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3 OPTIONS

1) Business as Usual (BAU) power generation development path which is based on current power planning practices, current policy objectives

2) Sustainable Energy Sector (SES) scenario, where measures are taken to maximally deploy renewable energy and energy efficiency measures to achieve a near 100% renewable energy power sector

3) Advanced Sustainable Energy Sector (ASES) scenario, which assumes a more rapid advancement and deployment of new and renewable technologies as compared to the SES

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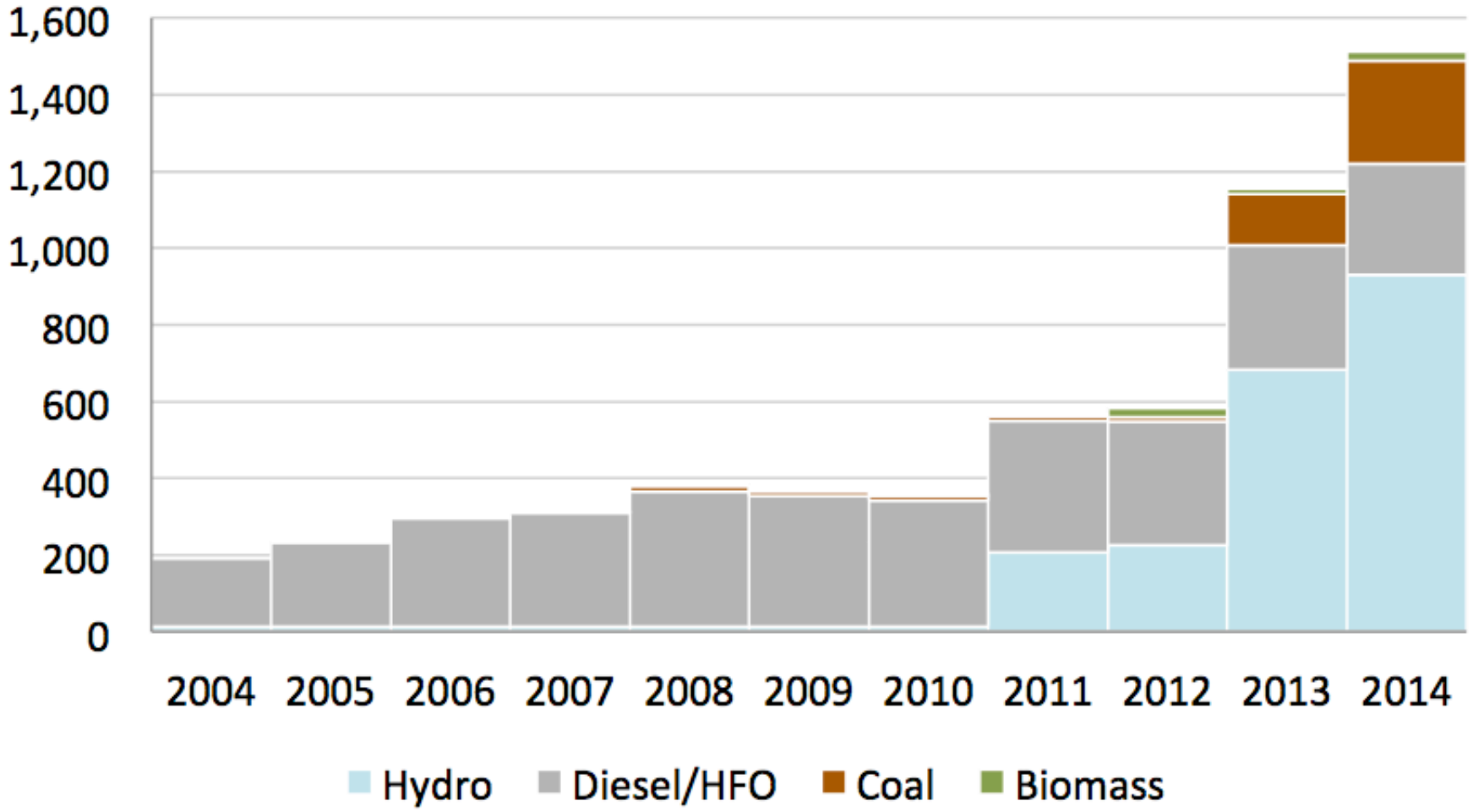
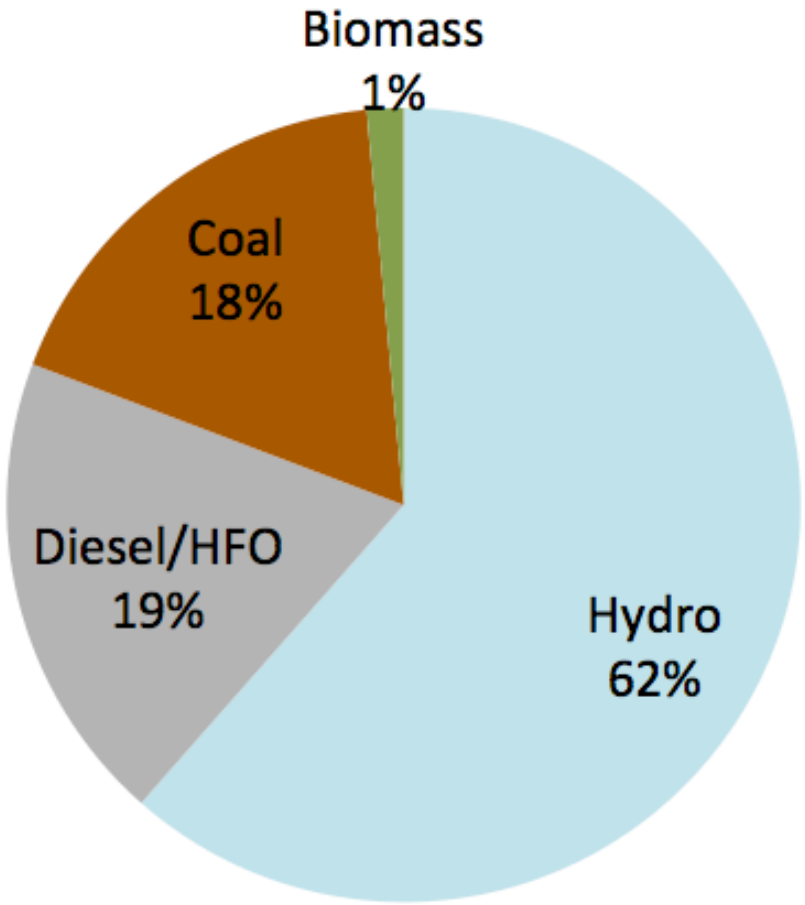
Figure 3 Cambodia Power Generation Installed Capacity (2004-14)



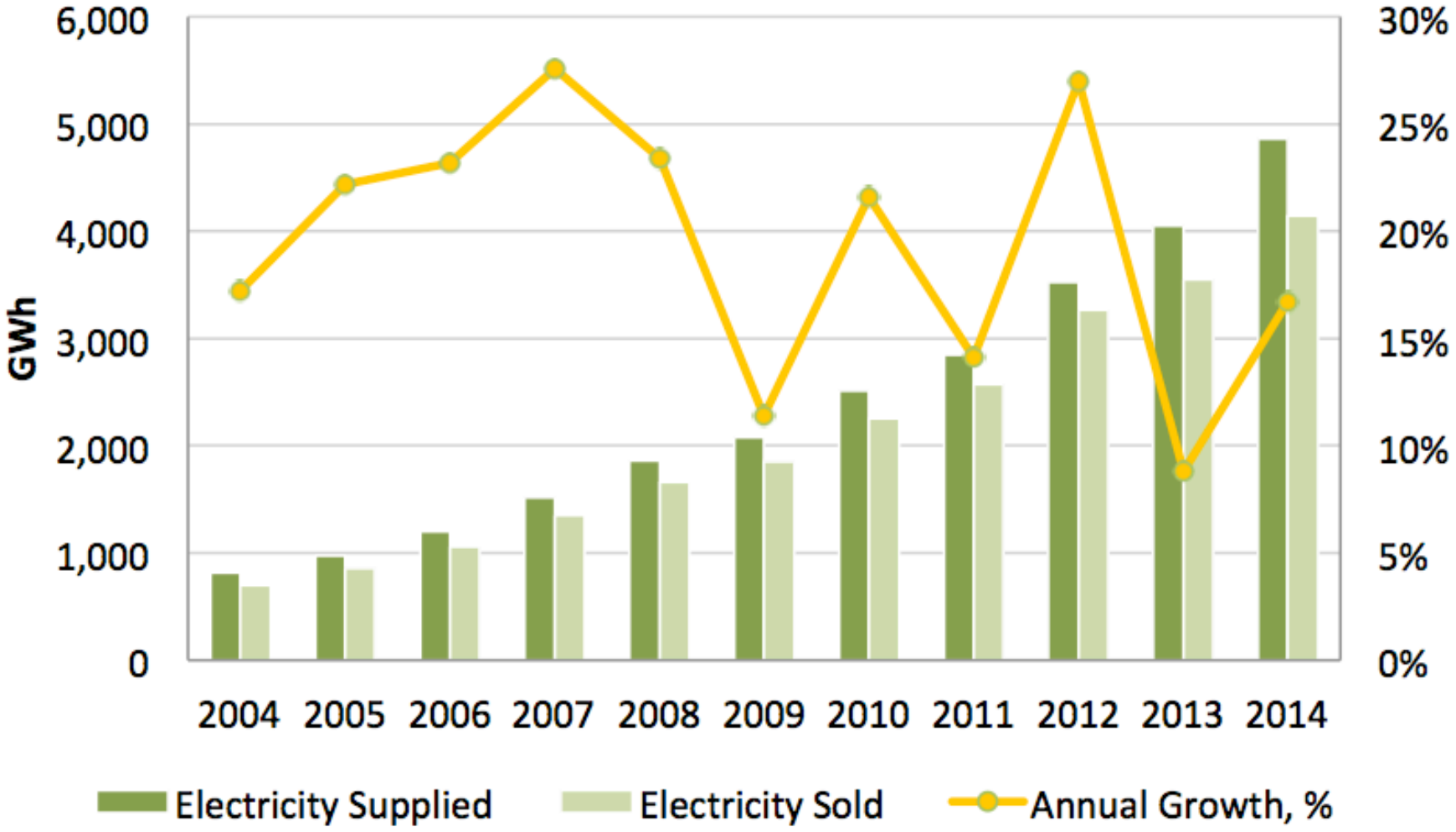
Source: EAC Statistics (2015)

Figure 4 Cambodia Capacity Fuel Mix (2014)



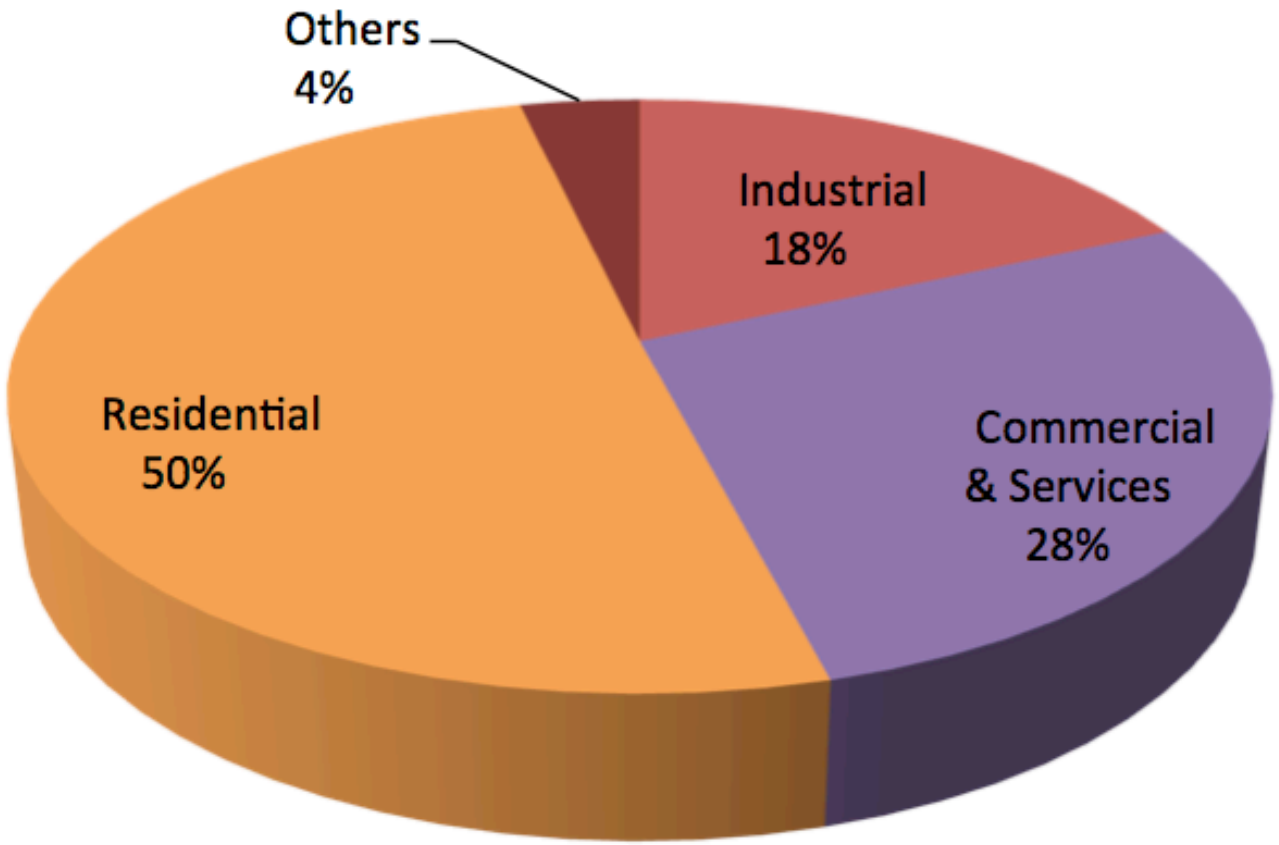
Source: EAC Statistics (2015)

Figure 5 Electricity Demand Trends (2004-14)



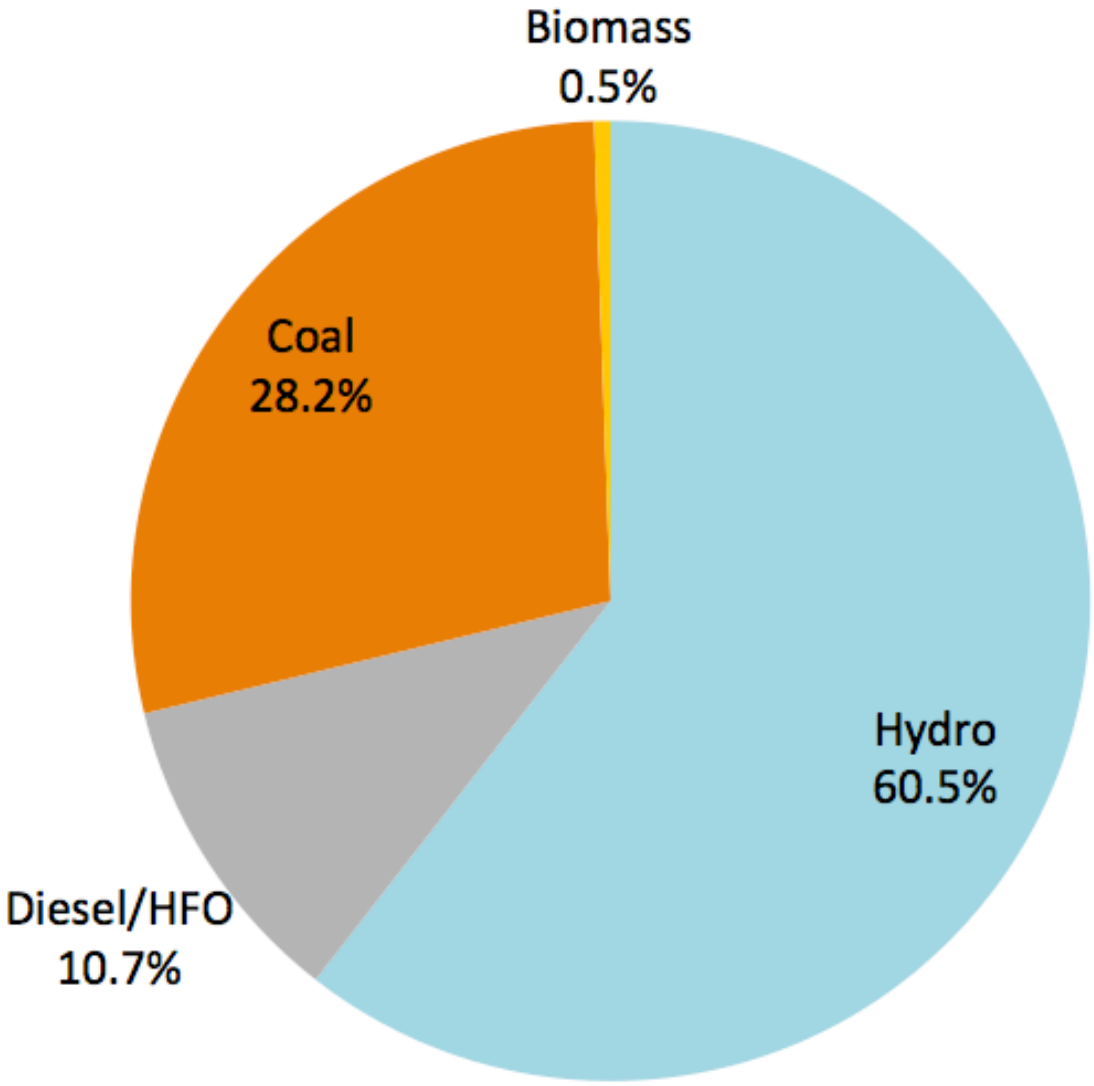
Source: EAC Statistics (2015)

Figure 6 Electricity Demand Shares by Category (2012)



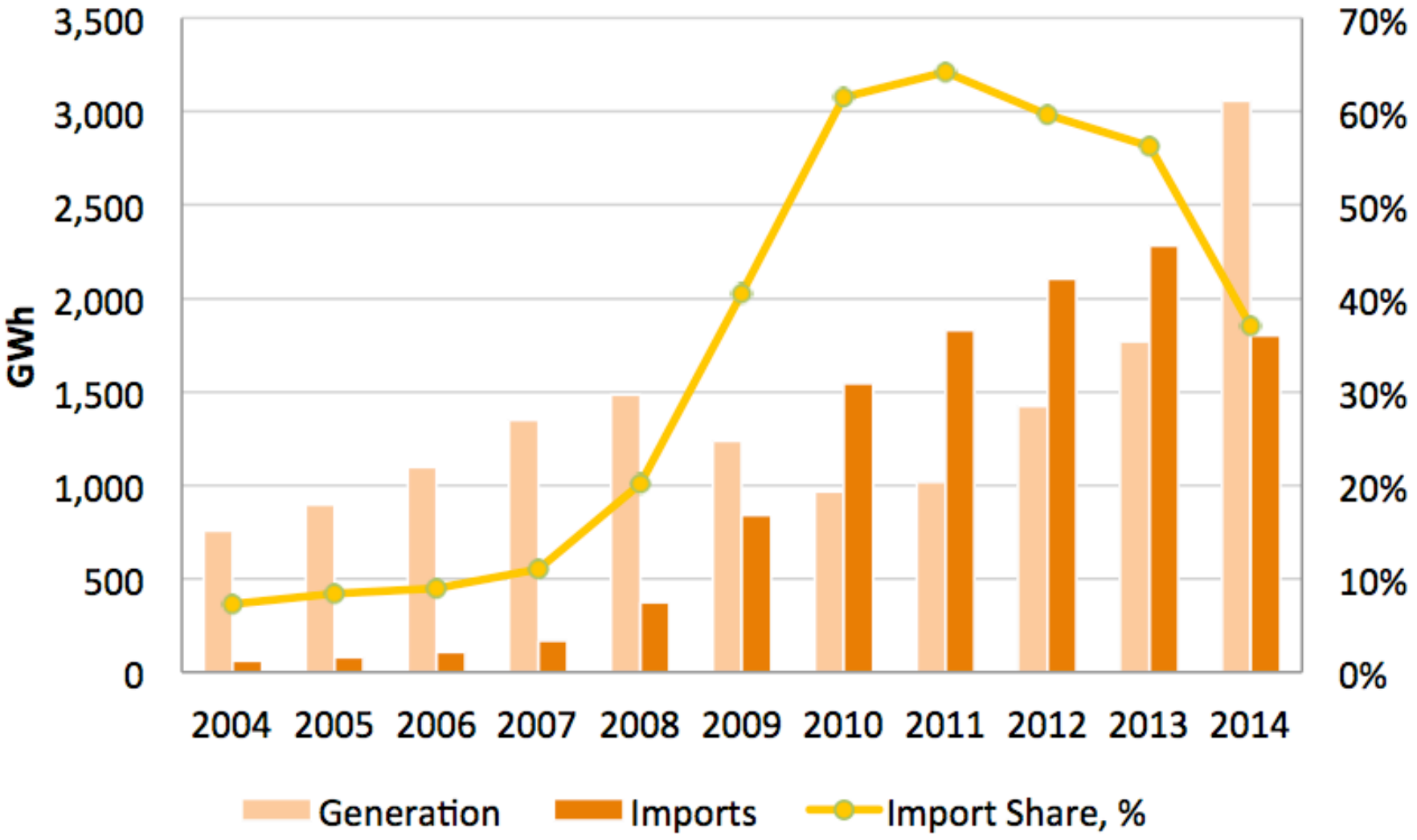
Source: IEA (2014)

