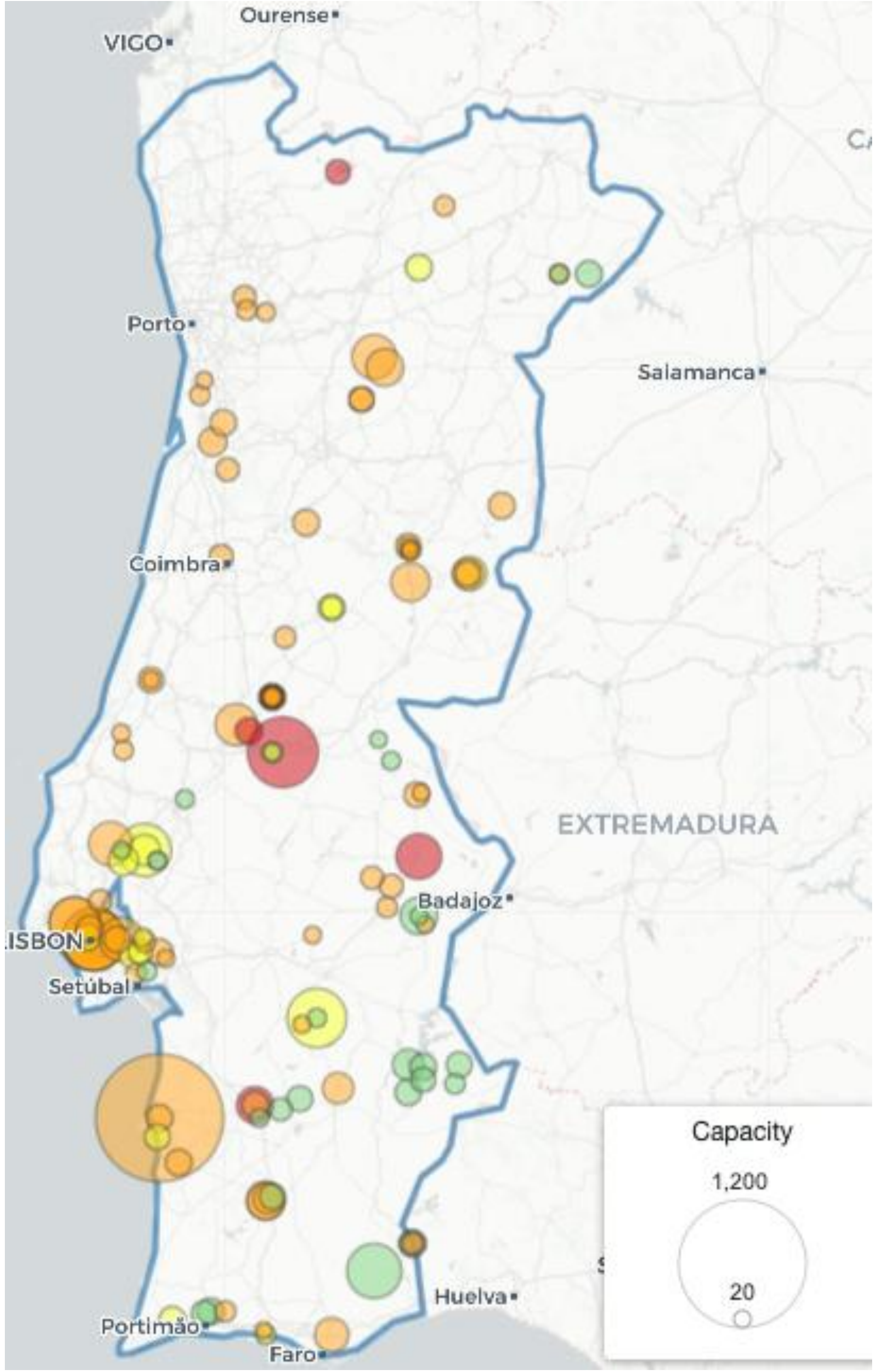
Global Solar Power Tracker, December 2023

Summary data includes large utility-scale solar farm phases 20 MW and greater, 10 MW and greate

Countries in **bold** indicate they were updated in the December 2023 release. All others were last

[Global Energy Monitor]

