WORKSHOP
Energy Big Push

Axis 1 - Mapping and analysis of databases on investments in SES RD&D in Brazil

André Tosi Furtado

cgee | Centro de Gestão e Estudos Estratégicos
Ciência, Tecnologia e Inovação

Brasília – Brazil: 30 e 31.10.2019

- Map and analyze data sources of investments in research, development and demonstration (PD&D) in sustainable energy (SE) in Brazil

- Provide a Preliminary Estimate of Brazilian Public RD&D efforts in SE

- Contribute to organize the sources of resources and the main actors responsible for the execution of these resources.

- The project should improve understanding of the final destination of technology R&D efforts in the energy sector and provide input for policymakers and stakeholders to formulate systematic policies to drive the sustainable energy sector in Brazil.

Guiding questions

- What are the Brazilian expenditures on energy R&D?

- What is the importance of spending on sustainable energy R&D?

- What are the sources of sustainable energy most supported by the Brazilian public sector?

- What is the relative importance of public R&D for energy efficiency in Brazil?

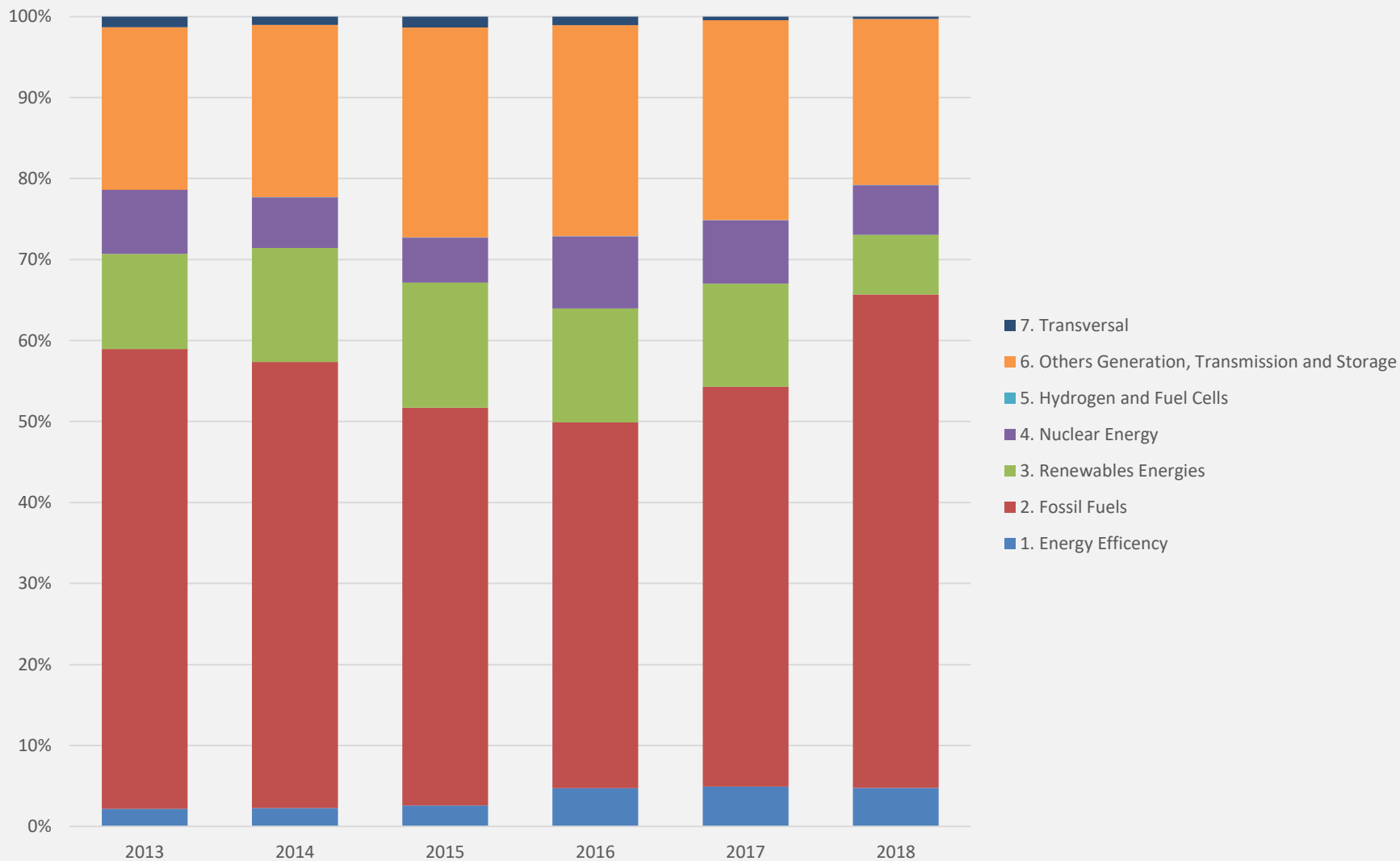- What are the main federal agencies and programs that fund sustainable energy R&D?

