The Great Energy Transition:

Scouting for Energy's Five-Tool Player

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Senior Analyst

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lux executive summit

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Efficiency: Last year we discussed three key strategies driving energy's comeback in a shifting global landscape

Sensing, connectivity, and analytics improve efficiencies in the intelligent oilfield

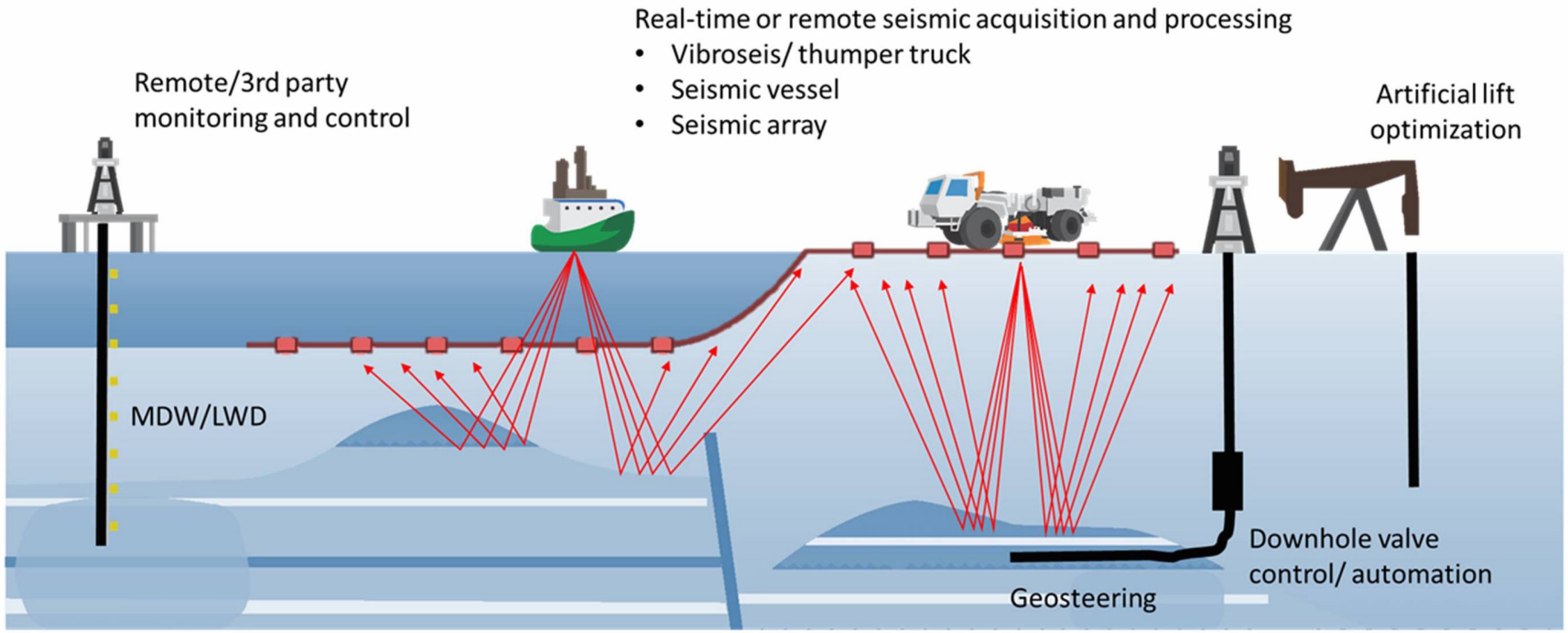


Image Source: Wikipedia

Versatility: Last year we discussed three key strategies driving energy's comeback in a shifting global landscape

Total adds four new pitches to fuel the future of transportation

Solar
- SUNPOWER
- TENESOL (TOTAL & EDF GROUPS)
- Photovoltech
- KONARKA

Storage
- saft
- AMBRI
- LightSail Energy
- AQUION ENERGY
- EnerVault

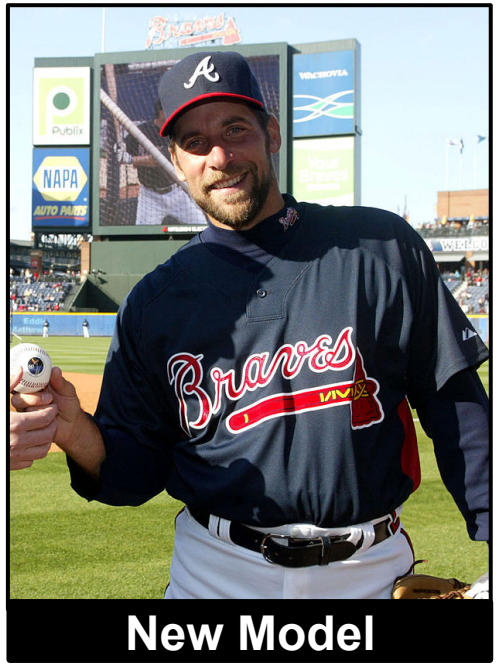
TOTAL

Distributed Generation
- OFF-GRID ELECTRIC
- powerhive
- AutoGrid

Low-Carbon Fuels
- AMYRIS
- sunfire
- Axens (IFP Group Technologies)
- nexsteppe

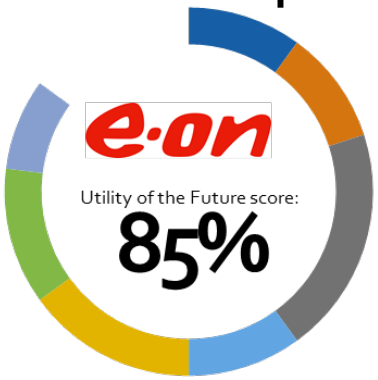
Image Source: Wikipedia

New Model: Last year we discussed three key strategies driving energy's comeback in a shifting global landscape



New Model

E.ON looks beyond renewables and its core competencies to become a utility of the future



Internal Innovation

Wireless charging: In preparation for the rise of plug-in vehicles and their associated infrastructure challenges, E.ON has partnered with three other organizations to test the inductive charging of plug-in vehicles. The first project involves a Peugeot iOn delivery vehicle that was converted to this type of charging.

External Venturing

GREENSMITH bidgely

E.ON invested into Greensmith's $18.3 million Series C in late 2015: **Software provider and system integrator for energy storage systems**

E.ON invested into Bidgely's $16.6 million Series B in late 2015: **Residential energy consumption disaggregation on the appliance level**

Renewables

Strategic pivot: Between late 2014 to 2016, E.ON has been executing a strategic, company-level pivot away from conventional generation, looking instead to renewables, distribution, and "customer solutions"

More than $10 billion invested: Led by its E.ON Climate & Renewables arm, the utility has spent heavily on wind, hydro, and solar power.

Image Source: Wikipedia

Agenda

1. Identifying five key technologies for the global energy transition
2. Following the evolution of the global energy system
3. Preparing for opportunities and threats in the new energy system

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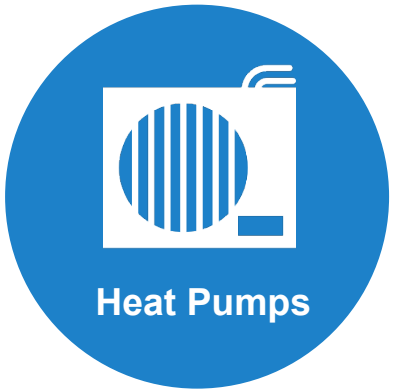
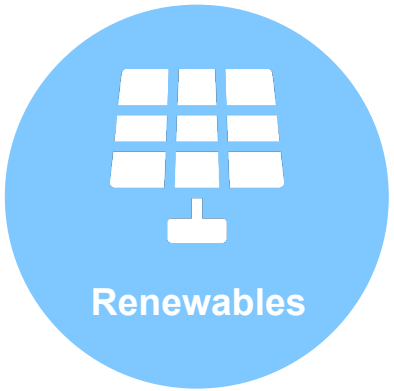
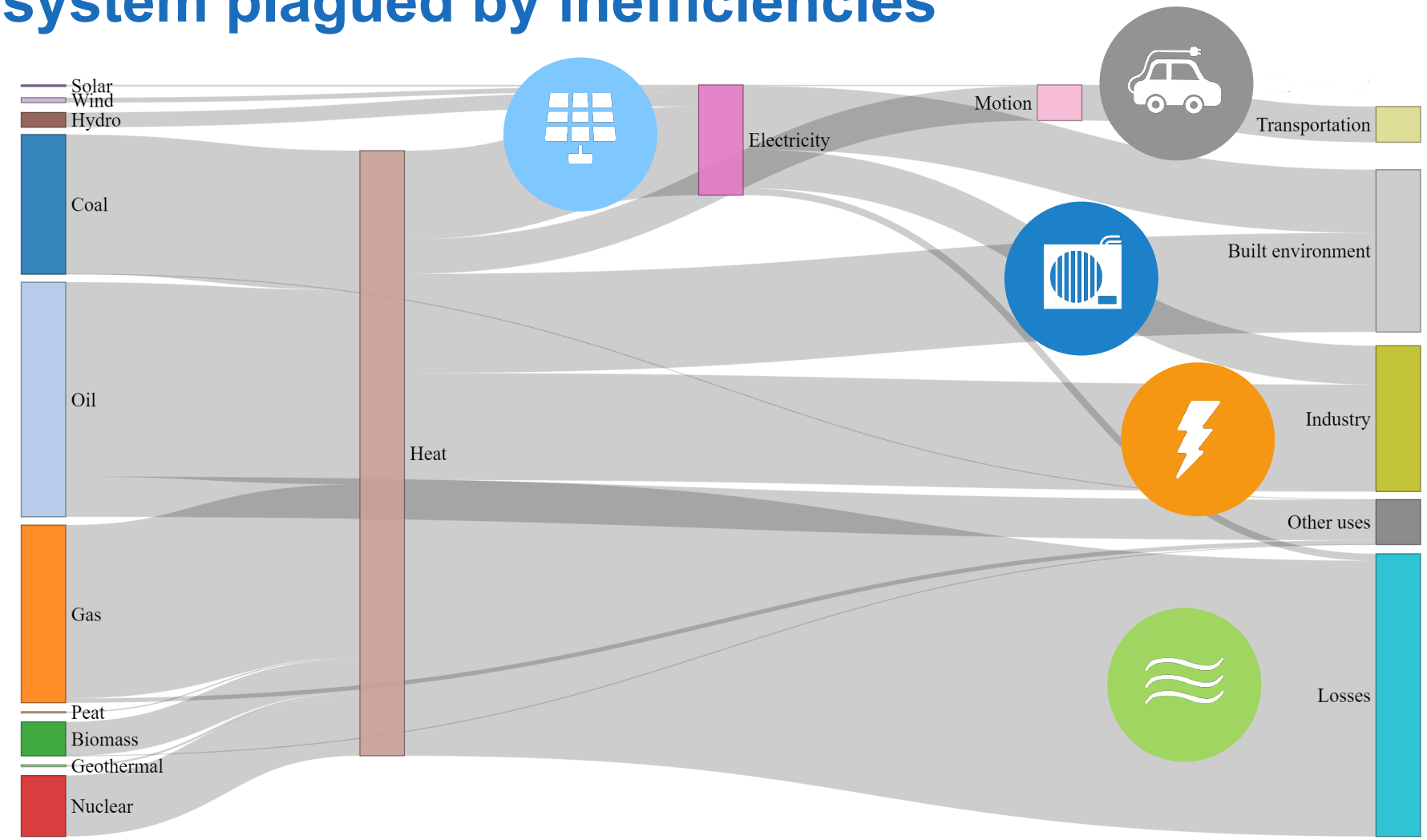
The エースで四番 excels at five fundamental skills that can potentially transform the game

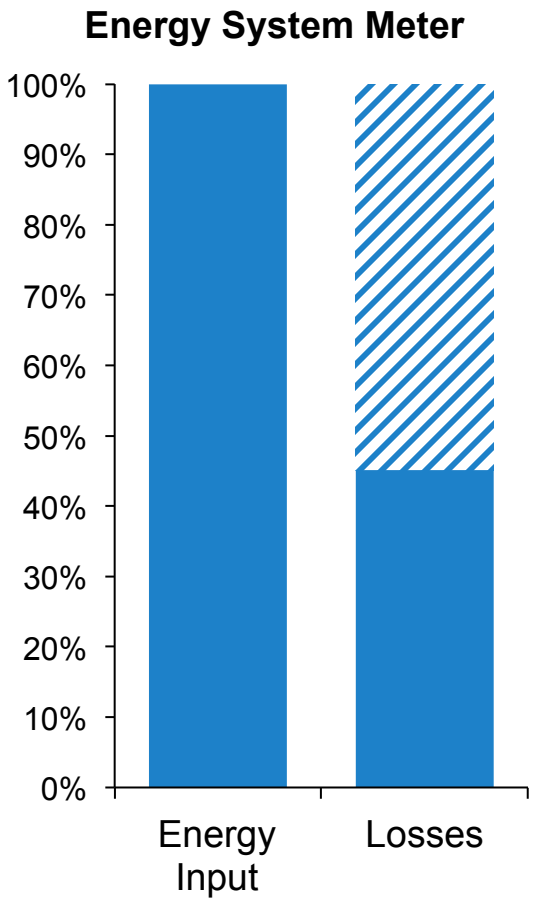
Five fundamental technologies will transform the global energy system





These five technologies present opportunities to alter an energy system plagued by inefficiencies





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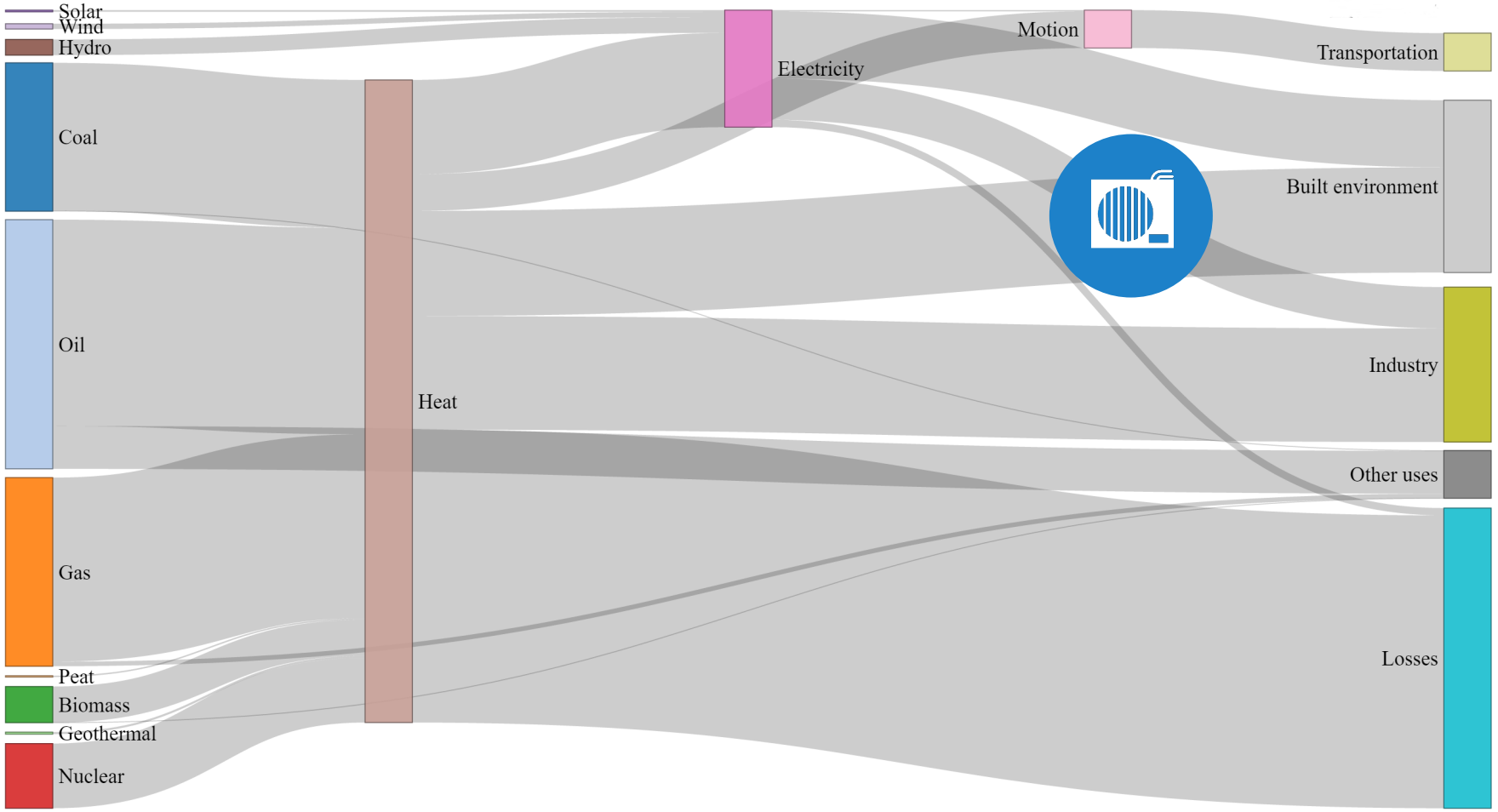
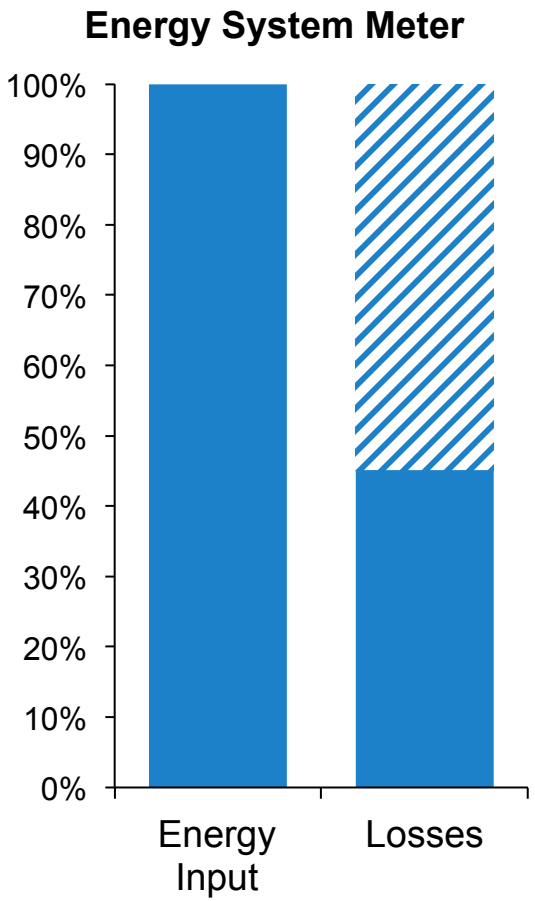
2 Following the evolution of the global energy system

