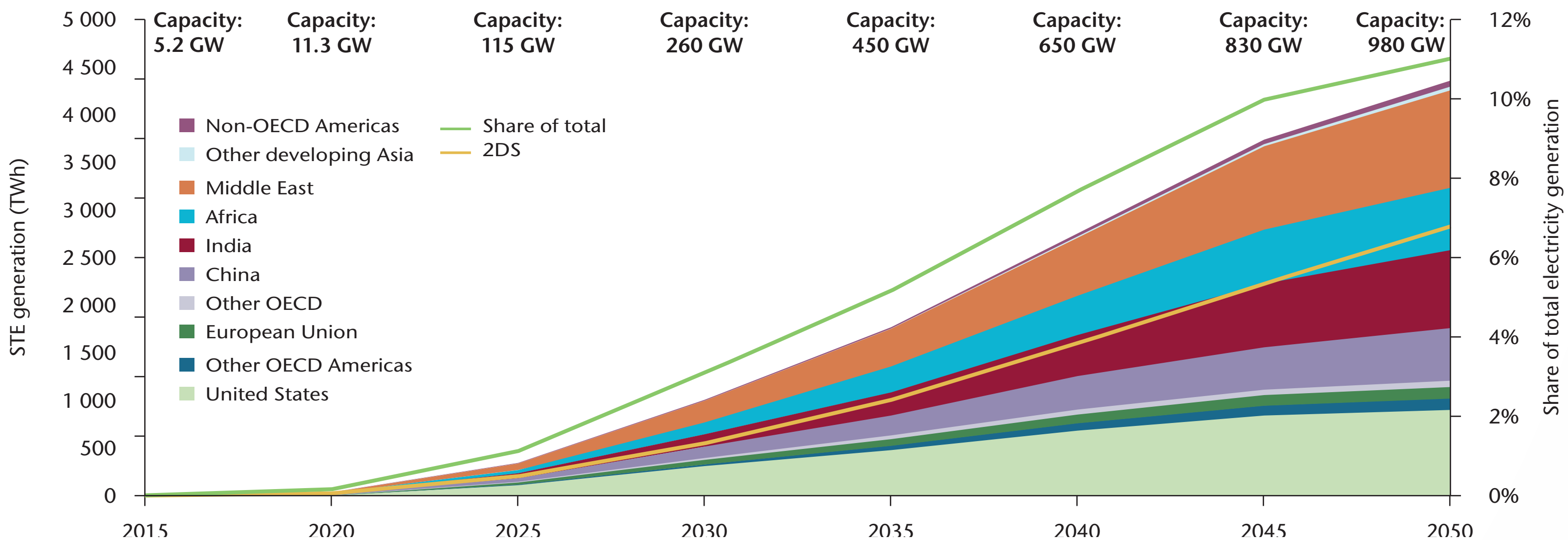
SOLAR THERMAL ELECTRICITY 2014 edition

International Energy Agency

Regional electricity production of solar thermal electricity in TWH and share of global electricity