Region	Country	Operating	Construction	Pre-construction	Announced	Prospective (Sum of Construction, Pre-construction, Announced)
	Global Total	**551,033**	**294,849**	**924,830**	**451,439**	**1,671,119**
Europe	Isle of Man	0	0	0	26	26
Europe	Italy	1,240	101	2,691	736	3,528
Europe	Kosovo	0	0	468	170	638
Europe	Latvia	0	0	0	210	210
Europe	Lithuania	0	0	375	353	728
Europe	Montenegro	0	0	262	100	362
Europe	Netherlands	1,170	344	326	200	870
Europe	North Macedonia	0	100	785	115	1,000
Europe	Poland	477	832	2,098	539	3,469
Europe	Portugal	1,183	1,122	5,727	798	7,647
Europe	Romania	359	153	3,595	85	3,833
Europe	Russia	1,246	88	25	984	1,097
Europe	Serbia	0	0	510	1,078	1,588
Europe	Slovakia	25	0	0	58	58
Europe	Spain	16,494	10,584	71,999	14,694	97,277
Europe	Sweden	0	0	1,875	340	2,215
Europe	Ukraine	2,503	0	0	0	0
Europe	United Kingdom	2,568	1,028	16,106	3,300	20,434



2024
A potência instalada na tecnologia fotovoltaica foi a que mais cresceu, tendo chegado a 3,9 GW.

PNEC 2030
PLANO NACIONAL ENERGIA-CLIMA

O PNEC 2030 traça uma meta de 51% para a quota de energias renováveis no consumo final bruto de energia até 2030, acima da meta anterior de 47%, o que reflete a aposta estratégica nas renováveis e nas suas potencialidades de atração de investimento.