3 Preparing for opportunities and threats in the new energy system

The built environment is the most energy efficiency energy end-user, but consistent improvements can still be made





New heat pumps for use in buildings generate on average 5 kWh for every kWh electricity input

Naked Energy

Develop of vacuum-tube-based photovoltaic thermal system

- **Technology and Differentiators:**
  - Developer of PVT modules with output of 70 W of electrical power and 230 W of thermal power
- **Strategy and Markets:**
  - Targeting deployment in commercial and light industrial applications with high heat demand

Solarus

Develops hybrid photovoltaic (PV)-thermal modules

- **Technology and Differentiators:**
  - Solar thermal component uses parabolic trough concentrators and collectors filled with heat exchange fluid or water
- **Strategy and Markets:**
  - Focused on residential applications and small businesses like boutique hotels and independent farmers

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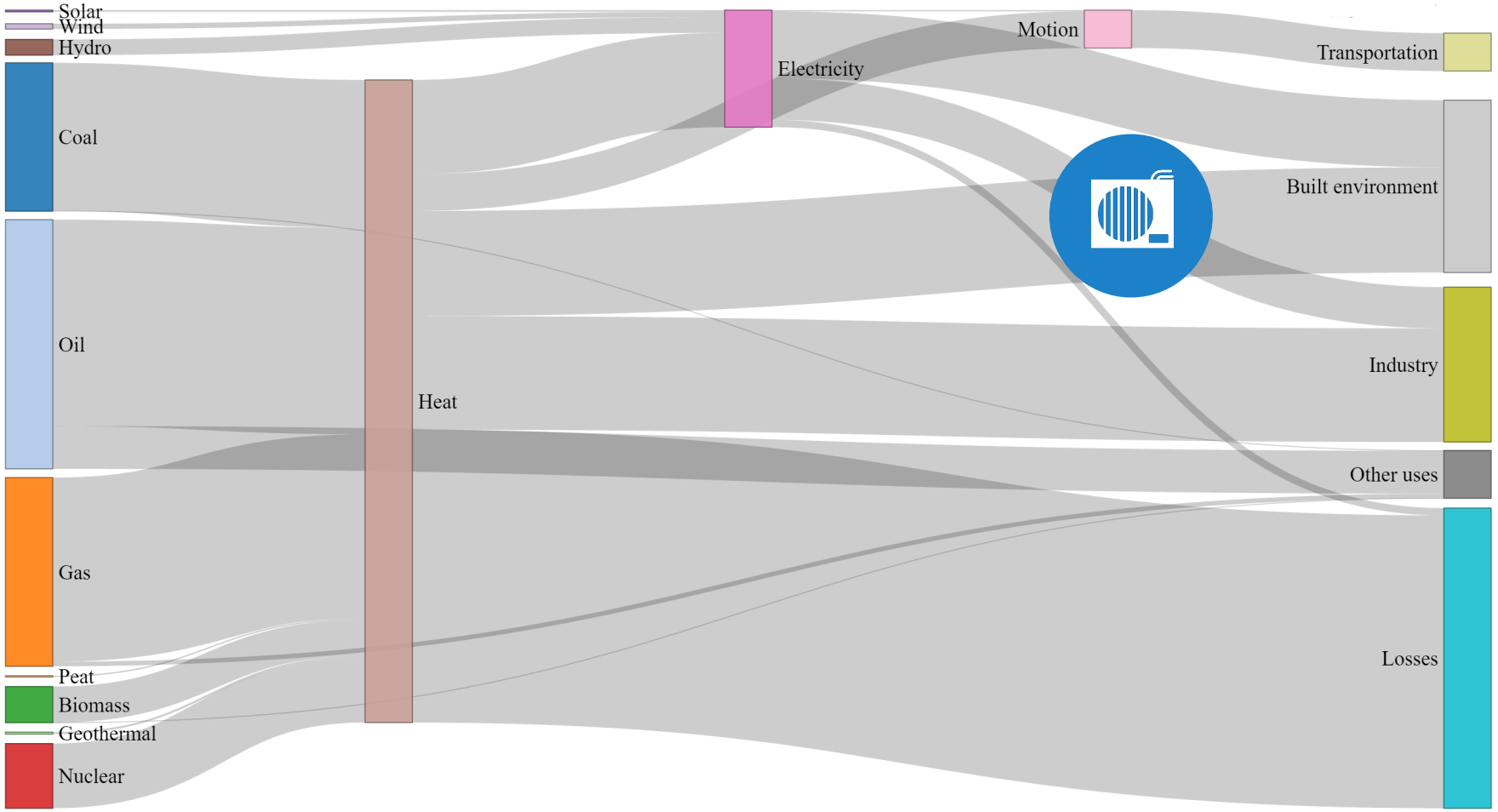
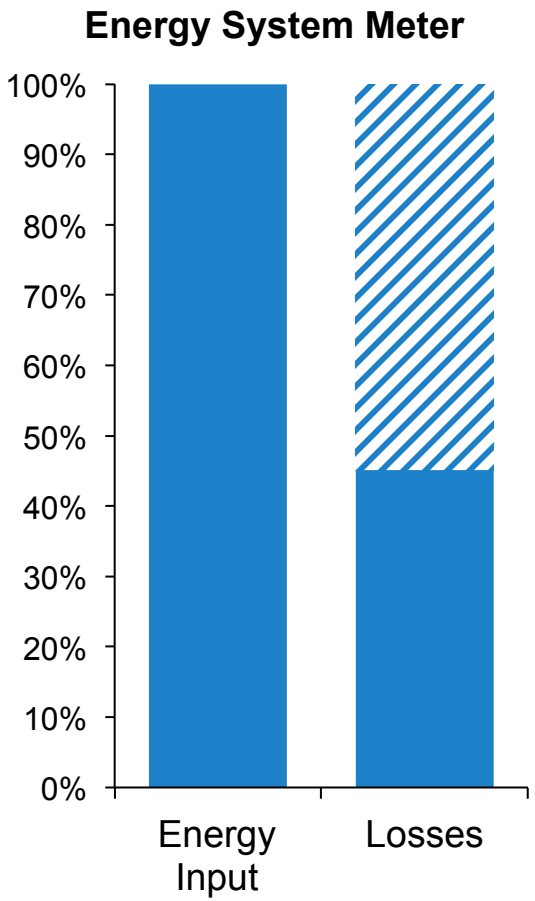
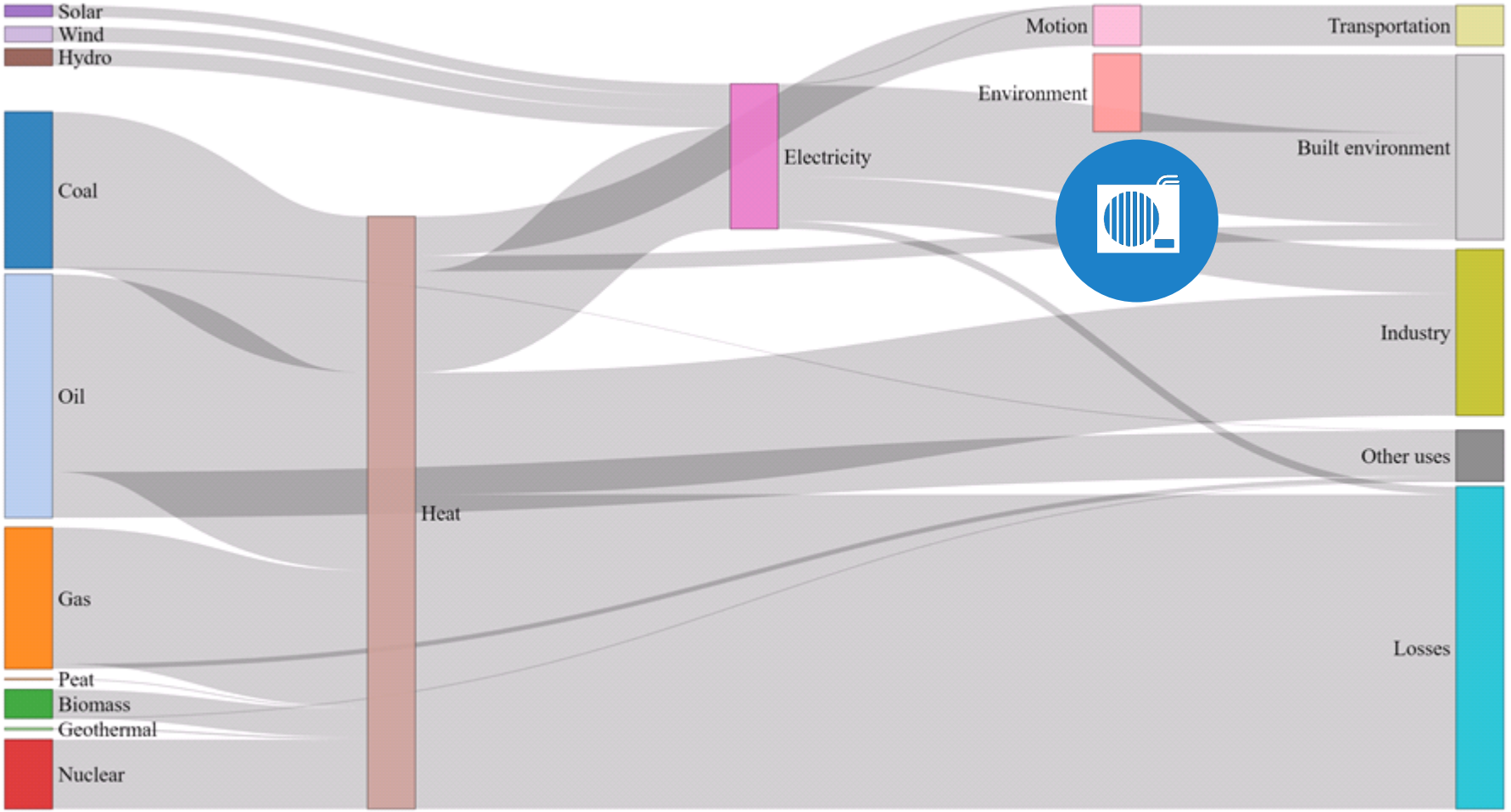
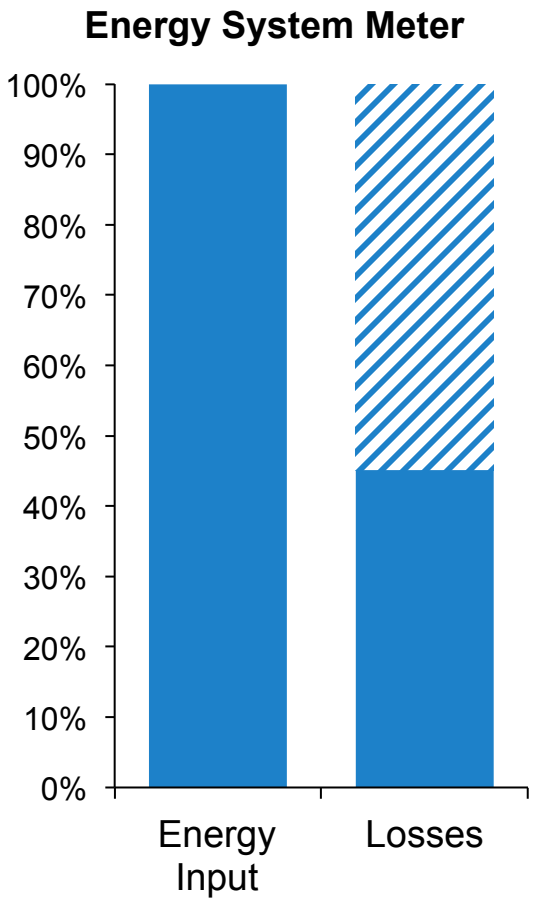




Replacing coal and liquefied petroleum gas for heating in the built environment beings to shift the energy system





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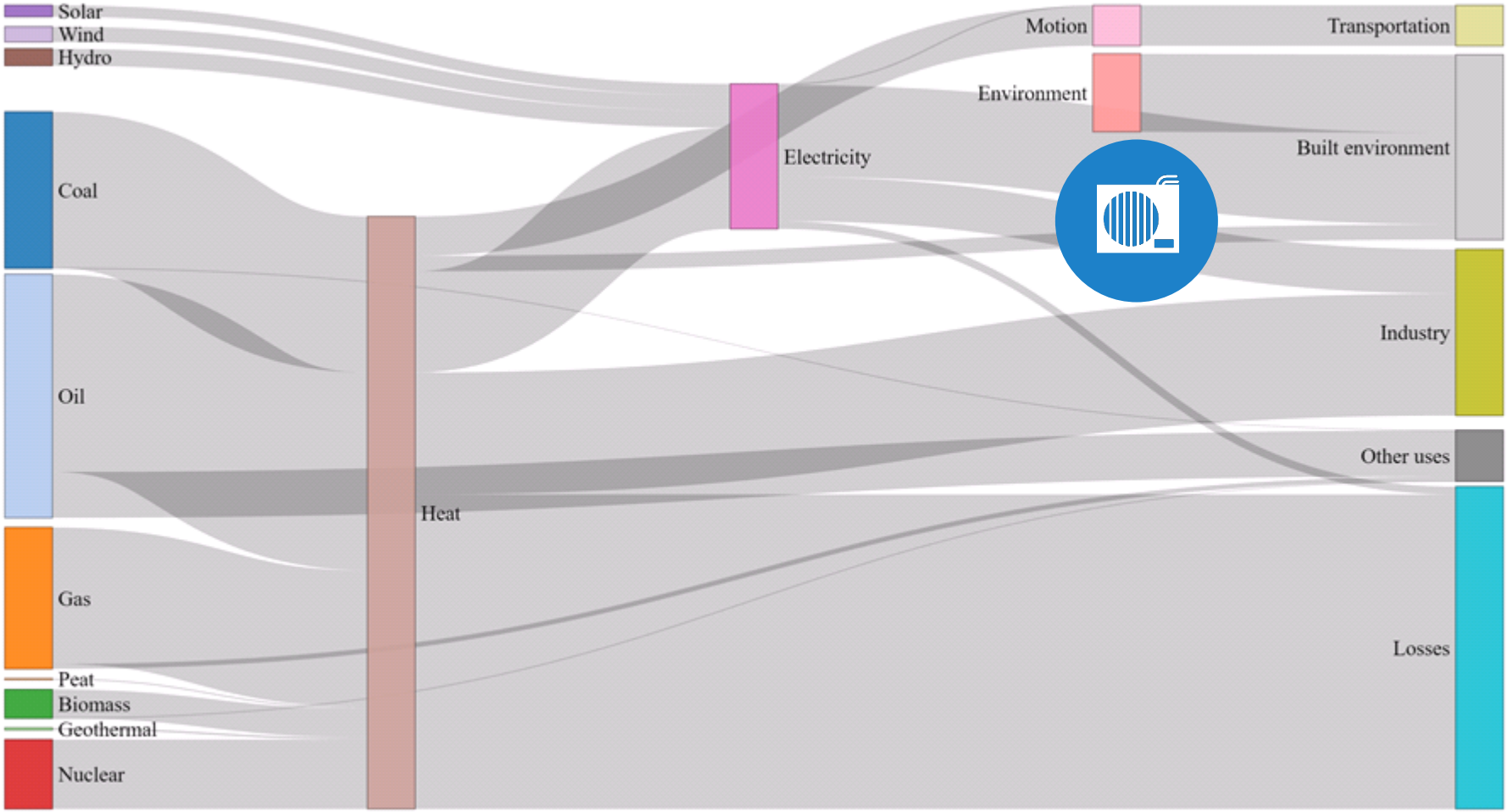
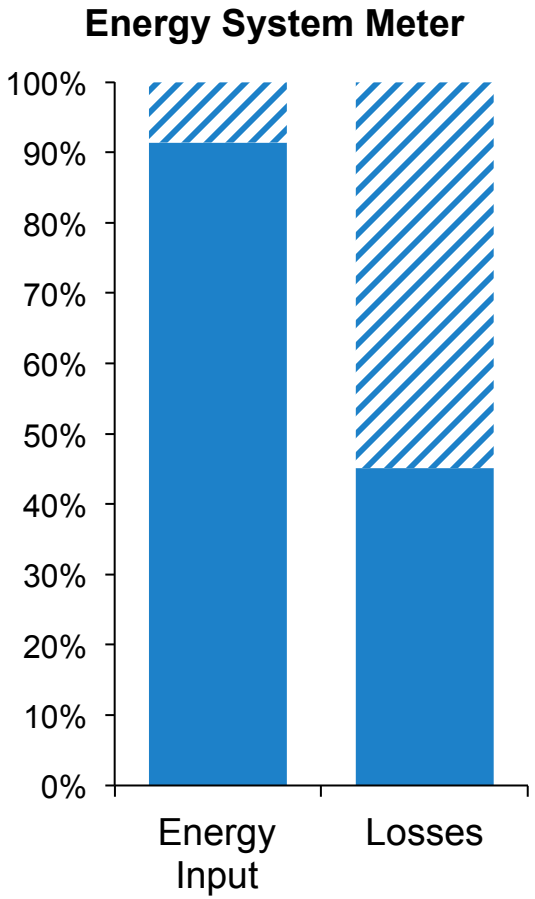
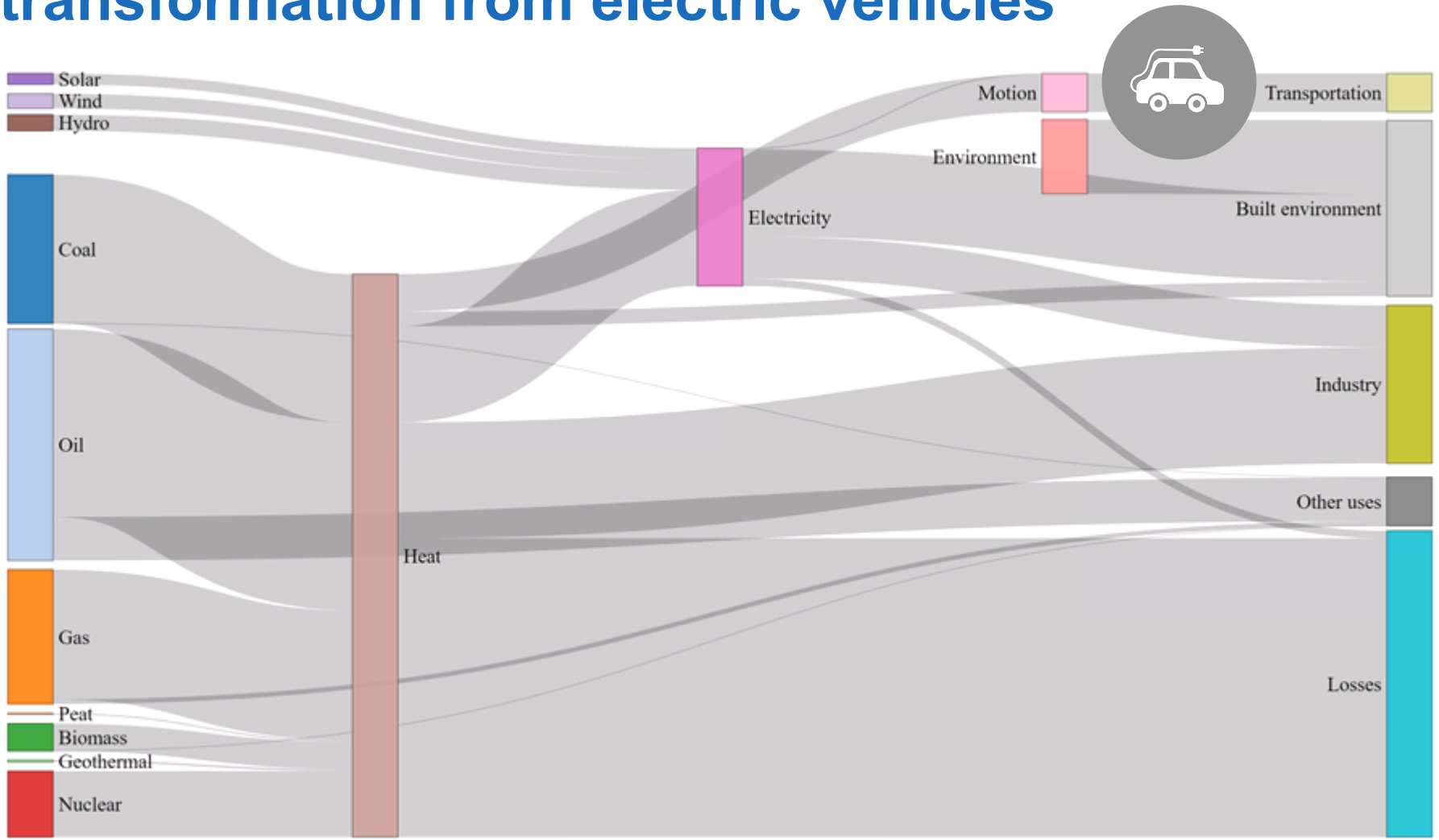
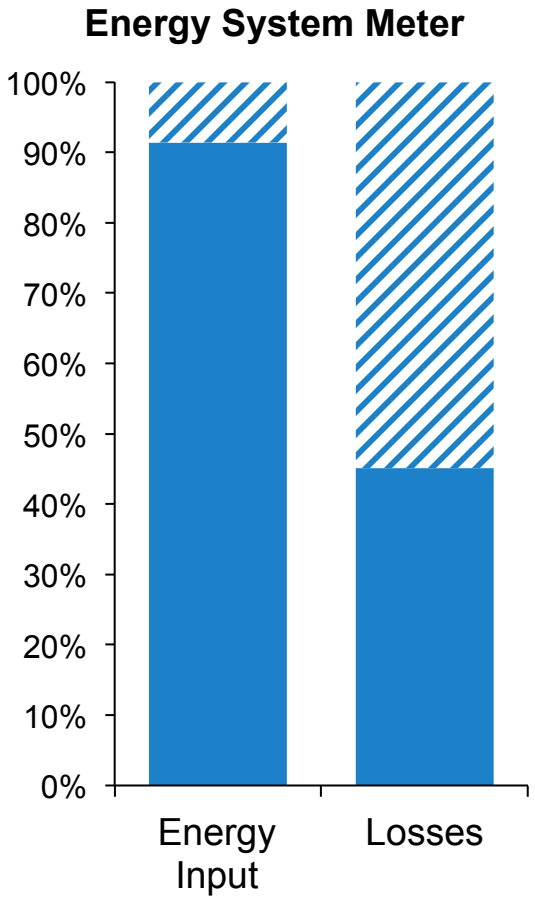


