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Renewable Energy in Cuba.
Role of intermittent renewable sources in the future.

Anaely Saunders, Jyrki Luukkanen, Yrjö Majanne & Burkhard Auffermann

23rd REFORM Group Meeting, Salzburg – October 13 – 19, 2019:
Geopolitics of the Energy Transformation and Energy Democracy

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CONTENTS OF THE PRESENTATION

- Characteristics of the Cuban Electrical System
- Reserves and Potential of Energy Resources in Cuba
- Potential of Renewable Energy Resources
- Development Plan until 2030: Renewable sources of energy and Energy efficiency.
- LINDA model.
- Conclusions

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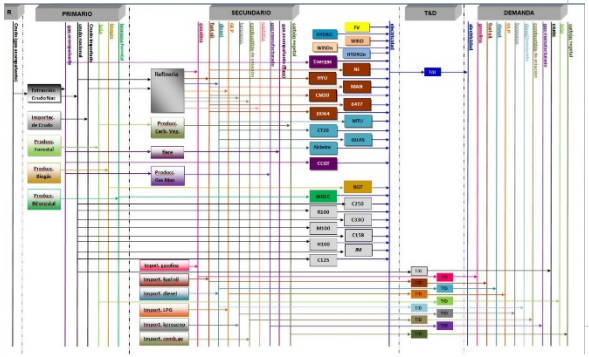
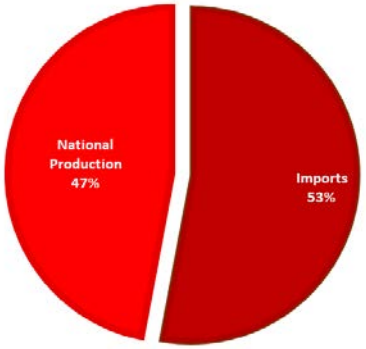
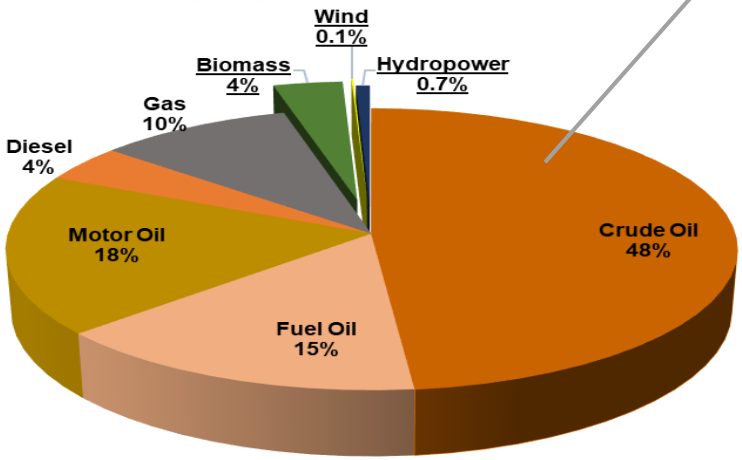
CHARACTERISTICS OF THE CUBAN ELECTRICAL SYSTEM

- At a high percentage it is a centralized system
- High dependence on the importation of crude oil for electricity generation.
- High average cost of energy delivered
- Low use of renewable energy sources.
- More than 98.5% of the population has access to electricity







RESERVES AND POTENTIAL OF ENERGY RESOURCES IN CUBA

Resources	Units	Reserves or potential	Oil equivalent (million toe)
Crude oil and associated gas (onshore)	PJ	4 095	97.8
Crude oil and natural gas (EEZ) (offshore)	PJ	29 308	700
Bagasse and crop residues	Annual GW·h	17 500	1505
Peat	PJ	8 374	200
Hydropower	Annual GW·h	1 300	0.10
Biogas	Annual PJ	7.50	0.18
Wind energy	Annual GW·h	2 418	0.20
Firewood	Annual PJ	21	0.50

Source: “Cuba: A country profile on Sustainable Energy Development.” IAEA. 2008

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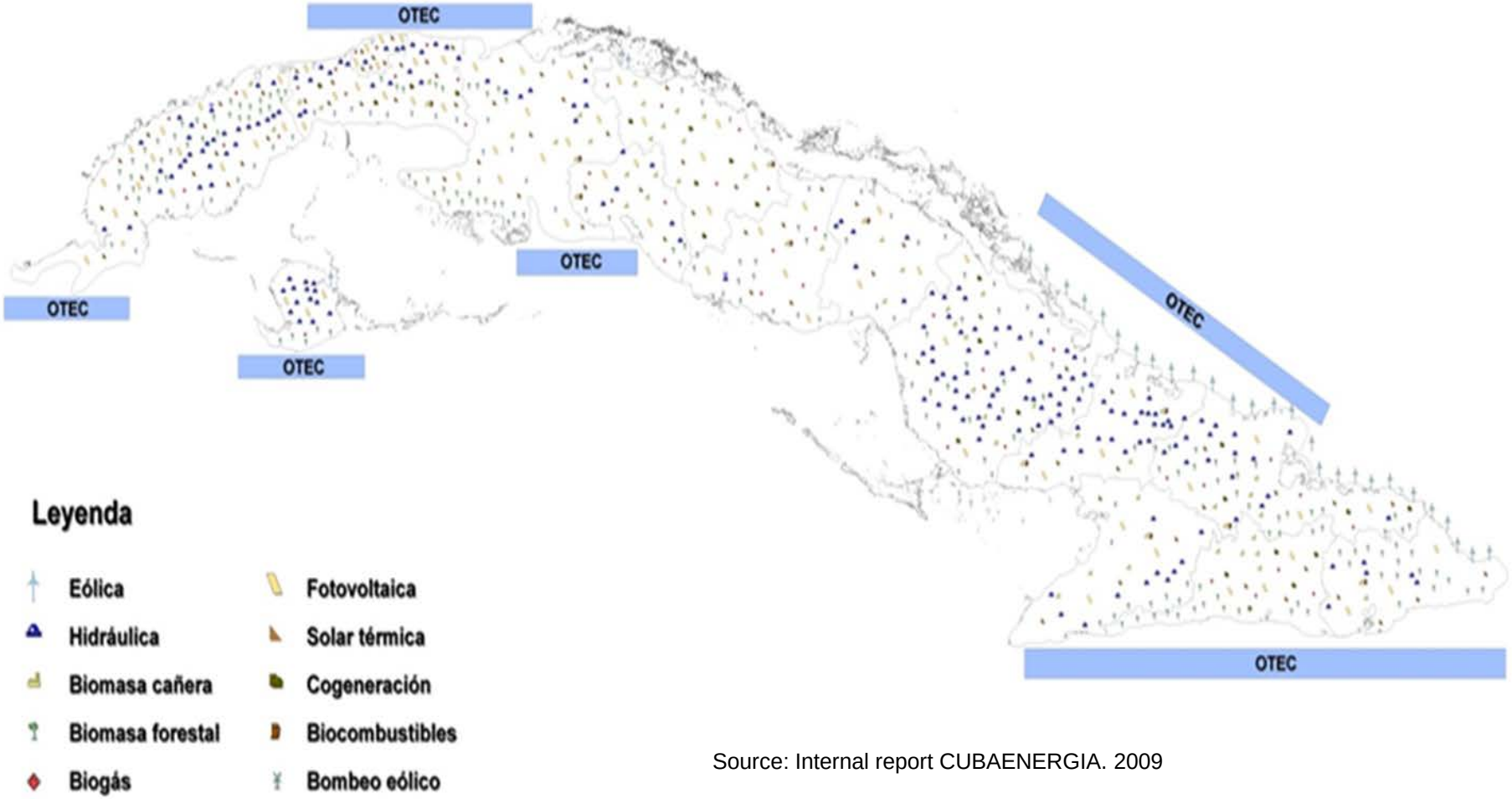
POTENTIAL OF RENEWABLE ENERGY RESOURCES



