

# Meeting well-below 2 degree target would increase energy sector jobs

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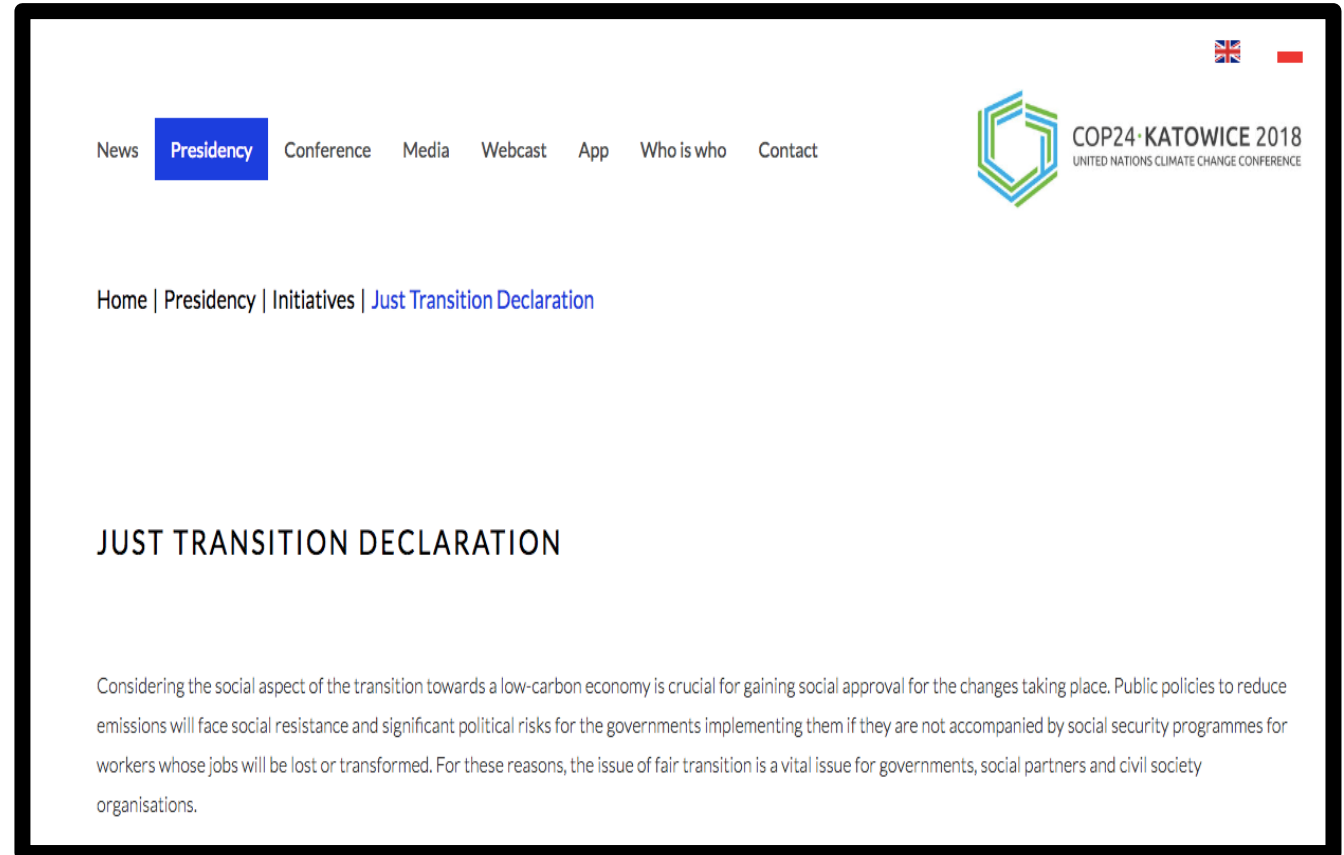
**RFF  
CMCC**

European Institute  
on Economics  
and the Environment

*Preliminary results,  
please don't cite or circulate!*

- Motivation
  - Justice based
  - Political
- Data collection on today's direct energy jobs
  - How many direct total energy jobs are there today?
- Implementation in an IAM in Reference and Paris Agreement scenarios
  - What happens globally to energy system jobs?
  - Regional differences and «new jobs»

- Climate policies will face political & social resistance in the absence of just transition plans
- From a justice point of view it's important to think about workers livelihoods
- Just transition endorsed by
  - ILO
  - UNFCCC
  - COP24



## Just transition – energy jobs



**What will happen to the livelihood of millions of coal & other fossil fuel workers?**



**“The coal industry is dirty, and I am dying a slow death living here. But I have no other option.”**

**“If I got the opportunity, I would love to work in the solar industry, but how will I find a job? My present is painful, but the future is uncertain.”**



# U.S. 2016 Presidential Elections

*“...I’m the only candidate who has a policy about how to bring economic opportunity using clean renewable energy as the key into coal country. Because we’re going to put a lot of coal miners and coal companies out of business, right?” –*

**At a town hall meeting in Ohio in March 2016**



**Later admitted in her book that this was the biggest mistake of her campaign...**



Candidate Trump promised to bring back coal jobs and won almost all major coal states

298 references to coal miners during his campaign –  
*The Washington Post*

# Jobs Data is difficult to obtain...

أرامكو السعودية  
Saudi Aramco

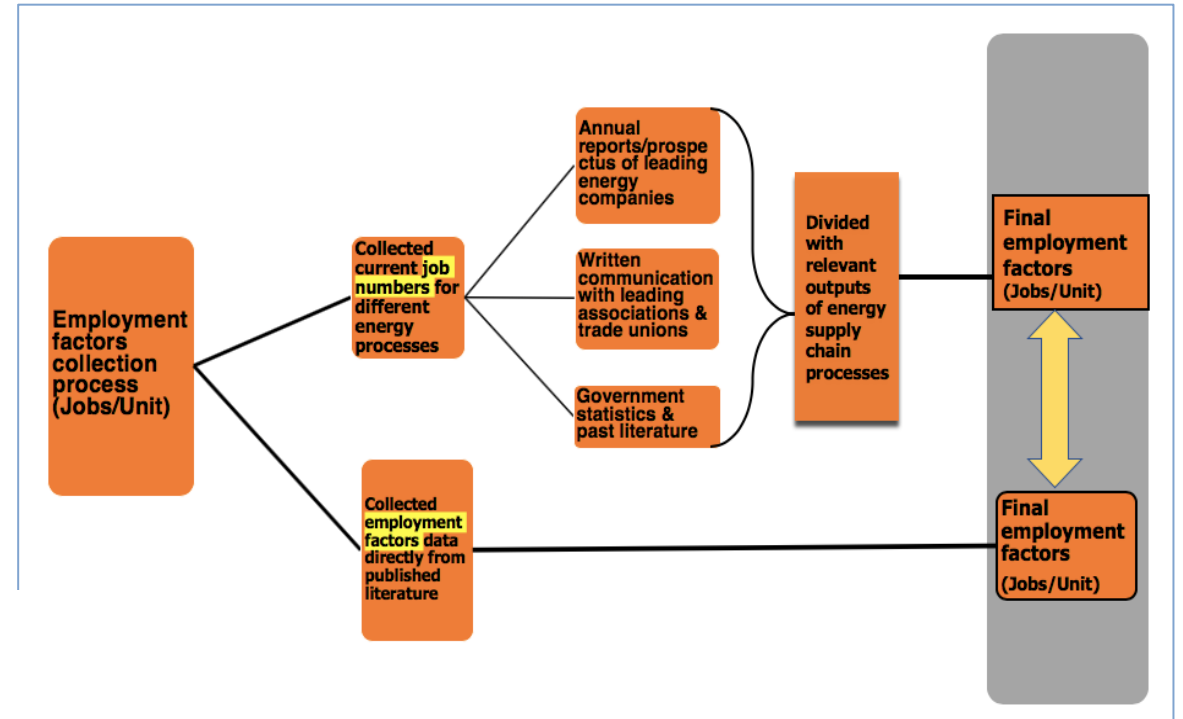
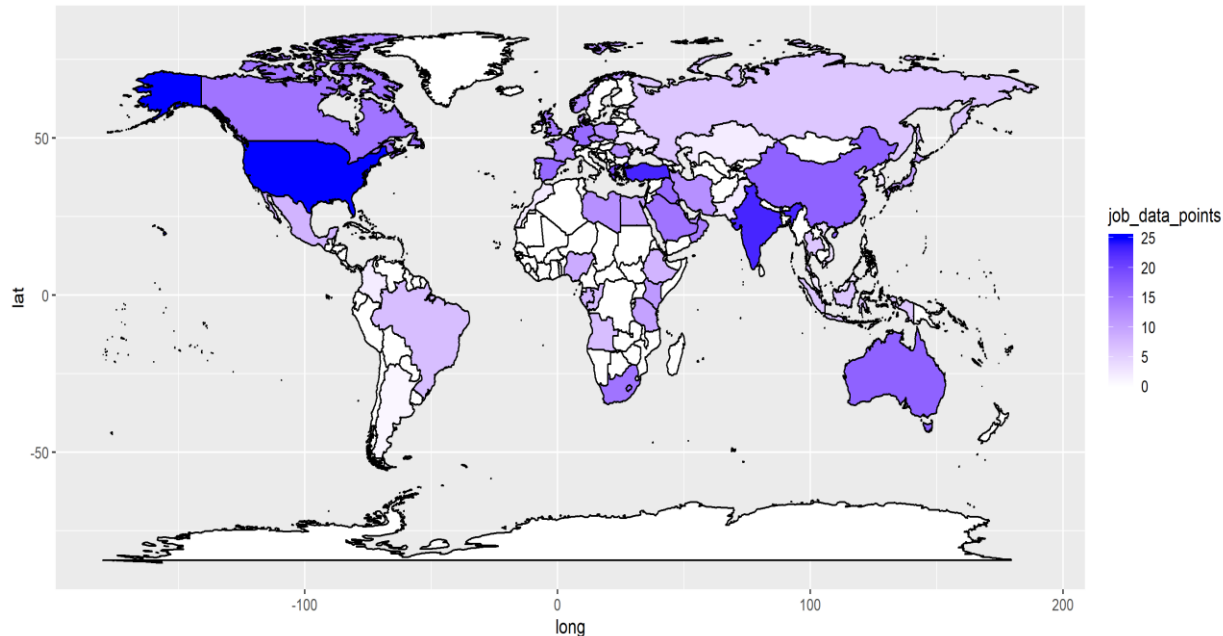