- What are the main entities involved in the execution of public spending on sustainable energy R&D?

- In which federation units are the main R&D investments located?

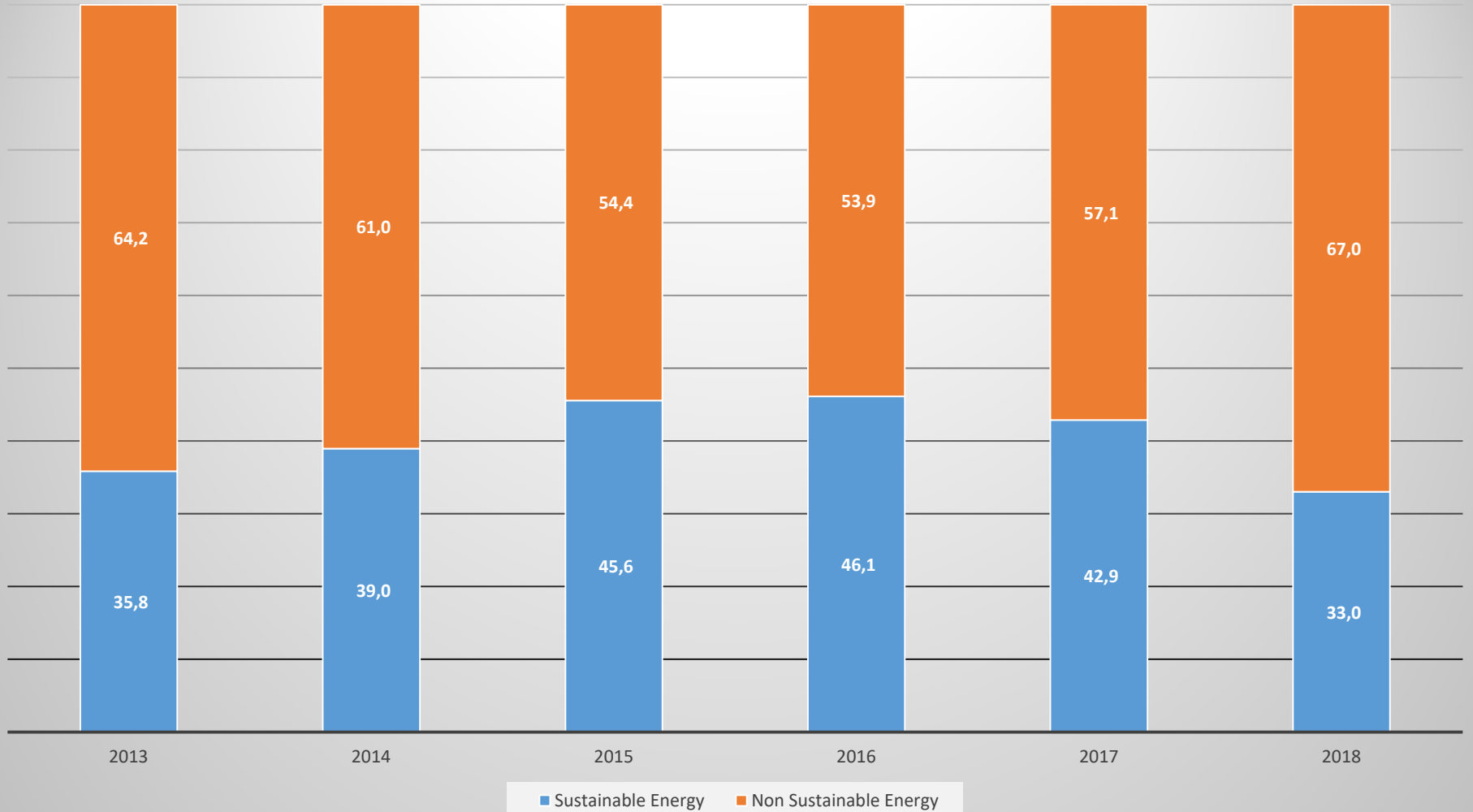# Brazilian Public Energy RD&D Efforts (in thousands US$)

