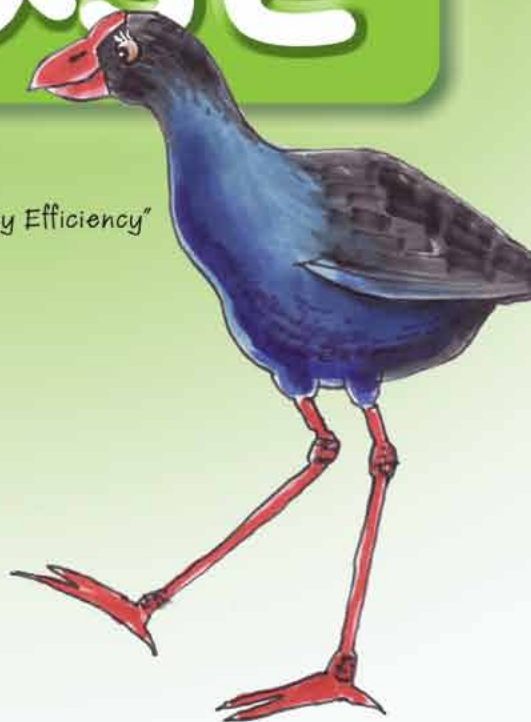


TWIGGY and TUA's

# GREEN DREAM HOUSE



"It's all about Energy Efficiency"



Written and illustrated by Rick McKinley

SUITABLE FOR  
**YEAR 5-8**



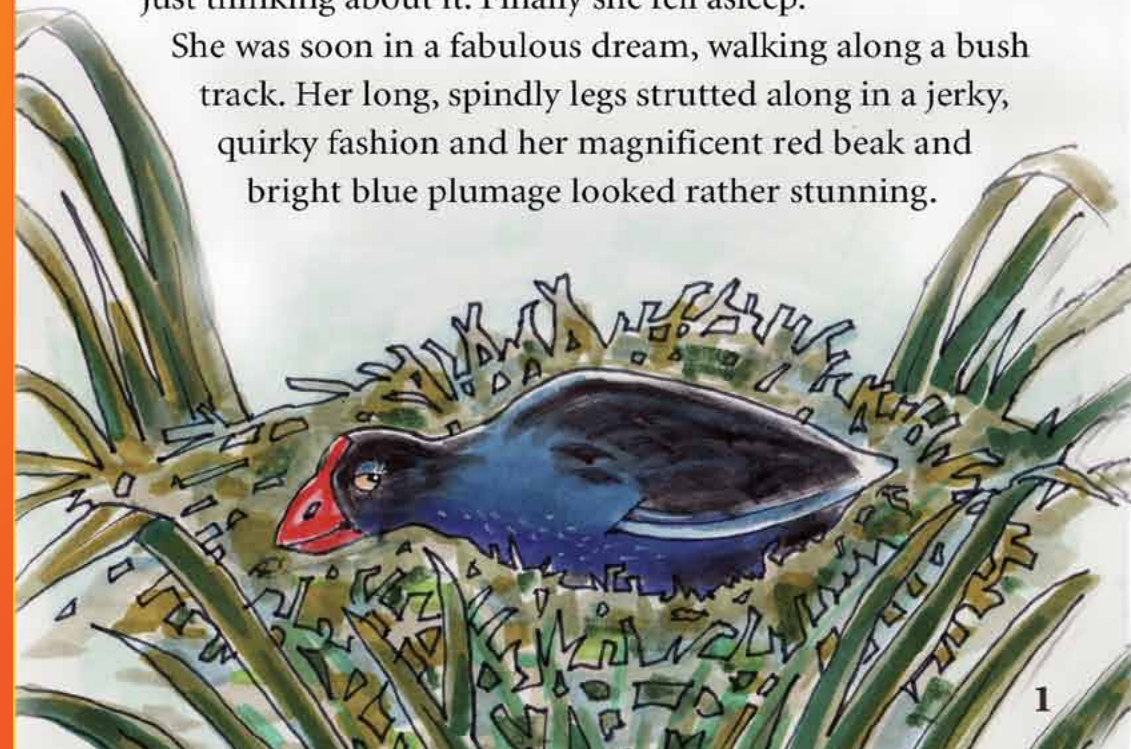
TWIGGY and TUA's



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**T**WIGGY was trying to go to sleep. The nest was damp and cold and she started wondering why Pukekos had always lived this way. Twiggy could only imagine how nice a warm, dry house would be. Of course she had no idea how to build it, in fact it made her tired just thinking about it. Finally she fell asleep.

She was soon in a fabulous dream, walking along a bush track. Her long, spindly legs strutted along in a jerky, quirky fashion and her magnificent red beak and bright blue plumage looked rather stunning.



Suddenly she saw a movement out of the corner of her eye. At the side of the track was a creature she had never seen before. It looked like a miniature dinosaur, lying on a rock and basking in the sun. Absolutely motionless, like a statue, it was so well camouflaged she might not have seen it at all.

Then Twiggy realized what had distracted her. At lightning speed its long pink tongue had caught a grasshopper, which was still struggling helplessly.

“What are *you* looking at?” croaked the prehistoric creature as he crunched his prey between scissor-like teeth, “you look like you’ve seen a ghost!”

His loud voice startled Twiggy.

“Ooh, I am s-s-sorry,” she stammered nervously. “It’s just that I’ve never seen anything like you, but I’m only one year old...”