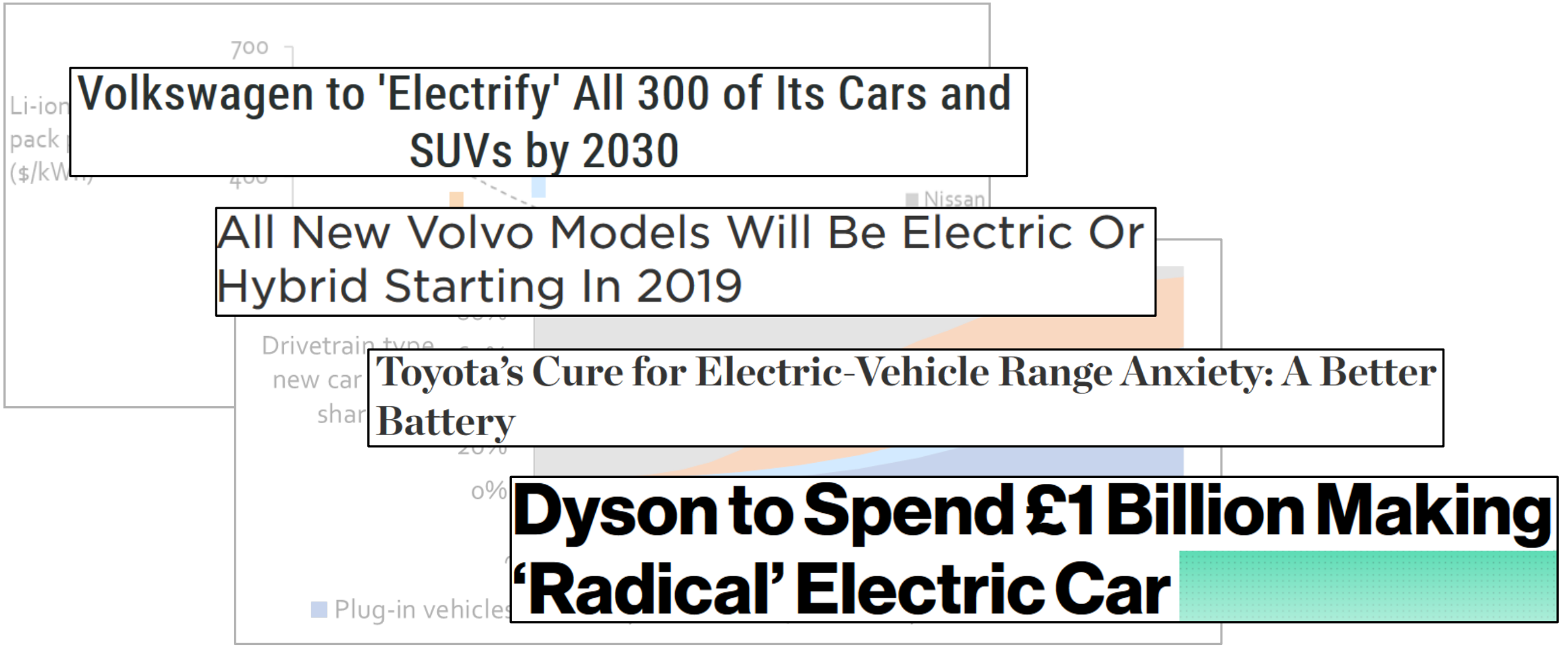


It’s no secret that the automotive industry is on the verge of a transformation from electric vehicles





Continuing drops in Li-ion battery prices and increased automaker activity will have the world running EVs



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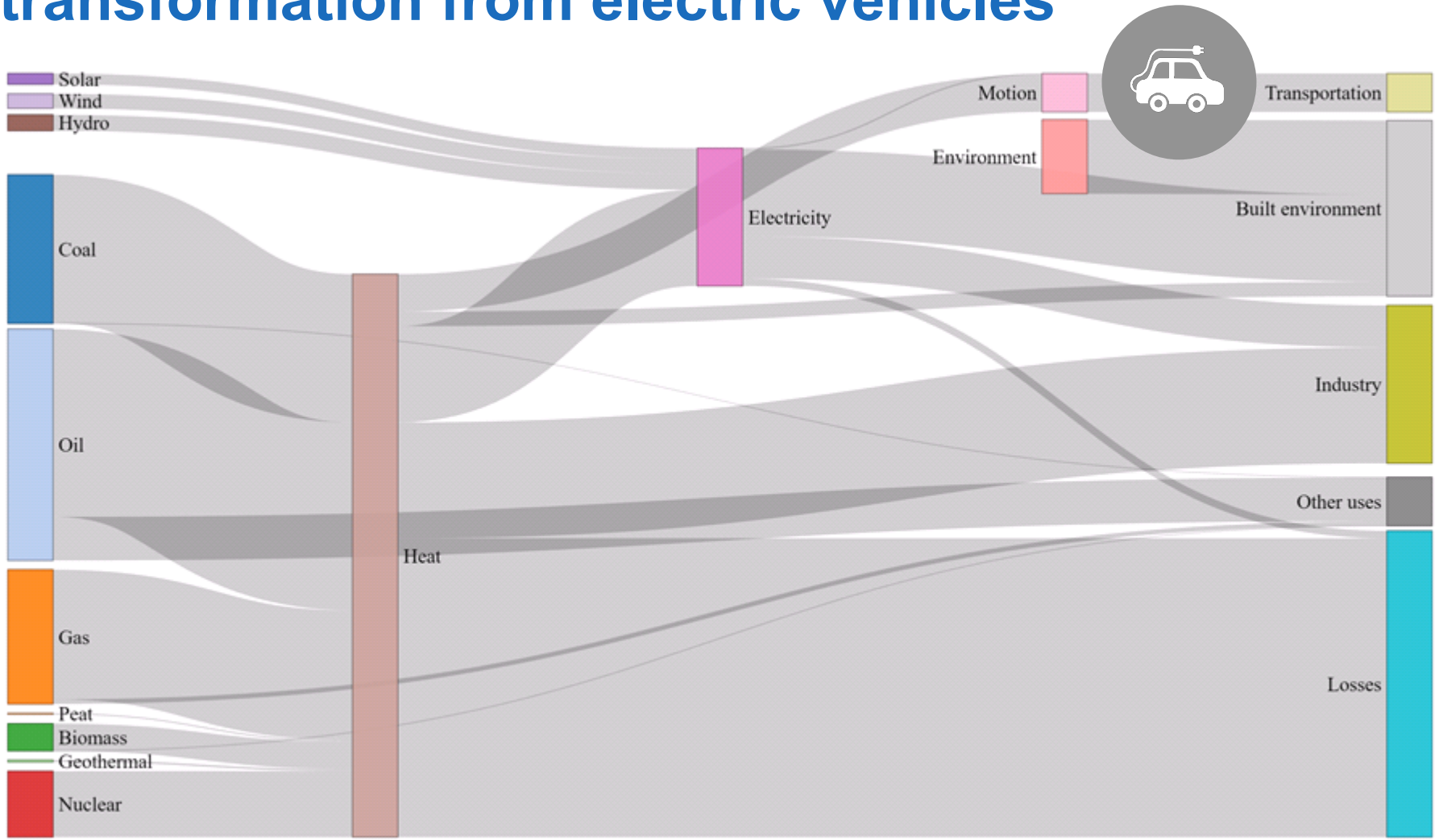
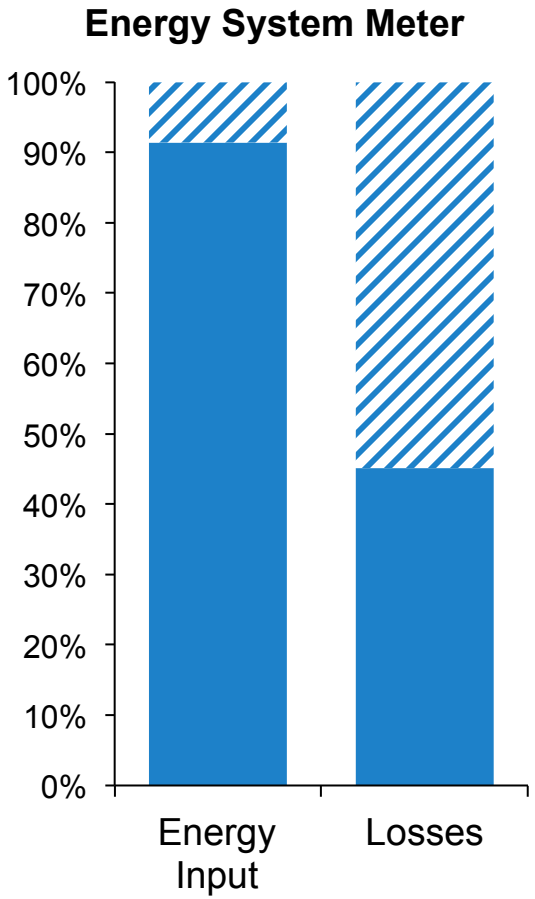
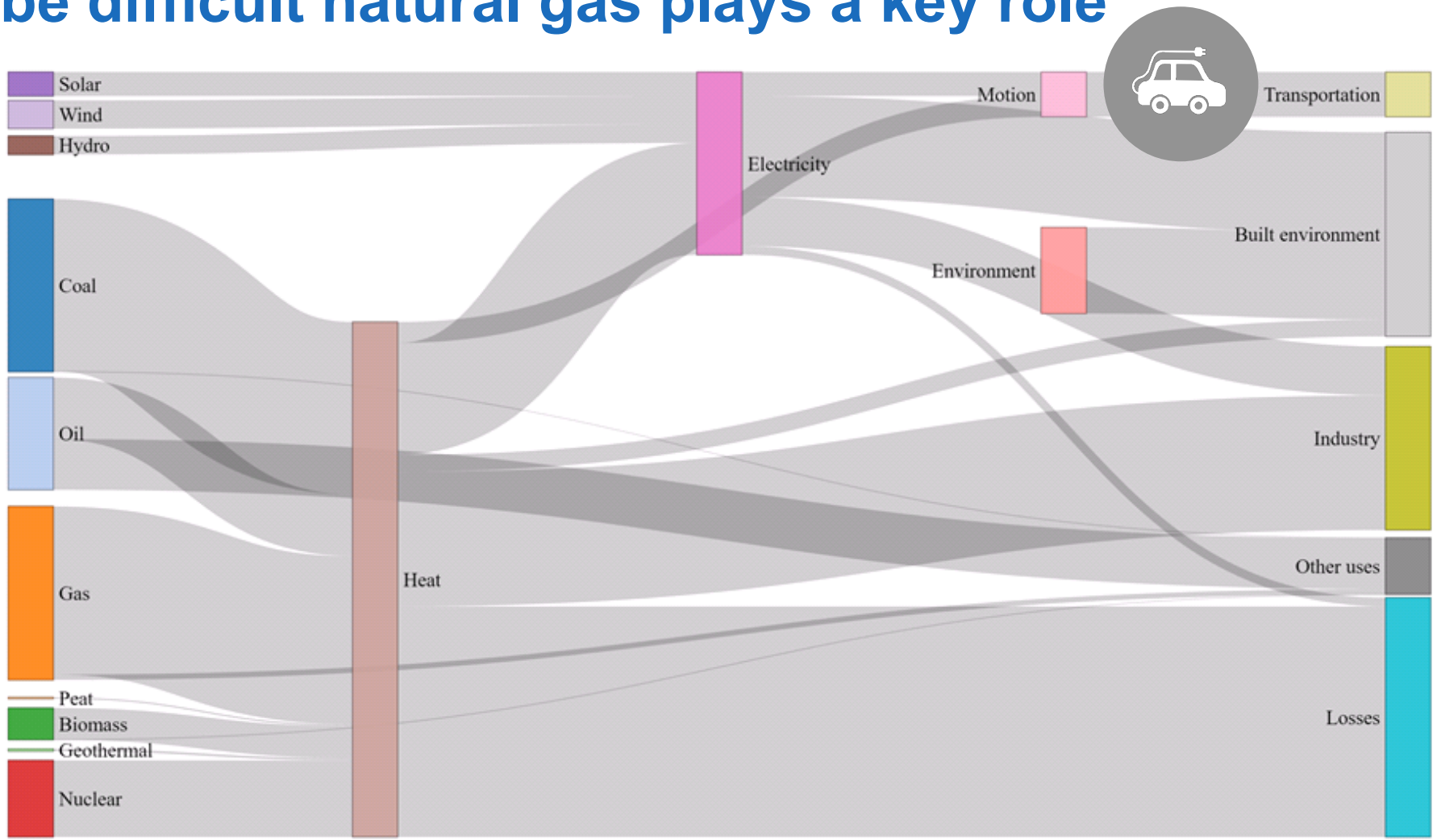
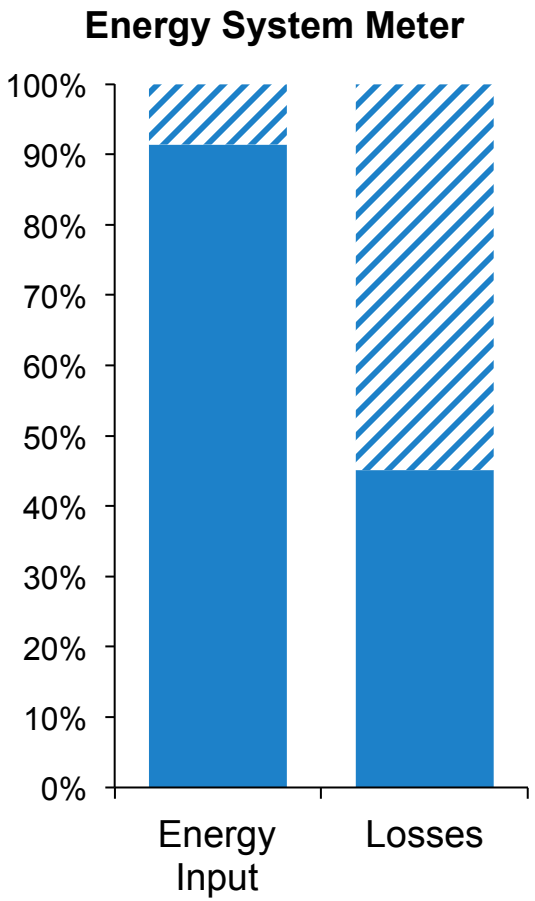