## 50+ country dataset

- Annual reports
  - Big oil companies
    - Saudi Aramco (Saudi Arabia), Gazprom (Russia), Sinopec (China), and Pemex (Mexico),
  - Big coal companies
    - Coal India (India), SUEK Ltd (Russia)
- Written communications
  - World Nuclear Associations
  - Trade unions like the Federation of Oil Unions (Iraq), Central de los Trabajadores y Trabajadoras (Brazil)
- Official statistics from countries
- International Organizations (IRENA)

# Quantifying today's global direct energy jobs

- 11 Energy Technologies
- 5 job categories
- 529 datapoints in total
- Country-level were available
- Covering 83% of total energy jobs



- Direct jobs
- Indirect jobs (further value chain)
- Induced jobs



- Summarizing jobs across 11 technologies, 5 job categories and countries:

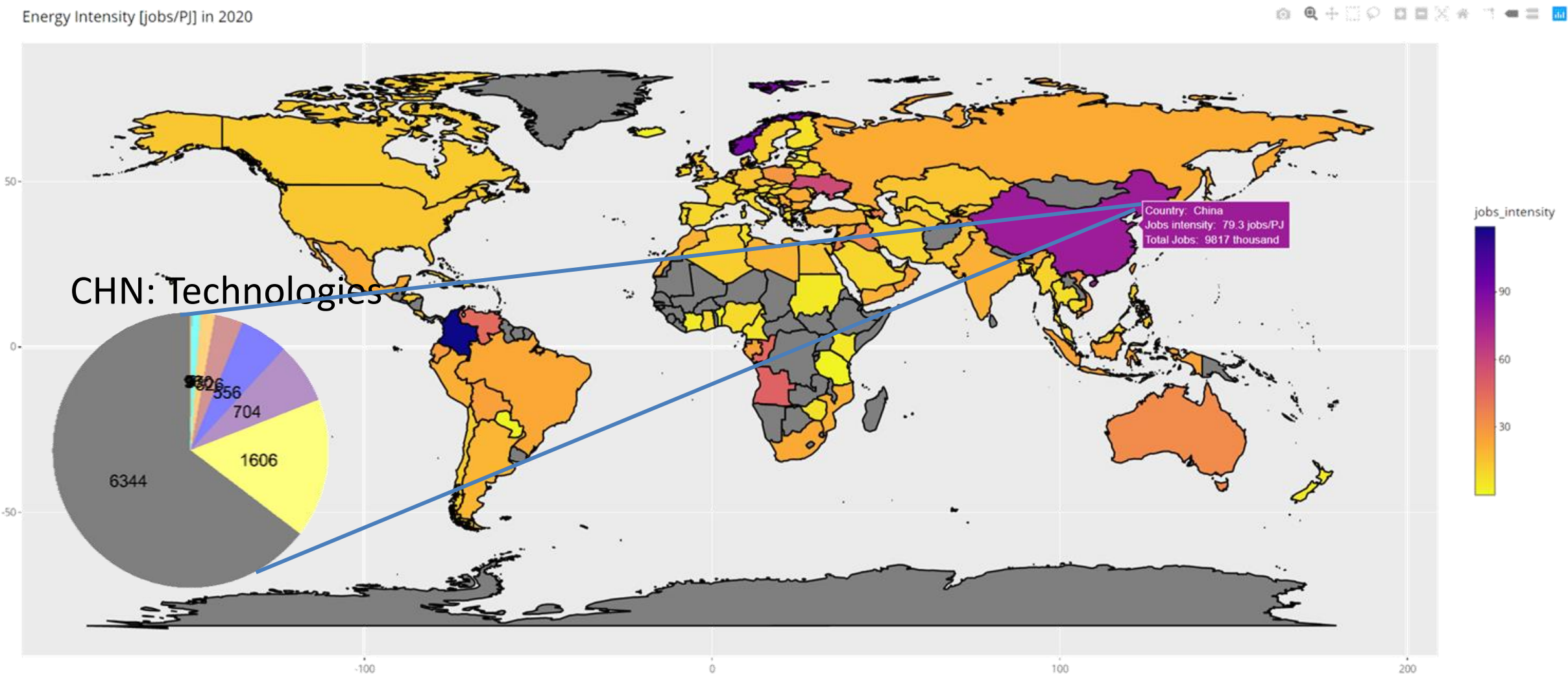
$$\begin{aligned} TotalJobs = & \sum_e jobint_{e,construction} \cdot I\_EN_e + \sum_e jobint_{e,manufacturing} \cdot I\_EN_e \\ & + \sum_e jobint_{e,O\&M} \cdot K\_EN_e + \sum_e jobint_{e,fuel\_production} \cdot Q\_OUT_e \\ & + \sum_e jobint_{e,refining} \cdot Q\_PES_e. \end{aligned}$$

Using country-level job intensities, and energy statistics (IEA WEB, IRENA, WPDB)

