

Climate change

Physical risks and adaptation plans



Climate Change Context Risks and Opportunities

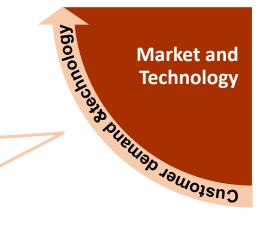
- Changes in weather patterns with more frequent and severe extremes of flood, drought, and typhoon intensity
- Global warming and rising sea water levels

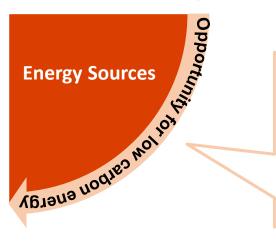
Physical Environment Impacts

Evolving compoliance requirements globally, setting regulatory framework such as cap and trade schemes, fuel/carbon taxes

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- Opportunities for energy efficient and low carbon technologies
- Changing markets and consumer preferences to more environmentally and socially responsible products





 Growing opportunity for low carbon energy sources (e.g., green hydrogen, electrolysis, and other alternative fuels) and renewable electricity supply to replace natural gas





Overall	Likelihood
• Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX	5- 10 years
• Flooding → reduced or halted plant generation → affect company revenue, OPEX, CAPEX, and maintenance	> 10 years
• Typhoons → damage infrastructure → impact transmission, solar panels, and ground infrastructure → affect company revenue, OPEX, CAPEX, and maintenance	> 10 years
• Extreme heat → increased temperature of cooling water → lower efficiency of steam turbine, disruption to distribution, and solar panel efficiency → affect company revenue, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years
 Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water supply 	Mostly > 10 years



Operating projects: SPP



	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Water supply agreement enables to claim for poor water quality from the water supplier List of suppliers who can provide backup water during crisis Maximize cycle of concentration – Cooling Water Recycle water from sludge thickener to clarifier Work Instruction: Operation for lack of raw material
•	Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance Online monitor flood water level from surrounding areas. Construct flood wall & gate / flood protection sump pump / gate flood protection
•	Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
•	Extreme heat \rightarrow increase temperature of cooling water \rightarrow lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment to prevent output dropping in rising temperature (>10 years) Install equipped chiller (<5 years) Install evaporating cooler (<5 years)
•	Sea level rise increase sea water in water supply affect OPEX of chemicals for treating water supply	> 10 years	 Improve resin system (Replace every 5 years, Top Up - every year) Improve water treatment system (>10 year) Online monitoring quality of raw water





	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water List of suppliers who can provide backup water during crisis Maximize cycle of concentration – Cooling Water Recycle water from sludge thickener to clarifier
•	Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Property insurance
•	Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
•	Extreme heat \rightarrow increase temperature of cooling water \rightarrow lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years) Install equipped chiller (<5 years) Install evaporating cooler (<5 years)
•	Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water supply	> 10 years	Online monitoring quality of raw water



BLPC 1-2, BPWHA 1, BGPM

Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
 Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX 	5-10 years	 Increase wastewater treatment capacity (<5 years) Own reservoirs (5-10 years) Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Water supply agreement enables to claim for poor water quality from supplier List of suppliers who can provide backup water during crisis Maximize cycle of concentration – Cooling Water
 Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance Online monitor flood water level from surrounding areas.
• Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
• Extreme heat → increase temperature of cooling water → lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years) Install equipped chiller (<5 years) Install evaporating cooler (<5 years)
• Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water	> 10 years	Online monitoring quality of raw water



	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Maximize cycle of concentration – Cooling Water
•	Flooding reduced or halted plant generation affecting company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance
•	Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
•	Extreme heat \rightarrow increase temperature of cooling water \rightarrow lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years) Install evaporating cooler (<5 years)
•	Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water supply	3-5 years	 Online monitoring quality of raw water Close monitoring situation of National Hydro Informatics Adjust chemical or process of water treatment plant Change equipment materials which could be impacted from chloride corrosion





