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Infrastructure & Cities for Economic Development

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A Whole System Approach tool: an Introductory Guide

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The energy sector and economic development

Access to affordable, reliable, and clean energy is central to economic development and is closely related to many of the Sustainable Development Goals

- ***Sustainable Development Goal 7 (SDG 7) sets the goal of ensuring access to affordable, reliable, sustainable, and modern energy.***
- ***Three targets are set for 2030:***
  - ✓ ***Ensure universal access to affordable, reliable, and modern energy services***
  - ✓ ***Increase substantially the share of renewable energy in the global energy mix***
  - ✓ ***Double the global rate of improvement in energy efficiency***

- Beyond SDG 7 there are a number of other SDGs that energy provision is central to, including:
  - ✓ **SDG 3: Good health and wellbeing:** moving away from traditional lighting and cooking technologies will reduce negative health outcomes associated household air pollution.
  - ✓ **SDG 5: Gender equality:** women and girls in particular benefit from improved energy access as they are most likely to be involved in fuel collection and cooking.
  - ✓ **SDG 9: Industry, innovation, and infrastructure:** energy can be used to support the growth of a wide range of businesses and enterprises.
  - ✓ **SDG 13: Climate action:** tackling emissions from the energy sector is central to meeting climate goals, but energy access can also be important for improving the resilience of communities vulnerable to the impacts of climate change.

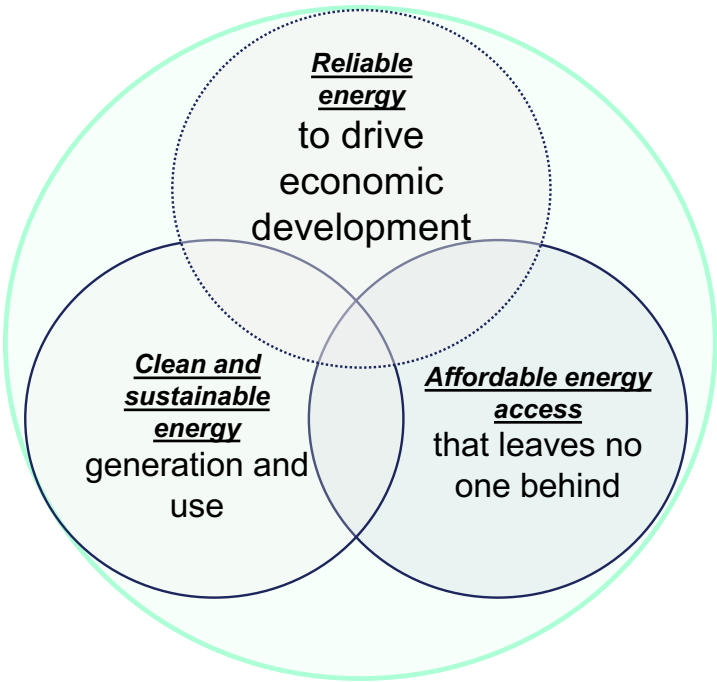
  This is not a complete list, but it does highlight some of the other SDGs that would be supported by improved energy access. Affordable and reliable energy supply can be critical to the delivery of some public services and for some of the industries most likely to create jobs.

A functioning energy sector is a critical ingredient to inclusive growth. However, this cannot be solved simply by adding MW of generation capacity to the grid, or by connecting more households and businesses to the grid. The Whole System Approach (WSA) aims to capture the complexity of the energy sector and to help advisers ask the right questions when analysing the sector.