Not all vehicles will be electrified, but where electrification will be difficult natural gas plays a key role





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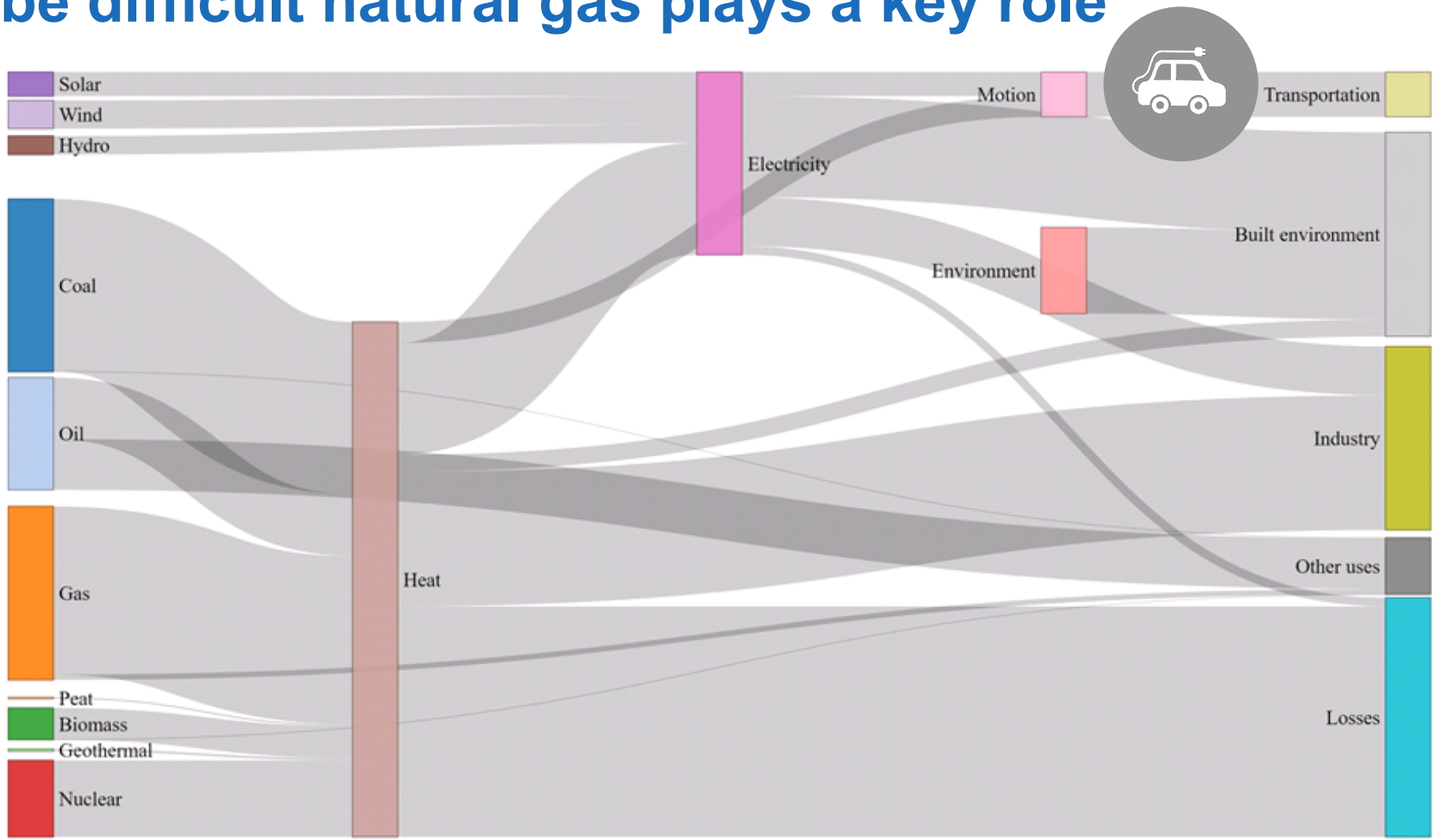
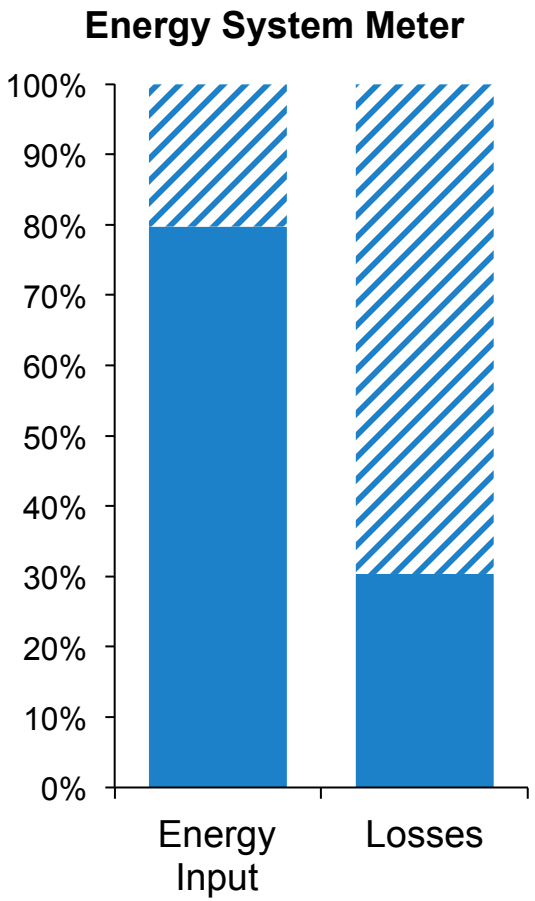
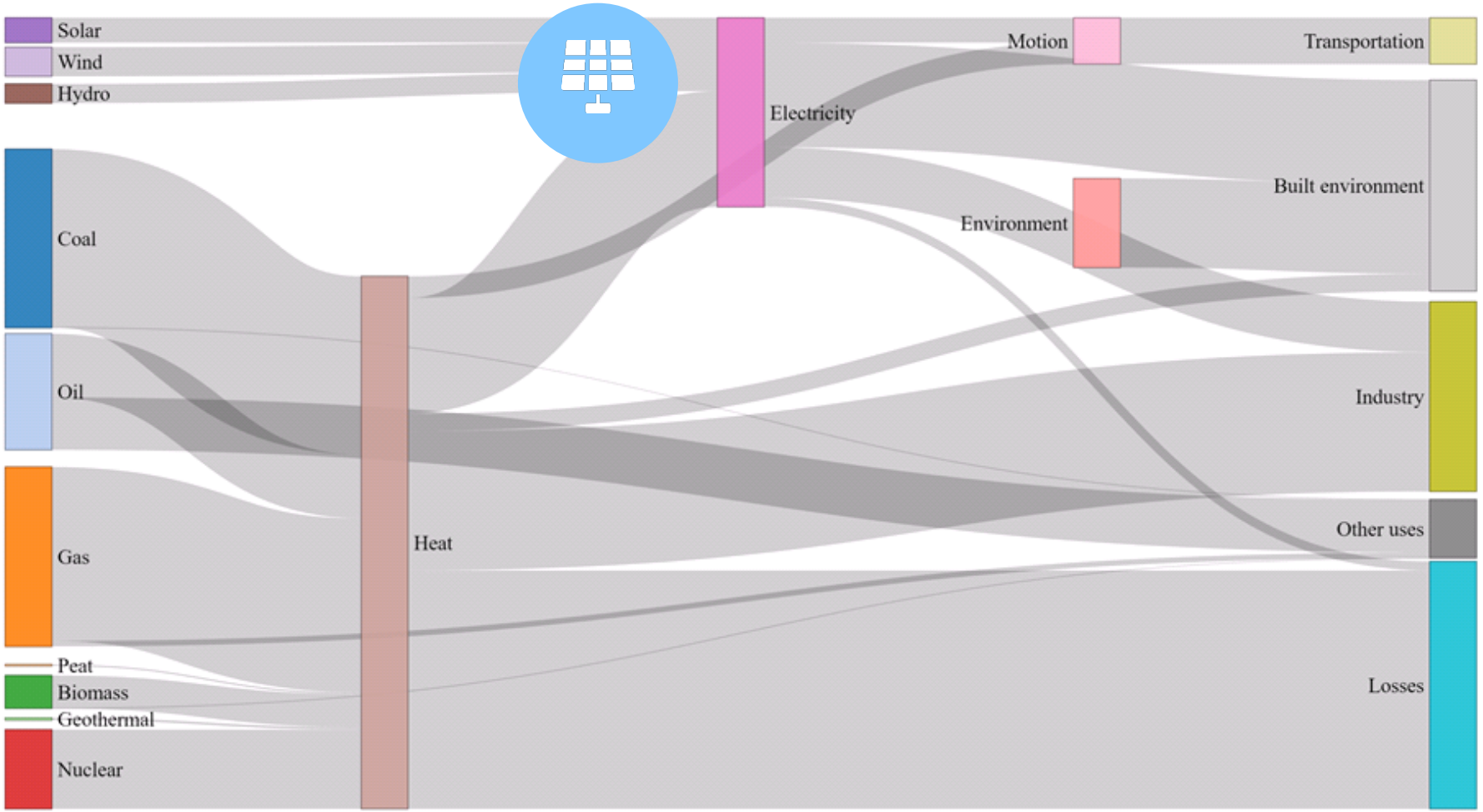
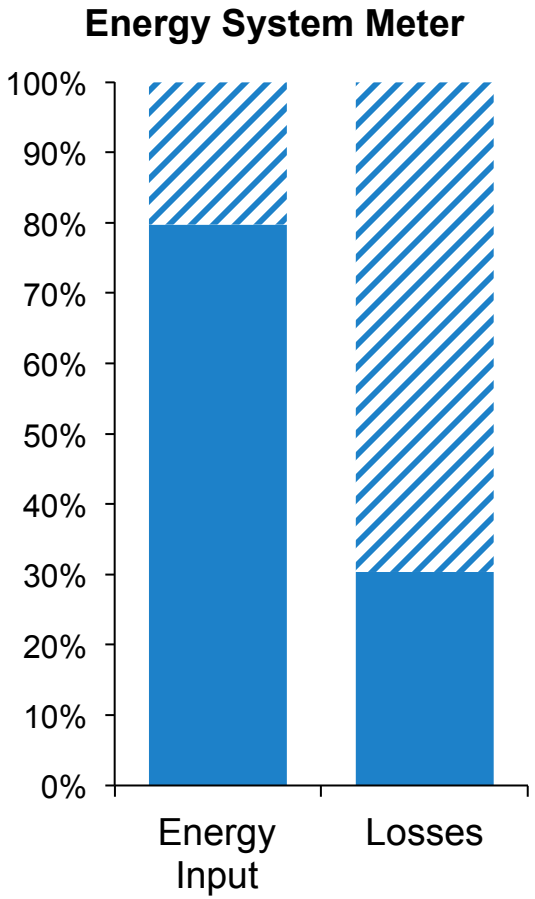


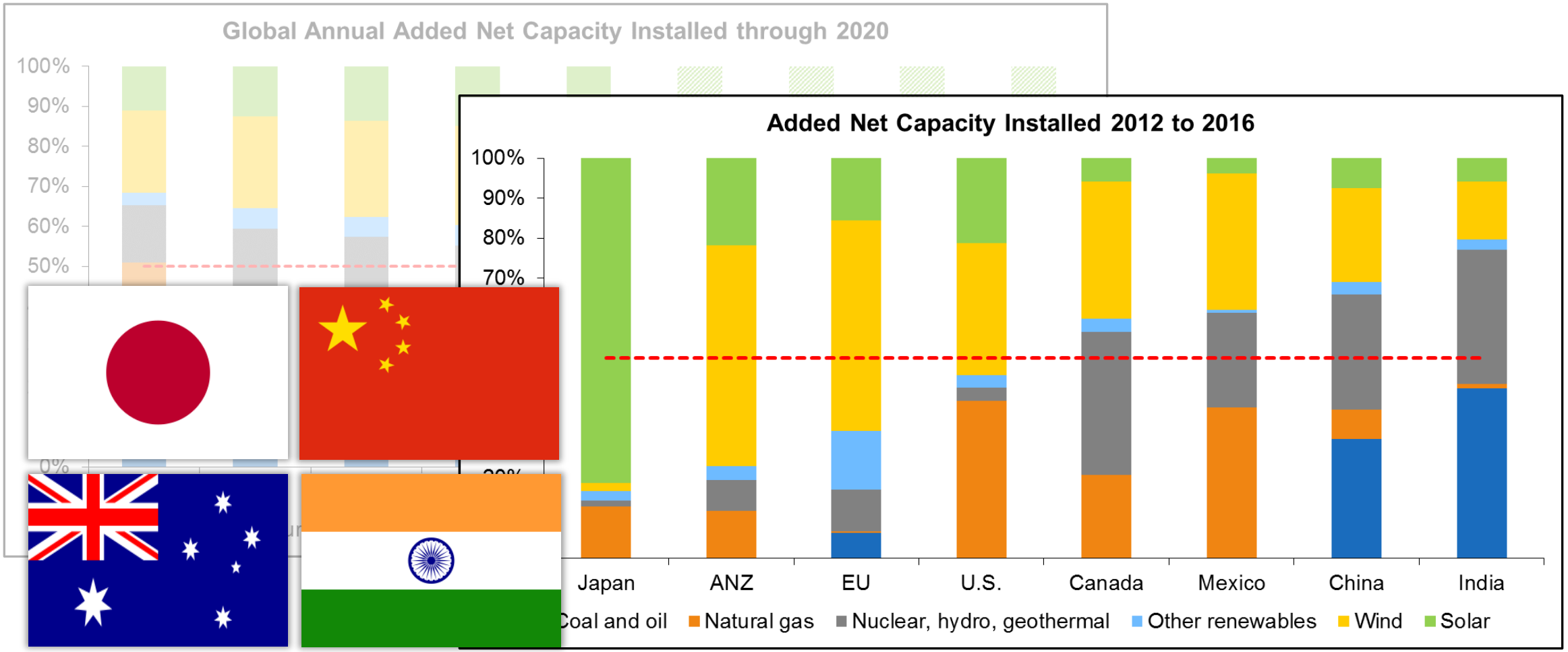


Intermittent renewables are gaining momentum in several key countries and capacity continues to expand





Intermittent renewables are on the cusp of a tipping as net capacity expansion will exceed 50% by 2020