Source: Internal report CUBAENERGIA. 2009

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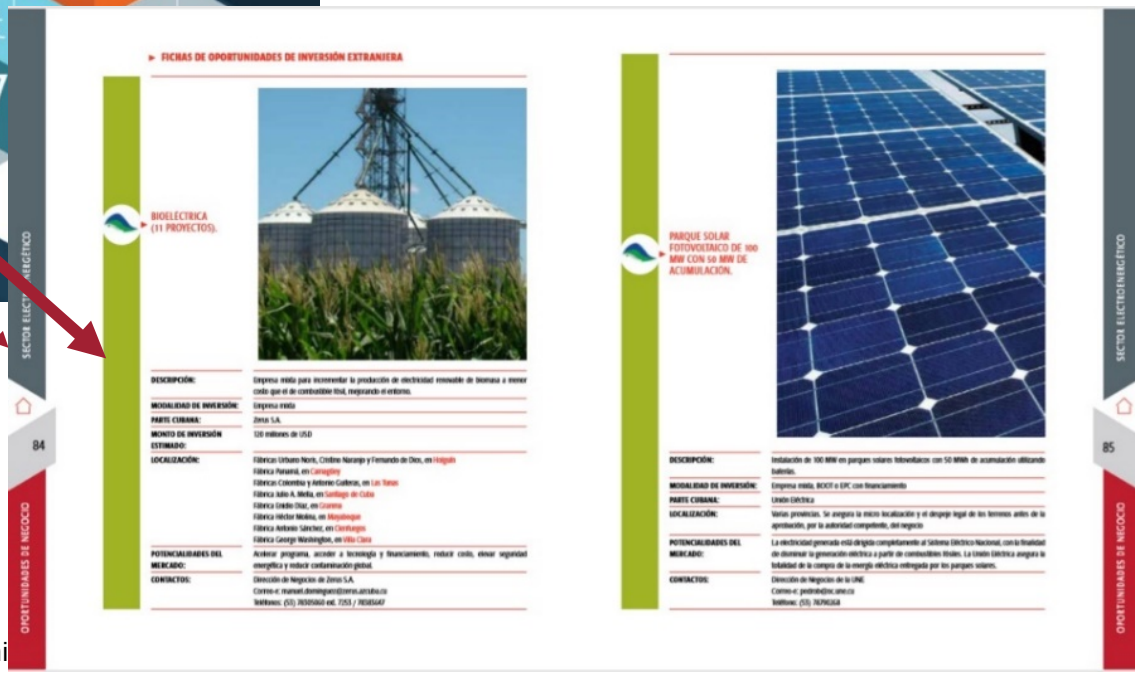
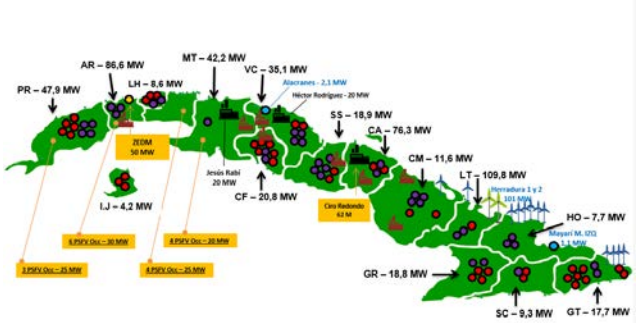
IS FOREIGN INVESTMENT IN RENEWABLE SOURCES POSSIBLE IN CUBA?



DEVELOPMENT PLAN UNTIL 2030: RENEWABLE SOURCES OF ENERGY AND ENERGY EFFICIENCY

Technology by source	To install (MW)	Planned Projects	Generation (GWh/año)	Crude oil replaced (Mton/año)
Biomass	872	25	4300	960
Industrial biogas	50	531	57	15
Wind power	656	14	1968	540
Solar PV	803	191	1071	240
Hydro power	56	74	650	72



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DEVELOPMENT PLAN UNTIL 2030: RENEWABLE SOURCES OF ENERGY AND ENERGY EFFICIENCY

Biomass power plants

- 57 sugar plants with 470 MW capacity
- Programme to install 25 biomass power plants which would provide 14% of electricity of the country
- Increase of bolier pressure and temperatura enables three fold increase of electricity per ton of sugarcane. Today the rate is 37 kWh/tcm and the projection is 110-120 kWh/tcm

Wind power

- Existing capacity in 4 wind parks is 11,7 MW
- Programme to install 656 MW in 14 wind farms
- There are wind measurement data at 50 and 100 meters high in 32 áreas of the country. The technical potential is greater than 2000 MW
- Capacity factor is estimated to be over 35%.

Solar PV

- The programme consists of installation of 191 solar PV parks in the country, 803 MW

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DEVELOPMENT PLAN UNTIL 2030: RENEWABLE SOURCES OF ENERGY AND ENERGY EFFICIENCY

Hydropower

- The Plan is install 56 MW.
- Present capacity is 63 MW, 147 power plants of with 30 are connected to the main grid and 117 are insolated systems.

Bioenergy

- The plan is to build 500 industrial biogás plants and 9000 small agricultural installations.
- Use of more than 1 million hectares of marabú, for energy purposes

Energy Efficiency

- Replacing existing street lights with LED technology
- Water pumping with solar energy for agriculture
- Installation of 100 000 m^2 solar heater at homes

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LINDA MODEL
LONG-RANGE INTEGRATED DEVELOPMENT ANALYSIS

LINDA model for energy system analysis

- Simple to use Excel based tool for energy sector analysis and scenario building
- Can be developed to accurately model different sectors of economy
- Outputs easy to visualize
- Accounting framework type of model
- Data storage

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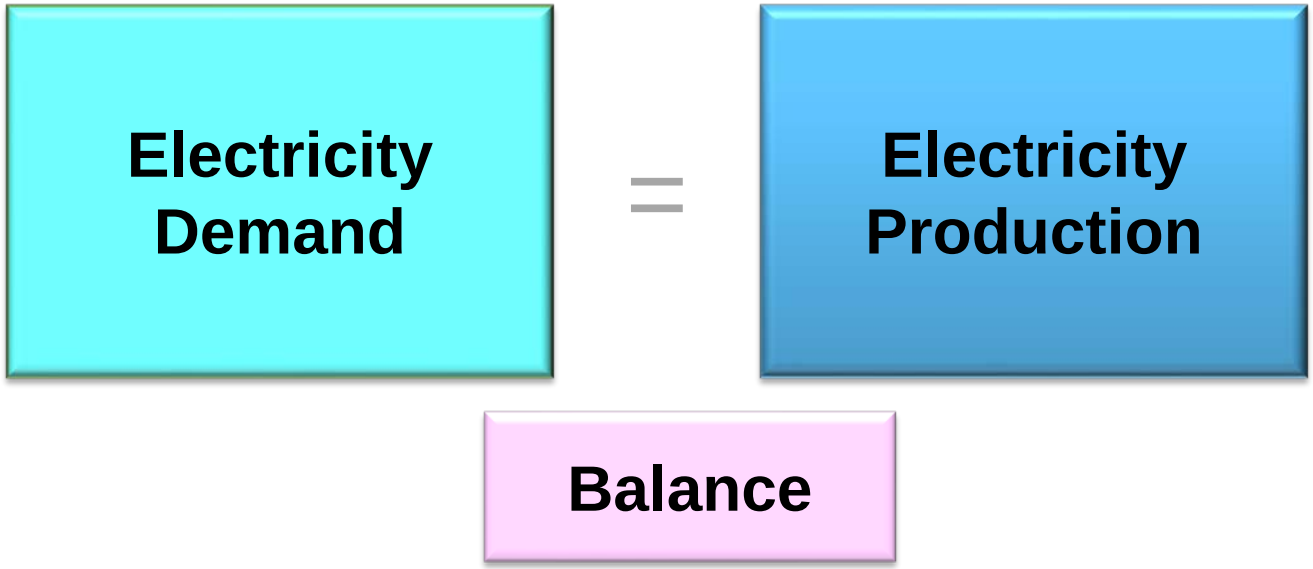
LINDA MODEL