“I’m a *Tuatara*, but you can call me *Tua*,” replied the reptile in a softer tone of voice. “I am a *hundred* years old, well, almost.” One of his large eyes blinked lazily. “Tuataras have been around for *millions* of years so we know everything, well, almost...”

He was *weird*, but Twiggy was fascinated by the leathery texture of his skin and the white speckles under his chin and belly. In a funny kind of way he looked rather stunning too. Anyway, he seemed friendly enough, even if he was a bit scary.



“I lie in the sun to keep warm, it’s a bit chilly in my burrow,” said Tua.

“It’s chilly in my nest too – there must be a better place to live,” added Twiggy.

“Ah, there is! It’s called the *Green Dream House* – come and I’ll show you!” shouted Tua, darting off the rock with surprising speed. “I know *all* about it!”

As she followed her new friend along the track, he explained that the house was designed to be **Energy Efficient**, using solar power and lots of energy-saving features.

“Close your eyes and imagine a beautiful green house,” said Tua, pointing to a lovely green field in front of them. Twiggy suspected some kind of trick, but she closed her eyes anyway. After all, this *was* a dream.

When she opened them there it was.

“WOW!” she exclaimed, “what a house!”

“It certainly is,” agreed Tua. “See the roof, it has **solar panels** set into the roofing to generate electricity for the house. The two solar panels at the right hand end of the roof heat the water for the house. Do you know, heating water and heating the house accounts for **60%** of household energy use, well, almost...”

“What about the lights?” asked Twiggy, “my cousin starred in a TV commercial and turned off the lights, and that was really important...”

“Lighting uses 10 - 15% of the power,” replied Tua, “appliances use the other 25 - 30%, like the fridge, oven, microwave, washing machine, clothes drier, vacuum cleaner, toaster, electric jug, iron, heated towel rail, TV, DVD, computers, charging up mobile phones, iPads...some humans have a lot of stuff!”

Twiggy looked bewildered.



“The sun keeps us *warm* too,” said Twiggy.

“That’s true, but it’s about using energy *efficiently*, and that means keeping the heat **IN** by installing insulation, using the right building materials, eliminating draughts and heat loss through windows as well as turning off lights and appliances when they are not needed.”

“Do all houses use solar energy?” inquired Twiggy.

“No they don’t. Houses are connected to mains power from the national grid which is the electricity network supplying New Zealand. Most of our electricity comes from

**hydro-electric power stations**. Water from our rivers and lakes is released through turbines to generate electricity.

This is one way of using **renewable** energy to make electricity.

Power companies operate the hydro-electric power stations and supply homeowners with the electricity they need,” Tua explained.

“So most electricity comes from water power?” asked Twiggy.

“Yes, but nearly half comes from other energy sources. For example,

**geothermal** power stations use the power of steam from underground to spin turbines and generate electricity. Then there are

**thermal power stations** burning

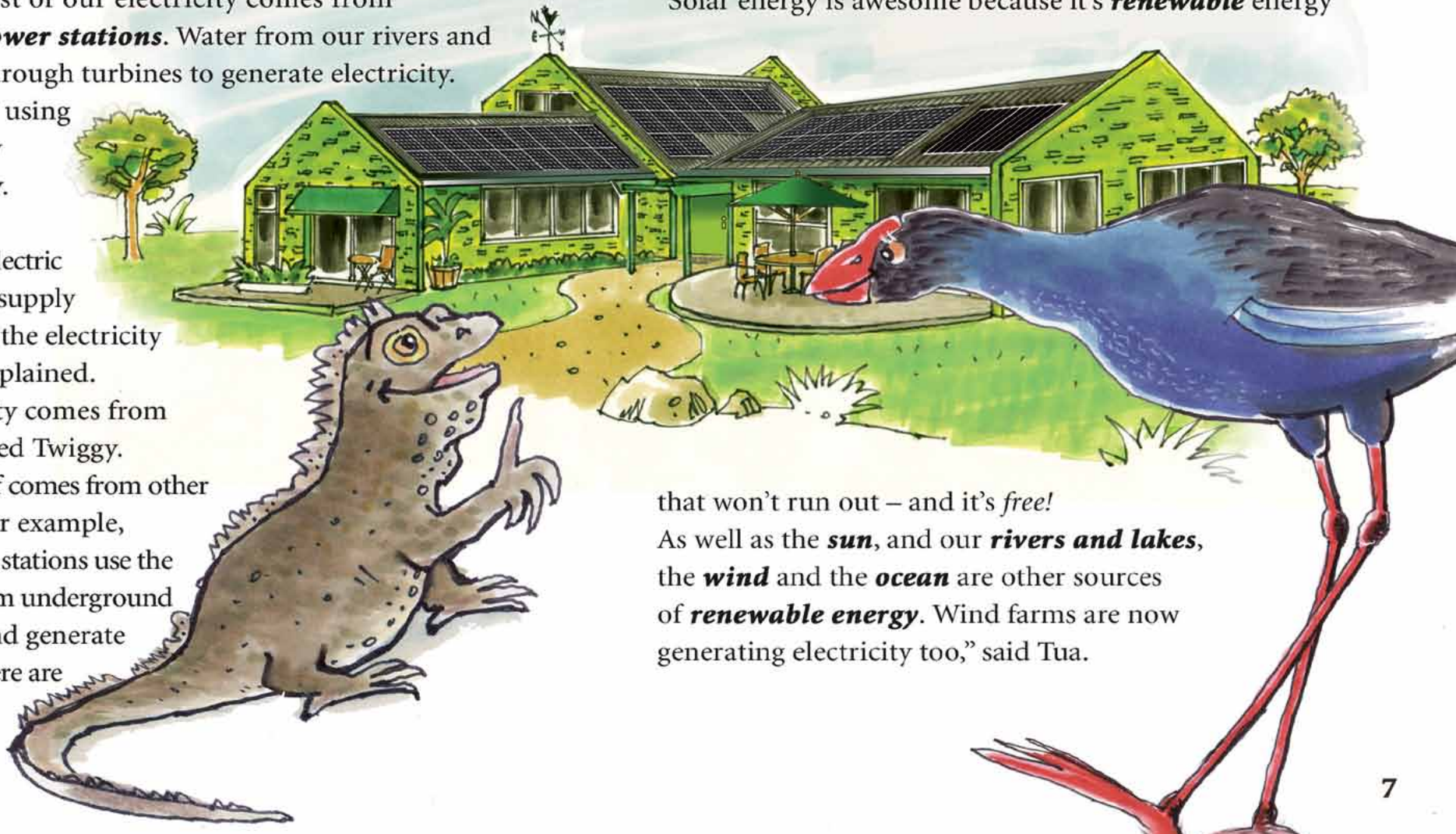
mainly gas or coal, which are *fossil fuels* that will eventually run out. Fossil fuels are *not* renewable because they take millions of years to make. Also, when they burn, *carbon dioxide* goes up into the air. It’s called a **greenhouse gas** because it traps some of the sun’s energy going back into space. This heats up the planet and contributes to **global warming**.” Tua paused to take a breath.