→ Comparable, consistent and complete dataset across countries

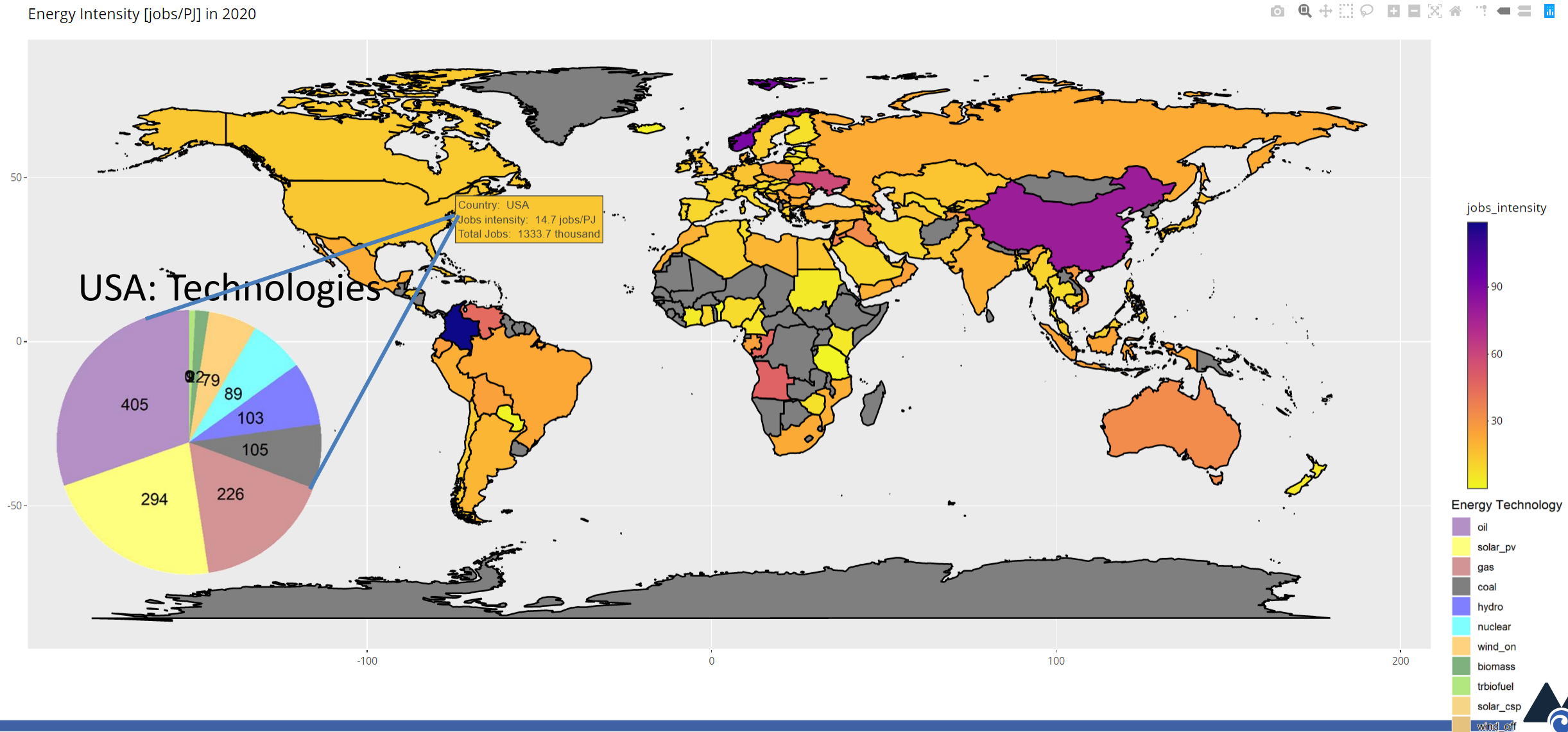
→ Data analysis and visualization

# Today's Energy Jobs in the USA



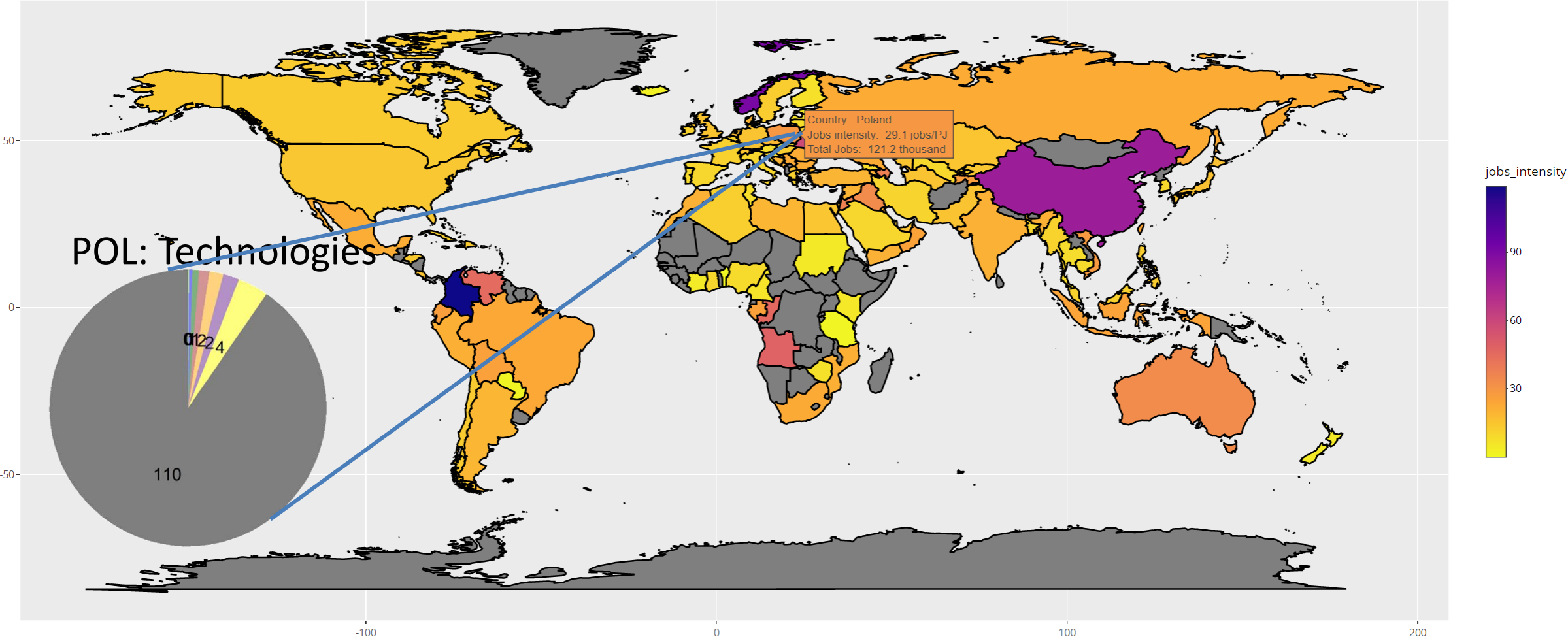
# Today's Energy Jobs in the USA

Energy Intensity [jobs/PJ] in 2020



# Today's Energy Jobs in Poland

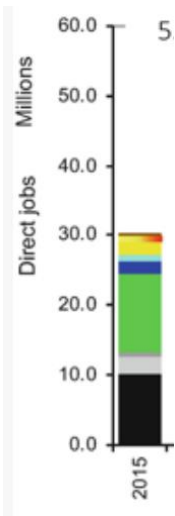
Energy Intensity [jobs/PJ] in 2020





# Globally, how many direct energy jobs are there today?

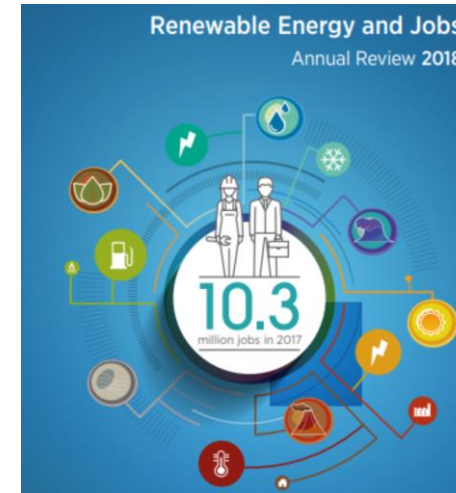
- How many total energy jobs are there today?



Dominish et al. (2019) book  
regional multipliers, few OECD countries  
Not all categories

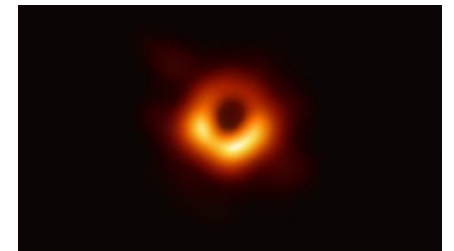
Many regional studies (EU, ...)  
country-level studies  
sectoral analyses

...



IRENA (2019): Direct and indirect  
only renewables

```
> print(sum(energy_jobs_iso3_completed$jobs, na.rm = T))  
[1] 17452144  
>
```

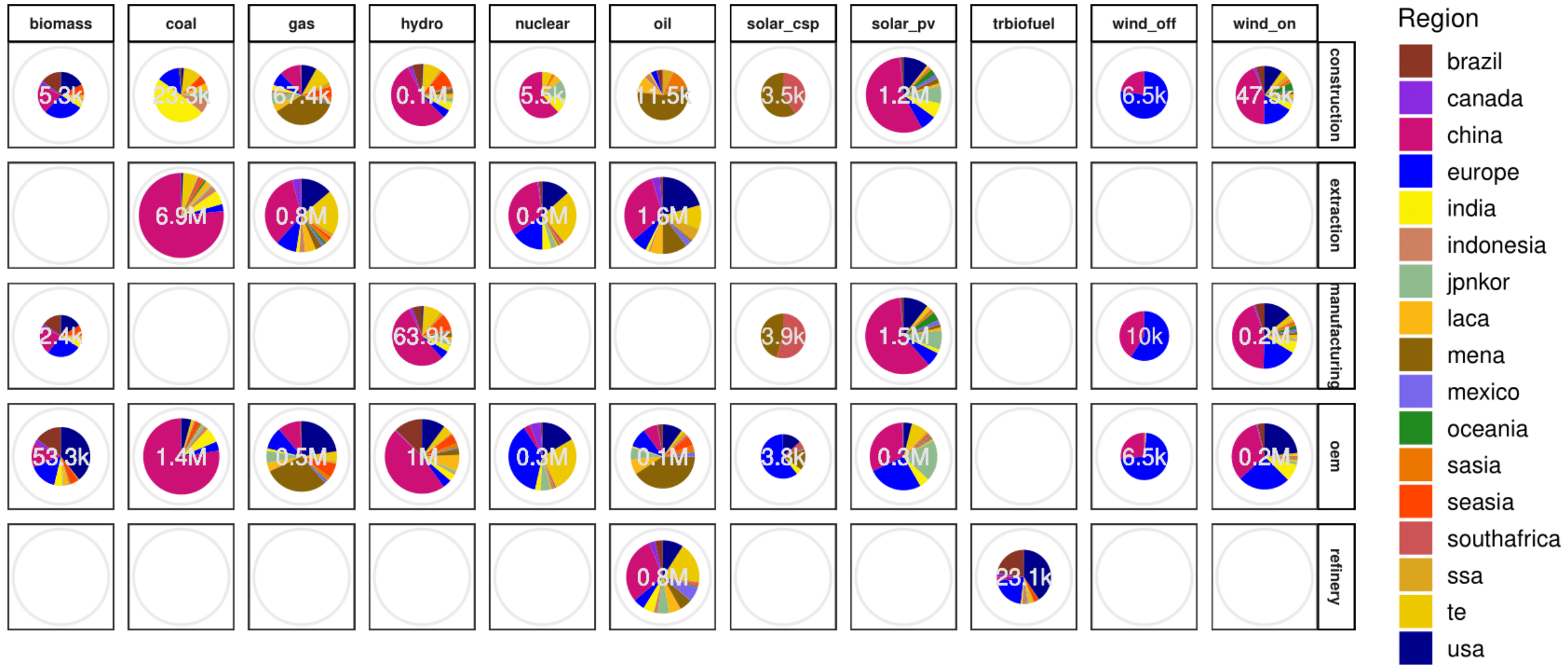


Doesn't exactly look like a black hole, but as researchers, we were  
still quite excited