LONG-RANGE INTEGRATED DEVELOPMENT ANALYSIS

- **Integrated means:**
  - **Economic (e.g. LCOE)**
  - **Technical (energy, technology)**
  - **Environmental (CO_2 and other emissions)**
  - **Social (e.g. employment, population, urban/rural)**
  - **Other issues (e.g. water demand module)**

ENERGY PLANNING: ELECTRICITY BALANCE



Every hour production and demand has to be equal

MODELLING THE ELECTRICITY DEMAND AND SUPPLY

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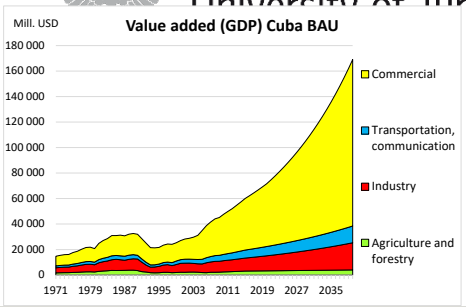
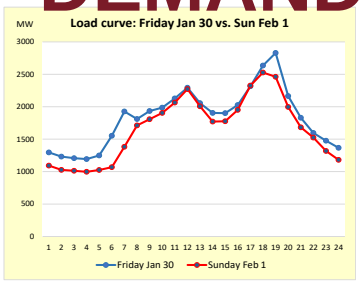
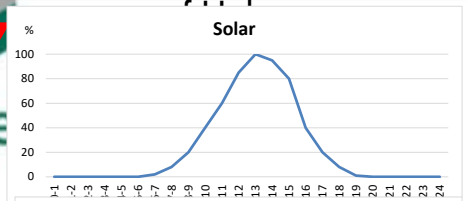
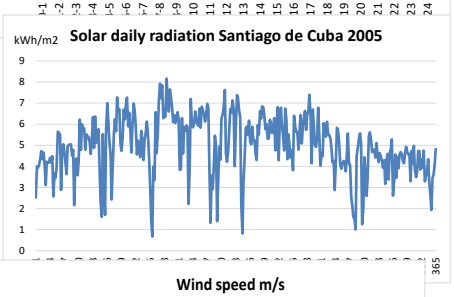
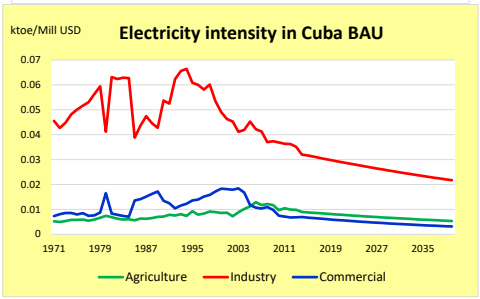


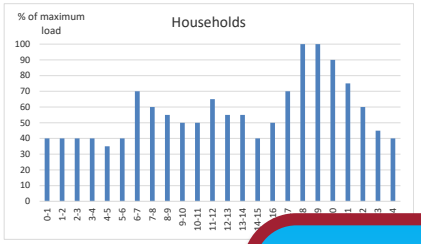


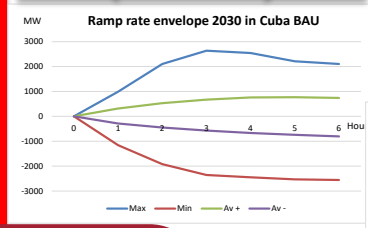
Corrollable power production (fossil)

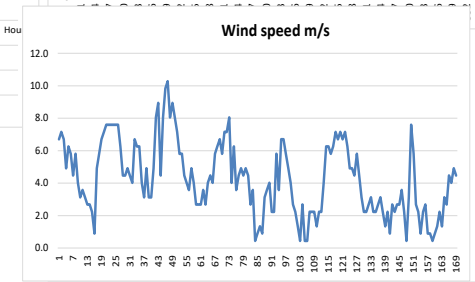




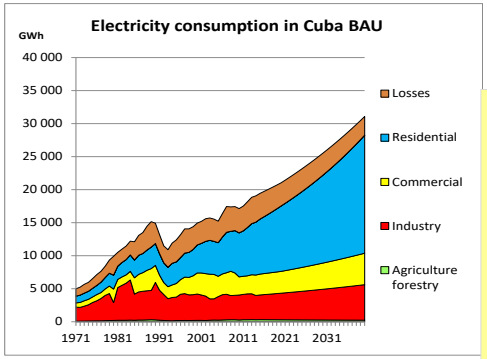


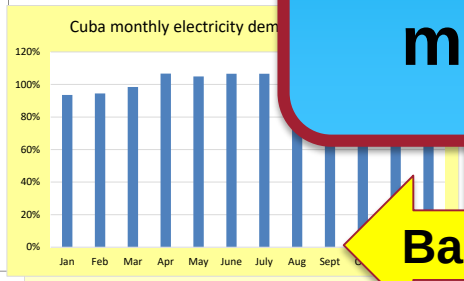




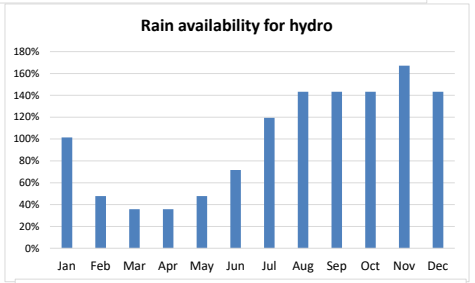


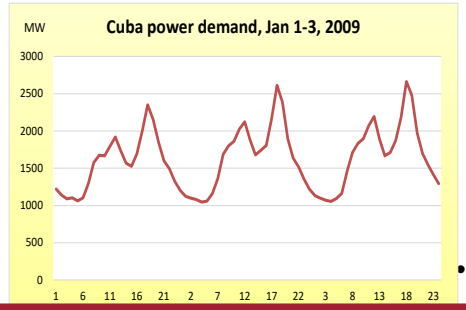
CubaLinda model

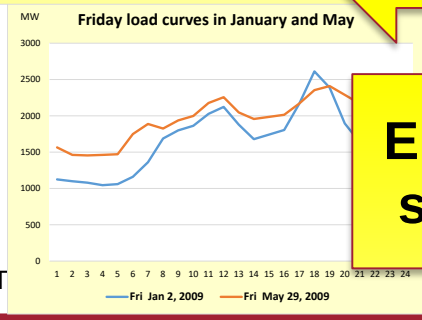




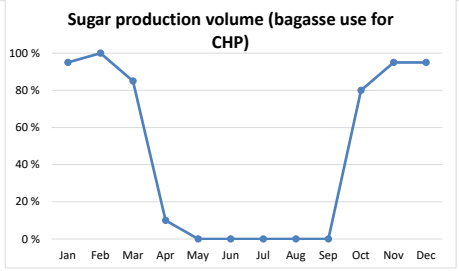
Balancing







Electricity storage?