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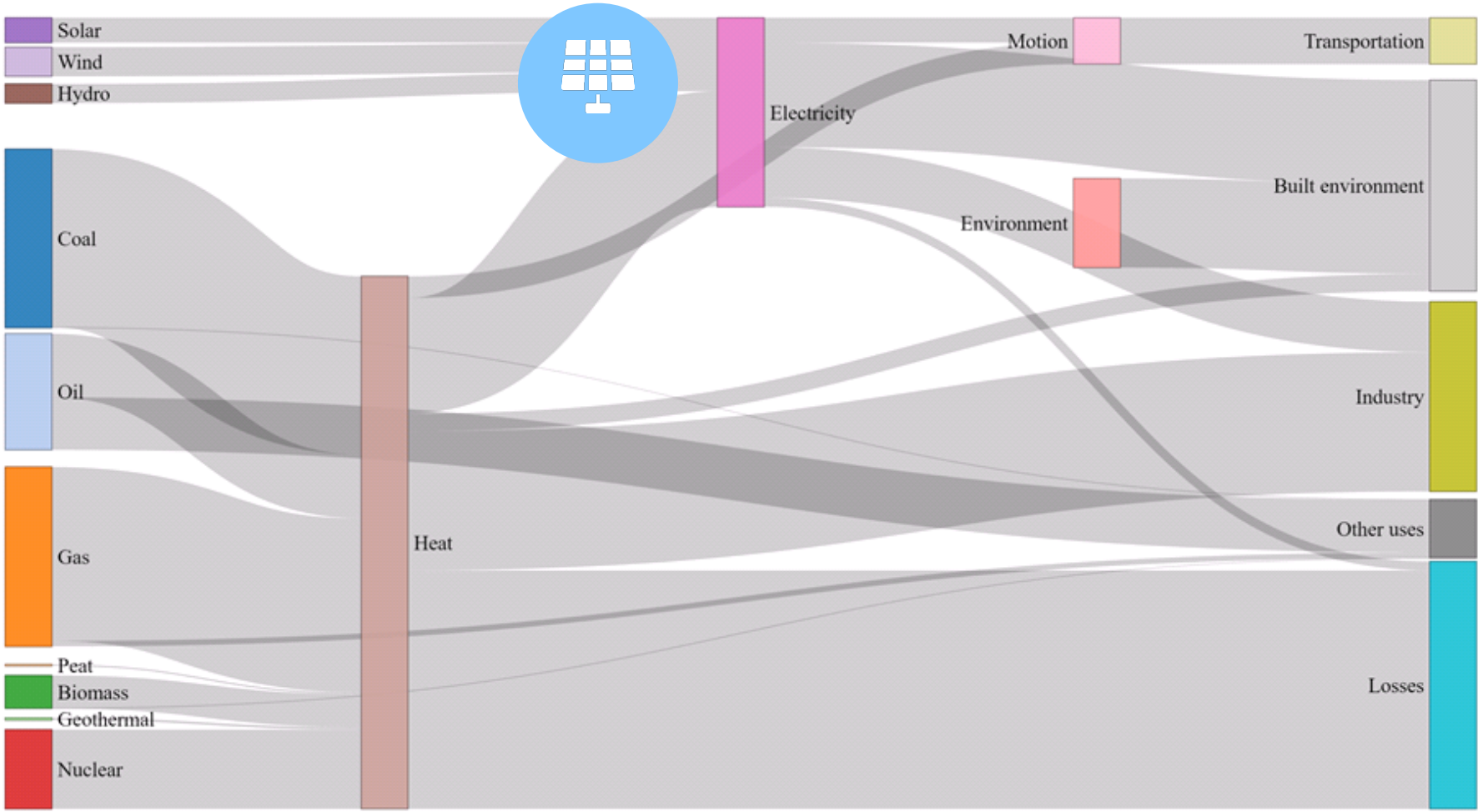
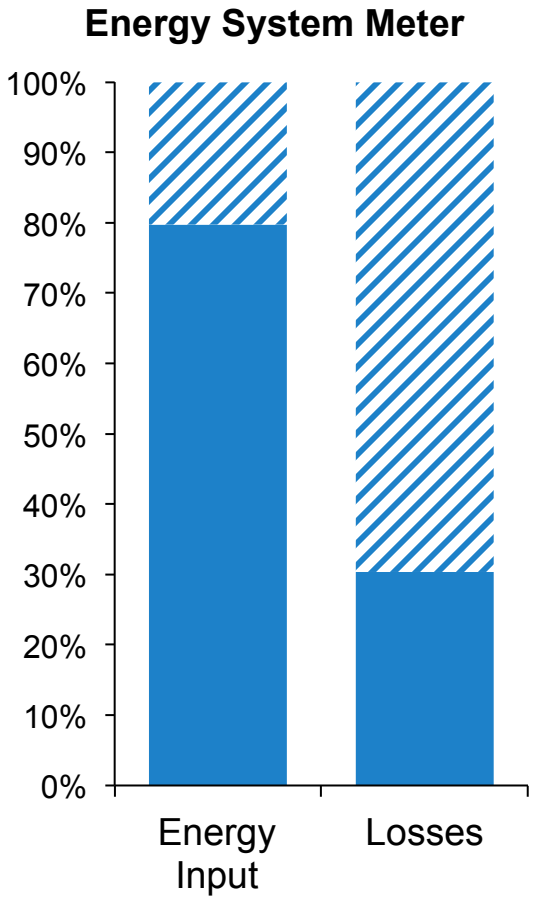
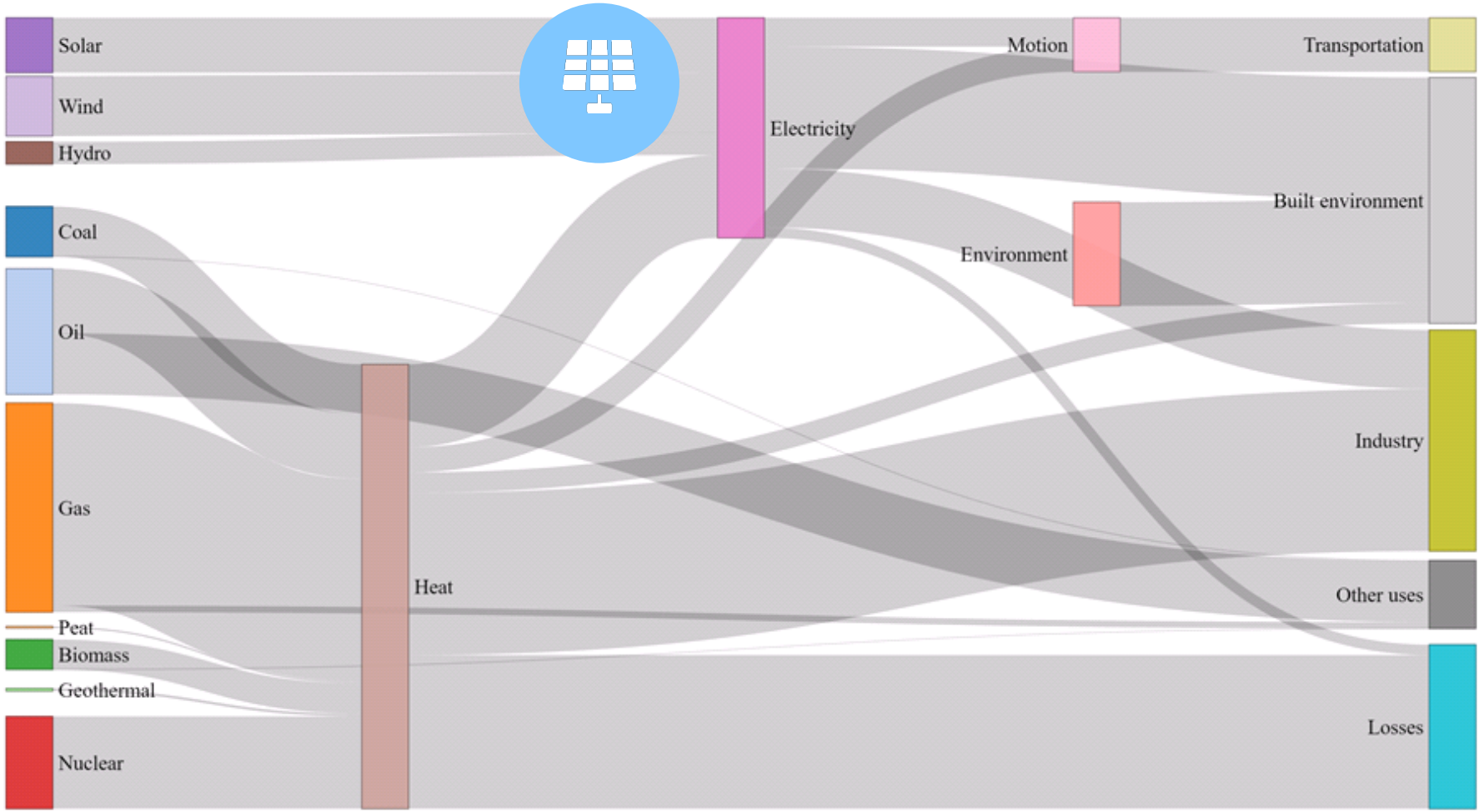
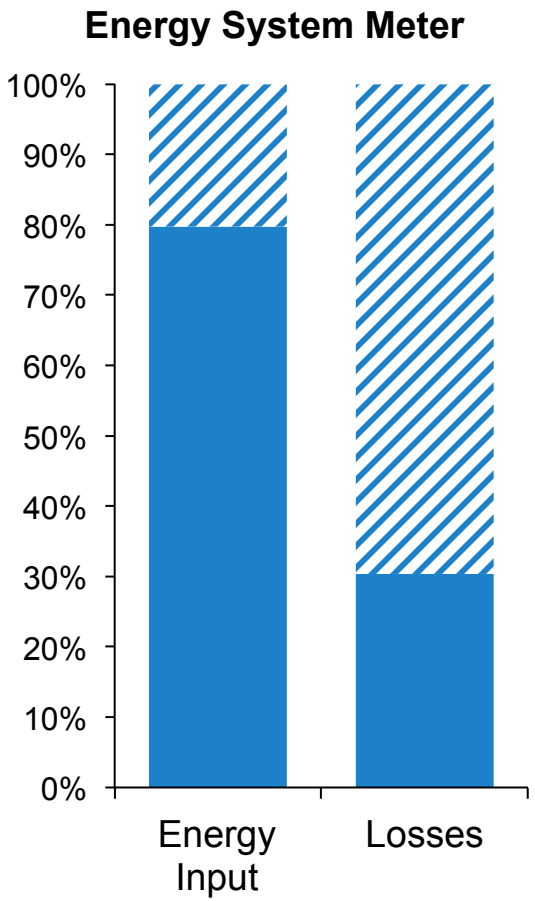




Replacing coal fired plants with solar and wind are the first signs of drastic changes to the energy system





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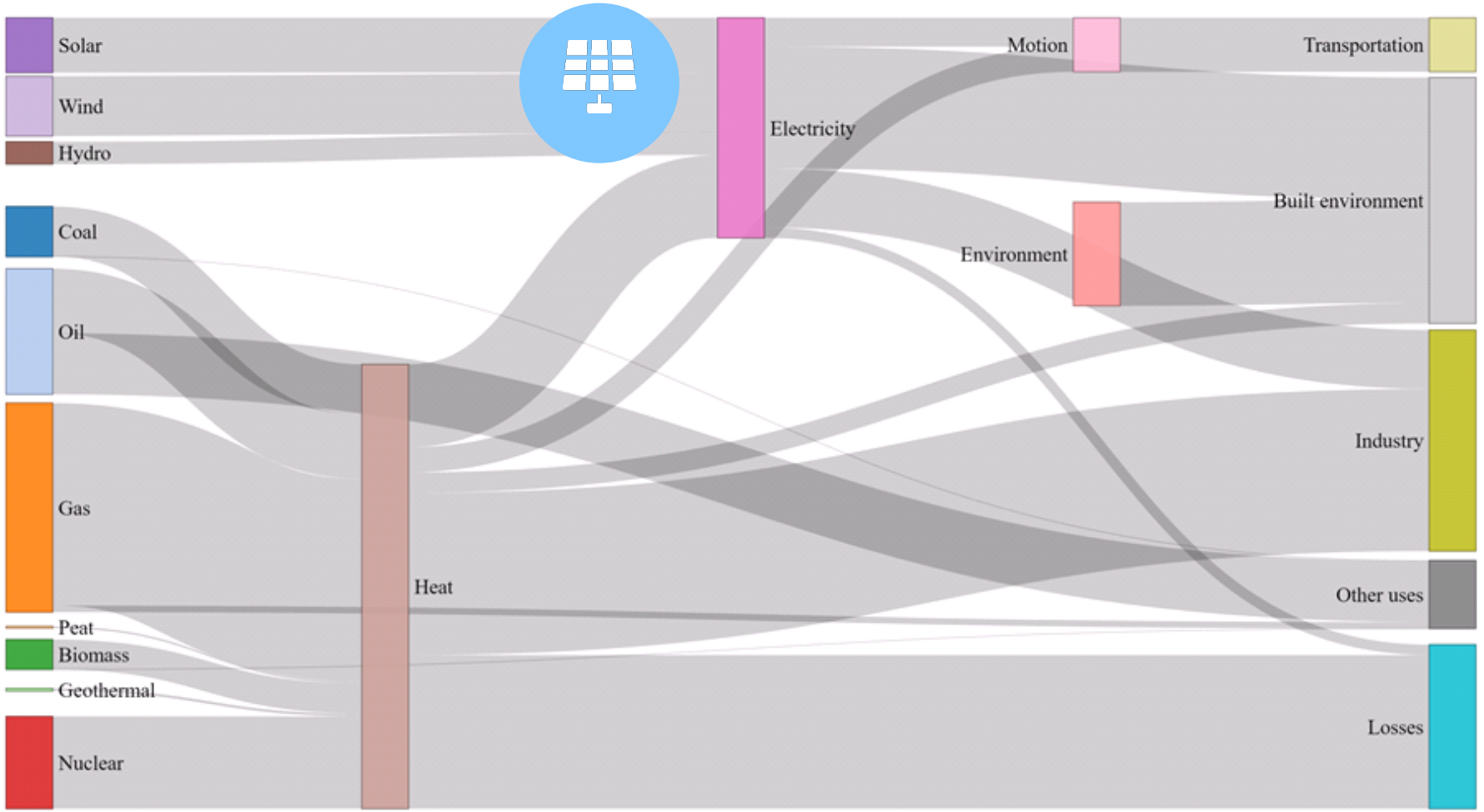
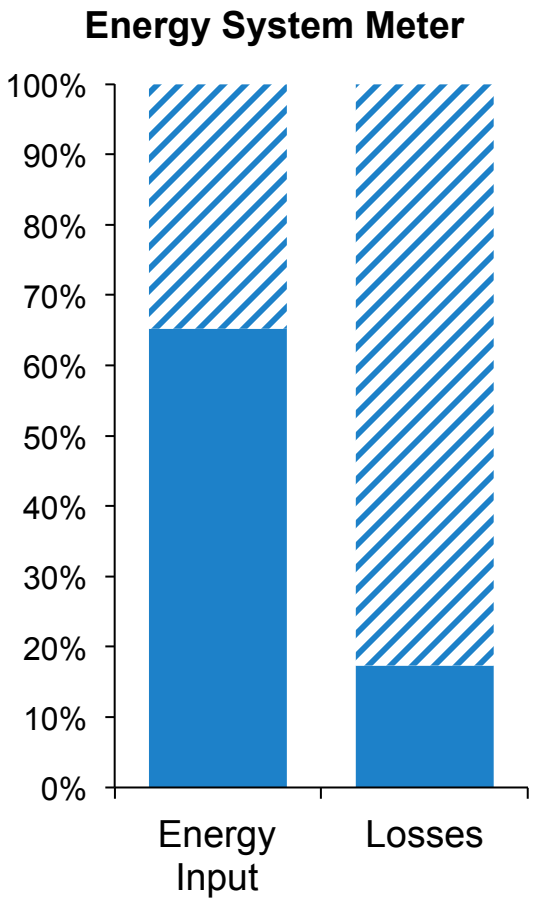
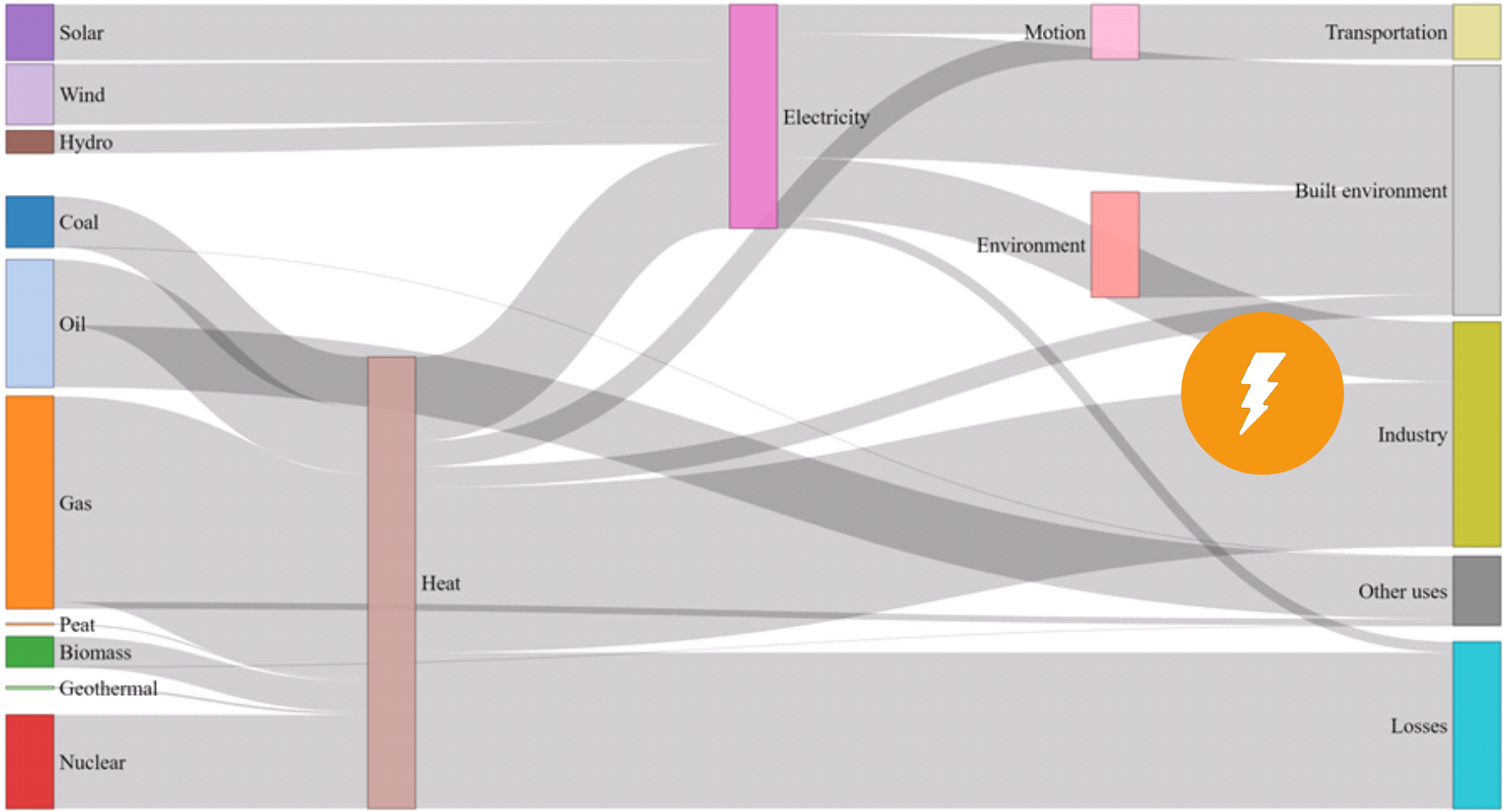
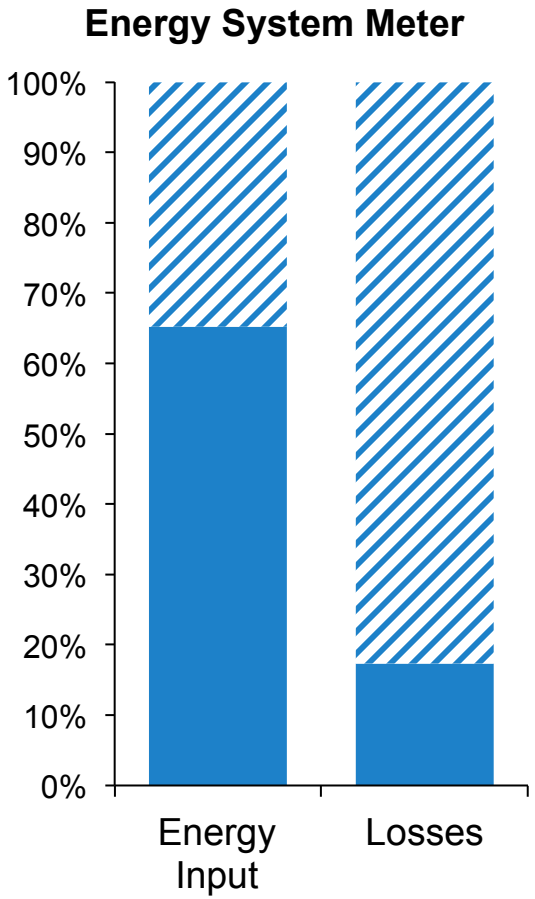


