ICLEI
Local Governments for Sustainability

100% RENEWABLES
CITIES & REGIONS ROADMAP

Supported by:

Federal Ministry for Economic Affairs and Climate Action

IKI INTERNATIONAL CLIMATE INITIATIVE

on the basis of a decision by the German Bundestag

CAPACITY BUILDING MODULE: DEVELOPING A 100% RE ROADMAP

CONTENTS

Sustainable Energy in an Urban Context

Learning from the 100% Renewables Experience

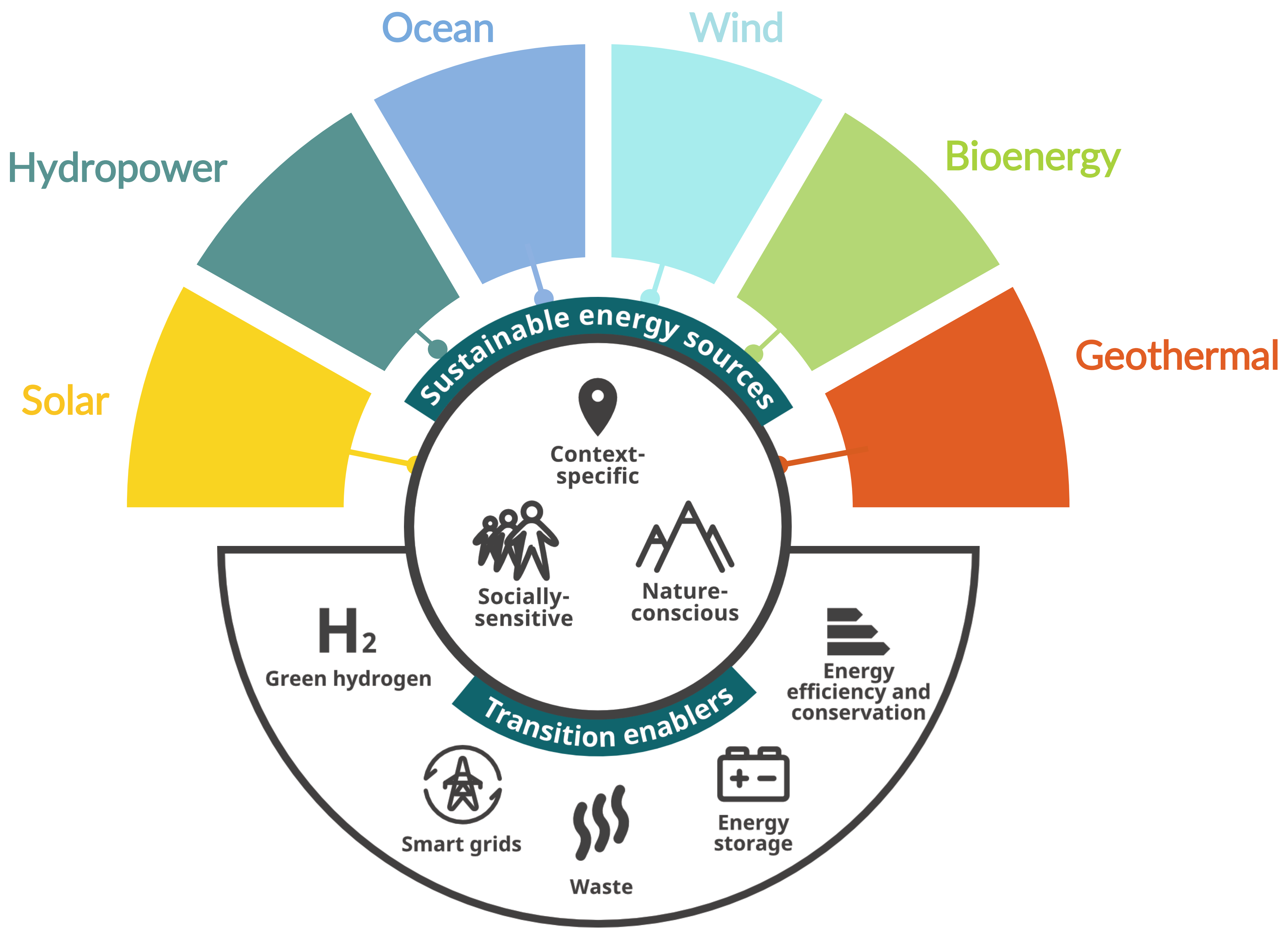
PART 1

SUSTAINABLE ENERGY IN AN URBAN CONTEXT

WHAT IS SUSTAINABLE ENERGY IN AN URBAN CONTEXT?

Energy sources can be sustainable in a city's specific context based on:

- The local renewable energy (RE) potential and energy use patterns
- Alignment with socio-economic realities and priorities
- Environmental/land-use impacts
- Possibility of integration into urban planning

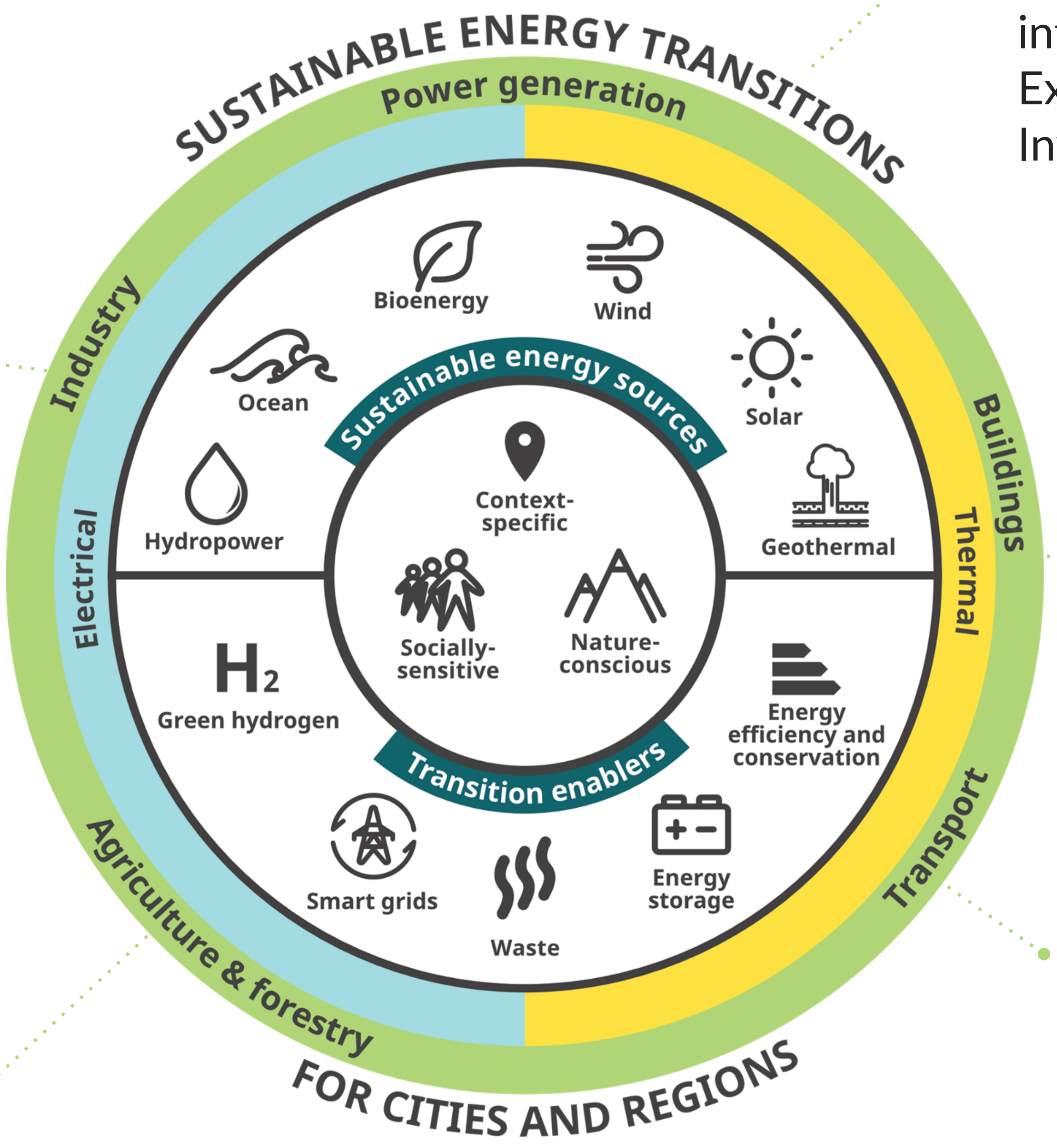


ICLEI's conception of the sustainable energy transition

WHERE CAN CITIES ACT?