	2013	2014	2015	2016	2017	2018
1.1. Energy Efficiency Industry	7	104	79	67	29	1
1.2. Energy Efficiency Buildings, Residential	36.672	33.895	24.022	6.367	6.688	9.583
1.3. Energy Efficiency Transport	8.129	14.312	11.966	53.048	57.837	49.386
1.4. Others Energy Efficiency	18.144	12.829	9.615	8.057	4.399	3.178
2.1. Oil and Gas	1.140.185	1.132.135	653.441	541.162	619.257	722.527
2.2. Coal	29.767	43.562	28.866	26.677	29.219	26.978
2.3. CO2 Capture and Storage	3	32	29	23	1.055	3.475
3.1. Solar Energy	38.570	74.222	53.307	49.923	47.488	896
3.2. Wind Energy	18.248	23.448	10.866	9.885	8.282	3.780
3.3. Ocean Energy	-	1	3	3	3	-
3.4. Biofuels	164.002	186.813	138.102	108.693	107.998	78.153
3.5. Geothermal Energy	-	-	-	-	3	4
3.6. Hydroelectricity	18.708	10.737	7.081	5.539	3.449	7.313
3.7. Other renewable energy sources	2.073	5.138	5.266	2.661	14	702
4.1. Nuclear fission	163.580	133.715	76.996	111.818	102.984	75.740
4.2. Nuclear fusion	11	121	85	81	89	78
4.9. Unallocated nuclear fission and fusion	4	5	4	4	2	-
5.1. Hydrogen	16	262	240	305	166	240
5.2. Fuel cells	13	199	194	154	43	131
6.1. Electric power generation	18.411	20.273	22.785	19.392	9.421	2.016
6.2. Electricity transmission and distribution	379.245	416.898	324.685	299.976	304.284	242.868
6.3 Energy storage (non-transport applications)	16.025	16.027	12.673	7.871	10.769	8.437
7.1 Energy system analysis	26.893	22.341	18.708	13.532	6.115	3.604
Total	**2.078.705**	**2.146.001**	**1.395.623**	**1.262.161**	**1.318.166**	**1.237.787**

Distribution of Brazilian Public Energy RD&D Efforts

Share of the Sustainable Energy Effforts

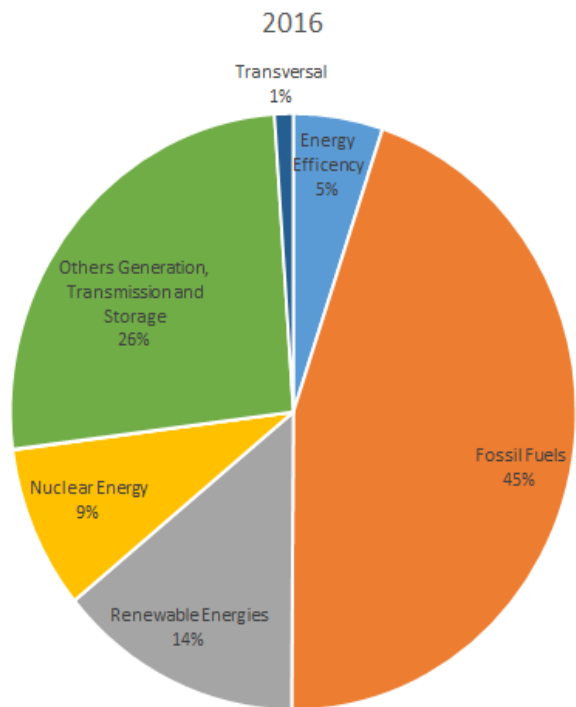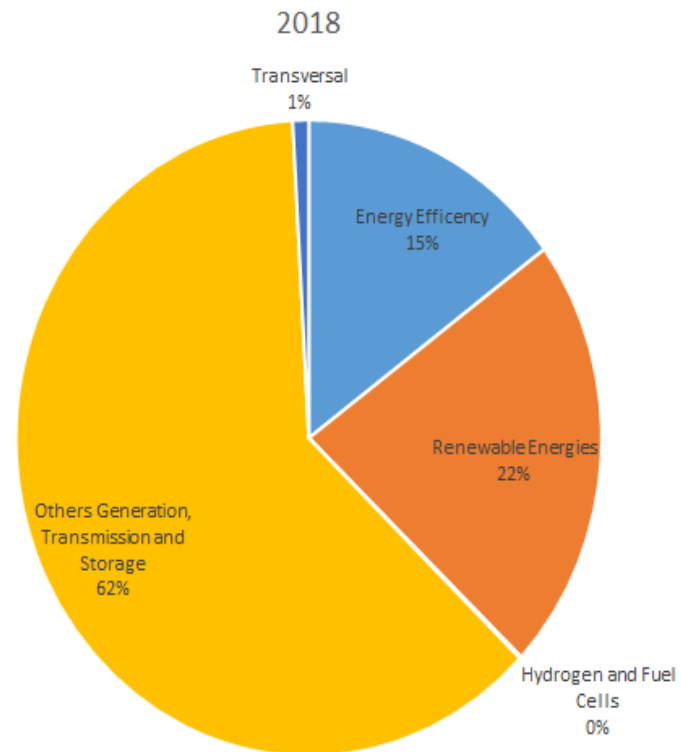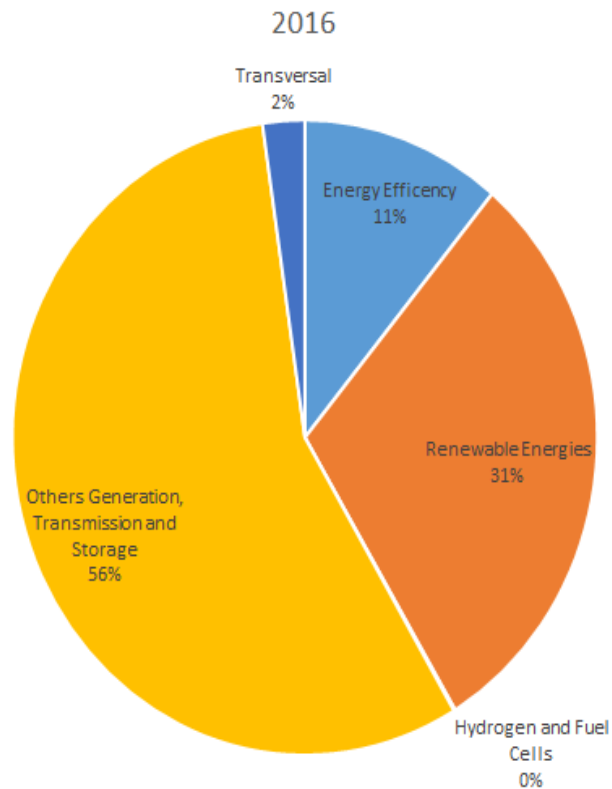|	2013	2014	2015	2016	2017	2018
Non Sustainable Energy	64,2	61,0	54,4	53,9	57,1	67,0
Sustainable Energy	35,8	39,0	45,6	46,1	42,9	33,0