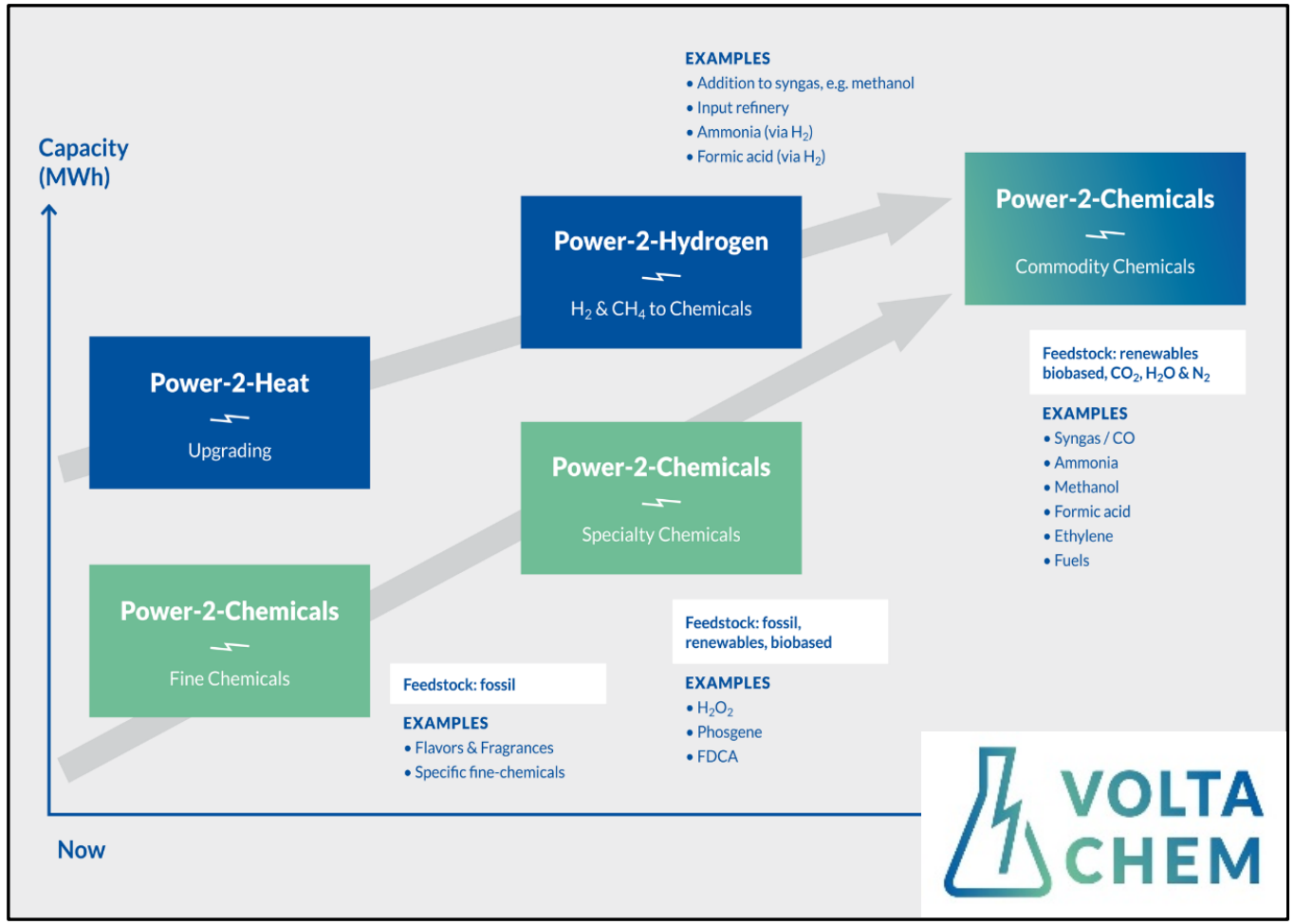


Converting industry towards electricity remains a major challenge as power-to-X remains a long-term goal





Several initiatives are focused on developing the technology roadmap and long-term R&D for power-to-X



Breakthrough Energy

Hydrogen Council

S C T 2
Smart CO_2 Transformation

nrg | cosia CARBON XPRIZE
Reimagine CO_2

JCAP
JOINT CENTER FOR ARTIFICIAL PHOTOSYNTHESIS

SOFI
Solar Fuels Institute

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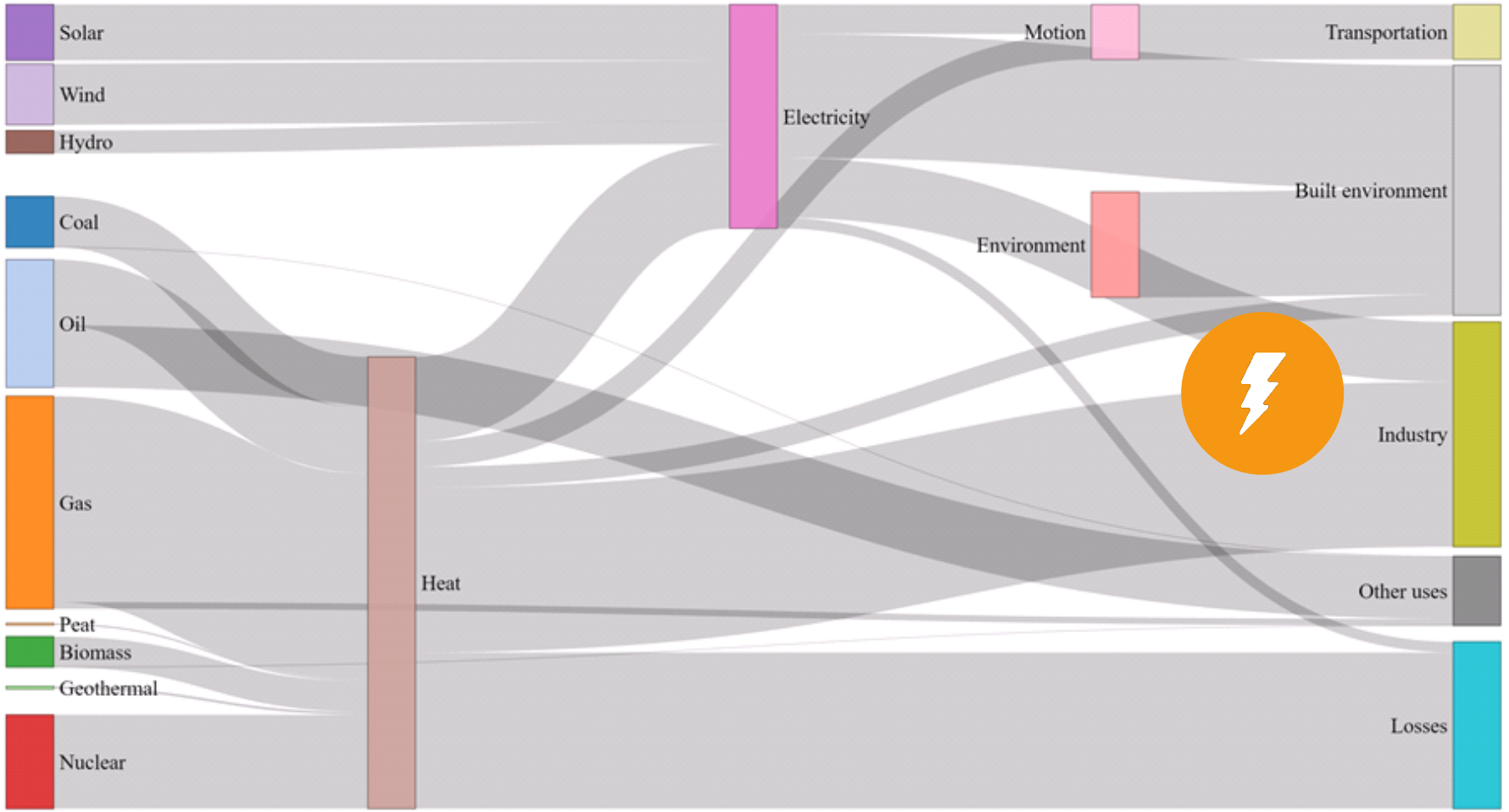
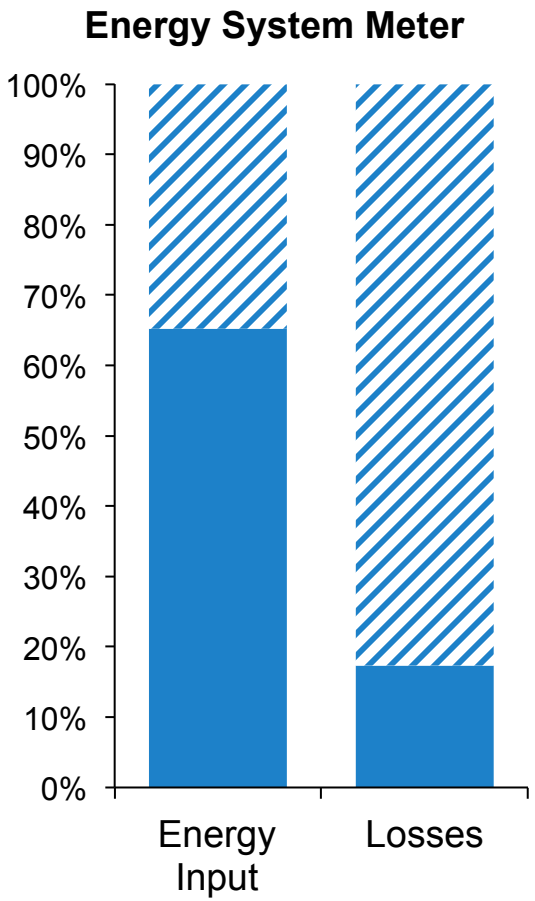
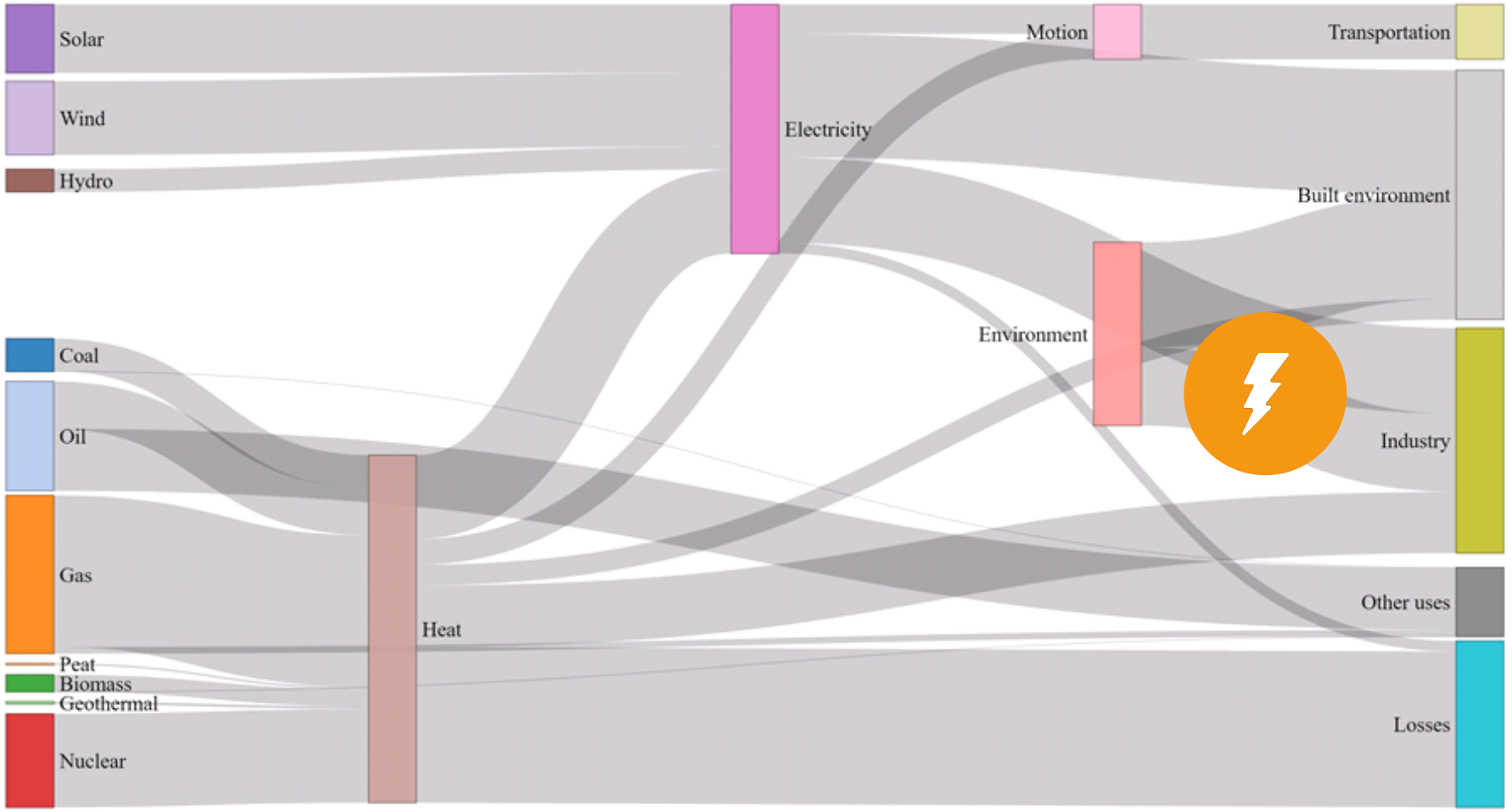
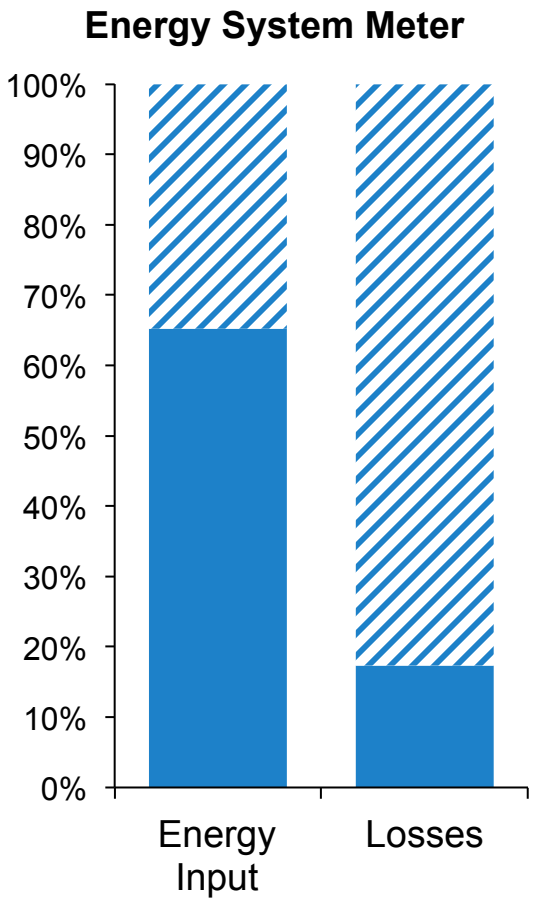




While heat will always be required in industry, opportunities do exist to replace part of the heat demand with electricity