Encourage local business and industries to adopt sustainable practices through incentives; Create opportunities for knowledge exchange within industry and with the LRG; Explore reskilling/training opportunities

Promote decentralized generation with DREs; Integrate RE into existing infrastructure; Explore off-grid possibilities; Involve communities



Enforce green building codes; Retrofit own buildings Offer incentives for sustainability; Integrate RE into structures; Emphasize energy efficiency and conservation; Adopt nature-based solutions;

Encourage innovative approaches such as agri-voltaics and mixed use of land with RE; urban farming; RE-based cold chains; agricultural waste for bioenergy; sustainable forest use

Invest in public transit; Electrification (local RE) of transport and charging infrastructure; Mobilize less energy-intensive transport (e.g. active multimodal mobility); Encourage alternative fuels in hard-to-decarbonize segments

BENEFITS FOR CITIES

Enhanced climate action and contribute to Net-Zero targets

Renewables as cornerstone of climate action with **low-to-zero GHG emissions**

Local revenue generation

Improved energy access can allow for greater **productive uses** for local communities, especially **SMEs**

Improved local resilience

Locally generated RE, robots energy infrastructure, able to function **off-grid** to address **acute energy crises** (energy security, independence, and lack of access)

National and international cooperation

A lot of international **resources** are flowing towards renewable energy, creating local **economic opportunities and localising SDGs**

Reduced local pollution

Generally much **lower emissions** and **pollutants** released compared to fossil fuels, leading to **improved air quality** and associated **health** outcomes

Green and local jobs

Decentralized RE and energy efficiency measures can create **jobs** within the community (e.g. installation, maintenance)

DEFINING SUSTAINABLE ENERGY FOR YOUR CITY/REGION

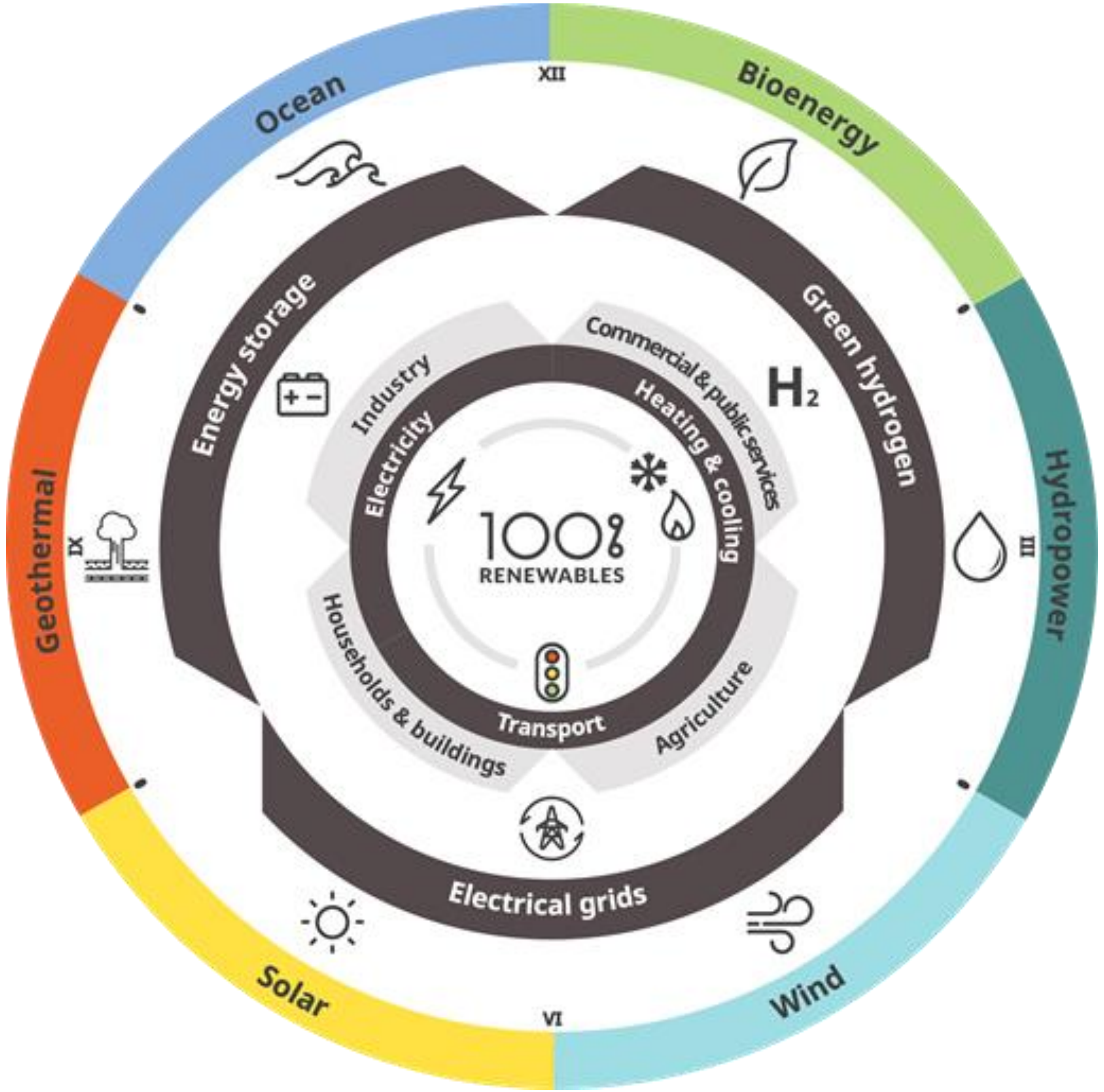
- Imagining a **sustainable energy future** requires answering certain questions…
  - “Where is my community consuming the most fossil fuels?”,
  - “What are my renewable energy sources?”,
  - “How affordable is energy in my community?”

- …and taking a **whole-of-system** approach:
  - ‘Energy’ goes **beyond just electricity** supply
  - Energy ‘sufficiency’ (energy for all) and ‘**efficiency and conservation**’ (optimized and/or reduced energy use) as a first resort
  - Everyone must have **access** to affordable, reliable and clean energy = RE
  - Energy **demand** across transport, buildings (lighting, heating/cooling), cooking must be transformed

WHAT DOES '100% RENEWABLES' INCLUDE?

- The 100% Renewables Cities and Regions initiatives reference the following definition of 100% renewable energy from the IRENA Coalition of Action:

"*Renewable energy encompasses all renewable resources, including **bioenergy, geothermal, hydropower, ocean, solar and wind energy**. One hundred percent renewable energy means that all sources of energy to meet **all end-use energy needs** in a certain location, region or country are derived from renewable energy resources **24 hours per day, every day of the year**. Renewable energy can either be produced locally to meet all local end-use energy needs (power, heating and cooling, and transport) or can be **imported** from outside of the region using supportive technologies and installations such as electrical grids, hydrogen or heated water. Any **storage facilities** to help balance the energy supply must also use energy derived only from renewable resources.*"



Graphical representation of 100% renewable energy by ICLEI - Local Governments for Sustainability

PART 2

LEARNINGS FROM THE 100% RENEWABLES CITIES AND REGIONS INITIATIVES

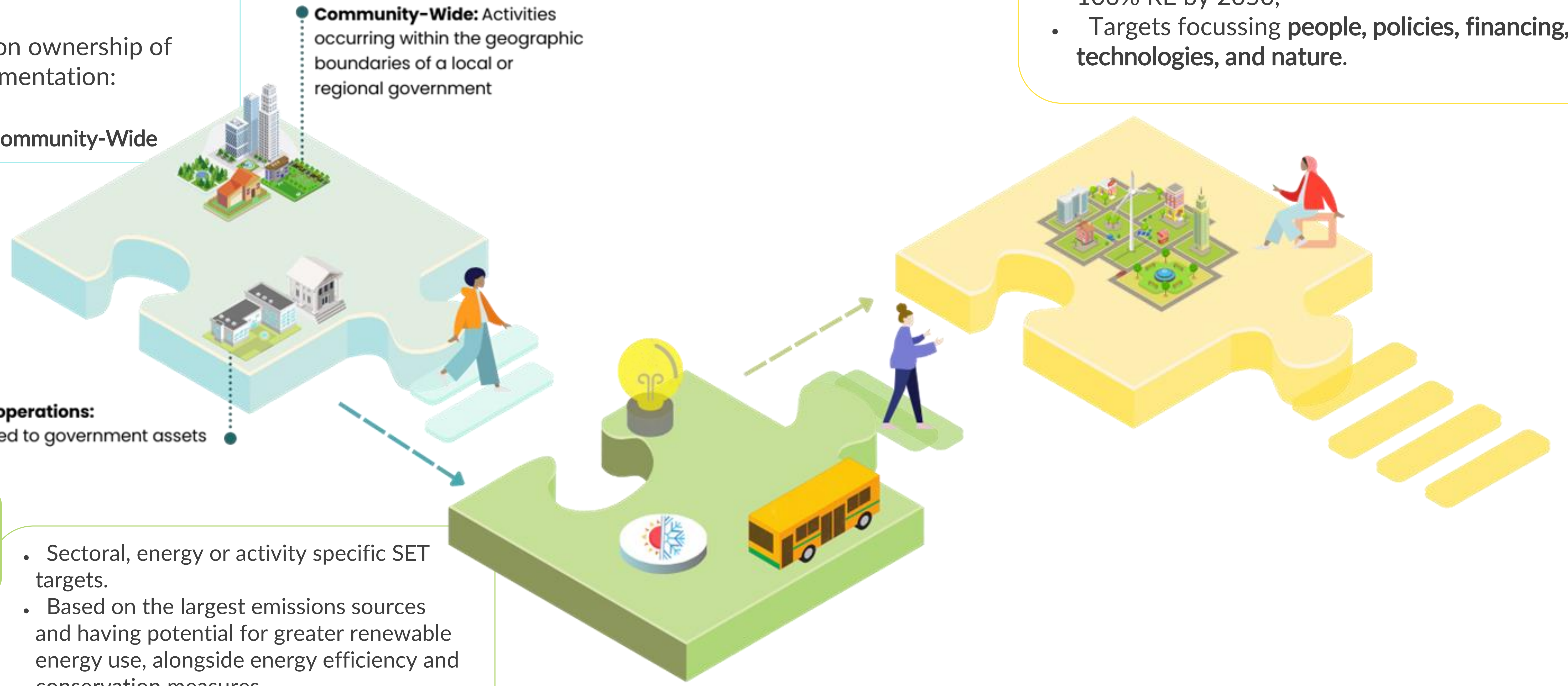
SETTING A SUSTAINABLE ENERGY TARGET

100% RENEWABLES CITIES & REGIONS ROADMAP

Approach 1: PICK A SCOPE

- Urban Local Bodies (ULBs) to consider suitable approach based on local needs and context
- E.g. SET targets based on ownership of assets and ease of implementation:

Government Operations or **Community-Wide**



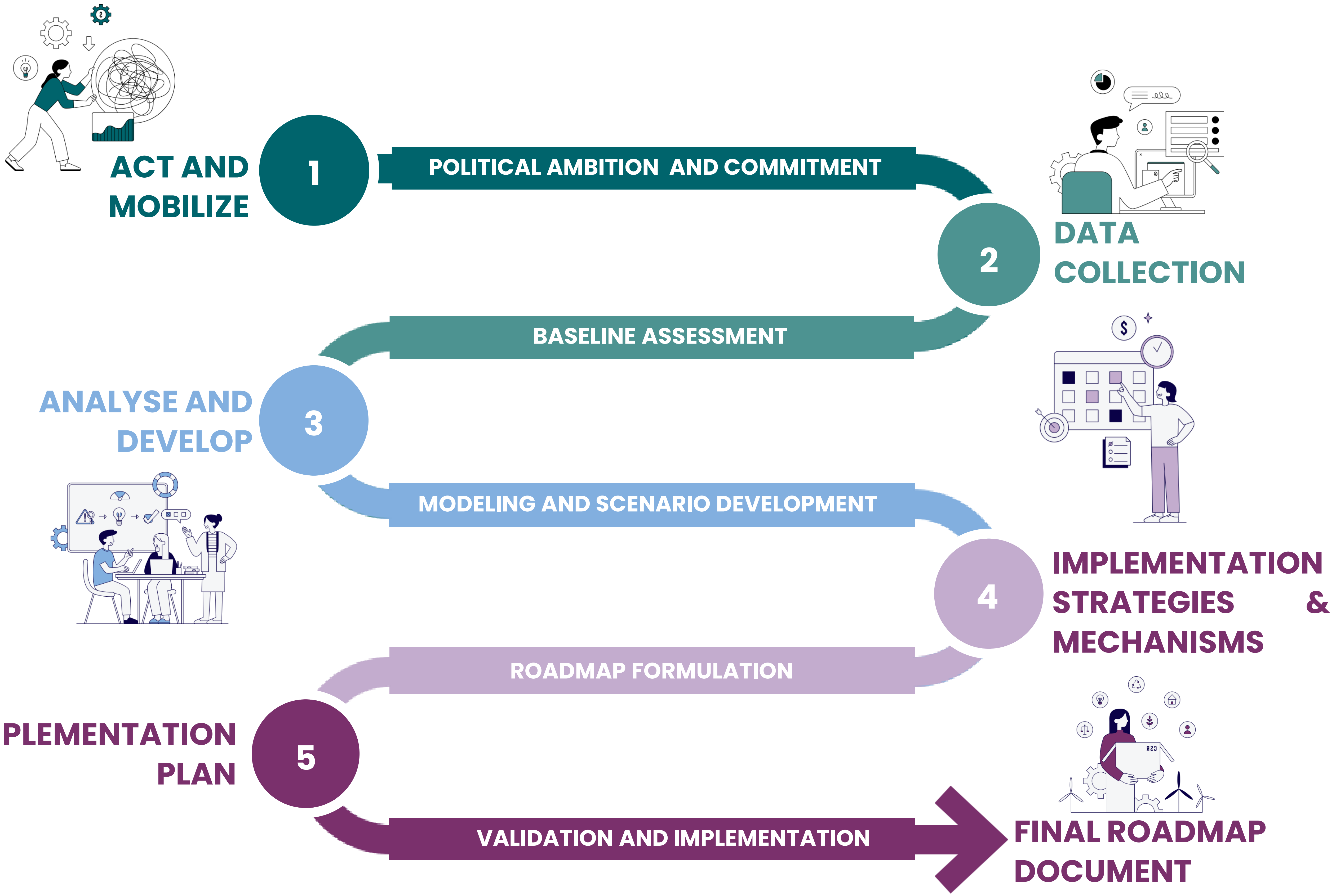
Approach 2: PICK A SECTOR

- Sectoral, energy or activity specific SET targets.
- Based on the largest emissions sources and having potential for greater renewable energy use, alongside energy efficiency and conservation measures.
- E.g. Buildings and Transport or **Electricity**, **heating** and **cooling**,

Approach 3: ADOPT & ACT

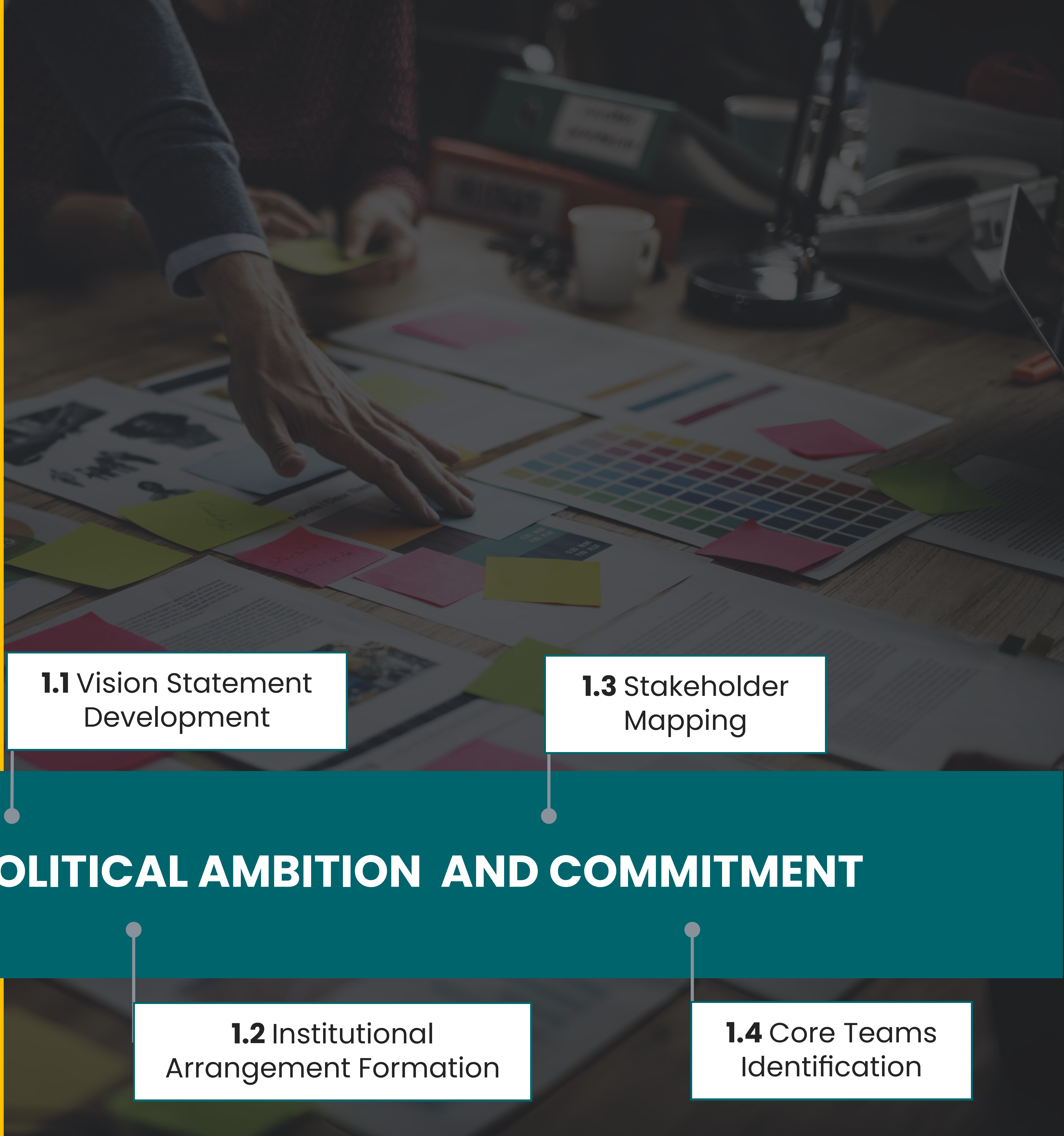
- ULBs to consider time period based targets- short, medium and long term, aligning with state and national level targets.
- E.g. 50 % renewable energy (RE) by 2030, 100% RE by 2050,
- Targets focussing **people, policies, financing, technologies, and nature**.

DEVELOPING A ROADMAP: 100% RE ROADMAP FRAMEWORK



ACT AND MOBILIZE

Defining the city's **vision**, identifying and engaging relevant **stakeholders**, and enabling cross-departmental **coordination** are key success factors in the initial stages of SET planning.



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POLITICAL AMBITION AND COMMITMENT

- **1.1** Vision Statement Development
- **1.2** Institutional Arrangement Formation
- **1.3** Stakeholder Mapping
- **1.4** Core Teams Identification

WHAT CAN POLITICAL COMMITMENT ACHIEVE?

100% RENEWABLES CITIES & REGIONS ROADMAP

- Leaders play a crucial role in prioritizing initiatives and mobilizing stakeholders, particularly across multiple levels of government.
- Committed leadership can remove roadblocks and help streamline climate and energy action planning into the ULB’s overall strategies.
- Inter-departmental cooperation can help break silo-ed thinking.
- Developing a common community vision through stakeholder engagement can help include community voices early on, and ensure the ULB’s energy goals are aligned with the needs of its community.