The Whole System Approach (WSA)

The WSA provides a framework for identifying priorities in the energy sector. It aims to capture much of the complexity of the sector and helps advisors to ask the right questions

- ***To achieve economic development, universal energy access and climate sustainability*** it is essential that the complex interdependencies within the energy sector, and in the pivotal role it plays across all industries, are considered in full rather than in isolation. ***This is the Whole System Approach (WSA).*** The WSA encourages holistic policies to assist national governments to reach Sustainable Development Goal 7 (SDG7), to catalyse inclusive economic development, and to meet commitments such as the Paris Agreement.
- Through applying the WSA, advisers can ***better identify the entry points where Official Development Assistance (ODA) can be transformative***. The WSA supports advisers to better understand, communicate and manage trade-offs across the energy sector for electricity, heating, cooking, cooling, transport, and industrial demand. The WSA enables integration of resilience, low carbon transition, and sustainable impact from the national level through to firms and the most vulnerable households.
- The WSA helps to ***maximise impact and manage risks in its energy technical assistance, investments and international influencing***. Dissemination and use of the WSA methodology, analysis and tools will promote more coherent and effective action to meet the global energy goals and global poverty alleviation.

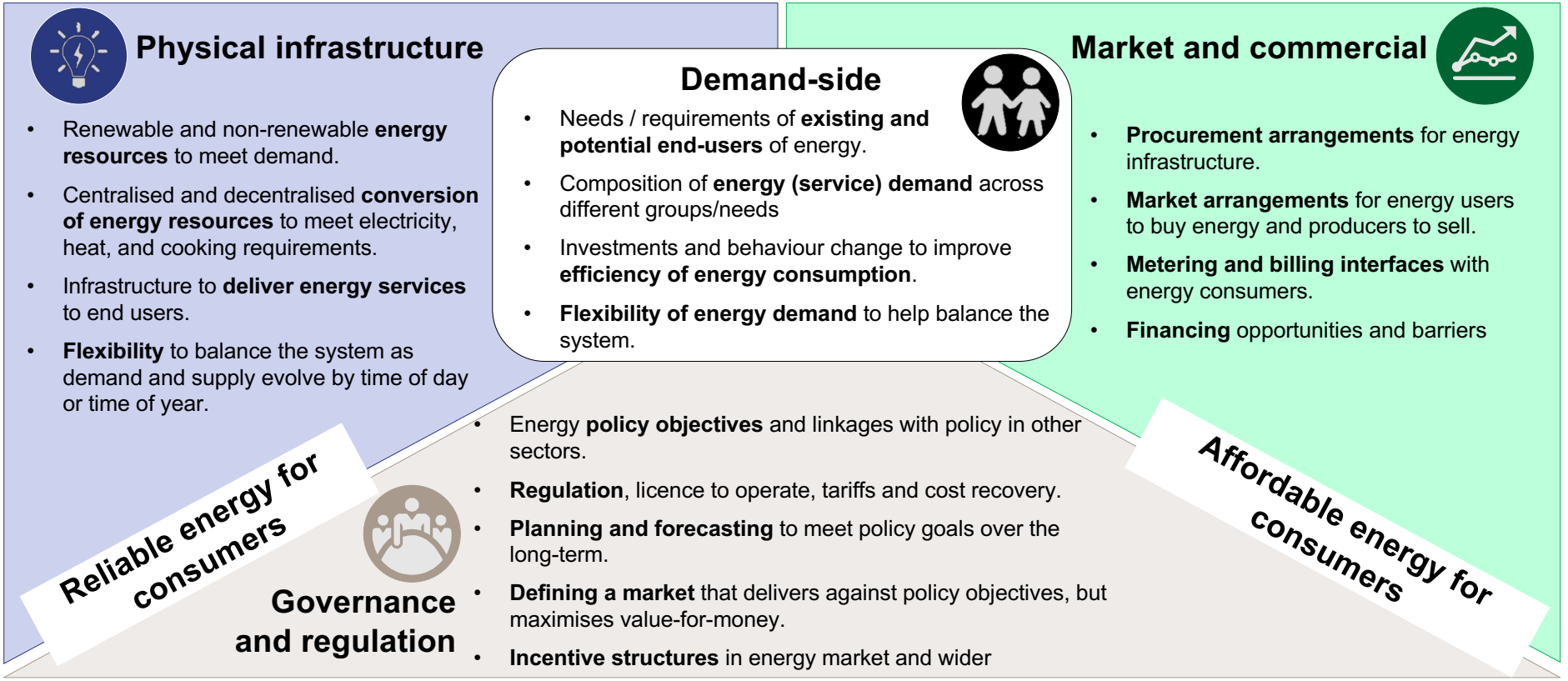


The Whole Systems Approach Tool (WSAT) is a tool to help advisers to analyse and understand the range of issues within the energy (and associated) sectors, to allow them to take a holistic view on the energy sector and achieve the aims of the WSA. The WSAT aims to provide guidance that covers a wide range of activities across the energy sector. However, the wide-ranging nature of the energy sector, and its interactions with a large number of other sectors, means that it is impossible to be exhaustive. Bear this in mind when using the WSAT: are there considerations that are relevant in your context that are not covered in the WSAT? If there are, and if you think those issues might be relevant elsewhere as well, do contact the WSAT team with your suggestions.

Introducing the four components of the WSA tool

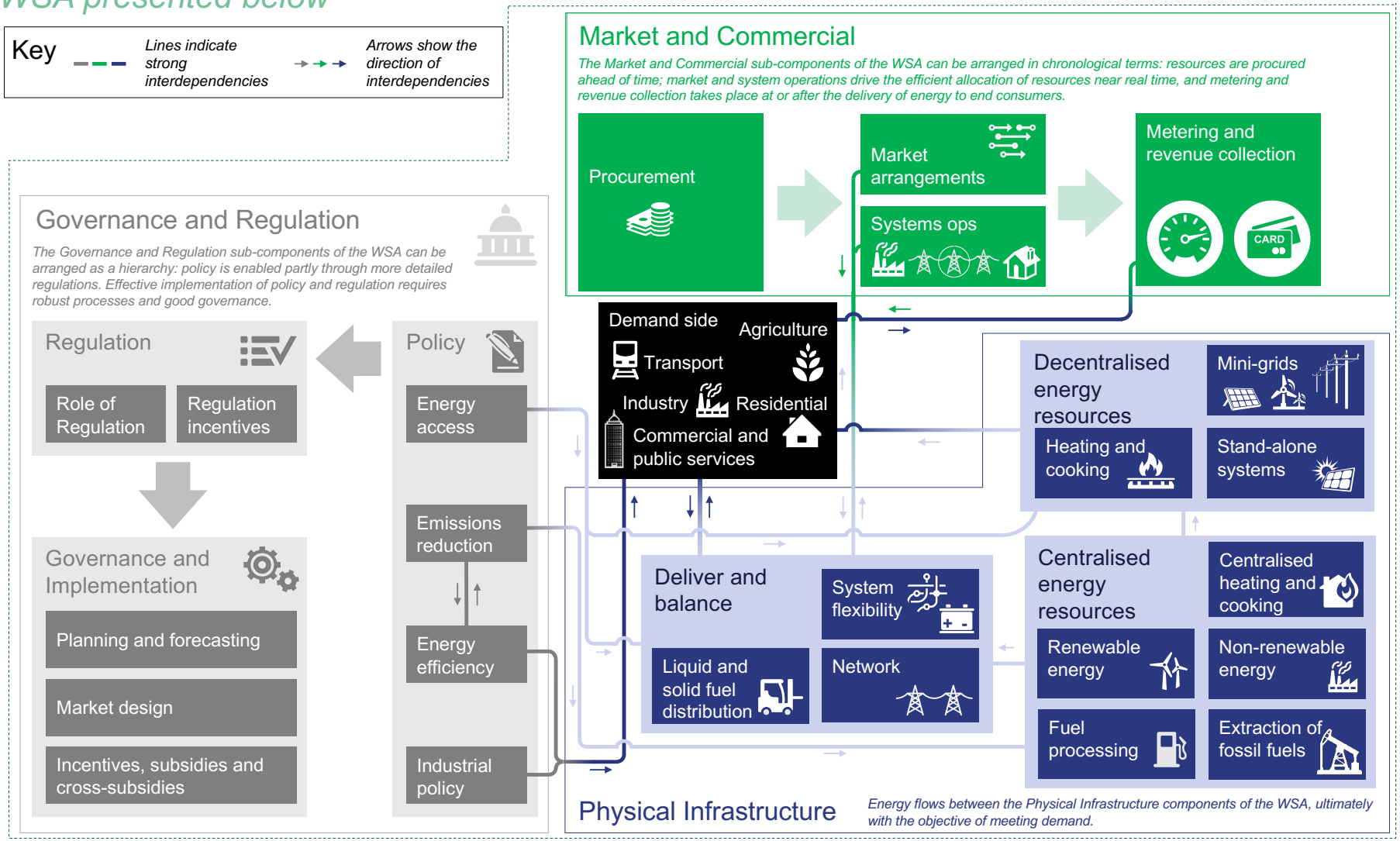
The WSA breaks down the complexity of the energy sector into four 'components'; these four components describe the 'whole system'