Para alcançar esta meta, o Governo propõe um reforço da exploração do potencial de energias renováveis, com foco nas tecnologias solar e eólica onshore/offshore, entre 2025 e 2030, com o aumento do solar de 8,4 GW para 20,8 GW; o incremento do eólico onshore de 6,3 GW para 10,4 GW e o crescimento do eólico offshore de 0.03 GW para 2 GW.

Tabela 4 – Meta de redução de emissões de CO_{2eq} do setor não-CELE (s\ LULUCF) face a 2005

	2020	2030 (meta anterior)	2030 (meta revista)
Contributo nacional para as metas da União (setor não-CELE)	+1%	-17%	-28,7%

Tabela 9 - Trajetória indicativa e contributo de Portugal para a meta vinculativa da União em 2030

Renováveis no consumo final bruto de energia[23]	2020	2022	2025	2027	2030
PNEC 2030	31%	34%	38%	41%	47%
Revisão do PNEC 2030	31%	34%	40%	44%	51%

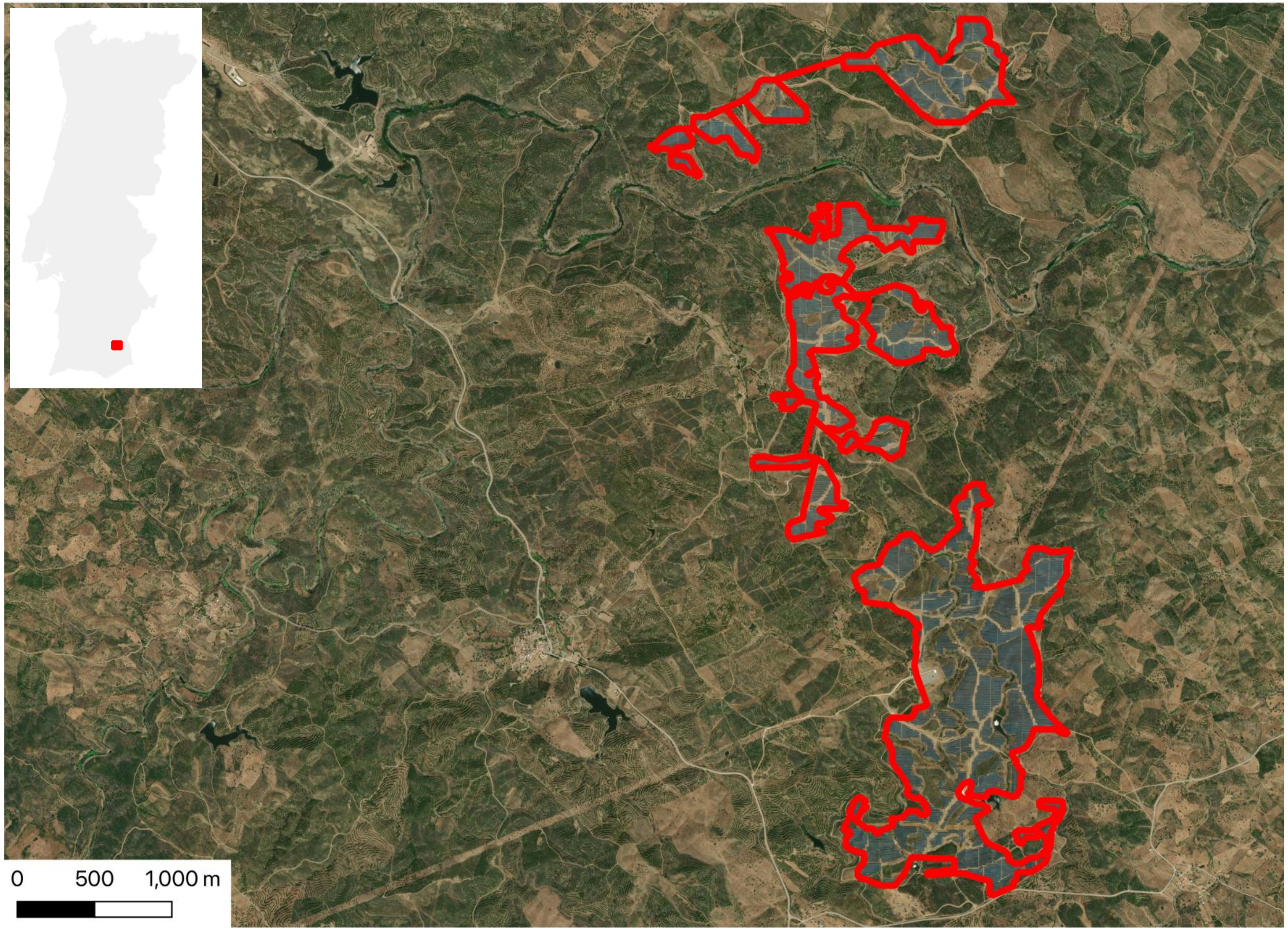
Tabela 11 - Perspetivas de evolução da capacidade instalada para a produção de eletricidade por tecnologia em Port no horizonte 2030, com base nas políticas e medidas planeadas - Cenário WAM