VISION STATEMENTS FROM THE 100% RE PROJECT

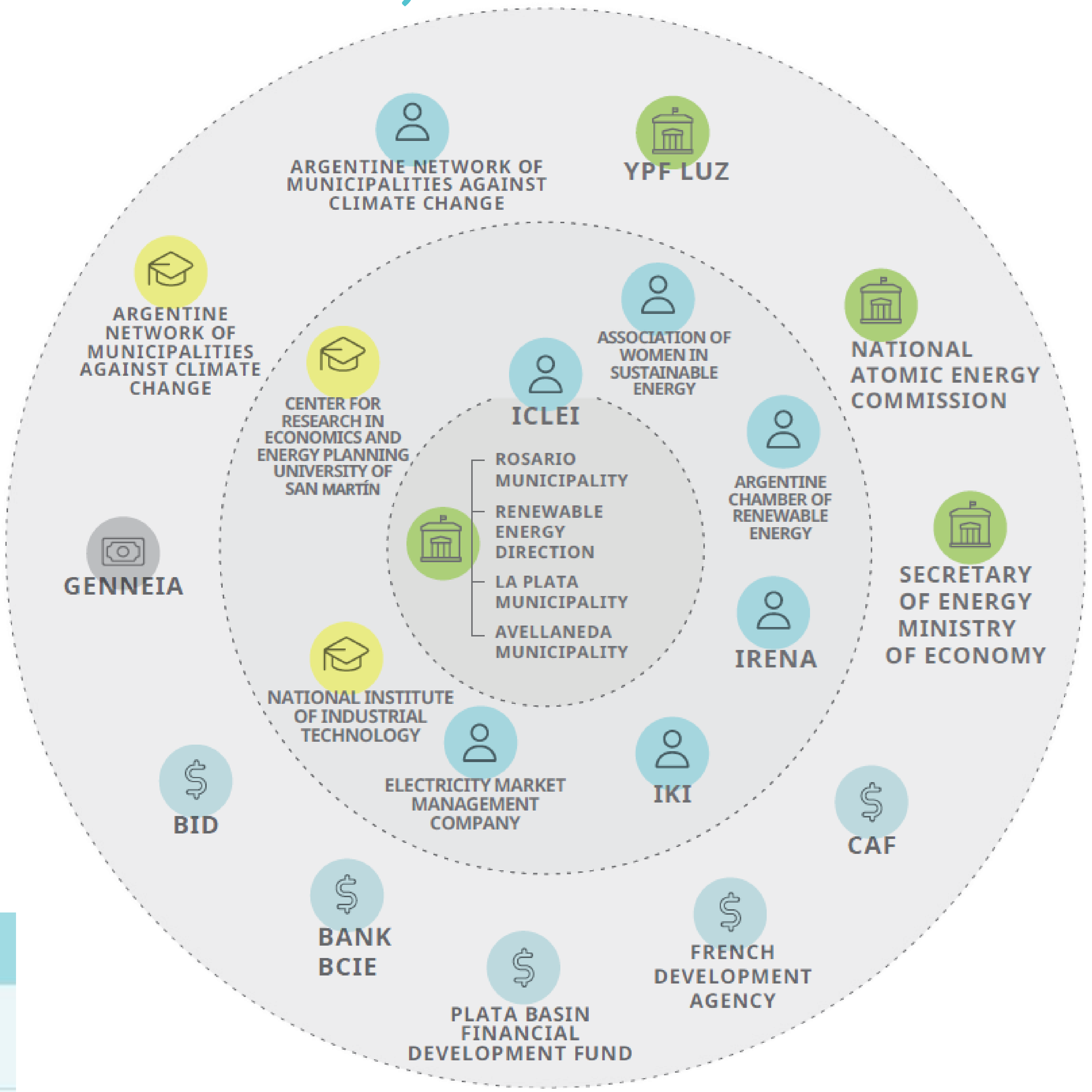
- “*Realizing the vision of a WNT Province which has energy security and independence sourced 100% from local, renewable, sustainable, and low-carbon energy resources, to ensure universal and reliable energy access for all people.*” – West Nusa Tenggara, Indonesia

- *“Universal access to reliable and affordable 100% renewable energy for sustainable development in Kisumu County by 2050.” – Kisumu County, Kenya*

STAKEHOLDER MAPPING FROM AVELLANEDA, ARGENTINA

Mapping was important to determine an actor's influence on the project, whether they are significantly impacted by the implementation of the project, or whether they have specific expertise or resources to support.

- Either way, they would need to be consulted.



INCIDENCE LEVEL
KEY STAKEHOLDER
PRIMARY STAKEHOLDER
SECONDARY STAKEHOLDER

JURISDICTION/SECTOR	
GOVERNMENT	CIVIL SOCIETY
ACADEMIC INSTITUTION	FINANCIAL INSTITUTION
COMMUNITY REPRESENTATIVE	PRIVATE SECTOR

DATA COLLECTION

Finding quality data at the city-level is a challenge globally. However, accurate data is critical for planning as well as monitoring progress.

2 BASELINE ASSESSMENT

- **2.1** Energy Demand
- **2.2** Existing Supply Generation
- **2.3** Energy Efficiency
- **2.4** GIS Data
- **2.5** Costs data
- **2.6** Socio-economic Data
- **2.7** Environment & Externalities
- **2.8** Policy Data
- **2.9** Data Assumptions and Constraints

GOOD DATA CREATES A STRONG FOUNDATION

- Creating an accurate **baseline** can help track progress and create evidence-based and ambitious—but achievable—**targets**.

- Accessing **granular data** about local energy demand and supply is not easy!

- But good data produces **good results**, and is crucial for the next few planning stages (energy modelling, Developing Local Strategies and Implementation Mechanisms, reporting, etc.)

RECOMMENDATIONS FOR DATA COLLECTION

100% RENEWABLES CITIES & REGIONS ROADMAP

- Collaborate! With other agencies, departments, partners, local academic institutions, utilities, communities for open-source data and for data collected in other similar projects by various development agencies
  - Standardize data recording practices and streamline data collection process
  - Keep in mind local data protection laws
  - Reporting platforms such as CDP-ICLEI Track can offer best practices and technical assistance related to data collection

- Estimation and extrapolation of data (from the regional or national level, or from peer cities) can help bridge data gaps, but accuracy is affected.

- Engage with concerned stakeholders (e.g. utilities)—the data they collect may not always be relevant for planning purposes, and so effective communication can help identify useful parameters

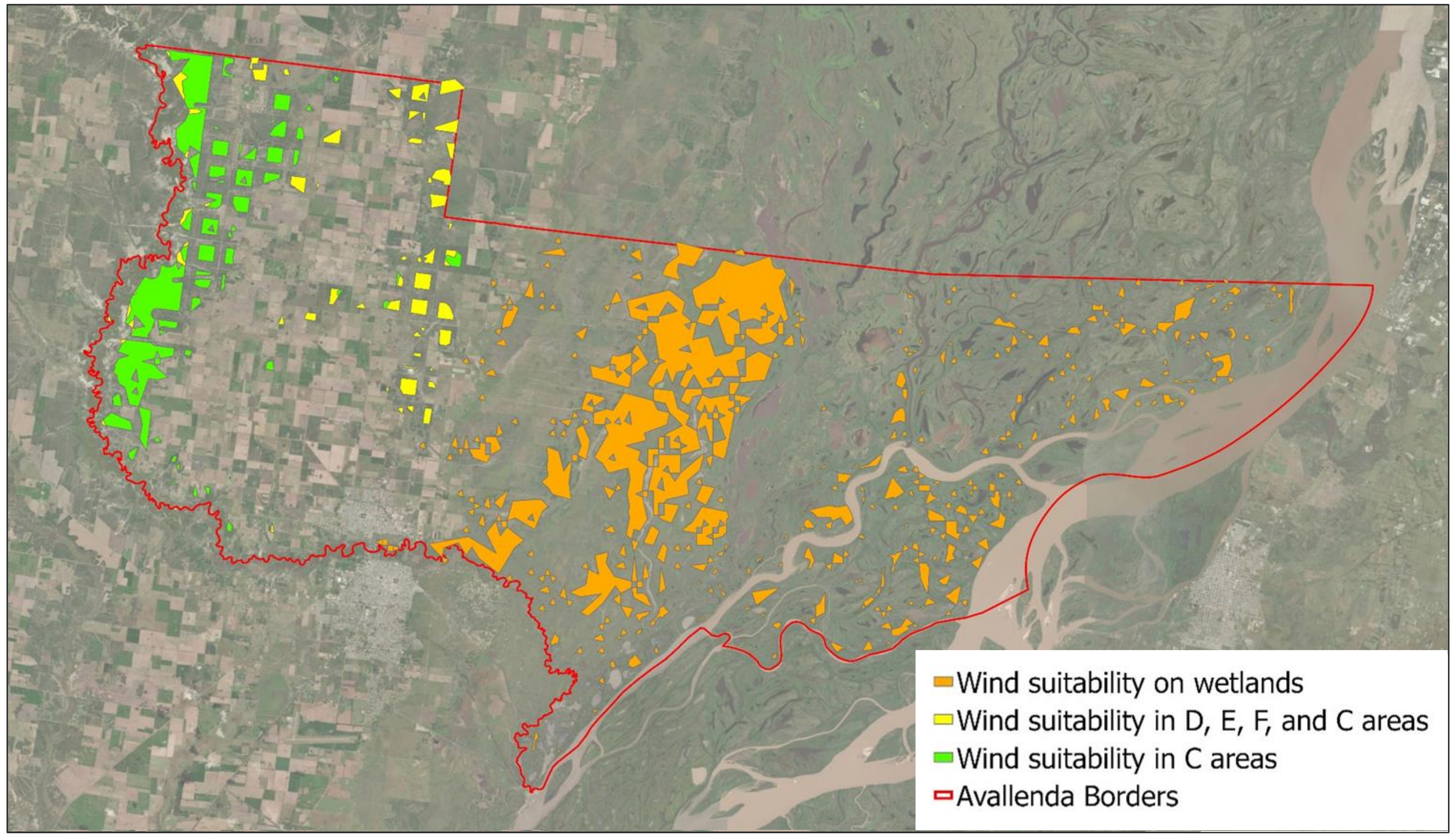
EXAMPLE: ESTIMATING ENERGY DEMAND DATA

- Example: in the case for **Avellaneda**, Argentina, the following data sources were used:
    - Socio-economic data from the provincial (i.e. state-level) statistics department
    - National data for electricity generation, prices, solar potential etc.
    - Local utilities commission for hourly electricity consumption
    - Local gas company for household fuel consumption data
    - Weather (wind, precipitation, etc.) data was publicly available from MeteoBlue
    - Livestock data from the local government to address bioenergy (manure) potential
    - Academic/research publications for technology costs, parameters etc.