Figure 8 Domestic Generation Mix Proportion by Fuel Type (2014)



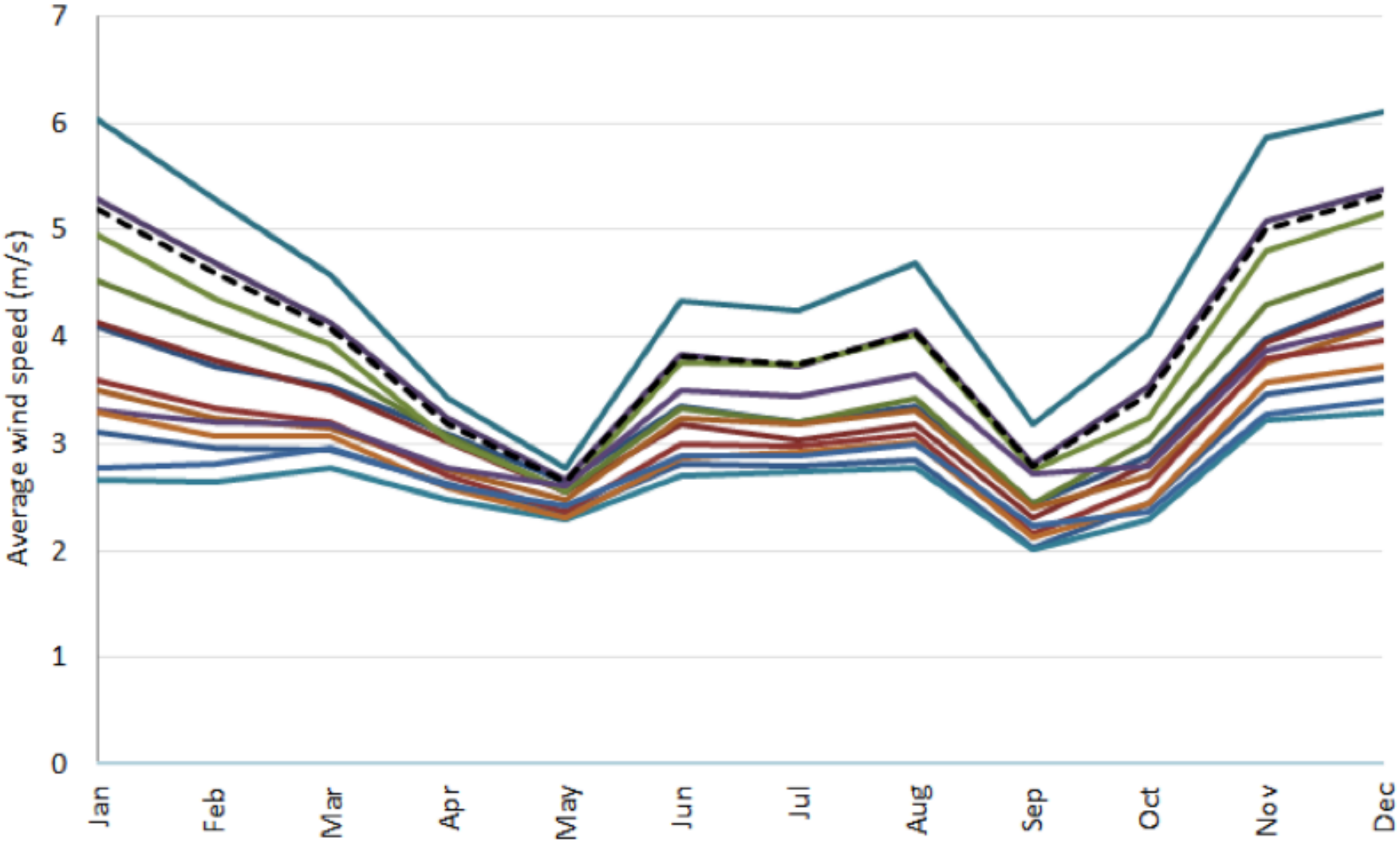
Source: EAC Statistics (2015)

Figure 9 Cambodia Electricity Imports (2004-14)



Source: EAC Statistics (2015)

Figure 13 Monthly Wind Speeds for Selected Locations in Cambodia (m/s)



Source: NASA Atmosphere Science Data Centre, obtained via the SWERA Geospatial Toolkit

Figure 14 Locations in Cambodia with Greatest Wind Potential

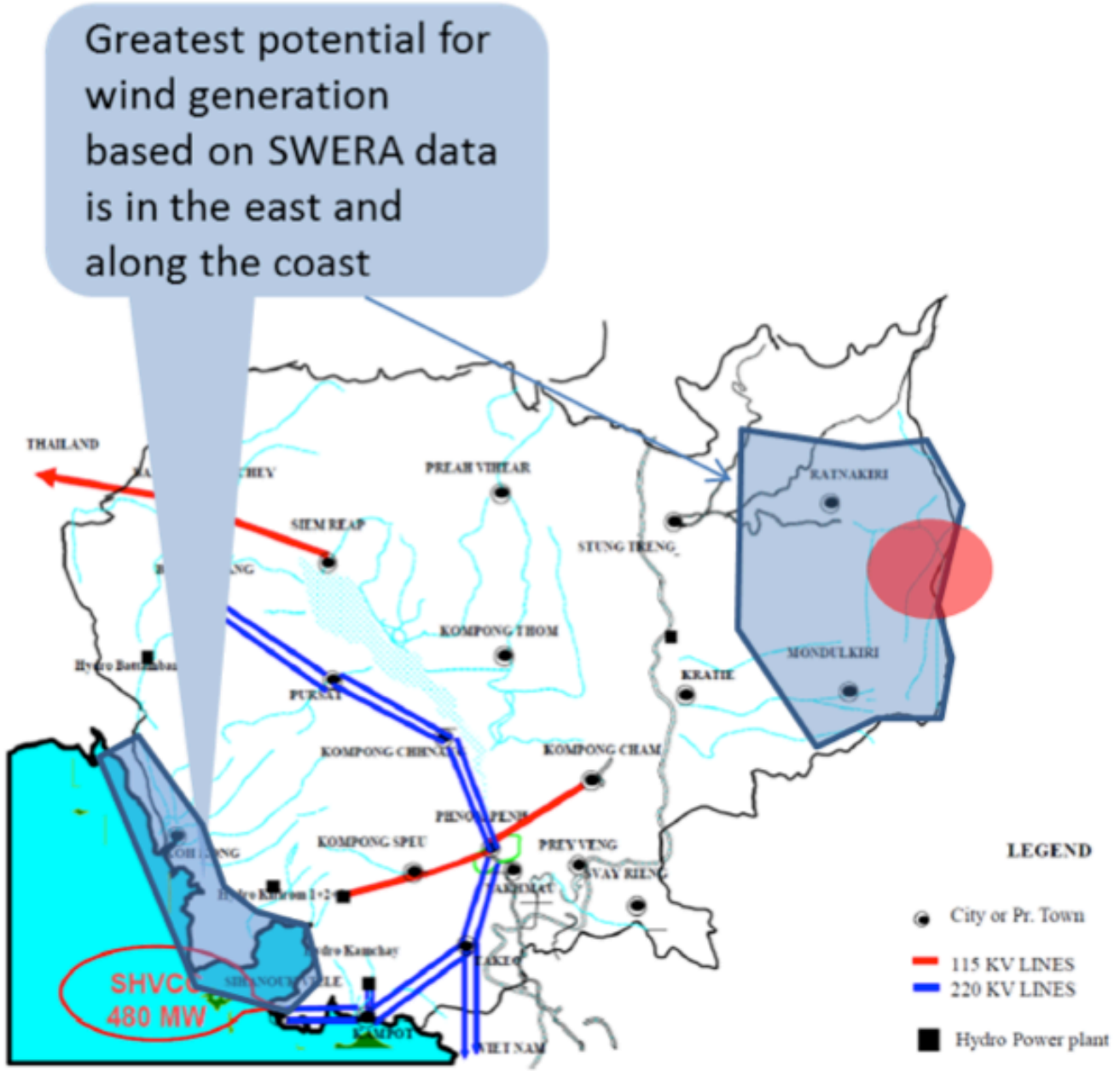
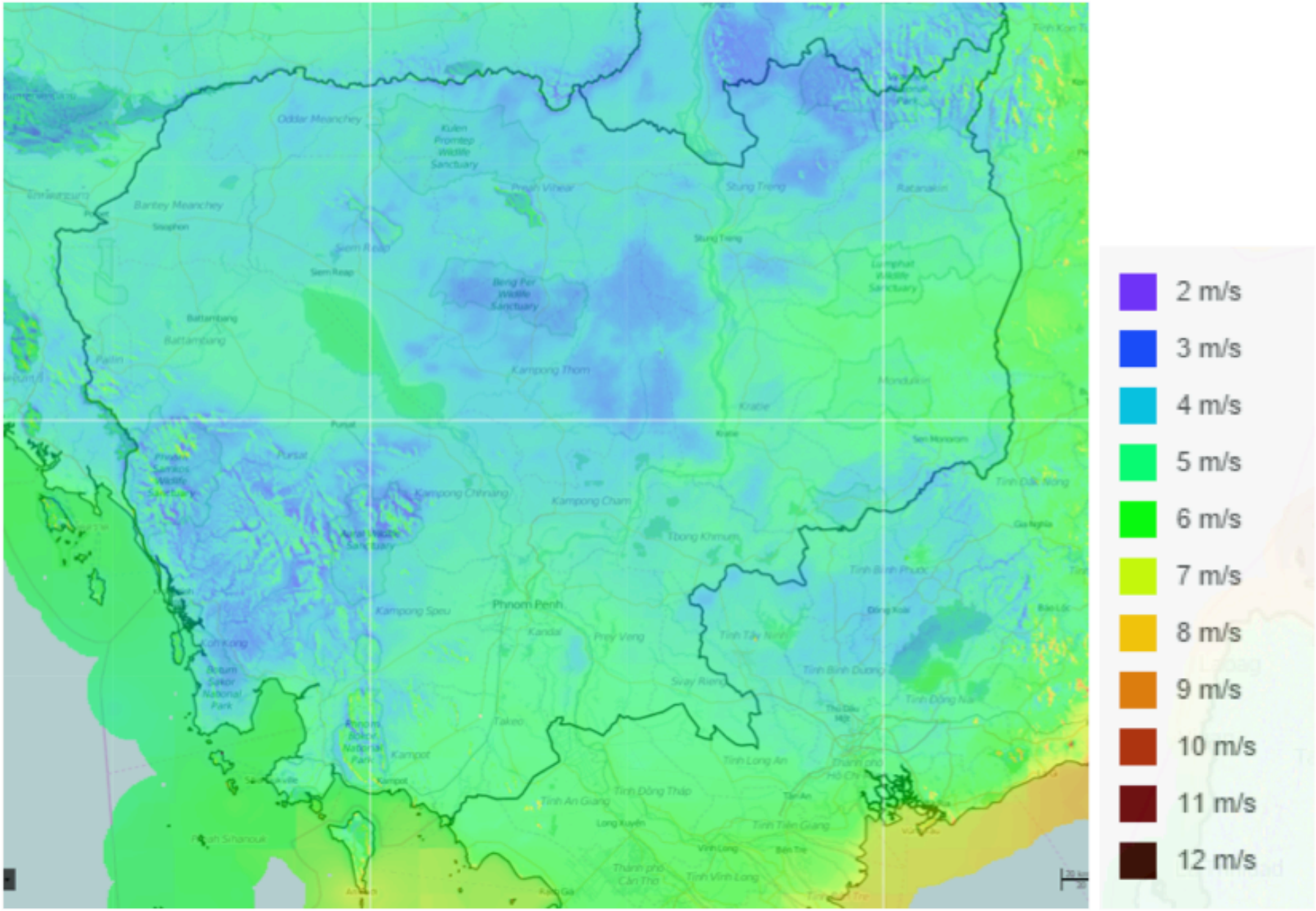


Figure 17 Average Wind Speed 1km at 100 m AGL DTU (2015)



Source: IRENA Global Atlas and Global Wind Atlas (2015)

Figure 18 Monthly DNI Levels for Selected Locations in Cambodia

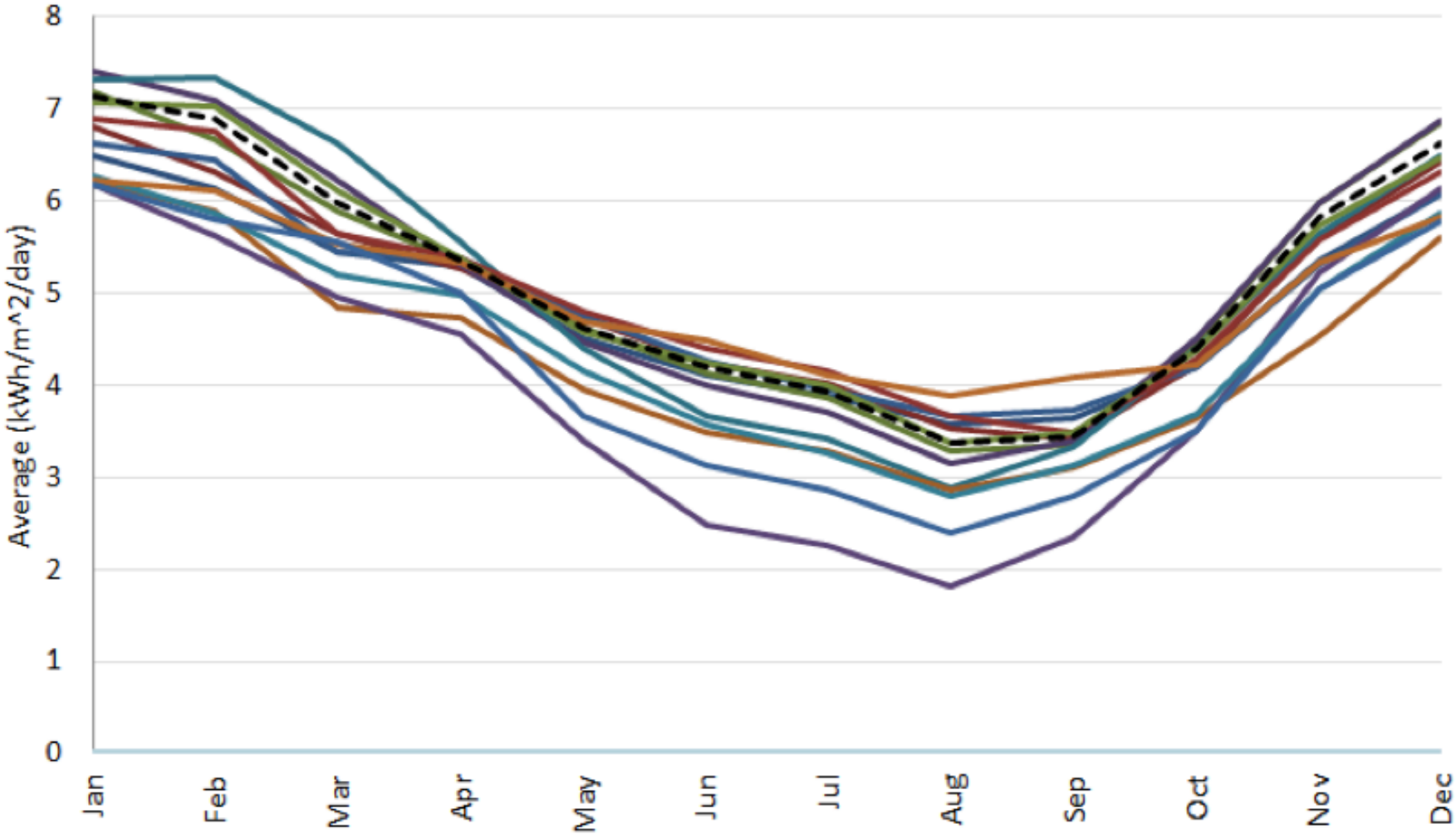


Figure 19 Main Locations with Solar Power Potential in Cambodia for DNI

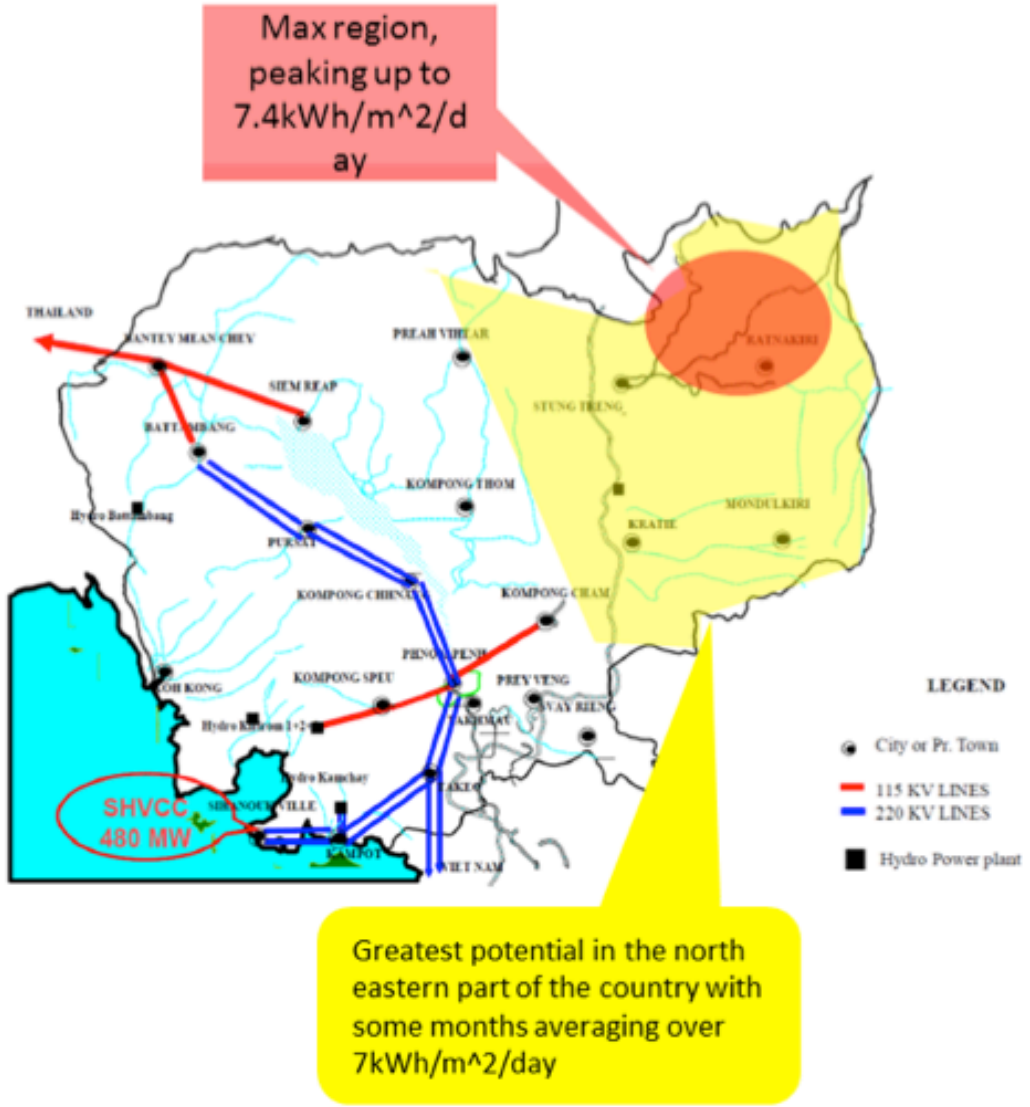
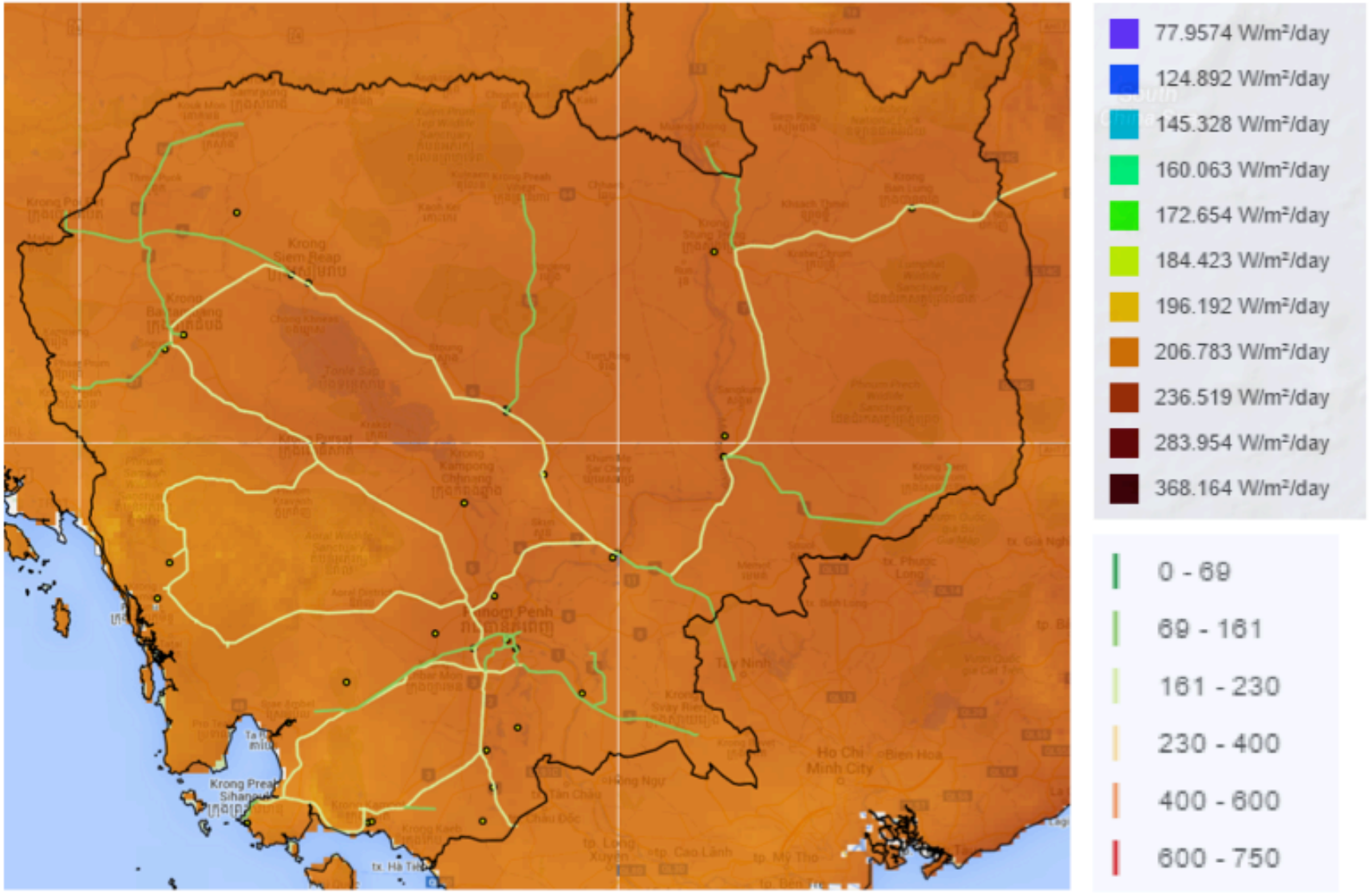