Legend: ■ Sustainable Energy ■ Non Sustainable Energy

Distribution of Brazilian Public Energy RD&D Efforts

2016

- Transversal 1%
- Energy Efficency 5%
- Others Generation, Transmission and Storage 26%
- Hydrogen and Fuel Cells 0%
- Nuclear Energy 9%
- Renewable Energies 14%
- Fossil Fuels 45%

2018

- Transversal 0%
- Energy Efficency 5%
- Others Generation, Transmission and Storage 21%
- Hydrogen and Fuel Cells 0%
- Nuclear Energy 6%
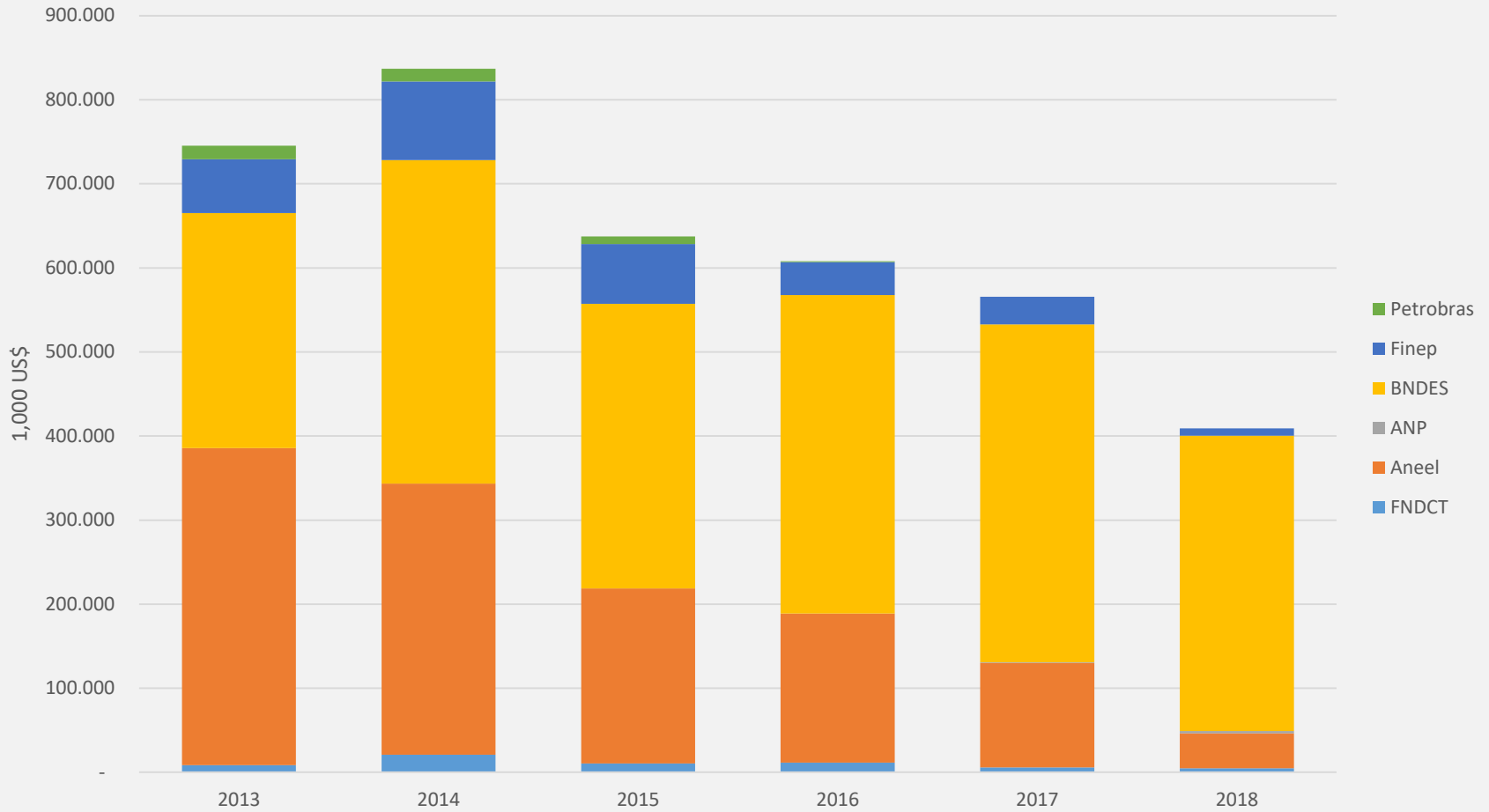- Renewable Energies 7%
- Fossil Fuels 61%