When reviewing the energy sector, advisers should seek to understand each of these four components: the demand-side need for energy, the physical energy infrastructure in place in the country, the regulatory framework in place to govern the sector, and the commercial arrangements in place between the main actors in the sector. These 'components' are used throughout the WSA to ensure that energy sector analysis considers the whole system. The interactions between these areas are complex and each has an important role in determining whether the energy sector provides a solid foundation for inclusive and sustainable growth and whether the sector delivers value for money for bill-payers and taxpayers.



A visual representation of the Whole System Approach

The four components are broken down further; this is shown visually in the 'infographic' of the WSA presented below



How to use the WSA tool

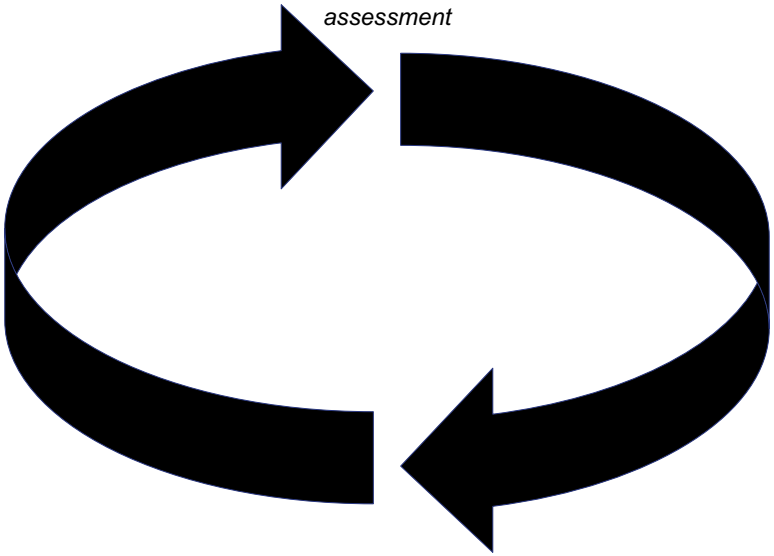
Applying the WSA involves a two-step approach: a high-level analysis to identify priority areas for the adviser's analysis to focus on, followed by more detailed analysis of the identified topics

The guidance presented in the WSA tool provides a framework for advisers to perform comprehensive analysis across the energy sector. The intention is not for advisers to perform analysis across all parts of the energy sector. Rather, advisers should perform targeted analysis, and the WSA tool provides guidance to encourage advisers to consider the most relevant issues.

High-level assessment of the energy sector

- Advisers will often start with hypotheses on where energy sector issues exist and where the opportunities might be for interventions.
- These hypotheses, informed by initial engagement with a wide range of stakeholders, form the starting point for an application of the WSA tool.
- It is important to note that these hypotheses don't need to be perfect. The WSA tool provides a framework for building a stronger evidence base and challenging initial hypotheses so that they can be refined.