Figure 21 **3TIER's Global Solar Dataset (3km in W/m^2) for GHI and Cambodia's Transmission Network (2013)**

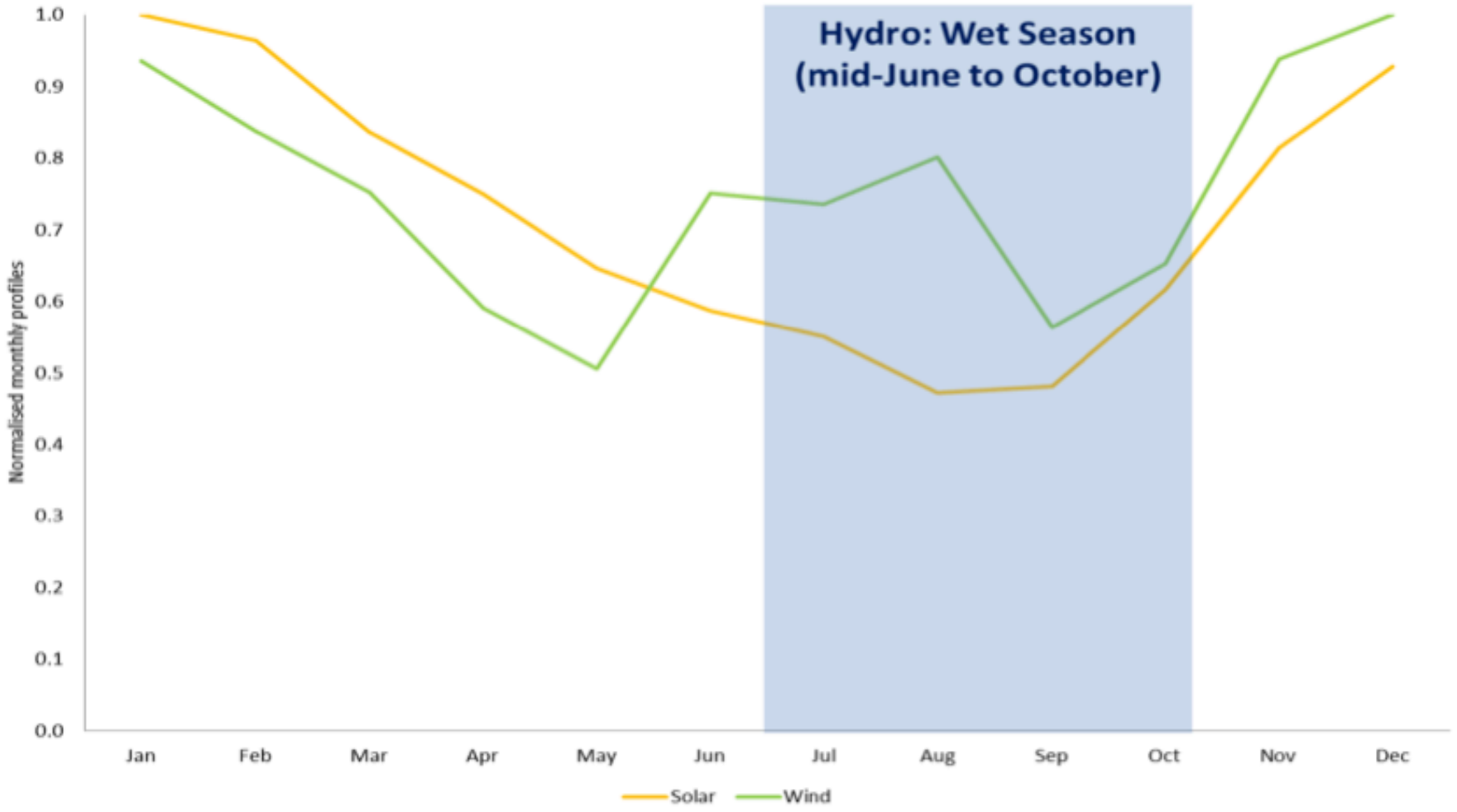


Source: 3TIER's Global Solar Dataset (accessed via IRENA Global Atlas)

Table 1 Summary of Estimated Renewable Energy Potential (Compiled from Various Sources and Analysis)

Renewable Energy Resource	Potential (MW)	Source and comments
Hydro (Large)	10,000	See section 3.4.
Hydro (Small)	700	World Small Hydropower Development Report (2013).
Pump Storage	0	Lack of studies available.
Solar	At least 11,000	IES assessment based on DNI and GHI resource maps and associated data as described in section 3.6.
Wind Onshore	500 and up	Power Sector Vision for the Mekong Region: the Blue Circle (2015).
Wind Offshore	Evidence for potential, but assumed 0 MW	Refer to resource maps in section 3.5.
Biomass	2,392	IES projections based on data from Renewable Energy Developments and Potential in the Greater Mekong Subregion (ADB, 2015).
Biogas	1,591	
Geothermal	0	Lack of studies available.
Ocean	0	Lack of studies available.

Figure 22 Seasonal Solar and Wind Profiles and Wet Season



SCENARIOS

Figure 27 Cambodia GDP Projection

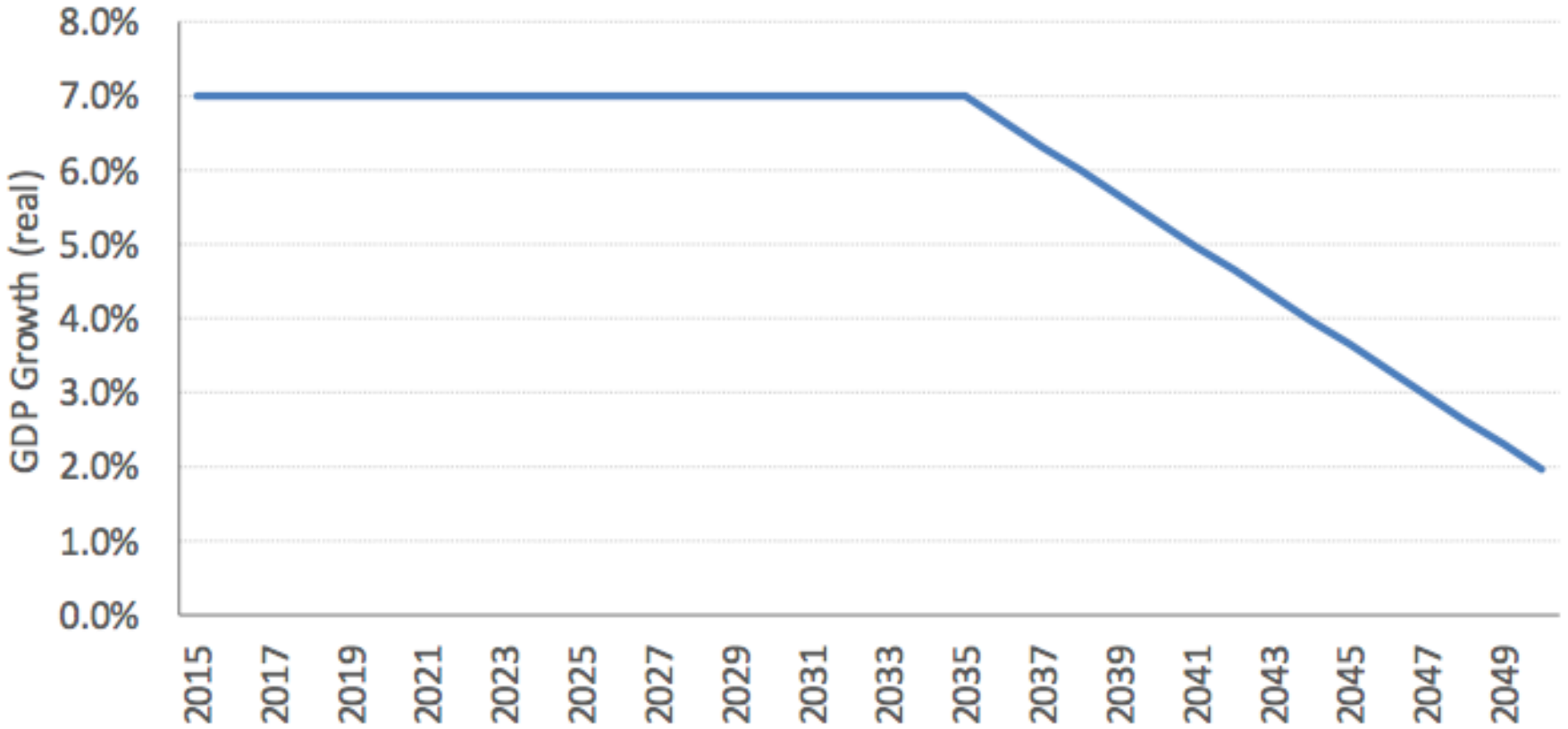


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Figure 28 Cambodia GDP Composition

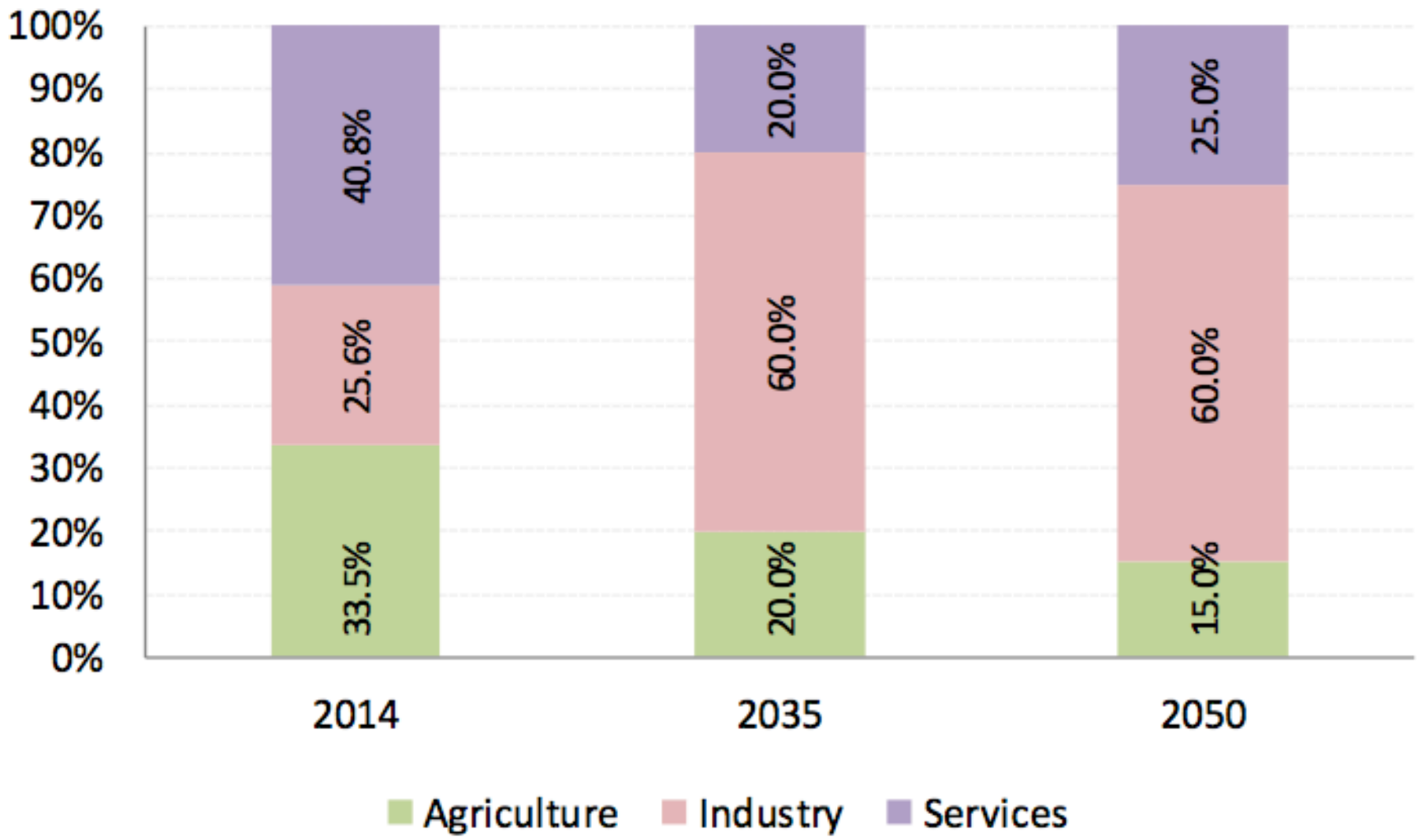


Figure 77 Cambodia Per Capita Consumption Comparison (kWh pa)

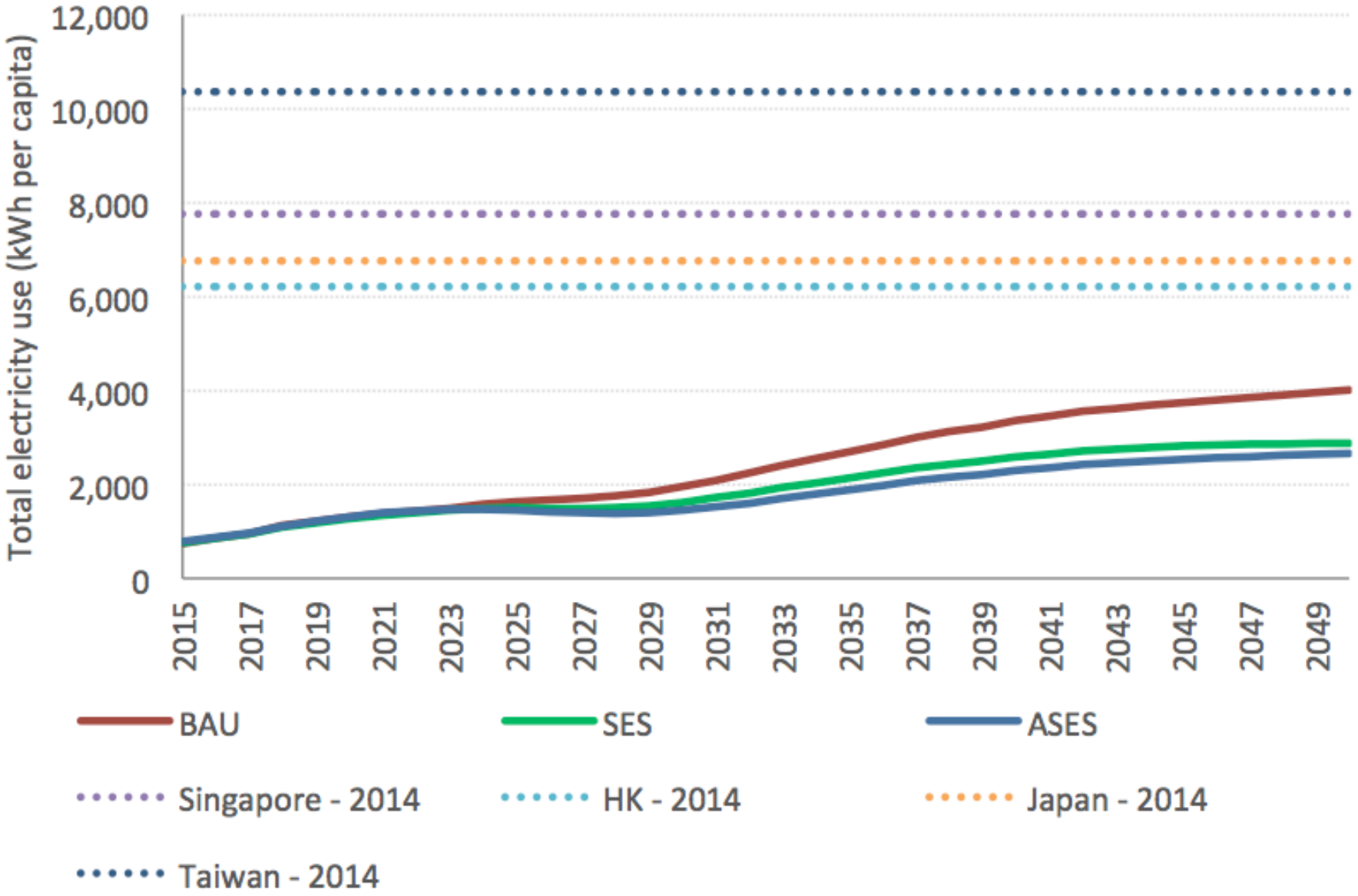


Figure 30 Cambodia Projected Electricity Demand (2015-50, BAU)