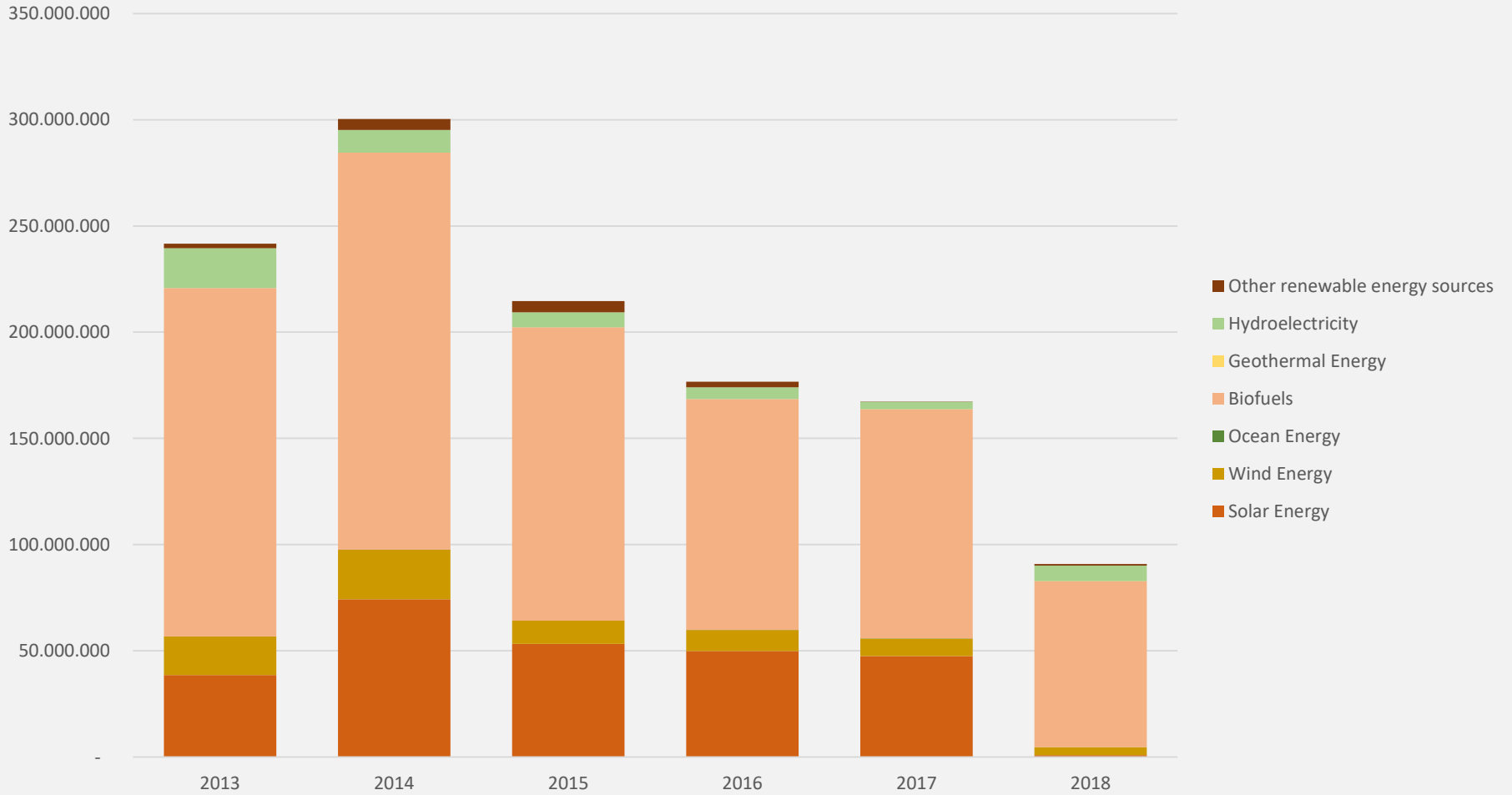# Distribution of Sustainable Energy RD&D Efforts

