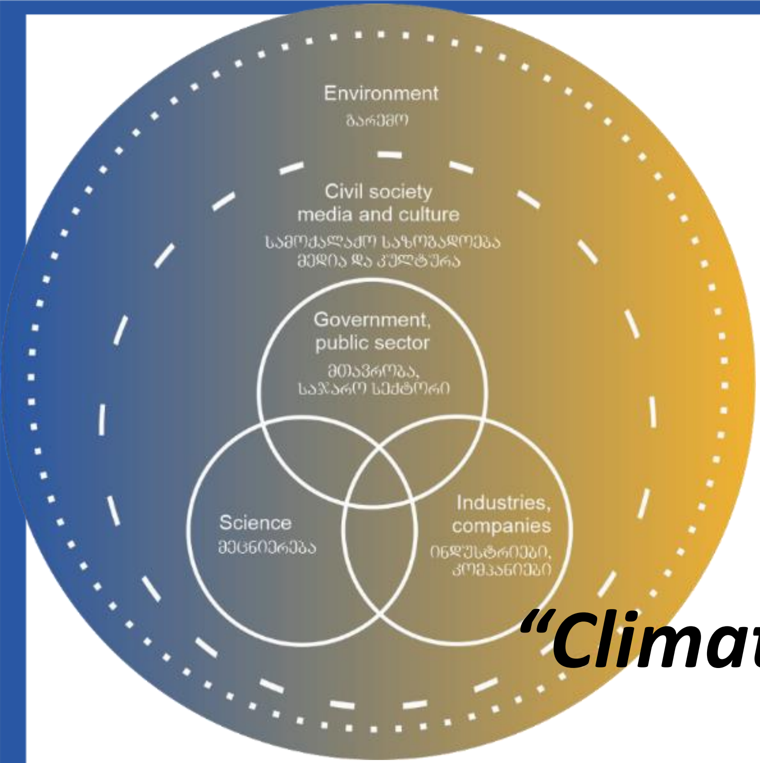

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EU ENI East Twinning project
Supporting inter-sectoral collaboration possibilities between Research and Industry
GE 18 ENI OT 02 19

Public lecture

"Climate change and renewable energy sources in Georgia"

24 September 2021, Tbilisi, Georgia,
in the framework of the "European Researchers' Night" organized by SRNSFG

science KNOW

by Gilbert Ahamer

business GROW

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SCIENTIA VINCES

2^{nd} title: how to communicate science?

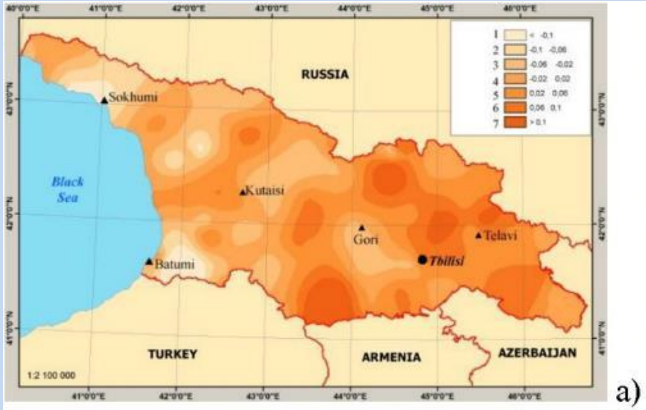
… learn from mistakes & positive examples

Source: https://iea.blob.core.windows.net/assets/24da4104-6971-4cde-99d3-630f455ae2c3/Georgia_2020_Energy_Policy_Review.pdf

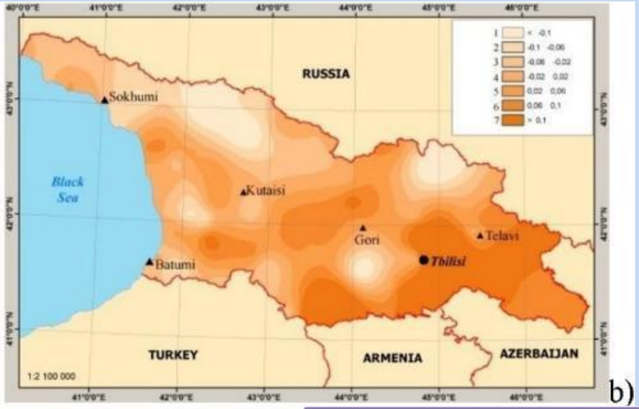
How did the climate change in Georgia?

Warming is more intense in eastern Georgia (cooling in the west).

Precipitation decreased at a rate of 1–3% per decade.



a)



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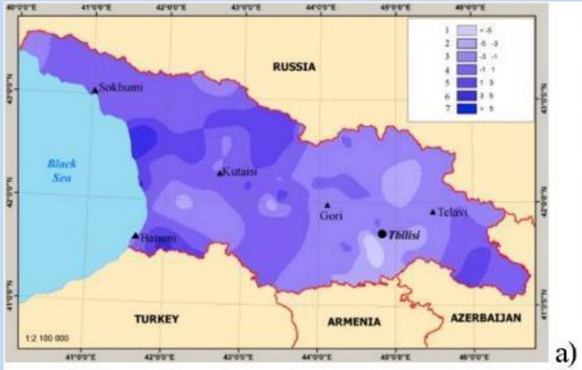
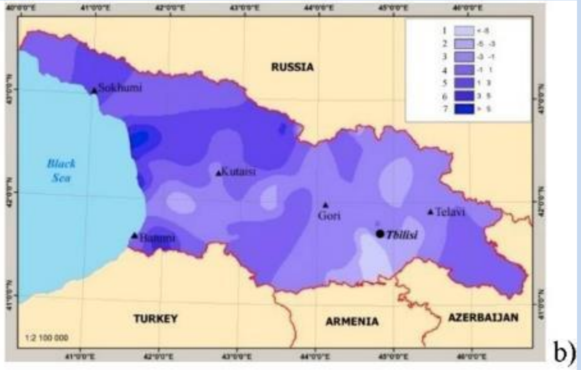


a)



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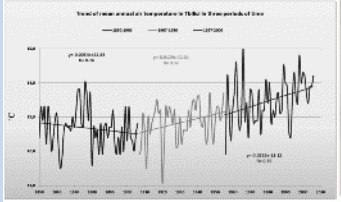


c)

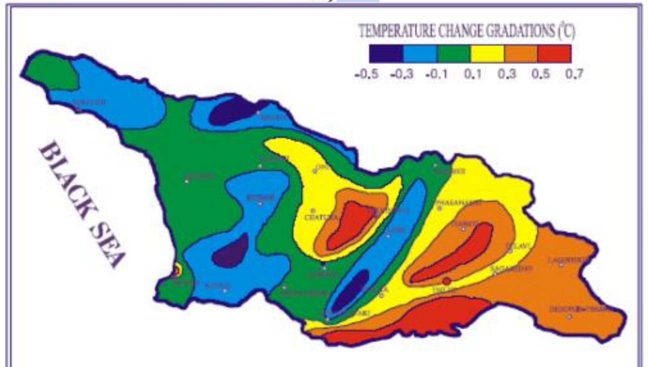
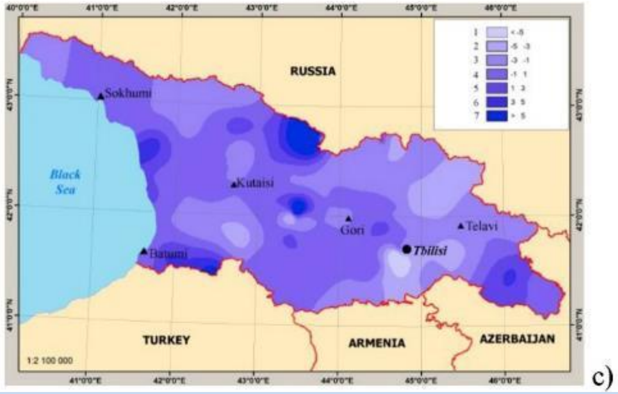


FIG. 7.1.4.CHANGE OF MEAN ANNUAL AIR TEMPERATURE FOR THE PERIOD 1906-1995



c)

Decadal trend of mean air temperature in °C (at left) and precipitation (at right): a) year; b) January; c) July.