# Energy Jobs across countries in 2020

Total Jobs across regions of all job types and technologies in 2020



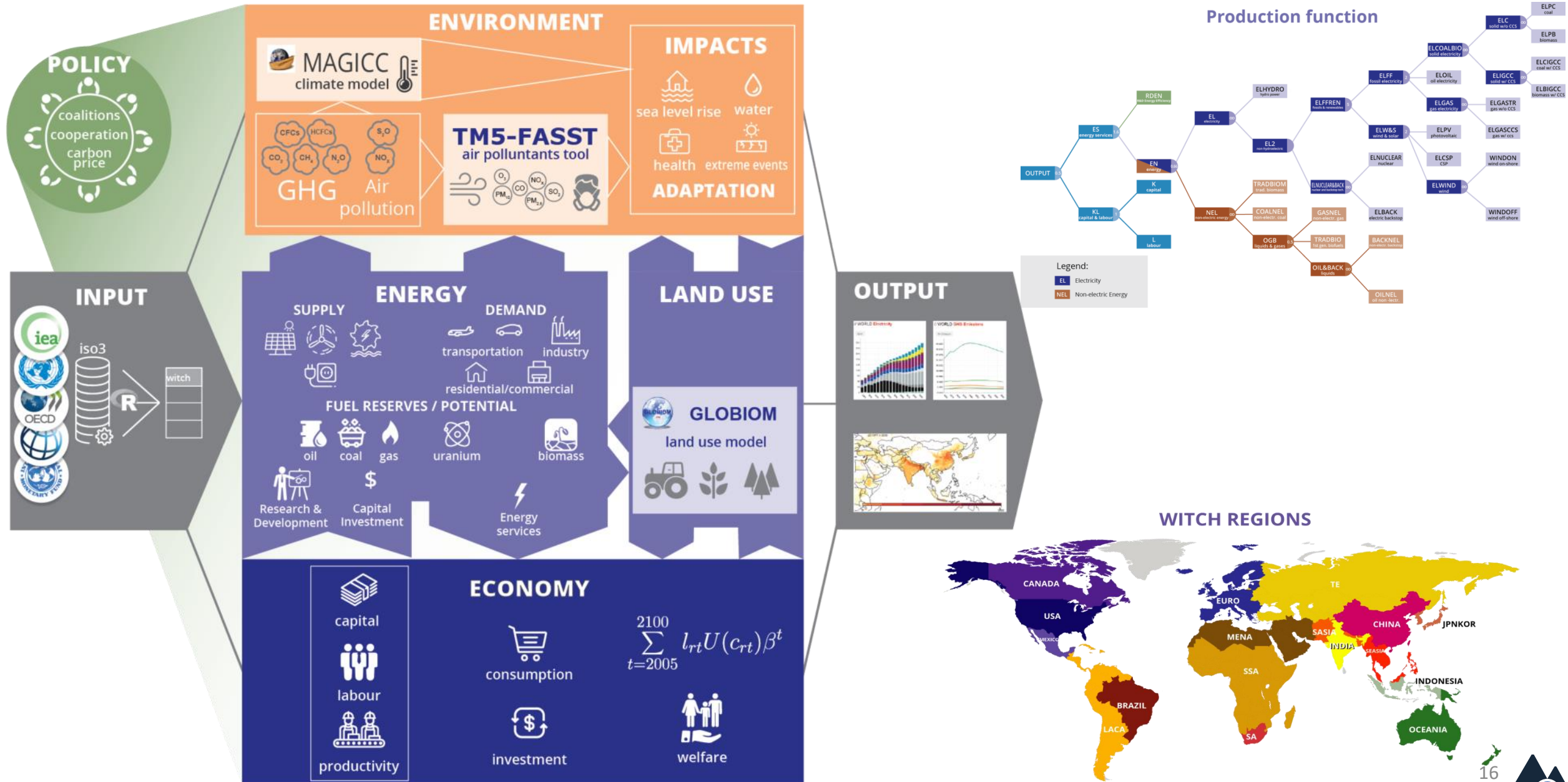
Size shows log10 of total jobs



# Extending Integrated Assessment Models to Estimate Future Jobs

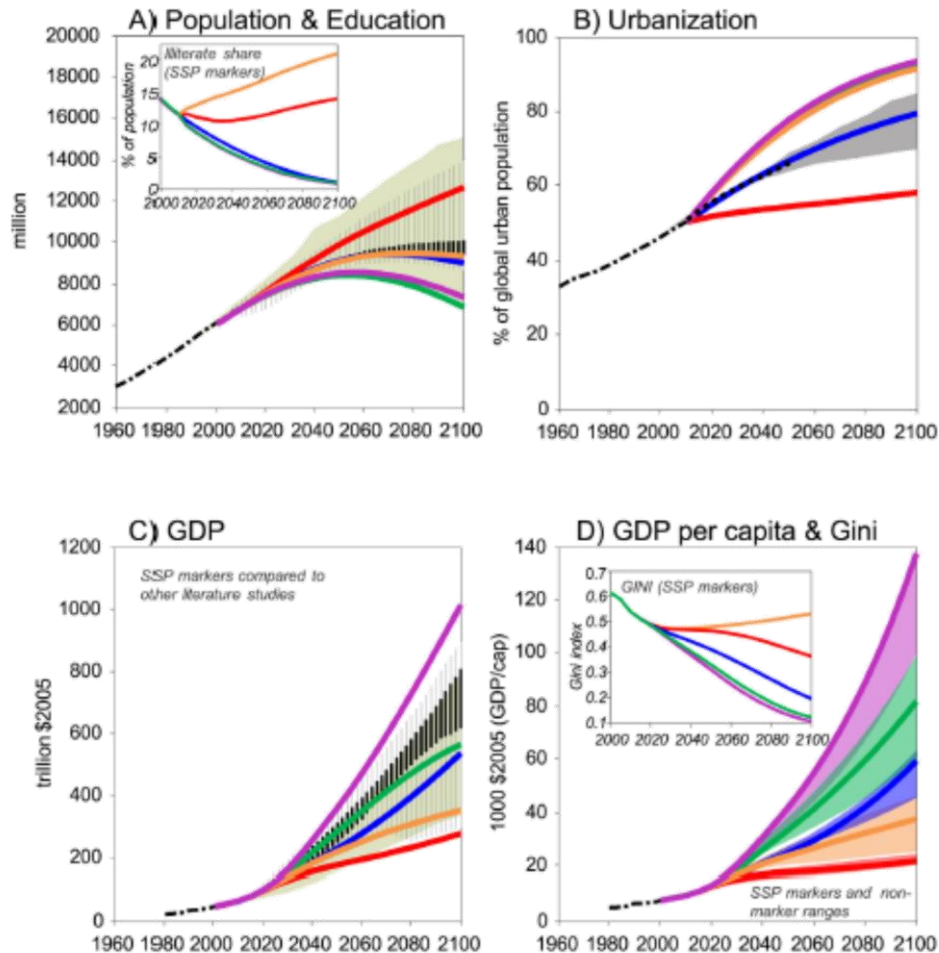


# IAM Model





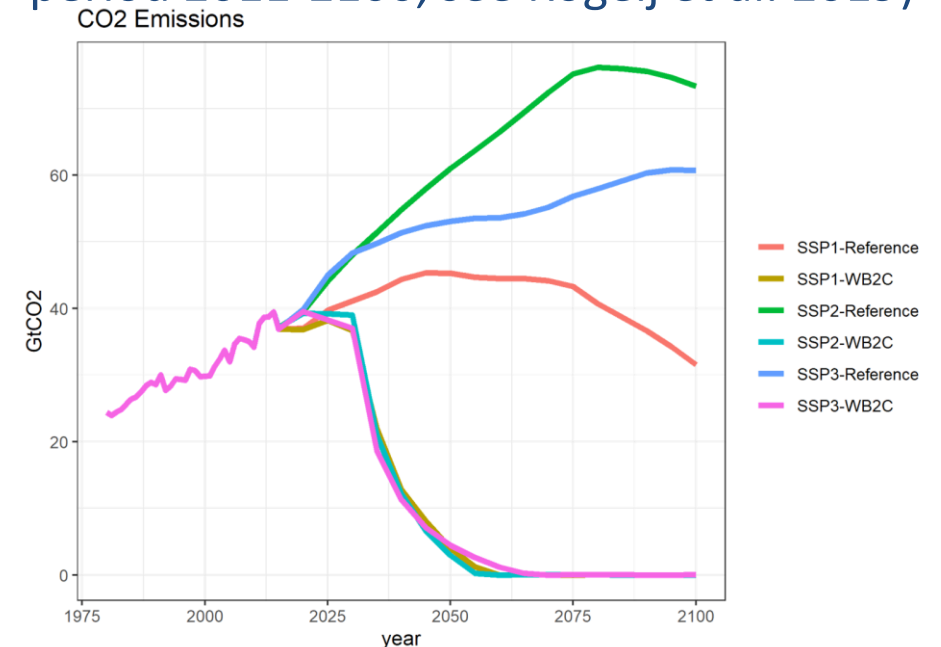
## Shared Socioeconomic Pathways (SSP)



