CLIMA 2025

REHVA 15th HVAC World Congress

4th - 6th June, Milan, Italy

Decarbonized, healthy and energy conscious buildings in future climates

REHVA Federation of European Heating, Ventilation and Air Conditioning Associations

AiCARR Associazione Italiana Condizionamento dell'Aria Riscaldamento e Refrigerazione

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Decarbonized, healthy and energy conscious buildings in future climates

Sustainable buildings' energy supply: an overview of clean production in the Gargano area

Rosa Agliata, Filippo Busato and Andrea Presciutti
Universitas Mercatorum

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RECs for Protected Areas, Why?

PRIN 2022 - Missione 4 Istruzione e Ricerca

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Ministero dell'Università e della Ricerca

Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

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UNICORN: **UN**derstand**I**ng energy **CO**mmunity ma**R**kets for the development of in**N**er and protected areas

in partnership with University of Foggia

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RECs for Protected Areas, Why?

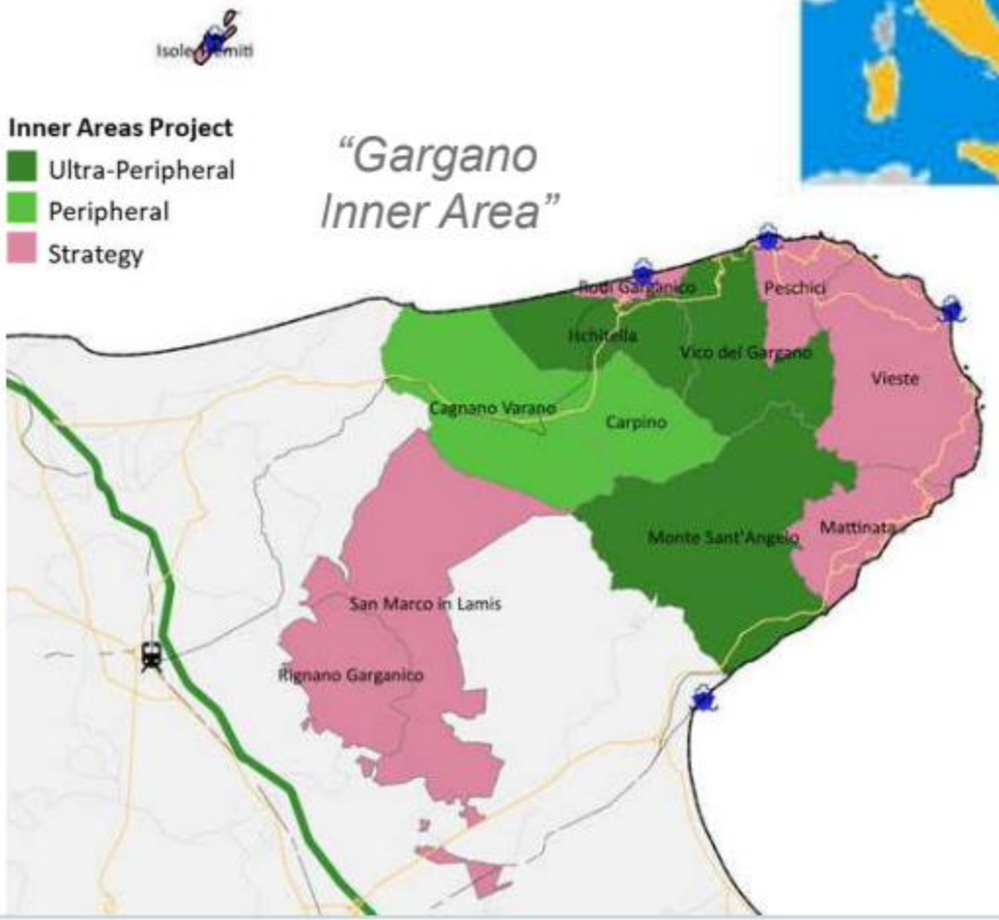
Energy transition → new socio-energy model based on renewables

- RECs enable local, collective energy systems (Red II Directive)
- RECs foster energy citizenship & collaborative economies
- Citizens as 'prosumers': produce + consume energy
- Energy sovereignty enables local sustainable development
- Inner Areas in Italy: strategic for REC deployment

Case study: the Gargano district

19 Municipalities

Apricena
Cagnano Varano
Carpino
Ischitella
Isole Tremiti
Lesina
Manfredonia
Mattinata
Monte Sant'Angelo
Peschici
Poggio Imperiale*
Rignano Garganico
Rodi Garganico
San Giovanni Rotondo
San Marco in Lamis
San Nicandro Garganico
Serracapriola
Vico del Gargano
Vieste



*lies within a geographic area identified as the "Gargano subregion" but it is the only municipality with no territory falling within the Gargano National Park

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RES challenges and resources in *Gargano*

Challenges

- Preservation of cultural and natural assets (*landscapes and historical sites*)
- Impact of wind turbines (*visual intrusion, noise, disturbance of the bird fauna*)
- Low population density (*potential low consumptions and number of consumers*)

Resources

- High values of solar irradiation (*PV installations*)
- Suitable wind speed (*e.g., offshore wind projects in the Gulf of Manfredonia*)
- Availability of substantial amounts of agricultural residues (*biomass energy*)

Goal and outline of the study

Overview on the chances of RECs implementation in the *Gargano*

1. Examining the Gargano's current RES capacity
2. Understanding the national and local regulatory framework for renewable energy implementation
3. Determining the Gargano's RES production potential
4. Identifying the most suitable municipalities for the constitution of a REC