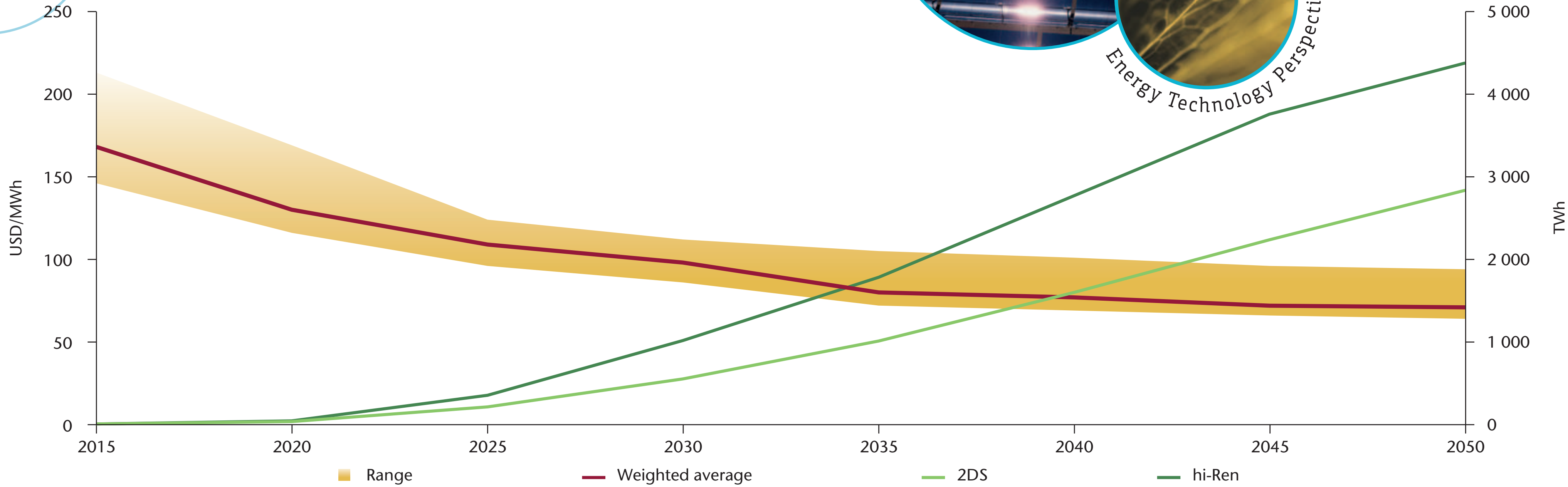


Selected key findings

- Global deployment of STE, about 4 GW at the time of publication, pales in comparison with PV (150 GW). Costs of CSP plants have dropped but less than those of PV. However, new CSP components and systems are coming to commercial maturity, holding the promise of increased efficiency, declining costs and higher value through increased dispatchability. New markets are emerging on most continents where the sun is strong and skies clear enough, including the Americas, Australia, the People's Republic of China, India, the Middle East, North Africa and South Africa.
- This roadmap envisages that STE's share of global electricity will reach 11% by 2050 – almost unchanged from the goal in the 2010 roadmap. This shows that the increased goal for PV in the companion roadmap (IEA, 2014a) is not at the detriment of STE in the long term. Adding STE to PV, solar power could provide up to 27% of global electricity by 2050, and become the leading source of electricity globally as early as 2040. Achieving this roadmap's vision of 1 000 GW of installed CSP capacity by 2050 would avoid the emissions of up to 2.1 gigatonnes (Gt) of carbon dioxide (CO_2) annually.
- From a system perspective, STE offers significant advantages over PV, mostly because of its built-in thermal storage capabilities. STE is firm and can be dispatched at the request of power grid operators, in particular when demand peaks in the late afternoon, in the evening or early morning, while PV generation is at its best in the middle of the day. Both technologies, while being competitors on some projects, are ultimately complementary.
- The value of STE will increase further as PV is deployed in large amounts, which reduces mid-day peaks and creates or increases evening and early morning peaks. STE companies have begun marketing hybrid projects associating PV and STE to offer fully dispatchable power at lower costs to some customers.
- Combined with long lead times, this explains why deployment of CSP plants would remain slow in the next ten years compared with previous expectations. Deployment would increase rapidly after 2020 when STE becomes competitive for peak and mid-merit power in a carbon-constrained world, ranging from 30 GW to 40 GW of new-built plants per year after 2030.
- Appropriate regulatory frameworks – and well-designed electricity markets, in particular – will be critical to achieve the vision in this roadmap. Most STE costs are incurred up-front, when the power plant is built. Once built, CSP plants generate electricity almost for free. This means that investors need to be able to rely on future revenue streams so that they can recover their initial capital investments. Market structures and regulatory frameworks that fail to provide robust long-term price signals beyond a few months or years are thus unlikely to attract sufficient investment to achieve this roadmap's vision in particular and timely decarbonisation of the global energy system in general.