Source: Riahi et al. (2017)

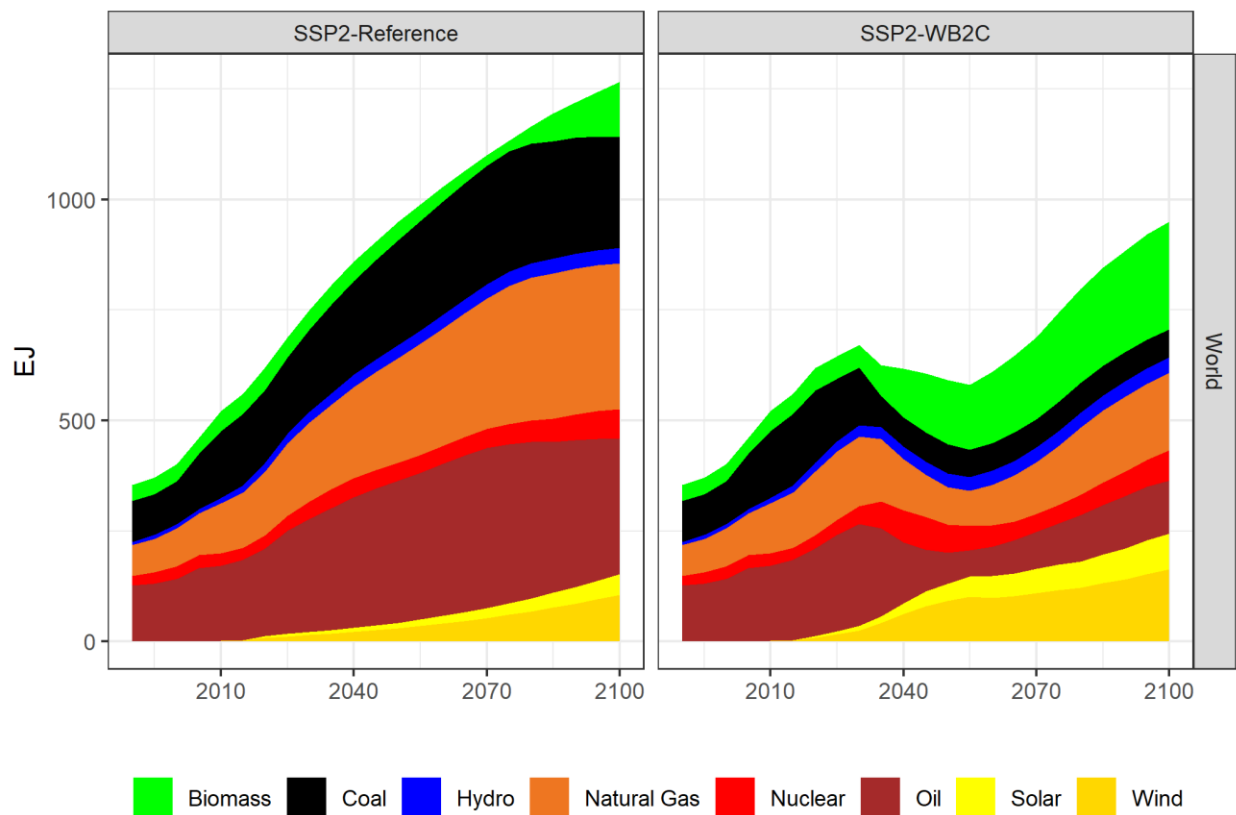
## Scenarios:

1. Reference  
(continued current policies and NDCs)
2. WB2C (staying below 2 degrees (very likely) or 1.5 degrees (likely)  
(Peak carbon budget of 742 GtCO<sub>2</sub> for the period 2011-2100, see Rogelj et al. 2019)