GIS DATA FROM THE 100% RE PROJECT

- GIS quantifies renewable source viability. Analysis and mapping pinpoint optimal deployment, advancing efficient, sustainable energy solutions.

Using GIS to Identify Suitable Areas for Wind in Avellaneda, Argentina



Using GIS to Identify Suitable Areas for Wind and Utility-Scale PV in West Nusa Tenggara

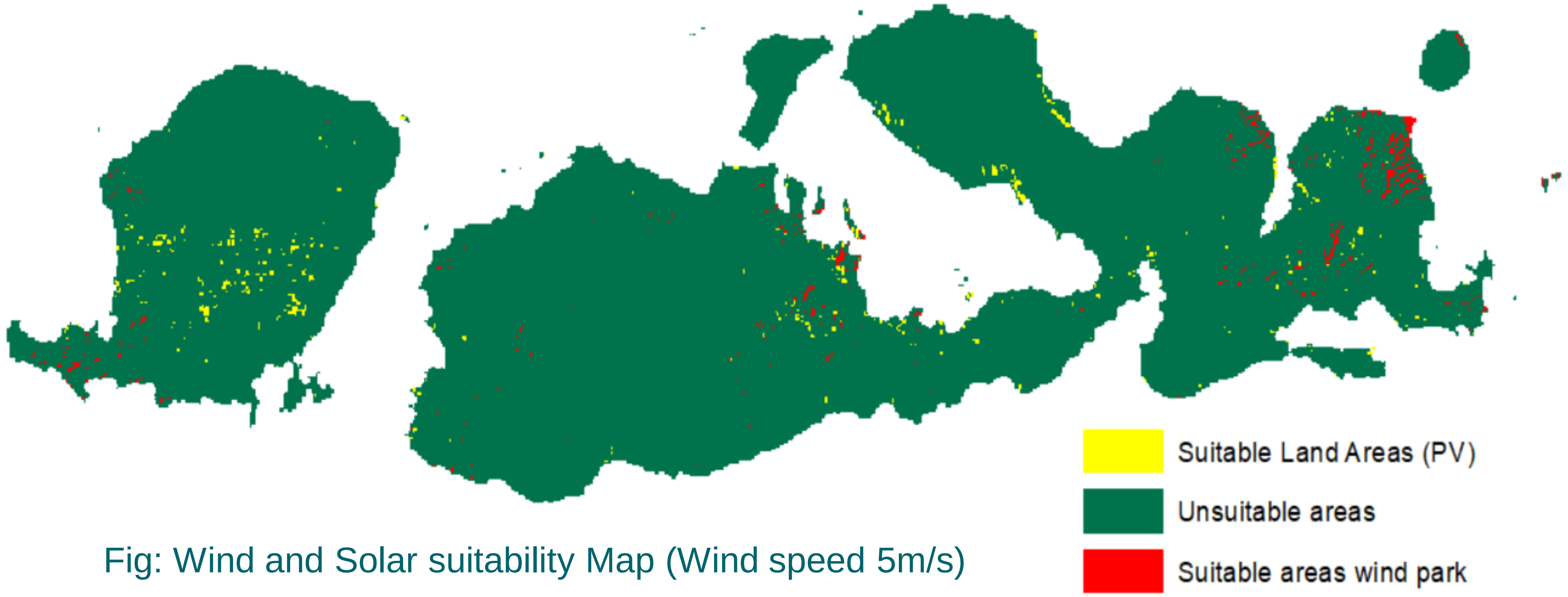


Fig: Wind and Solar suitability Map (Wind speed 5m/s)

ANALYSE AND DEVELOP

This step involves developing an energy systems model to map out potential future energy scenarios, based on various parameters of the city.

3.1 Energy Demand and Supply Assessment

3.2 Energy Efficiency Assessment

3.3 GIS Mapping

3.4 Energy Costs Assessment

3.5 Socio-Economic Assessment

3.6 Energy System Impact Assessment

3

ENERGY MODELING AND SCENARIOS

RE Technical & Economic Resources

Externalities (environmental etc.)

Existing Policies

THE PURPOSE OF ENERGY SYSTEMS MODELING, PT. 1

- It is a **planning tool** that can outline possible future scenarios of an energy system
  - Based on available data and certain assumptions. Quality in, quality out!

- It is *not* a prediction of the future
  - But it can offer ways to **understand the impacts** of changes in prices, technologies, etc. in an energy system and the interplay of various factors

- Of particular use is the comparison to a **business-as-usual scenario** to understand the overall impacts of including Renewable Energy Sources or other measures (e.g. energy efficiency)

THE PURPOSE OF ENERGY SYSTEMS MODELING, PT. 1

- The choice of **modelling software** is important—not all are suited for city-level modelling. The 100% RE Roadmap project used Fraunhofer ISE's 'KomMod' software.

- Models may provide a path forward, but actual implementation will involve further consideration of **socio-economic concerns**, **resources** (human, technical, financial), **policies**, **efficiency**, etc. and **timelines** may vary.

- Finally, models provide a somewhat static picture of the future based on present assumptions. They cannot account for **future technological developments**, or **structural changes** in an economy, reducing their power for longer timelines. Periodic revisions may also be necessary.

ENERGY MODELING PROCESS FROM THE 100% RE PROJECT

INPUTS

1 year, hourly **demand profiles** for electricity and heat

Economic and **technological** parameters for considered technologies

Detailed information on **RE potentials**

Climate and **weather** data is also required

Projected to 2050

PROCESS

Identifying the **cost-minimized** combination of **supply technologies** for an energy system, given **specific goals** (e.g. 100% RE by 2050) and defined boundary conditions

Can include:

- **Target share** of RE generation (e.g. fully utilize hydro potential)
- Restriction on **energy import or export**
- Total **costs**, including investments, operation and maintenance, and fuel costs, if applicable

OUTPUTS

Optimal **installed RE capacity** for each technology

Optimal **hourly operation** plan

Temporal profile of **import and export** of electricity (if applicable)