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Source: https://www.sciencedirect.com/science/article/pii/S1512188717300118

Key climate impacts in Georgia

CLIMATE PROJECTIONS

0.8°–1.4°C increase in temperatures by 2050

Increased unpredictability and intensity of seasonal rains

Increased incidence of natural disasters such as landslides, mudslides, floods and droughts

KEY CLIMATE IMPACTS

Agriculture
Shifts in production zones
Crop loss in extreme events
Introduction of new pests/diseases

Water
Accelerated glacial melt, altering river flows and water availability
Damage to water infrastructure

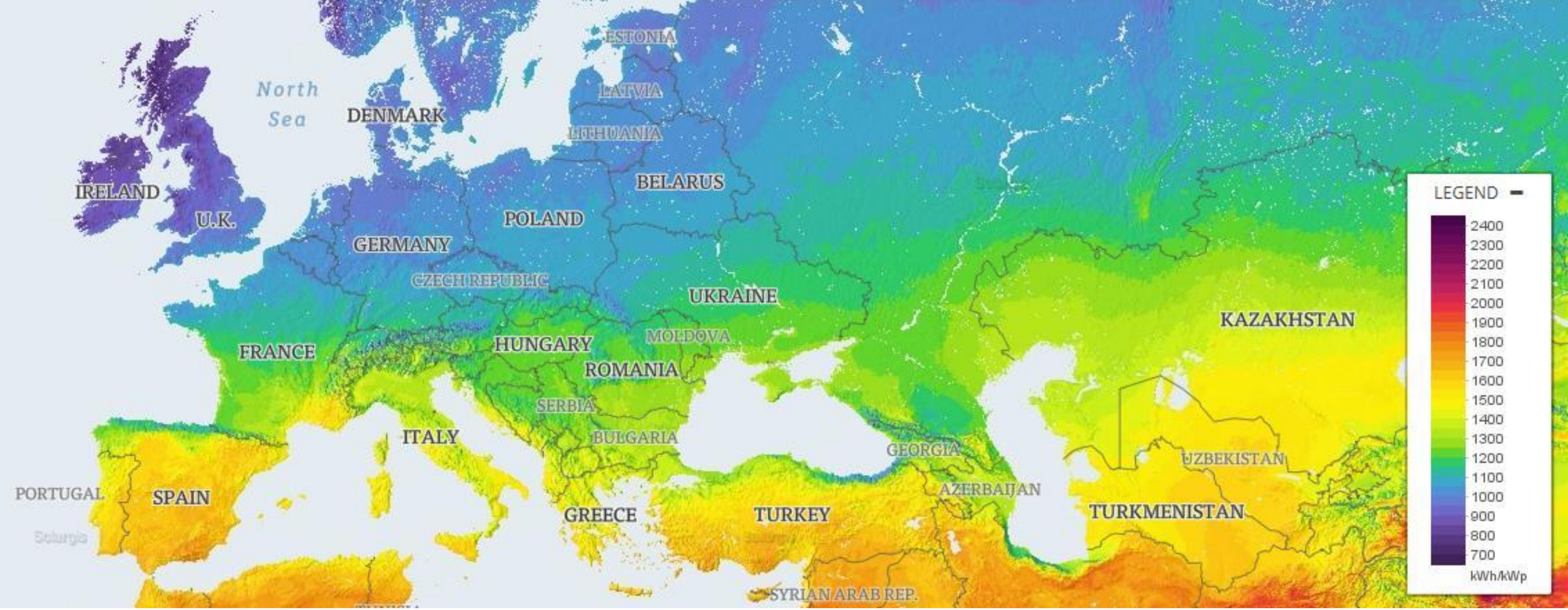
Human Health
Increased incidence of heat-related issues
Exacerbation of existing diseases
Risk of spreading vector-borne disease

Energy
Decreased hydropower potential
Damage to energy infrastructure, interrupting services

Tourism
Losses to key tourist centers, particularly ski resorts, beaches, and hiking and birdwatching destinations

Ecosystems
Displacement/migration of species
Shift/reduction in forest cover
Introduction of new pests/diseases

Source: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20ATLAS_Climate%20Change%20Risk%20Profile%20-%20Georgia.pdf



COULD GEORGIA 🇬🇪 BECOME A PIONEER IN FIGHTING GLOBAL CLIMATE CHANGE?

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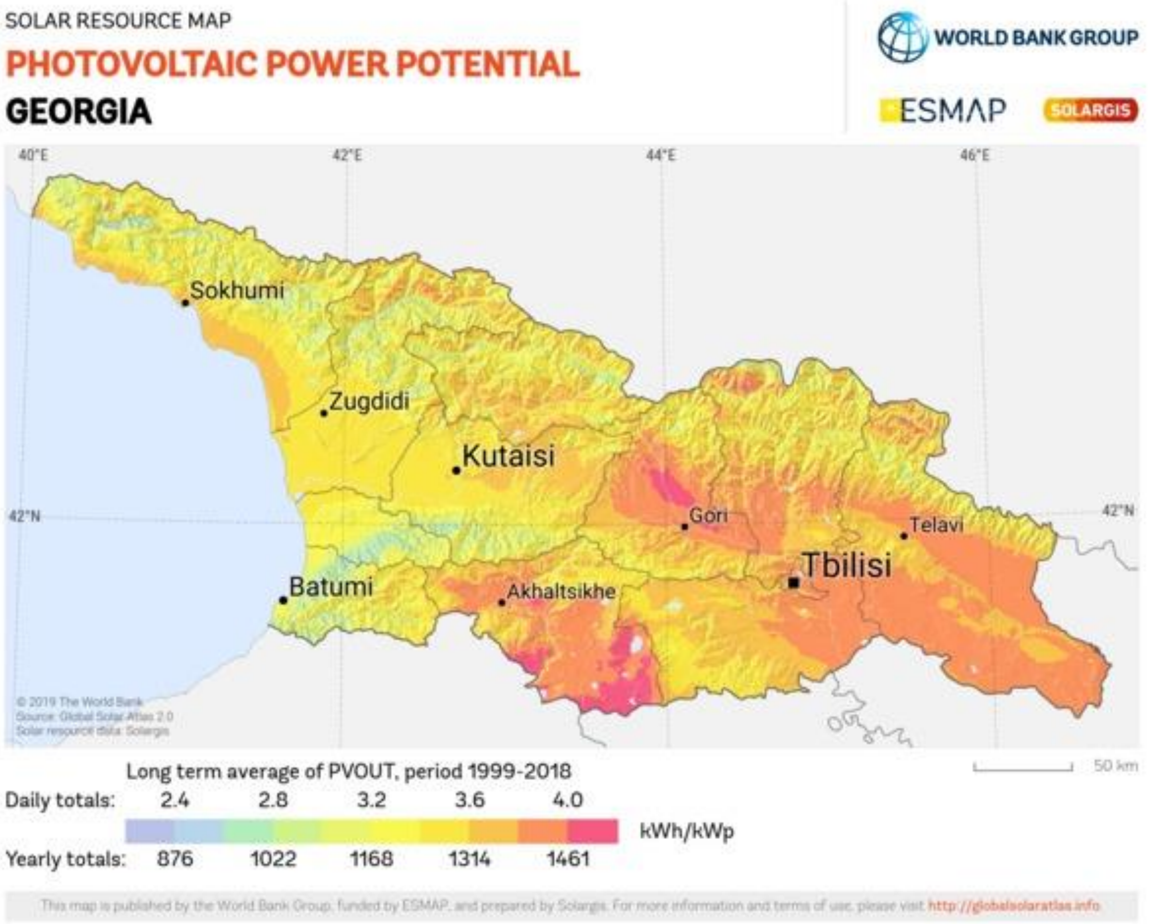
Yes!

(in Georgia, the US state)



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Examples from Georgia, as it is now: 1

ENERGY WEEK GEORGIA 2020
28-30 JANUARY TBILISI

RENEWABLE ENERGY PROJECTS ON CONSTRUCTION, LICENSING AND FEASIBILITY STAGES *

* source - the Ministry of Economy and Sustainable Development of Georgia

SOLAR

PROJECT	ESTIMATED INSTALLED CAPACITY (MW)	ESTIMATED ANNUAL GENERATION (GW*h)
FEASIBILITY STUDY		
Gareji Solar Farm	15	22
Karaleti Solar Farm	2.00	2.873
Plavi Solar Farm	7.00	10.36
Kvemaki Solar Farm	14.00	19.84
AE Power Tbilisi Solar Farm	50	70
TOTAL	**88.00**	**125.07**
CONSTRUCTION STAGE		
Udabno Solar Farm	5.00	6.80

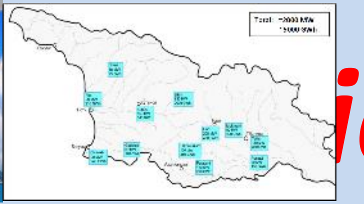
ENERGY WEEK GEORGIA 2020
28-30 JANUARY TBILISI

RENEWABLE ENERGY PROJECTS ON CONSTRU[...] LICENSING AN[...] STAGES *

* source - the Ministry of Economy and Sustainab[...]

WIND

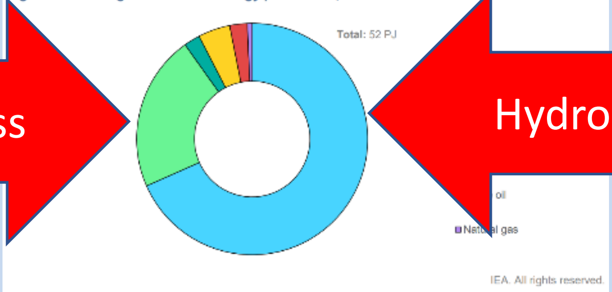
PROJECT	ESTIMATED INSTALLED CAPACITY (MW)	ESTIMATED ANNUAL GENERATION (GW*h)
FEASIBILITY STUDY		
Imereti 1 Wind Farm	300	1100
Rikoti Wind Farm	65	218.97
Phona Wind Farms	25	87
Central Wind Farms	120	560
Nigoza Wind Farm	40	207
Kartli 2 Wind Farm	100	317
Tkibuli Wind Farm	50	321
Tbilisi Wind Farm	49.5	199.938
Martkopi Wind Farm	50.4	172.196
Kutaisi Wind Farm	50	171.1
Kaspi Wind Farm	50	204.8
Phlevi Wind Farm	34.5	140.463
Zestaponi Wind Farm	50	165
Khashuri Wind Farm	12	21.6
Pirveli Wind Farm	110	388
Pirveli 1 Wind Farm	30	114
Saskadze Wind Farm	15	56
Zemo Wind Farm	11	39.4
TOTAL	**462.40**	**1672.50**