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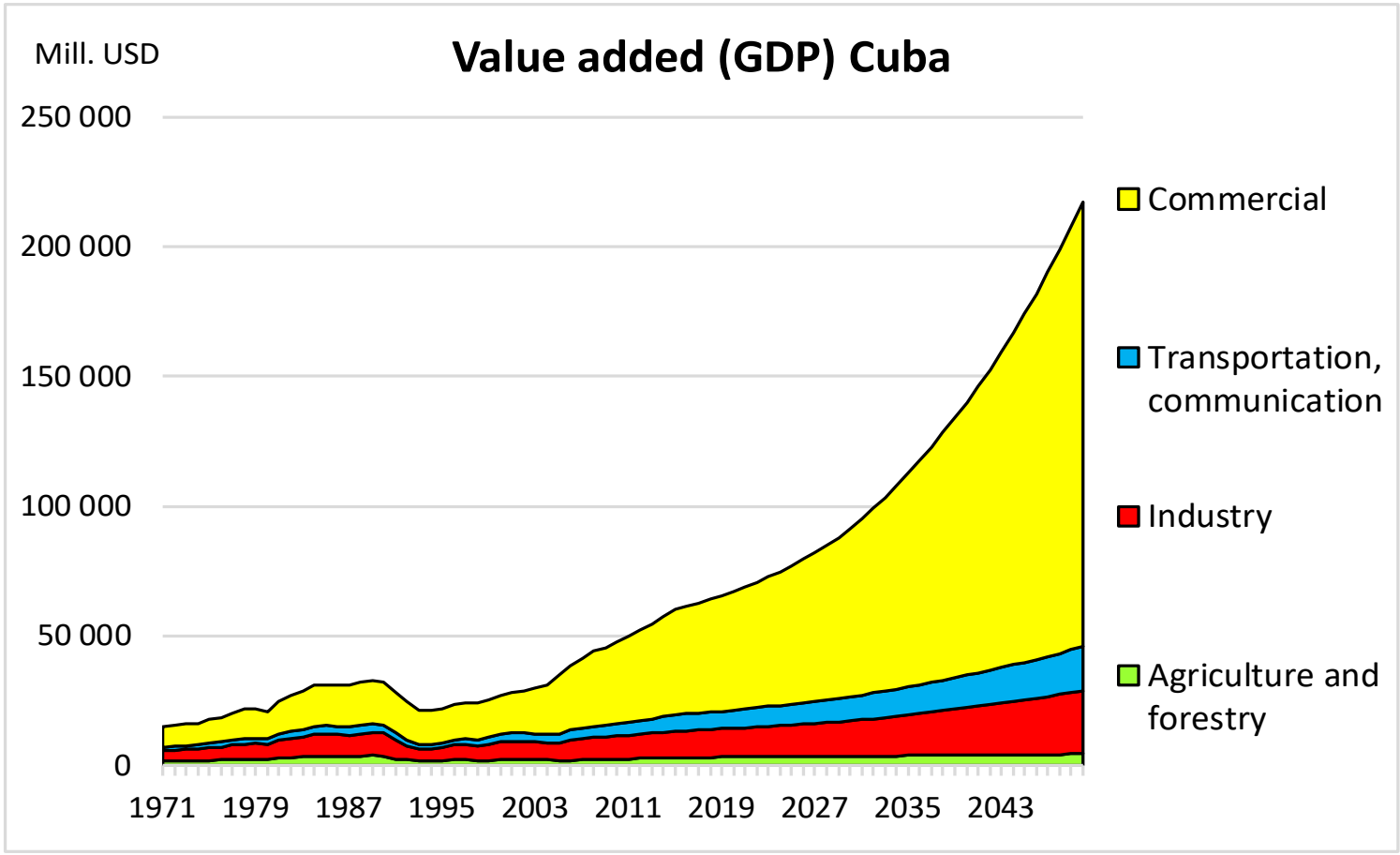
CUBALINDA-RESULTS.



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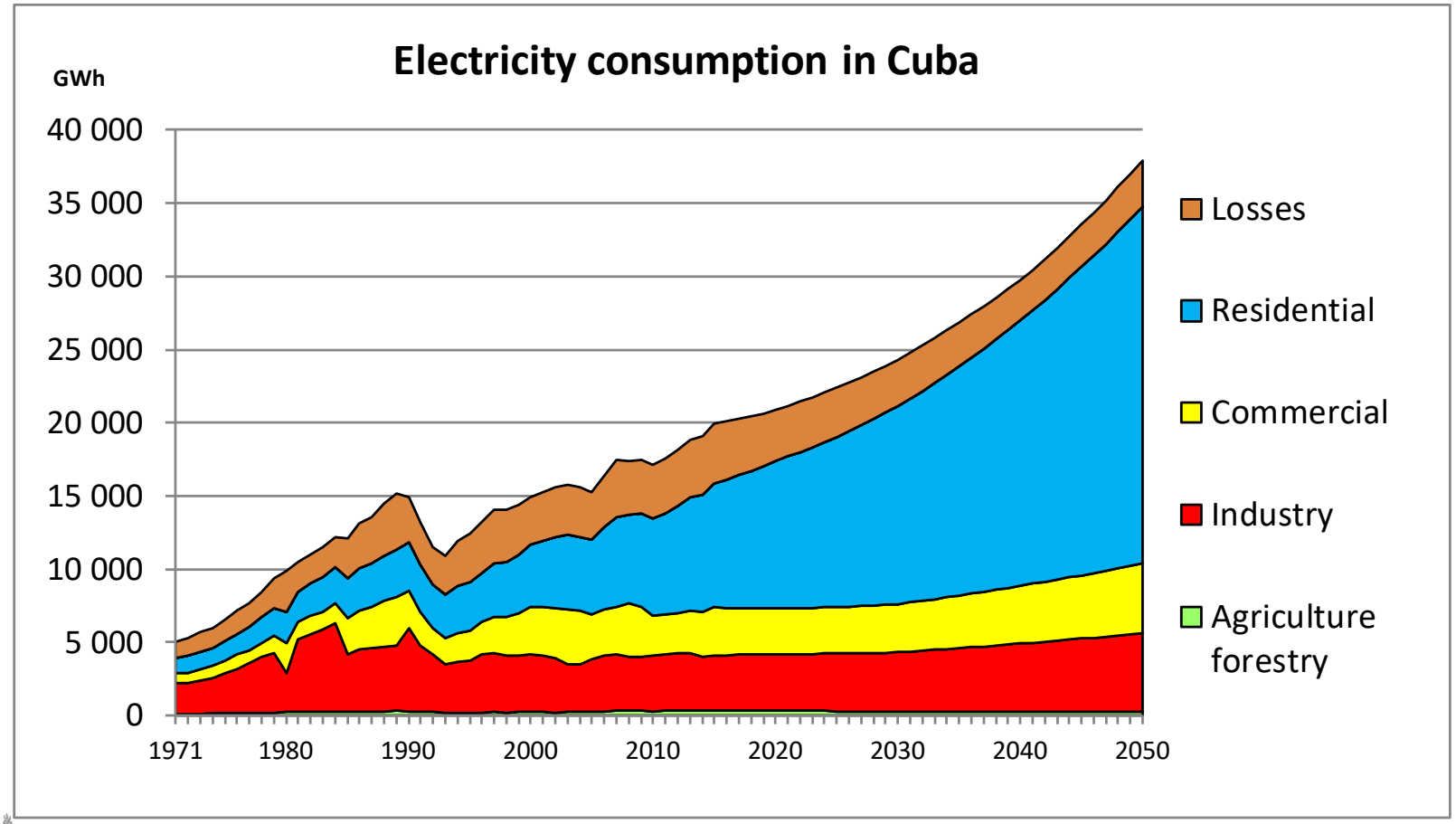