Participation of Federal Agencies and Programmes in Sustainable Energy RD&D Efforts
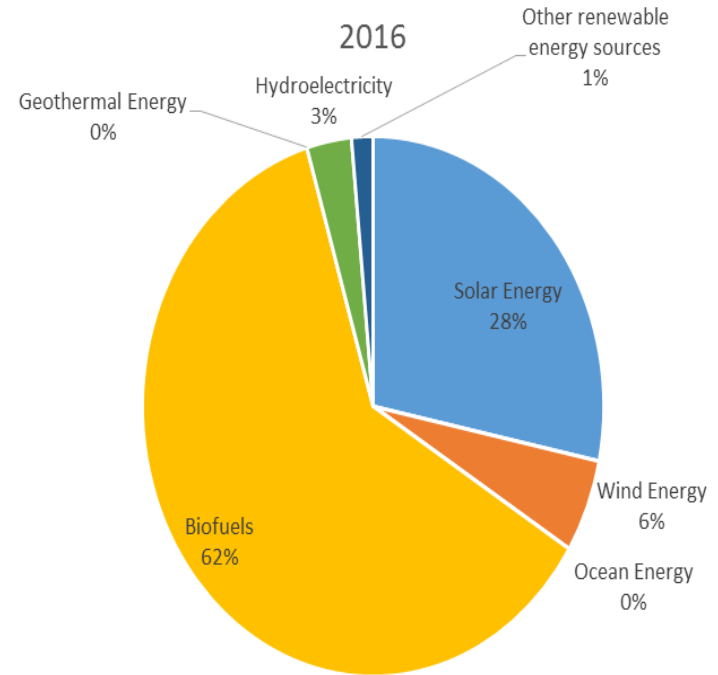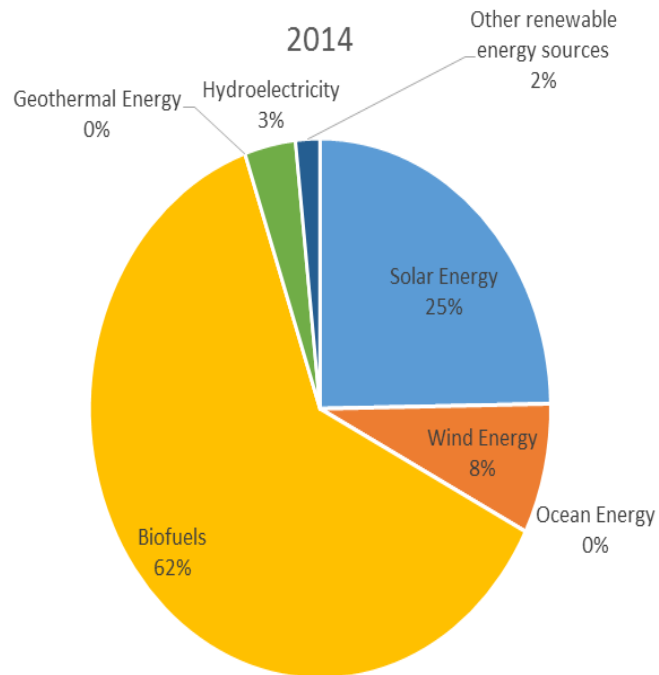
Renewable Energies RD&D Expenditures (in US$)

Distribution of Renewables Energies RD&D Efforts

1

Definitions and concepts important to delimit the conceptual model of R&D and sustainable energies

2

Delimitation of information sources: mapping and characteristics of data series, methodological aspects used in the organization of each one.

3

Definition of a classification of energy technologies based on the IEA, which allows broad identification of sustainable energies.