“So why does the Green Dream House use **solar** energy?” asked Twiggy, sounding rather confused.

“Solar energy is awesome because it’s **renewable** energy

that won’t run out – and it’s *free*!

As well as the **sun**, and our **rivers and lakes**, the **wind** and the **ocean** are other sources of **renewable energy**. Wind farms are now generating electricity too,” said Tua.





“Also, if you have a stream nearby you can use a small hydro electric generator to make electricity. In fact, nearly **80%** of New Zealand’s electricity is generated from renewable sources.”

“How do the solar panels on the roof work?”

mumbled Twiggy as she gazed at the roof.

Tua was pleased she asked because this was his favourite subject.

“Actually solar panels that make electricity are called **photovoltaic panels**, or PV systems.” Tua’s big round eyes lit up as he spoke.

“Do you know, Tuataras get energy from the sun too! We are cold-blooded, you see, and need less food for energy than you warm-blooded animals. We get lots of our energy from lying about in the sun...”

Twiggy recalled her surprise at Tua’s sudden burst of energy jumping off the rock.

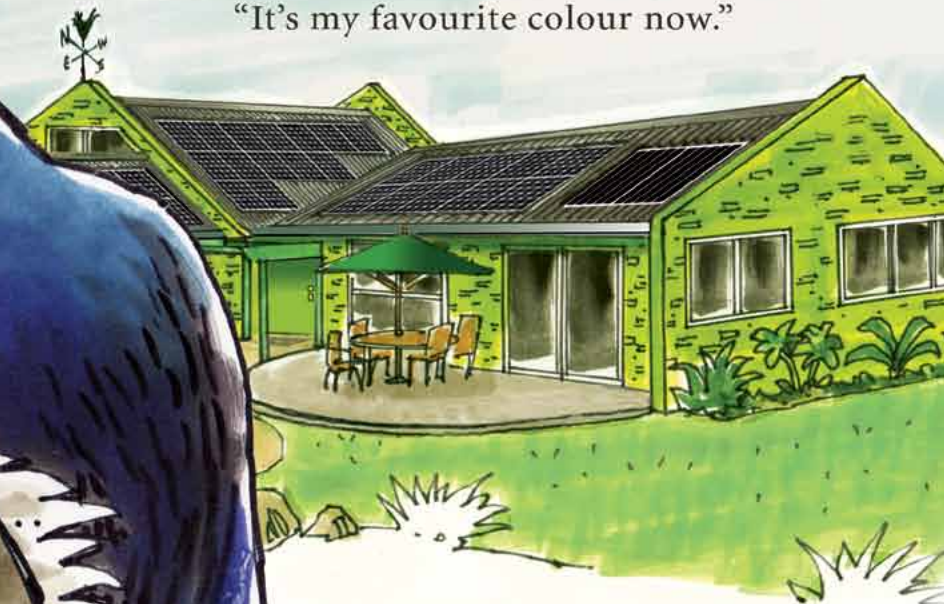
“So how do they work?” asked Twiggy impatiently.

“Well, in New Zealand the sun




always shines from a *Northerly* direction as it moves from East to West during the day, so solar panels work best when they are tilted to face the **North**,” said Tua, pointing to the North like a weather expert. “They absorb tiny packets of solar energy called **photons**. Then the photons’ energy is taken by **electrons**, which flow as **direct current**, which is a kind of electricity. An **inverter** is needed to turn the direct current into **alternating current**, which is the kind of electricity needed to turn on the lights and TV in most houses...”

“Are there *lime green* ph-photov-v-voltaics?” stammered Twiggy, who always struggled with big words. “It’s my favourite colour now.”



“Photovoltaics are usually black or dark blue,” Tua replied, “because dark colours *absorb* most of the light. Now there are new photovoltaic roofing materials, so the *whole roof* catches the sun. One day these could replace solar panels.”



“Wow, that’s all a bit much for my bird brain!” joked Twiggy, “but what if the sun isn’t shining?”