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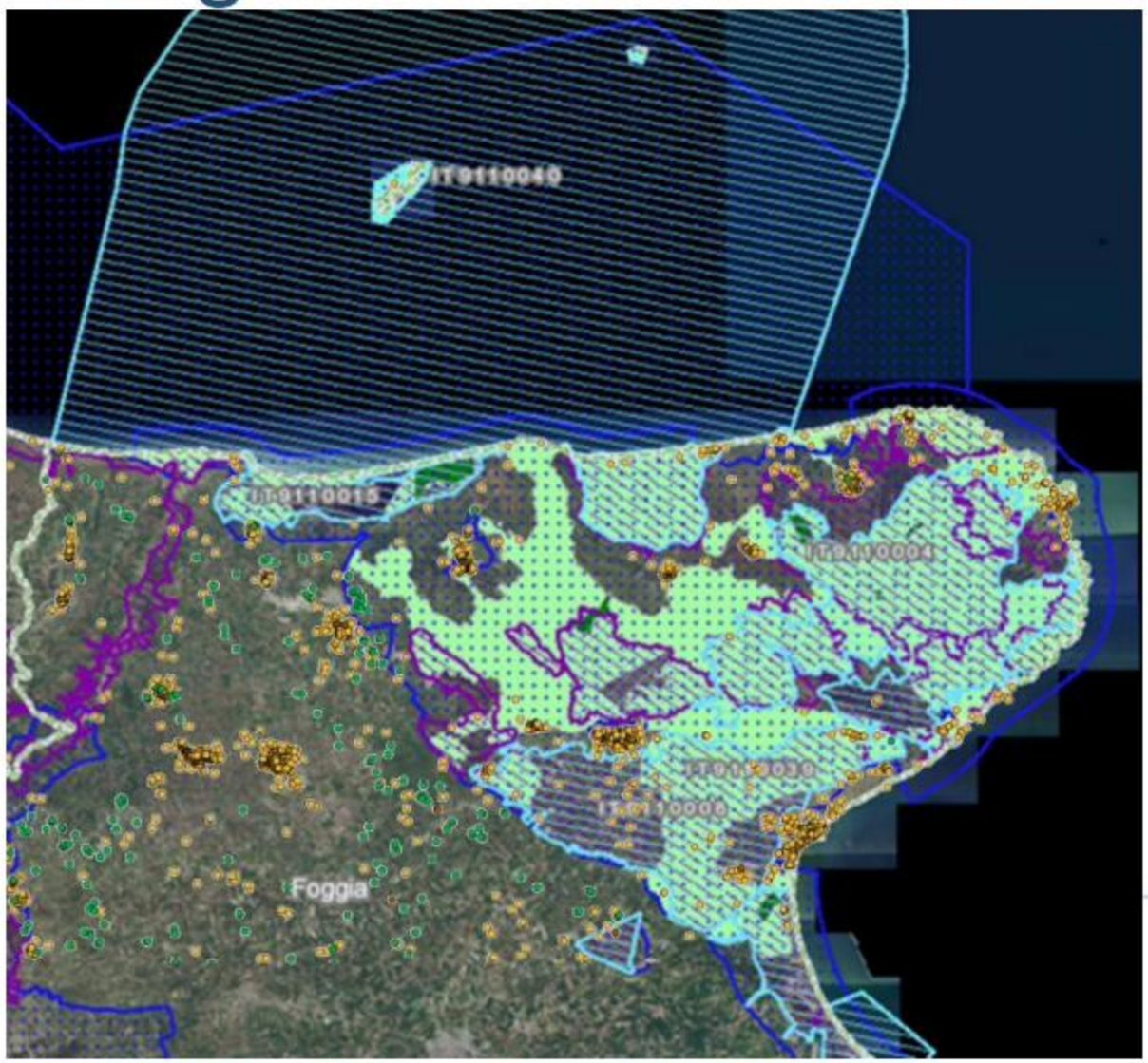
Regulatory Framework

R = Regional Statute
N = National Statute

RES type	Source		Restriction / Permission
Solar	R	RR 24/2010 [23]	Zoning of areas suitable for different categories of PV systems
	R	RR 24/2010 as modified per RR 29/2012 [25]	No PV systems in zone 'A' as per urban planning regulations
	N	DLgs 199/2021 and ss. mm. [2]	No ground-based PV systems on agricultural land Unless within the creation of a REC Allows certain categories of PV systems in protected areas, if located in malls' vicinity
	R	DGR 1875/2022 [26]	Defines 'Obligatory Conditions' for PV interventions in Natura 2000 Sites
Wind	R	RR 24/2010 [23]	Zoning of areas suitable for different categories of wind turbines • Up to 20 kW • Up to 60 kW • Up to 200 kW
	R	DGR 1875/2022 [26]	Defines 'Obligatory Conditions' for wind turbines in Natura 2000 Sites
Biomass	R	RR 12/2008 [27]	Defines typologies of biomass and maximum distances (short supply chain)
	N	DLgs 199/2021 [2] and ss. mm.	Define categories and quantities of biomass to be used
	N	Decree 414/2023 [4]	