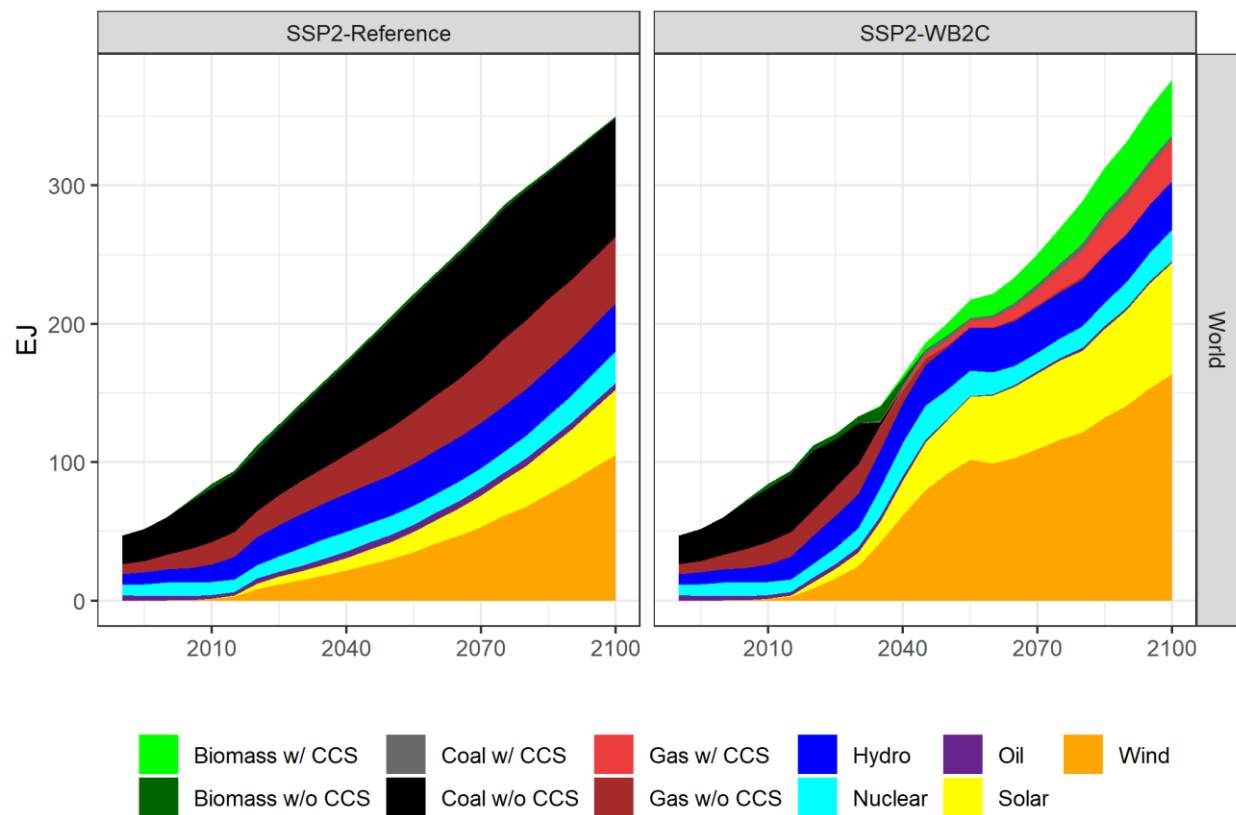


# Energy and Electricity Mix

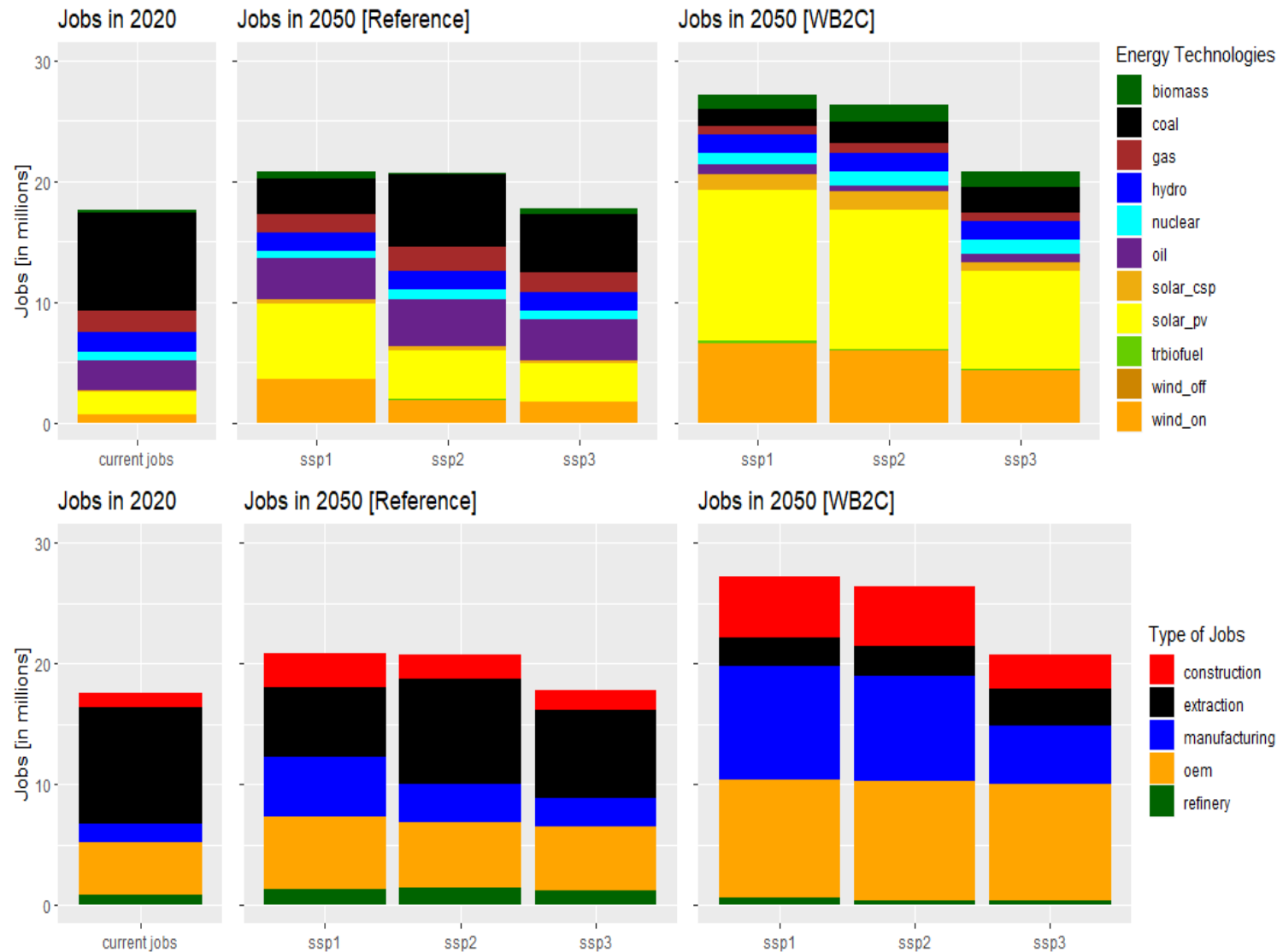
Primary Energy Mix



Electricity Mix



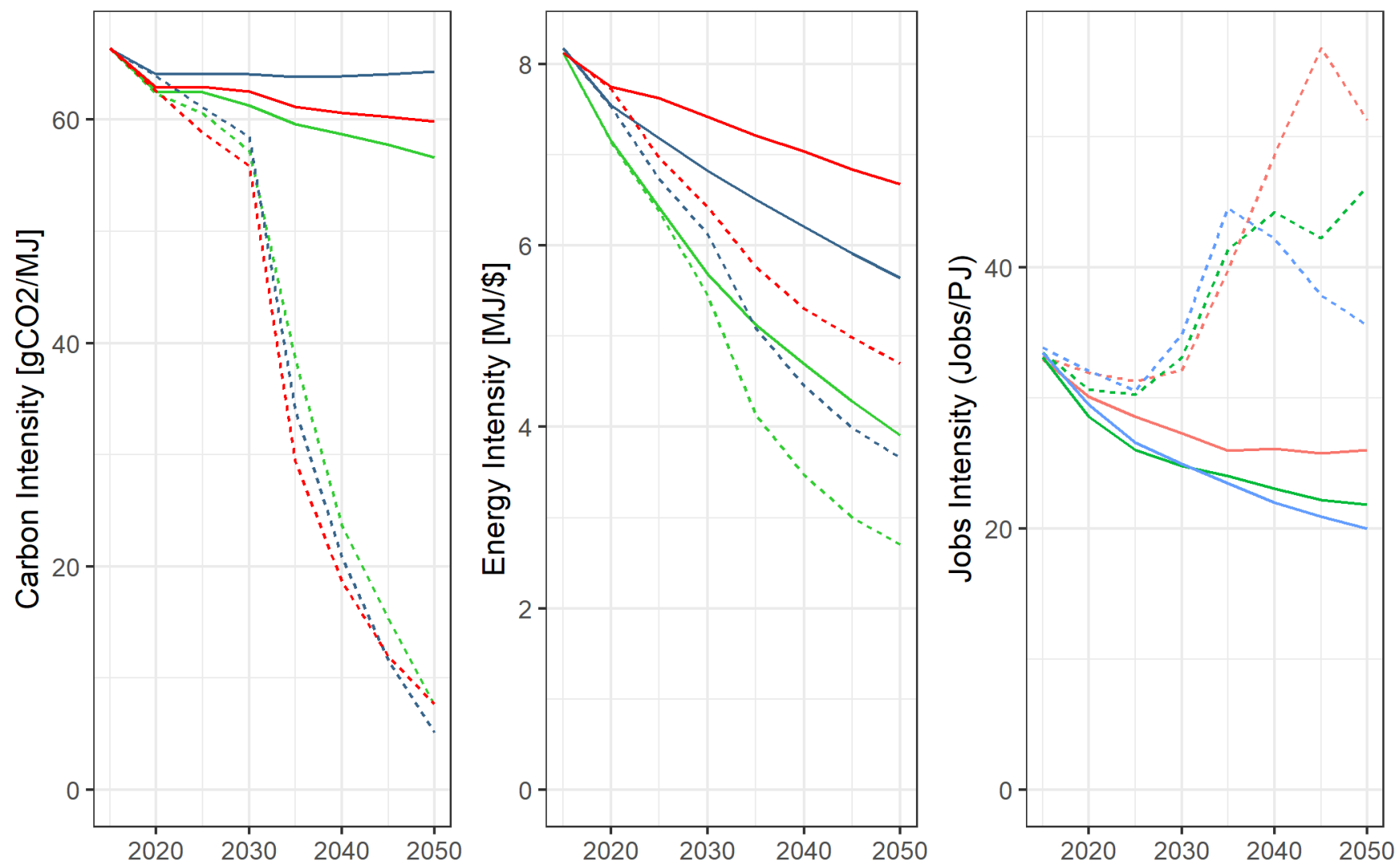
# Energy Jobs Evolvment



- **2020: 17 million direct energy jobs**
- **Almost 12 million in fossil fuel industries**
- **By 2050:**
  - **Current NDC policy: 21 million [18-21]**
  - **Well below 2° C : 26 million [21-27]**