Map of highly productiove wind energy in Georgia

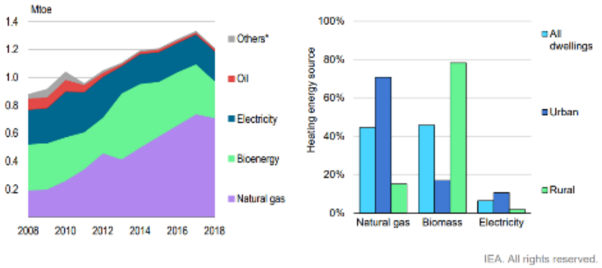
Source: https://geenergyweek.com/wp-content/uploads/2019/11/Solar.pdf

Figure 1 Georgia's domestic energy production, 2018



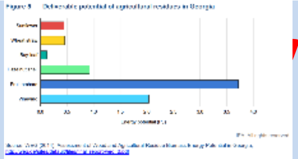
Notes: PJ= petajoule. "Other renewables" = geothermal, solar and wind.
Source: Geostat (2019), *Energy Balance of Georgia.*

Figure 2 TFC in Georgia's residential sector (left) and heating fuel by location (right)



* Includes coal, solar thermal, geothermal and district heat; not visible at this scale.
Notes: TFC = total final consumption. Mtoe = million tonnes of oil equivalent (1 Mtoe = 41.9 PJ).
Sources: IEA (2020), *World Energy Balances 2020* (database), www.iea.org/statistics; Geostat (2017), *Energy Consumption in Households.*

ion



hat

Source: https://iea.blob.core.windows.net/assets/5ec84fa6-e6fe-40ce-b1b0-661efa84f99c/Sustainable_Bioenergy_for_Georgia_A_Roadmap.pdf

Total Installed Capacity of the Energy System

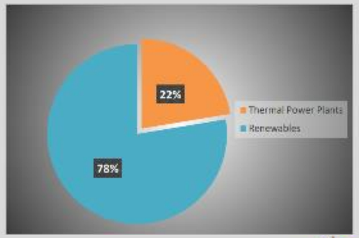
Ministry of Economy and Sustainable Development of Georgia

Total: 4206.8 MW

Hydro Power:
87 Operating HPPs
Installed Capacity –3260.07 MW

Wind Power:
1 Operating WPP
Installed Capacity – 20.7 MW

Thermal Power:
5 Operating TPPs
Installed Capacity – 926 MW



Hydro Potential of Georgia

Ministry of Economy and Sustainable Development of Georgia

- Untapped hydro resources
- One of the top countries in water resources per capita
- 300 out of 26,000 rivers capable of providing excellent opportunities for hydropower production
- Only 22% of total hydro potential is utilized
- HPP Greenfield potential of 40 TWh
- World's second highest concrete arch dam with a height of 271.5 meters (891 ft)

Source: https://unece.org/fileadmin/DAM/energy/se/pp/gere/GERE.6_Oct.2019/2_RE_Auctions/2_M.Arabidze_Georgia.6th.GERE.pdf

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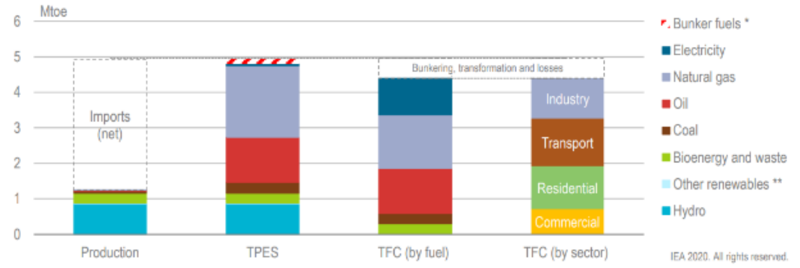
Examples from Georgia, as it is now: 2

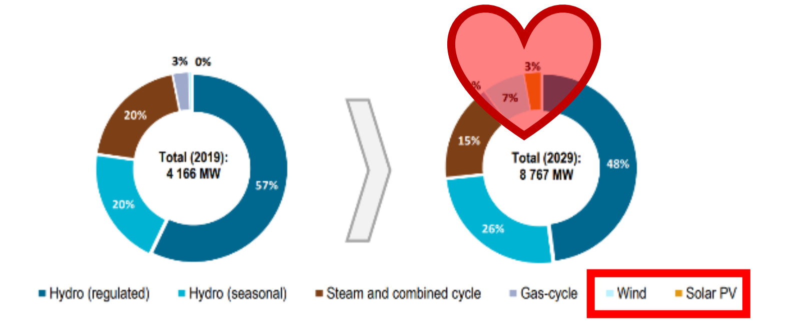
Figure 2.2 Energy production, supply and consumption by fuel and sector, 2018



Georgia is a net energy importer, with natural gas and oil dominating the energy supply.

* Includes international aviation and marine bunker fuel. Not included in TPES.
** Includes wind, geothermal and solar thermal.
Note: Mtoe = million tonnes of oil equivalent.
Source: IEA (2020), *World Energy Balances 2020* (database), www.iea.org/statistics.

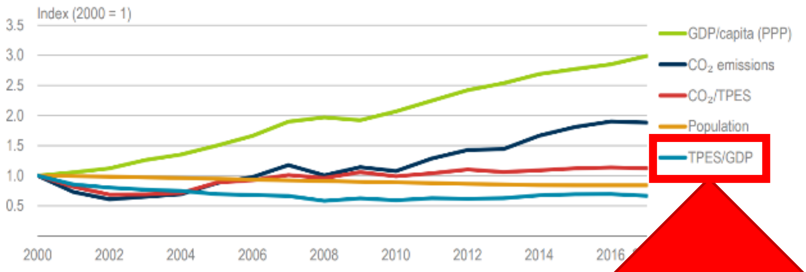
Figure 6.4 Georgia's projected electricity generating capacity



Considering Georgia's recent progress in commissioning new plants, the GSE projection that total installed capacity will more than double by 2029 is unlikely to be realised.

Source: GSE (2019), Ten-Year Network Development Plan of Georgia 2019-2029.

Figure 7.3 Georgia's energy-related CO_2 emissions and main emissions drivers, 2000-17

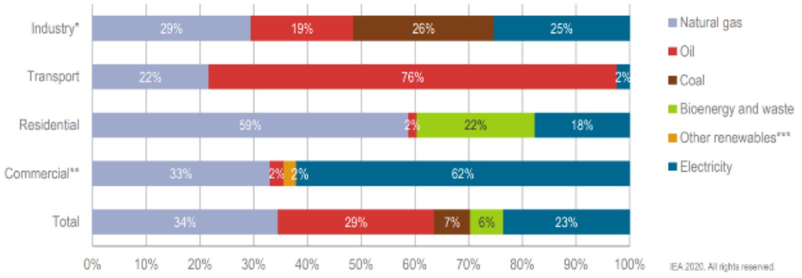


Georgia's GDP per capita (at PPP) has grown by over 150% since 2000, a … increase in energy-related CO2 emissions.

Notes: TPES = total primary energy supply. GDP/capita (PPP) is constant GDP in USD 2010 …
Source: IEA (2019), *CO_2 Emissions from Fuel Combustion* (database), www.iea.org/statistics.

energy intensity improved, then worsened

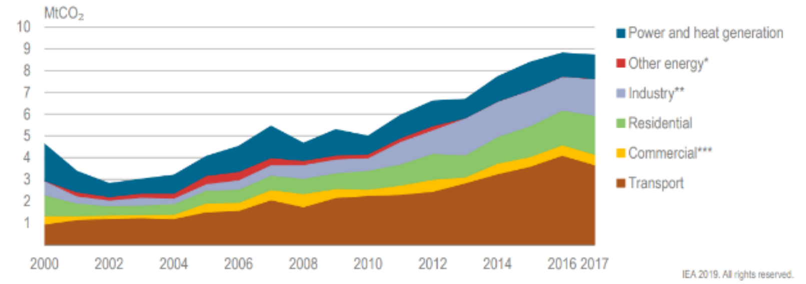
Figure 2.7 Total final consumption by source and sector, 2018



Natural gas and oil dominate except in the commercial sector, which uses mainly electricity.

* Includes non-energy consumption.
** Includes commercial and public services, agriculture and forestry.
*** Includes geothermal and solar thermal.
Note: For ease of readability, shares of less than 1% are not shown.
Source: IEA (2020), *World Energy Balances 2020* (database), www.iea.org/statistics.

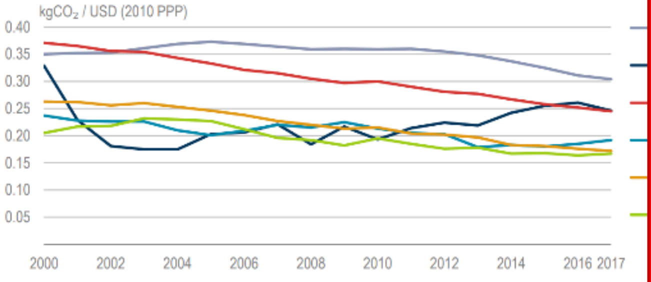
Figure 7.2 Georgia's energy-related CO_2 emissions by sector, 2000-17



Georgia's energy-related CO_2 emissions have increased mainly because of higher energy consumption in the transport sector.

* Includes emissions from coal mines and oil and gas extraction.
** Includes CO_2 emissions from combustion at construction and manufacturing industries.
*** Includes commercial and public services, agriculture/forestry and fishing.
Source: IEA (2019), *CO_2 Emissions from Fuel Combustion* (database), www.iea.org/statistics.

Figure 7.5 CO_2 intensity in Georgia and selected countries, 2000-17



Georgia's CO_2 intensity is on an upward trajectory, contrary to the avera… Annex I countries. The increase is linked primarily with the country's eco…

Source: IEA (2019), *CO_2 Emissions from Fuel Combustion* (database), www.iea.org/statistics.