Gargano's current RES capacity 1/3



RES Installations
vs
Protected Areas

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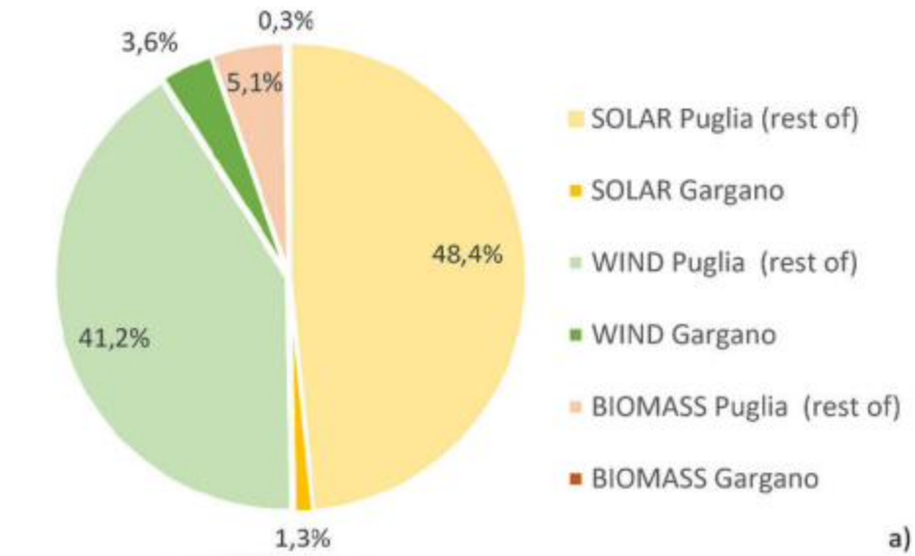
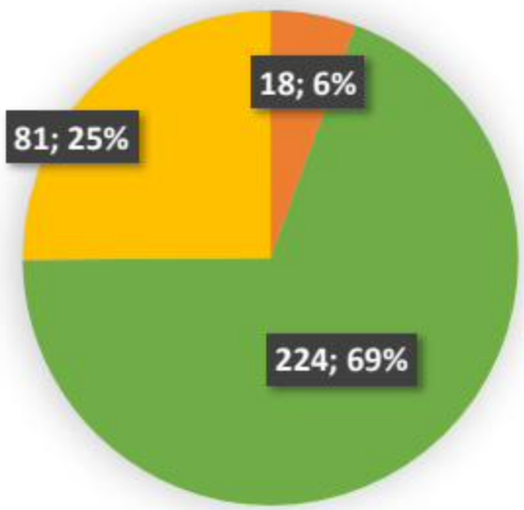
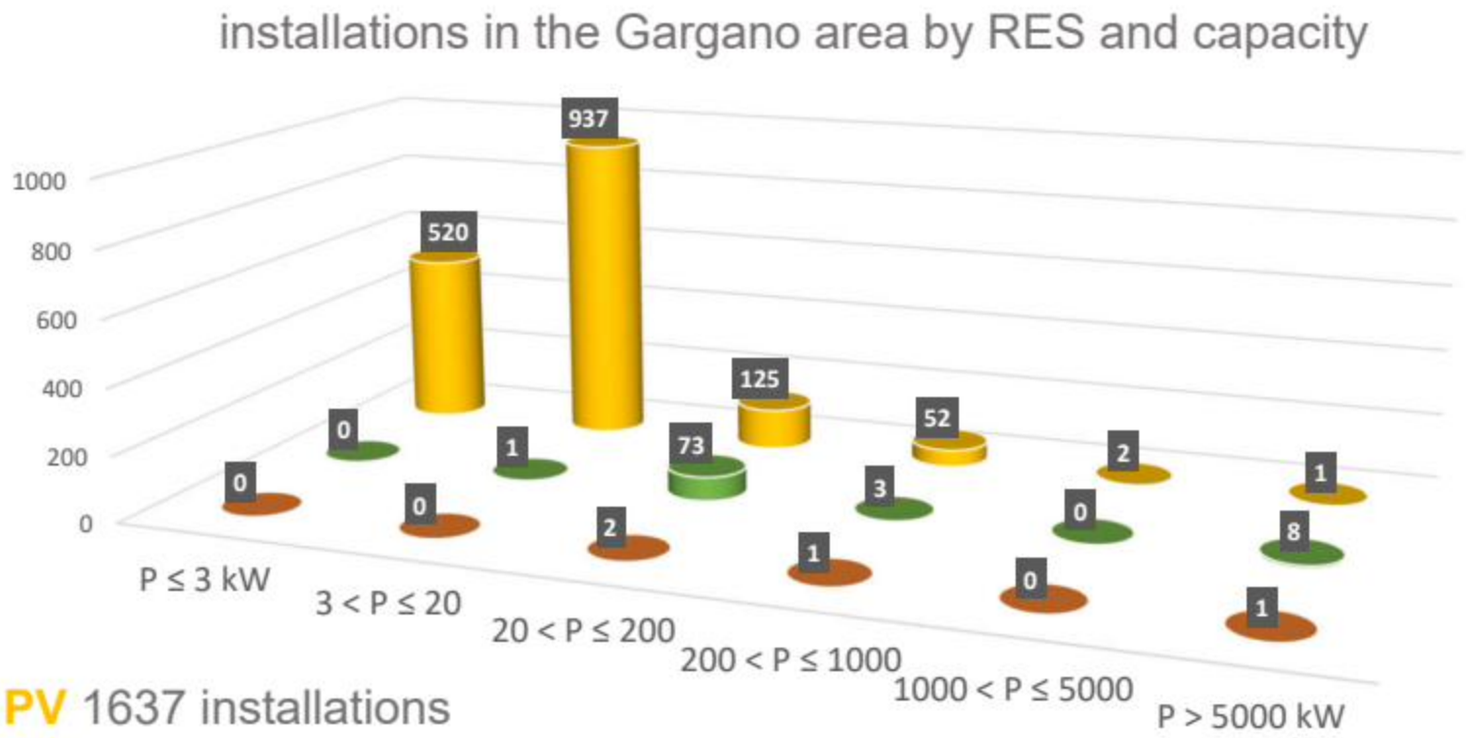
Gargano's current RES capacity 2/3



a)