Possible transition pathways

Scenario in 2050

ENERGY MODELING PROCESS FROM THE 100% RE PROJECT

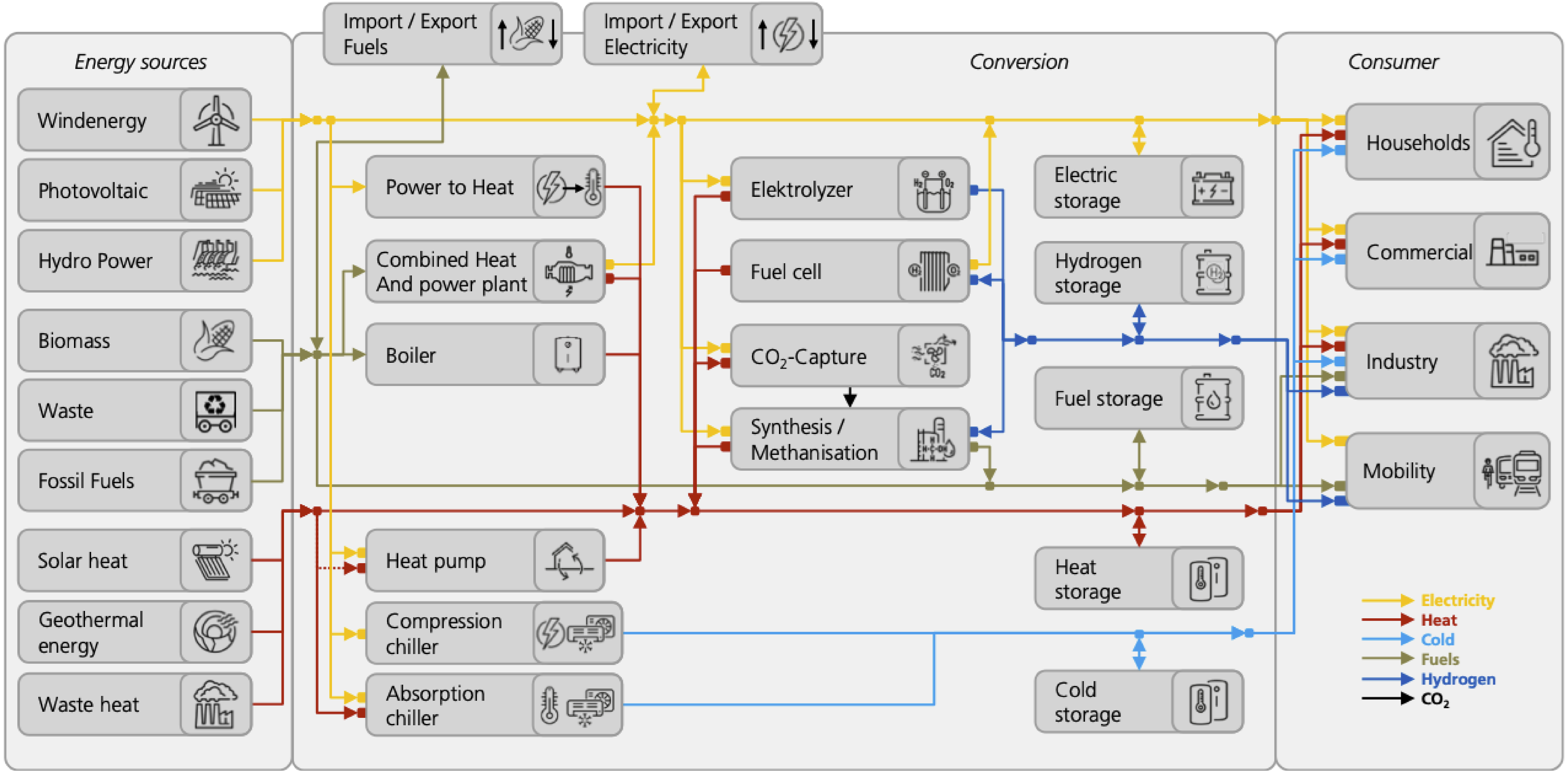
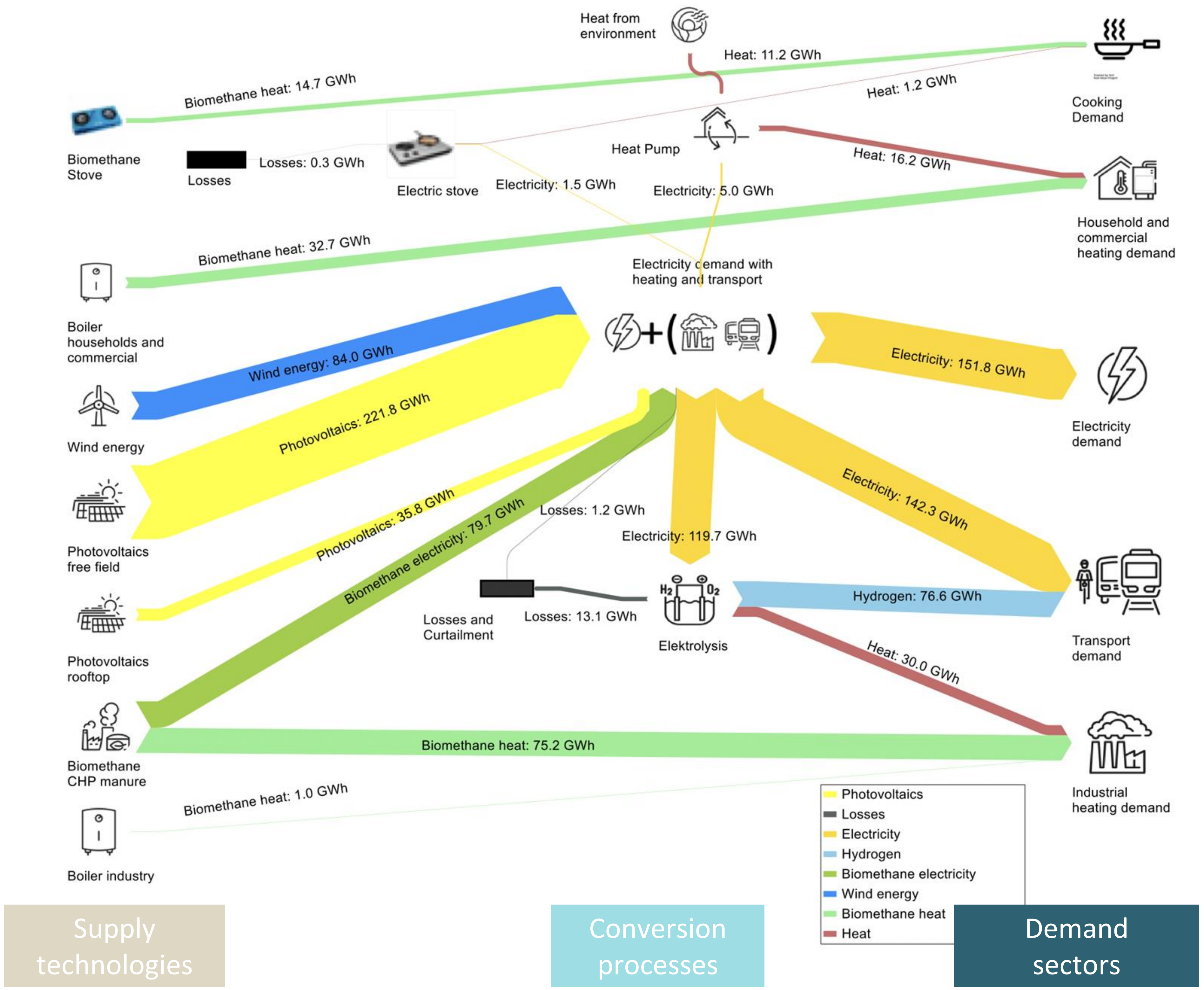


Figure 2: Graphical representation of the model KomMod with all technologies included

ENERGY FLOW DIAGRAM: AVELLANEDA, ARGENTINA

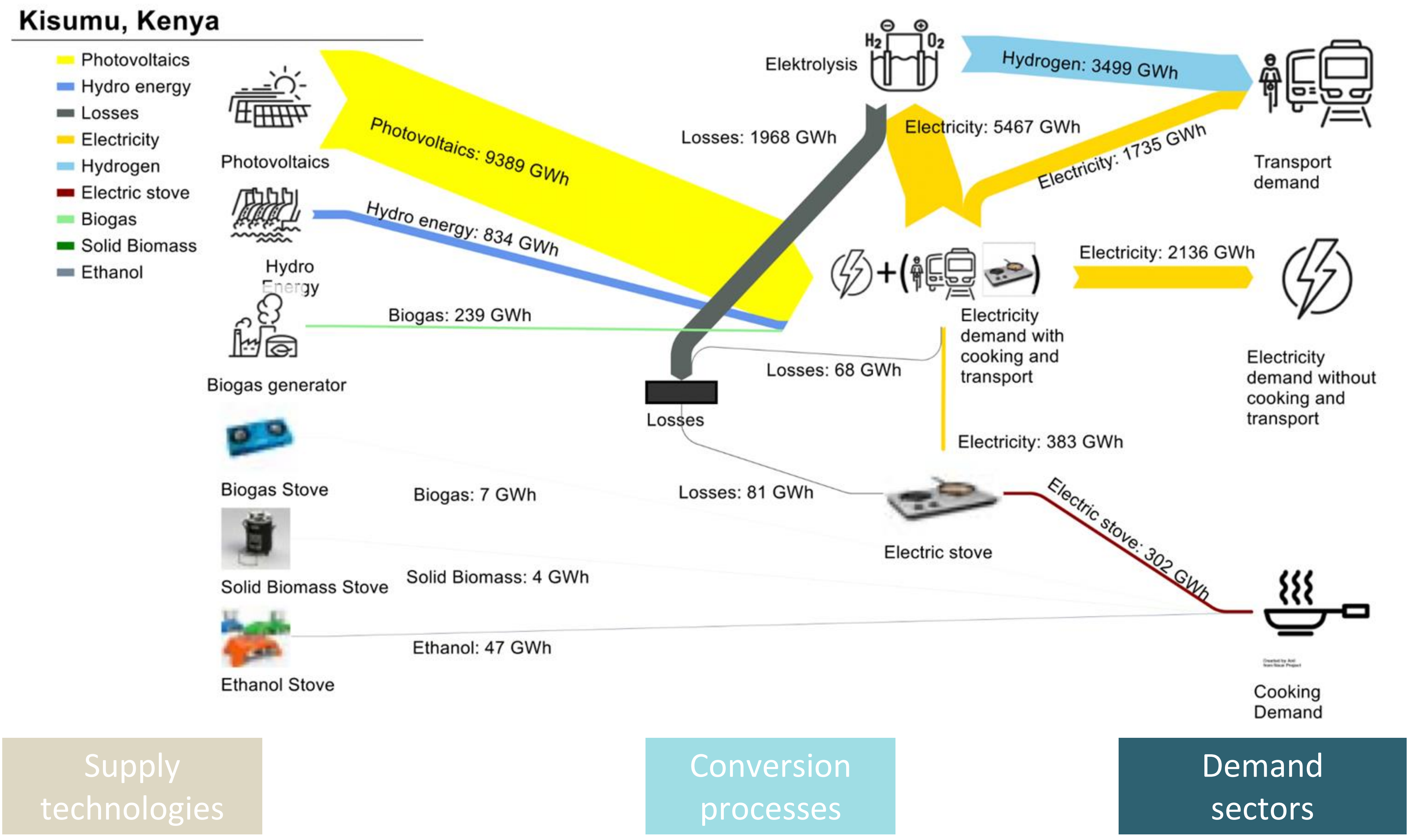
The overall demand to be met in 2050 through RE was determined through the process outlined in the previous slide.