High-level assessment informs initial areas of focus for the detailed assessment



Detailed assessment yields new information which can be fed back into the high-level assessment, allowing the adviser to regularly step back and take stock

Detailed assessment of the energy sector

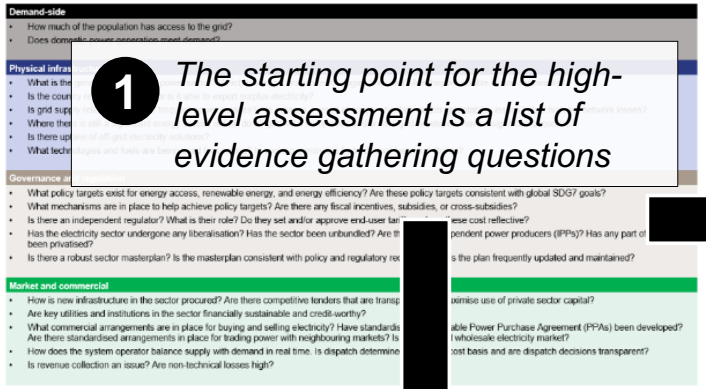
- The WSA tool provides guidance to direct analysis that the adviser can perform across each part of the energy sector.
- Detailed analysis should start by focusing on areas directly relevant to the hypotheses informed by the high-level assessment. The WSA tool will suggest adjacent areas that might warrant further analysis, depending on what the adviser finds.
- This analysis allows the adviser to refine their conclusions on the key issues in the country's energy sector, and to propose areas to provide support.

Exactly how energy sector advisers use the material provided by the WSAT will depend on their background. Some advisers may be familiar with much of the detailed guidance presented in the pack, but the structure of the WSA tool will still provide a useful completeness check that all interdependencies in the sector have been properly considered.

The WSA tool provides a structure that can be used to analyse and identify opportunities for intervention in the energy sector. However, advisers should not feel constrained by this structure in how they present their findings. Some interventions might cut across the various components of the WSA tool and its structure might not provide the best headings against which analysis should be presented for a given assignment.

High-level assessment

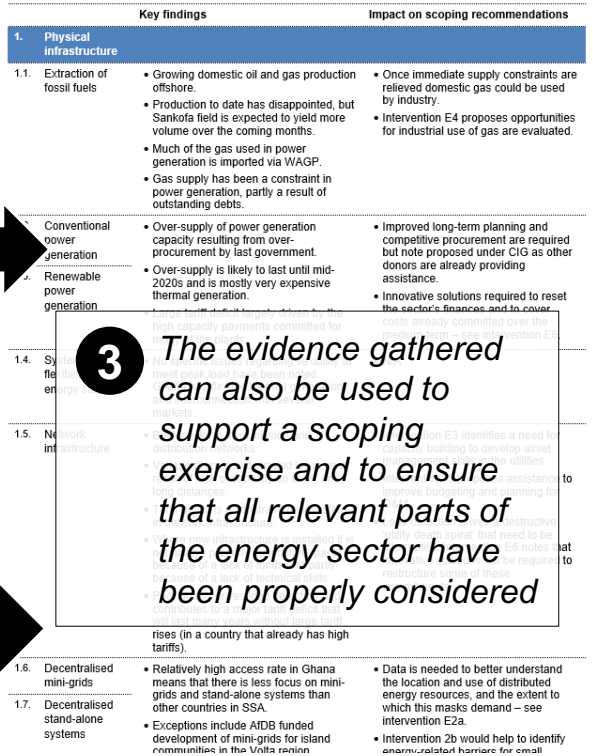
Evidence gathering questions from the WSA tool can be used to identify priority areas that warrant further analysis and to develop hypotheses



1 *The starting point for the high-level assessment is a list of evidence gathering questions*

Demand-side		
1.1.	Demand-side participation	[Notes and hypotheses]
…	…	…
Physical infrastructure		
4.1.	Decentralised heating and cooking	[Notes and hypotheses]
4.2.	Decentralised mini-grids	[Notes and hypotheses]
…	…	…

2 *Evidence gathered is used to develop hypotheses, and to identify priority areas and gaps in the evidence base. An Excel template is available that advisers can use to collect this initial evidence*