Total installed capacity [MW] tot 323



PV 1637 installations

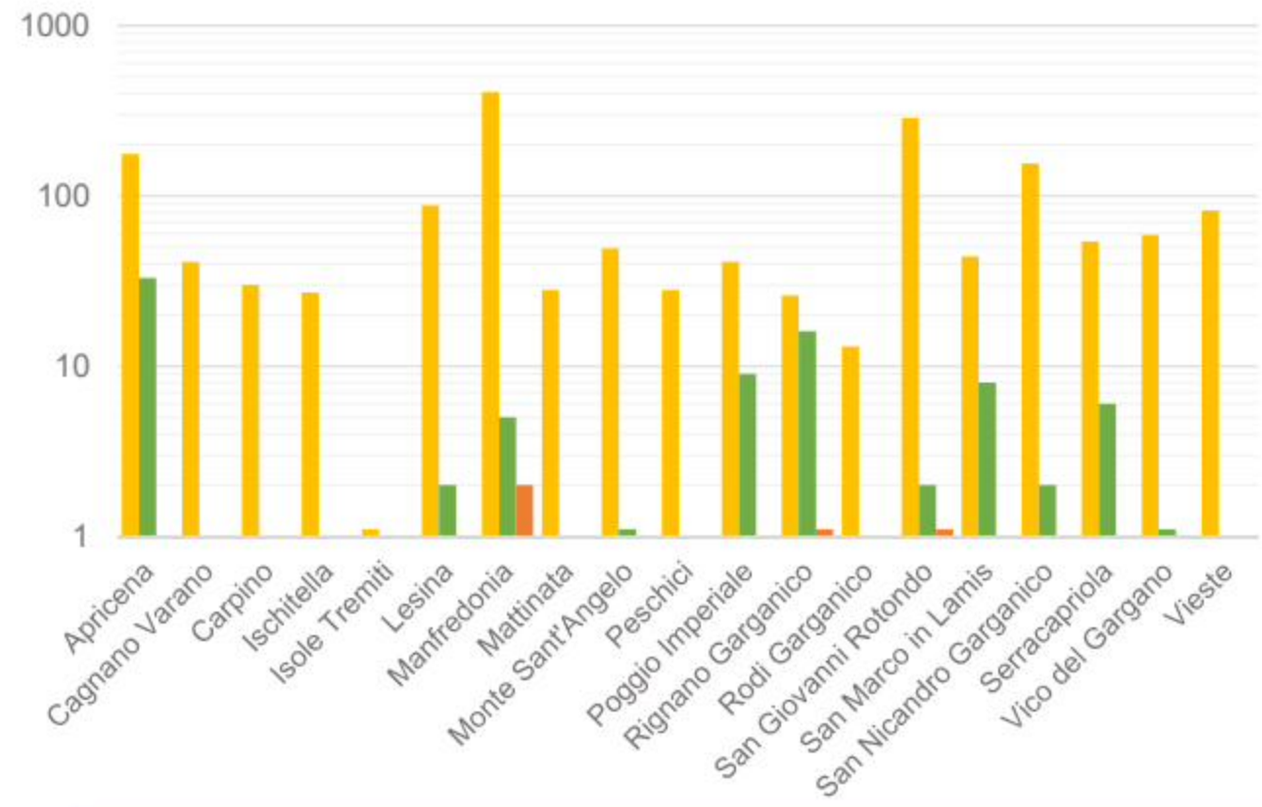
WIND 85 installations

Bioenergy 4 plants

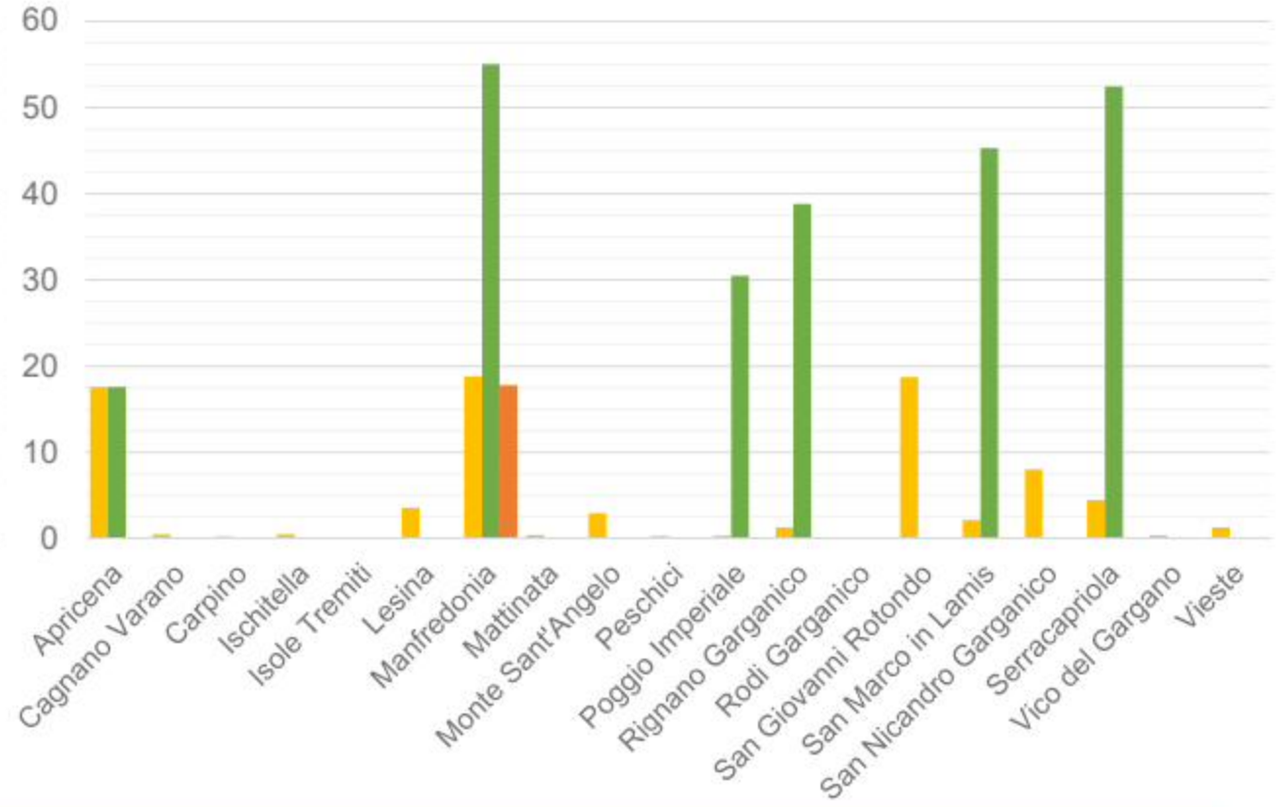
source: *Atla Impianti* - GSE