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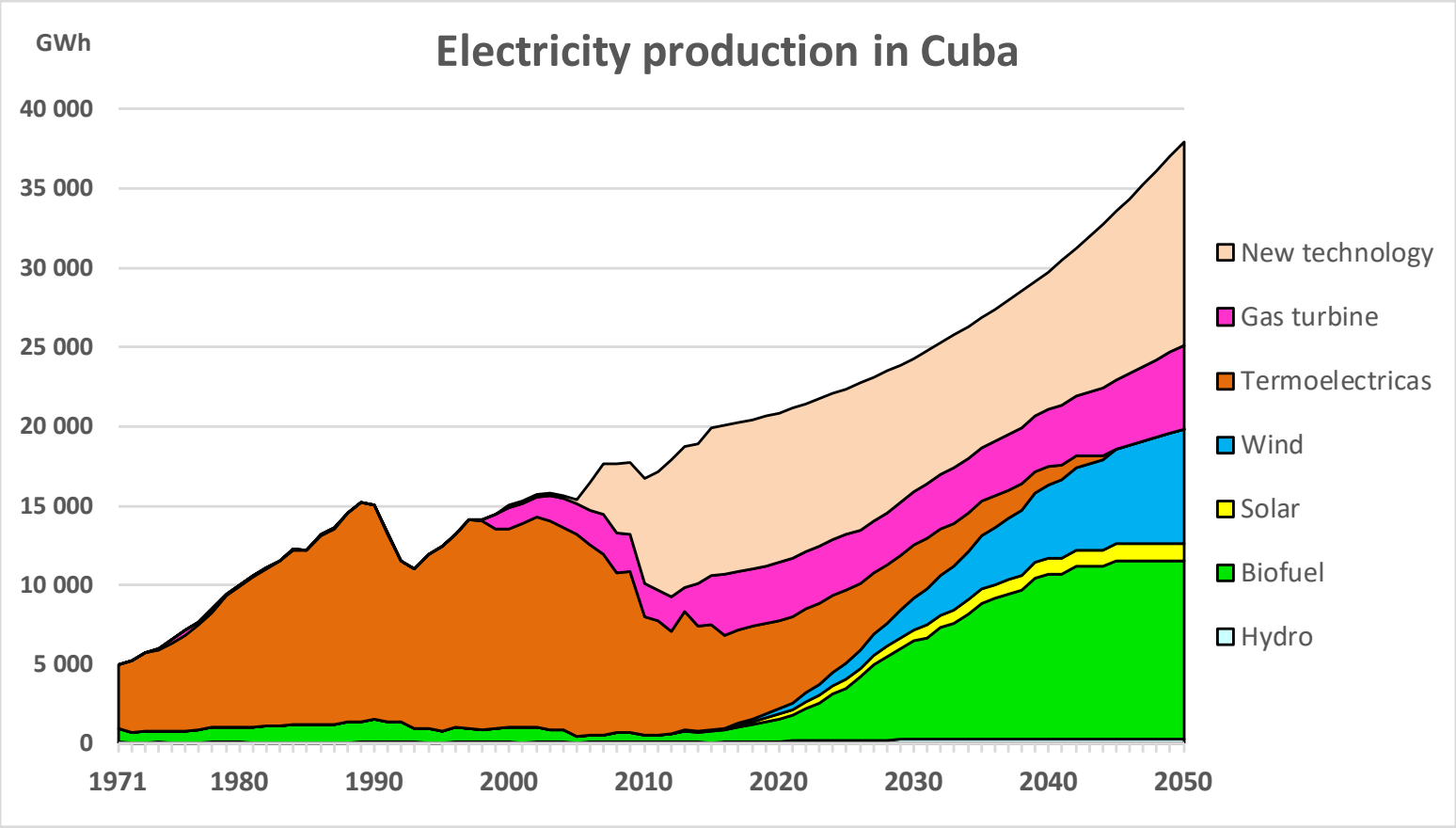

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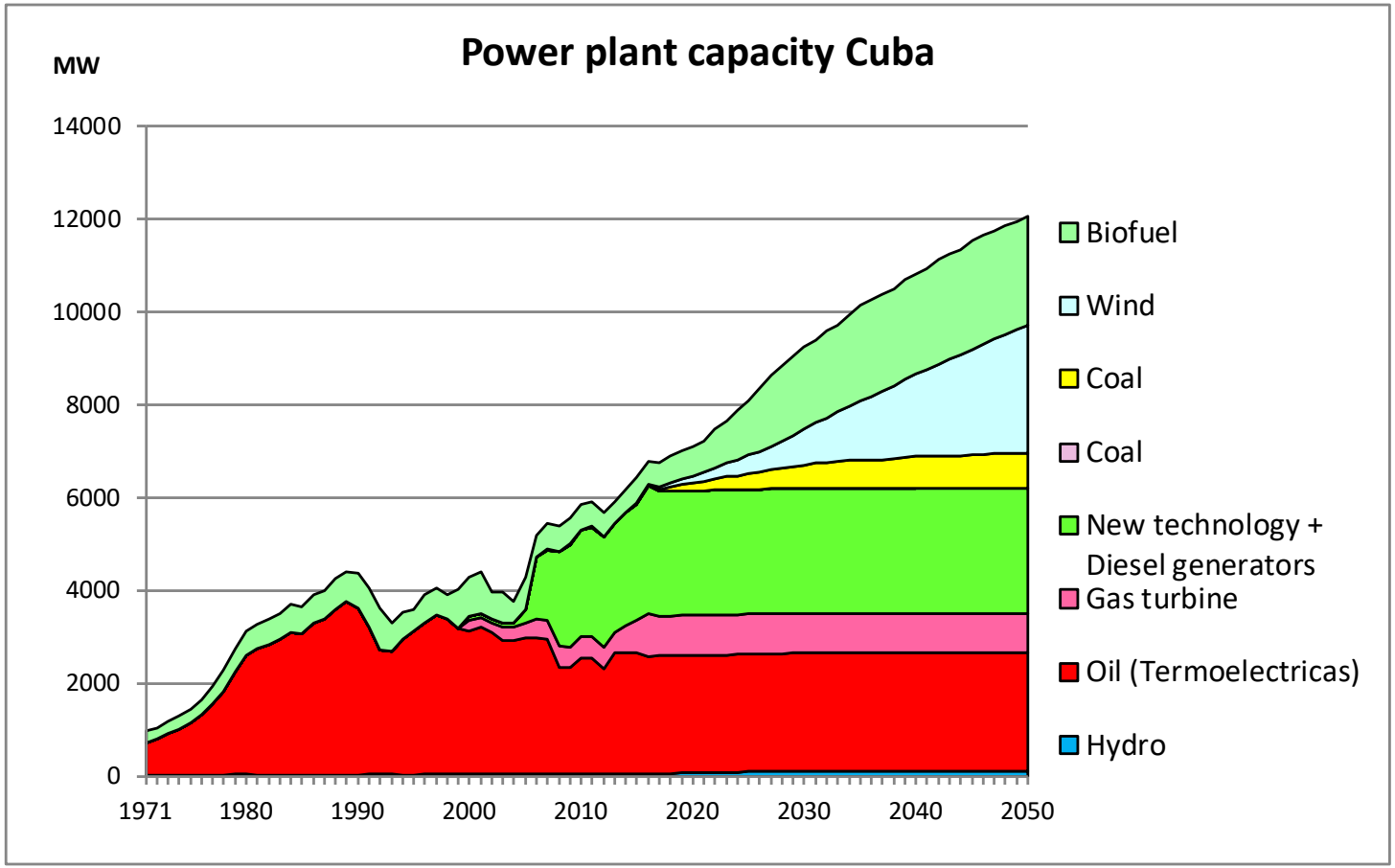