“Photovoltaics produce *some* electricity even on cloudy days,” explained Tua. “Excess electricity generated by the photovoltaics can be sold to the national grid or stored in batteries which serve as a back-up when the photovoltaics do not produce enough electricity to satisfy household needs. However, a *totally* energy efficient house generates all the power it needs from the sun or another source of renewable energy.”

“Did you say the solar panels at the right hand end of the roof heat water?” asked Twiggy inquisitively.

“Correct,” replied Tua. “It’s a **solar water heating system** which provides hot water heated by the sun. Basically the water is pumped up from the hot water cylinder to the solar panels, heated by the sun, and pumped back down again. When there isn’t enough sun to heat the water, electricity or gas is used to keep the water in the cylinder at the right temperature. So the sun provides the house with lovely hot water, saving lots of electricity,” said Tua.

“It would be nice to have hot water,” sighed Twiggy, “I only have a freezing cold stream!” Her eyes were closed and she was still facing North to catch the sun’s warmth. “It’s getting a bit chilly now, can we go inside?” she asked.



Almost magically, a little green man appeared out of nowhere, holding a large golden key. The dream was getting *weirder* by the minute!

“Top o’ the mornin’ to ya,” said the little man cheerfully as he unlocked the green door. “Come on in!”

“Oh, th-th-thank you,” replied Twiggy, who was startled by his appearance. His hair and bushy eyebrows were bright green and green spectacles sat on his pink nose. Dressed in shades of green, he had very short legs - or, very long shorts. Either way he truly was a flamboyant character.



“This is my house and I know all about it, to be sure”, he said in a lilting accent, almost singing the words.

“You too?” exclaimed Twiggy, glancing at Tua as they stepped inside.

“Ooh, it’s *so* cosy!”

“Yes, because the house is fully insulated to retain the heat,” said Tua, acknowledging the little green man with a smile.

“Twiggy, I’d like you to meet my old friend Greeny.”

“Pleased to meet you Miss Twiggy, to be sure. My real name is Patrick Greenstreet, but everyone calls me *Greeny!*” he announced. He opened his arms wide to show off his green T-shirt:

**G - R - E - E - N...**

**Get Renewable Energy Efficient Now!**

“Cool shirt!” Twiggy squealed.

“Cool name too!”





Greeny always liked to show off a little, so Tua simply carried on regardless with his hot water lesson. “An **insulation wrap** fitted around the hot water cylinder can make it more energy efficient,” he continued, opening the hot water cylinder cupboard, “and the cylinder pipes can be wrapped with an **insulation foam**, to reduce heat loss. The hot water should be set to 55 degrees and a water-efficient shower head can save hot water. It all helps to save power.” “M-m-m-m-m,” was all Twiggy could think of saying. After all, she had never heard of a hot water cylinder - or a shower head for that matter.

“Designing buildings to optimize light and heat from the sun is called **‘passive solar design’**, and there are many factors to consider, to be sure,” added Greeny who grabbed the chance to get a word in.



“First, the house should be built facing **North**, preferably on a sunny site. The living areas, or the rooms you use most during the day, should be on the North side to maximize the sun’s light and heat, while less-used rooms like the bathroom, laundry and garage, should be on the South side. **Eaves** are most important because they let the sun in during winter when the sun’s elevation is lower, while keeping it out to prevent overheating in summer. **Awnings, blinds** and **external shutters** can help too,” Greeny concluded.

“Oooh, there’s so much to remember,” said Twiggy, trying hard to concentrate.



“Mmm, but that’s not all,” Greeny went on, “the house should be built well away from obstacles that will shade the house in winter, like other buildings, hillsides or trees. It pays to plant **deciduous** trees that let the sunlight through in winter but provide shade to keep the house cool in summer...”

“And using heavyweight materials is good passive solar design,” added Tua, “such as a concrete floor slab, ceramic tiles or brick walls. These create **‘thermal mass’** which absorbs and ‘stores’ solar heat when exposed to direct sun, then slowly releases heat back into the house as it cools down at the end of the day.”

“Like a rechargeable battery storing heat,” Twiggy cleverly observed. “Exactly! Well done Twiggy, but one of the most important things for an energy efficient home is **effective insulation**, which is needed to **keep the heat IN**,” Tua emphasized. “Roof and ceiling insulation alone reduces heat loss by up to **40%** and that saves a *lot* of energy...”

“Nests don’t have ceilings to insulate!” Twiggy remarked. “To be sure Miss Twiggy, but heat is lost through *windows* too,” Greeny chipped in. “So it’s good passive design to have larger windows on the North side of the house to capture the sun, and smaller ones on the other sides to minimize heat loss. Glass roofs or skylights might look nice but they can also cause heat loss in winter - and let in too much heat during summer. And it’s a fact that more heat is actually lost through *aluminium* window joinery than timber or PVC...”





“I notice the bedroom is cooler than the lounge,” observed Twiggy as she checked out the rooms.

“To be sure, that’s due to **passive solar design** too,” said Greeny. The bedrooms are on the West side to stay cool in the morning, yet catch the warmth of the setting sun in the evening. The rooms most used, such as the lounge and patio, are on the sunny North side. The kitchen faces East to get the morning sunlight and warmth as the sun rises, while the bathroom, laundry and garage need sunlight the least so they’re facing South – the coldest side of the house,” explained Greeny, waving his arms in four directions as he spoke.