	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
stea elect	er stress \rightarrow reduce water supply \rightarrow impact m turbine, potentially affect 1/4 of the total tricity production \rightarrow directly impact company enue and OPEX	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Maximize cycle of concentration – Cooling Water
\rightarrow	oding >> reduced or halted plant generation affecting company revenue, OPEX, CAPEX, maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance
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supp	level rise → increase sea water in water oly → affect OPEX of chemicals for treating er supply	5-10 years	Online monitoring quality of raw water



Operating projects: Solar Thailand



15 solar projects

Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
• Water stress → (minimal impact)	5-10 years	• N/A
 Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	 Monitoring situation of National Hydro Informatics Provide dike around power plant for flooding protection Emergency response plan & Business continuity plan in case flooding Property insurance
 Typhoons → damage to equipment → affect company revenue, OPEX, CAPEX, and maintenance 	> 10 years	 Preventive maintenance and Corrective Maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department Engineering Design accepted wind speed 0 – 25 m/s
• Extreme heat → Effect solar panel efficiency → affecting company revenue and maintenance	> 10 years	Change New Batter Technology of PV Module to increase efficiency/or find the solution to cooling PV Module in case of PV Module Temperature increase
• Sea level rise → (minimal impact)	> 10 years	• N/A



WVO/COOP 7 solar projects

	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → (minimal impact)	5-10 years	• N/A
•	Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance
•	Typhoons → damage to equipment → affect company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance and Corrective Maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department Engineering Design accepted wind speed 0 – 30 m/s
•	Extreme heat → Effect solar panel efficiency → affecting company revenue and maintenance	> 10 years	• N/A
•	Sea level rise → (minimal impact)	> 10 years	• N/A



Under construction: 7 SPP projects



ABP 1R and ABP 2R (COD in 2022)

	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Water supply agreement enables to claim for poor water quality from the water supplier List of suppliers who can provide backup water during crisis Maximize cycle of concentration – Cooling Water Recycle water from sludge thickener to clarifier Work Instruction: Operation for lack of raw material
•	Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance Online monitor flood water level from surrounding areas. Construct flood wall & gate / flood protection sump pump / gate flood protection
•	Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
•	Extreme heat \rightarrow increase temperature of cooling water \rightarrow lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment to prevent output dropping in rising temperature (>10 years) Install equipped chiller (<5 years) Install evaporating cooler (<5 years)
•	Sea level rise increase sea water in water supply affect OPEX of chemicals for treating water supply	> 10 years	 Improve resin system (Replace every 5 years, Top Up - every year) Improve water treatment system (>10 year) Online monitoring quality of raw water



BPLC 1R (COD 2022)

	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX	5-10 years	 Increase wastewater treatment capacity (<5 years) Own reservoirs (5-10 years) Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Water supply agreement enables to claim for poor water quality from supplier List of suppliers who can provide backup water during crisis Maximize cycle of concentration – Cooling Water
•	Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance Online monitor flood water level from surrounding areas.
•	Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
•	Extreme heat \rightarrow increase temperature of cooling water \rightarrow lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years) Install equipped chiller (<5 years) Install evaporating cooler (<5 years)
•	Sea level rise increase sea water in water supply affect OPEX of chemicals for treating water	> 10 years	Online monitoring quality of raw water



BGPM 1 & 2 R (COD 2022)

Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
 Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX 	5-10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Maximize cycle of concentration – Cooling Water
• Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance Online monitor flood water level from surrounding areas.
• Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
• Extreme heat → increase temperature of cooling water → lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years)
• Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water	> 10 years	No Risk



BPAT 2 & 3 (COD 2023)

	Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
•	Water stress → reduce water supply → impact steam turbine, potentially affect 1/4 of the total electricity production → directly impact company revenue and OPEX		 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Maximize cycle of concentration – Cooling Water
•	Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance	> 10 years	 Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance
•	Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance	> 10 years	 Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
•	Extreme heat \rightarrow increase temperature of cooling water \rightarrow lower efficiency of steam turbine, OPEX from more gas consumption, and CAPEX investment to reduce temperature	> 10 years	 Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years) Install evaporating cooler (<5 years)
•	Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water supply	5-10 years	Online monitoring quality of raw water