Gargano's current RES capacity 2/3

number of installations



total capacity [MW]



source: *Atla Impianti* - GSE

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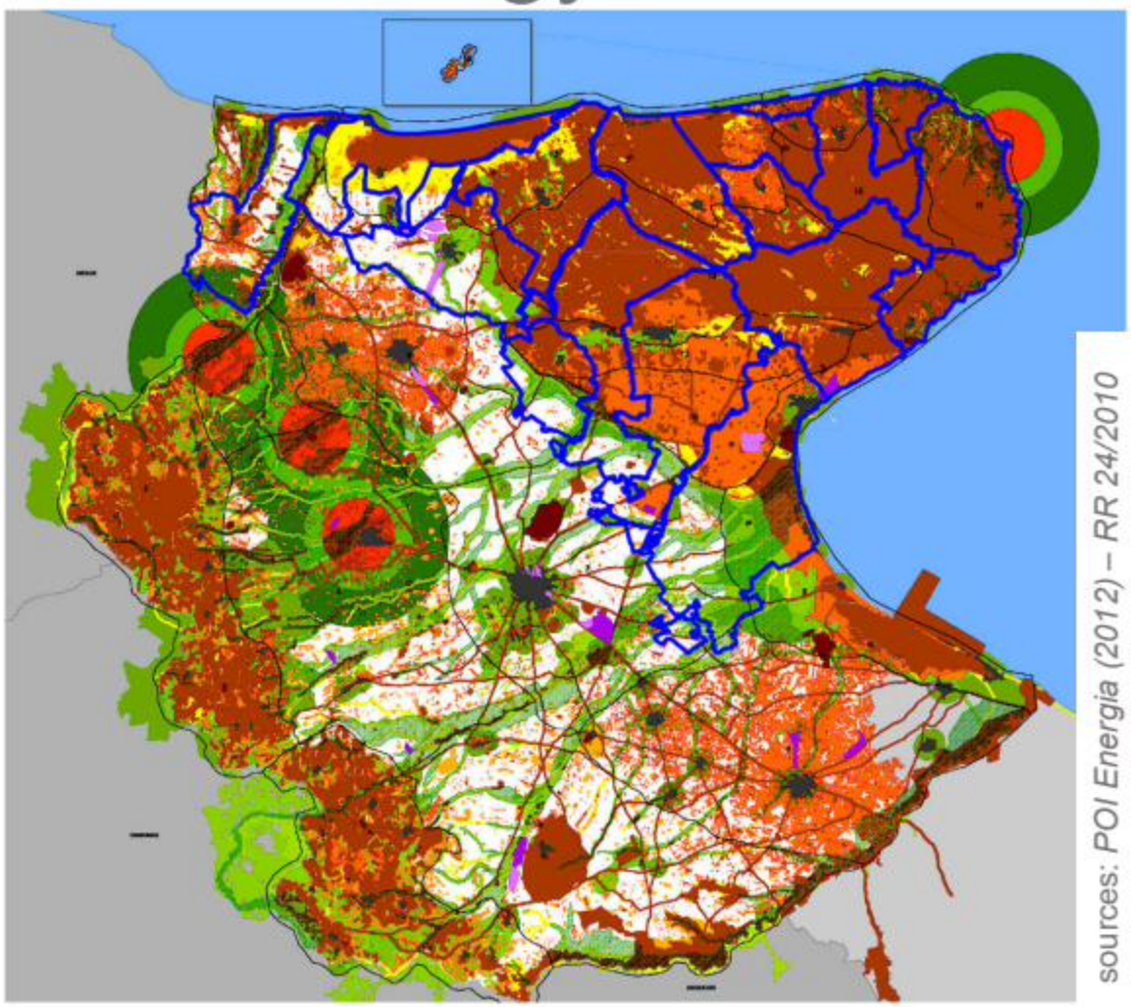
Gargano's RES production potential