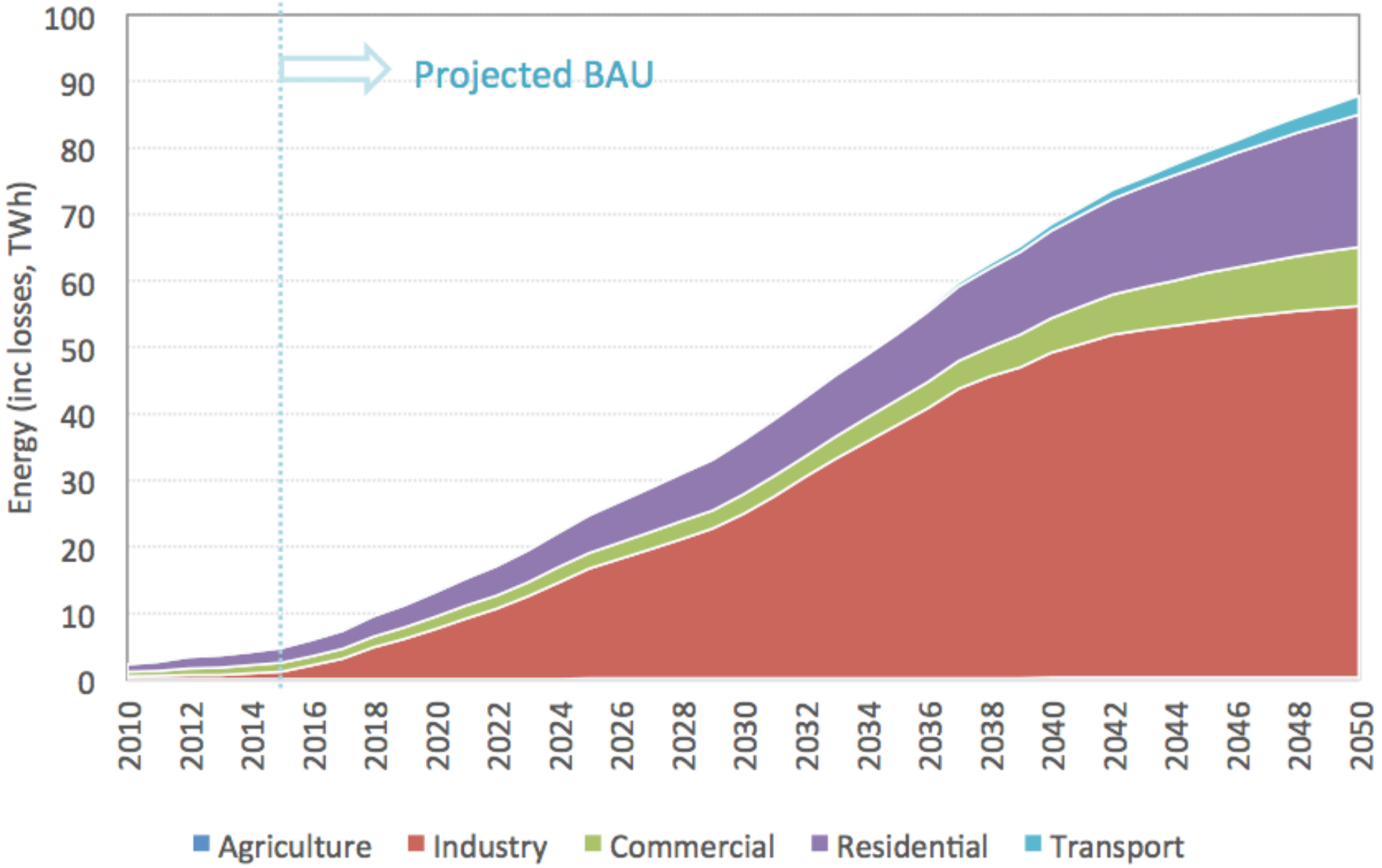


Figure 43 Cambodia Projected Electricity Demand (2015-50, SES)

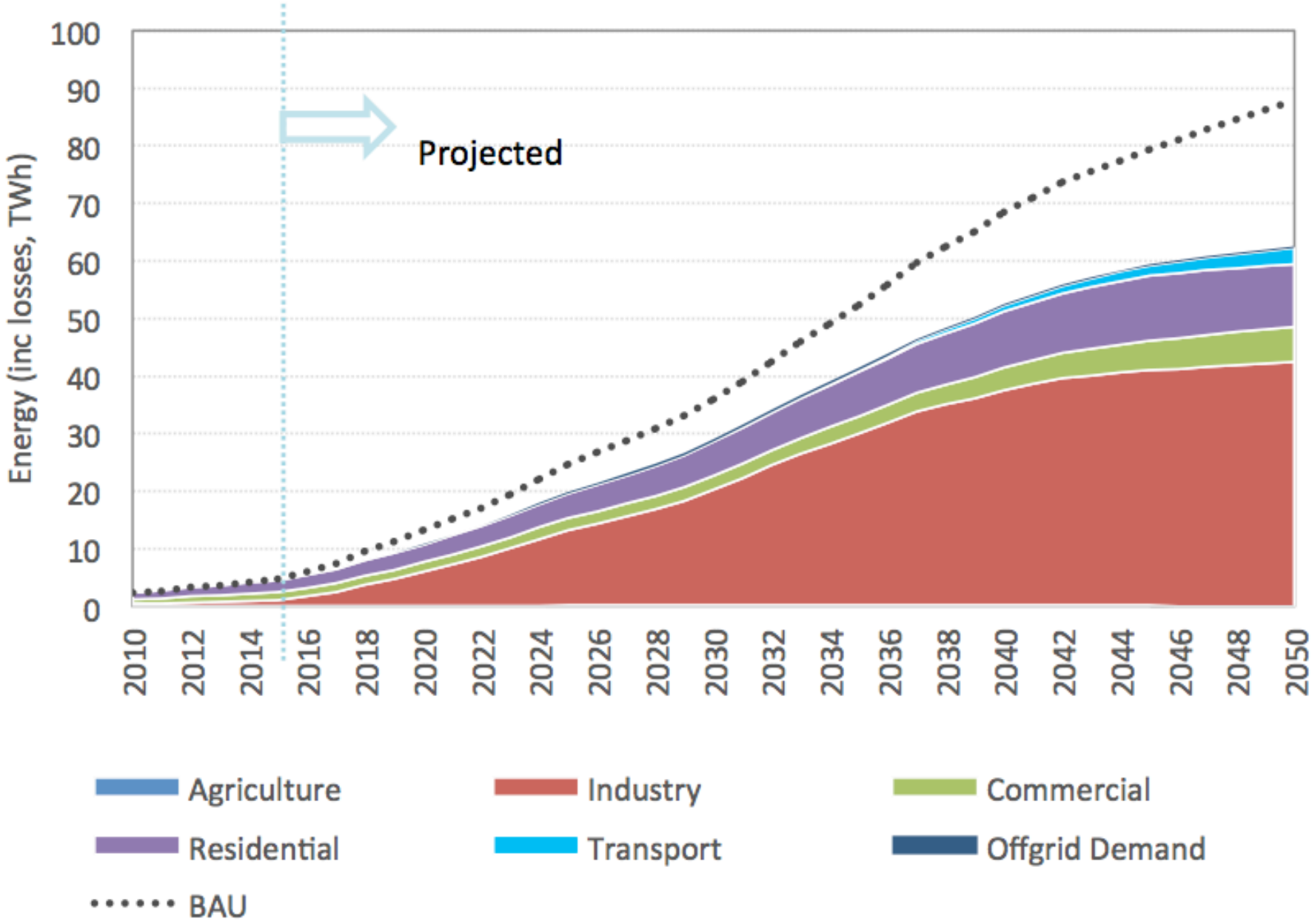


Figure 58 Cambodia Projected Electricity Demand (2015-50, ASES)

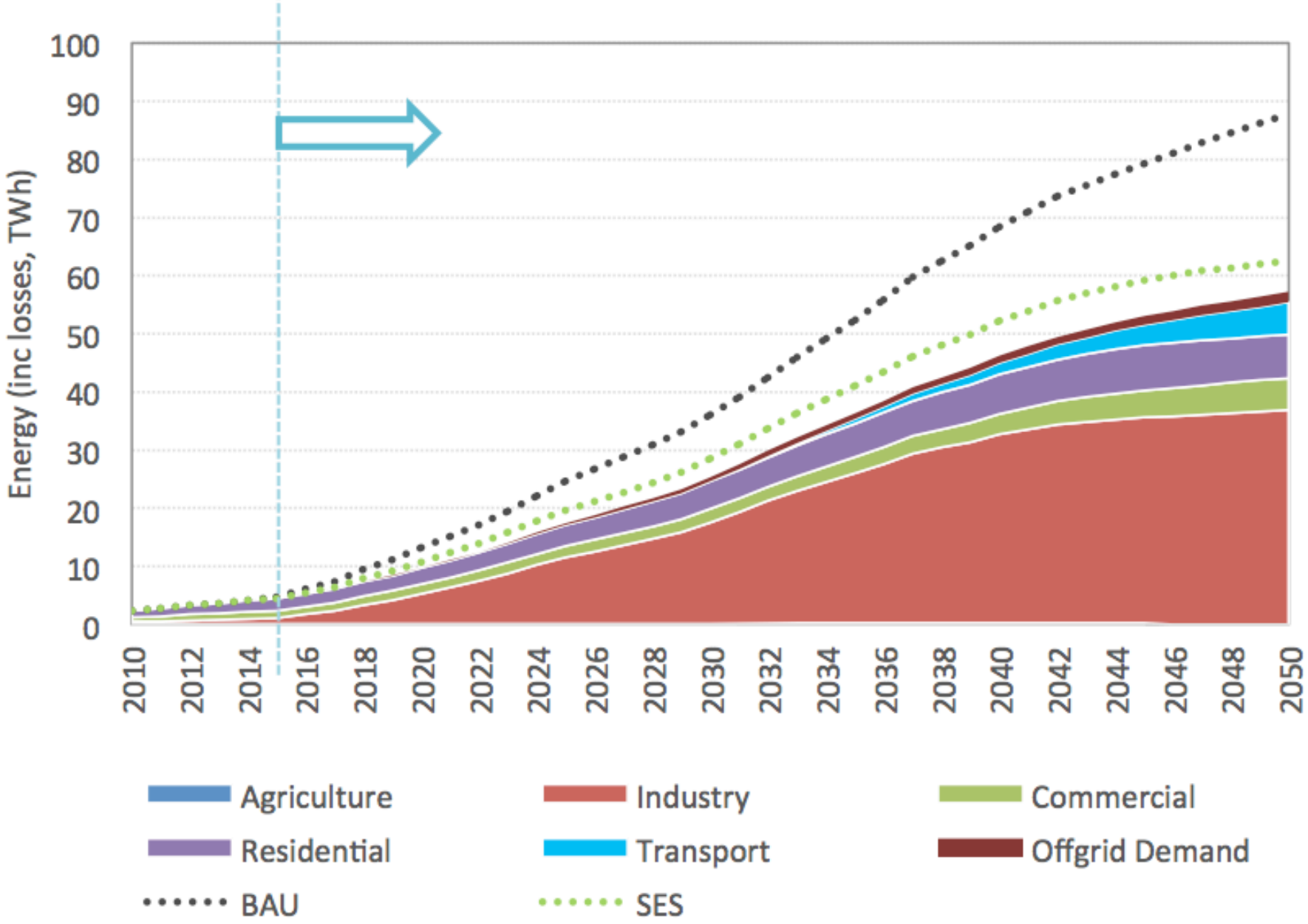


Figure 31 Cambodia Projected peak Demand (BAU)

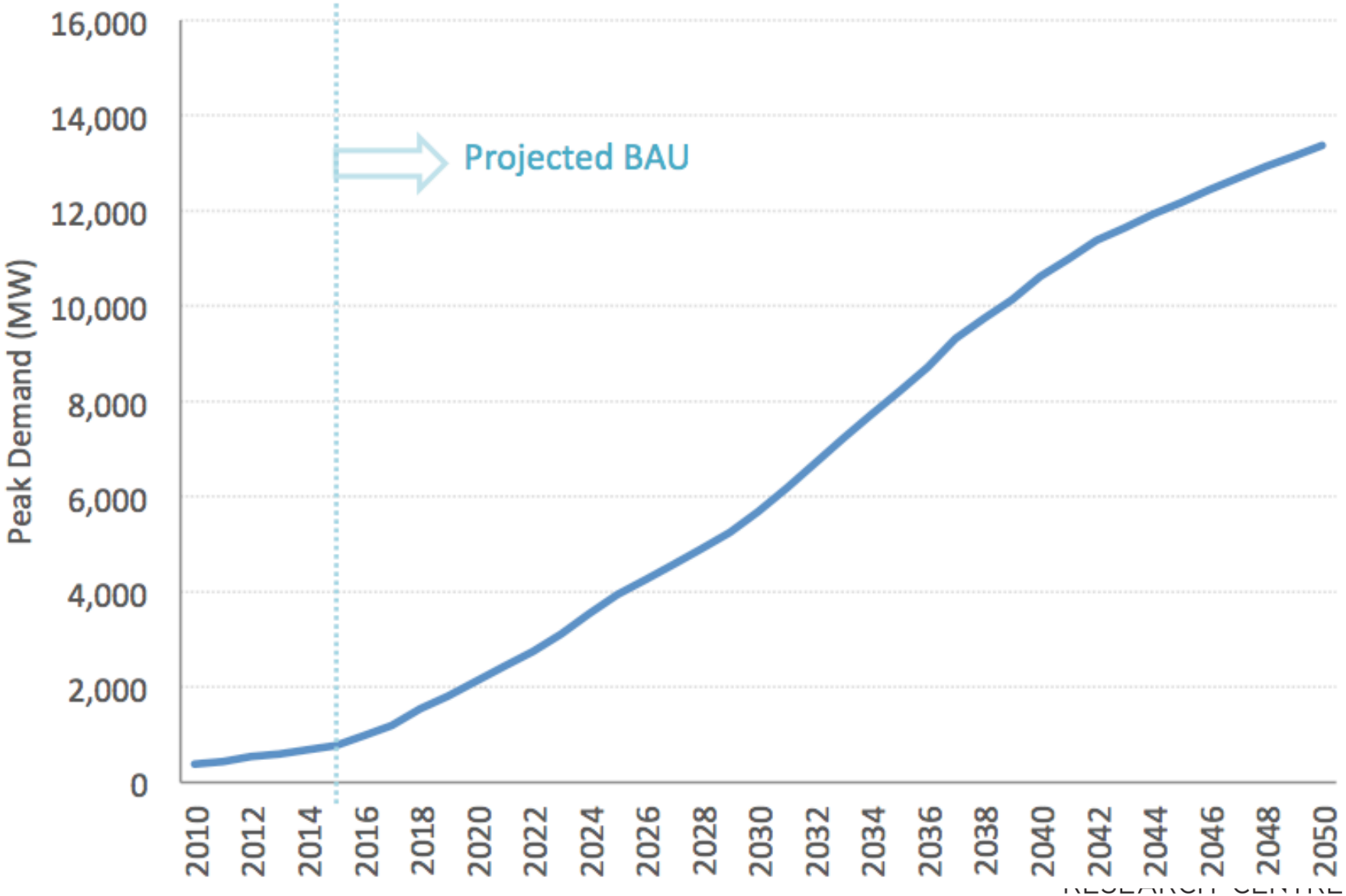


Figure 44 Cambodia Projected Electricity Demand (SES, Grid Connected)

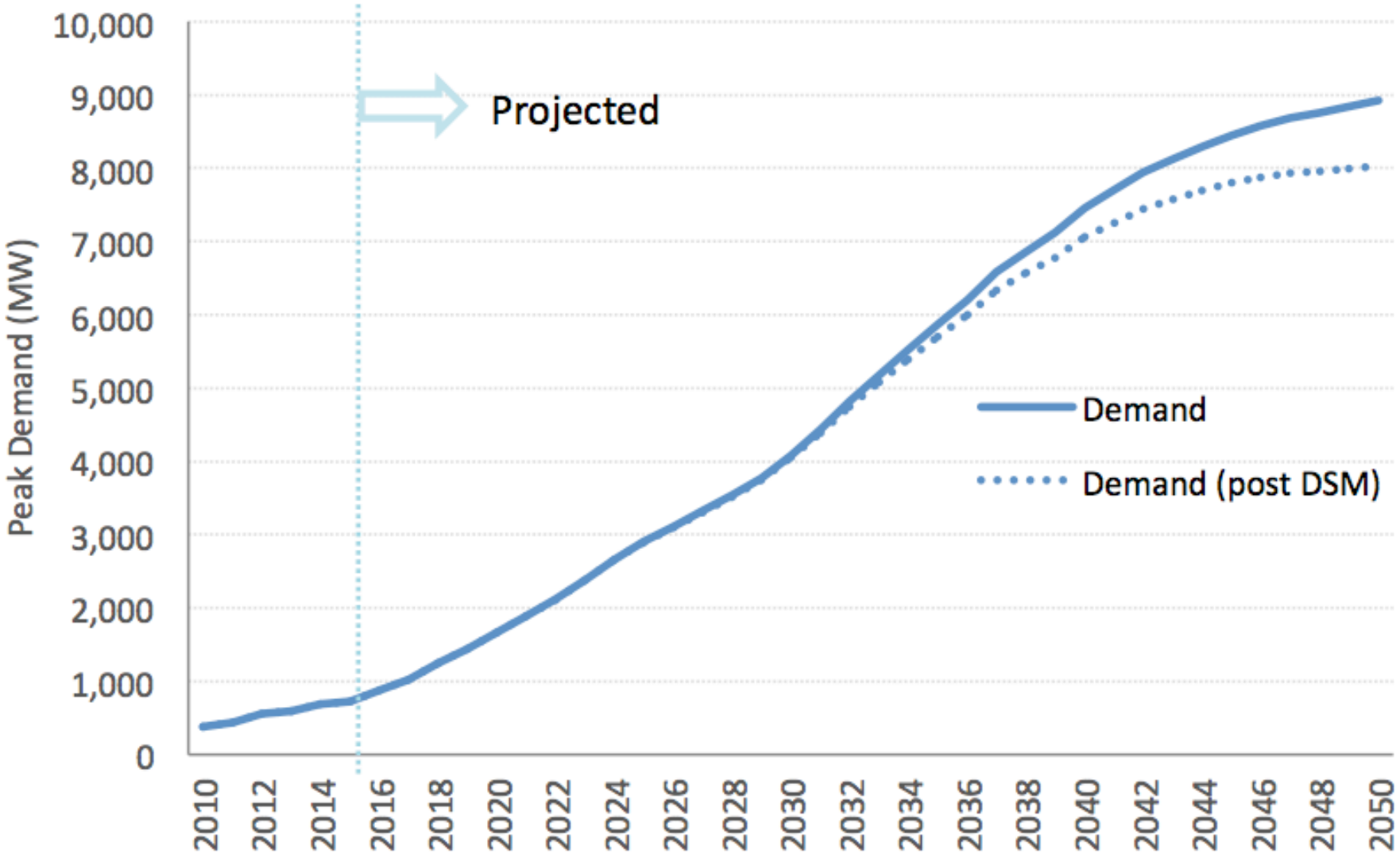
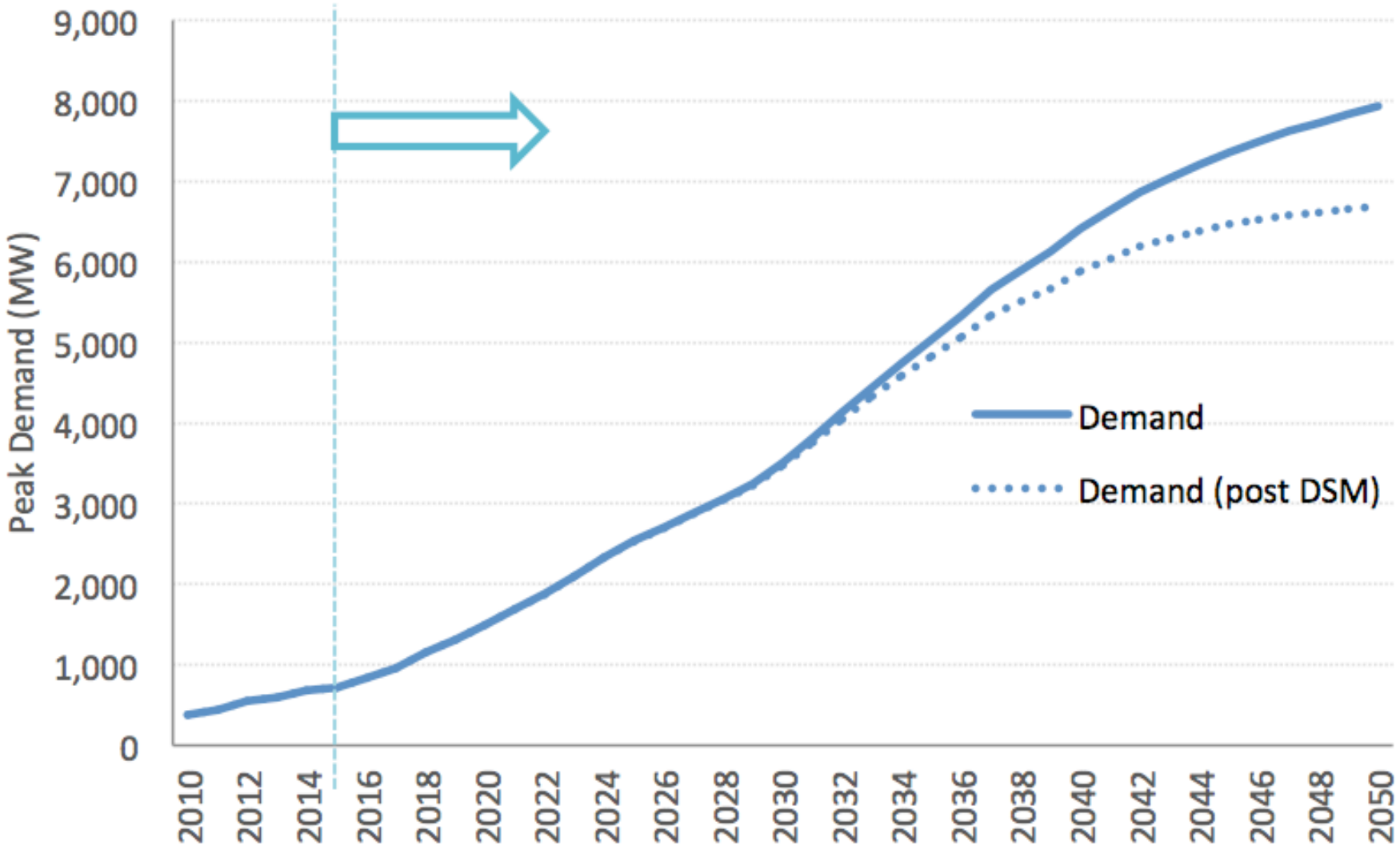