(GW)	**2025**	**2030**
Hídrica	**8,1**	**8,1**
da qual em bombagem	3,6	3,9
Eólica*	**6,3**	**12,4**
Eólica onshore	6,3	10,4
Eólica offshore	0,03	2,0
Solar Fotovoltaico*	**8,4**	**20,8**
do qual centralizado	6,1	15,1
do qual descentralizado	2,8	5,7
Solar Térmico Concentrado**	**0**	**0**
Biomassa/Biogás e resíduos	**1,3**	**1,3**
Geotermia	**0,1**	**0,1**
Ondas	**0**	**0,2**
Gás Natural	**4,8**	**3,5**
Produtos Petrolíferos	**0,6**	**0,5**
Armazenamento (Baterias)	**0,5**	**2,0**
TOTAL	**31**	**48**

* Inclui capacidade instalada para a produção de hidrogénio.

** Esta tecnologia é identificada em 2040, onde se prevê uma capacidade instalada de 600 MW





~ 320 ha

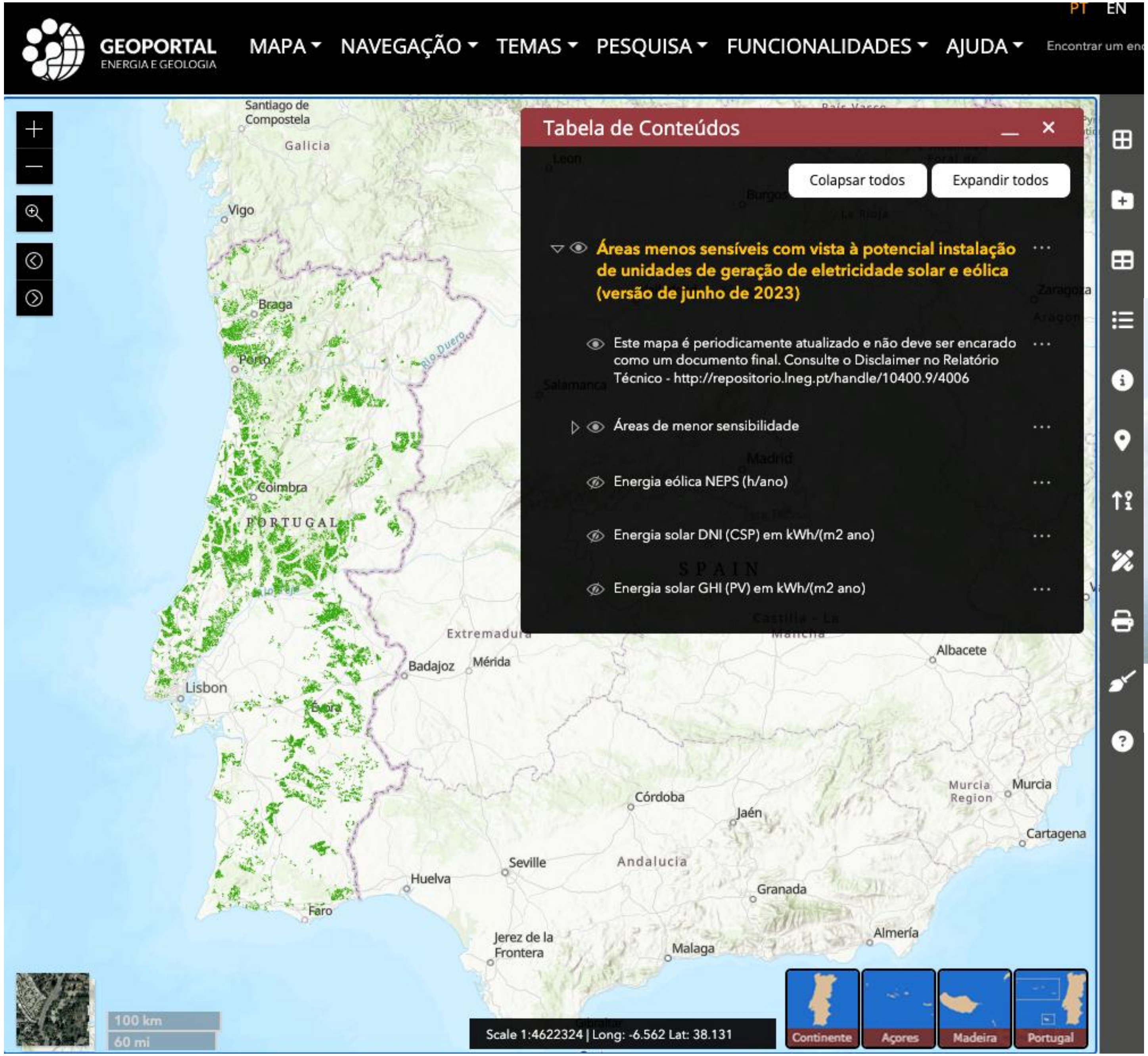
Área Total unitária (inclui acessos)

3,3-3,7 ha/MW (Dias et al, 2019)
3,336 ha/MW (Távora et al, 2020)
4,04 ha/MW (GPI, 2021)