Methodology Solar PV



sources: *POI Energia (2012) – RR 24/2010*

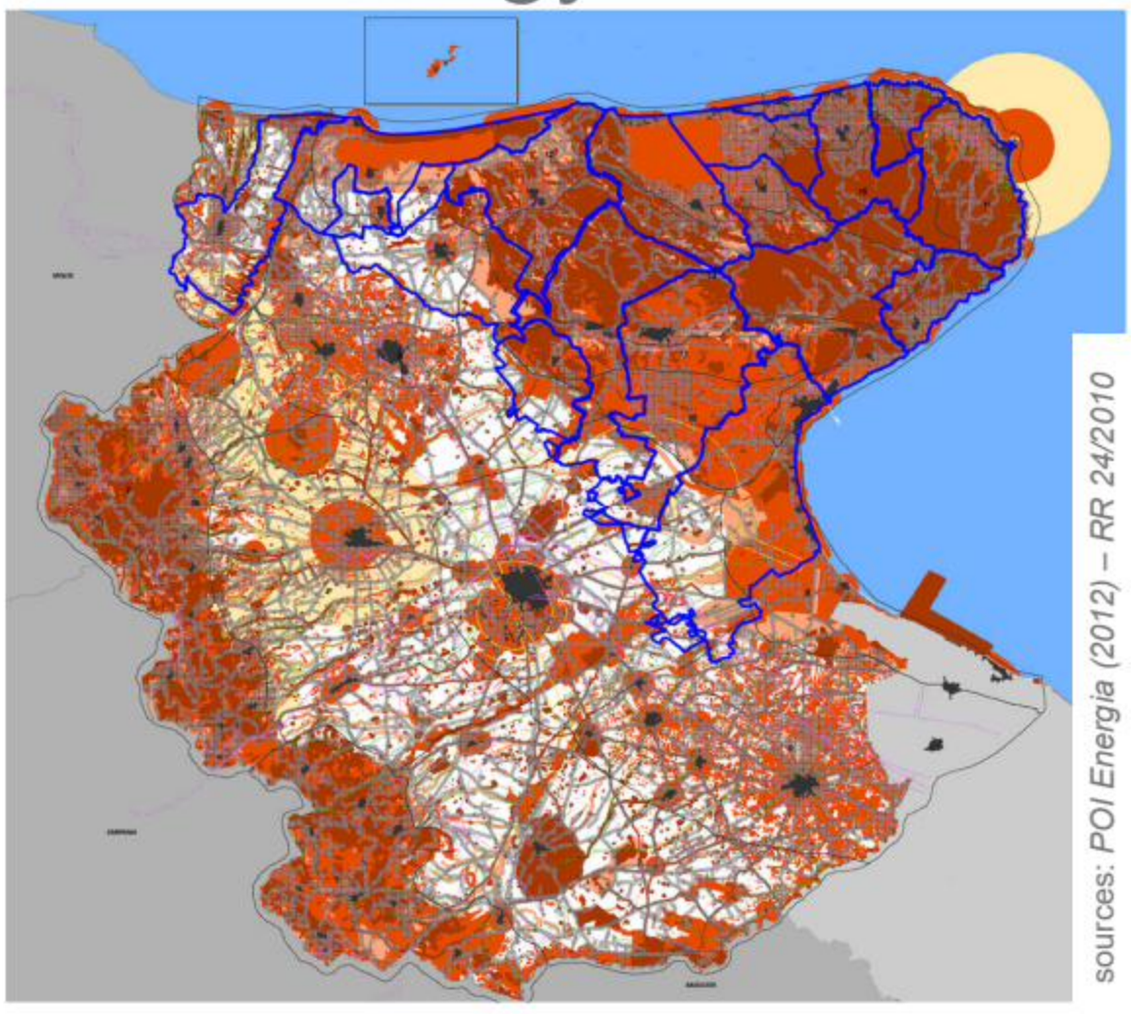
- <u>sources</u>: municipal urban planning documents + Google Maps
- <u>prioritized surfaces</u>**:** public buildings with large roofs *(e.g., city halls, hospitals, sport complexes, military barracks, schools, existing uncovered parking areas…)*
- <u>excluded</u> surfaces oriented towards the N, N-E, and N-W, and those likely to be shaded during the sunniest hours of the day

$$P_{PV} = R_{ggmm} \times Area \times 0.167 \times 0.85\ [kWh]$$

P_{FV} = PV potential productivity
R_{ggmm} = global solar radiation on a horizontal plane [kWh/m²]
Area = size of the identified potential surface area [m²]
0.167 = potential specific photovoltaic capacity [kW/m²]
0.85 = system efficiency

Gargano's RES production potential

Methodology Wind



sources: *POI Energia (2012) – RR 24/2010*

✗ wind, site suitability, visual impact and environmental analysis (require an in-depth knowledge of the specific site)

☑ municipal arbitrary P_W value

- installation of 15 wind turbines
- each operating at the maximum power capacity permitted within the municipality (RR 24/2010)
- wind speed set at 5 m/s for turbines up to 100 kW and 6[1] m/s for 200kW (difference in height of the support tower)

$$\boldsymbol{P_W = 15 \times Pt_{max}\ [kWh]}$$

P_W = wind potential productivity
Pt_{max} = productivity of the allowed turbines [kWh]

NB in municipalities where capacity > 200 kW is allowed, this study may underestimate P_W, as it primary focuses on small-scale wind system (up to 200 kW)