4

Definition of search terms: identification of terms that allow the classification of technologies into the energy categories that are the focus of EBP

5

Data systematization protocols: CGEE intelligence cycle model

RD&D Investment Flows and their Classification

Funding Source approach was adopted

Funding Source	Public agency	RD&D Execution	Nature of flow	Form of Accounting
FNDCT	FINEP	ICT	Transfer	Public Funding
FINEP		Company	Loan	Public Oriented Company's RD&D Funding
FNDCT / Other Budget	CNPq	ICT	Transfer	Public Funding
Federal budget	MCTIC	CNEN	Internal Execution	Public Funding
Company	Aneel	Own company	Internal Execution	Public Oriented Company's RD&D Funding
		ICT	PD&D Procurement	
		Other Company		
Company	ANP	Own company	Internal execution with internal resources	Public Oriented Company's RD&D Funding
		ICT	PD&D Procurement	
		Other Company		
BNDES	BNDES	Company	Loan	Public Oriented Company's RD&D Funding
		ICT	Transfer	Public Funding
Petrobras (extra-ANP)	Petrobras	Own company	Internal execution with internal resources	State Company Funding
		ICT	PD&D Procurement	
		Other Company		
Sao Paulo State Tax Revenue	FAPESP	ICT	Transfer	Public Funding

Energy R&D Investment Flows
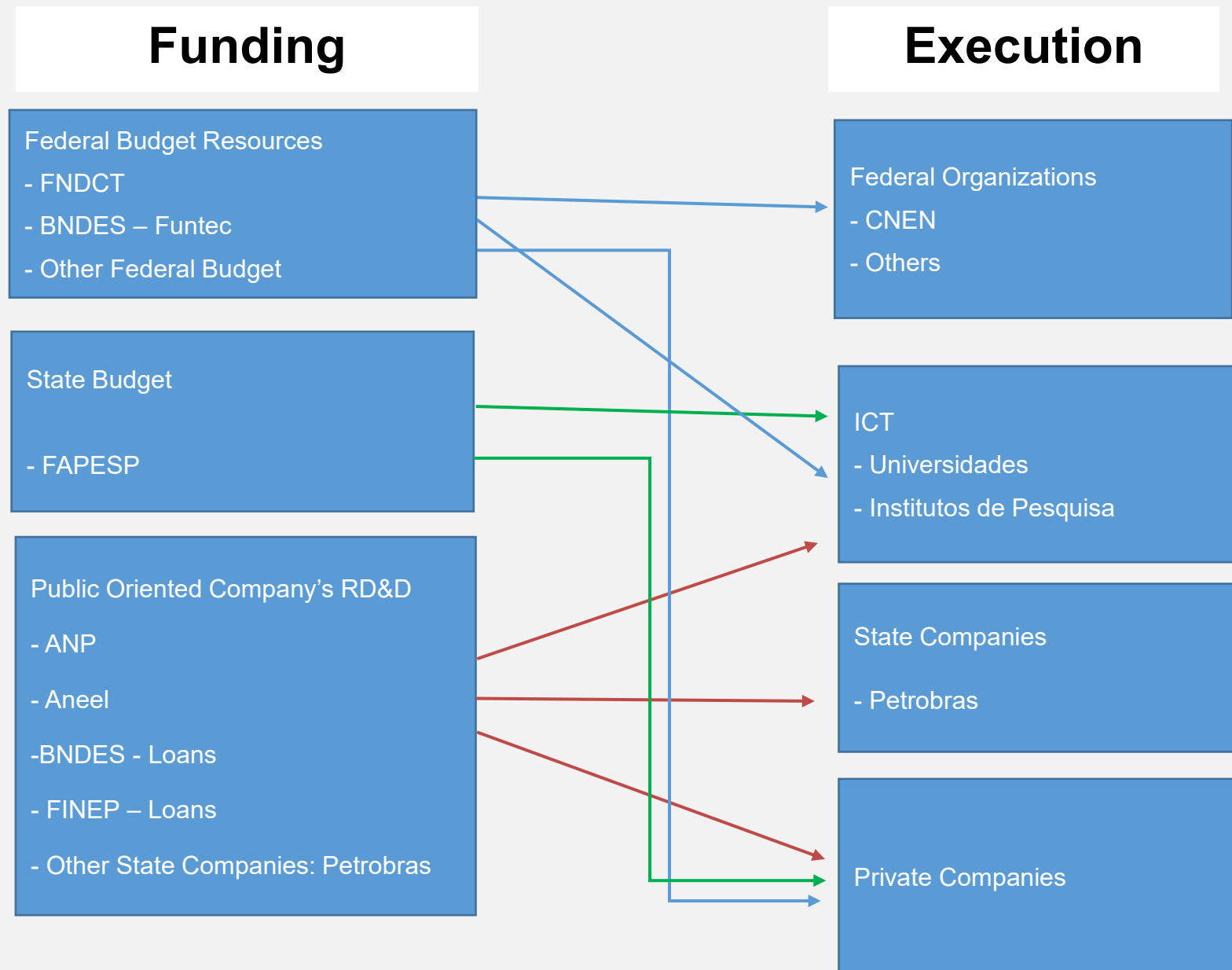
Attributes and Variables that must characterizes the databases after data processing

- Item
- Data source
- Time interval
- Contracted value
- Amount Executed
- Name of Financing Agent
- Nature of Financing Agent (Federal Government, State Government, Public Company, Private Company, State Company)
- Nature of funding (public, policy driven public, private)
- Financing Mode (reimbursable, non-reimbursable)
- Executing Agent Name
- Nature of the Executing Agent (Federal Public Agency, ICT-University, ICT-Public Research Institute, State-Owned Enterprises, Private Company)
- Digit-1 Technology Category
- Digit-2 Technology Category
- R&D or Demo