# Changes over time and intensities

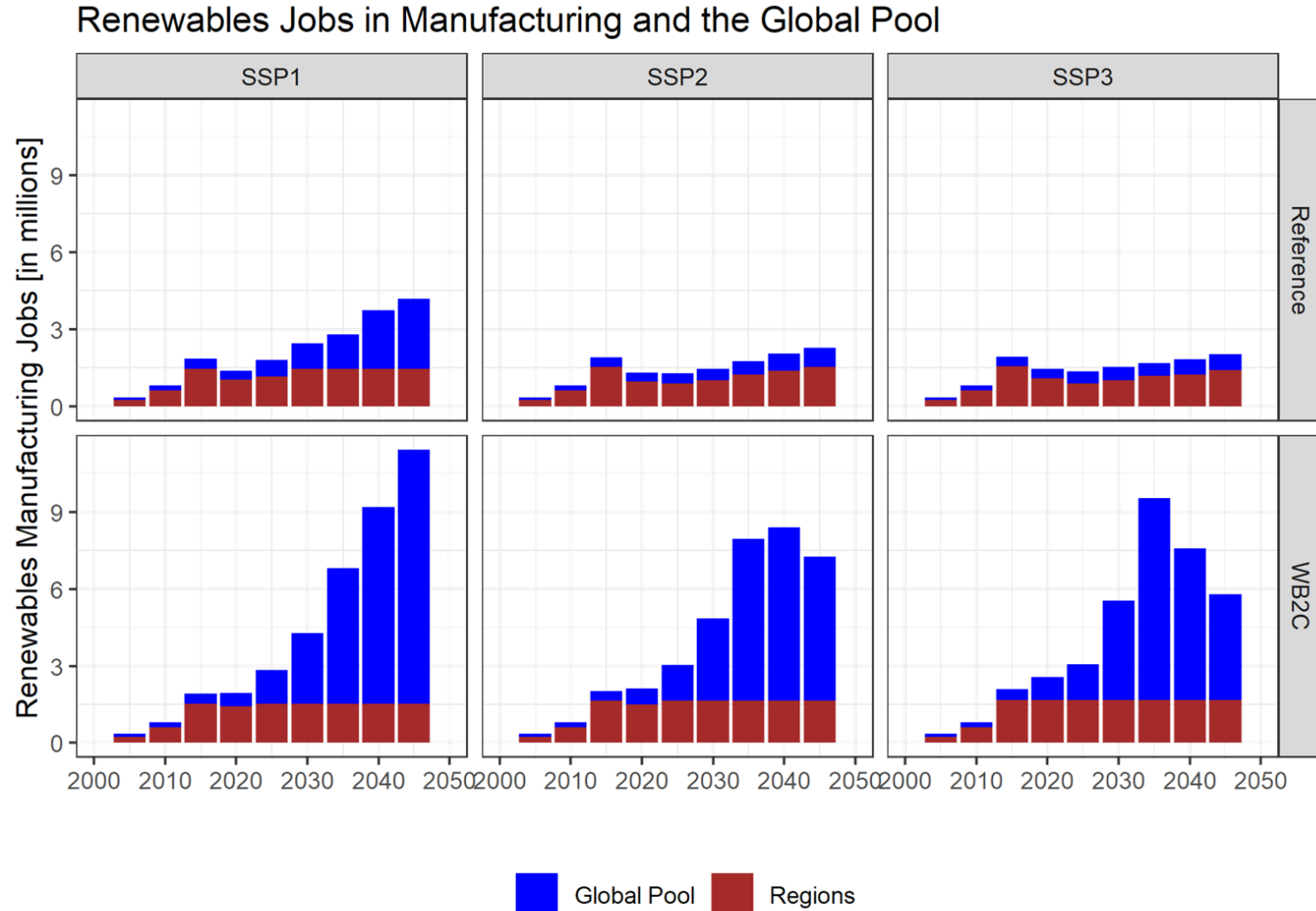


Scenario — Reference    - - - - WB2C    SSP    — SSP1    — SSP2    — SSP3

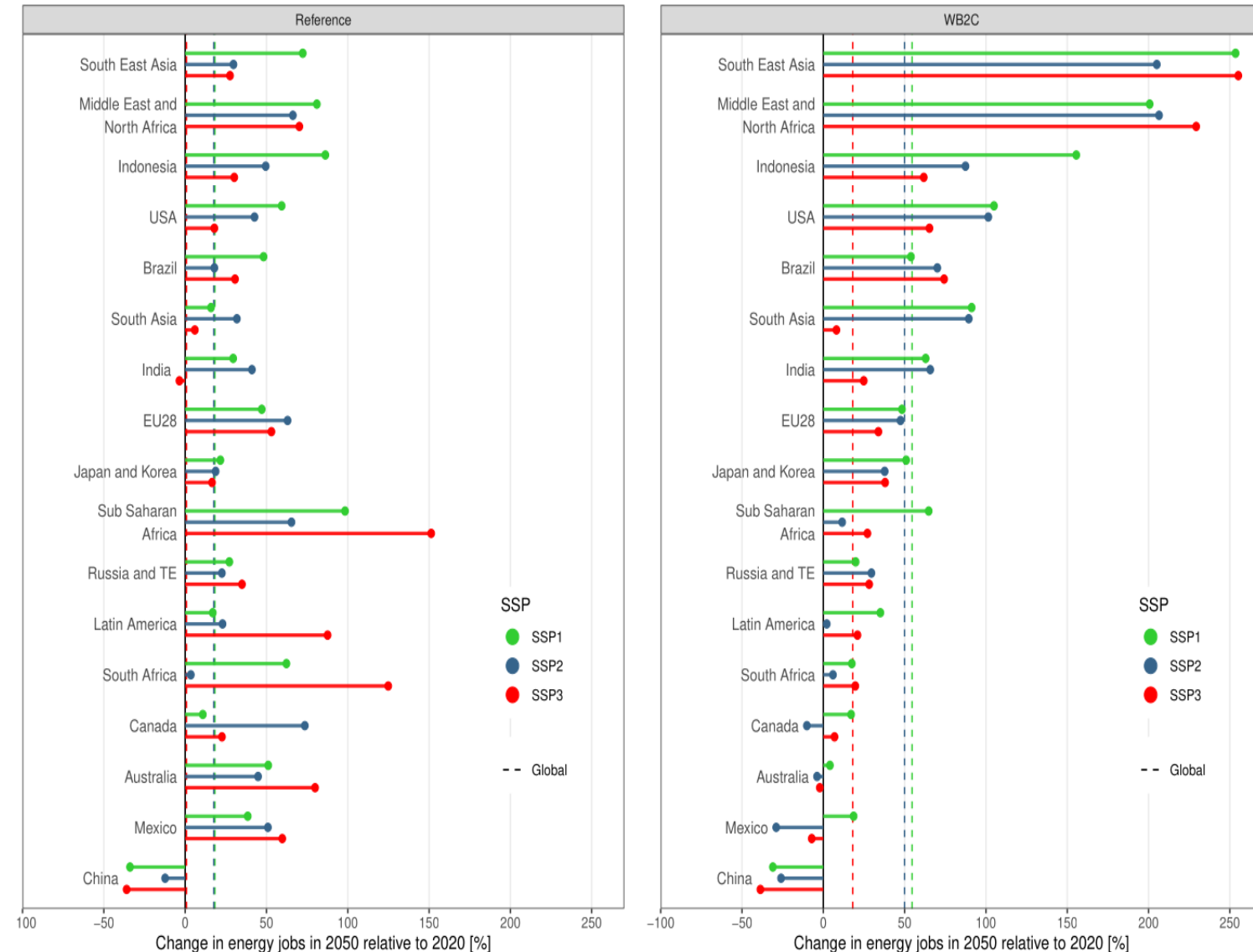




- Solar and Wind Manufacturing, country of production depends on many factors --> assigned to the «global pool» for jobs



# China & Fossil Fuel Exporting Regions lose Jobs

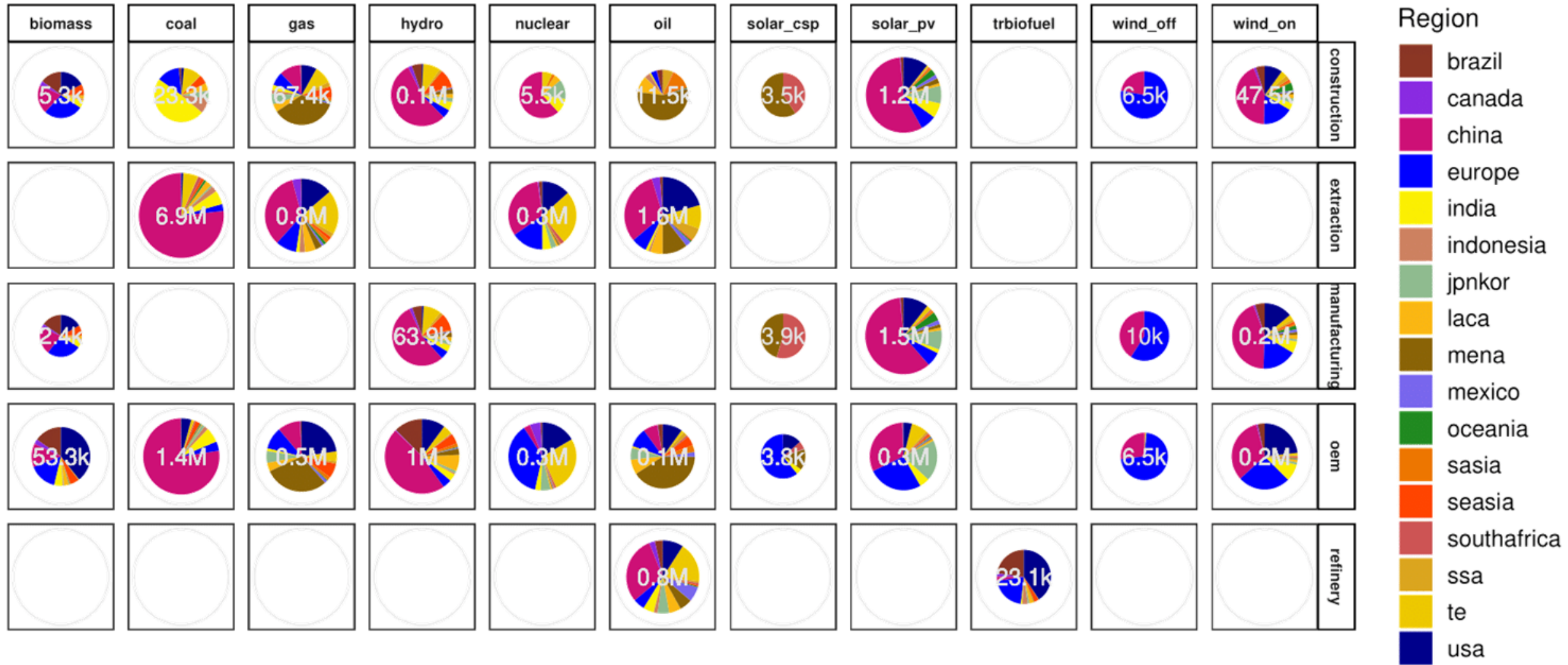


- Many regions gain under WB2C: South East Asia, Middle East and North Africa, Indonesia, the US, Brazil, South Asia, India, and Japan & Korea
- Some regions don't see much difference: European Union, Russia and TE, and Latin America