Figure 59 Cambodia Projected Electricity Demand (ASES, Grid)



Turun yliopisto
University of Turku

DEMAND DRIVERS

No.	Aspect	2015-30	2030-40	2040-50
1	Demand Growth (pa)	14.3%	6.4%	2.3%
2	GDP Growth (Real, pa)	7.0%	6.5%	3.5%
3	Central Grid Electrification Rate (population)	68.5%	97.1%	98.7%
4	Population Growth	1.37%	0.94%	0.71%
5	Per Capita Consumption (kWh)	710	1,768	3,128
6	Electricity Elasticity*	11.96	2.49	1.77
7	Electricity Intensity (kWh/USD)	0.264	0.385	0.520

2015-30	2030-40	2040-50
12.0%	6.2%	1.8%
7.0%	6.5%	3.5%
54.6%	78.6%	85.6%
1.37%	0.94%	0.71%
578	1,401	2,388
9.74	2.42	1.70
0.215	0.305	0.397

2015-30	2030-40	2040-50
10.9%	6.2%	2.2%
7.0%	6.5%	3.5%
45.4%	54.8%	55.7%
1.37%	0.94%	0.71%
522	1,205	2,055
8.79	2.31	1.70
0.194	0.263	0.342

Figure 36 Cambodia Imports and Exports (BAU)

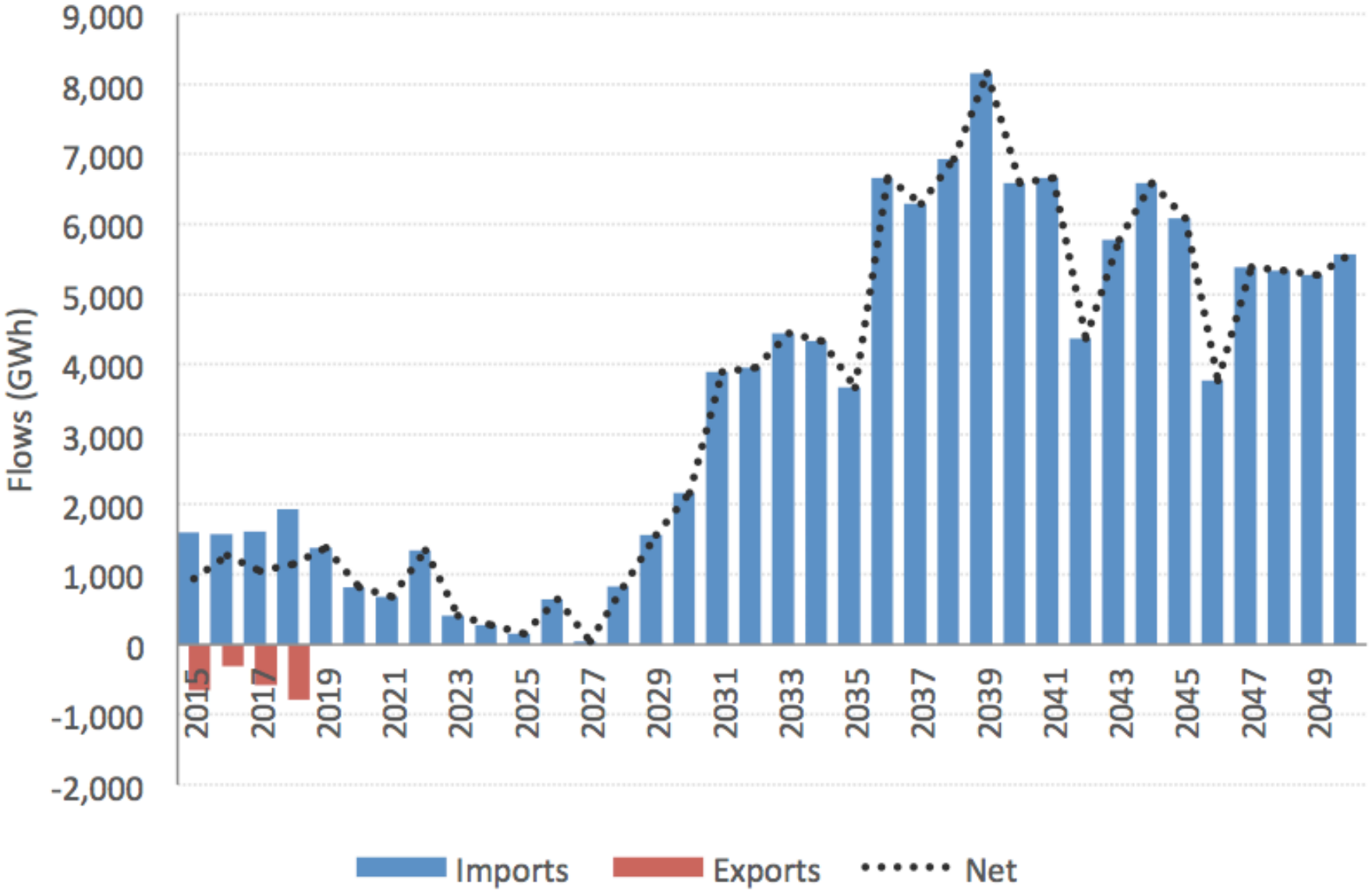


Figure 49 Cambodia Imports and Exports (SES)

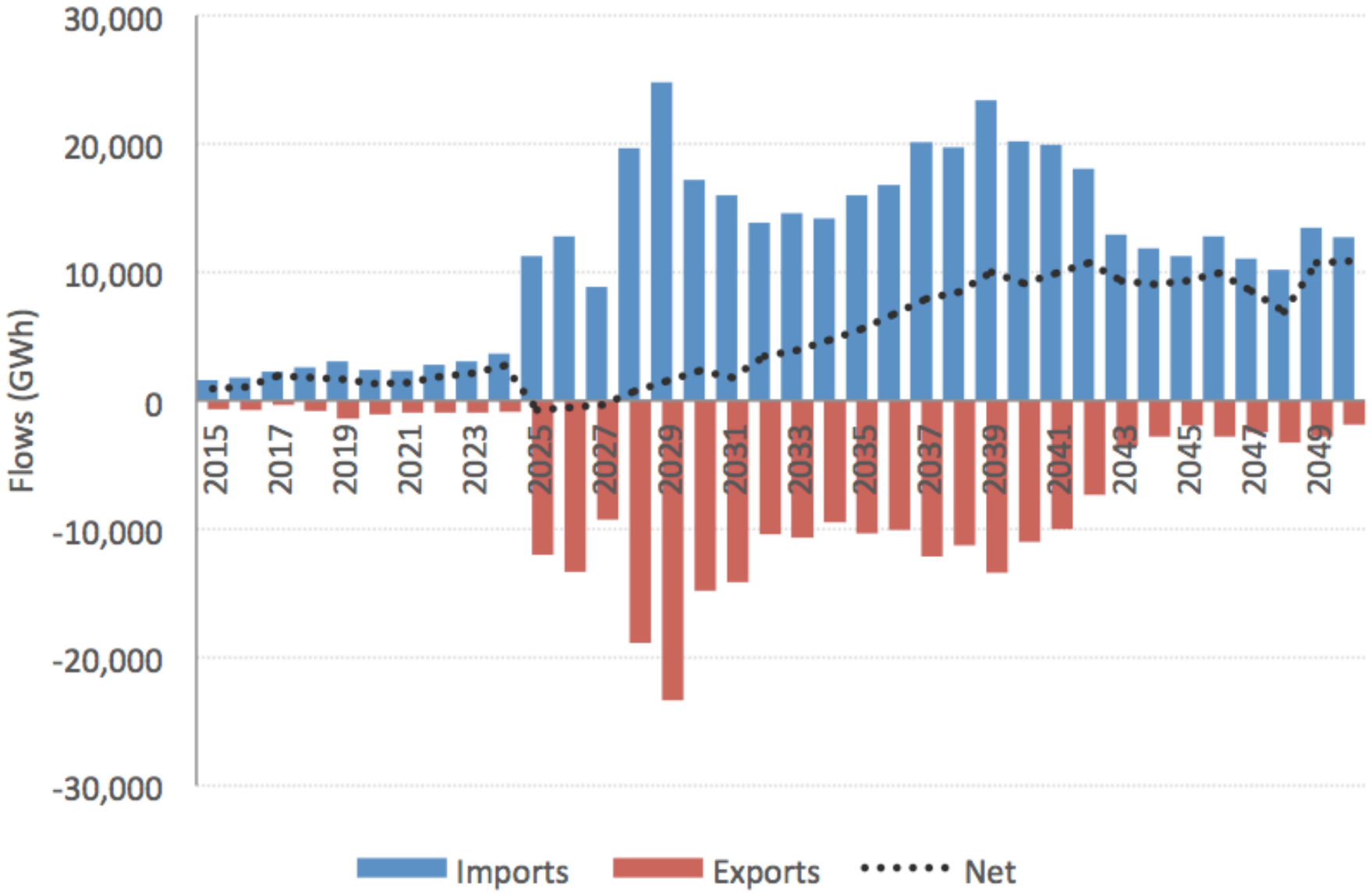


Figure 64 Cambodia Imports and Exports (ASES)

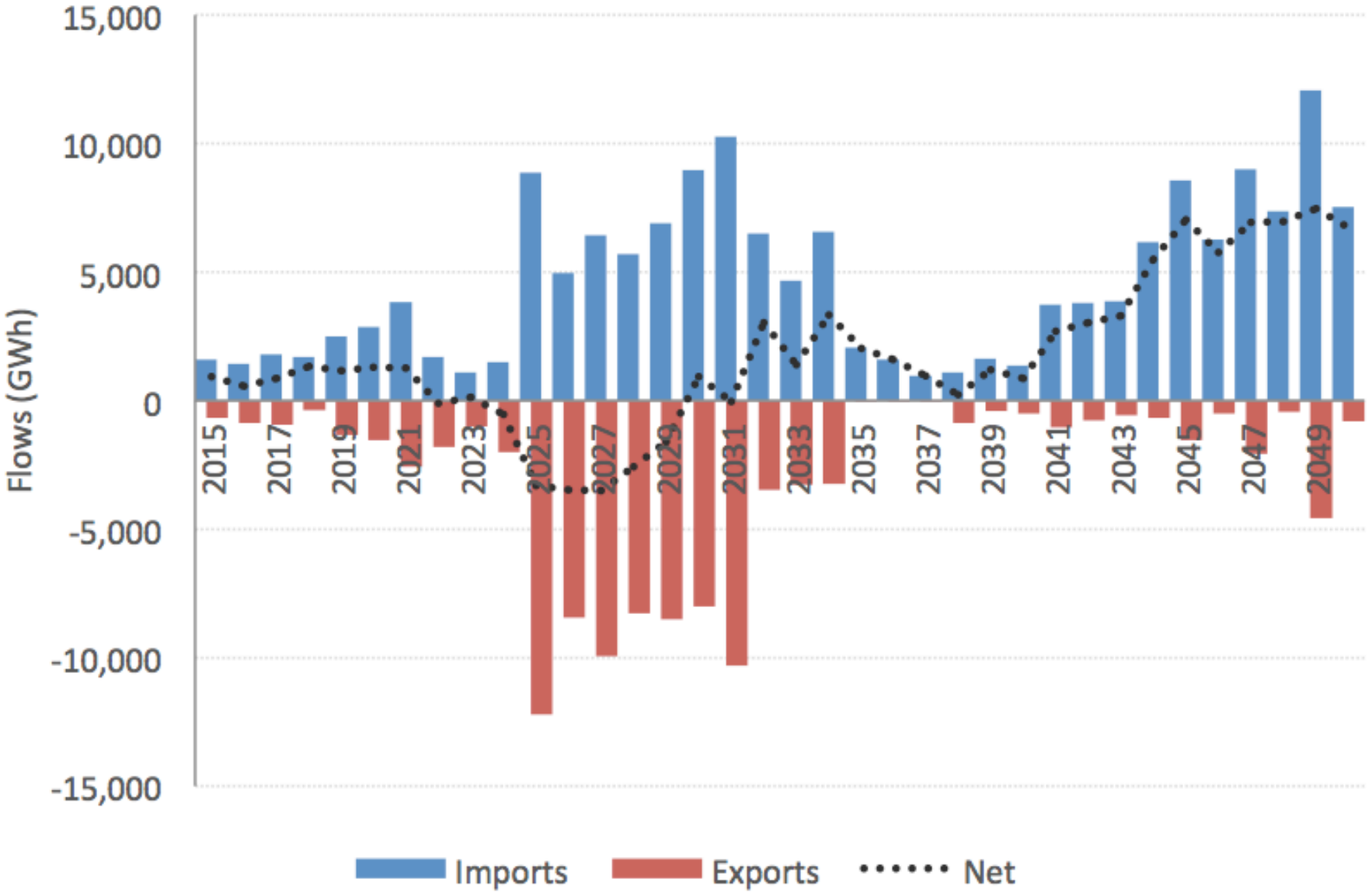


Figure 29 Regional Transmission System Model of GMS

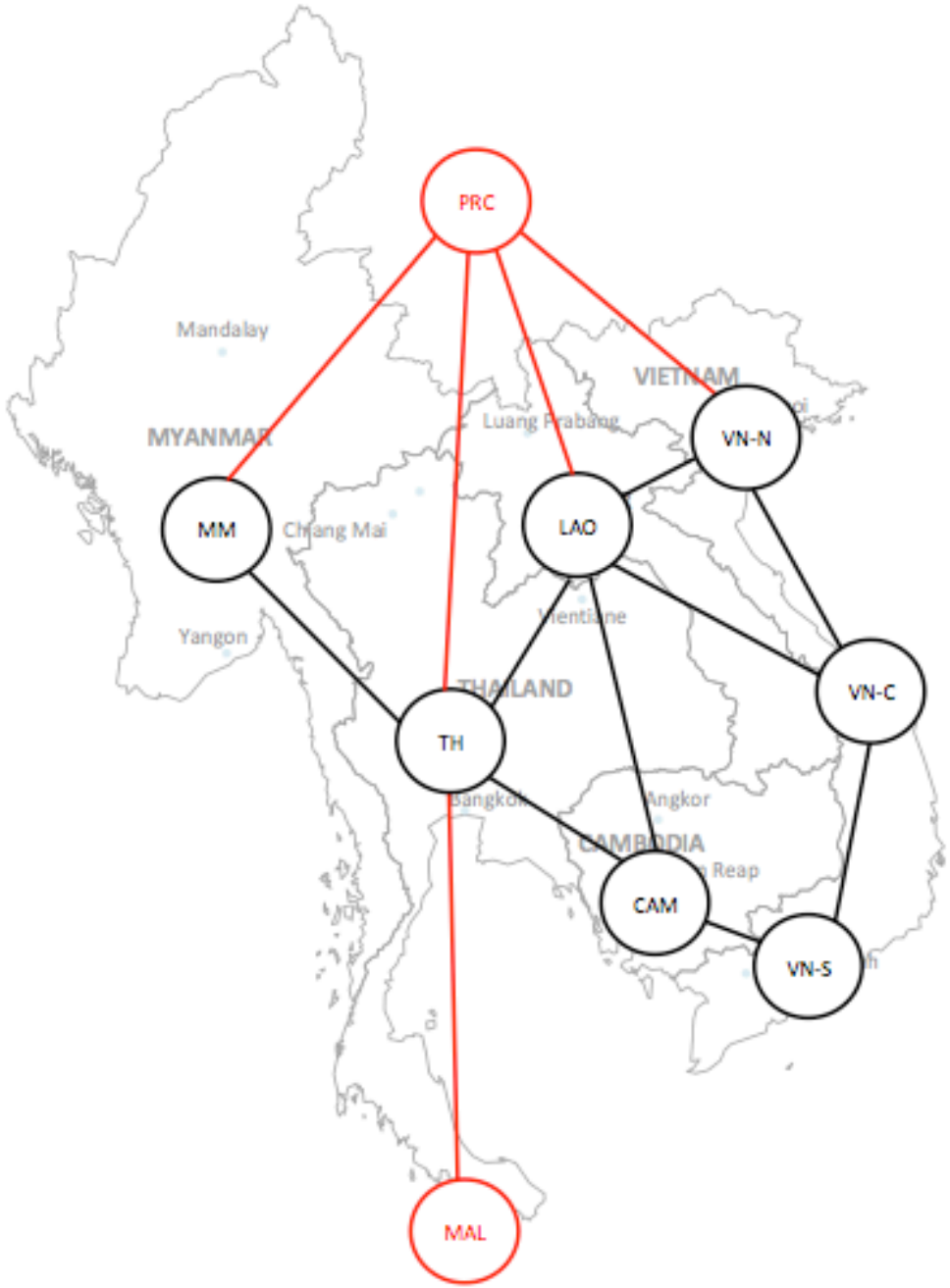


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Figure 32 Cambodia Installed Capacity (BAU, MW)

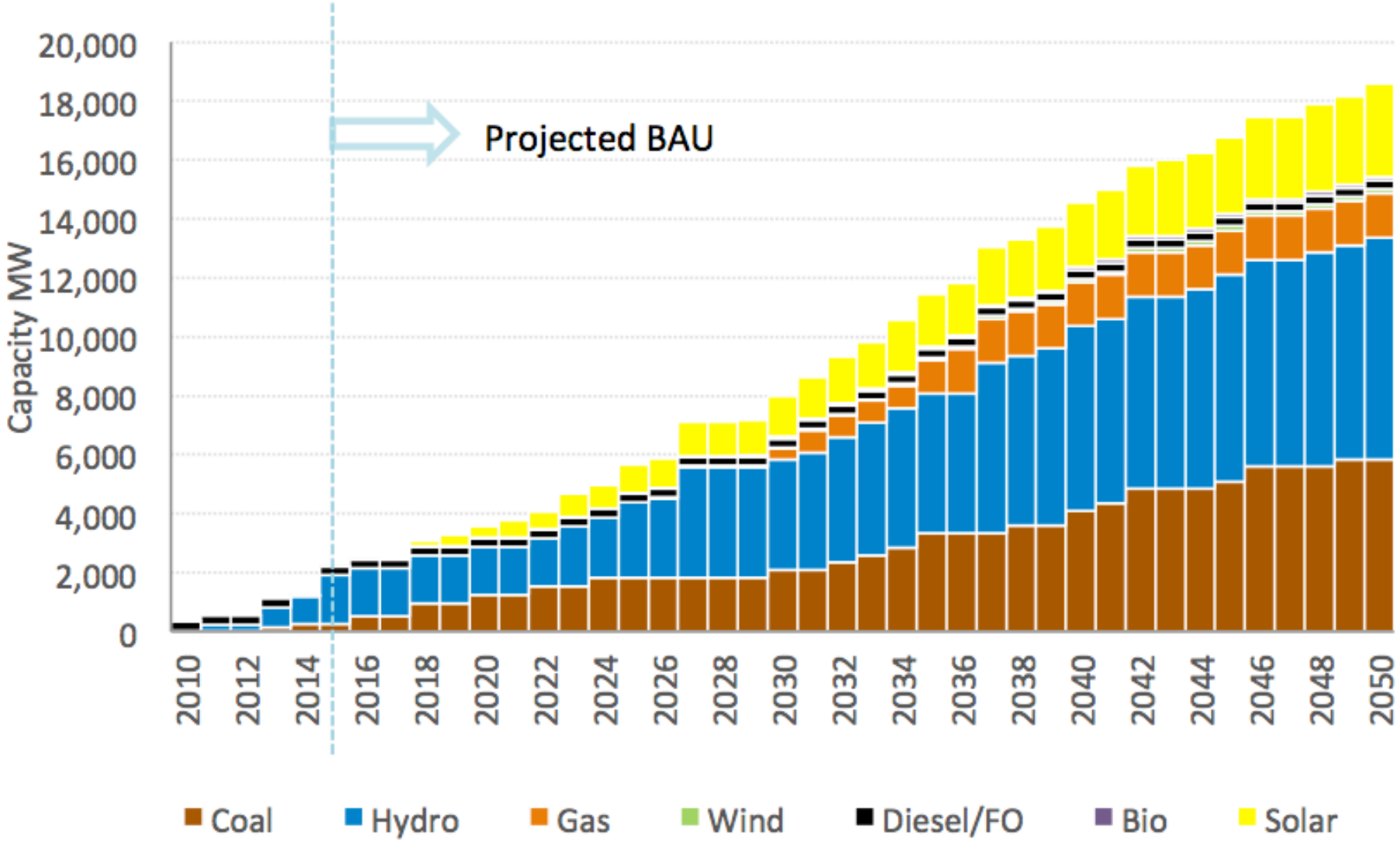

Figure 45 Cambodia Installed Capacity by Type (SES, MW)