Cost reductions deployment and investments

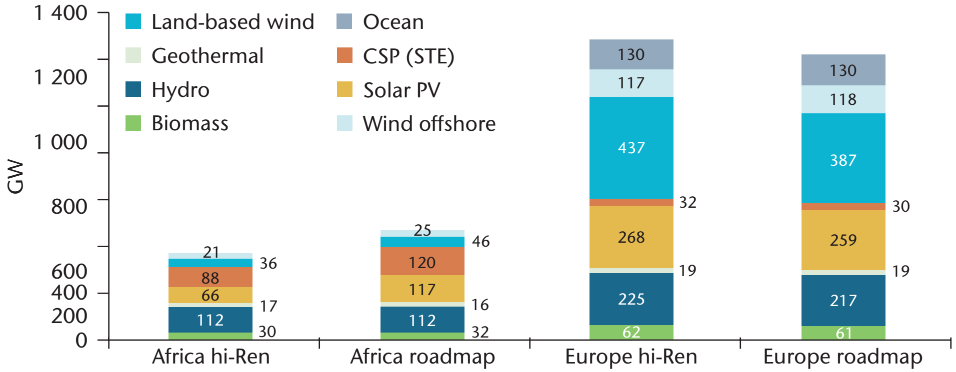
LCOE of STE from new-built CSP plant with storage, and STE generation



Note: LCOE values rest on 8% real discount rates.

***KEY POINT:** The LCOE of new-built plant with storage will be below USD 100 by 2030.*

Renewable capacities in North Africa and Europe by 2050



Note: For this roadmap the *ETP* model was complemented with the possibility of building trans-continental HVDC lines. As a result Africa would install more CSP/STE, wind and PV capacities, and Europe less.

***KEY POINT:** Net electricity imports from North Africa could account for about 10% of European consumption.*

Cumulative investments in CSP/STE in this roadmap (Billion USD 2012)

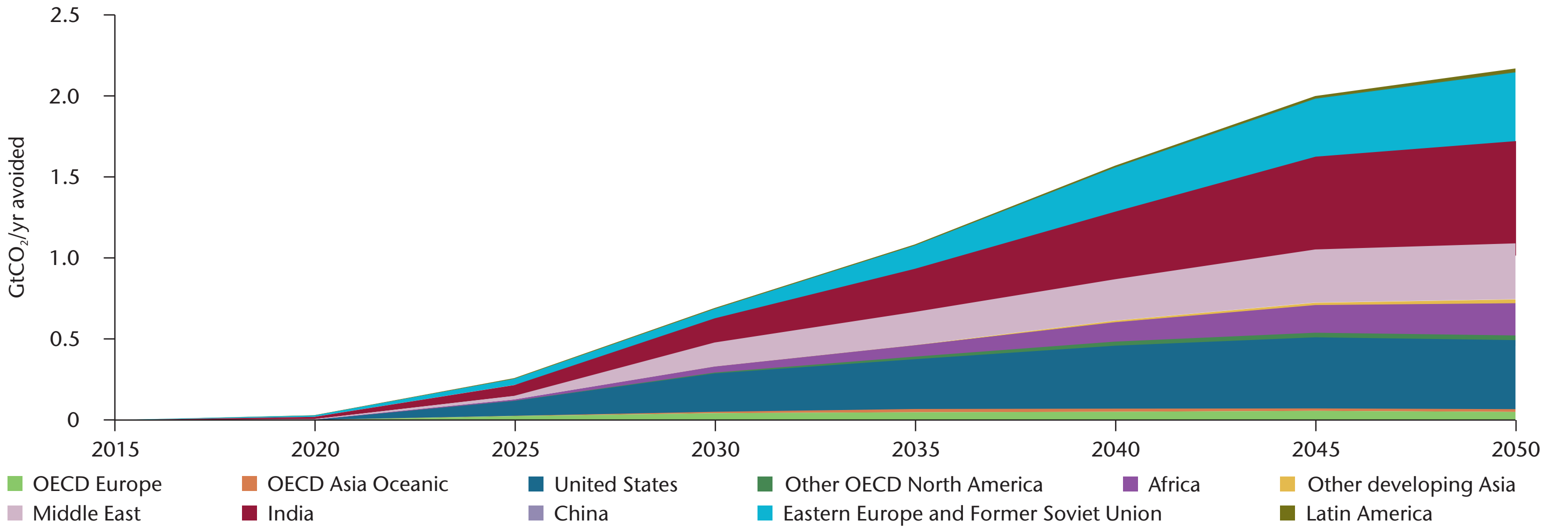
	2011-30	*2031-50*	*2011-50*
United States	468	616	**1 084**
OECD Europe	100	98	**198**
Other OECD	50	143	**193**
China	178	439	**617**
India	166	606	**772**
Latin America (excl. Chile)	14	67	**81**
Other developing Asia	2	56	**58**
Middle East and Africa	450	1 068	**1 518**
World	**1 428**	**3 093**	**4 521**