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Source: https://iea.blob.core.windows.net/assets/24da4104-6971-4cde-99d3-630f455ae2c3/Georgia_2020_Energy_Policy_Review.pdf

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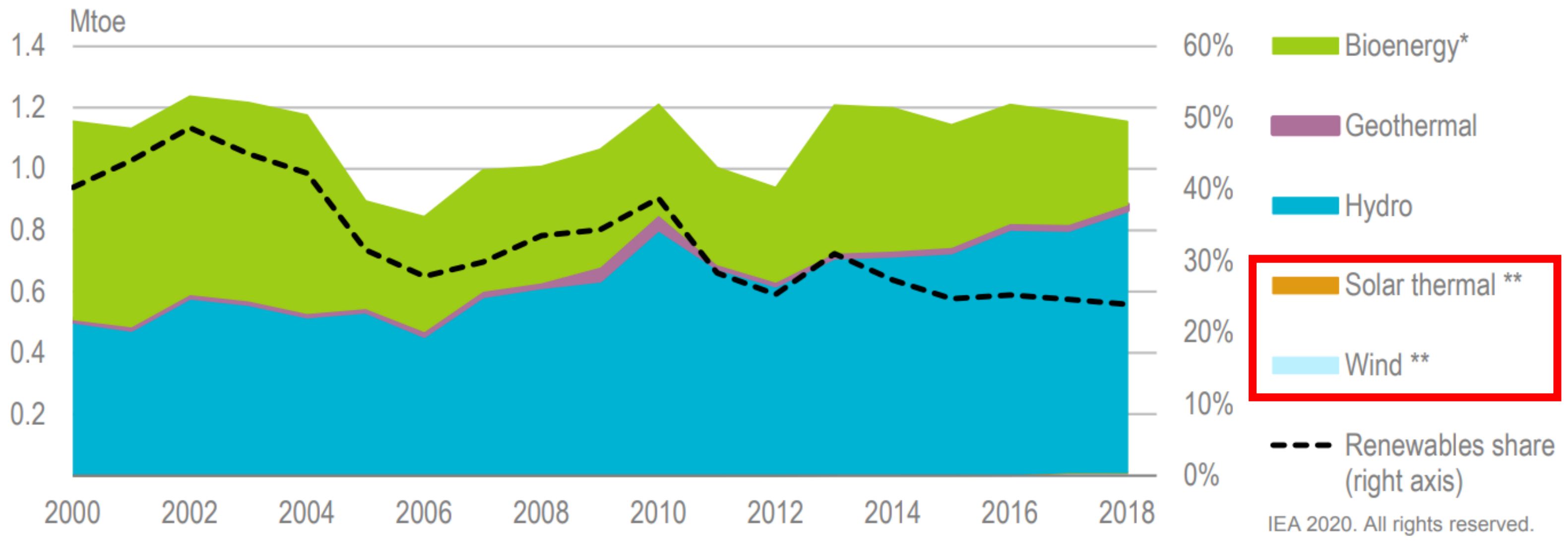
Examples from Georgia, is more possible?

Figure 9.2 Renewable energy in Georgia's TPES, 2000-18



Bioenergy and hydro are currently Georgia's main renewable energy sources.

* Includes solid primary biofuels

** Not visible at this scale.

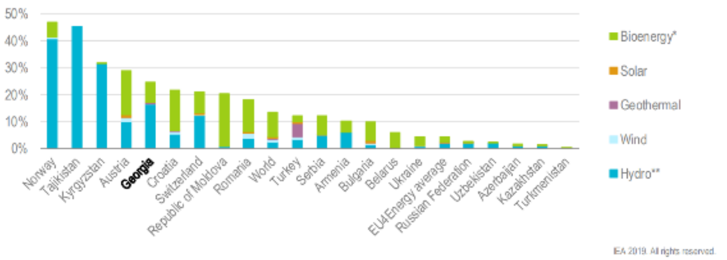
Note: Mtoe = million tonnes of o

Source: IEA (2020), *World Energy Balances 2020* (database), www.iea.org/statistics.

Solar & wind: too small to be seen NOW!

While Georgia ranks high …

Figure 9.4 Renewable energy shares in TPES of selected countries, 2017



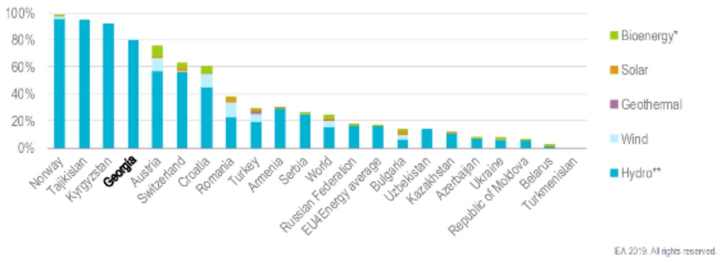
Georgia's share of renewables in the TPES (almost 30%) is two times higher than the world average.

* Includes solid biofuels, renewable waste, liquid biofuels and biogases.

** Includes hydropower (excluding pumped storage) and tidal, wave and ocean energy.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Figure 9.6 Renewable energy in electricity generation in selected countries, 2017



Georgia's renewable share in electricity generation (almost 80%) is notably higher than the world average of just above 20%.

* Includes solid biofuels, renewable waste, liquid biofuels and biogases.

** Includes hydro power (excluding pumped storage) and tidal, wave and ocean energy.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

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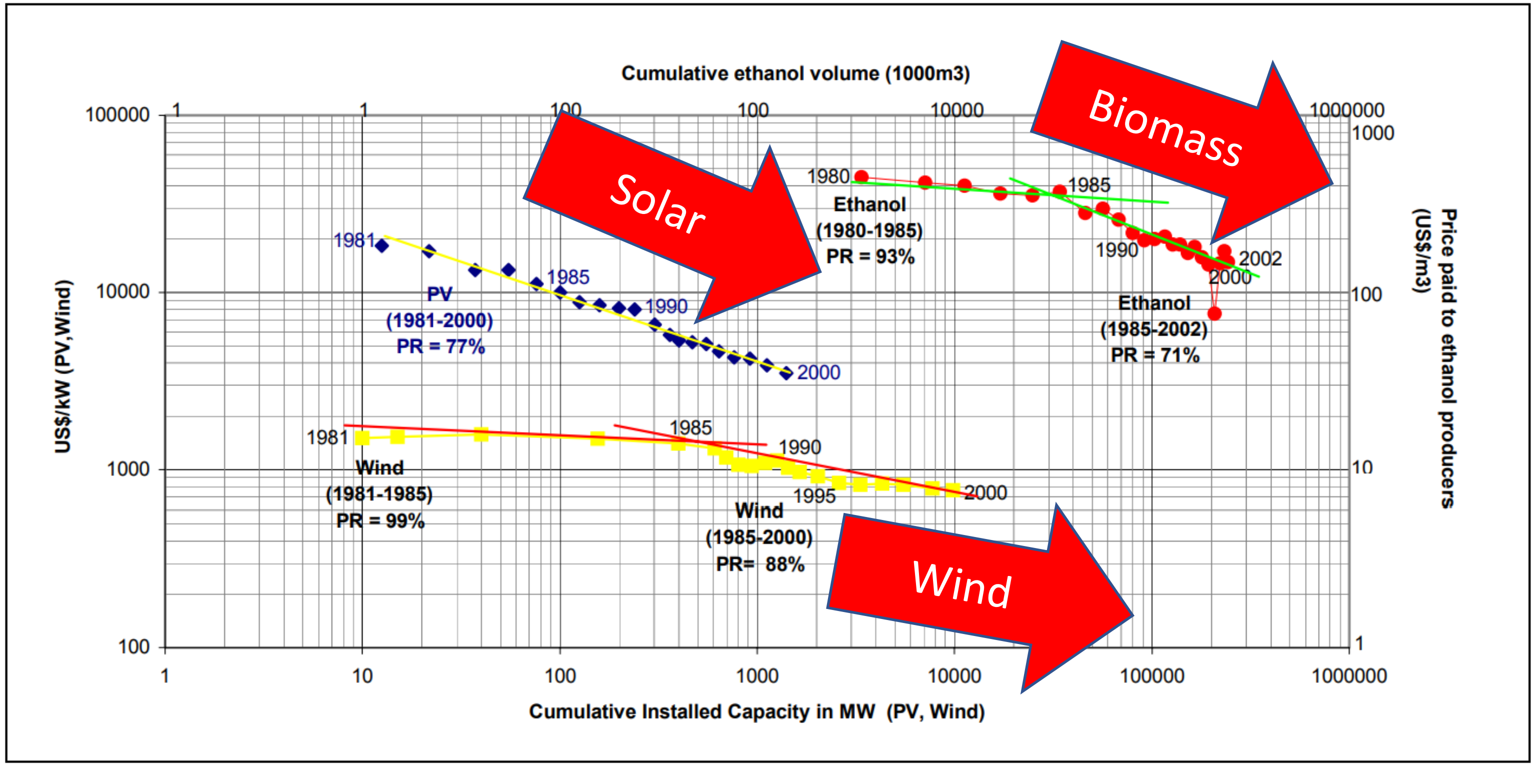
Source: https://iea.blob.core.windows.net/assets/24da4104-6971-4cde-99d3-630f455ae2c3/Georgia_2020_Energy_Policy_Review.pdf