[1] source: https://atlanteeolico.rse-web.it/

Gargano's RES production potential

Methodology Biomass

DGR 2275/2012 – *Regional Biomass Potential Database of Puglia*

municipal and regional data on the net potential available biomass for RES plants

DGR 1484/2024 – *Environmental and Energy Plan of Puglia*

- regional data on the net potential available biomass for RES plants
- estimates of potential electrical energy availability

Proportional assessment of the municipal biomass potential productivity (P_{BM}) in the following categories

- pruning residues from tree crops
- exhausted olive pomace
- olive mill wastewater
- straw
- forest products and by-products
- tomato processing residues
- wet biomass (including dairy residues and cattle manure)

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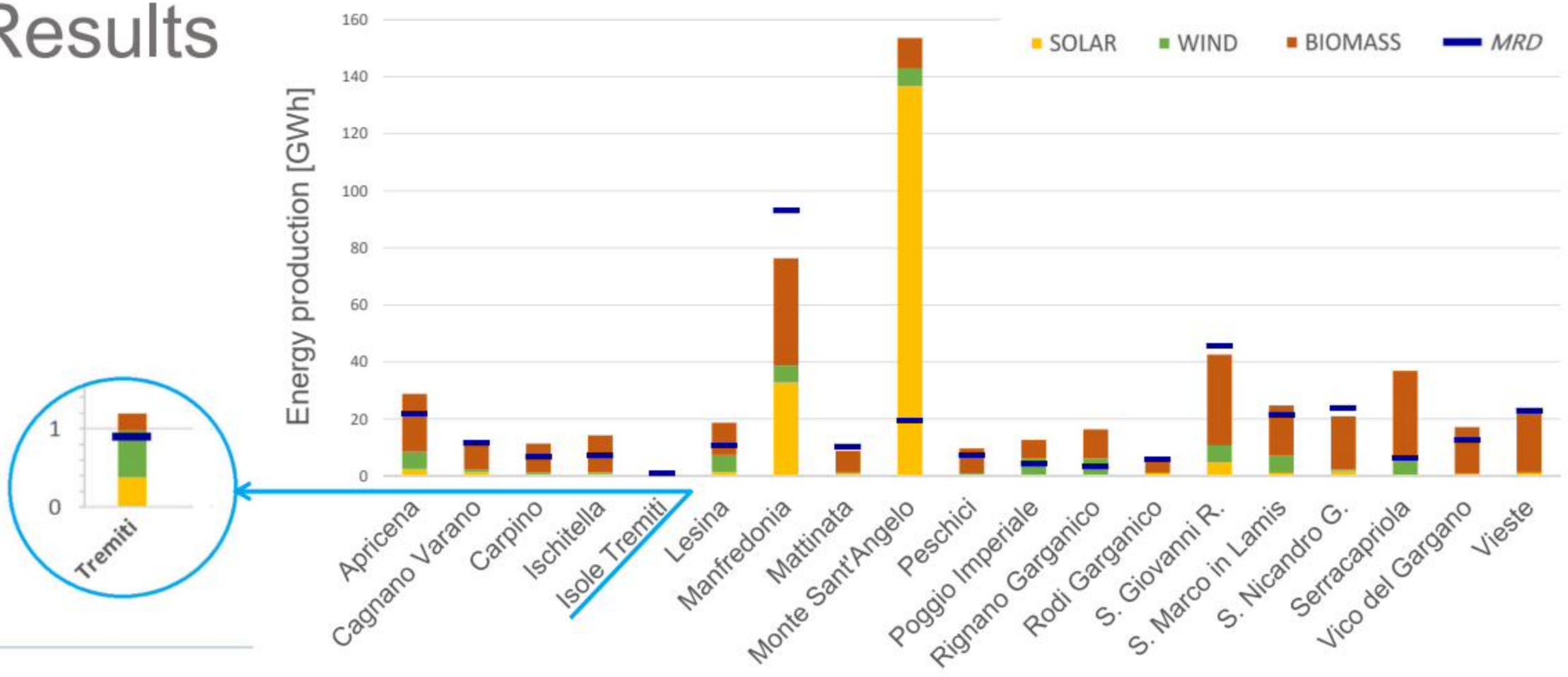
Gargano's RES production potential (P_E)

Results



MRD = Municipal Residential Demand

Foggia's average annual per capita electricity consumption in 2022 (1737 kWh) × municipality's inhabitants

Where to establish a REC? 1/2

Criteria and Indicators for PV-based REC

Economic viability: min 100 kWp

%SPV = area for 100 kWp (600 m²) / possible space

Energy sharing: annual consumption ≥ 3 × production

%MRD = required no. of participants / total population

Criteria and Indicators for WIND-based REC

Economic viability: min 100 kWp

1. extent of land free from environmental constraints
2. presence of existing wind turbines

Energy sharing: annual consumption ≥ 2 × production

%MRD = required no. of participants / total population

Where to establish a REC?