	Key findings	Impact on scoping recommendations
1. Physical infrastructure		
1.1. Extraction of fossil fuels	• Growing domestic oil and gas production offshore. • Production to date has disappointed, but Sankofa field is expected to yield more volume over the coming months. • Much of the gas used in power generation is imported via WAGP. • Gas supply has been a constraint in power generation, partly a result of outstanding debts.	• Once immediate supply constraints are relieved domestic gas could be used by industry. • Intervention E4 proposes opportunities for industrial use of gas are evaluated.
Conventional power generation	• Over-supply of power generation capacity resulting from over-procurement by last government.	• Improved long-term planning and competitive procurement are required but note proposed under CIG as other donors are already providing assistance.
Renewable power generation	• Over-supply is likely to last until mid-2020s and is mostly very expensive thermal generation.	• Innovative solutions required to reset the sector's finances and to cover costs already committed over the
1.4. Sy… fle… en…		
1.5. Ne… int…		
1.6. Decentralised mini-grids	• Relatively high access rate in Ghana means that there is less focus on mini-grids and stand-alone systems than other countries in SSA.	• Data is needed to better understand the location and use of distributed energy resources, and the extent to which this masks demand – see intervention E2a.
1.7. Decentralised stand-alone systems	• Exceptions include AfDB funded development of mini-grids for island communities in the Volta region	• Intervention 2b would help to identify energy-related barriers for small

3 *The evidence gathered can also be used to support a scoping exercise and to ensure that all relevant parts of the energy sector have been properly considered*

Each sub-component is evaluated and an initial view is formed on whether it should be a focus area for the detailed assessment

- Priority area for further analysis
- Evidence gaps, but potential issues that need to be investigated further
- Low priority area

High-level assessment – Top 5 questions

The 5 key questions listed below highlight broad strategic areas that senior in-country personnel might want to be familiar with

1. **Are energy sector policy objectives well defined and do these clearly flow through to sector plans and actions on the ground?**

2. **Is there a robust economic rationale for the energy resources utilised, with planning processes giving due consideration to the availability of renewable resources and all appropriate centralised and decentralised energy conversion technologies to ensure energy supply is affordable?**

3. **Do energy consumers have access to reliable and affordable energy, and does that energy meet their requirements?**

4. **Do sector policies and processes minimise the sector's potential for negative impact on communities and the environment?**

5. **Are robust market and commercial arrangements in place that maintain the financial viability of the sector and of key utilities and service providers within the sector.**

High-level assessment – Questions by WSA tool component

A broader range of questions can be used to help advisers ensure that their high-level assessment considers the whole system

Demand-side

- How much of the population has access to energy? Is this energy clean, reliable, and affordable? Does the available energy supply support productive use?
- Are distributed or behind-the-meter energy resources used to meet demand?
- How much is demand expected to grow? How is the nature of that demand (energy vector, sector, time of day, flexibility) likely to evolve?

Governance and regulation

- What policy targets exist for energy access, renewable energy, and energy efficiency? Are these policy targets consistent with the sustainable development goals and other international commitment, such as the Paris climate change agreement? Is there scope to increase carbon reduction ambitious beyond existing national strategies?
- What mechanisms are in place to help achieve policy targets? Are there any fiscal incentives, subsidies, or cross-subsidies?
- Which are the key institutions in the energy sector? Are their roles clearly defined and is there good coordination between those institutions?
- Is there an independent regulator? What is their role? Do they set and/or approve end-user tariffs and are these cost reflective?
- Has the electricity sector undergone any liberalisation? Has the sector been unbundled? Are there any IPPs? Has any part of the sector been privatised?
- Is there a robust sector masterplan? Is the masterplan consistent with policy and regulatory requirements? Is the plan frequently updated and maintained?