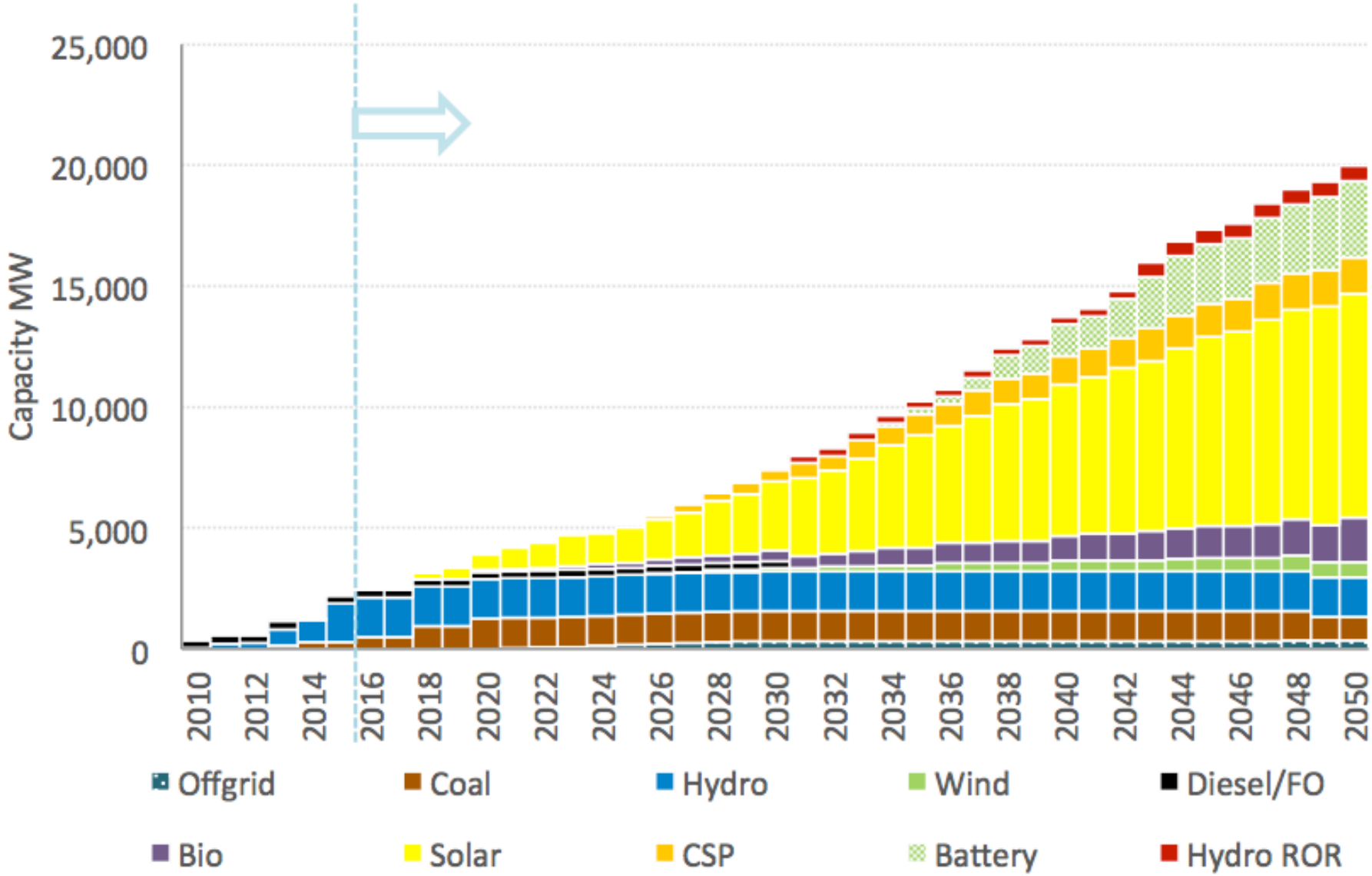

Figure 60 Cambodia Installed Capacity by Type (ASES)

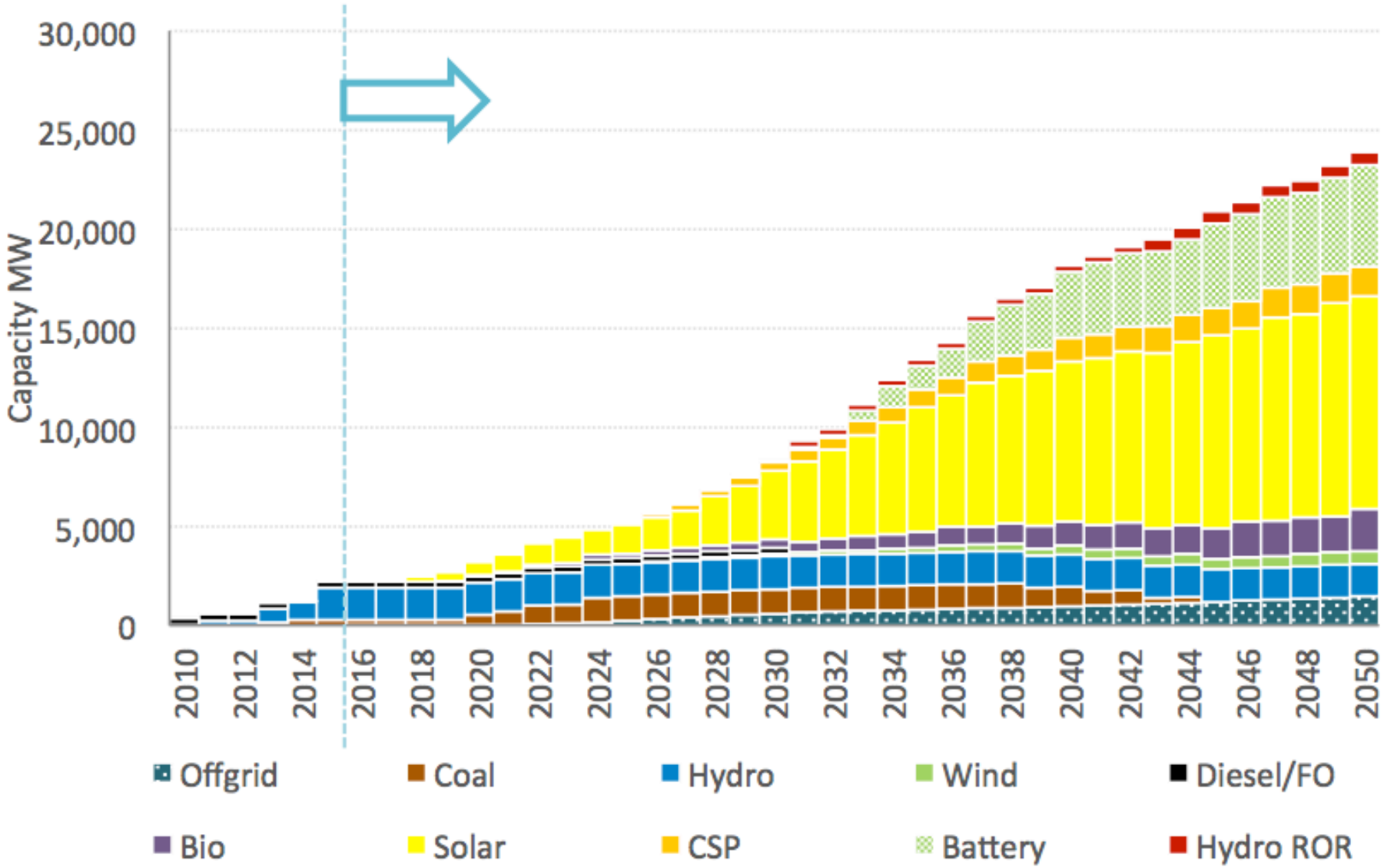

Figure 35 Cambodia Generation Mix Percentages (BAU, %)

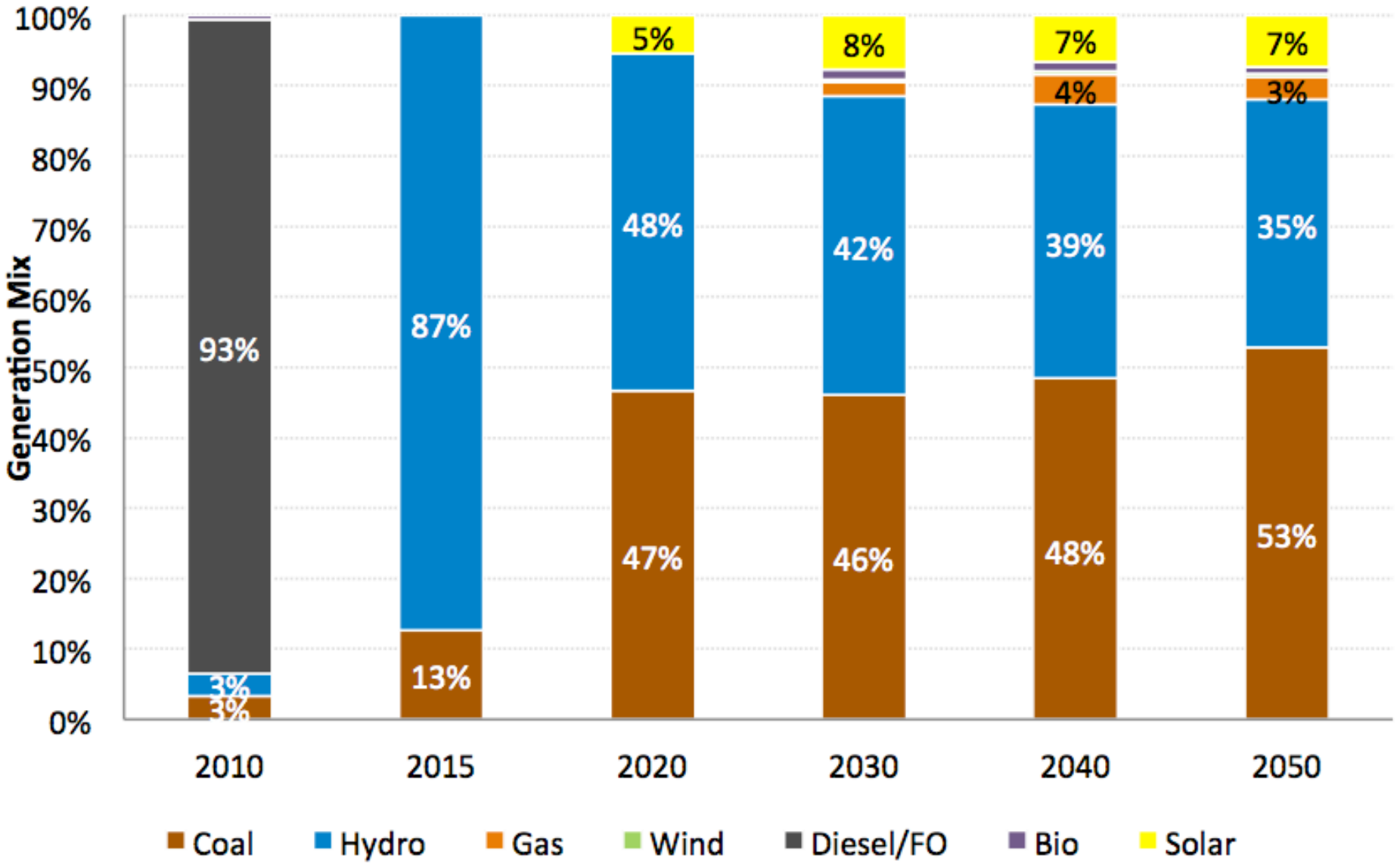

Figure 48 Cambodia Generation Share (SES, %)

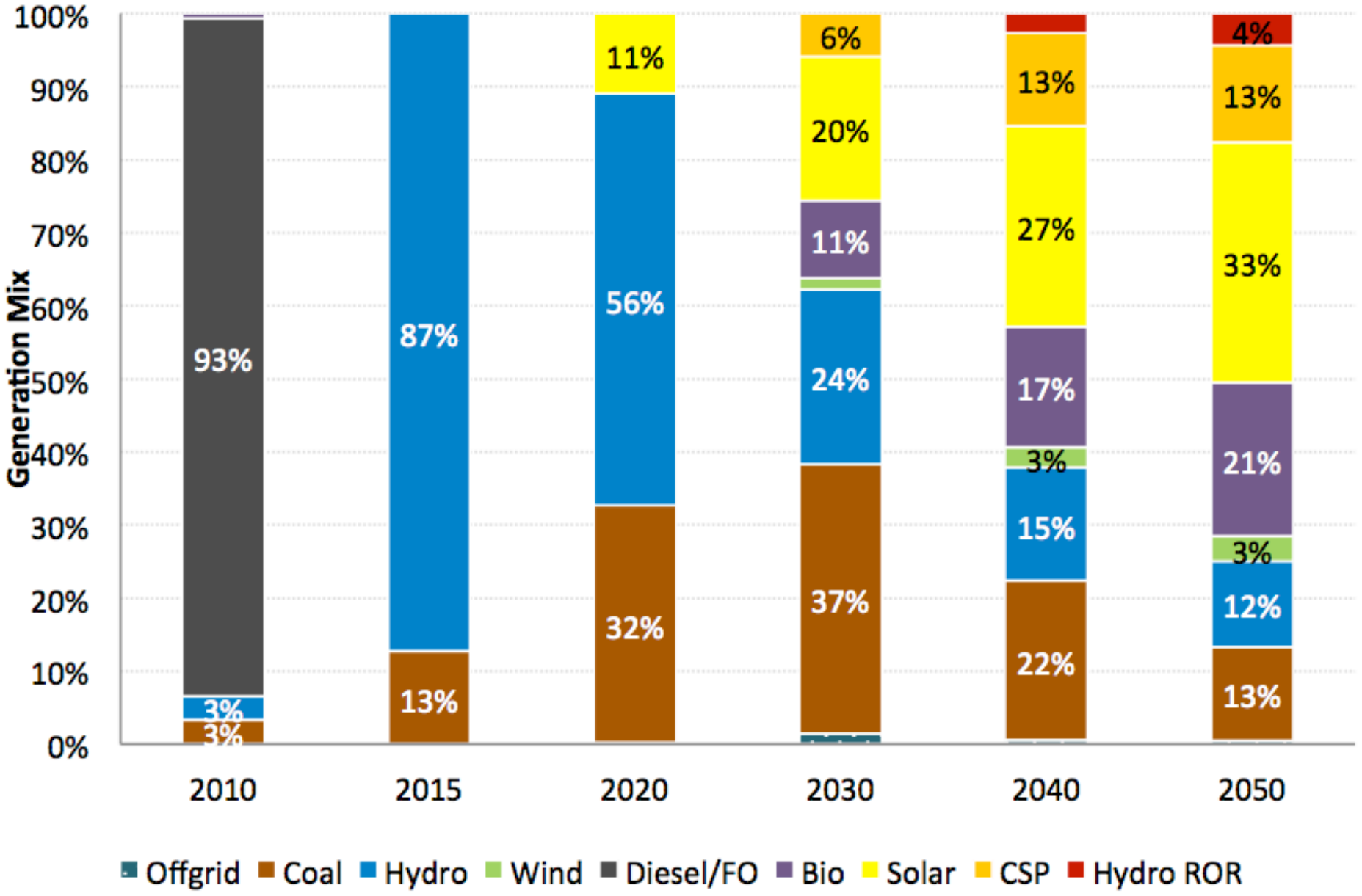

Figure 63 Cambodia Generation Mix (ASES, %)

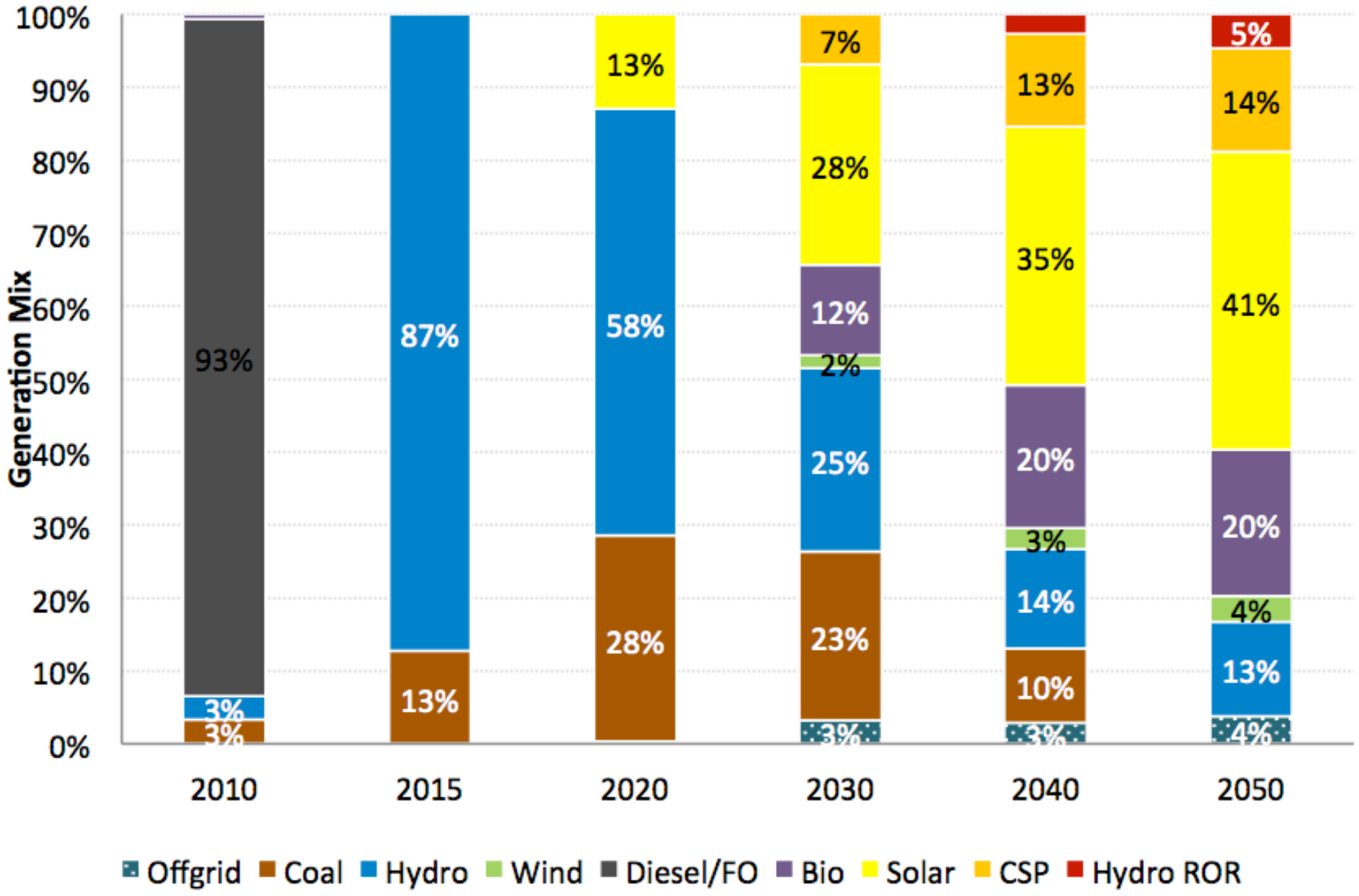

Figure 34 Cambodia Generation Mix (BAU, GWh)