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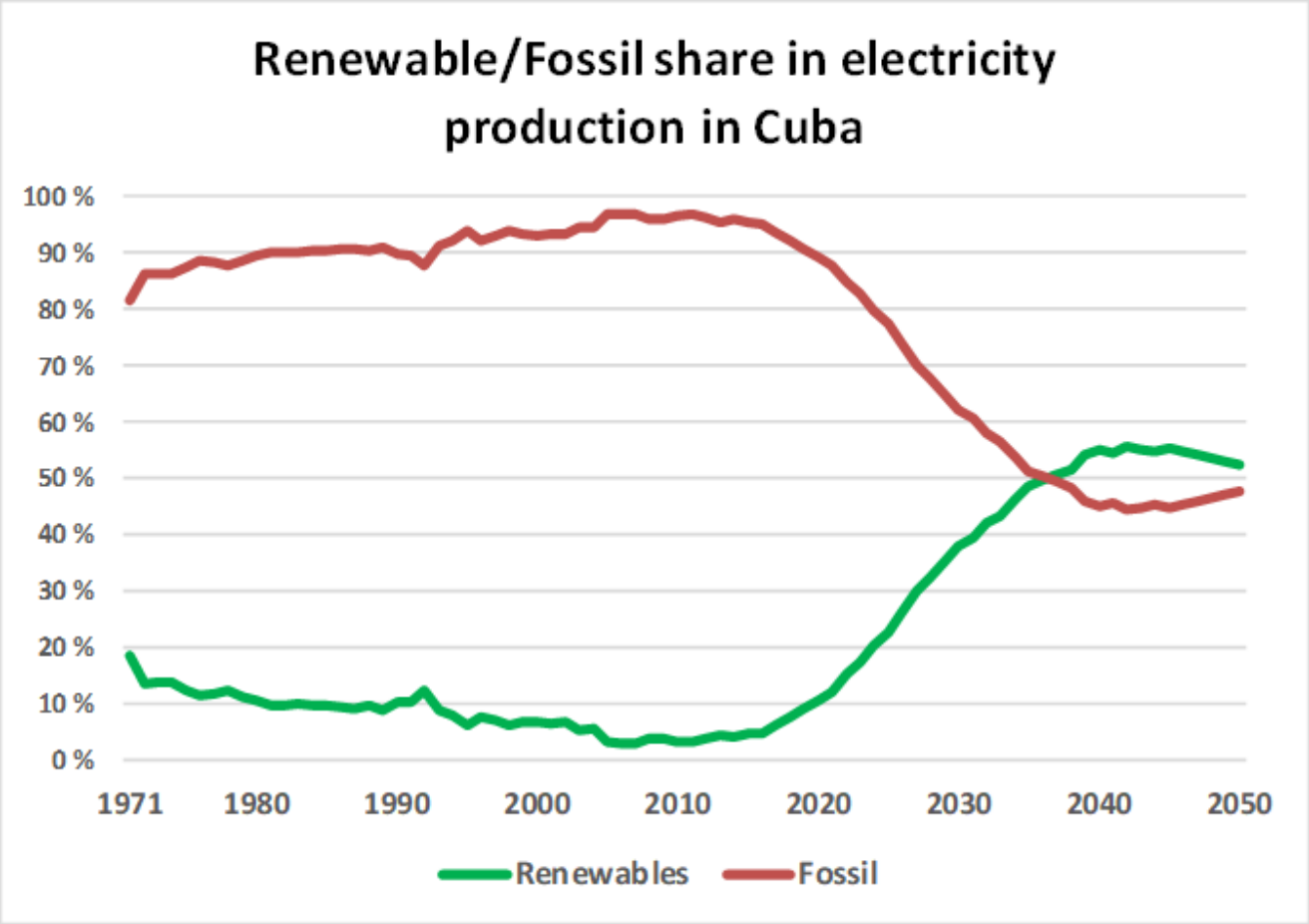

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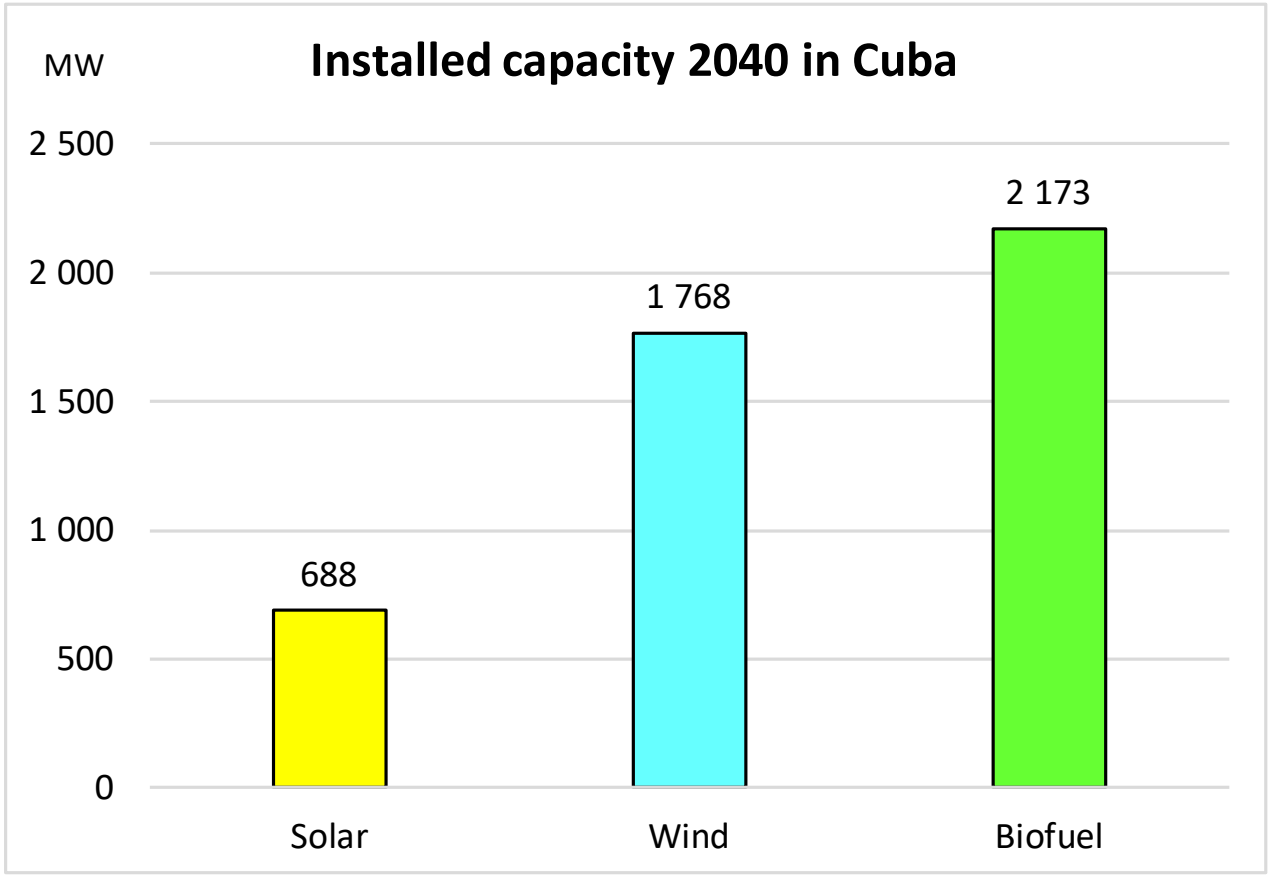

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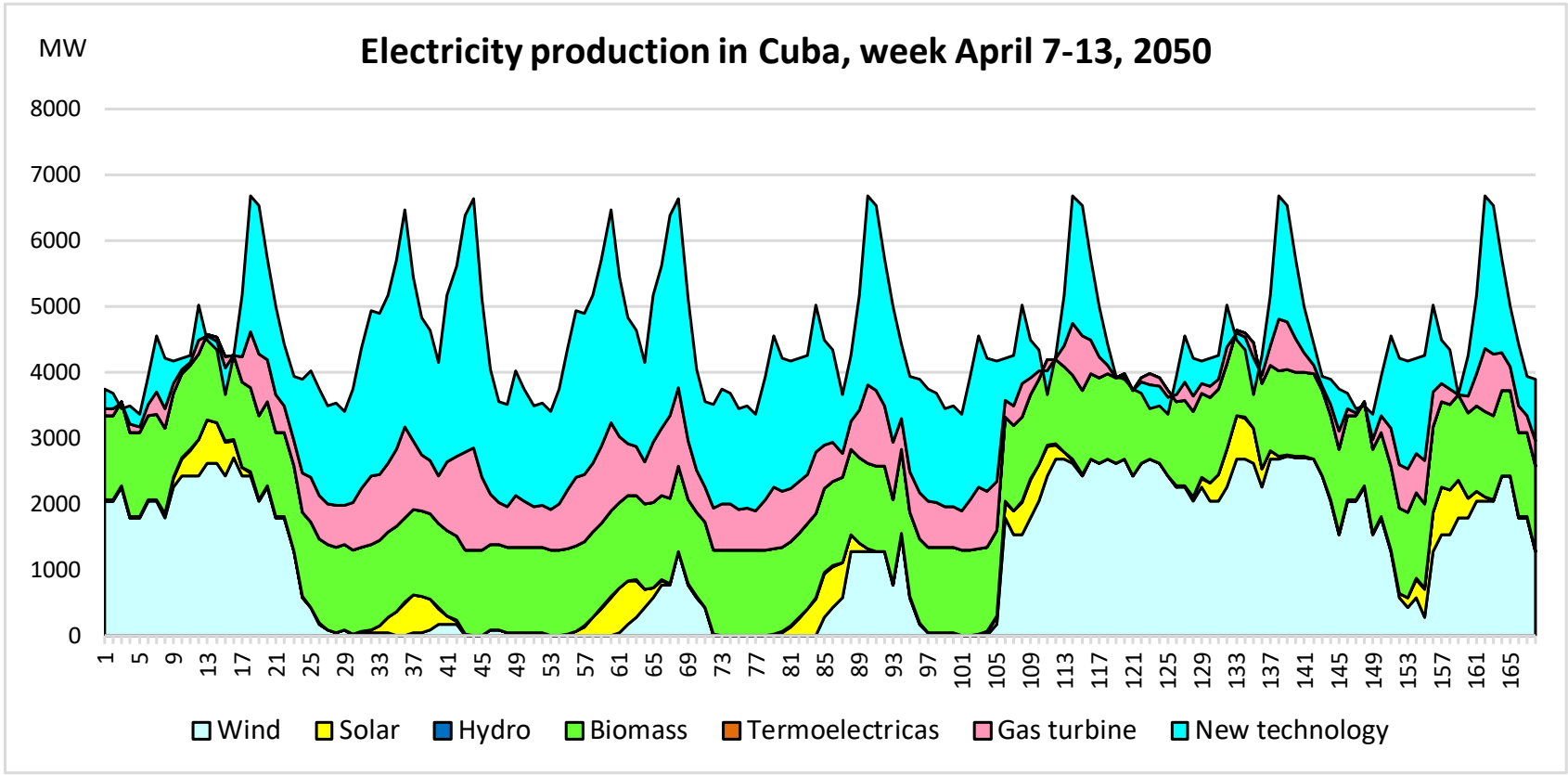