Search Terms for IEA Energy Categories (Example of Renewables Energies)

Dígito 1	Grupos de Tecnologias Energéticas	Dígito 2	Categorias Sintéticas	Categorias	Palavras-chave ou termos de busca
3	Fontes de Energia Renováveis	3.1	Energia solar	Energia solar (aquecimento e refrigeração, solar fotovoltaico, geração termosolar, outros de energia solar)	energia & solar ; aquecimento & solar ; arrefecimento & solar; fotovoltaica; "célula* solar*"; "módulo* fotovoltaico*"; "sistema* fotovoltaico*"; solar & térmica ; concentrador* & solar; heliotérmica; aplicaç* & alta & temperatura;
		3.2	Energia Eólica	Energia Eólica (tecnologias onshore, offshore, sistemas eólicos e outras)	energia & eólica ; eólicas & onshore ; eólica* & offshore; usina* de vento; turbina & eólica; rotor ; aerogerador*; conversor*; pás & eólica;
		3.3	Energia dos Oceanos	Energia dos Oceanos (energia das marés, energia das ondas, outras)	energia & oceânica ; energia & maré* ; energia & ondas; poder & gradiente & salinidade;
		3.4	Biocombustíveis	Biocombustíveis (bioetanol, biodiesel, outros biocombustíveis líquidos, biocombustíveis sólidos, biogás, aplicações para geração de calor e eletricidade a partir da biomassa)	biocombustível* & líquido*; biocombustível* & sólido*; biogás; biomassa; etanol; bioetanol; cana-de-açúcar; bagaço; palha; bioeletricidade; gaseificação; pirólise; resíduo*; glicerol ; enzima* & hidrólise; "hidrolise enzimática"; hidrólise & ácida; lignocelulose; biocombustível & segunda & geração; biodiesel; "óleos vegetais"; oleaginosa*; gordura* anima*; óleo de soja; transesterificação; esterificação; algas; microalga*; "biocombustível* de terceira geração"; biorreator;
		3.5	Energia Geotérmica	Energia geotérmica;	"energia geotérmica"; energia & recurso* & hidrotermal*; energia & recurso* & rocha* & seca* & quente; rocha & perfuração; rocha & exploração;
		3.6	Hidroeletricidade	Hidroeletricidade (pequena e grande)	hidroeletricidade; centra* hidroelétrica*; pch; pequena* centra* hidroelétrica*; UHE; barrage*; turbinas hidroelétrica*
		3.7	Outras energias renováveis	Outras energias renováveis	fontes & energia & renovável*;

Databases Main Features

Databases used to adjust the search terms						
Data Source	Time Interval	Captured Value	Funding Agent	Executing Agent	IEA Technology	Demonstration
FNDCT	2013-2018	executed	yes	yes	Search terms	no
ANP	2017-2018	commited	yes	yes	ANP classification Search Terms	no
Aneel	2013-2018	executed	Yes	Yes	Aneel classification Search Terms	no
BNDES	2013-2018	contracted	yes	yes	BNDES classification Search Terms	no
FAPESP	2013-2018	Not available	Yes	yes	FAPESP classification Search Terms	no
FINEP	2013-2018	executed	Yes	yes	Search Terms	no

Challenges

- Time series are incomplete (ANP)

- Execution data is missing in more recent years (Aneel)

- Committed or Contracted Values were used in place of Executed Values (BNDES, ANP)

- Difficulties in using search terms in several databases

- Difficulties to identify and separate Demonstration Data

- Difficulties to identify project executors (Aneel)

- Incomplete coverage (FAPESP and non FNDCT CNPq data is missing)

- State companies data are incomplete (Public Electricity Companies)

- Data from Petrobras are difficult to classify by IEA Energy Categories

- Data from others public Ministries are missing (Agriculture, Education, Mines and Energy)

- Data from others State Foundation are missing

- The quality of the databases (FNDCT, ANP, Aneel, BNDES, Finep) has to be improved to fit the requirements of good RD&D statistics
  - Specific question about the project energy category
  - Indication of Demonstration project
- State companies are very important in Brazilian RD&D efforts
  - Data from others Energy State Companies
  - More accurate information about energy category of RD&D expenditures
  - More accurate information of Demonstration Expenditures
  - More accurate information about executors
- Federal Energy RD&D Budget (other than MCTIC and FNDCT) should be accounted more comprehensively
  - Ministries of Agriculture, Education, Energy and others have to be accounted
- State Energy RD&D has to be accounted
  - FAPESP expenditure
  - Others State Research Foundations

Thank you!

afurtado@unicamp.br