Market and commercial

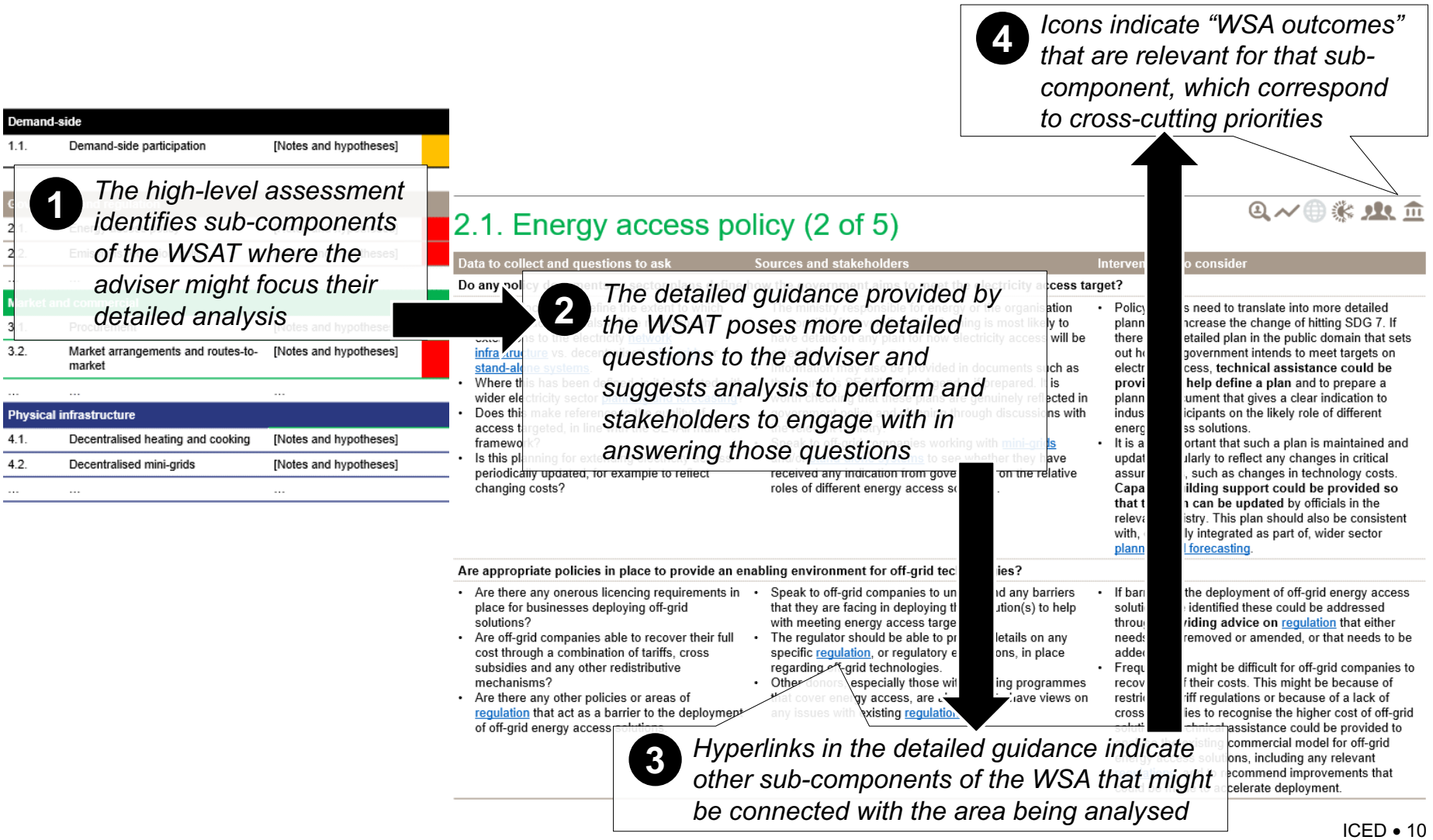
- How is new infrastructure in the sector procured? Are there competitive tenders that are transparent and maximise use of private sector capital?
- Are key utilities and institutions in the sector financially sustainable and credit-worthy?
- What commercial arrangements are in place for buying and selling energy? Have standardised and bankable commercial arrangements (e.g. PPAs) been developed? Are there standardised arrangements in place for trading energy (power, gas) with neighbouring markets? Are there liquid wholesale markets for power or gas?
- How does the system operator balance supply with demand in real time? Is dispatch determined on a least-cost basis and are dispatch decisions transparent?
- Is revenue collection an issue? Are losses high in transporting energy to end users?