Key actions for the next 5 years

- Set long-term targets, supported by predictable mechanisms to drive investments.
- Address non-economic barriers and develop streamlined procedures for permitting.
- Remunerate STE according to its value, which depends on time of delivery.
- Implement support schemes with fair remuneration to investors but predictable decrease over time of the level of support.
- Design and implement investment markets for new-built CSP plant and other renewable energy plants, and markets for ancillary services.
- Avoid retroactive legislative changes.
- Work with financing circles and other stakeholders to reduce financing costs for STE deployment, in particular involving private money and institutional investors.
- Reduce the costs of capital and favour innovation in providing loan guarantees, and concessional loans in emerging economies.
- Strengthen research, development and demonstration (RD&D) efforts to further reduce costs.
- Strengthen international collaboration on RD&D and exchanges of best practices.

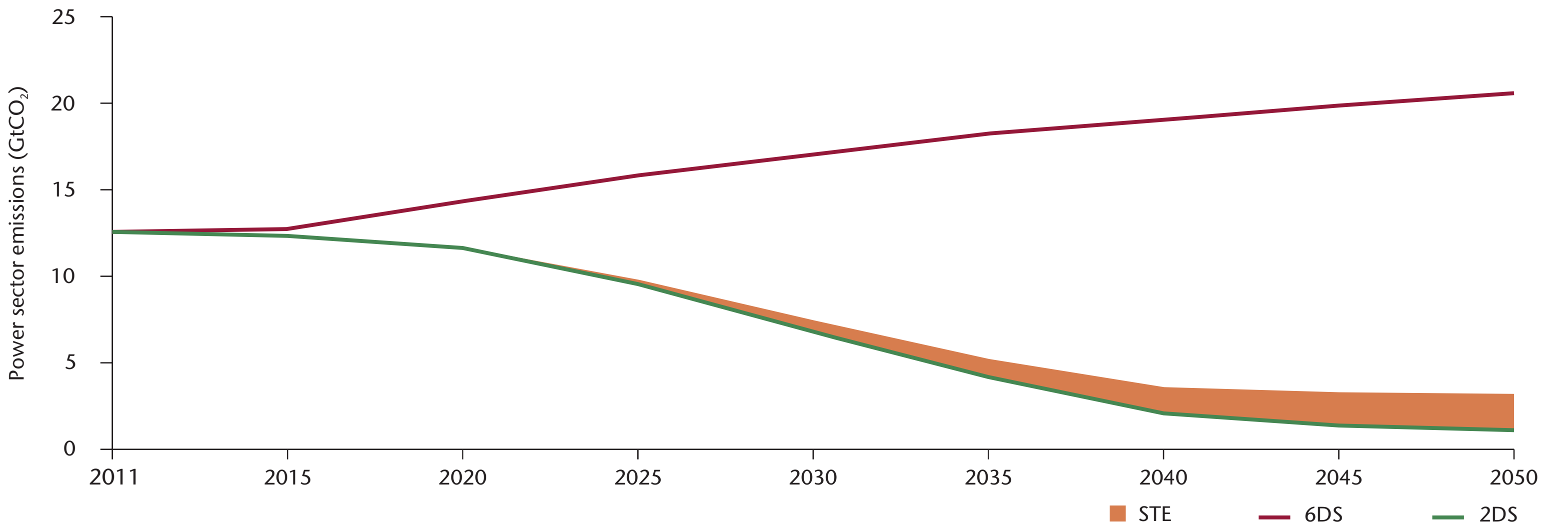
CO_2 emission reductions from solar thermal electricity

Regional CO_2 abatement through STE in this roadmap, 2015-50, over the 6DS



***KEY POINT:** The largest emission reductions due to STE take place in India, followed by China, the United States, the Middle East and Africa.*

The contribution of STE to avoided CO_2 emissions in this roadmap over the 6DS, 2015-50