PV-based

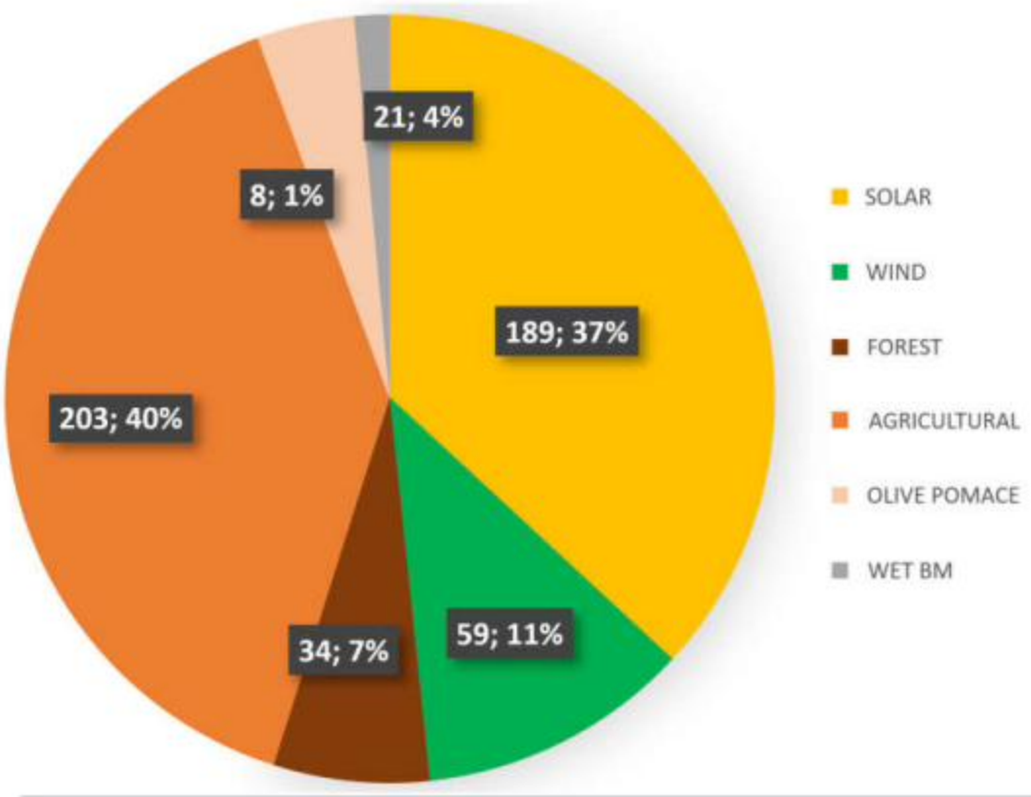
Municipality	Production [MWh/anno]	$\%S_{FV}$	$\%F_{ECR}$	$\%(S_{FV}+F_{ECR})$
Manfredonia	135	0.4%	0.4%	0.8%
Mt. Sant'Angelo	135	0.1%	2.1%	2.2%
S. Giovanni R.	137	2.9%	0.9%	3.8%
Apricena	137	5.5%	1.9%	7.3%
S. Nicandro G	137	8.2%	1.7%	9.9%
Cagnano Varano	136	8.7%	3.6%	12.3%
Lesina	137	9.6%	3.8%	13.4%
S. Marco in Lamis	137	13.0%	1.9%	14.9%
Vieste	136	14.3%	1.8%	16.1%
Mattinata	135	15.1%	3.9%	19.0%
Vico del Gargano	136	16.1%	3.2%	19.4%
Rodi Garganico	136	12.6%	7.0%	19.6%
Ischitella	136	19.2%	5.7%	24.8%
Carpino	136	22.8%	6.2%	28.9%
Serracapriola	137	28.8%	6.4%	32.5%
Peschici	136	48.7%	5.5%	54.2%
Poggio Imperiale	137	68.8%	9.5%	78.4%
Rignano G.	137	68.8%	12.8%	81.7%
Tremiti Islands	138	36.4%	46.1%	82.5%

WIND-based

Municipality	Capacity [n x kW]	Wind Turbines	Free area [km²]	$\%F_{ECR}$
Manfredonia	1x100	si	175.0	0.22%
Serracapriola	1x100	si	120.0	3.13%
Apricena	1x100	si	93.0	0.91%
Lesina	1x100	si	57.6	1.85%
S. Marco in Lamis	1x100	si	53.0	0.93%
Rignano G.	1x100	si	44.0	6.25%
Poggio Imperiale	1x100	si	44.0	4.65%
S. Giovanni R.	1x100	si	39.0	0.44%
Mt. Sant'Angelo	1x100	si	12.0	1.03%
S. Nicandro G.	5x20	si	8.0	0.83%
Vieste	5x20	no	1.4	0.87%
Cagnano Varano	5x20	no	0.0	1.74%
Ischitella	5x20	no	0.0	2.78%
Carpino	5x20	no	0.0	3.03%
Mattinata	5x20	no	0.0	1.92%
Peschici	5x20	no	0.0	2.70%
Tremiti Islands	5x20	no	0.0	22.22%
Rodi Garganico	n.a.	no	5.0	n.c.
Vico del Gargano	n.a.	no	1.8	n.c.

Conclusions

Gargano's total annual potential [GWh]



1. Factor impacting RES capacity to meet the MRD:
   - demographic size of the municipality
   - availability of suitable areas for turbine installation
   - availability of agricultural and/or forestry biomass

2. Territorial constraints predominantly affect P_W, necessitating either increased biomass availability or expanded PV installations

3. Small municipalities with minimal land-use restrictions are more likely to achieve energy self-sufficiency via RES

4. Achieving high levels of energy self-sufficiency in larger municipalities requires a combination of technologies and optimized power installation to maximize P_E

5. Despite environmental and landscape constraints, the findings suggest that it would be possible the establishment of a REC in the region

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Forthcoming questions

1. Where to establish a Biomass-based REC?
2. Multi-Criteria Decision-Making analysis to assess the suitability for a REC implementation

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Thank you for your kind attention

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