## Energy Jobs across countries in 2020

## Total Jobs across regions of all job types and technologies in 2020

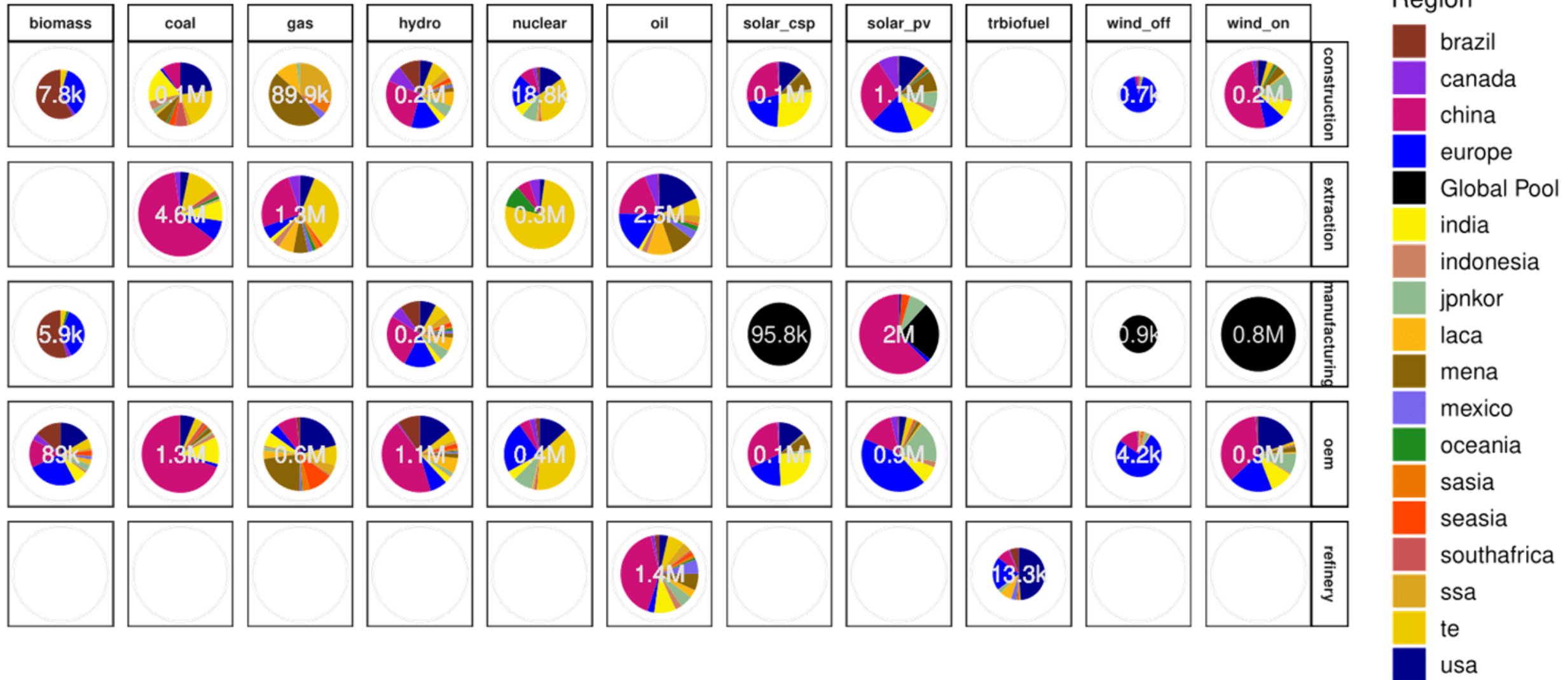


Size shows log10 of total jobs



# Energy Jobs across countries in 2050 (Reference)

Total Jobs across regions of all job types and technologies in 2050 [Reference]



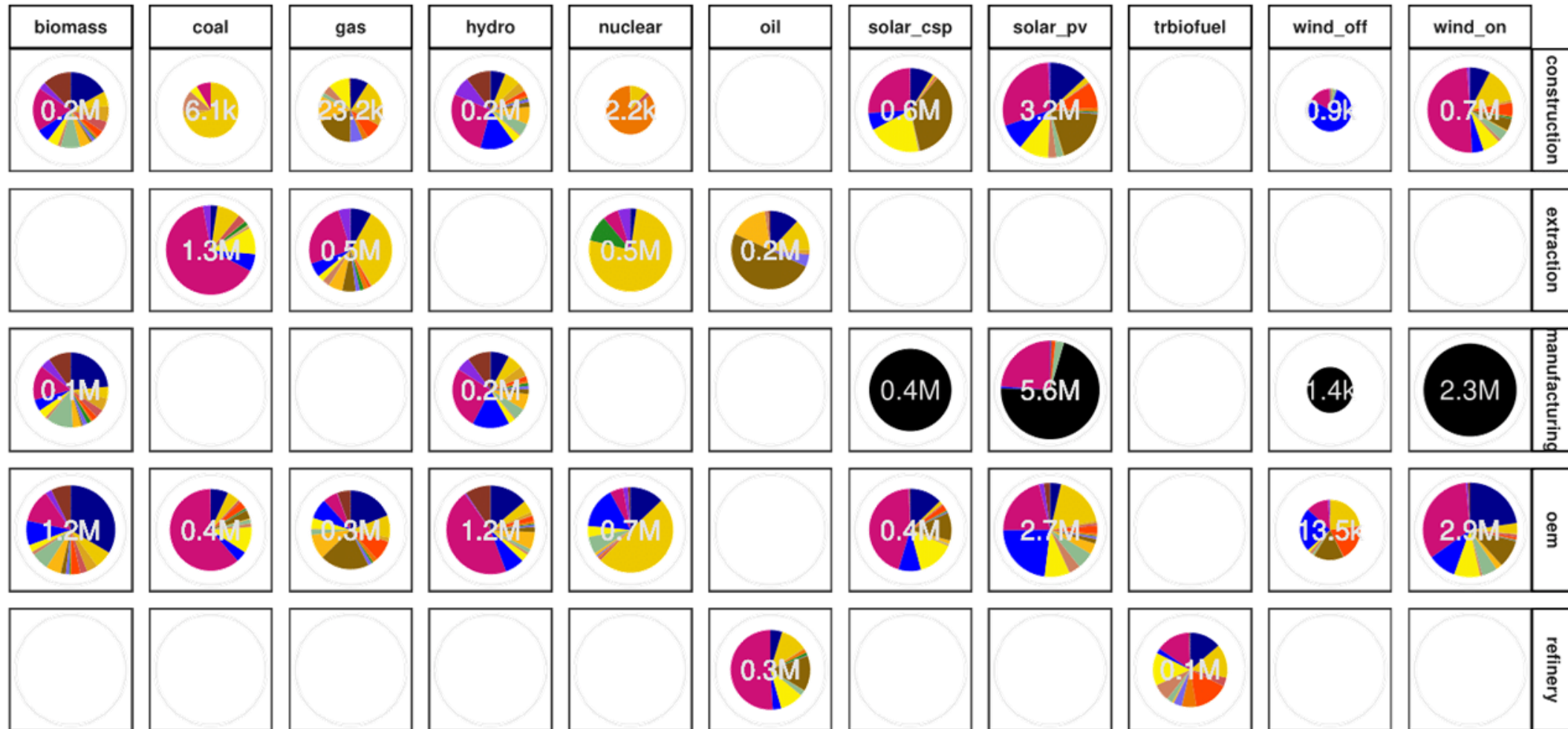
Size shows log10 of total jobs





# Energy Jobs across countries in 2050 (WB2C)

Total Jobs across regions of all job types and technologies in 2050 [WB2C]



## Region



Size shows log10 of total jobs



- Today's direct energy jobs in the order of 17.5 millions (12M Fossils)
- Small increases in the reference scenario expected (21-27 millions)
- Manufacturing renewables («global pool») with big potential (2-6 Mio.)
- Energy jobs discussion in the «Just Transition» debate important, especially at regional level as well as political realm
- In ESM/IAM results energy dimension typically reported, but jobs dimension might be as important
  - open source dataset for further and detailed analyses  
*(to be released in the fall of 2020 with the paper)*

# *Thanks*