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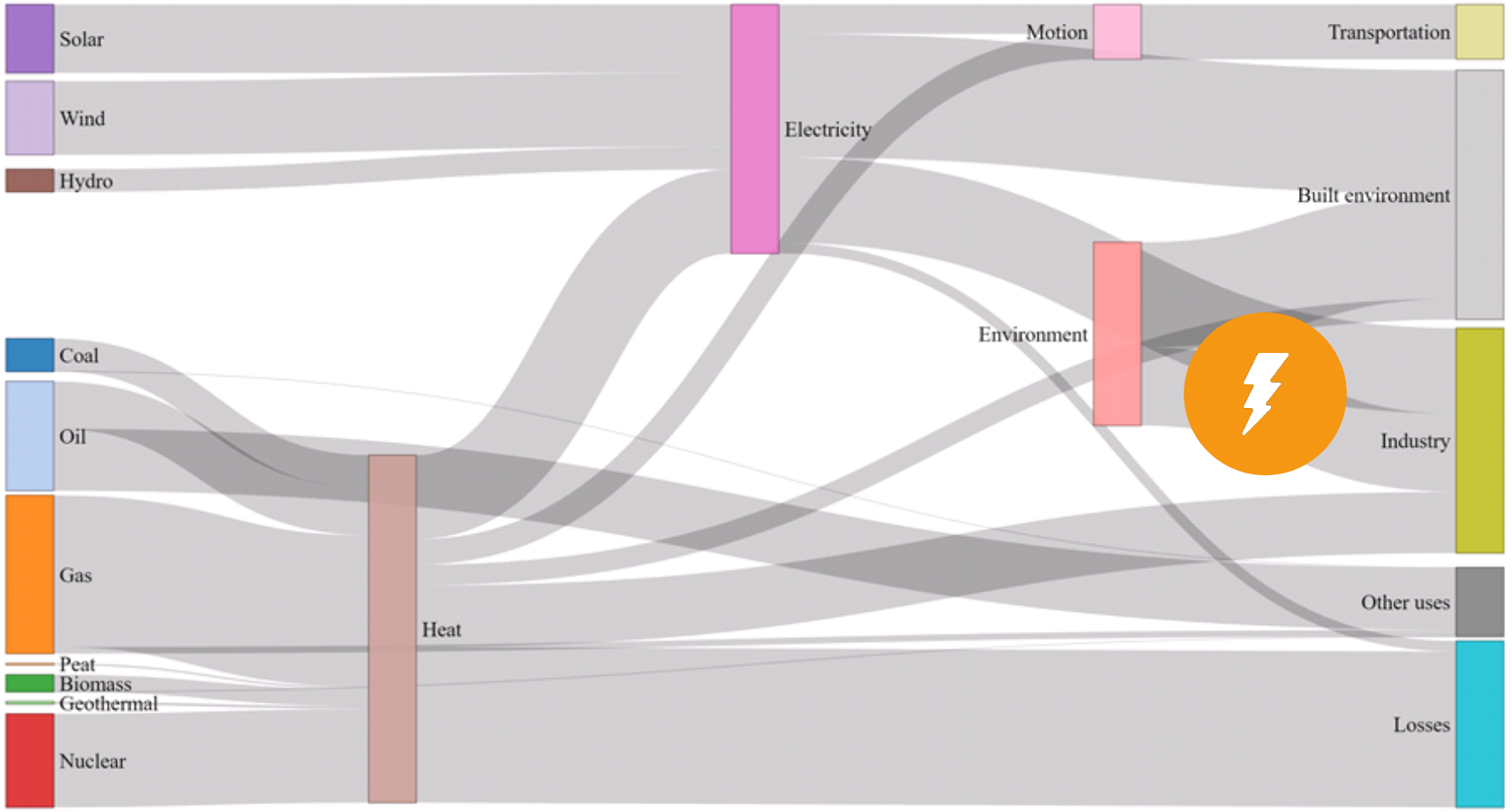
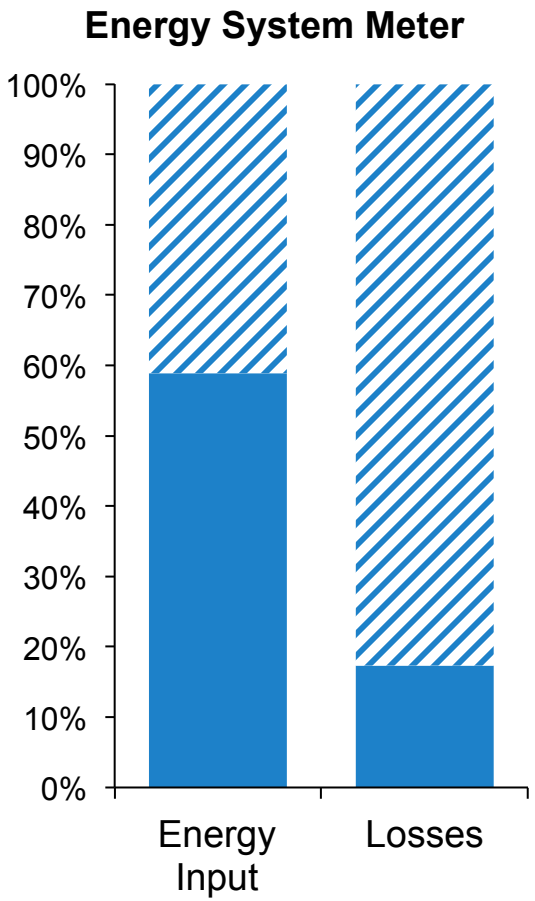
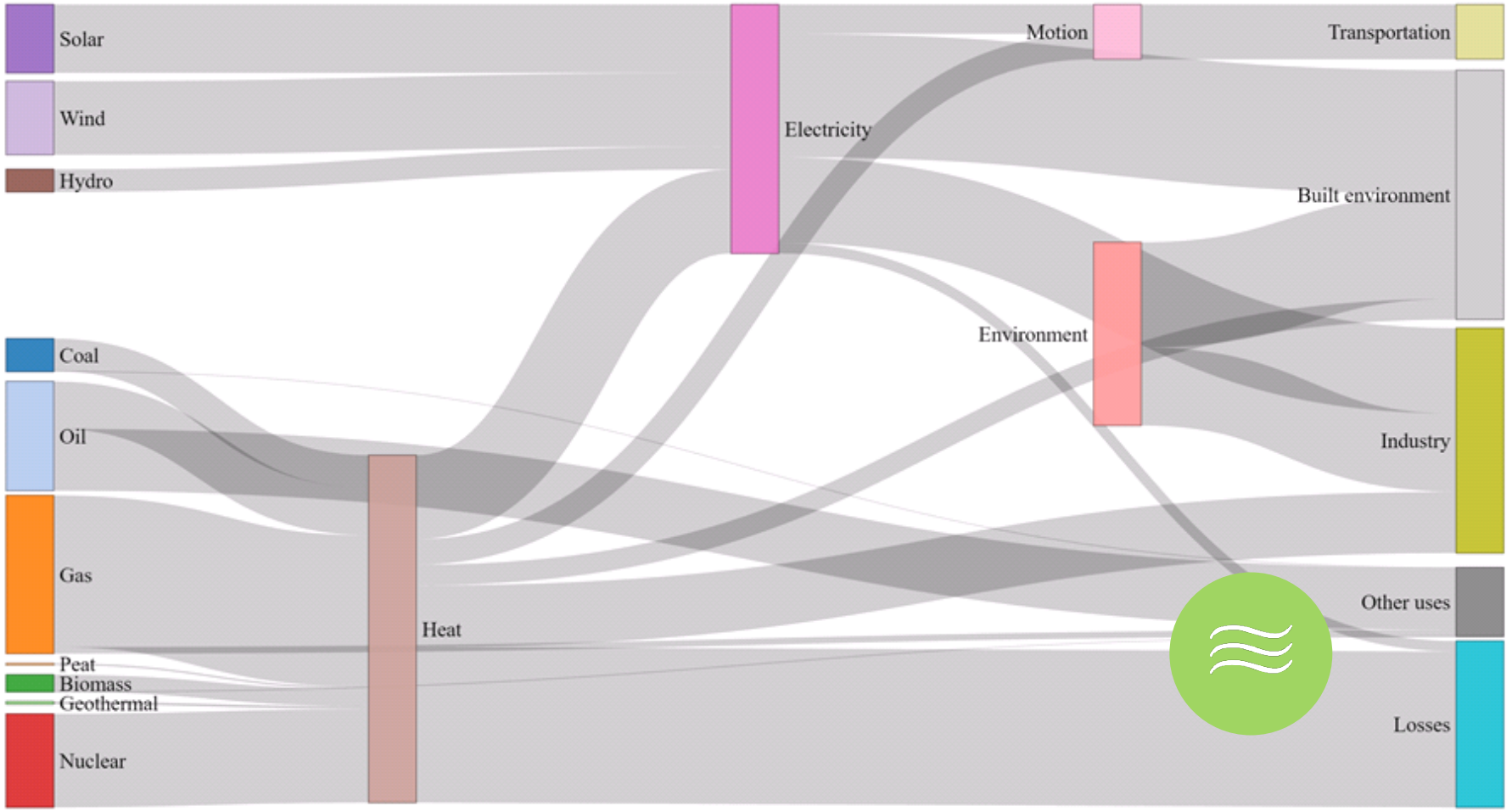
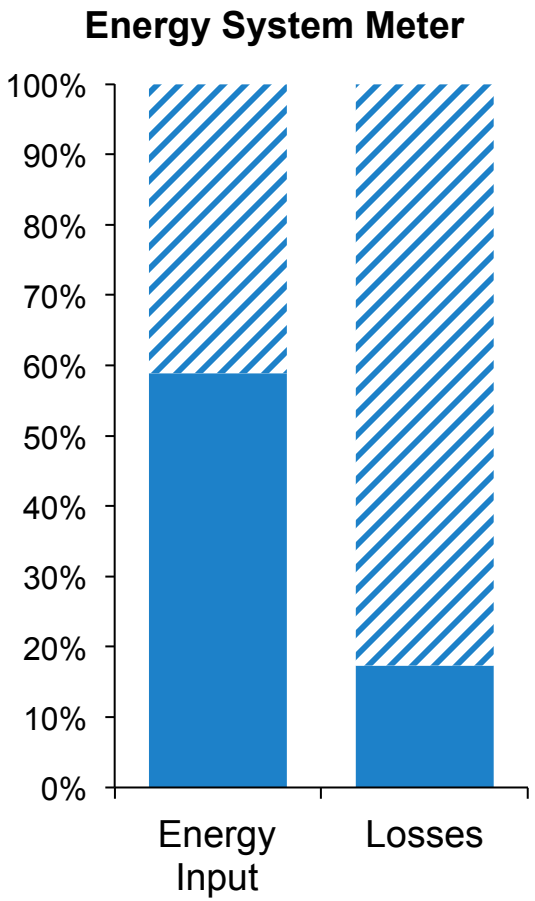




Fielding waste heat losses prevents the biggest opportunity to address the energy system's inefficiencies





Inverse CHP improves thermal efficiency and generates additional electricity

Triogen

Organic Rankine Cycle (ORC) generators for waste heat recovery

- **Technology and Differentiators:**
  - Targets applications with waste heat at 350 °C or higher, achieving high electric efficiencies of up to 20%
- **Strategy and Markets:**
  - Primarily focused on gas engine exhaust, but expanding into biomass heating plants

Ener-G-Rotors

Organic Ranking Cycle waste heat to power

- **Technology and Differentiators:**
  - Offers 7% to 15% electric efficiencies, but lower LCOE between $0.03/kWh and $0.05/kWh
- **Strategy and Markets:**
  - Expansion plans into Asia by pairing system with industrial waste heat recovery, stationary engines, and CHP systems

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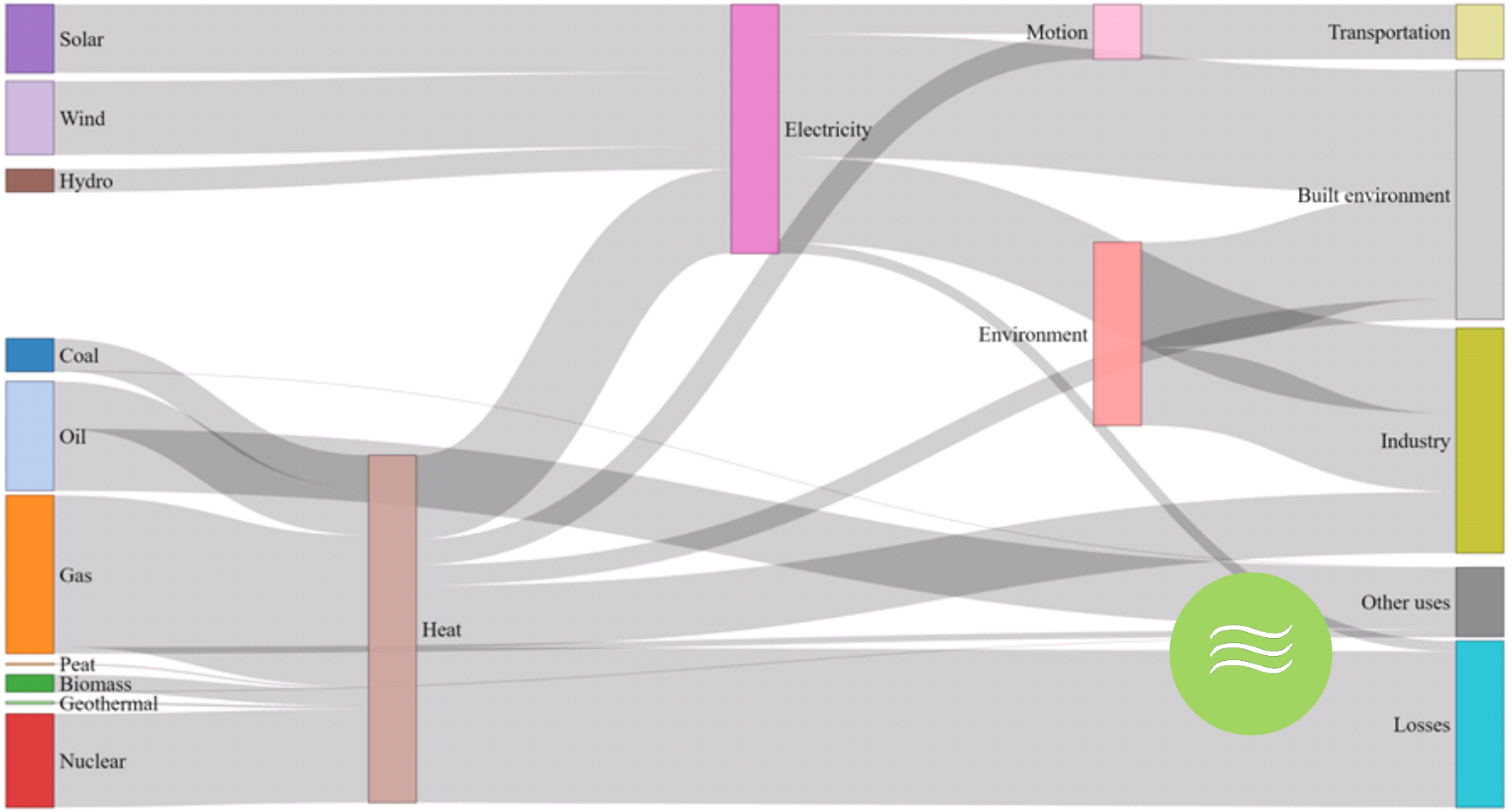
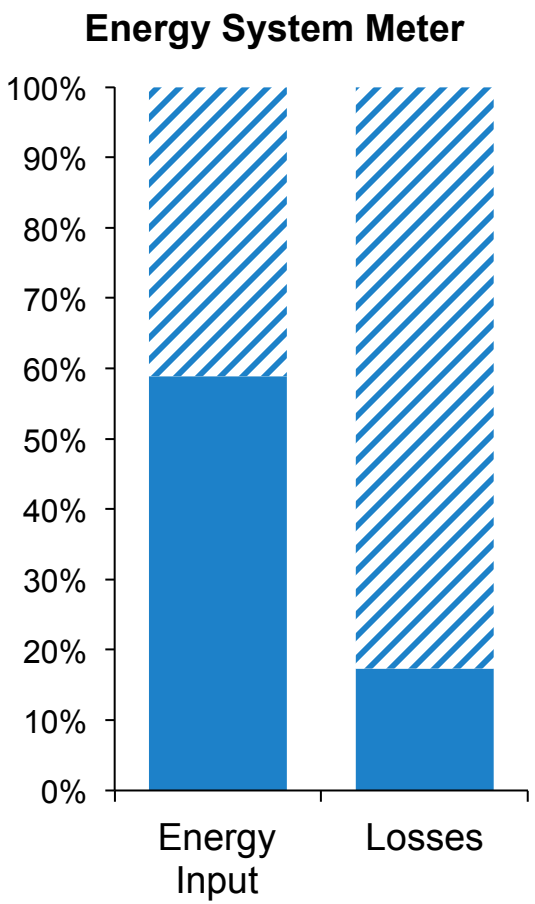
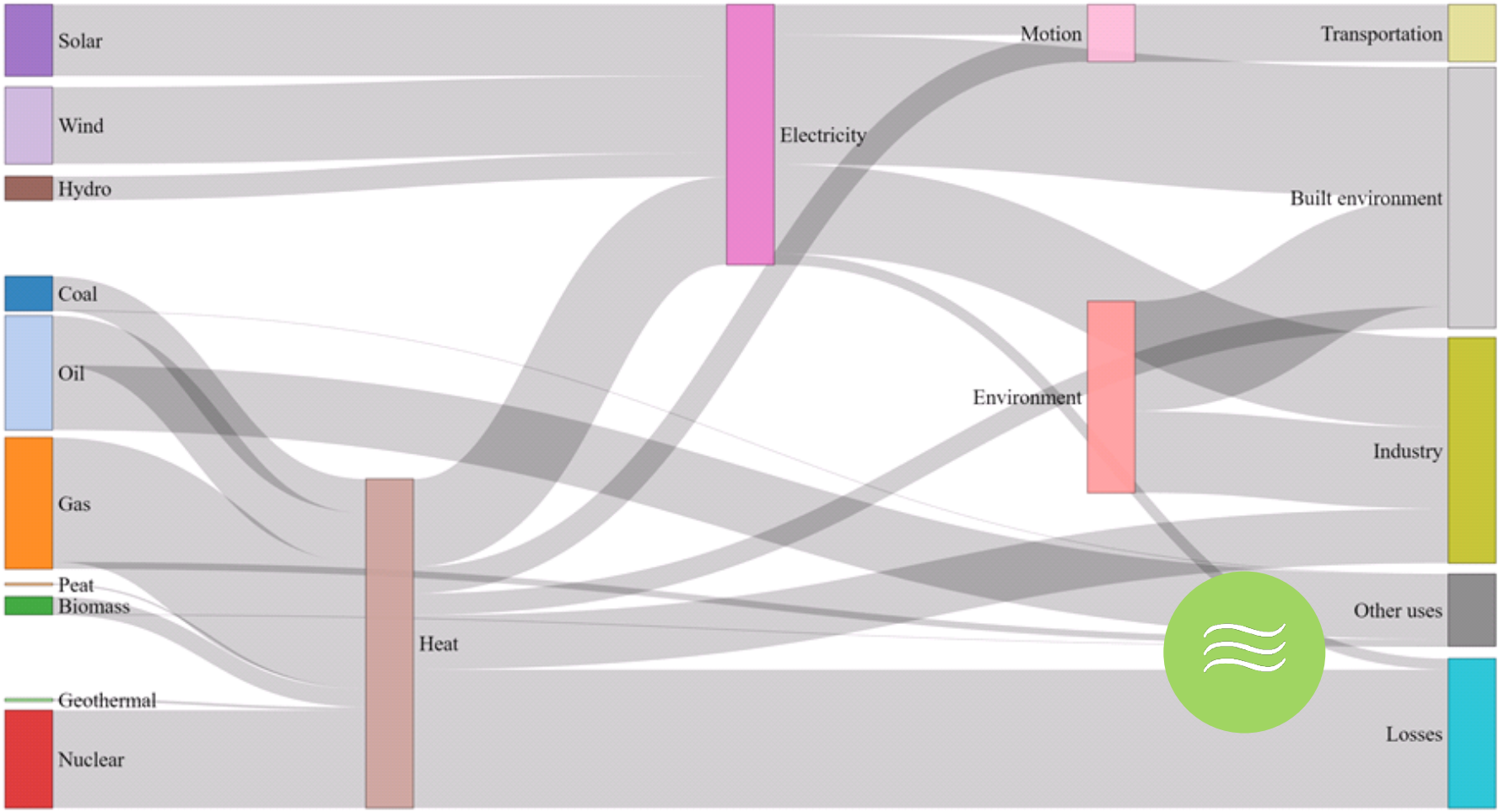
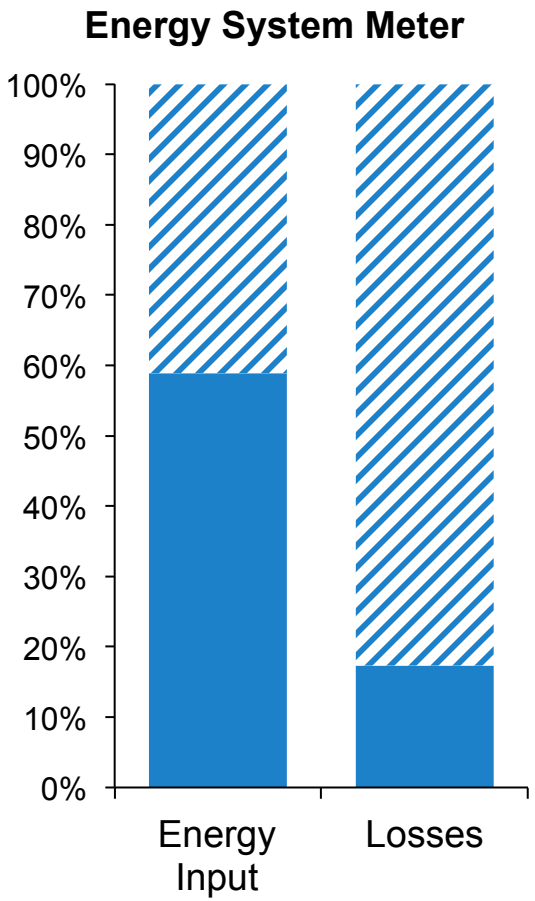