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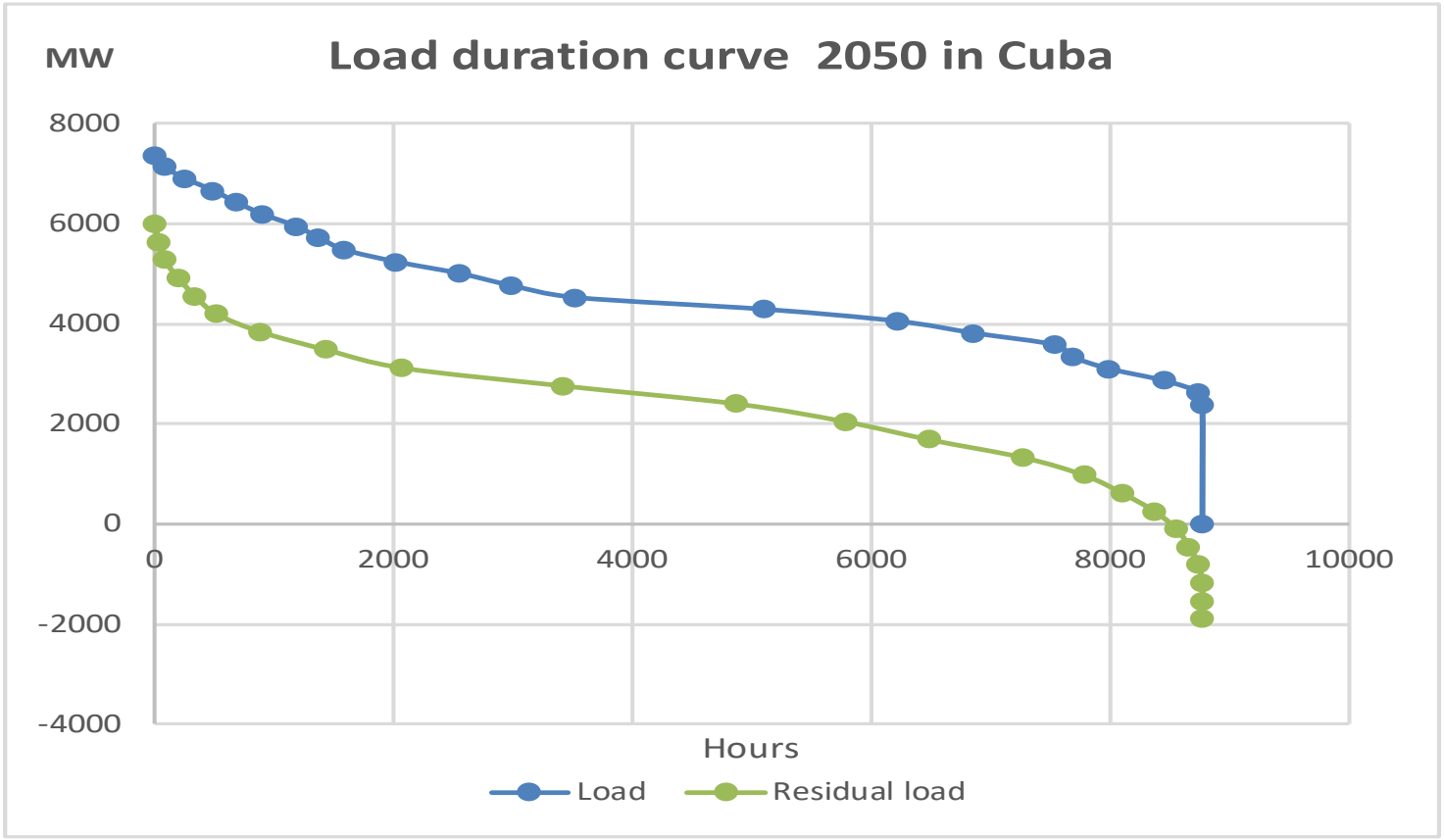

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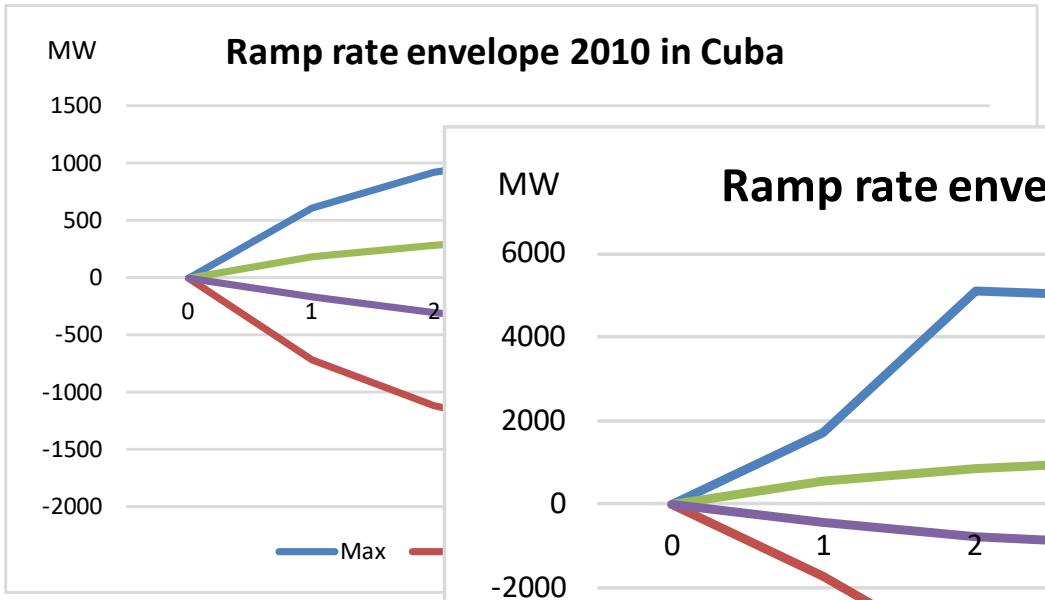