“Remember, **home heating and water heating use 60%** of household electricity, well, almost,” added Tua, showing off his knowledge once again. “So to save electricity it’s important to use the power of the sun in every way possible. In winter this can be supplemented by other forms of heating such as a heat pump, electric heater, oil-filled heater, gas heater, wood burner or an open fire, but the *Green Dream House* needs very little heating due to passive solar design. In fact, by using the sun to generate its own electricity and to heat water, it may not need much electricity from the national grid at all!”

“That really is *green!*” said Twiggy, who realized that the word “green” referred to being **energy efficient**. She also knew it was used in relation to ‘environmentally friendly’ products. “Using energy efficiently not only saves money, but also benefits the entire country by reducing demand for energy. It also reduces our production of greenhouse gases that cause global warming and climate change,” declared Tua, still waving his arms about like an eloquent politician.

“Do you know, generating electricity for the average house causes over one tonne of carbon dioxide greenhouse gas emissions every year! That’s why using energy efficiently **‘reduces our carbon footprint’** on the environment.”

Twiggy looked down at their feet. Tua had more claws than her which would make a larger footprint, but she decided the word must be a figure of speech. Meanwhile, Greeny’s shoes were just too bright to look at.

“If **insulation** is so important, where *is* it?” questioned Twiggy, trying to be intelligent.

“To be sure, that’s the awesome thing about energy efficient houses!”

Greeny enthused, “you can’t see much difference at all, but you can *feel* it. Now, let’s imagine we can see through the walls, it is a dream after all,” he reminded her with a wink.

Twiggy’s beady eyes noticed sheets of fluffy stuff fitted neatly between the timber framing inside the walls.

“It looks like *candy floss!*” she squealed.

“Yes, it’s a blanket type of insulation,” Greeny explained, “there are many kinds – fibreglass, wool, mineral fibre, polyester and expanded polystyrene - made of fibres that criss-cross each other to form tiny air cells which slow down the transfer of heat

through the insulation. The thicker or denser it is, the better, and it needs to be installed with no gaps that will let the heat out. There is a loose-fill type of insulation available too.”

“How did it get it *in* there?” asked Twiggy.

“It’s best to insulate inside the walls when the house is being built, but it’s even more important to **insulate the ceiling,**” stressed Greeny, “and this can be done at the same time, or retrofitted in older houses.”



“Heat rises, you see, so up to **40% of heat loss is through the ceiling,**” Tua elaborated while pointing skyward. “Compared to up to **25% of heat lost through outside walls** and up to **15% through the floor.**”

“So in winter insulation keeps heat **IN**. In summer, it helps to keep heat **OUT**, to be sure,” Greeny added emphatically.

“Warm in winter, cool in summer,” Twiggy summed up.

“How *perfect* is that!”

“Well almost, but the **heat loss through windows** can be even worse than walls, so how can we stop that?” challenged Tua.

“*Insulate* the windows?” guessed Twiggy with a shrug.

“Well almost,” said Tua as he put one eye against a window pane. “Let’s look closely, because these windows do have their own kind of insulation. It’s called **double glazing** which

**reduces heat loss from windows by up to 50%** in winter! No wonder

double glazing is now compulsory in new houses, and it can be retrofitted to older houses too...”

“I can’t see anything - except the garden,” said Twiggy, staring through the window, “ooh, and a butterfly...”

Greeny chuckled with delight.

“Would you believe there are actually **two panes of glass** with space in between – like a glass and air sandwich.”

*A sandwich?* thought Twiggy, looking puzzled.



“You see, the sealed air pocket in between forms a thermal separation between inside and outside, helping to keep the house warm in winter and cool in summer. Double glazing also reduces condensation, to be sure, and noise from outside...”

“A *sandwich*? It wouldn’t *taste* very nice,” mumbled Twiggy.

“Ha! You birds, always thinking about food,” Tua scoffed, “while I’m thinking about curtains...”

“You eat *curtains*?” gasped Twiggy in shock.



“No, I prefer grasshoppers!” said Tua, “but **curtains help to reduce heat loss**. They should be made from heavy thermal or close-woven materials, full length to the floor where possible, with thermal linings as well,” he stated like an instant curtain expert. “They should be bigger than the window frame, closely fitted without gaps that warm air can escape through, and they should be drawn at sunset to keep warm air in. A **pelmet** at the top of the curtain reduces heat loss even further,” added Tua as he drew back the curtain to show the thermal lining behind it. “The sun’s streaming through these large front windows – it’s lovely and warm,” said Twiggy.

“To be sure,” replied Greeny, “because they’re facing **North**. The windows facing East and West are smaller - smaller still on the cold South side of the house - to prevent heat loss.”

“At least it’s not *draughty* like my nest,” remarked Twiggy. “Not at all,” Greeny affirmed in his high-pitched voice, pointing to the foot of the front door. “**Draught stoppers** are fitted under the doors, while **building paper** in the floor, walls and ceiling joints helps to keep the house airtight. **Landscaping** can help too, with trees and shrubs to shield the house from strong prevailing winds. In older houses, **adhesive foam tape** is often used around door and window frames to stop draughts. If there’s a fireplace, a **fireguard** helps to prevent draughts too. You can even block the chimney up during summer – but it’s a good idea to leave a reminder note in the fireplace or you might forget and smoke the house out!”

Greeny erupted with hoots of laughter.



“There are no draughts in here at all - it’s not *damp* like my nest either,” Twiggy noted.

“A **polythene moisture barrier** laid under the house prevents dampness rising from the ground,” Tua continued with his wealth of knowledge. “Steam moisture from cooking and showers can be removed with **vents** in the kitchen, bathroom and laundry. **Fans** and **ventilation** systems can also be used. Insulation, double glazing, thermal curtains and ventilation all help to prevent moisture forming on the inside of windows, too – it’s called **condensation**.”