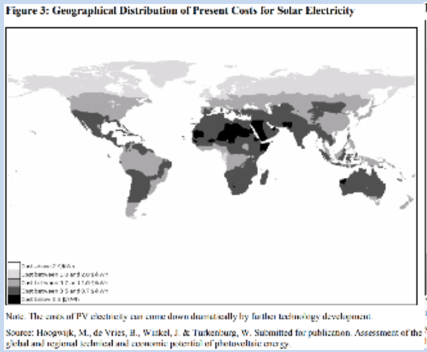
Prices for renewables decrease strongly

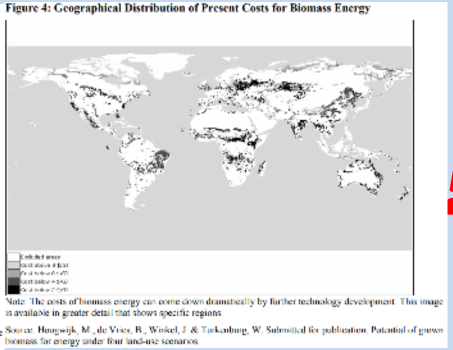
Figure 1: Experience Curves for Photovoltaics, Windmills, and Ethanol Production



Sources: for wind turbines, L. Neij., P. Dannemand Andersen., M. Durstewitz, P. Helby, M. Hoppe-Kilpper, and P.E. Morthorst, Experience Curves: A Tool for Energy Policy Assessment (2003); for photovoltaics, V. Parente, R. Zilles, and J. Goldemberg, "Comments on Experience Curves for PV Modules," Progress in Photovoltaics: Research and Applications, John Wiley & Sons, Ltd (2002); for ethanol, J. Goldemberg, S.T. Coelho, P. M. Nastari, and O. Lucon, "Ethanol Learning Curve: The Brazilian Experience," Biomass and Energy (Submitted for publication).

With increasing capacity installed, prices for solar, wind and biomass energy) decrease considerably – and already overtook attractivity of fossil fuels as of now!





!

Source: https://ren21.net/Portals/0/documents/irecs/renew2004/The%20Potentials%20of%20Renewable%20Energy.pdf

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Examples from Georgia: the IEA assessment

Avoid huge text!

Reduce to key message!

Create:

1. Strategies

2. Competitiveness

Assessment

Georgia has vast renewable energy resources, but there has been no comprehensive assessment of their economic potential. Although hydropower sites have been inventoried,[31] there seems to be no systematic procedure assessing and ranking optimal locations for the construction of HPPs or other RES plants. Such an assessment should be done using a comprehensive methodology that analyses production potential, cost of deployment for individual renewable technologies by region, the existing and planned grid, estimated environmental and social impacts, and resource-sharing across sectors. In assessing hydropower potential, alternative water uses – for irrigation, drinking, tourism, etc. – should be considered, as well as projections of climate change effects. Site selections should be made public and prioritised to give clear signals to investors.

Georgia's net metering programme for small-scale RES installations (less than 100 kW) is off to a good start. The incentives have begun to attract small business and household investments in rooftop PV, and total capacity had reportedly reached 1.2 MW by September 2019. These distributed generation sources have numerous benefits, including network loss reductions (because the energy is generated close to where it is consumed) and improved energy security (because many small generation sources are less likely to fail simultaneously, compared with one large generation source with a complex delivery system). However, seizing these opportunities may require that changes be made to connection codes, regulations and market rules. It is important that the government keep this in mind as Georgia's power market reform advances.

Regarding medium- and large-scale projects, the PPAs introduced in 2008 offered predictable conditions and a protective framework for investors. They successfully attracted hydropower investment even though the allocation of PPAs and price determination were not transparent. Because of the high fiscal liability created by them, however, they have been abolished. No new RES support schemes had been introduced as of late 2019 to replace PPAs for medium- and large-scale projects, although the MoESD is studying several mechanisms.

Box 9.1 Barriers to RES development in Georgia

In 2019, the US Agency for International Development (USAID) assessed barriers to RES development in Georgia, and the developers and investors surveyed reported the following problems:

- Complex administrative procedures, and a lack of clarity and certainty about some processes.
- Lack of guaranteed offtake at an attractive price or alternate support. The cap of USD 0.06/kWh in the new PPAs for HPPs is considered unattractive by investors.
- Uncertainties about the structure and functioning of the new electricity market, which is a risk.
- Grid connection delays and refusals for small projects; inappropriate connection points for larger ones.
- Opposition of the local population.
- Lack of hydrology data and resource assessments for other RESs.

Source: Data provided at meeting with donors and IFIs, 2 October 2018, Tbilisi.

The Energy and Water Supply Law and the Law of Georgia on Promoting the Production and Use of Energy from Renewable Sources were approved by the Georgian government in late 2019 after the review mission took place. The next step would be to put in place the relevant secondary legislation; until then, framework conditions and legal certainty for investors will remain insufficient and investment in RESs will therefore likely continue to fall.

To comply with the EU acquis, Georgia should introduce market-based support schemes for RESs to ensure the smooth integration of renewable-energy generators into the future power market. Even during the transition period – i.e. before the electricity market is fully functional – competitive and transparent mechanisms for RESs can be put in place. Auctions could be a good option, and to limit the risk of collusion, annually adjusted price caps could be introduced.

Although the government adopted the Energy Strategy in October 2019, the country still lacks a comprehensive document or work process to develop a strategic vision, specific targets, and clear and transparent prioritisation of development projects, especially for RESs. This adds to uncertainty about the future of RESs in Georgia.

The development of targeted strategies needs to be underpinned by good data. The Georgian government should therefore produce and publish comprehensive data on renewables following international standards (e.g. the UN International Recommendations for Energy Statistics), including:

- Resource data for different RESs (e.g. solar and wind atlas).
- Deployment data for individual renewable technologies under specific policy mechanisms.
- Deployment cost data (e.g. in terms of levelised cost of energy).

The whole process – from receiving the rights to the site and data for project evaluation and planning, to negotiating terms and conditions with the government – is a complicated and lengthy process. There is a lack of co-ordination within and among the different government agencies, and there is no single point of contact or one-stop shop. The licensing process should therefore be streamlined and co-ordination among government agencies improved through establishment of a one-stop shop. The newly established Public-Private Partnership Agency could assume this role.

The lack of water-use permits and only dynamic water-use fees have created a legal and contractual gap that hinders the resolution of conflicts over water use, both upstream and downstream. Water rights have not yet been a serious issue as most HPPs are run-of-river installations and their sites neither have use of the river upstream nor affect downstream irrigation. However, as more HPPs are added (some with storage capacity), issues and conflicts over water use may well emerge. Also, as Georgia is required to align its regulations with the EU Water Framework Directive, which has some rather strict provisions, the government and policy makers are encouraged to continue working towards integrated river basin management.

Growing opposition to new HPPs by NGOs and local populations stems from the environmental and social impacts of these plants as well as some implementation flaws. In some cases, opposition is caused by a lack of understanding, whereas in others the assessments of environmental and/or social impacts do not correspond to international standards of quality. Clear government commitment to the development of certain hydropower projects, coherent communication with local communities, and better-quality impact assessments could help facilitate the development of new projects.

An issue that requires urgent attention at the highest policy level is the unsustainable use of biomass. Illegal biomass use has devastated Georgia's forests, especially around towns and villages and in the vicinity of forest roads. The disappearance of biomass resources results in biodiversity loss, landslides and land erosion, flash floods and greater energy poverty.

The government should therefore enhance efforts to ensure the replacement of unsustainable biomass use by more viable alternative solutions, keeping in mind that the transition to more modern fuels can be financially challenging for households. First, the ongoing forestry reform should be accelerated to implement robust forest resource management. Second, the use of waste and residue resources should be supported, for example by developing logistical solutions and targeted support mechanisms for small businesses. Third, more efficient stoves should be introduced along with other energy efficiency measures to reduce consumption.

As climate change is making it more challenging to generate renewable energy from water and biomass, its impact on hydropower production should be assessed and Georgia's reliance on hydropower could be reduced through the development of other RESs. Hydropower development should be incorporated into the wider context of water resource management and climate change adaptation.

Recommendations

The Government of Georgia should:

- ☐ Ensure that the NREAP and the overall national Energy Strategy have a strategic vision for RES development, including production targets for hydropower and other RES technologies, and that a transparent methodology is used to prioritise RES projects on the basis of this strategic vision.
- ☐ Establish a monitoring and reporting system to produce and publish comprehensive data on renewable resources, the deployment of RES technologies under specific policy mechanisms and the cost of deployment.
- ☐ Create competitive and transparent mechanisms, such as auctions, to attract investment for RES projects, and consider setting price caps as part of an auction mechanism.
- ☐ Clarify and streamline the authorisation and licensing process for new RES plants, for example by establishing a single point of contact.
- ☐ Define a transparent communication strategy for contentious RES projects and support project developers with awareness-raising campaigns and stakeholder involvement.
- ☐ Develop and apply a methodology for comprehensive resource assessment and identification of RES potential to select the best locations for RES plants, taking environmental and social impacts into account.
- ☐ Enhance efforts to stop the unsustainable use of forest wood.

Source: https://iea.blob.core.windows.net/assets/24da4104-6971-4cde-99d3-630f455ae2c3/Georgia_2020_Energy_Policy_Review.pdf

The new mindset

Table 12: Renewable Energy Paradigms

Old Paradigm	New Paradigm
Technology assessment	Market assessment
Equipment supply focus	Application, value-added, and user focus
Economic viability	Policy, financing, institutional, and social needs and solutions
Technical demonstrations	Demonstrations of business, financing, institutional and social models
Donor gifts of equipment	Donors sharing the risks and costs of building sustainable markets
Programs and intentions	Experience, results, and lessons
Cost reductions	Competitiveness on the market place

Adapted from: Martinot, E., Chaurey, A., Lew, D., Moreira, J.B. & Wamukonya, N. 2002. Renewable Energy Markets in Developing Countries. Annual Review of Energy and the Environment. 27: 309-348.