- In Avellaneda, there is a high potential for **bioenergy** due to the large agricultural sector. Its local industry is the primary consumer of this fuel for heating.
- Some amount of **waste heat** from intermediate process, such as electrolysis, can also be channeled into productive purposes.



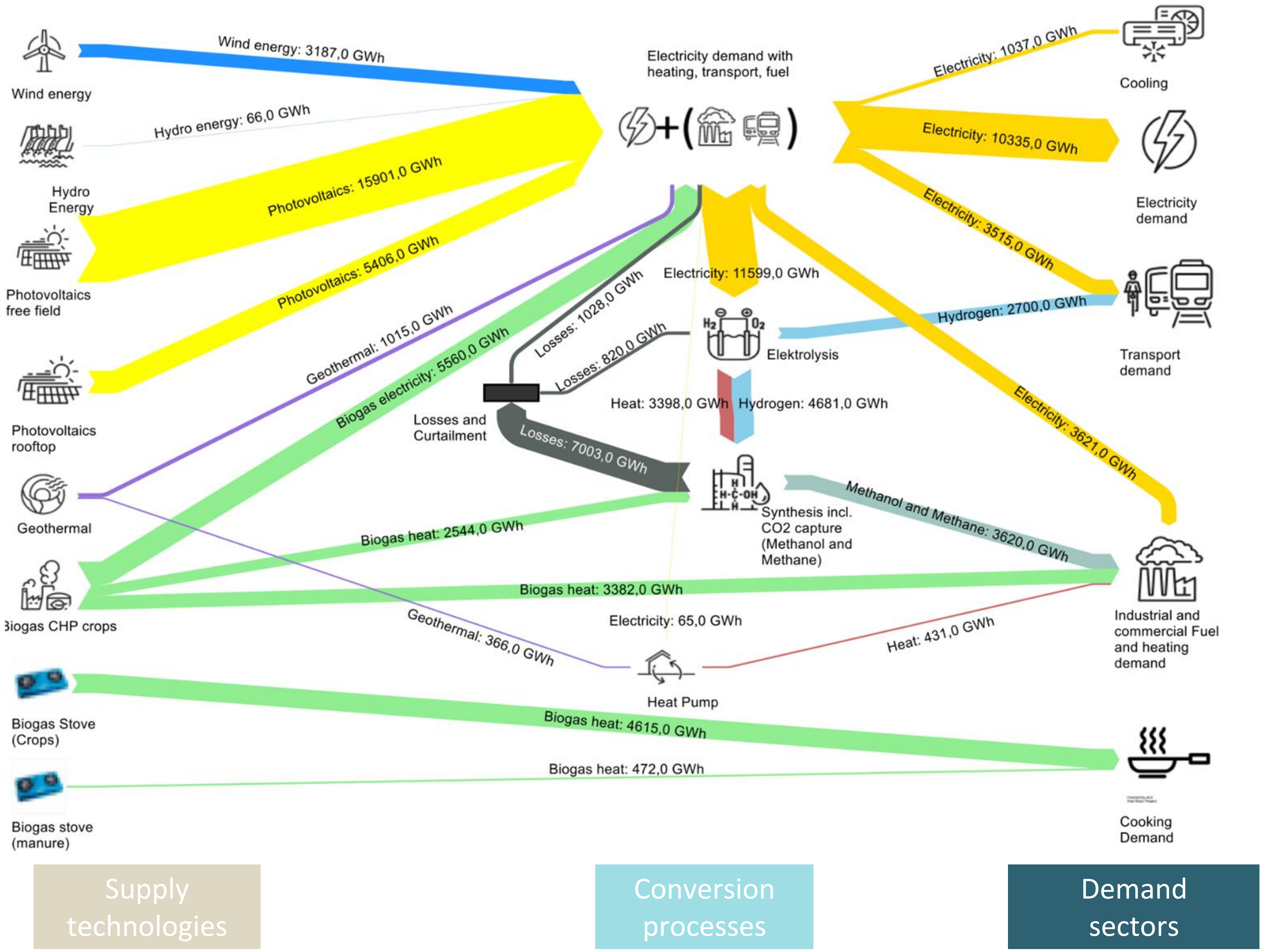
ENERGY FLOW DIAGRAM: KISUMU COUNTY, KENYA

- Kenya's electricity is almost fully renewable, with a large share of **geothermal** electricity.
- Kisumu's energy demand comes primarily from **buildings** and **transport**, which can be met from the large **solar PV** and **hydrogen** potential.



ENERGY FLOW DIAGRAM: WEST NUSA TENGGARA, IDN

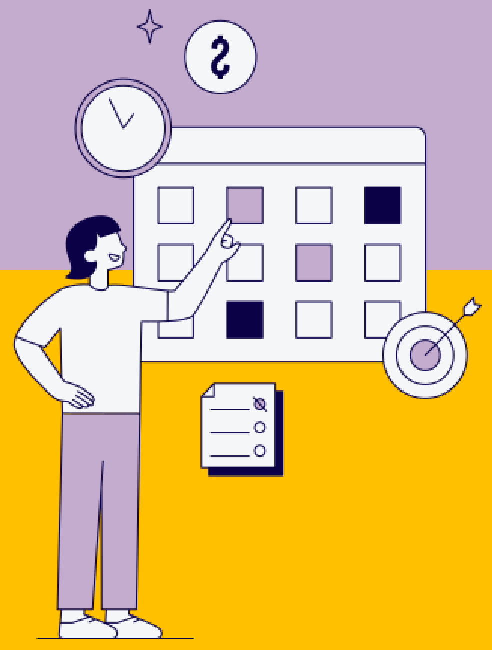
- In WNT, there is a high potential for **solar PV and bioenergy** due to the large agricultural sector, and plenty of land.
- Additional **electricity** is needed for **hydrogen** production, some of which is further used to produce **synthetic methane** and **methanol** for industry.



IMPLEMENTATION STRATEGIES AND MECHANISMS

This stage is vital for defining the strategic objectives and actions for implementing the SET. Here we outline strategies and address financial, land use, economic, and policy aspects based, building from the energy systems modelling.

4 ROADMAP FORMULATION



- **4.1** Finance & Investment Needs
- **4.2** Future Energy Scenario (FES) Land Use
- **4.3** FES Economic Impact Assessment
- **4.4** Other FES Impact Assessment
- **4.5** Policy Gap Analysis

DEVELOPING A ROADMAP, PT. 1

- The roadmap answers the question of "*How do we implement our SET*?"
  - It involves defining broad **local strategies** (e.g. transitioning transport is a priority)...
  - ... followed by specific **actions** and **implementation mechanisms** (e.g. electrifying public transport through green procurement, phasing out ICE vehicles through incremental bans)...
  - ... and defines **timelines**, roles and **responsibilities**, and **monitoring** mechanisms.

- Also important is identifying **resources for implementation** (financial, technical, human), such as own sources of revenue, national government programs/assistance, international finance (DFIs, MDBs, etc.), private sector partnerships (e.g. PPPs)

DEVELOPING A ROADMAP, PT. 2

- Based on previous exercises in vision definition and prioritization of certain sectors, certain principles of **gender**, **justice**, **equity**, and **inclusion** can be included in the roadmap actions.

- A roadmap would enable **cross-departmental cooperation** by providing a common reference and sharing responsibilities (highlighting once again the need for political commitment).

- Roadmaps should also include **progress monitoring** efforts, as well as undergo **periodic revision** as targets are achieved (or not), technologies evolve, and a city's circumstances and priorities change

FINALIZING THE PROCESS

A roadmap, once defined, should be validated and communicated to the community, not only for transparency but to also attract visibility and resources for further implementation.

5

VALIDATION AND IMPLEMENTATION

ENSURING THE ROBUSTNESS OF A ROADMAP, PT. 1

- Increasing knowledge of project development and project finance to support implementation over the long-term
  - This was done through the development of bankable projects and associated capacity building
  - Taking advantage of city networks and their partnerships with financial institutions and project preparation facilities, such as the Transformative Actions Program.

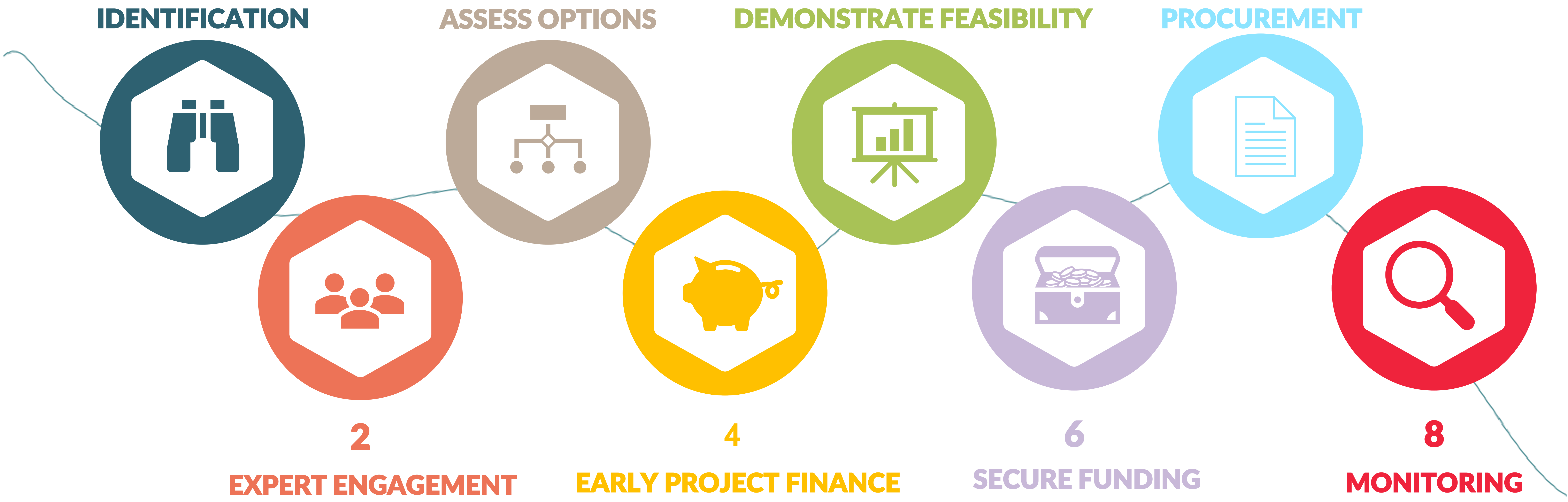
- Policy support was also provided, for local and national governments. Multilevel governance was incorporated into the project to create linkages between the local and national governments to address challenges and concerns.