Physical infrastructure

- What is the generation mix in the power sector? What technologies are used more broadly across the energy sector? To what extent are renewables prevalent?
- Are there fossil fuel reserves in the country? Where these are extracted are there processing facilities in the country?
- Is the country reliant on imports, or is it able to export surplus energy resources? What capacity exists for importing or exporting energy?
- Is energy supply reliable? Are there frequent outages? For power, are outages a result of supply shortfalls and/or grid stability issues? How high are network losses?
- Where there is still an energy access deficit, do off-grid solar companies and/or mini-grid developers have a presence? Is there uptake of off-grid electricity solutions?
- What technologies and fuels are being used for heating, cooking, and cooling? Is cooking dominated by traditional fuels and stoves?

Detailed assessment

The WSA tool contains much more detailed guidance on each of the WSA's sub-components, which can be used to inform additional analysis as well as to identify potential interventions



Considering trade-offs

When applying the WSA it is important to remember the various trade-offs that exist in the energy sector. There might be multiple options available, rather than one 'right' answer

- When gathering evidence to consider the key constraints in the energy sector, there may be trade-offs between the different components of the WSA. These trade-offs may sometimes restrict the intervention options available to tackle barriers that have been identified.
- Below we highlight some of the key trade-offs that advisers may encounter, although it should noted that this is far from an exhaustive list. Where appropriate, trade-offs are identified in the detailed guidance notes in the WSAT.

Trade-off	Description
Cost recovery, subsidies, and affordability	Governments often face trade-offs between providing subsidies for energy (whether that be electricity, liquid fuels, or indirectly through not regulating cooking fuels) and ensuring that customers pay a cost-reflective tariff. Subsidies or cross-subsidies are not always a bad thing if they are properly targeted to meet a specific policy outcome, and if they are structured such that they are financially sustainable. However, frequently it is the better off (who consume more energy) that benefit most from subsidies.
Affordability and quality of service	It is may not be appropriate to offer the same quality of service or reliability to all customers. The level of service offered will have an impact on the cost and therefore the affordability. The context of what is required by the consumer needs to be considered first. A large industrial customer might need a High Voltage grid connection with n-1 contingency, some communities may require reliable Tier 4-5 access, others may only have demand that can be met with Tier 1-2 access.
Domestic employment and the use of new technologies	The obvious example here is displacing domestic coal with renewable energy technologies. There is a body of literature supporting the idea that renewable energy value chains support more jobs than fossil fuel value chains. However, that is often not the case at a local level. Many of the new jobs are in more developed countries, which displace (e.g.) low-skilled mining jobs. Obviously there are strong reasons for making this shift, but policy discussions should be honest about the trade-offs, and address the concerns of communities that lose out.
Different sources of flexibility in the electricity system	As the use of renewable energy in generating electricity grows the need for flexibility increases. This might be provided by a range of different solutions: flexible generators, battery storage, more interconnection with neighbouring markets. The most appropriate solution will depend on the exact system requirement.
Renewable energy and energy efficiency policy	Renewable energy targets are often expressed in absolute power or energy terms (e.g. in MW terms for renewable electricity). If a robust energy efficiency policy is successful in reducing demand for energy this can be counter-productive, requiring more generation capacity for example to be built at a time when demand is falling. It might be more appropriate to define renewable energy targets in % terms, but this has the disadvantage of being a moving target, especially in small, rapidly changing markets.
Speed and value for money	When procuring energy sector infrastructure there can sometimes be a trade-off between the simplicity and speed (sometimes!) of an unsolicited tender and the use of a competitive tender to increase competition and drive down prices.

Concluding remarks

The WSA tool provides a common framework for analysis in the energy sector and also provides detailed guidance for advisers covering each component of the energy system

- The components and sub-components identified in the WSA provide a **common framework** and a **common language** for advisers to follow in analysing the energy sector.
- The WSA tool provides **detailed guidance** covering each part of the energy system. This guidance is designed to help advisers identify where the real underlying **bottlenecks** are in the sector, and to identify potential **interventions** that might help to tackle those bottlenecks.
- Even for experienced energy advisors, the WSA provides a useful **completeness check** to ensure that the **whole energy system** has been considered when analysing and diagnosing issues in the sector.