With waste heat utilization the energy system replaces gas-fired power generation





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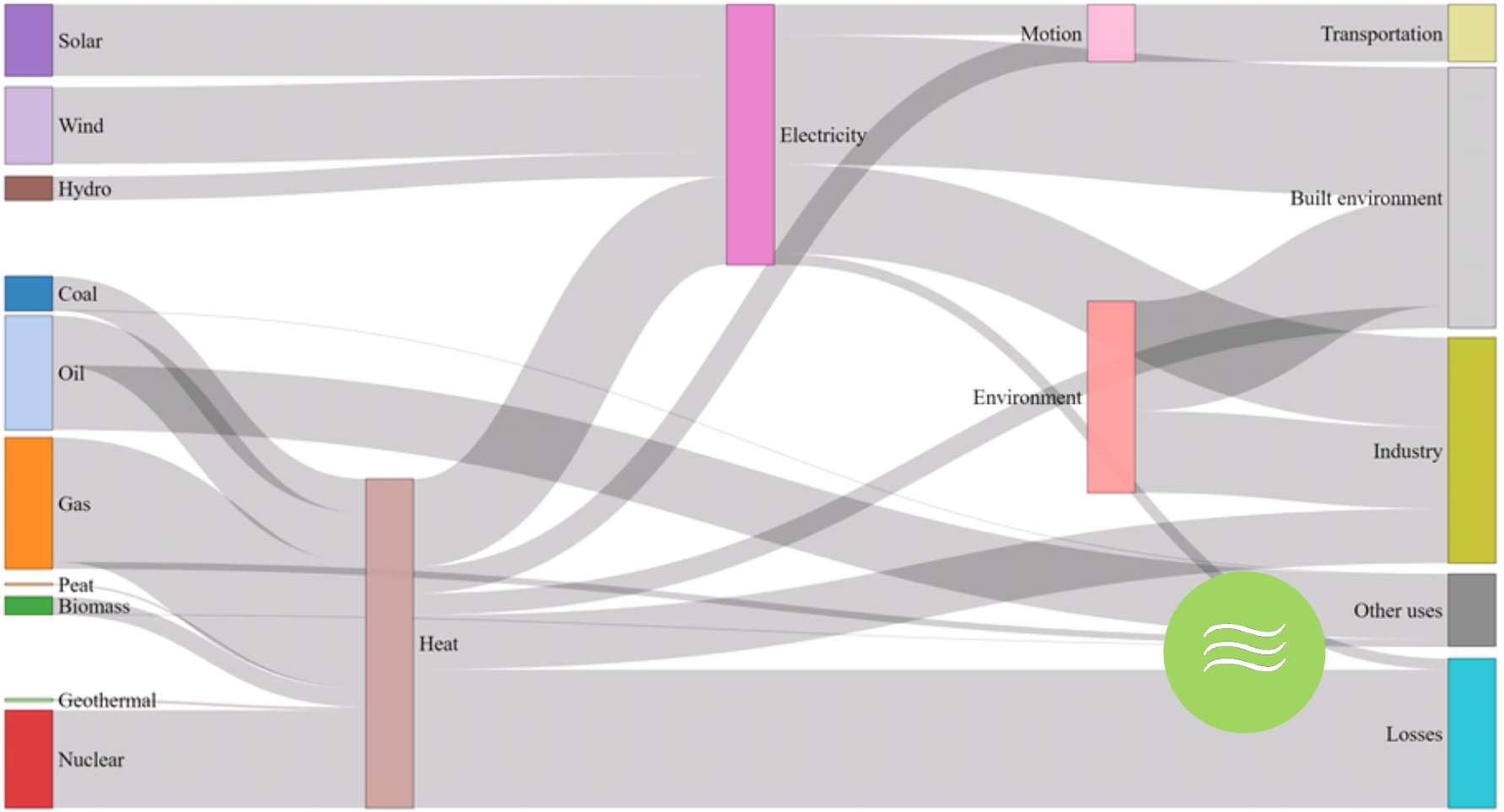
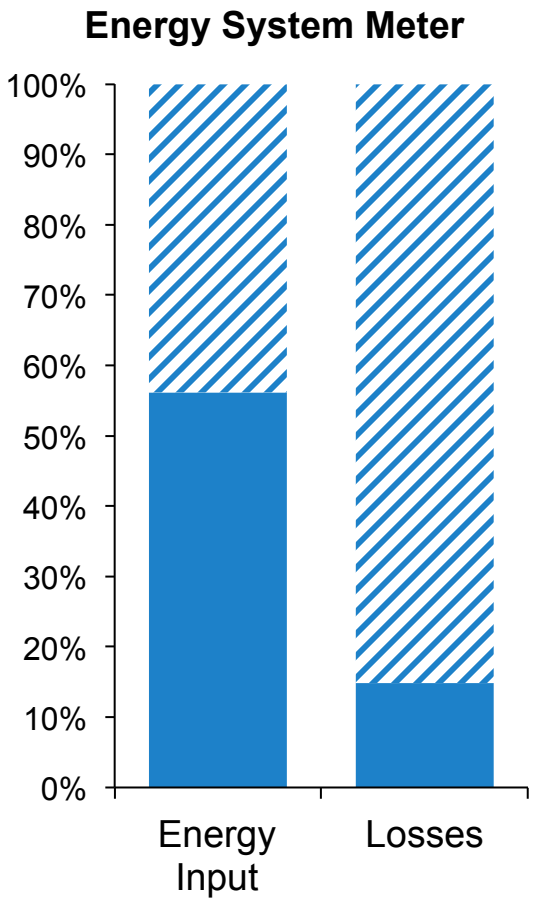
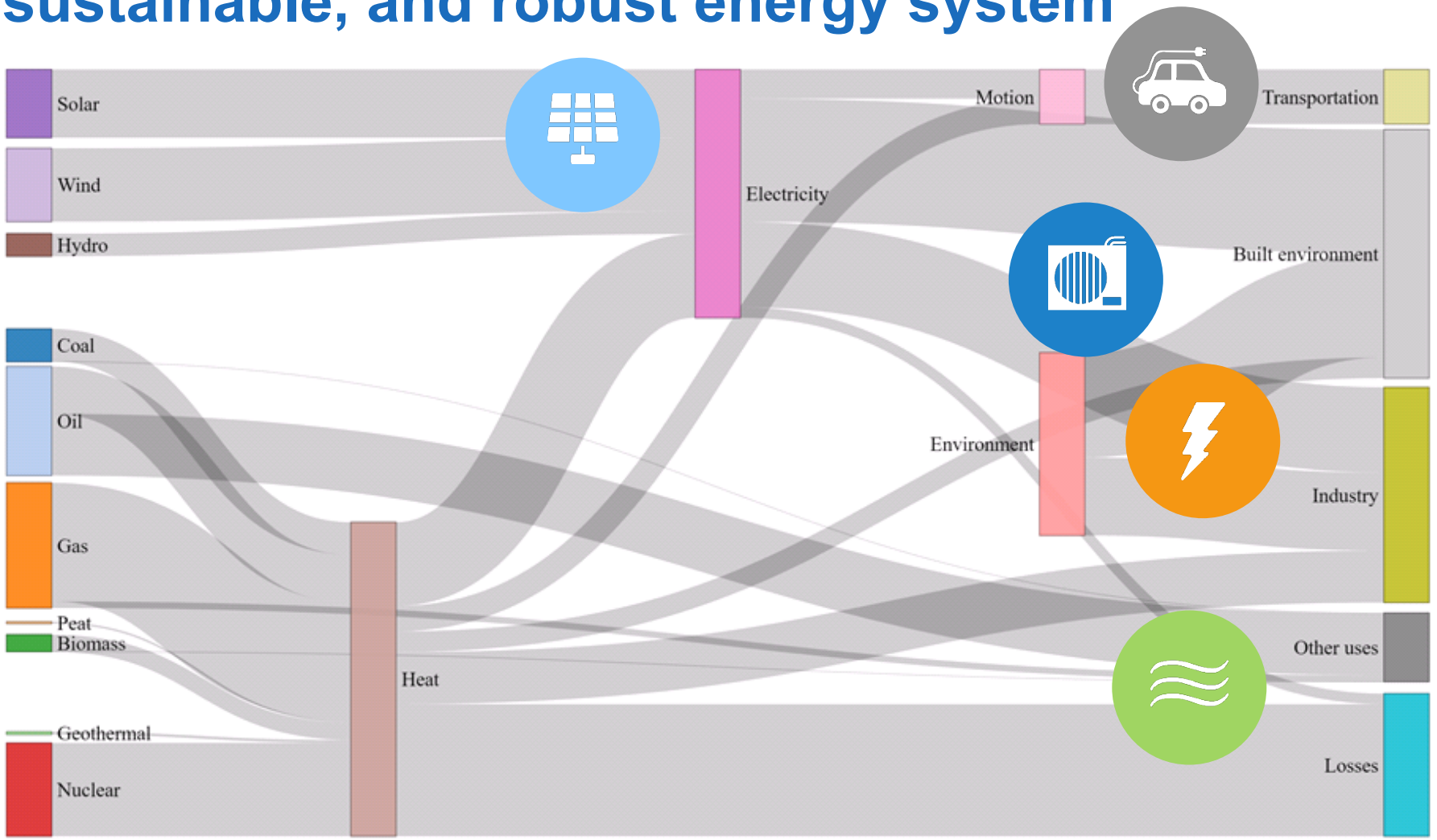
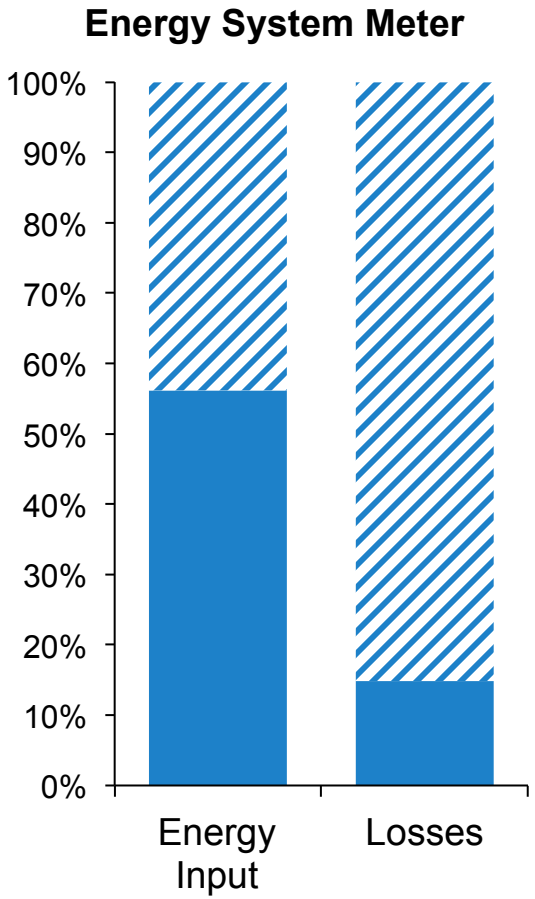




These five technologies combined result in an efficient, sustainable, and robust energy system





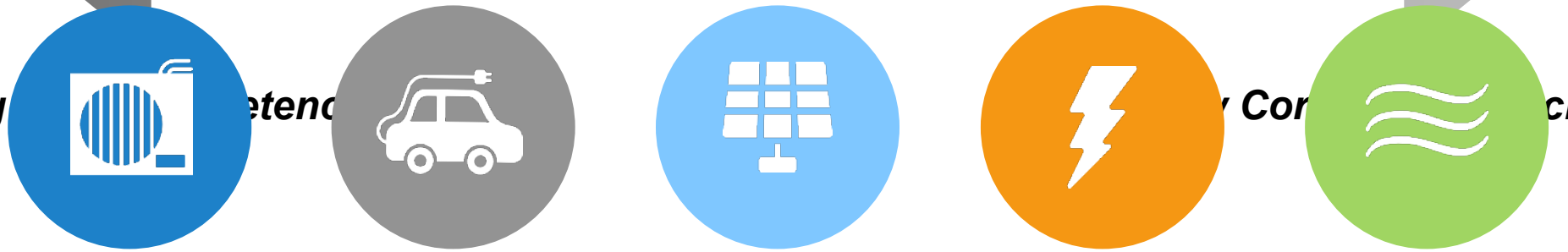
Agenda

1 Identifying five key technologies for the global energy transition

2 Following the evolution of the global energy system

3 Preparing for opportunities and threats in the new energy system

Where do these five key technologies fall within your core competencies?



You can use corporate venturing as one approach as several companies have entered the entrepreneurial ecosystem

The Rise Of Corporate Venture Capital: As It Booms In Tech, Consumer Giants Should Follow Suit

Forbes

Inc.

What's Really Driving the Boom in Corporate VC Firms

7-Eleven. Patagonia. Walgreens. These days nearly every corporation wants to create a VC arm. And it's not about the potential returns.

Corporate venture capital

The Economist

If you can't beat them, buy them

Fear of being displaced by startups is turning firms into venture capitalists

GV

QUALCOMM VENTURES

SAMSUNG VENTURE INVESTMENT

Johnson & Johnson INNOVATION

intel capital

GE VENTURES

salesforce ventures

COMCAST VENTURES

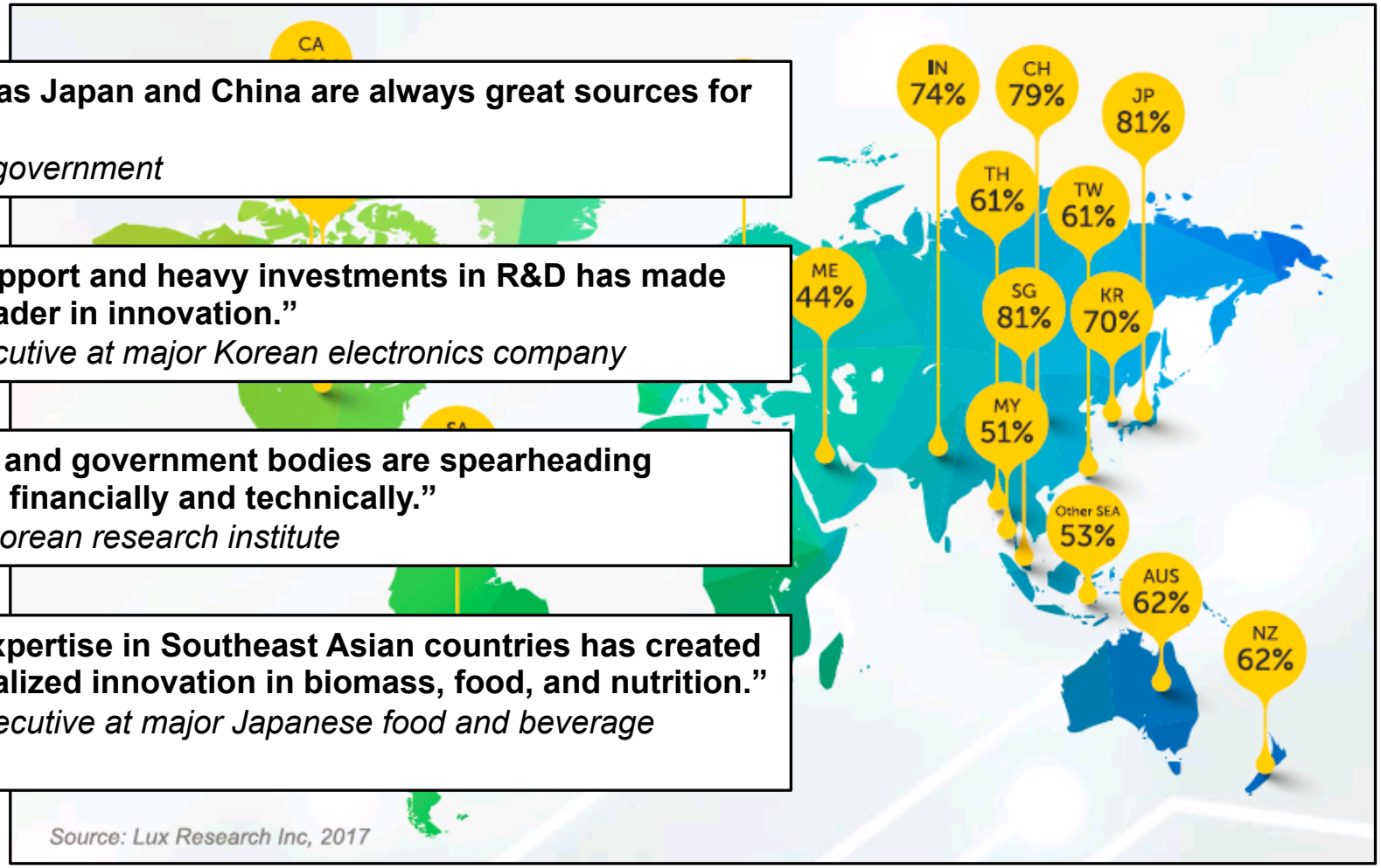
Asia-Pacific is emerging as a global innovation hotspot – you must understand how to nurture and tap the ecosystem

"Innovation hubs such as Japan and China are always great sources for external innovation."
–*Official from Malaysian government*

"Strong government support and heavy investments in R&D has made Singapore a regional leader in innovation."
– *Corporate strategy executive at major Korean electronics company*

"Involvement of private and government bodies are spearheading innovation in India both financially and technically."
– *Head of R&D at Singaporean research institute*

"Advancements R&D expertise in Southeast Asian countries has created great sources for specialized innovation in biomass, food, and nutrition."
– *Corporate venturing executive at major Japanese food and beverage company*



As you prepare for the global energy transition

- Understand that despite policy or regulatory uncertainties technology innovations are continuously evolving the way the energy system looks.

- Do not ignore the disruptive potential this transition has on several industries and the domino effect it will have on everyone and everything along the entire value chain

- Surviving and succeeding during this transition will require a proactive approach in innovation – something that might require you to move outside of your core competency and your organization

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