Source: https://ren21.net/Portals/0/documents/irecs/renew2004/The%20Potentials%20of%20Renewable%20Energy.pdf

Energy systems … mirror … **social** systems

Pyramids = *vertical*

Noosphere = *horizontal*

Source: https://ren21.net/Portals/0/documents/irecs/renew2004/The%20Potentials%20of%20Renewable%20Energy.pdf

Energy systems … mirror … social systems

Centrally planned energy systems:
nuclear, fossil –
need strong protection

Distributed energy systems:
solar, efficiency improvements

Source: https://ren21.net/Portals/0/documents/irecs/renew2004/The%20Potentials%20of%20Renewable%20Energy.pdf

What are the obstacles to a renewable energy future?

Our survey in a typical post-socialist country (Ukraine) yielded answers:

- The key obstacles for further Renewable Energy increase were identified to belong to the following main five groups:

1. **Financial, e.g. how to obtain suitable and cheap credits**
2. **Administrative, e.g. how to master the complex application process**
3. **Technological, e.g. types of RES installations and how to choose them**
4. **Social, e.g. energy cooperatives**
5. **Fact-based information on RES**

Source: https://iea.blob.core.windows.net/assets/24da4104-6971-4cde-99d3-630f455ae2c3/Georgia_2020_Energy_Policy_Review.pdf

Can we reach the target?

How?

Source: https://iea.blob.core.windows.net/assets/24da4104-6971-4cde-99d3-630f455ae2c3/Georgia_2020_Energy_Policy_Review.pdf

What was going on in Europe in 2019?

KLEINE ZEITUNG 15. März 2019 FREITAG GRAZ PRINT | WEB | APP

2.700 | Die Kleine Zeitung hat die meisten Digital-Abonnenten* Österreichs. Interesse? kleinezeitung.at/abo

In 1650 Städten in aller Welt demonstrieren heute nach dem Vorbild der schwedischen Umweltaktivistin Greta Thunberg Schüler und Studenten.

Junge machen fürs Klima mobil

4 | Thema des Tages

Kleine Zeitung Freitag, 15. März 2019

Die Klimakrise ist bereits gelöst. Wir haben schon alle Fakten und Lösungen. Alles, was wir tun müssen, ist aufzuwachen und uns zu verändern.

Greta Thunberg, schwedische Klimaaktivistin

Längst mehr als ein zartes Pflänzchen

Die Schülerin Greta Thunberg trat mit ihrem Protest für das Klima eine eindrucksvolle internationale Bewegung los: An 1650 Orten demonstrieren heute die Jungen für die Umwelt.

DREI FRAGEN AN ...

Marlene Seidel, die in Graz den Protest-Freitag für das Klima mitträgt

Worum geht es euch?

Kleine Zeitung Freitag, 15. März 2019

Jugend kämpft fürs Klima | 5

Fotos und Videos von den Protesten Kleine-Zeitung-App kleinezeitung.at

Die streitbare Greta Thunberg (Mitte) mit ihrer belgischen Verbündeten Anuna De Wever (links von ihr im Bild)

Junger Protest von wegen Spaßgesellschaft

FRIDAYS FOR FUTURE

Die Protestierenden, sehr viele von ihnen sind Mädchen, fordern von der Politik „radikale Umweltschutzmaßnahmen" in Übereinstimmung mit dem zu erfüllenden 1,5-Grad-Ziel. Es gehe um Nachhaltigkeit und eine gesunde Atmosphäre – vor allem auch für kommende Generationen.

Youth says: **we** are now the "good examples" for you!

2 | Österreich

Kleine Zeitung Samstag, 16. März 2019

„Wir sind jetzt die Vorbilder"

DREI FRAGEN AN ...

Johannes Stangl, der „Fridays for Future" in Österreich mitorganisiert.

Wie fällt dein Fazit für den weltweiten Protesttag aus?

JOHANNES STANGL: Wir sind sehr glücklich. Bei dem Marsch in Wien waren viele Leute. Alle haben sich friedlich verhalten und ein starkes Signal an die Entscheidungsträger gesendet. Jetzt wollen wir mit der Politik in einen Dialog treten.

Zu Tausenden zogen Schülerinnen und Schüler durch Österreichs Hauptstädte, um den Schutz des Weltklimas einzufordern.

Von Thomas Götz

Sternmärsche haben in Wien Tradition. Aus allen Himmelsrichtungen zogen

Für das Klima

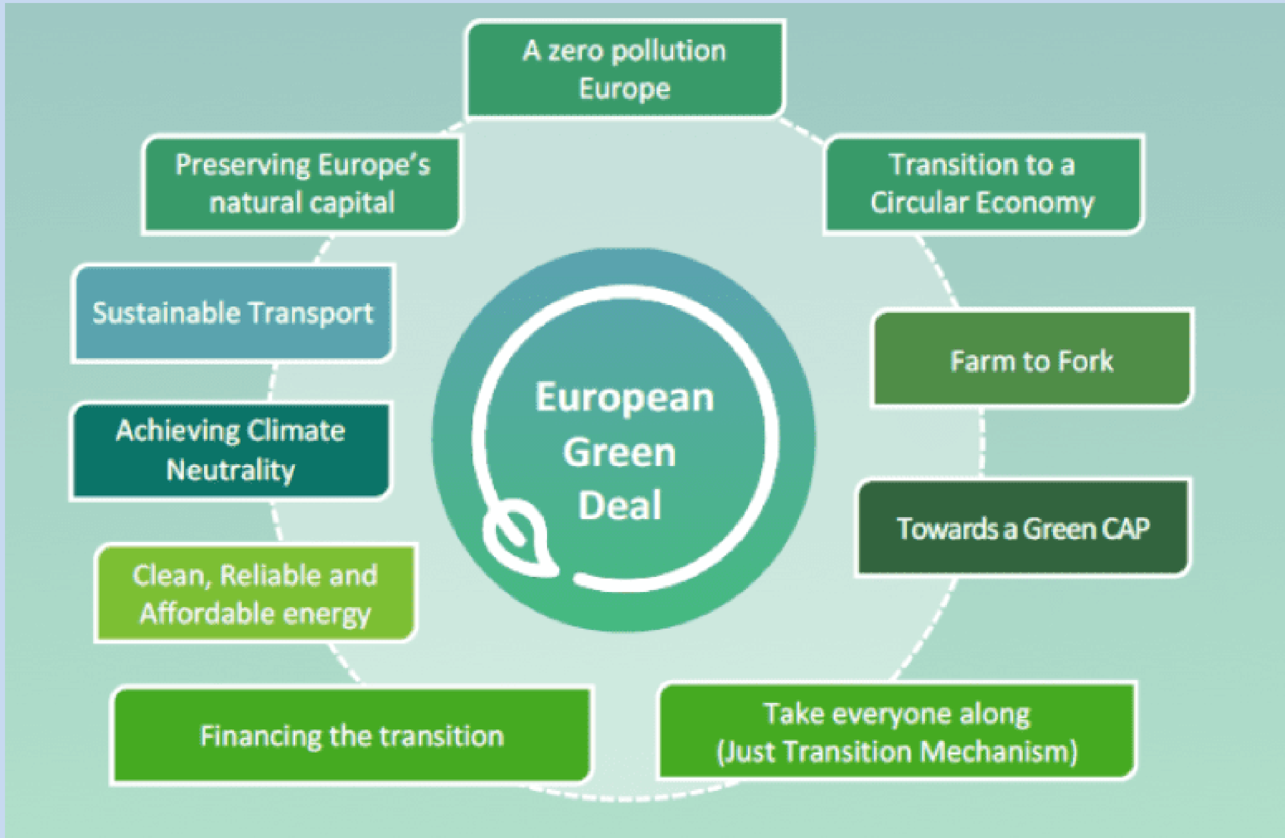
Greta Thunberg ist Ursprung der „Fridays for Future"-Bewegung. Die Schwedin war die Erste, die „Schulstreik fürs Klima" propagierte.

Alexander

Source: Kleine Zeitung

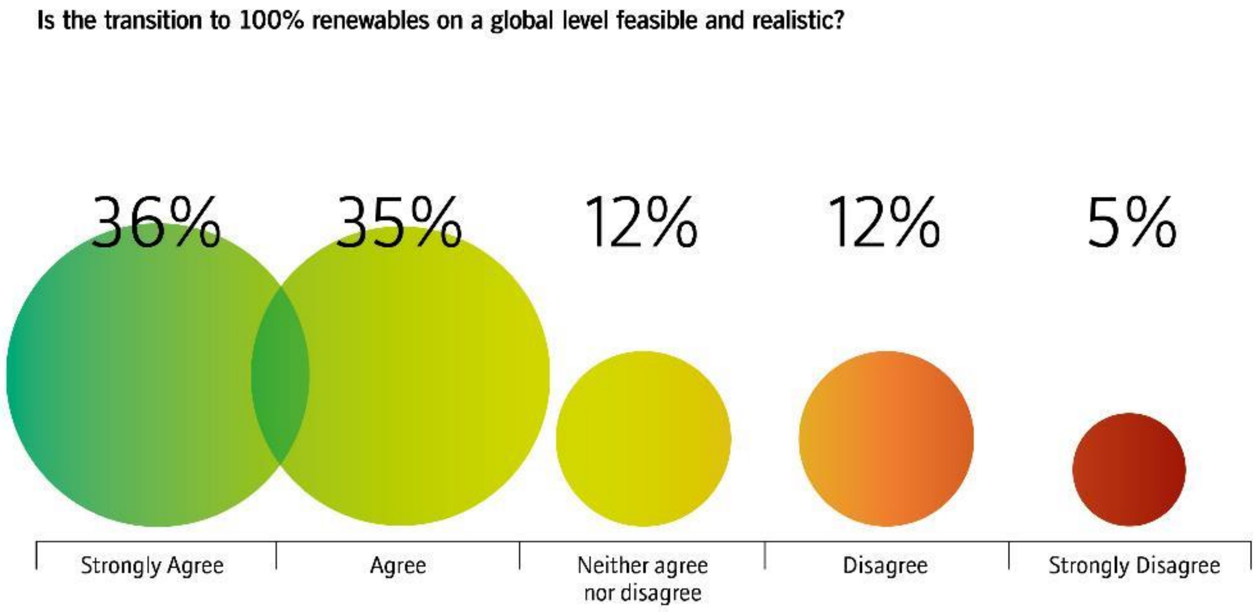
After these demonstrations, in 2020, the political result was: "EU Green Deal"!