ENSURING THE ROBUSTNESS OF A ROADMAP, PT. 2

- Multiple rounds of **feedback** involving different stakeholders (government agencies, ministries, city departments, academics, CSOs, utilities) to identify gaps and ways forward
  - Such an **iterative process** also helps create **ownership** of the document within the city government, rather than 'only' belonging to the energy department
  - Use of **innovative** stakeholder engagement mechanisms such as **serious games**, to bring together diverse viewpoints in an interactive and engaging session

- **Capacity building** is important to take full advantage of the **synergies** present in local government planning, especially related to a fundamental input such as energy

ENSURING THE ROBUSTNESS OF A ROADMAP, PT. 2



Note: See the Capacity Building Module on Project Development for more details

EXAMPLE: AVELLANEDA'S PRIORITY ACTIONS

100% RENEWABLES CITIES & REGIONS ROADMAP

Roadmap progress timeline

2030

Electricity
60% Renewable

Thermal energy
30% Renewable

Transport
30%
of the public passenger transport and municipal fleet is from renewable sources

20%
of the fuel consumption by private transportation is from renewable sources

2040

Electricity
100% Renewable

Thermal energy
60% Renewable

Transport
50%
of the public passenger transport and municipal fleet is from renewable sources

40%
of the fuel consumption by private transportation is from renewable sources

2050

100% Renewable in all sectors:

electricity, thermal energy and transport.

Axis 1
Energy Efficiency (EE)

Objectives
- Promote actions for efficiency and responsible consumption in the public, residential, and commercial sectors.
- Encourage the efficient use of energy resources in the industrial and agricultural production environment.
- Incentivize and promote sustainable, efficient, and inclusive territorial planning and construction.

GOALS
- 30% of the energy consumption is reduced in municipal public buildings through energy efficiency measures compared to the baseline year (2019), by 2040
- 30% of the energy consumption is reduced in the commercial, industrial, and agricultural sectors through energy efficiency measures compared to the baseline year (2019), by 2050
- 20% of per capita energy consumption is reduced in the residential sector through energy efficiency measures, by 2050
- 50% of homes in vulnerable conditions incorporate energy efficiency measures, by 2050

Axis 2
Renewable Energy Technology (RE)

Objectives
- Promote distributed, community and inclusive energy generation
- Promote technological innovation for the acquisition and development of renewable energies
- Bring renewable energy technologies closer to the population, promoting the circular economy and green jobs

GOALS
- The equivalent of 100% of the electricity consumption is generated by renewable sources, on an annual basis, by 2040
- 100% of the city's thermal requirement is supplied by renewable sources, by 2050
- 100% of registered residual biomass is energetically utilized, by 2050.

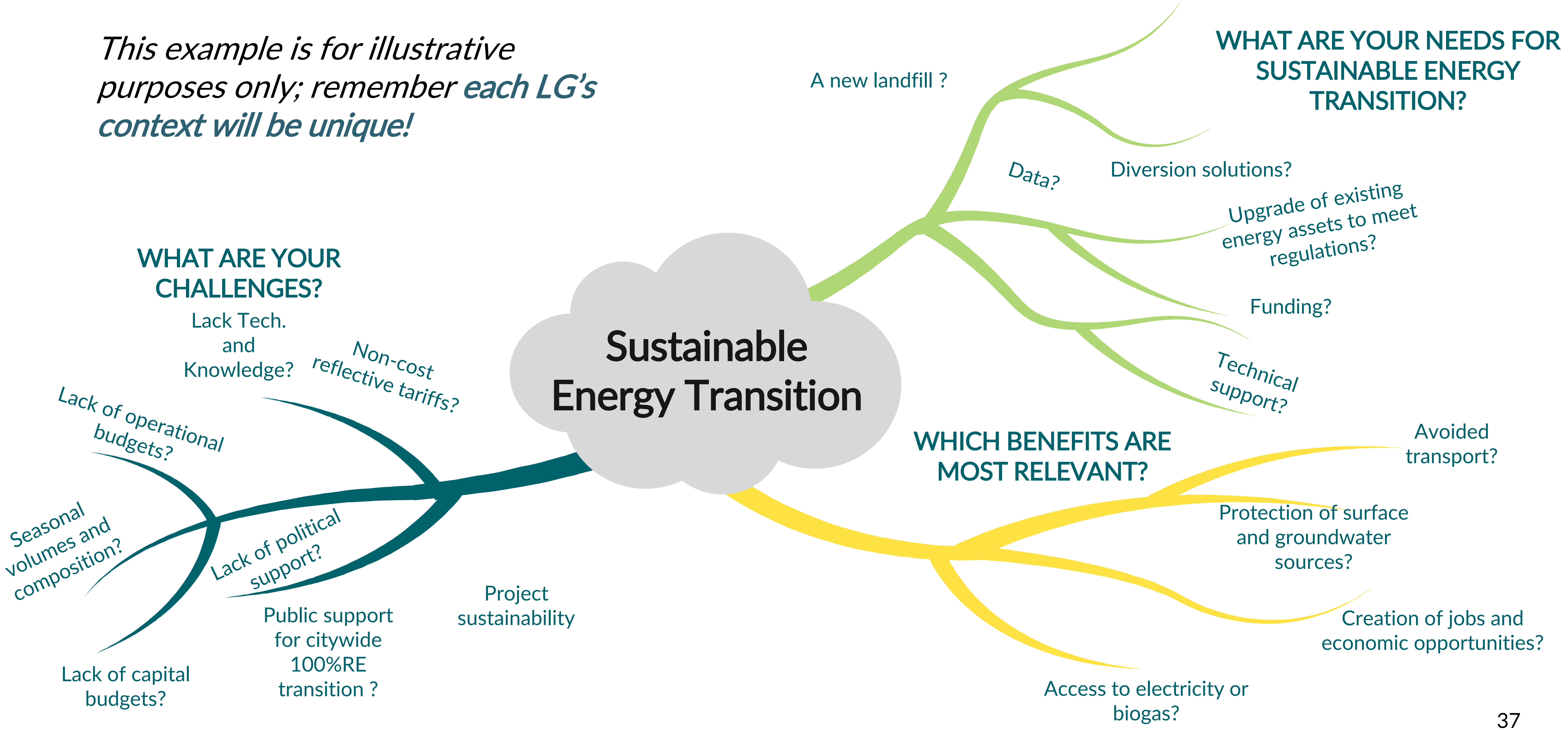
Axis 3
Transport and Sustainable Mobility (TM)

Objectives
- Promote active and low-carbon mobility through urban planning.
- Achieve energy transition in the public passenger transport fleet and municipal fleet.
- Encourage renewable energies in private transportation.

GOALS
- Active mobility rate of 50%, by 2050
- The entire fleet of public passenger transport and municipal fleet will be supplied by renewable sources, by 2050
- The equivalent of 100% of the fuel consumption by private transportation within the Avellaneda District is generated from renewable sources on an annual basis, by 2050

EXERCISE: IDENTIFY NEEDS, BENEFITS, CHALLENGES

*This example is for illustrative purposes only; remember **each LG's context will be unique!***



COMMON BARRIERS TO IMPLEMENTATION

100% RENEWABLES CITIES & REGIONS ROADMAP

Institutional capacity

Limited Capacity and Governance challenges

Jurisdiction and enforcement

Limited authority of ULBs in private sector developments and governed by state authorities with complex and time-taking administrative processes

Policy barriers

Spatial planning absence.
Ambiguous guidelines.

Technical challenges

Infrastructure restrictions.
Complex technical requirements

Data management

Limited availability and accuracy of data. Poor data management practices.

Financial limitations

Lower budgetary resources for SET plans.
Need for innovative financing

SUCCESS FACTORS FOR IMPLEMENTATION

Stakeholder Engagement

Involving diverse stakeholders early-on for representative and responsive planning

Flexibility

Adapting to evolving challenges and using innovative approaches

Political Commitment

Demonstrating strong leadership from local authorities

Collaborative Learning

Partnering with other partners and exchanging experiences and best practices with peers

Institutional Setup

Establishing clear responsibilities and ownership within local departments

Innovative financing

Making use of a diverse range of financial resources to suit a specific city context

FURTHER READING AND RESOURCES

- The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI and funded by the German Federal Ministry for Economic Affairs and Climate Action through the International Climate Initiative.

    - Roadmap Framework
    - Case studies
    - Factsheets
    - Project reports (incl. modelling)
    - Serious game

- **Website:** https://renewablesroadmap.iclei.org

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END OF MODULE

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