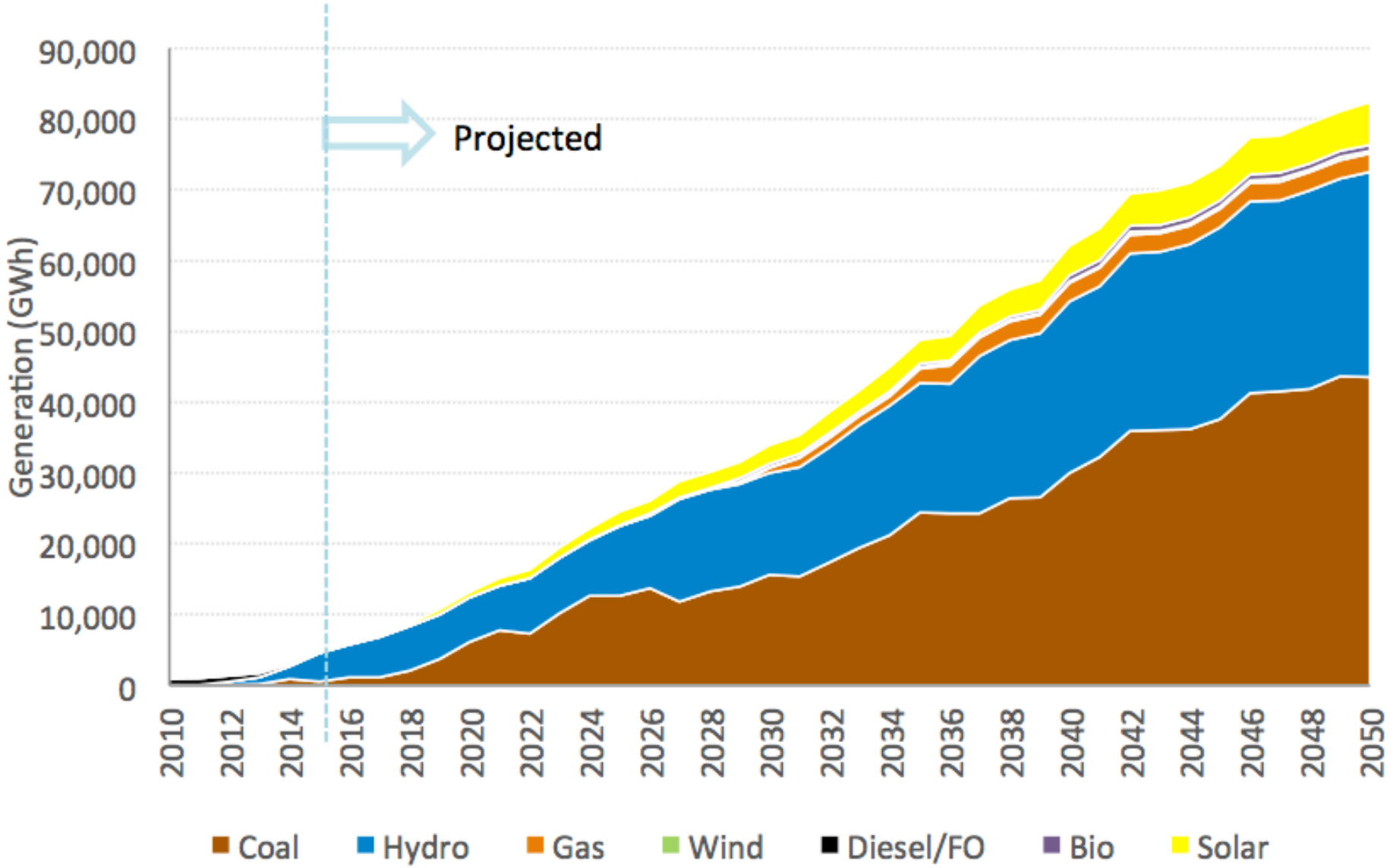

Figure 62 Cambodia Generation Mix (ASES, GWh)

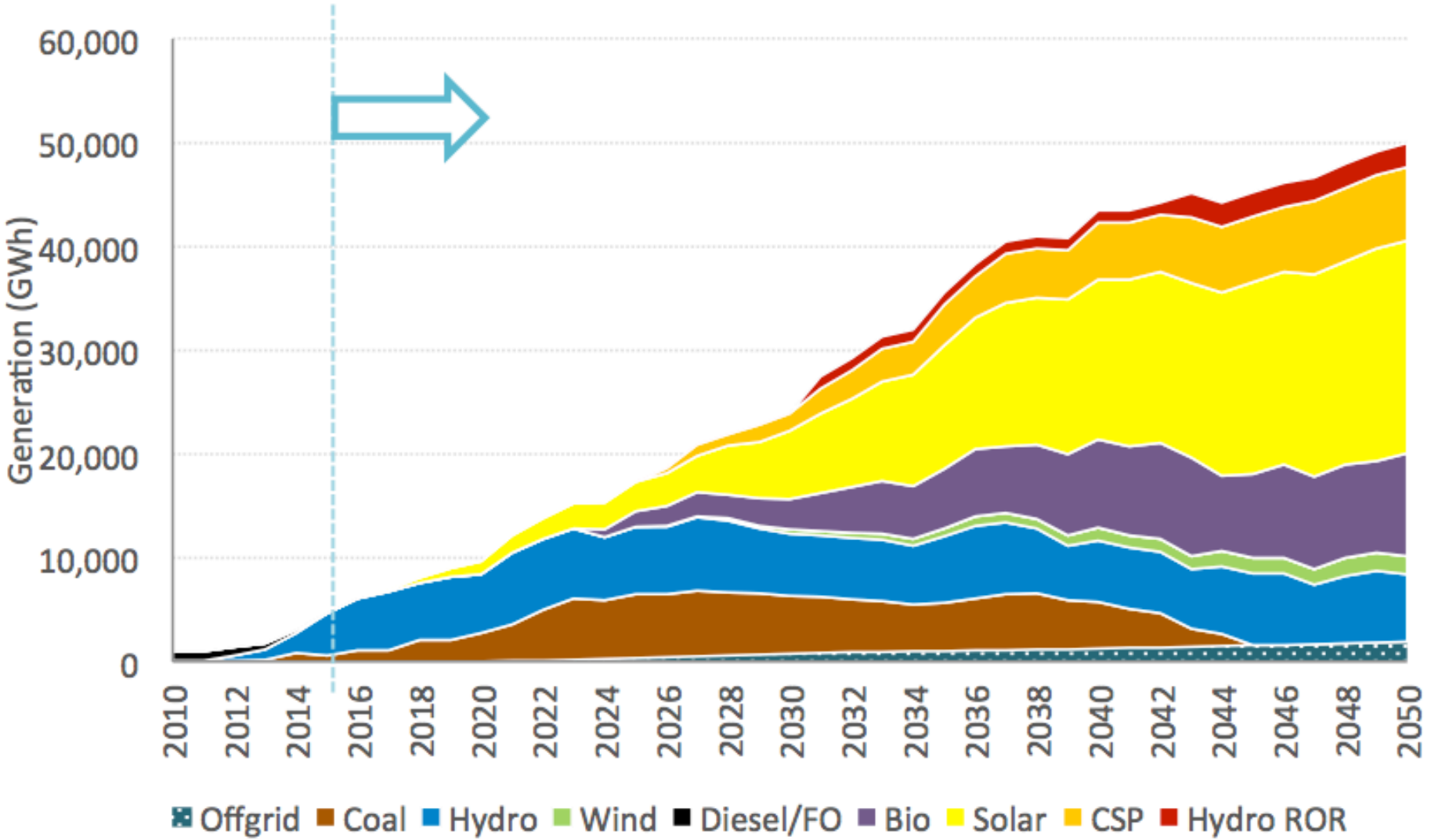

Figure 85 **Cambodia Security of Supply Measure: Percentage of Electricity Generated by Domestic Resources**

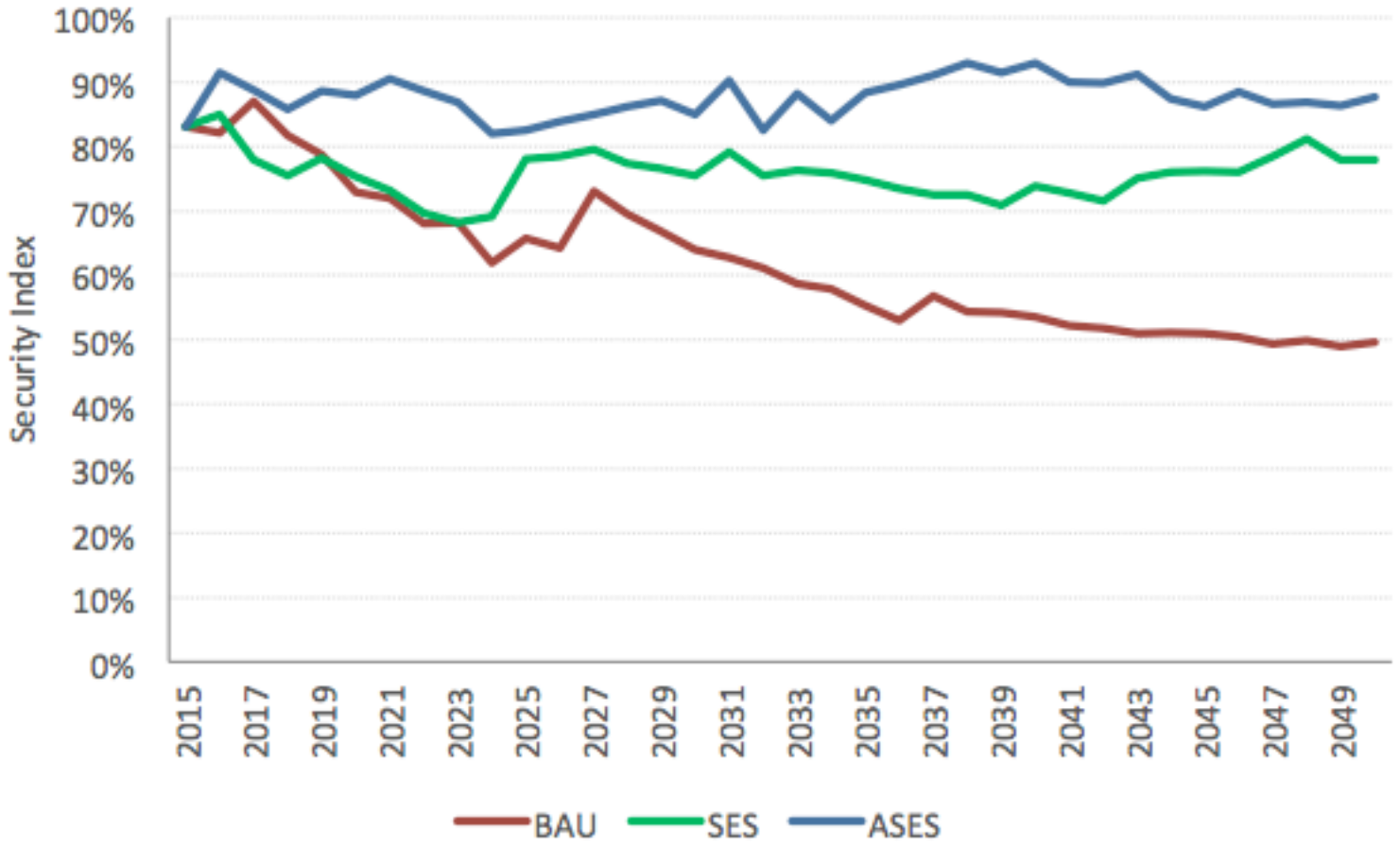

Figure 78 Cambodia Renewable Installed Capacity Mix

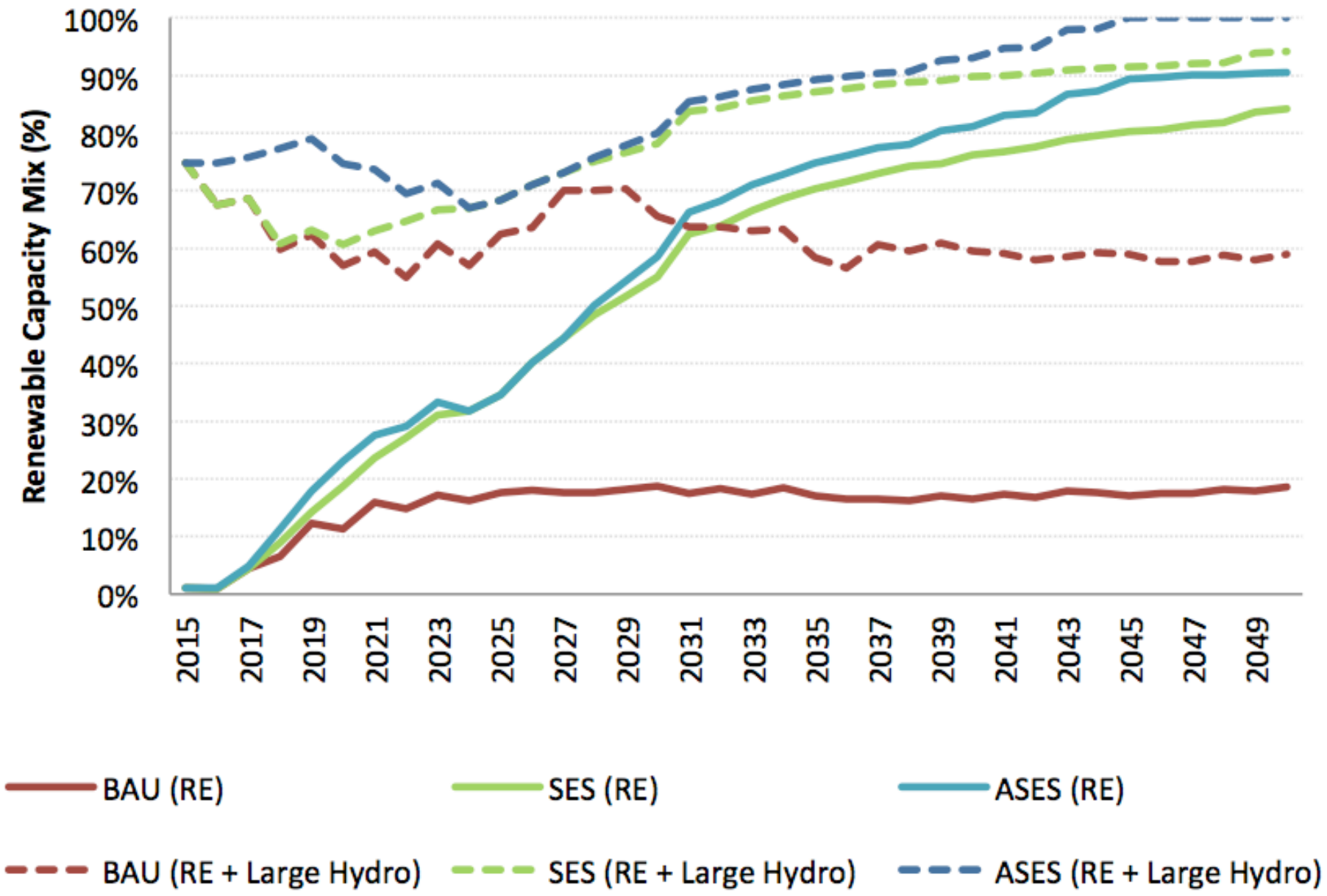

Figure 76 Cambodia Electricity Access Rate Comparison

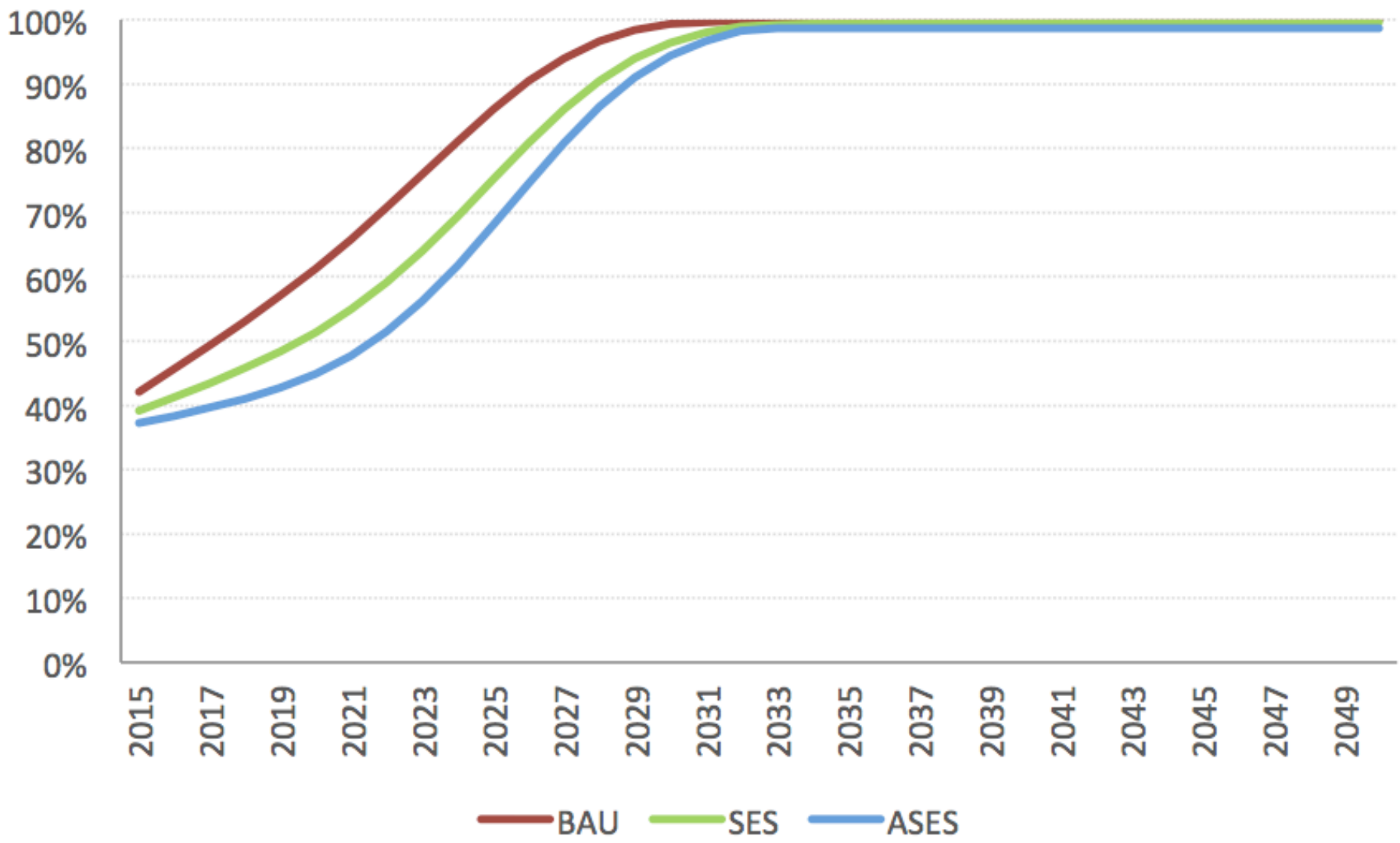

Figure 81 Cambodia Carbon Emissions Comparison

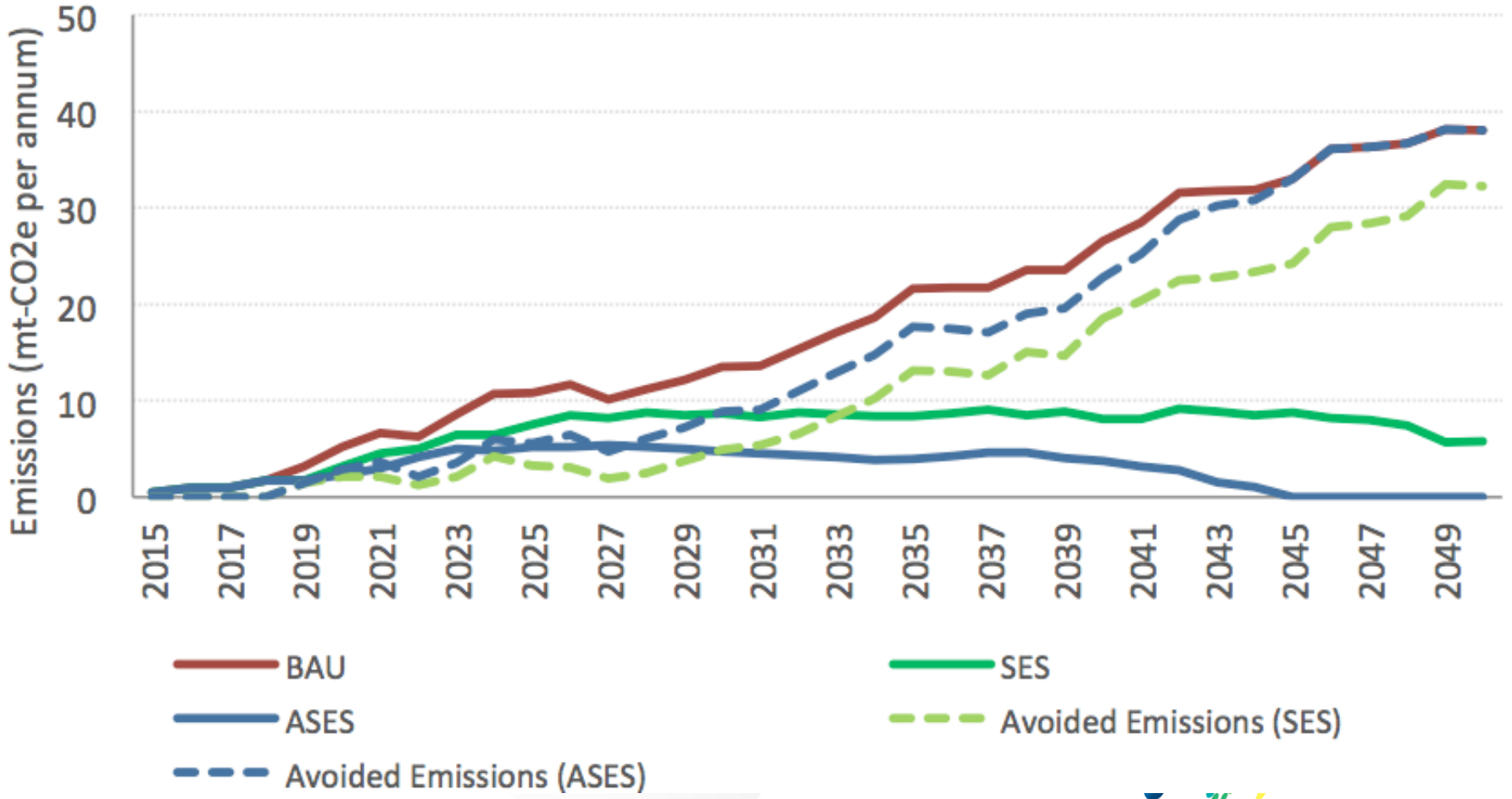

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Figure 95 Cambodia Cumulative Investment by Type (BAU, Real 2014 USD)