- … a respectful result for engaged European Youth!
- ***Hopes** turned into a political **plan**:*
  - Climate neutrality
  - Clean, reliable & affordable energy
  - Financing the transition
  - "Leave no one behind"



ARE WE ALL REALISTS? – WHAT EXPERTS THINK:

- **71% agree** that a transition to 100% renewable energy is globally **feasible**



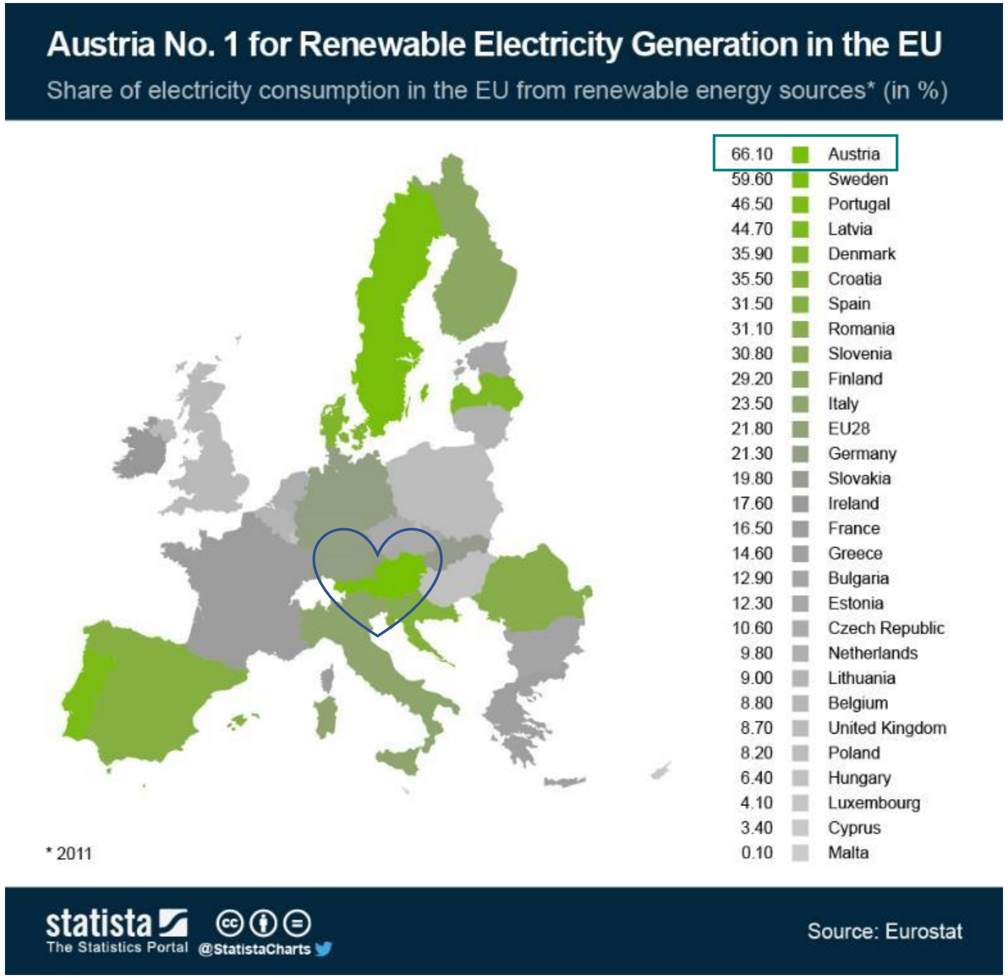
(114 expert interviewees from energy institutions worldwide)

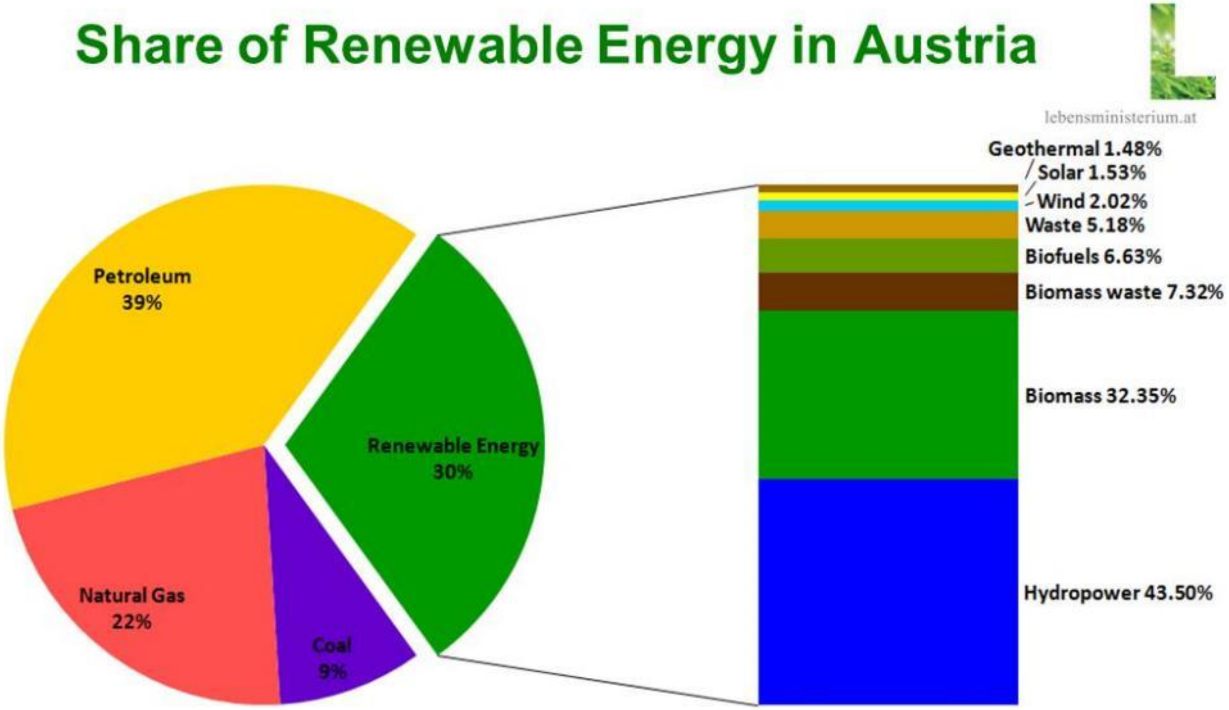
Renewables Global Futures Report Great debates towards 100 % renewable energy

