



B.GRIMM

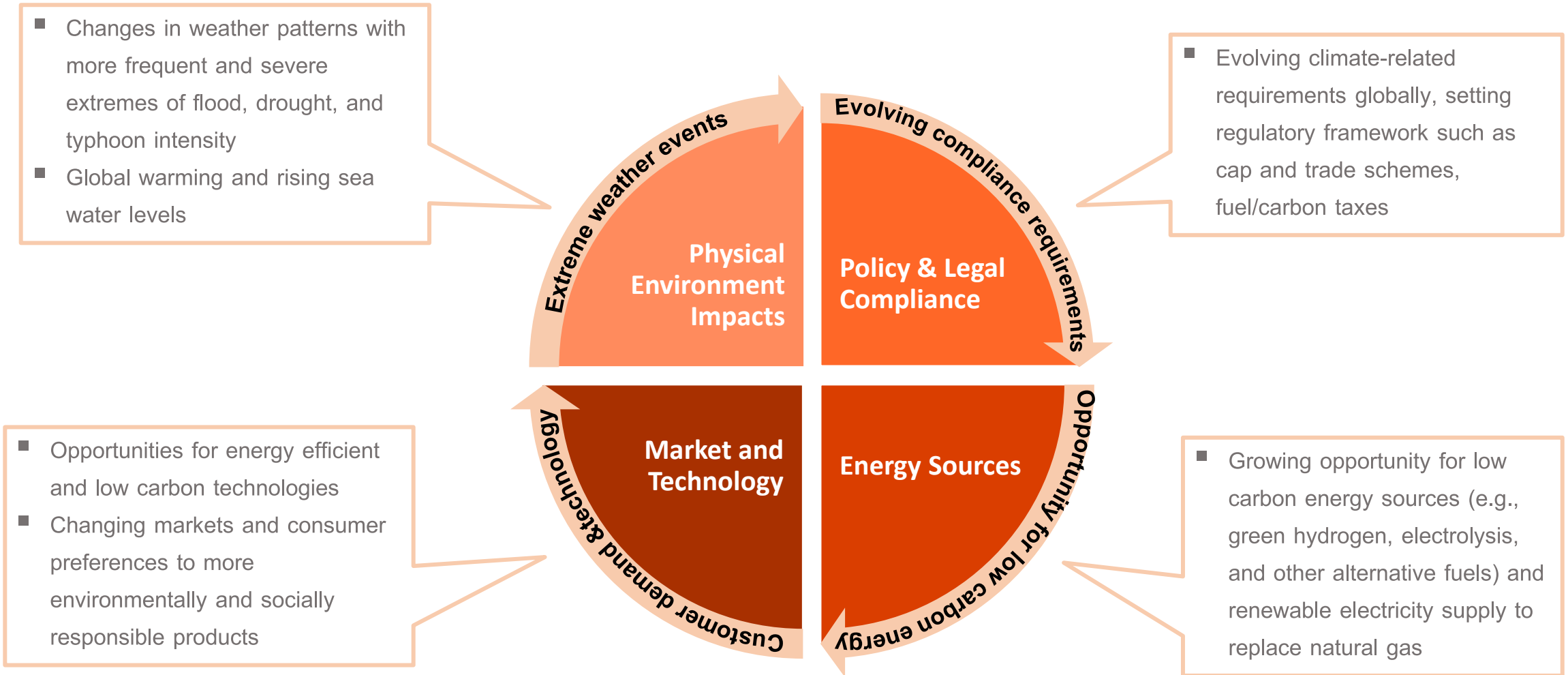
SINCE 1878

Climate change

Physical risks and adaptation plans

Climate Change Context

Risks and Opportunities



Overall	Likelihood
<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • Flooding → reduced or halted plant generation → affect company revenue, OPEX, CAPEX, and maintenance 	> 10 years
<ul style="list-style-type: none"> • Typhoons → damage infrastructure → impact transmission, solar panels, and ground infrastructure → affect company revenue, OPEX, CAPEX, and maintenance 	> 10 years
<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	5-10 years	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Upgrade equipment to prevent output dropping in rising temperature (>10 years) Install equipped chiller (<5 years) Install evaporating cooler (<5 years)
<ul style="list-style-type: none"> Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water supply 	> 10 years	<ul style="list-style-type: none"> Improve resin system (Replace every 5 years, Top Up - every year) Improve water treatment system (>10 year) Online monitoring quality of raw water

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<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> Monitoring situation of National Hydro Informatics Property insurance
<ul style="list-style-type: none"> Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
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<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> 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.
<ul style="list-style-type: none"> Typhoons → damage infrastructure → impact transmission and ground infrastructure → affect revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> Preventive maintenance infrastructure system of power plant and transmission line Monitoring climate from Thai Meteorological Department
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<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan for lack of raw water Maximize cycle of concentration – Cooling Water
<ul style="list-style-type: none"> Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance
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<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Upgrade equipment for main machine (to prevent output dropping in rising temperature) (>10 years) Install evaporating cooler (<5 years)
<ul style="list-style-type: none"> Sea level rise → increase sea water in water supply → affect OPEX of chemicals for treating water supply 	3-5 years	<ul style="list-style-type: none"> 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

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Operating projects: Solar Thailand

Physical Risks	Likelihood	Adaptation Plans (and Implementation Timeline)
<ul style="list-style-type: none"> Water stress → (minimal impact) 	5-10 years	<ul style="list-style-type: none"> N/A
<ul style="list-style-type: none"> Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Typhoons → damage to equipment → affect company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Extreme heat → Effect solar panel efficiency → affecting company revenue and maintenance 	> 10 years	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Sea level rise → (minimal impact) 	> 10 years	<ul style="list-style-type: none"> N/A

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<ul style="list-style-type: none"> Water stress → (minimal impact) 	5-10 years	<ul style="list-style-type: none"> N/A
<ul style="list-style-type: none"> Flooding → reduced or halted plant generation → affecting company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> Monitoring situation of National Hydro Informatics Emergency response plan & Business continuity plan in case flooding Property insurance
<ul style="list-style-type: none"> Typhoons → damage to equipment → affect company revenue, OPEX, CAPEX, and maintenance 	> 10 years	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Extreme heat → Effect solar panel efficiency → affecting company revenue and maintenance 	> 10 years	<ul style="list-style-type: none"> N/A
<ul style="list-style-type: none"> Sea level rise → (minimal impact) 	> 10 years	<ul style="list-style-type: none"> N/A

Under construction: 7 SPP projects

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

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