CAPACIDADE INSTALADA SOLAR CENTRALIZADO (PNEC 2030)
15,1 GW – 2030

(4.0 MW/ha) ~ 60,000 ha

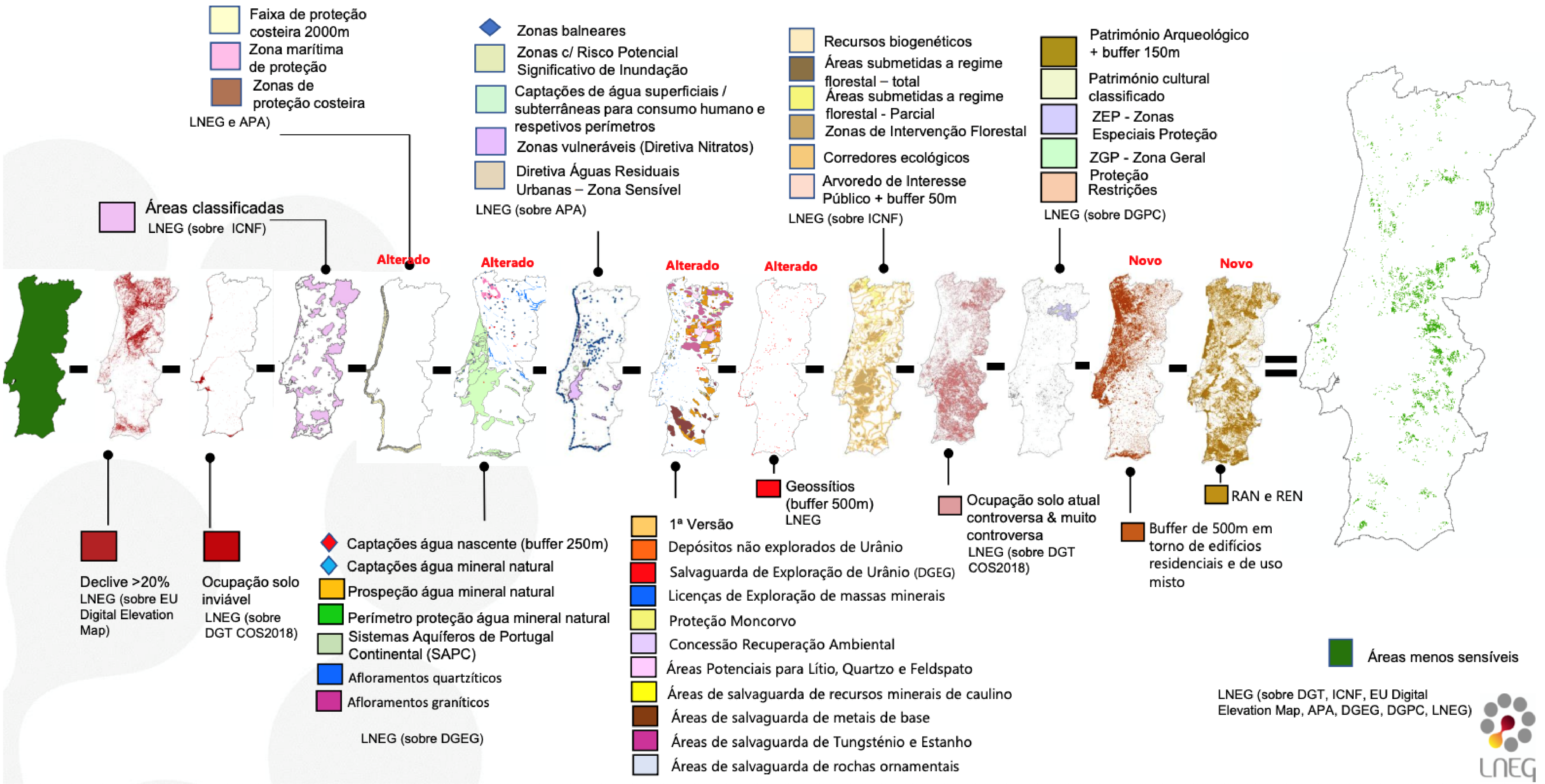
(3.5 MW/ha) ~ 45,300 ha


PT EN
GEOPORTAL
ENERGIA E GEOLOGIA
MAPA
NAVEGAÇÃO
TEMAS
PESQUISA
FUNCIONALIDADES
AJUDA
Tabela de Conteúdos
Colapsar todos
Expandir todos
Áreas menos sensíveis com vista à potencial instalação de unidades de geração de eletricidade solar e eólica (versão de junho de 2023)
Este mapa é periodicamente atualizado e não deve ser encarado como um documento final. Consulte o Disclaimer no Relatório Técnico - http://repositorio.lneg.pt/handle/10400.9/4006
Áreas de menor sensibilidade
Energia eólica NEPS (h/ano)
Energia solar DNI (CSP) em kWh/(m2 ano)
Energia solar GHI (PV) em kWh/(m2 ano)
Santiago de Compostela
Galicia
Vigo
Braga
Porto
Coimbra
PORTUGAL
Lisbon
Évora
Faro
SPAIN
Extremadura
Badajoz
Mérida
Albacete
Córdoba
Jaén
Murcia Region
Murcia
Cartagena
Seville
Andalucia
Huelva
Granada
Almería
Jerez de la Frontera
Malaga
100 km
60 mi
Scale 1:4622324 | Long: -6.562 Lat: 38.131
Continente
Açores
Madeira
Portugal


Lisbon Renewable Energy Smart Siting Workshop
Lisbon, 22 February 2024
09.30-17.30
LNEG Premises, Lumiar Campus, Solar XXI building
Estr. Paço do Lumiar 22, 1600-038 Lisboa, Portugal
The Nature Conservancy Europe
LNEG
APREN
zero.