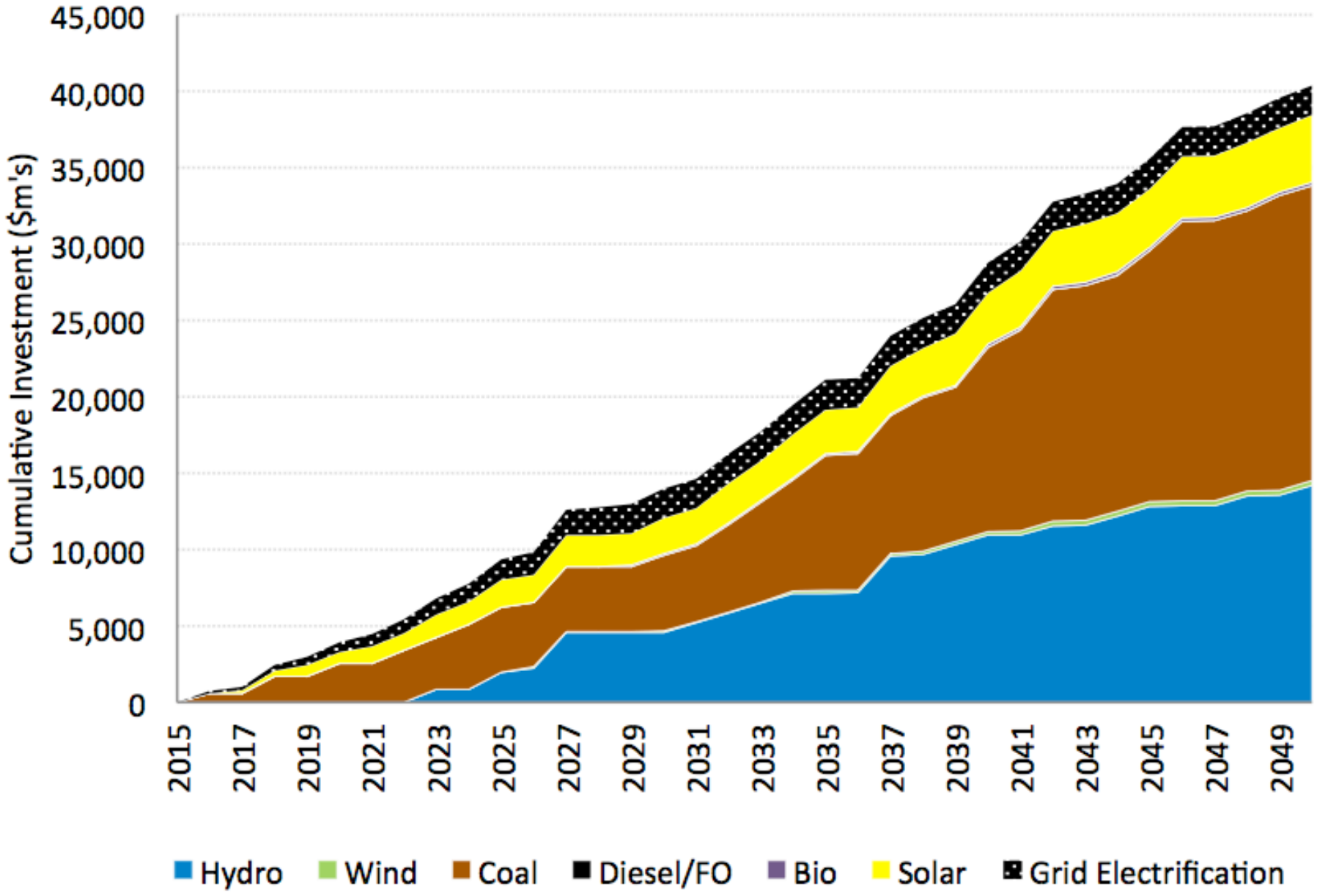


Figure 96 Cambodia Cumulative Investment by Type (SES, Real 2014 USD)

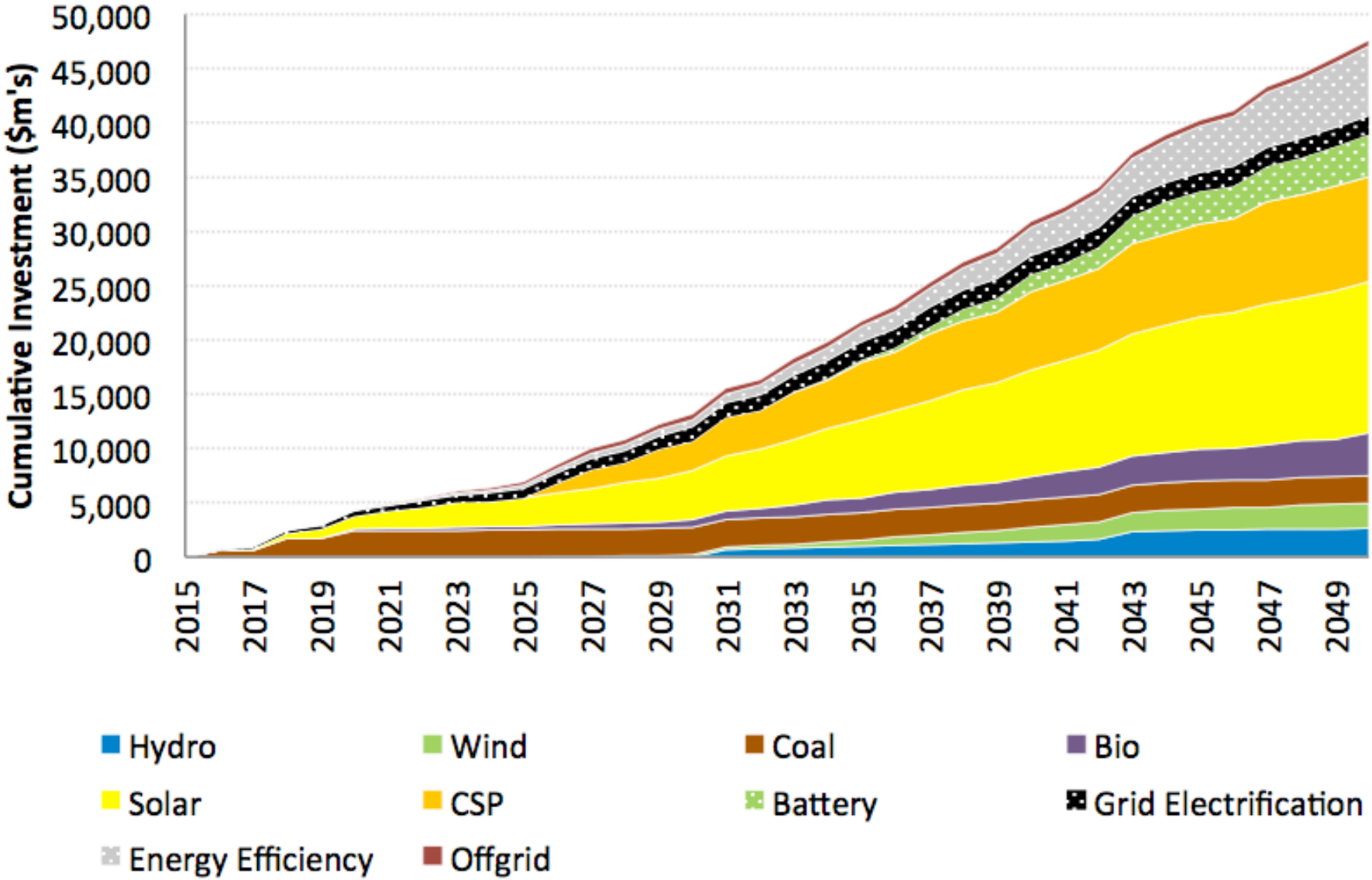
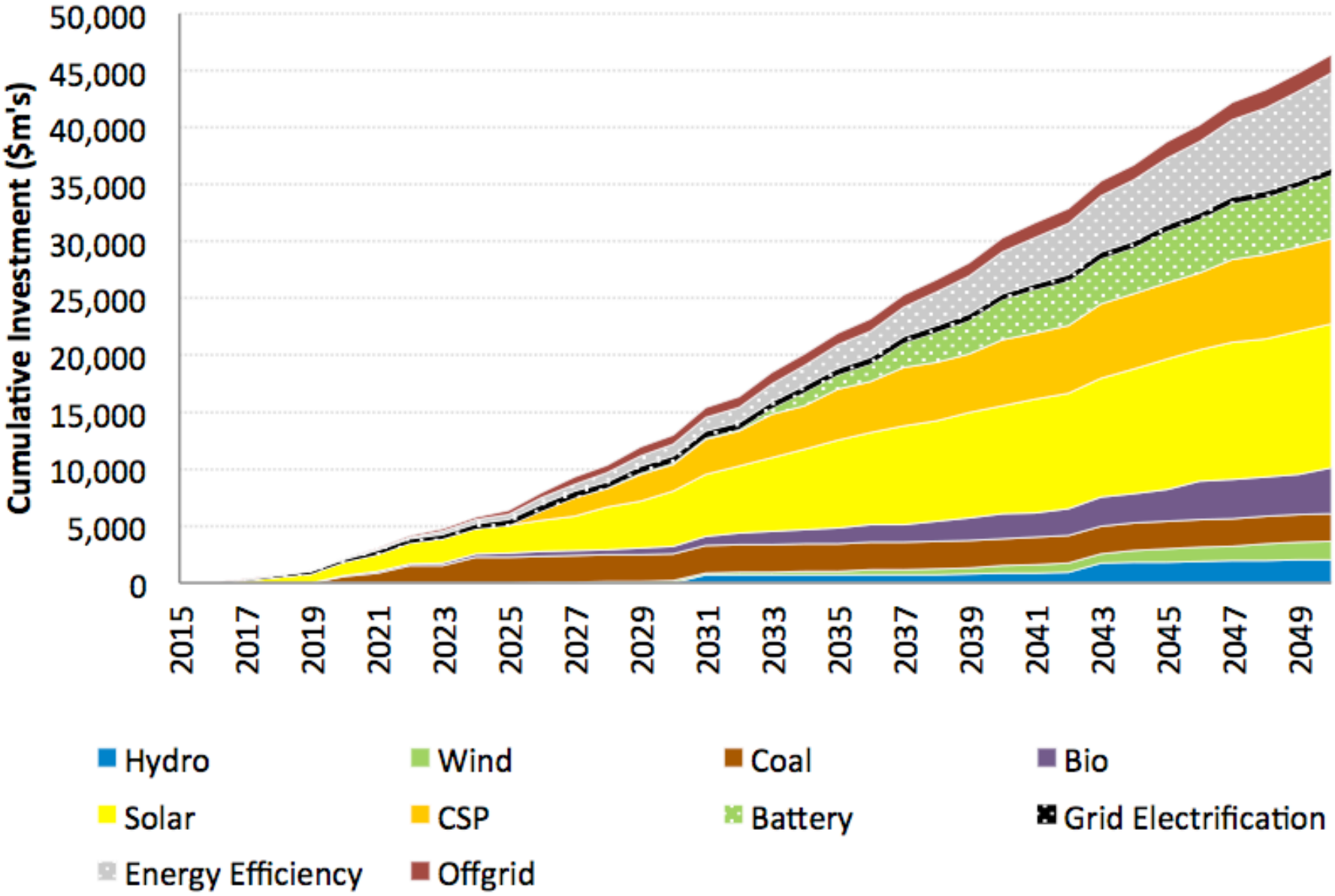


Figure 97 Cambodia Cumulative Investment by Type (ASES, Real 2014 USD)



Turun yliopisto
University of Turku

BY 2050

$42 billion BAU

VS.

$48 billion SES

VS.

$47 billion (Real 2014 USD) ASES

$42 billion is required to develop the BAU generation requirements

In the SES, $39 billion is required to develop generation projects (and energy efficiency) in Cambodia and an additional $8 billion spent on projects outside of Cambodia

ASES also requires $42 billion in total but with only $4 billion (half of that compared to SES) invested in neighbouring countries to export surplus resource

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BY 2050

$42 billion BAU

vs.

$48 billion SES

vs.

$47 billion (Real 2014 USD) ASES

The BAU investment (80%) to coal and hydro projects

SES (and ASES) some 55% (57%) is directed to solar and battery system technologies, with other significant investments in energy efficiency measures, bioenergy, wind and off-grid.

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BY 2050

BAU from 2015 to 2050 would be accompanied by the creation of some **722,727 jobs** years (27% man., 57% constr., 11% oper. & maint. and 4% fuel supply)

SES 1,049,428 job years (23% , 65%, 10% & 1%)

ASES 1,292,960 job years (23%, 67%, 10% & 0.4%)

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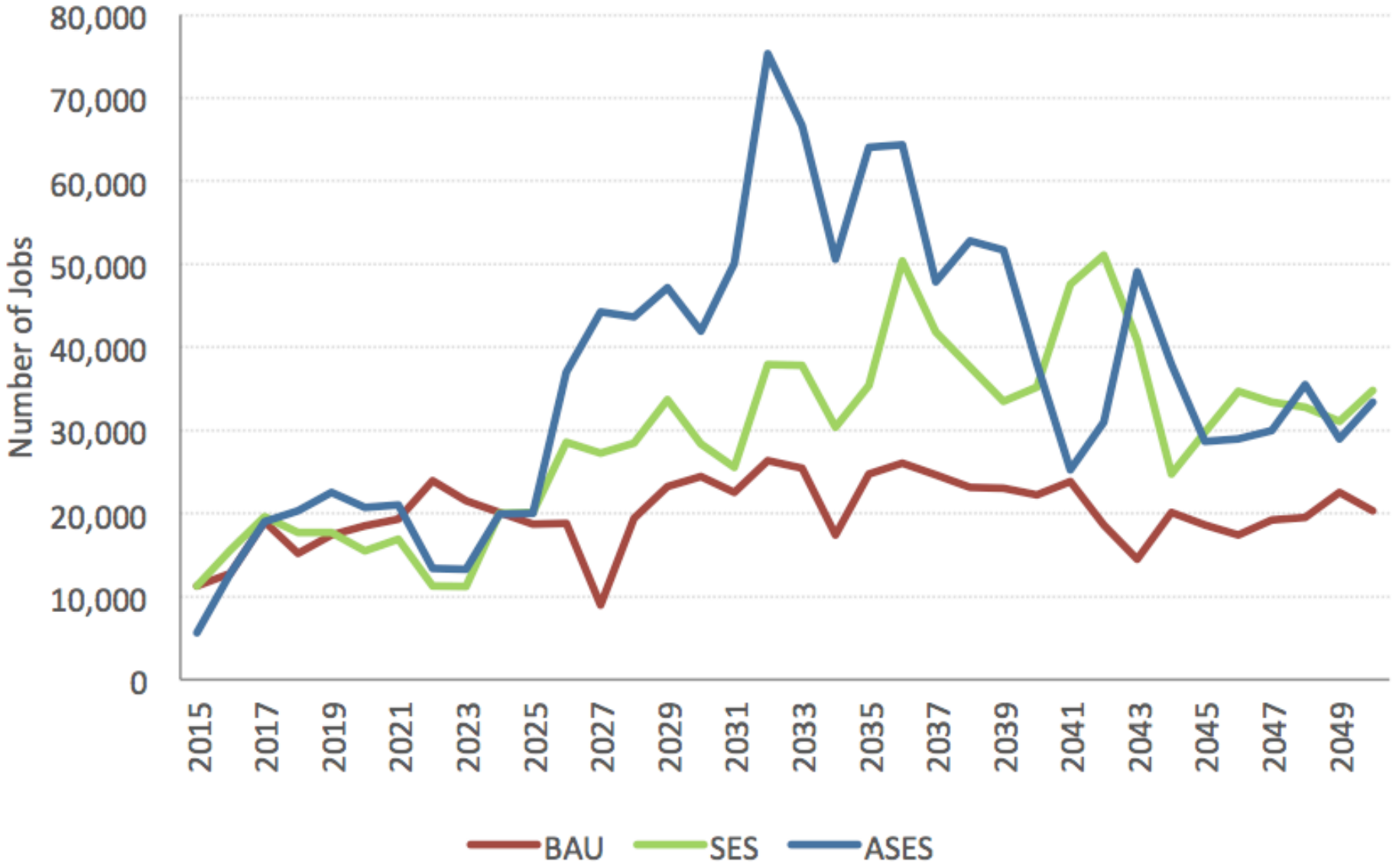
Figure 114 Total Job Creation Comparison BAU, SES and ASES



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University of Turku

BY 2050

Levelised cost of electricity (LCOE)

By 2050 the **BAU** trends towards **$77/MWh**.

The **ASES and SES** initially decline then increases together to approximately **$90/MWh** by 2050 driven by investment in more expensive renewable energy technologies (battery storages deployed further from the grid, CSP and bio generation technologies)

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CHALLENGES

1) Heavy reliance on the Mekong Basin flow and Cambodia's downstream location puts Cambodian hydropower at a distinct disadvantage in the future.
2) Lack of a comprehensive renewable energy policy.
3) The banking and finance sector supporting small and medium businesses remain in a relatively early stage of development.
4) Cambodia's management and planning systems need improvement, while the country is drawing up relevant laws and building out necessary infrastructure.

CHALLENGES

5) Lack of technical and operational expertise.
6) There are no significant incentives put in place or specific budget towards renewable energy.
7) Lack of accurate or updated renewable energy resource studies.
8) Lack of awareness of the importance of energy efficiency

WAY FORWARD

1) Comprehensive and transparent energy and energy efficiency policies regulatory framework
2) Electricity pricing policies and mechanisms that encourage investment in generation technologies, transmission and distribution equipment and end use energy consumption.
3) Detailed assessments of renewable energy potential and publicy the results

WAY FORWARD

4) Knowledge transfer and capability building in renewable energy technologies and energy efficiency for policy makers, energy industry and education institutions staff
5) Investments in ICT systems to allow for greater real-time monitoring, control and forecasting of power system, smart-grid technology and renewable energy systems and tools
6) Measures to encourage cross-border power trade in the region to exploit scattered renewable energy resource potentials
7) Measures to improve power planning in the region

END OF PART III
QUESTIONS?
COMMENTS?