REN21 Renewable Energy Policy Network for the 21st Century

Source: www.ren21.net/future-of-renewables/global-futures-report/

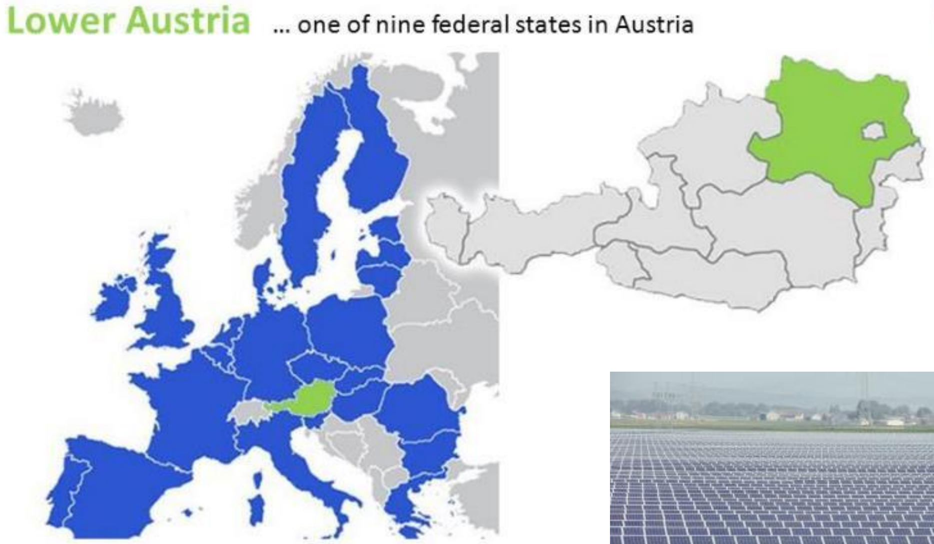
AUSTRIA IS A NUMBER 1: TODAY‘S REALITY

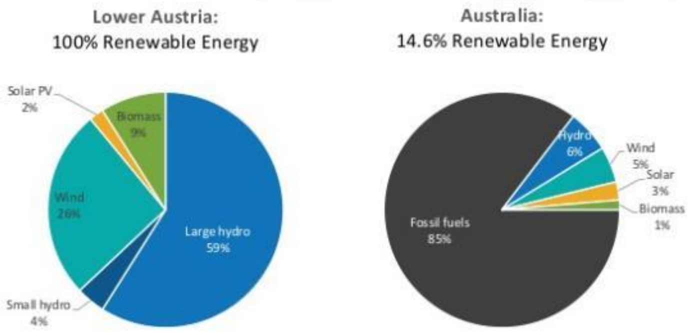




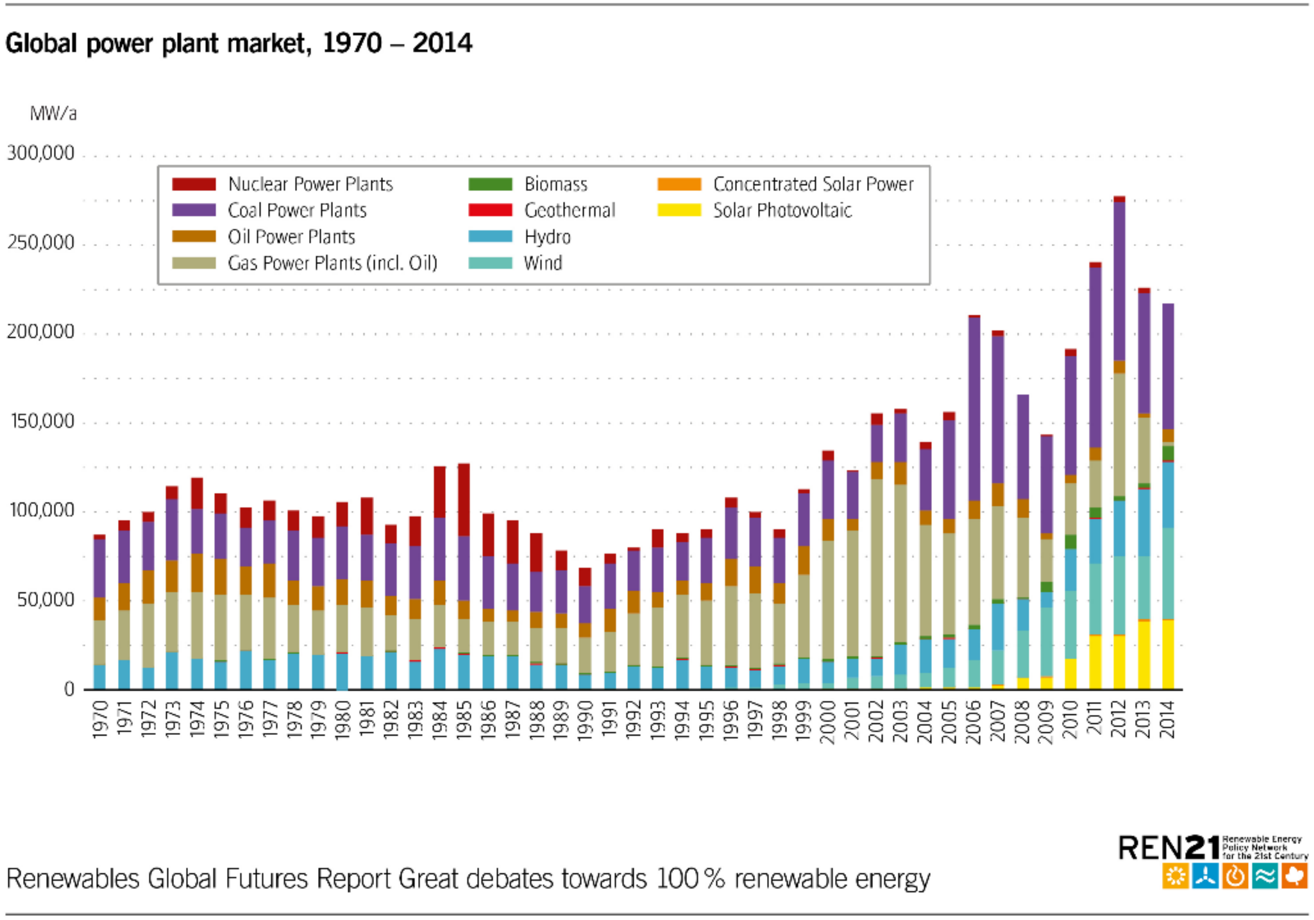
LOWER AUSTRIA: 100% RENEWABLE ELECTRICITY

- All electricity in Austria's largest federal state is now produced from renewables
- Hydroelectric power,
  wind energy,
  biomass and
  solar provide
  100% of electricity
  for 1.65 million people





WORLDWIDE: WHAT DOES **REAL MARKET** TELL US?



Source: Data: Platts, GWEC, SolarPowerEurope, REN21, Greenpeace, Data compilation: Dr. Sven Teske, UTS/ISF

Fuels for **new** power plants:

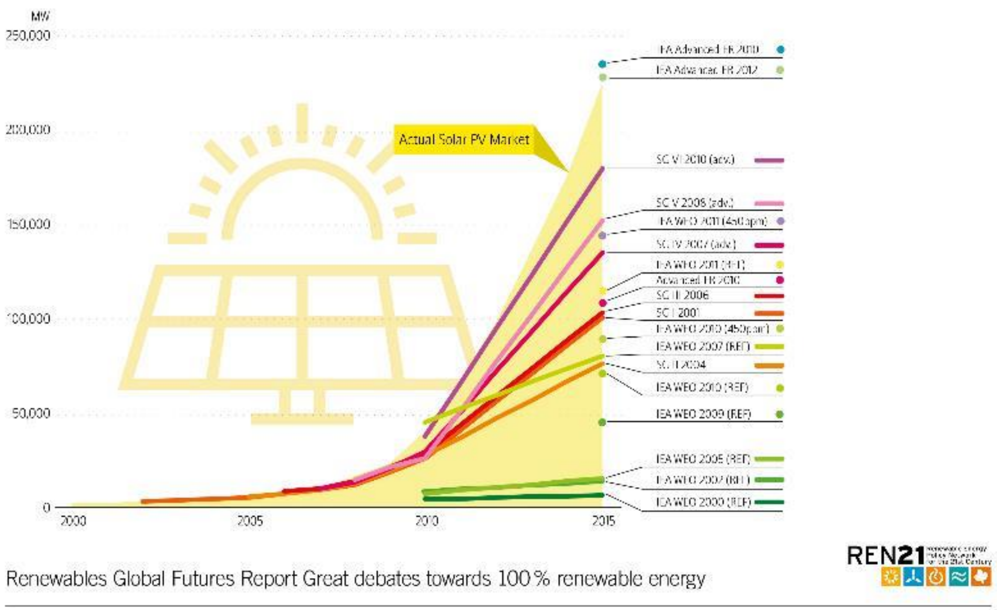
- Gas and Oil: ↓↓
- Nuclear: ↓↓
- **Solar: ↑↑**
- **Wind: ↑↑**
- **Hydro: ↑↑**

Source: REN21 report: www.ren21.net/future-of-renewables/global-futures-report/

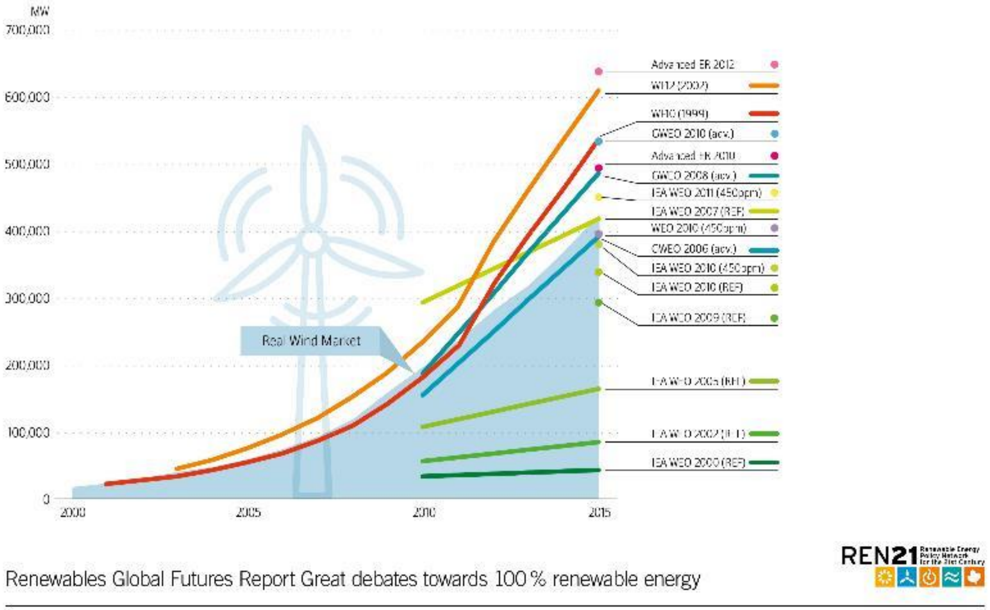
DID SCENARIOS TRULY TELL THE **FUTURE**?

- For solar (and wind), earlier scenarios were even **“under-optimistic”!**

Solar photovoltaic projections versus real market developments



Wind power projections versus real market developments



Source: REN21 report: www.ren21.net/future-of-renewables/global-futures-report/

My personal conclusion:

The **energy** system is the *manifestation of values* of the **societal** system.

I suggest: Self-responsible, reliable, sustainable, democratic values

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Source: life experience ;-)

მადლობა ყურადღებისთვის

Thank You!