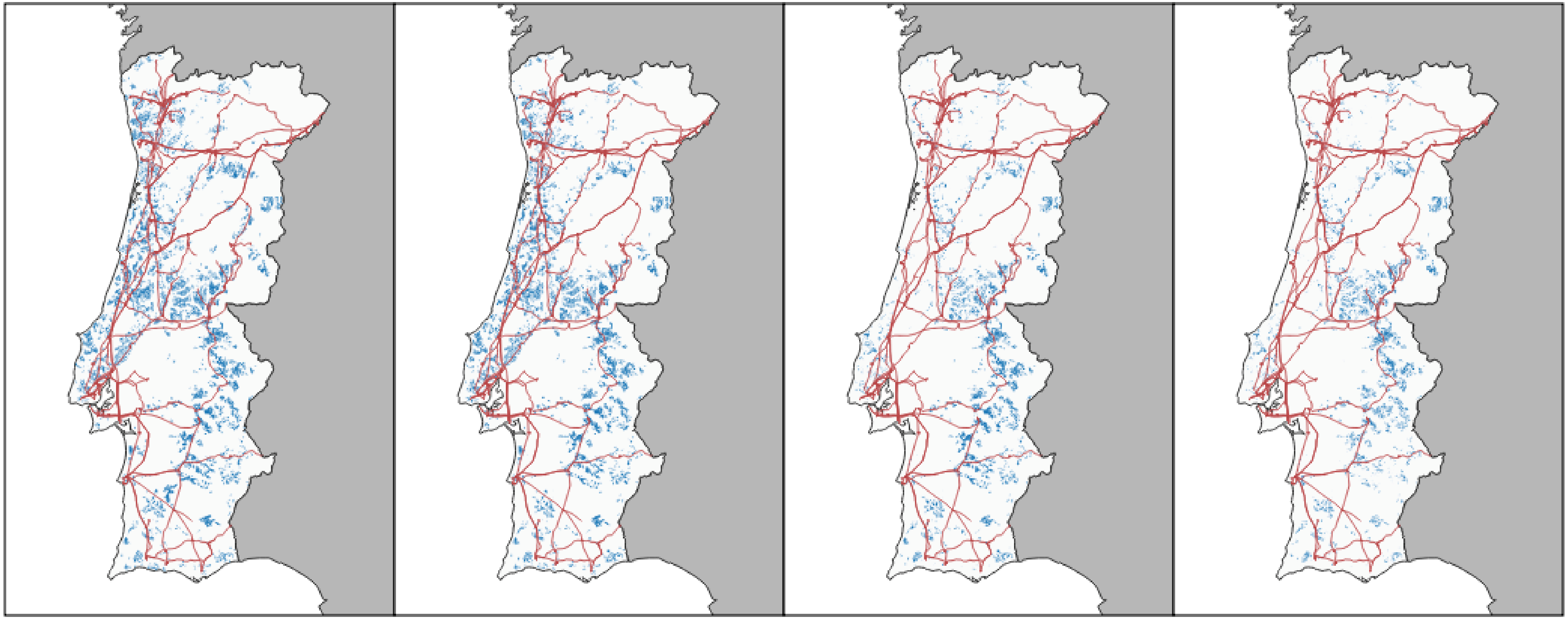
Áreas menos sensíveis
(igual ao Cenário 3 e considera exclusão da RAN e REN)

Cenário 4 (2ª versão)