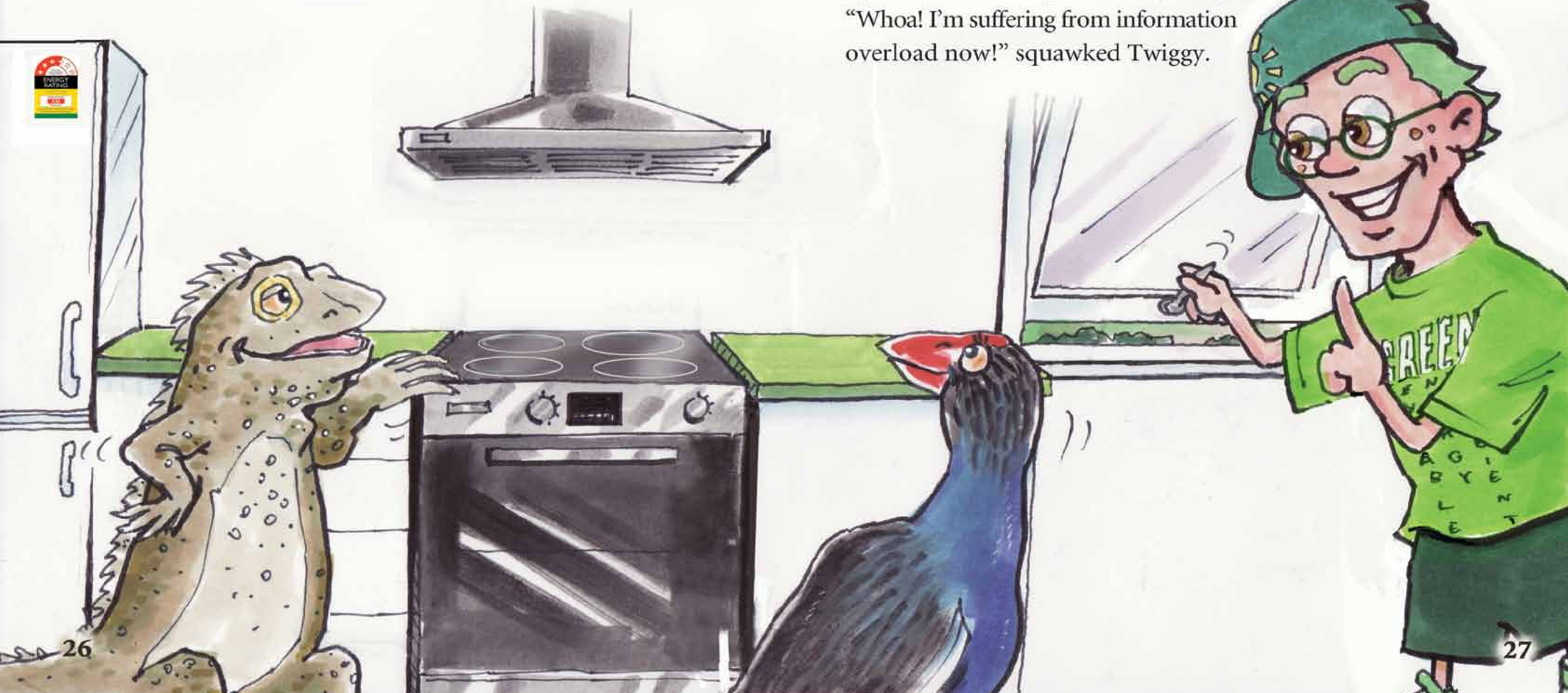
“Can’t you just open a window to ventilate the room?” asked Twiggy simplistically.

“To be sure, but maybe not in mid winter!” replied Greeny who felt it was his turn to speak. “Windows should be opened to ventilate rooms which may overheat in summer, and to remove steam from wet areas. In fact, at least 30% of windows should be windows that can open.”

“In extreme sun-spaces, like conservatories, high and low vents are needed for outgoing and incoming airflow,” added Tua.

“A **ceiling fan** can also be used to circulate warm air and suck up cold air, creating a cooling draught.”

“Whoa! I’m suffering from information overload now!” squawked Twiggy.



“What’s that twirly thing? It looks like a Mr Whippy ice cream!” squealed Twiggy as she looked inquisitively under a lampshade. “Dream on! That’s an **energy efficient light bulb**,” answered Greeny who was clutching a few light bulbs. His face lit up as he spoke. “It uses 80% less electricity than an old-style incandescent bulb and lasts up to 10 times longer!”

“Well, almost...” Tua added conservatively.

Twiggy screeched with delight at his obvious competitive streak. “It’s a **Compact Fluorescent Lamp, or CFL**,” verified Tua. “That’s a spiral shape, but there are candle shapes and traditional shapes as well. CFL’s are very energy efficient light bulbs and use the same technology as fluorescent tubes which are also long lasting and efficient. There are also new generation **Halogen** incandescent bulbs available. They look like the old-style bulbs but use 30% less electricity, last twice as long and can be used with dimmers...”

How did Tua *know* all this stuff? wondered Twiggy.

“There are also **LED** lamps, or *Light Emitting Diodes*, which come in many strengths and varieties,” Tua continued relentlessly.



Some have smaller LED’s clustered together and are not as bright as high powered LED’s which can last up to 30 years or more. I believe these are the light bulbs of the future.”