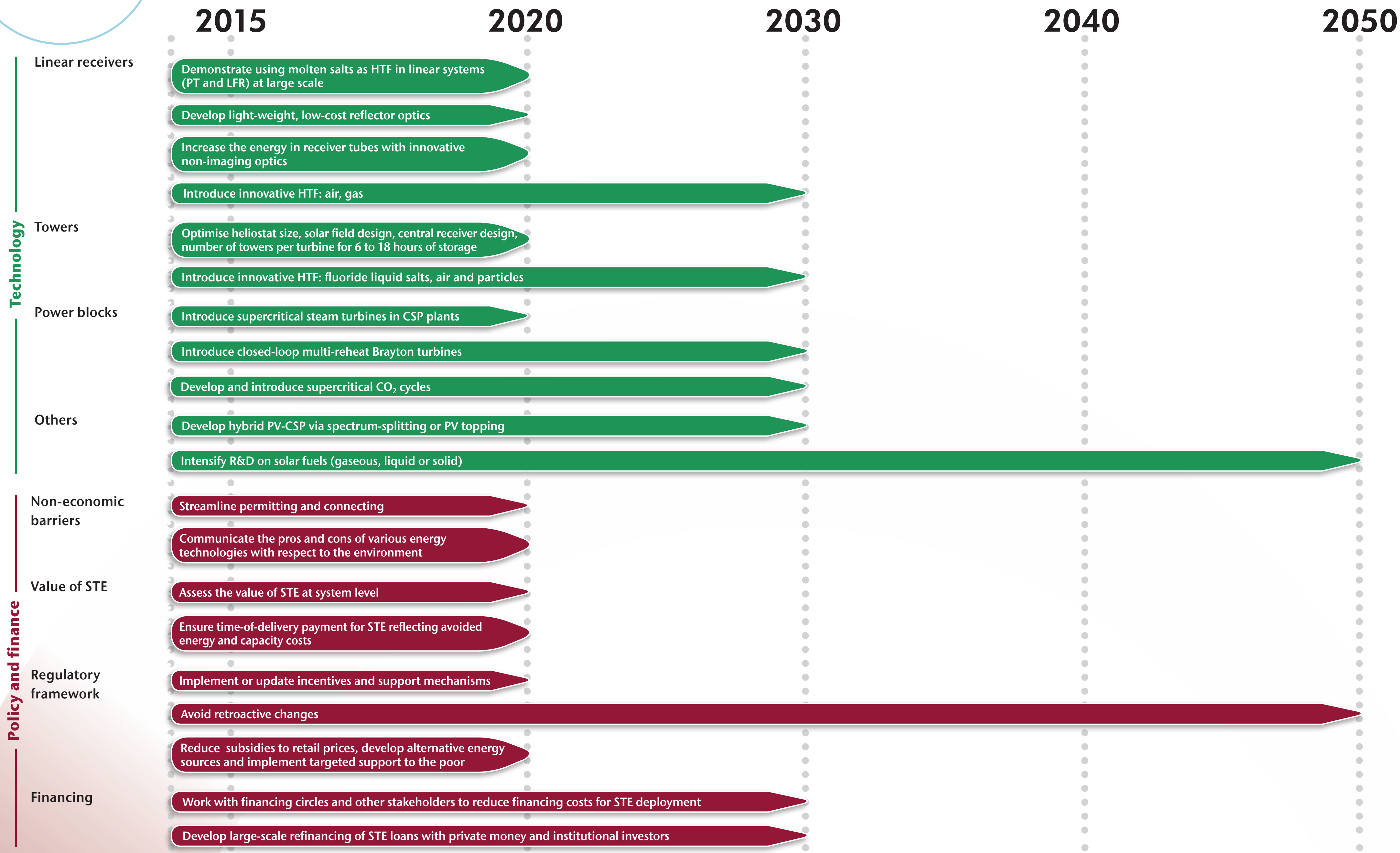


***KEY POINT:** In 2050, power sector CO_2 emissions rise to 21.4 $GtCO_2$/yr in the 6DS and fall to 1.2 $GtCO_2$/yr in the 2DS hi-Ren. Solar thermal electricity provides 2.2 $GtCO_2$/yr (11%) of the difference.*

International Energy Agency

www.iea.org/roadmaps

Solar thermal electricity roadmap milestones



International Energy Agency *www.iea.org/roadmaps*