Scenarios

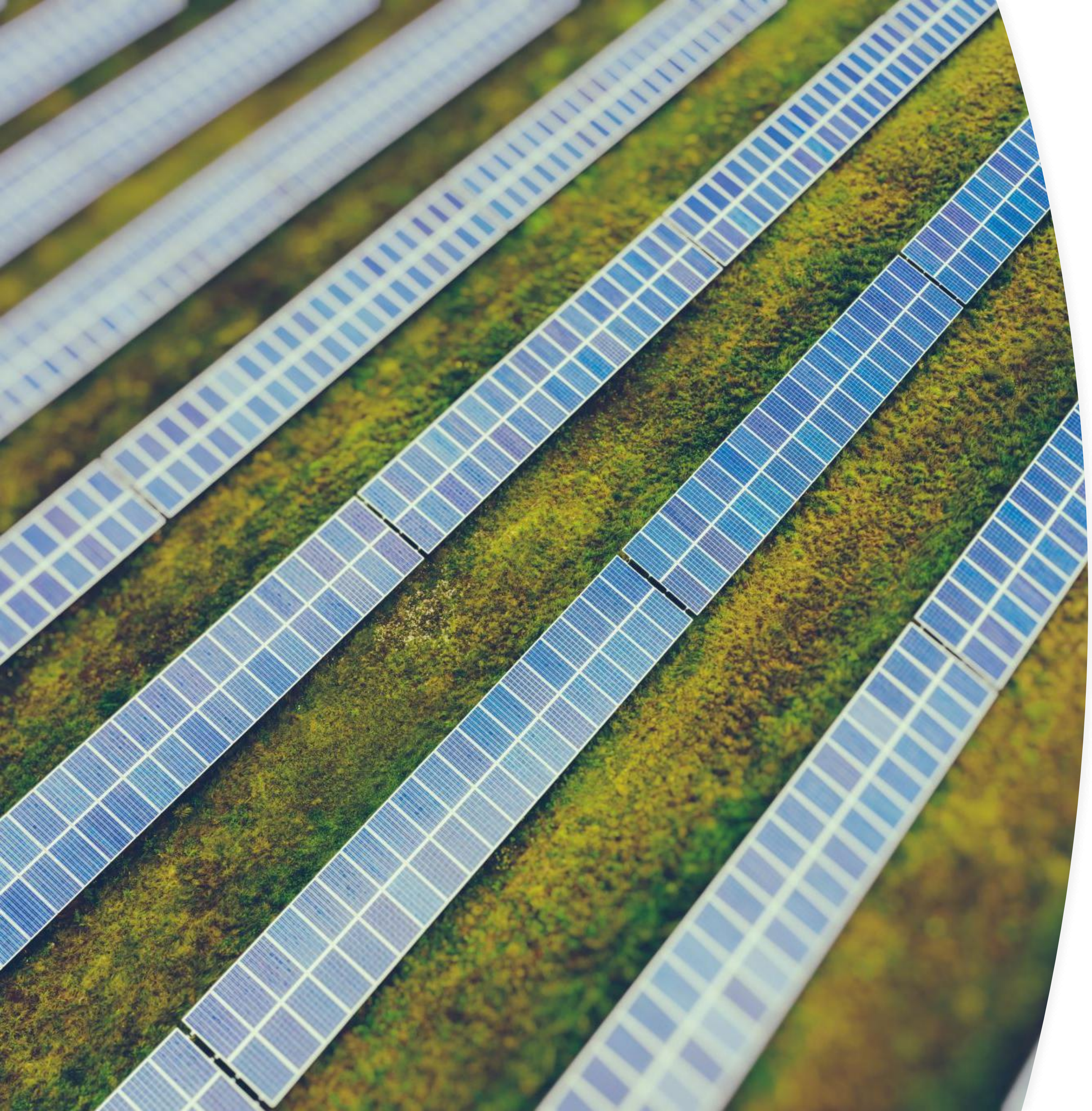
1 — 4



10,356 km²
ca. 11% territory

2,652 km²
ca. 3% territory

(~10x of what is required)



- Few information about impacts (positive and negative) of PV Solar Farms on Biodiversity

Conservation Letters
Open Access
A Journal of the Society for Conservation Biology

REVIEW | Open Access

Solar photovoltaic energy development and biodiversity conservation: Current knowledge and research gaps

Julia Gómez-Catasús, Manuel B. Morales, David Giralt, David González del Portillo, Robert Manzano-Rubio, Laura Solé-Bujalance, Francesc Sardà-Palomera, Juan Traba, Gerard Bota

- Most of the research has been carried out in North America ([USA] ~50%), followed by Europe (20%)
- Most were carried out in desert ecosystems
- Handful of studies on Agrivoltaic; fewer on Conservoltaic and Ecosystem Services
- Mostly Plants
- Mostly 1 PV facility
- Any (?) with BACI design

Impacts (*)

- **Impacts on microclimate and soil properties**
- **Habitat fragmentation, loss, or alteration**
  - **(animal movement)**
- **Wildlife mortality (?)**

Research Article

Solar farm management influences breeding bird responses in an arable-dominated landscape

Joshua P. Copping, Catherine E. Waite, Andrew Balmford, Richard B. Bradbury, Rob H. Field, Isobel Morris & ...show all

Received 20 Mar 2024, Accepted 27 Nov 2024, Published online: 12 Feb 2025

Cite this article https://doi.org/10.1080/00063657.2025.2450392 Check for updates

"Solar farms contained a greater bird abundance and species richness than arable farmland, but this varied with solar farm management."

BRITISH ECOLOGICAL SOCIETY Journal of Applied Ecology

RESEARCH ARTICLE | Open Access

Renewable energies and biodiversity: Impact of ground-mounted solar photovoltaic sites on bat activity

Elizabeth Tinsley, Jérémy S. P. Froidevaux, Sándor Zsebők, Kriszta Lilla Szabadi, Gareth Jones

First published: 07 August 2023 | https://doi.org/10.1111/1365-2664.14474 | Citations: 18

The activity of six of eight species/species groups analysed was negatively affected by solar PV panels, suggesting that loss and/or fragmentation of foraging/commuting habitat is caused by ground-mounted solar PV panels.

BRITISH ECOLOGICAL SOCIETY Journal of Applied Ecology

RESEARCH ARTICLE | Open Access

Insectivorous bats alter their flight and feeding behaviour at ground-mounted solar farms

Kévin Barré, Alice Baudouin, Jérémy S. P. Froidevaux, Vivien Chartendrault, Christian Kerbiriou

First published: 01 December 2023 | https://doi.org/10.1111/1365-2664.14555 | Citations: 2

"...bats shifted their flight towards faster and straighter trajectories with lower probability of prey capture attempts at solar farms."