“Was there anything *wrong* with the old-style bulbs?” asked Twiggy.

“Old-style bulbs are not energy efficient at all because only 5% of the energy they use makes light - the other 95% just makes *heat!*”

Tua answered disdainfully. “Recessed downlights are not energy efficient either, because holes have to be cut in the insulation around them for fire safety reasons, leaving gaps that cause heat loss.”

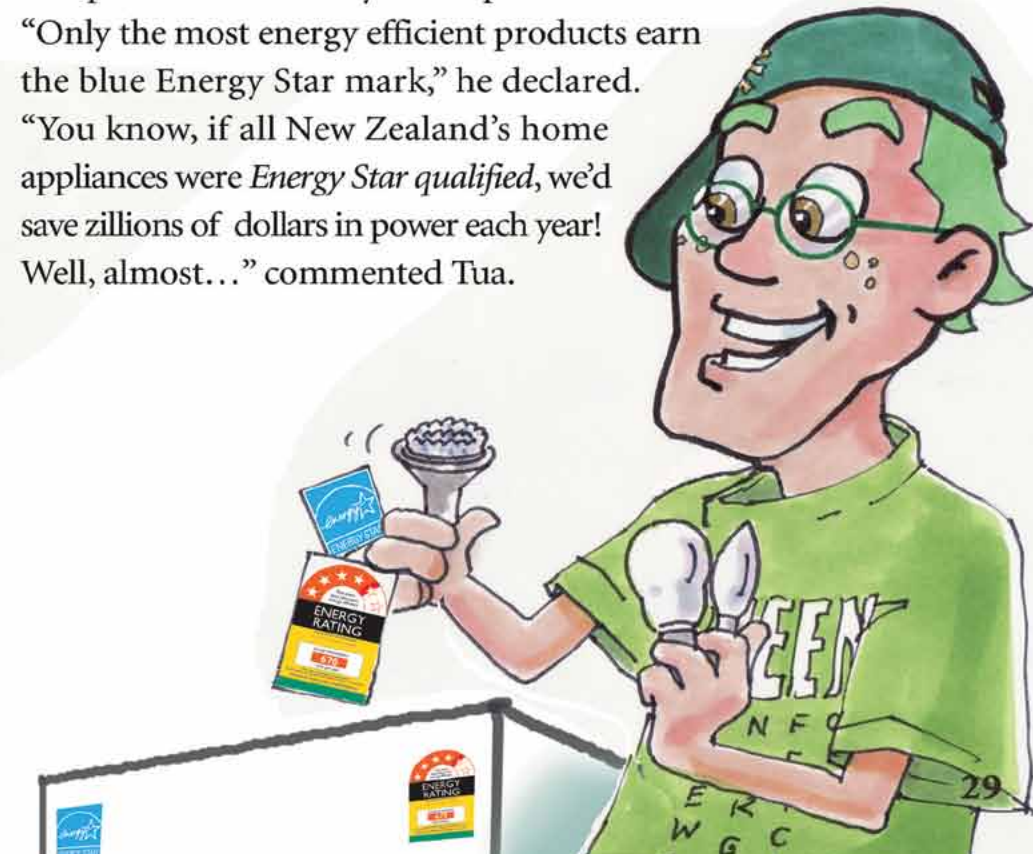
“And, last but not least, when you choose home appliances, electrical goods and light bulbs, be sure to look for *this!*” Greeny interjected.

“The **ENERGY STAR!**” he announced with a flourish. “It’s a label that rates the energy, water or gas usage of products, so you can compare them.” Greeny held up two labels.

“Only the most energy efficient products earn the blue Energy Star mark,” he declared.

“You know, if all New Zealand’s home appliances were *Energy Star qualified*, we’d save zillions of dollars in power each year!

Well, almost...” commented Tua.





“And if everyone switched off their lights and appliances when they aren’t needed, we’d save *squillions!* A warm, dry house is a healthy house, to be sure. So here’s my list of tips for saving energy!” Greeny announced excitedly as he produced a green banner and balloons. “Good idea...I *suppose,*” replied Twiggy, whose head was now spinning totally out of control with all she had learnt.

# G-R-E-E-N TIPS ...Get

- ✓ Use renewable forms of energy wherever possible - rely less on mains power
- ✓ Heat the house efficiently - passive solar design (design for the sun - sunny site, position of house on site, house layout, photovoltaics, thermal mass building materials, correctly sized windows, etc), supplementary heating, only heat the rooms being used, plant trees to shelter from prevailing wind
- ✓ Heat water efficiently - solar water heating system, supplementary water heating, insulate cylinder and pipes, water efficient shower head, set hot water temperature
- ✓ Reduce heat loss - effective insulation, double glazing, correctly sized windows, well fitted thermal curtains (close at sunset), curtain linings, pelmets, stop draughts around / under doors and windows, airtight joinery (building paper), timber or PVC rather than aluminium joinery
- ✓ Retain heat - thermal mass, insulation, correctly sized windows, thermal drapes, keep doors closed in winter
- ✓ Eliminate moisture - polythene ground cover, insulation, vents, double glazing, sized drapes, fans
- ✓ Prevent overheating - eaves and awnings, ventilation (correctly sized / positioned windows), draw curtains, fans, blinds, external shutters, deciduous planting