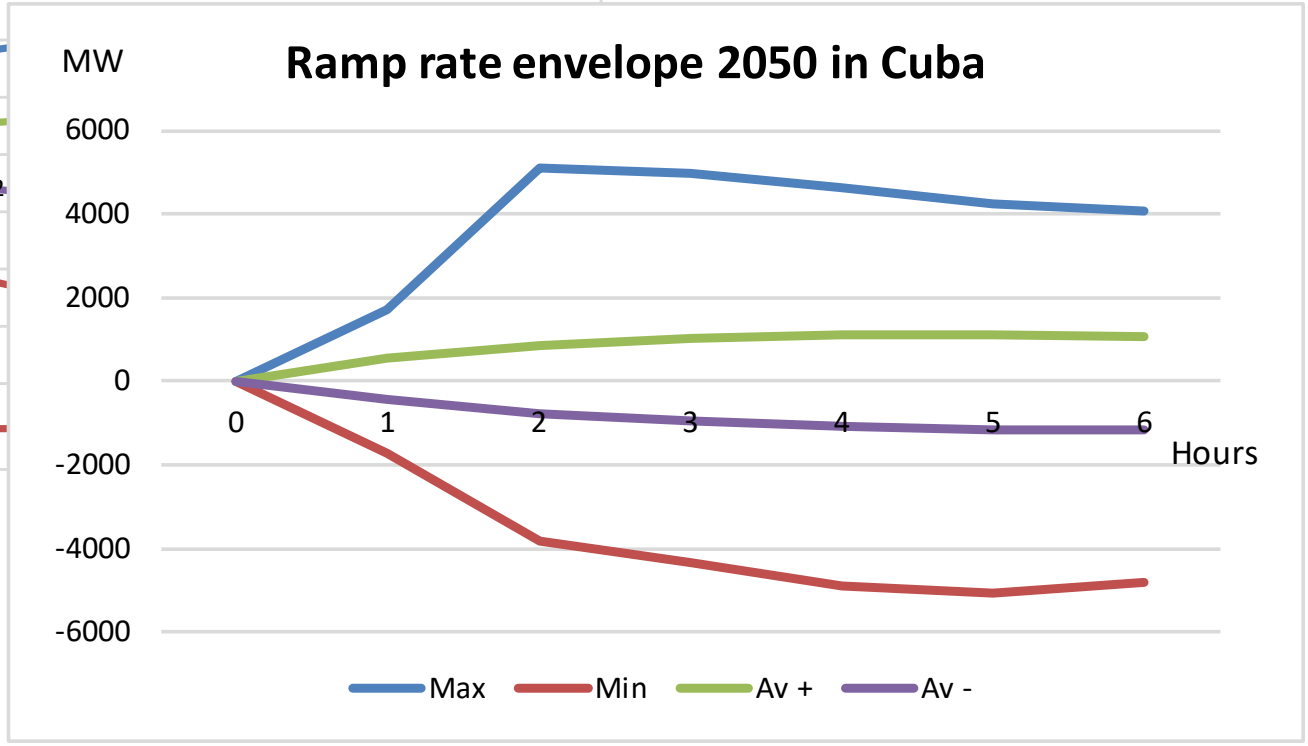

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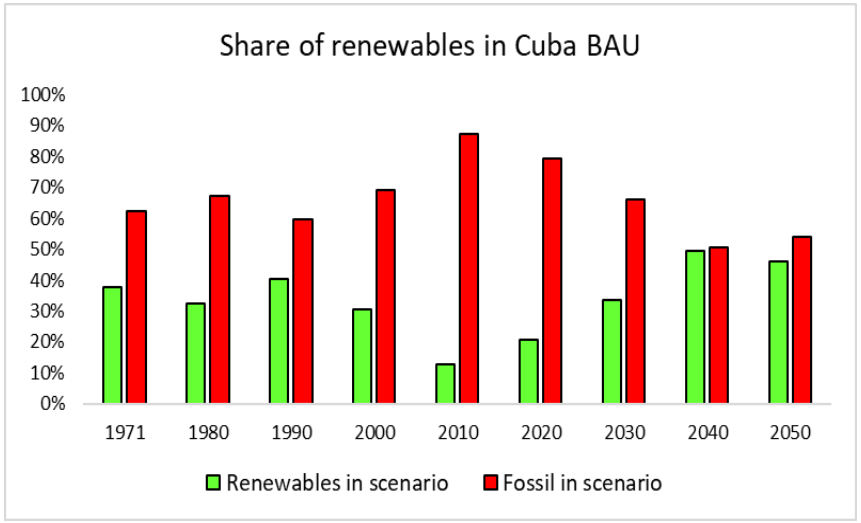
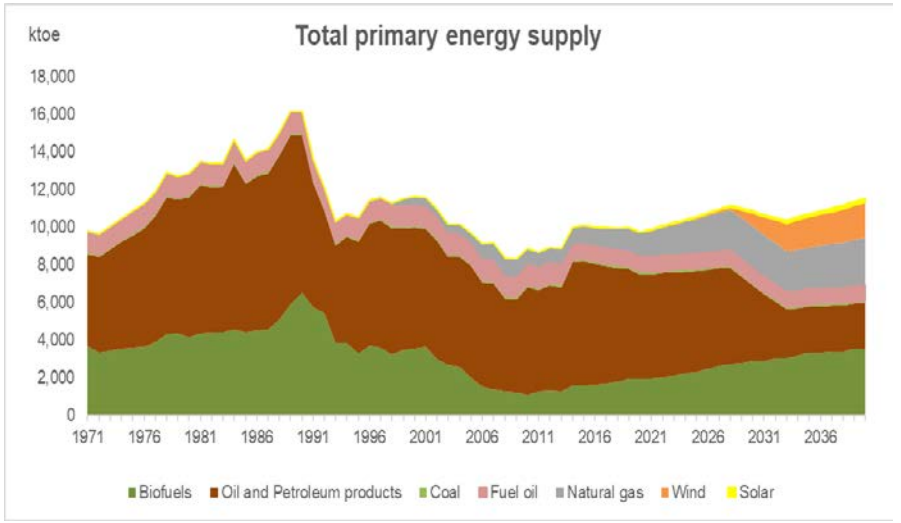
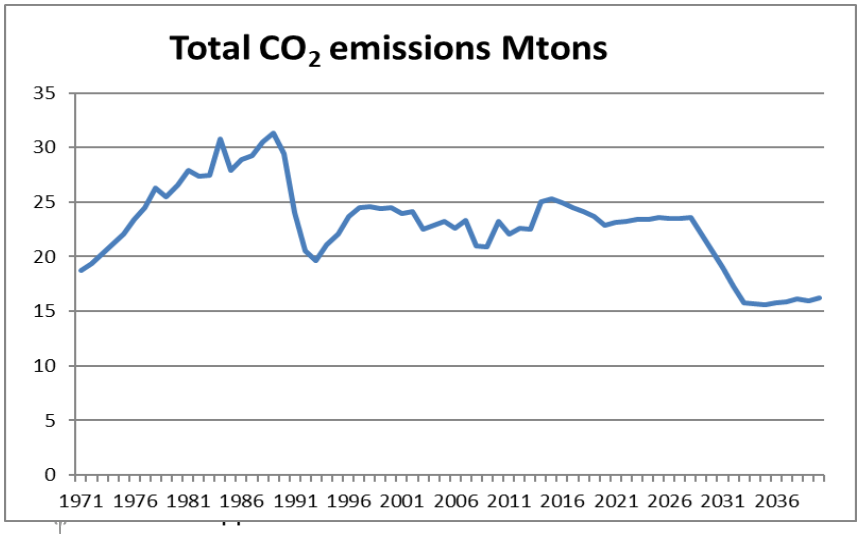
CONCLUSIONS







- Change of the Electricity Generation Matrix
- Increase in the use of renewable energy sources
- Reduction of the costs of the energy supplied
- Reduction of environmental pollution

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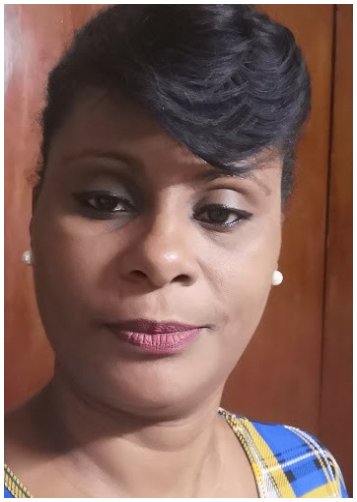
Thank you

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