- SOCIAL CONFLICTS ARE EMERGING

- Competition with agriculture
- Impacts on biodiversity
- Change Aesthetics and Traditional land transformation


Integrated Management





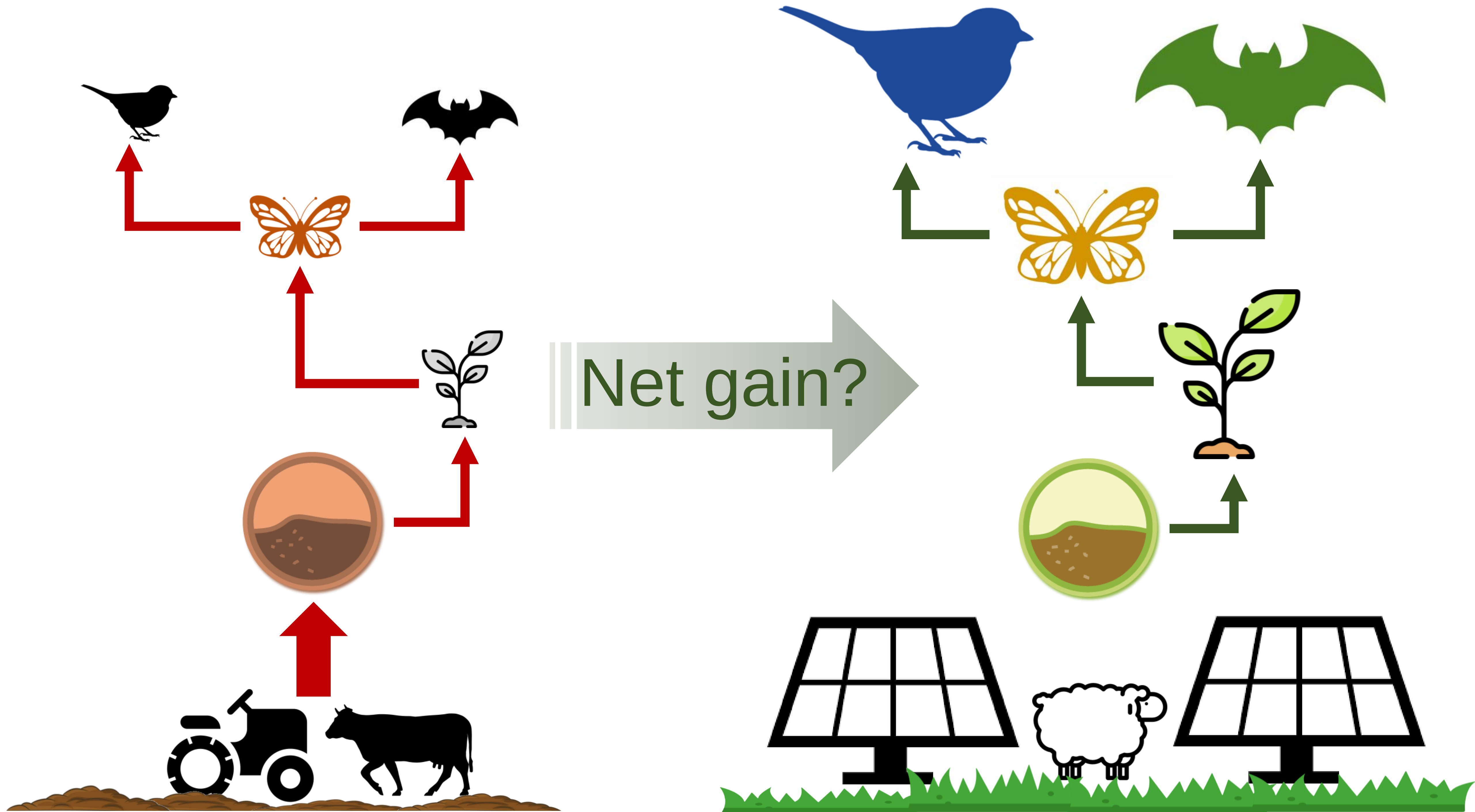




INTEGRATE energy production in PV farms with sustainable *agricultural* practices, promoting conservation of *biodiversity*, enhancing the provision of *ecosystem services*.

sun4all

Smart management of **U**tility-scale photovoltaic facilities with **N**ature: Clean Energy together with Agriculture activities, Biodiversity Conservation, and Ecosystem Services provision


Net gain?

THANK YOU!

centre for ecology, evolution and environmental changes

CHANGE
Global Change and Sustainability Institute