# Renewable Energy Efficient Now!

- ✓ Energy efficient lighting with Energy Star label - CFL's, halogen incandescent, LED's, avoid recessed lighting
- ✓ Use natural light whenever possible
- ✓ Energy efficient electrical appliances - look for Energy Star energy/water efficient labels
- ✓ SWITCH OFF lights and appliances when not in use
- ✓ Switch off unnecessary appliances even when on standby - switch off at the wall eg sound system, TV, bedside radio alarms, computer
- ✓ Turn off electric storage hot water system if away for more than a week - switch cylinder back on when you return. It will take 6 or 7 hours to reheat.
- ✓ Reduce reliance on air conditioning - stay cool by having effective insulation, ventilation, fans
- ✓ Shower rather than bath - keep showers to 4 minutes
- ✓ Use heated towel rail only 4 hours a day - put in a timer
- ✓ Use cold water for laundry
- ✓ Use clothes line instead of dryer
- ✓ Fully stack the dishwasher before turning on
- ✓ Open and close fridge and freezer doors quickly to prevent cold air escaping
- ✓ Check your fridge and freezer door seals work properly

In fact she was quite dizzy. All she could see were green stars shooting in all directions. Then she realized Tua and Greeny had simply vanished!

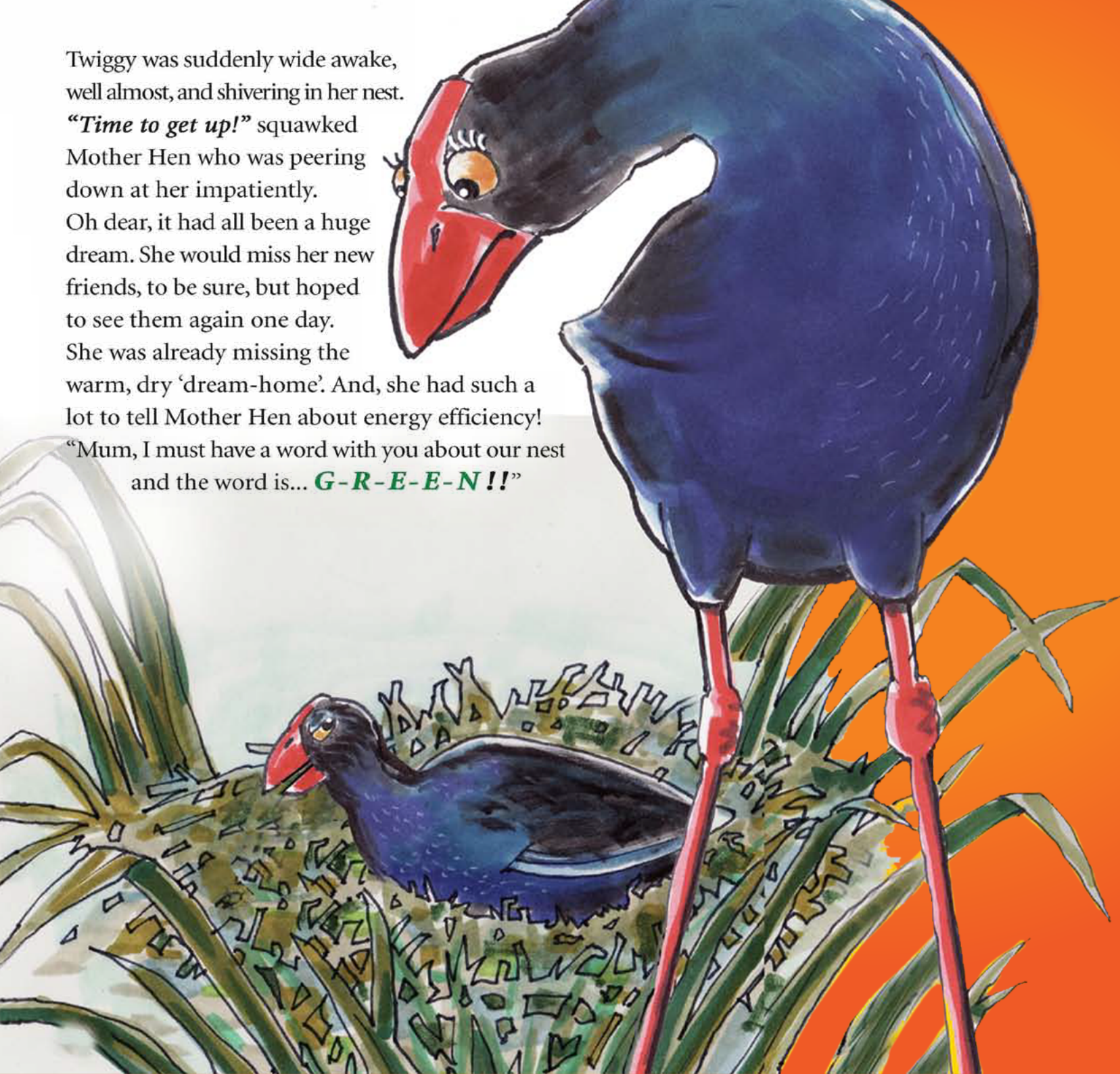
Twiggy was suddenly wide awake,  
well almost, and shivering in her nest.

*“Time to get up!”* squawked  
Mother Hen who was peering  
down at her impatiently.

Oh dear, it had all been a huge  
dream. She would miss her new  
friends, to be sure, but hoped  
to see them again one day.

She was already missing the  
warm, dry ‘dream-home’. And, she had such a  
lot to tell Mother Hen about energy efficiency!

“Mum, I must have a word with you about our nest  
and the word is... **G-R-E-E-N!!**”





**A Genesis Energy initiative to bring solar energy  
and energy efficiency to life for New Zealand schools**